PULSE PROGRAM CATALOGUE: I. 1D & 2D NMR EXPERIMENTS

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TOPSPIN v2.0
NMRGuide

03-03-2006
Part Number --------

VOLUME I: 1D & 2D NMR EXPERIMENTS

BRUKER
Pulse Program
Catalogue

written by Teodor Parella

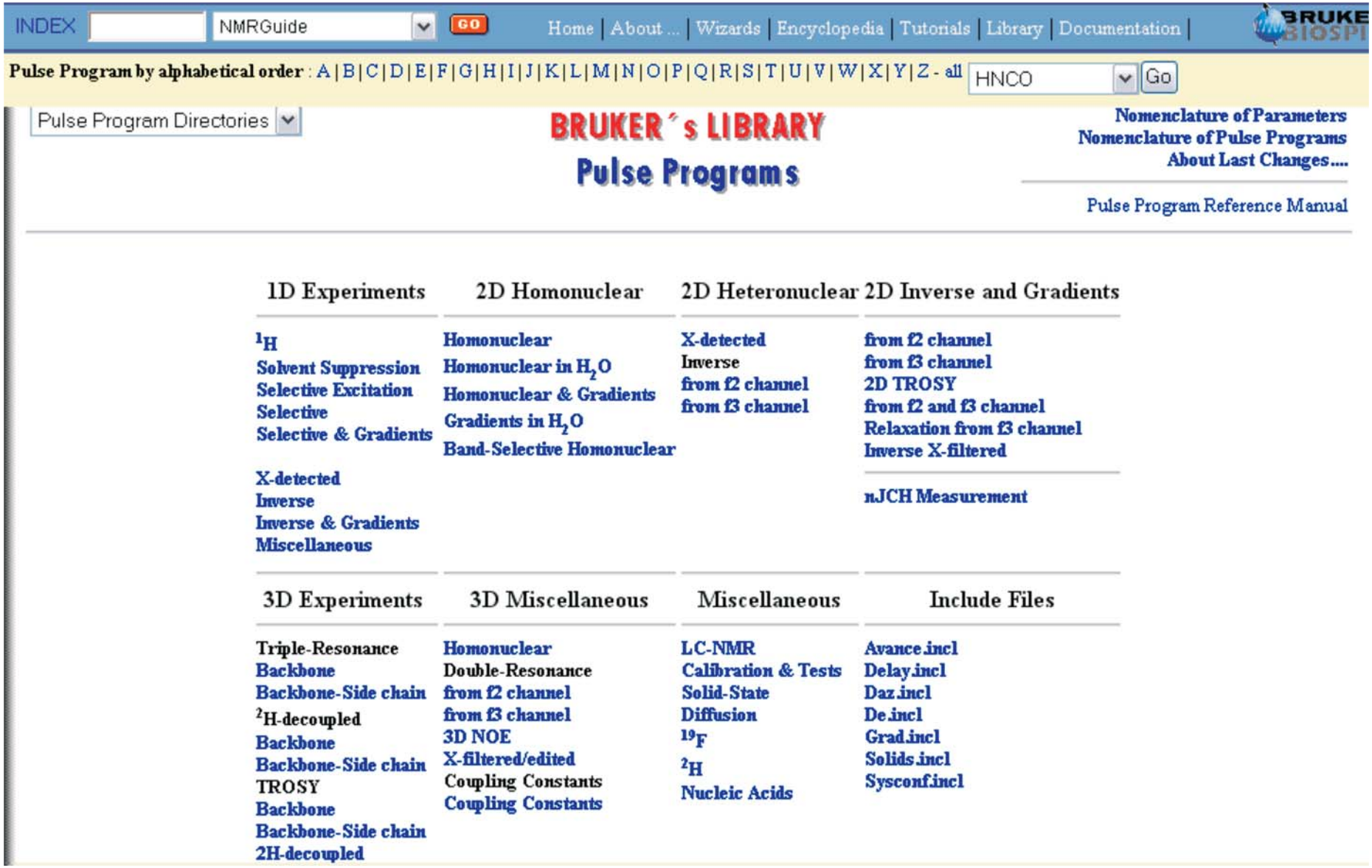
This catalogue presents the pulse sequence diagram for all standard pulse programs included in TOPSPIN v2.0. This information is part of NMRGuide 4.1, also available for BRUKER AVANCE spectrometers.

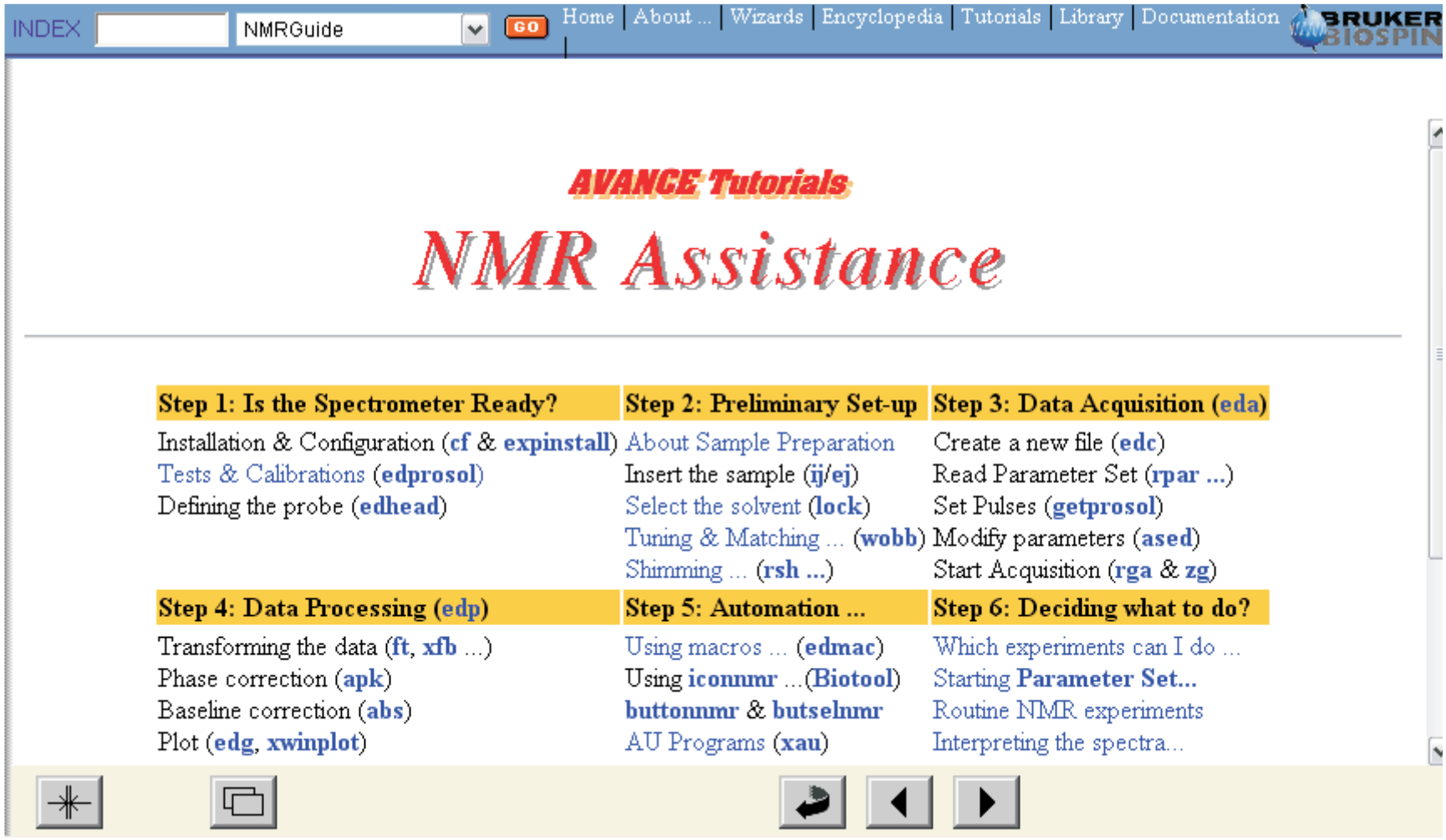
These pulse programs are located in the

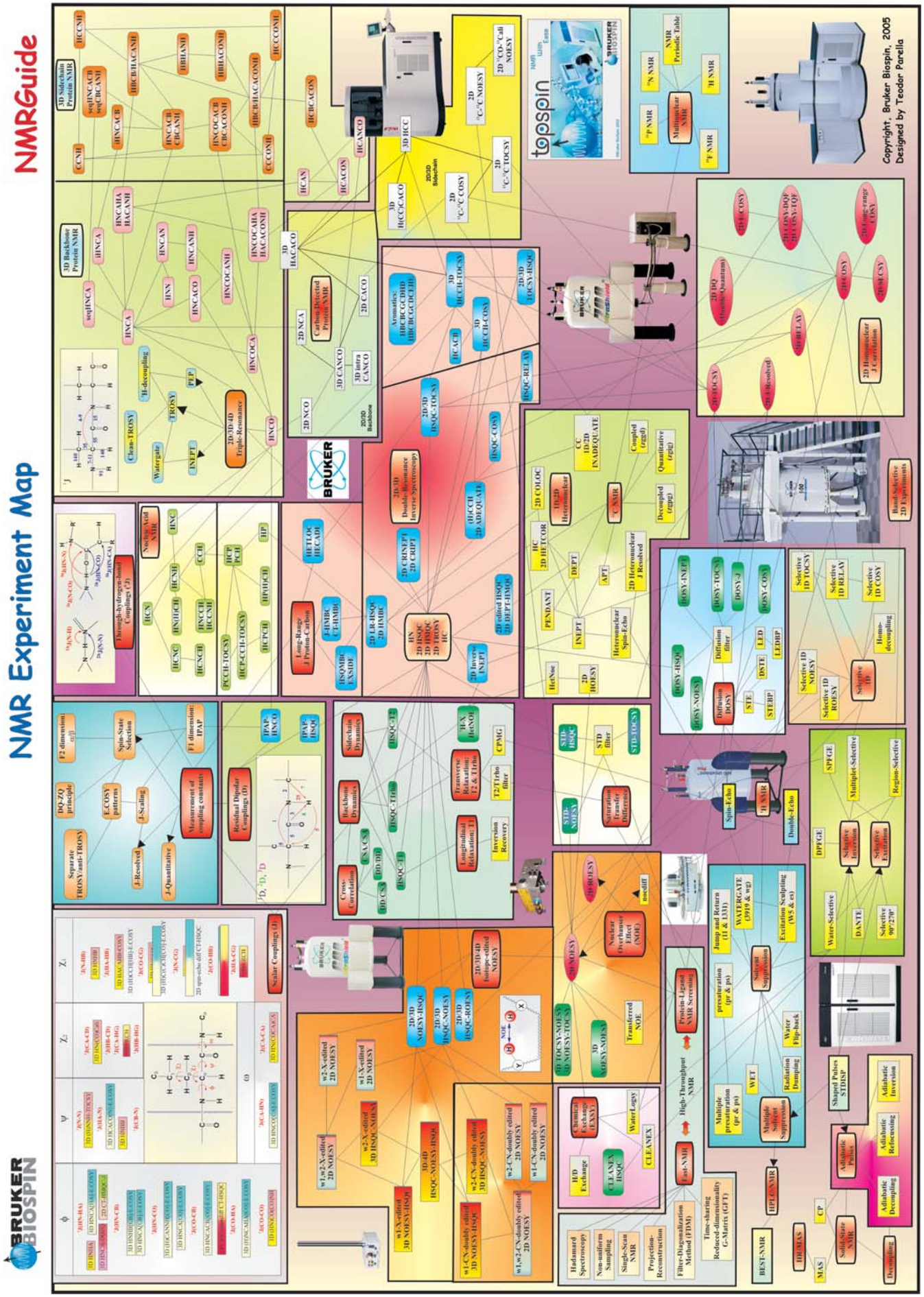
/TOPSPINHOME/pp/stan/nmr/lists/pp

directory after conventional installation using **expinstall** and they can be visualized directly into the TOPSPIN program from the PulsProg section. Otherwise, alternative pulse program sequence representation is also available using the **showpp** program.

For more details on pulse programs, parameter sets, tutorials, experiment descriptions, bibliographic references and other related information, please refer to the electronic version of NMRGuide 4.1.






NMRGuide
NMR Experiment Map
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NMRGuide

BASIC 1D PULSE SEQUENCES

- **Standard Experiments:**

Conventional ^{1}H spectrum (**zg30** / **zg** / **zg0** | **PROTON**)
Acquired as 2D (**zg2d**)

1D ^{1}H Homodecoupling (**zg0hd** / **zghd** / **zghd.2** | **PROHOMODEC**)
1D ^{1}H Band-selective homodecoupling (**zghc** / **zghc.2**)
NOEDIFF experiment:
Single irradiation (**zgf2pr**)
Using frequency list (**noediff** / **noediff.2** / **noedif.2** | **NOEDIFF**)
Irradiation multiplet frequencies within one multiplet (**noemul**)

^{13}C spectrum with selective ^{1}H decoupling using CW (**zgcw30** / **zgcw** / **zg0cw**)
^{1}H-decoupled ^{13}C spectrum (**zgdc30** / **zgdc** / **zg0dc** | **C13CPD**)
^{1}H-coupled ^{13}C spectrum (**zggd30** / **zggd** / **zg0gd** | **C13GD**)
^{1}H-decoupled ^{13}C spectrum without NOE (**zgig30** / **zgig** / **zg0ig** | **C13IG**)
^{1}H,^{31}P-decoupled ^{13}C spectrum without NOE (**zgfbig**)

Antiring sequence (**aring**, **aring2**)
1D sequence for suppression of background signals using composite pulse (**zgbs**)

- **Examples:**

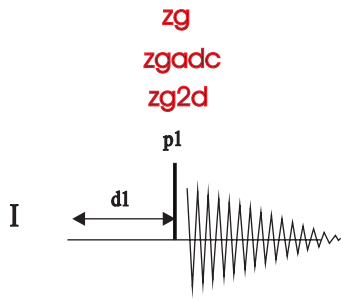
^{31}P-decoupled 1D ^{1}H spectrum (**zgig30** / **zgig** | **PROP31DEC**)
^{11}B-decoupled 1D ^{1}H spectrum (**zgig30** / **zgig** | **PROB11DEC**)

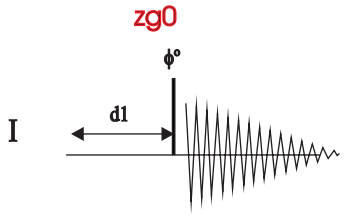
^{1}H-decoupled ^{15}N spectrum without NOE (**zgig** / **zgf3ig** | **N15IG**)
^{1}H-coupled ^{15}N spectrum without NOE (**zg** | **N15**)

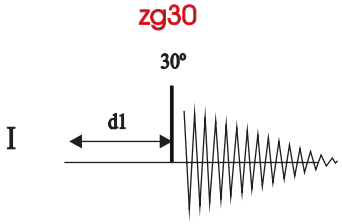
^{1}H-decoupled ^{31}P spectrum (**zgpg30** | **P31CPD**)
^{1}H-coupled ^{31}P spectrum (**zg30** | **P31**)

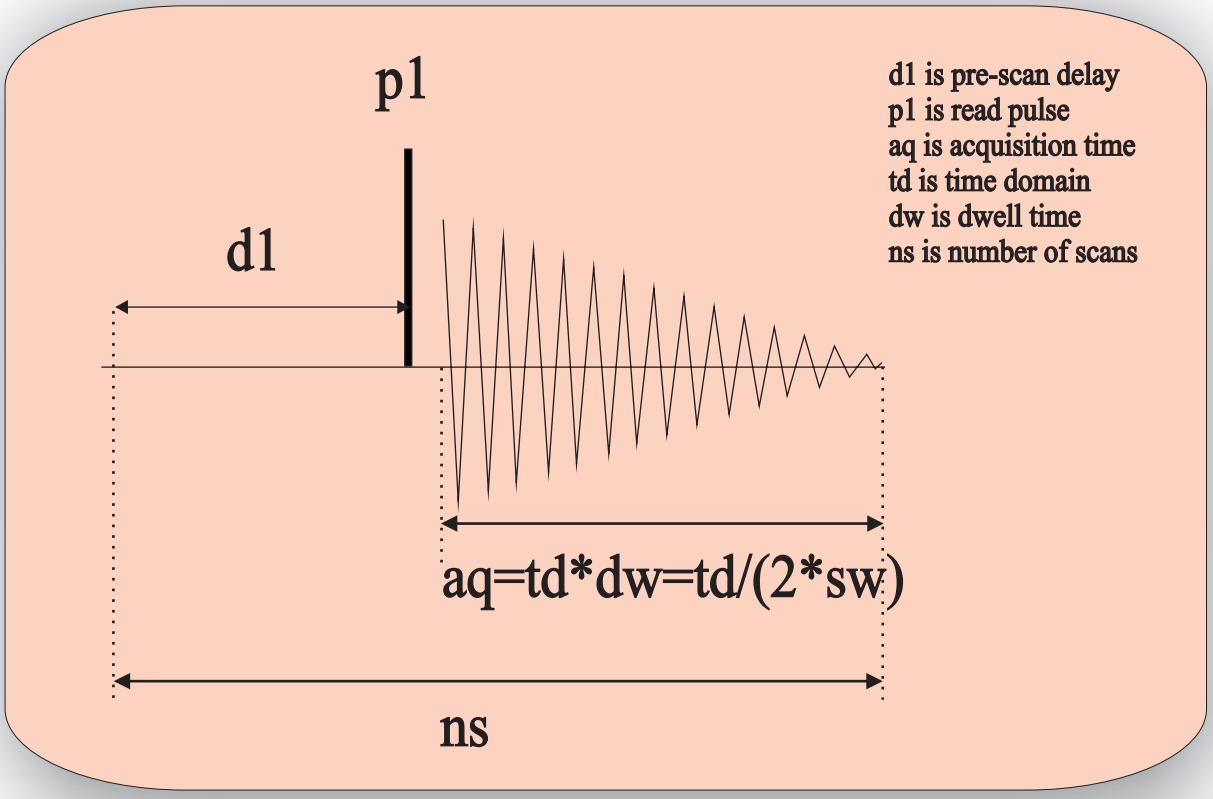
- **Standard BRUKER parameter sets available for other nuclei:**

1D ^{11}B spectrum (**zg** | **B11ZG**)
1D ^{17}O spectrum (**zg** | **O17ZG**)
1D ^{23}Na spectrum (**zg** | **NA23ZG**)
1D ^{27}Al spectrum (**zg** | **AL27ND**)
1D ^{1}H-decoupled ^{29}Si spectrum (**zgig** | **Si29IG**)
1D ^{35}Cl spectrum (**zg** | **CL35ZG**)
1D ^{37}Cl spectrum (**zg** | **CL37ZG**)
1D ^{71}Ga spectrum (**zg** | **GA71ZG**)
1D ^{71}Ga spectrum (**zg** | **SE77ZG**)
1D ^{103}Rh spectrum (**zg** | **RH103ZG**)
1D ^{111}Cd spectrum (**zg** | **CD111ZG**)
1D ^{113}Cd spectrum (**zg** | **CD113ZG**)
1D ^{1}H-decoupled ^{119}Sn spectrum (**zgig** | **SN119IG**)
1D ^{195}Pt spectrum (**zg** | **PT195ZG**)
1D ^{199}Hg spectrum (**zgpg** | **HG199CPD**)

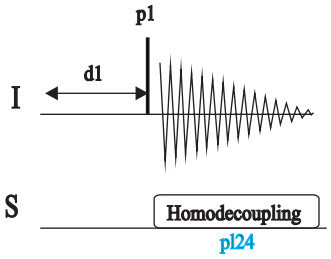

zg
zgadc
zg2d
p1
d1
I


zg0
ϕ°
d1
I

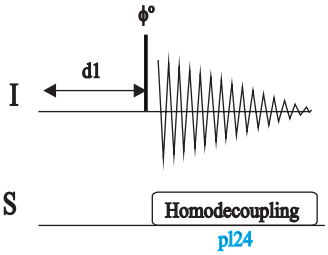

zg30
30°
d1
I


p1
d1
d1 is pre-scan delay
p1 is read pulse
aq is acquisition time
td is time domain
dw is dwell time
ns is number of scans
aq=td*dw=td/(2*sw)
ns

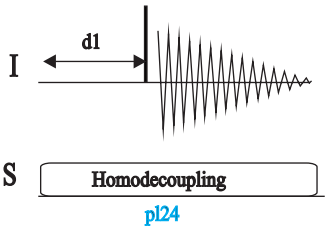
zghc
zghc.2
zghd.2
zghd

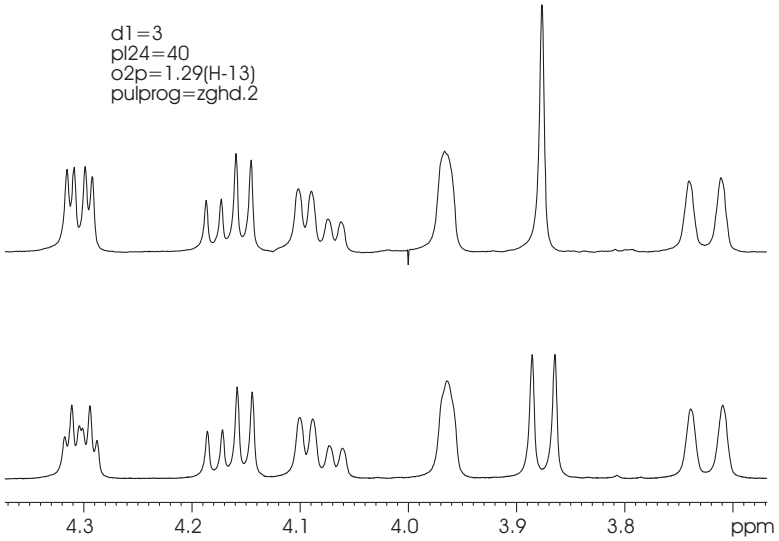


zg0hd

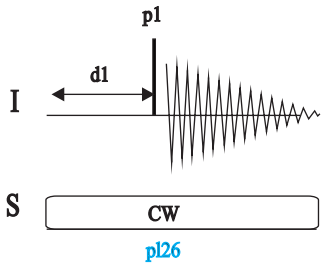


zgadchd

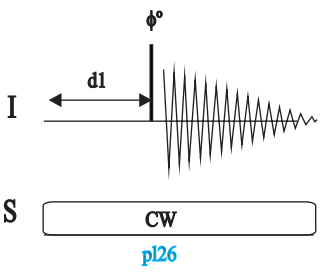




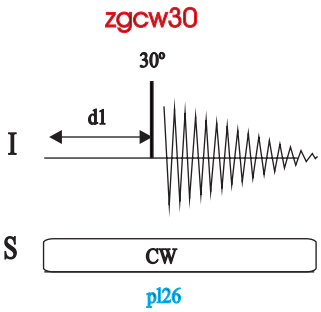
zgcw



zg0cw

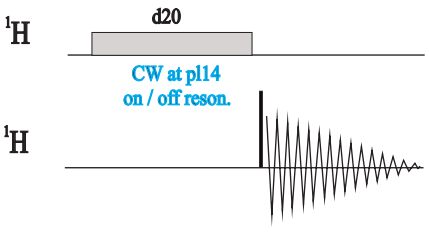


zgcw30



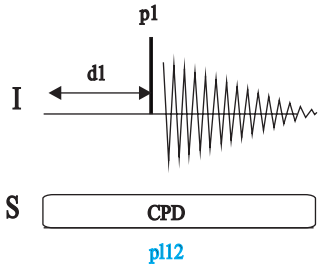
noedif.2
noemul

noediff
noediff.2

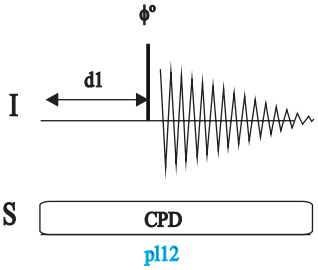


Also see: solvent suppression
(zgf2pr)

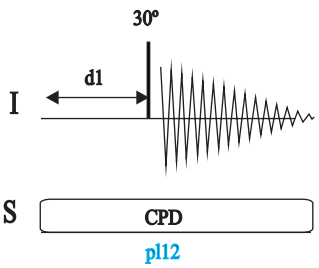
zgpg pl13 - pl12
zgdc



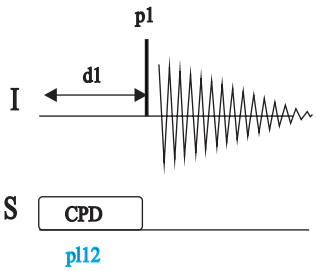
zg0pg pl13 - pl12
zg0dc



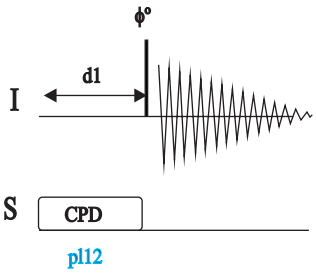
zgpg30 pl13 - pl12
zgdc30



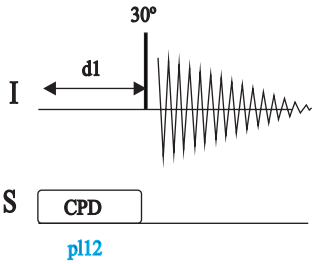
zggd



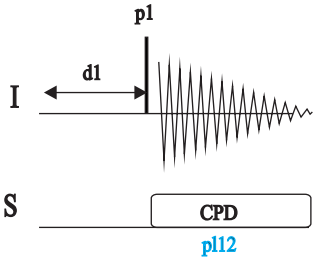
zg0gd



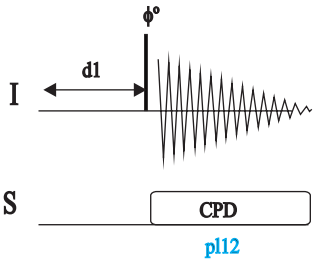
zggd30



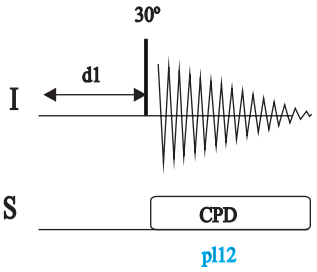
zgf3lg pl16
zglg



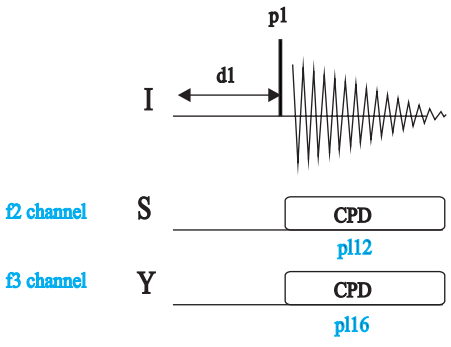
zg0lg



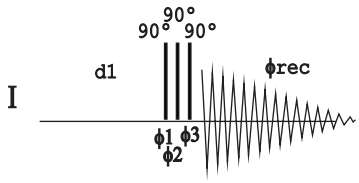
zglg30



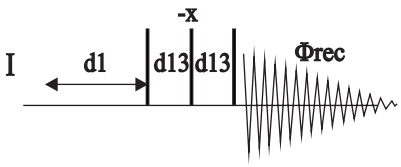
zgfblg



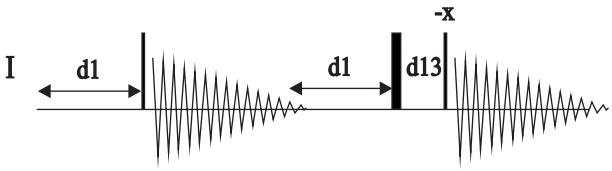
zgbs



aring



aring2



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T1 & T2 RELAXATION

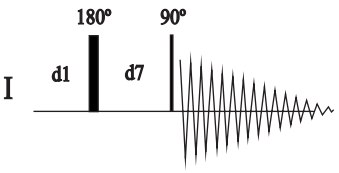
^{1}H T_2 measurements
- As 1D acquisition (**cpmg1d**)
- As 2D acquisition (**cpmg**)
- As 1D acquisition with presaturation (**cpmgpr1d**)

^{1}H T_1 measurements:
- As 1D acquisition (**t1ir1d**)
- As 2D acquisition (**t1ir** || **PROTONT1**)

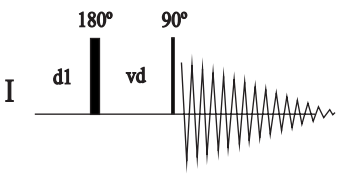
T_1 ^{13}C measurements (**t1irpg**)

Also see: 2D HSQC for Backbone Dynamics

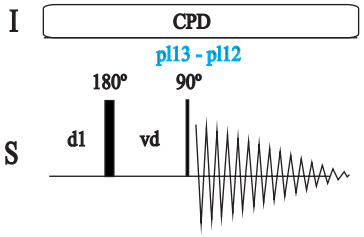
t1ir1d

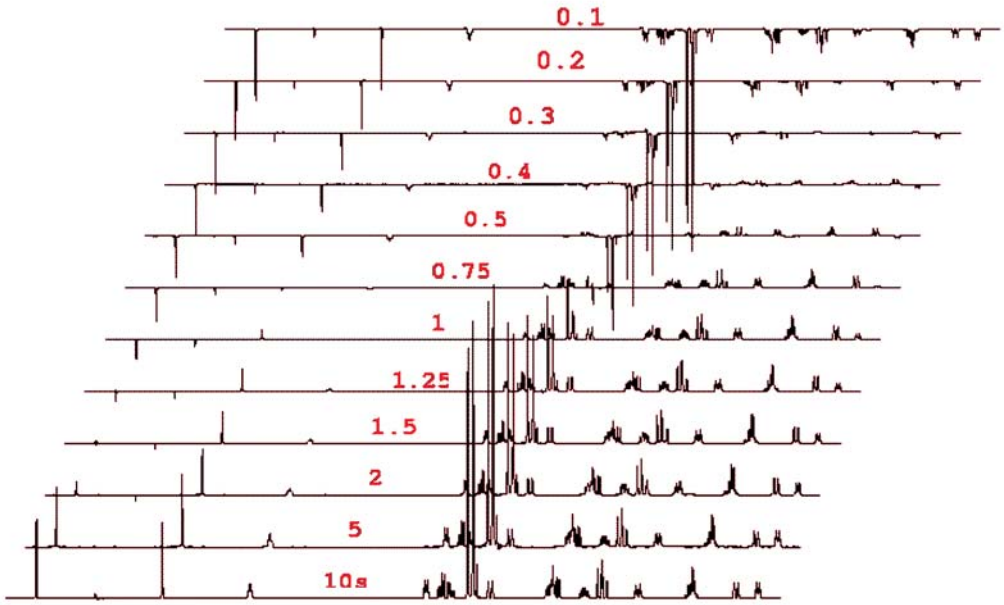


t1ir



t1irpg



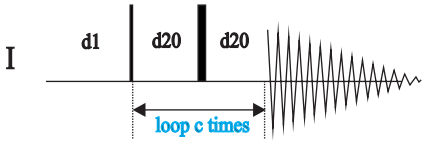


$I_z = I_0(1-2\exp(-d7/T_1))$

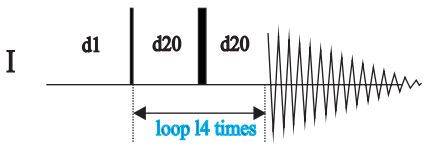
$\ln(I_0-I_z) = \ln(2I_0)-d7/T_1$

$t_{null} = T_1 * \ln 2$

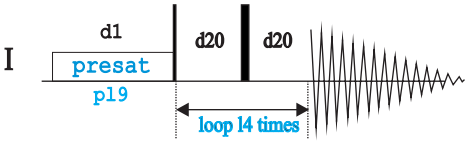
cpmg



cpmg1d



cpmgpr1d



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SELECTIVE EXCITATION &
SELECTIVE 1D EXPERIMENTS

• **Phase-Cycled:**

Using a shaped 90º pulse (**selzg** | **SELZG1H**)

Selective 1D COSY experiment (**selco** | **SELCO1H**)
Selective 1D RELAY experiment (**selcorl**)
Selective 1D TOCSY experiment (**selmlzf** | **SELMLZF1H**)
Selective 1D NOESY experiment (**selno** | **SELNO1H**)
Selective 1D ROESY experiment (**selro** | **SELRO1H**)

• **Gradient-based:**

Using selective pulsed-field-gradient spin-echo or SPFGE (**selgpse** | **SELGPSE**)

Selective ge-1D COSY experiment (**selcogp** | **SELCOGP**)
Selective ge-1D TOCSY experiment:
using MLEV (**selmlgp** | **SELMLGP**)
using MLEV With ZQ suppression (**selmlgp.2**)
using DIPSI-2 (**seldigp**)
Selective ge-1D NOESY experiment (**selnogp** | **SELNOGP**)
Selective ge-1D ROESY experiment (**selrogp** | **SELROGP**)
Selective ge-1D T-ROESY experiment (**selrogp.2**)

• **^{13}C Selective:**

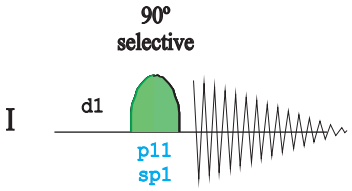
^{13}C Selective excitation using a shaped 90º pulse (**selzgpg**)

Selective 1D X-X COSY experiment (**selcopg**)
Selective 1D INADEQUATE experiment (**selina**)

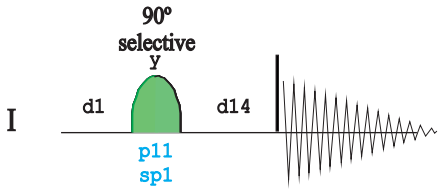
• **Miscellaneous:**

2-2-6-2-2 DANTE-z scheme (**dazzg**)
3-6-3 DANTE-z scheme (**daz363zg**)
1-1 DANTE-z scheme (**daz11zg**)

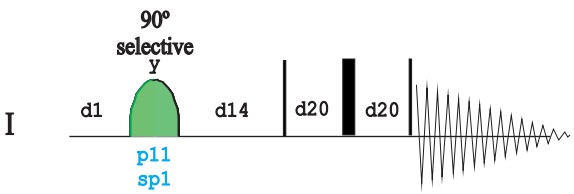
selzg



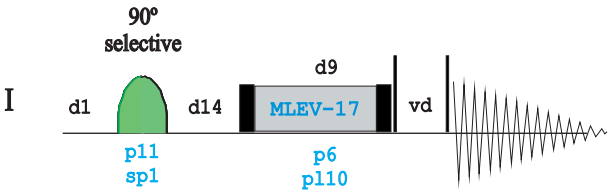
selco



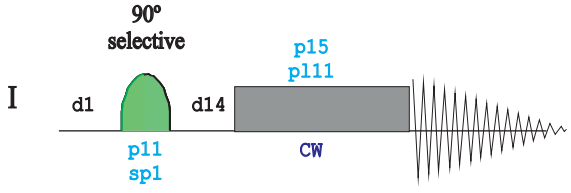
selcorl



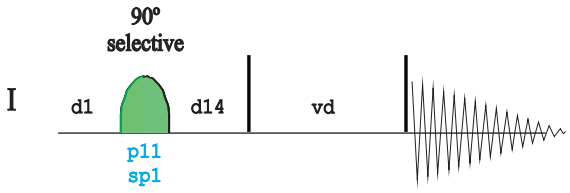
selmlzf



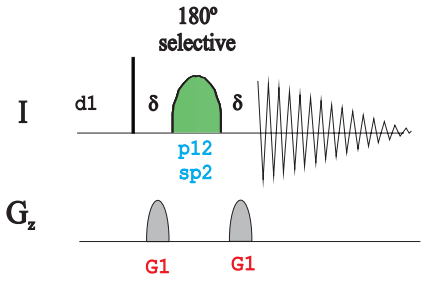
selro



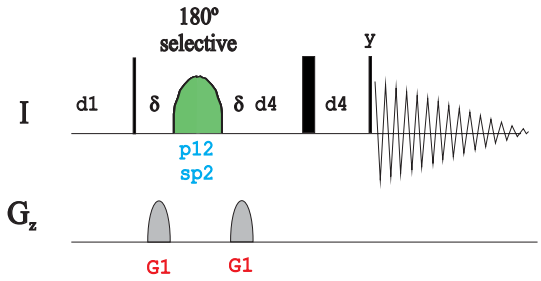
selno



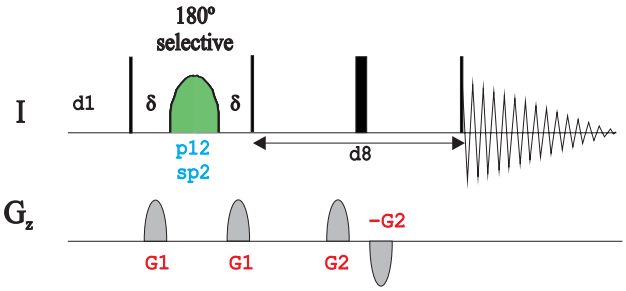
selgpse



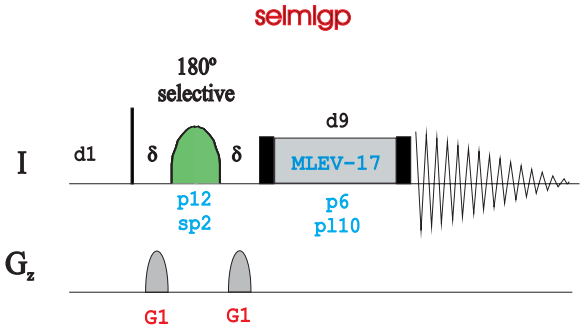
selcogp



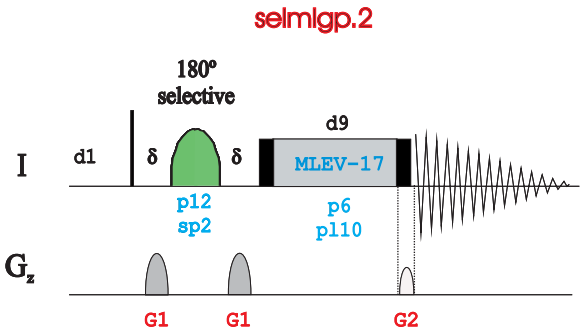
selnogp



selmlgp



selmlgp.2



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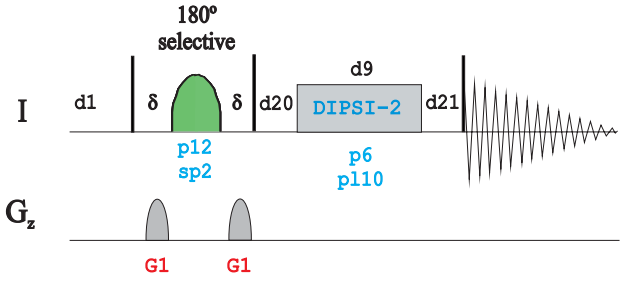
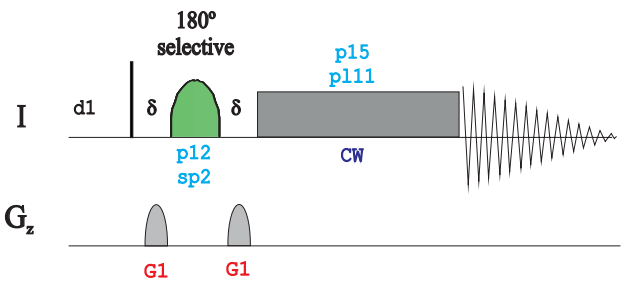


selrogp



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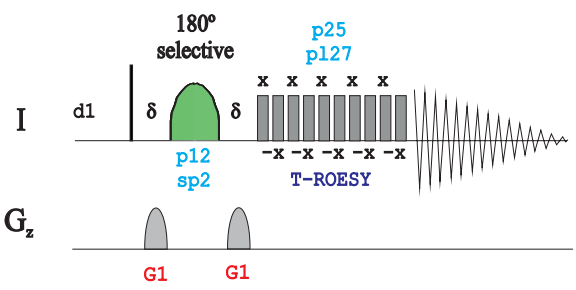
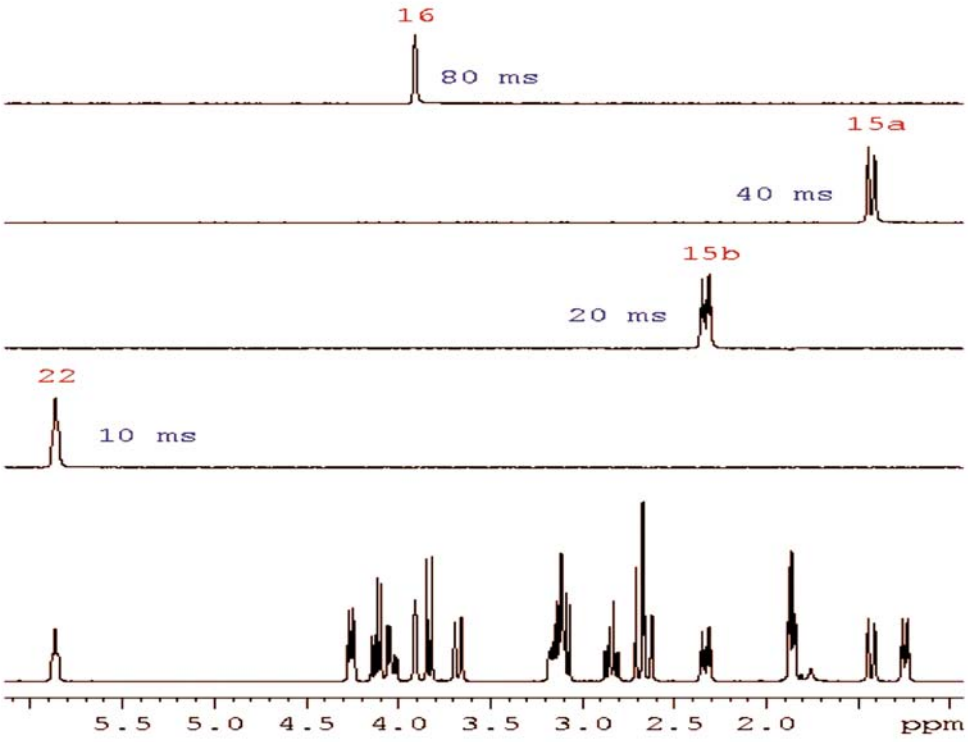
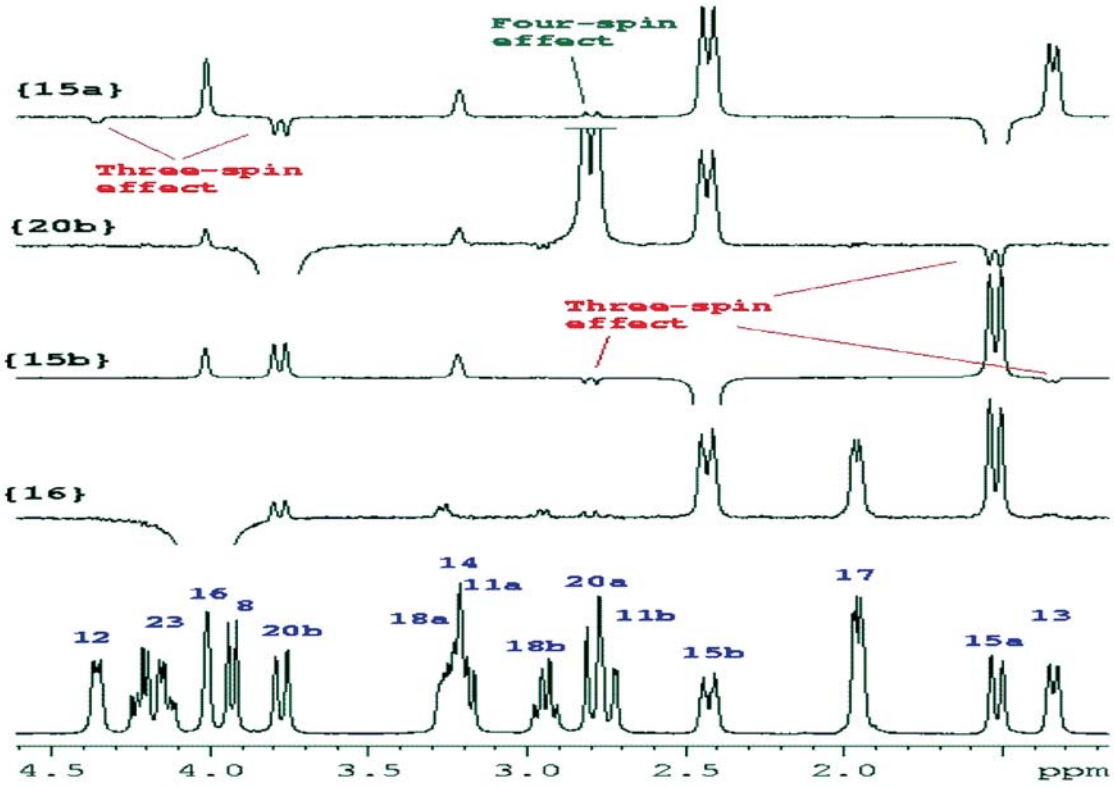
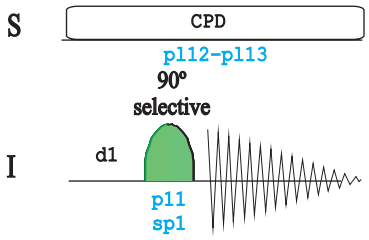


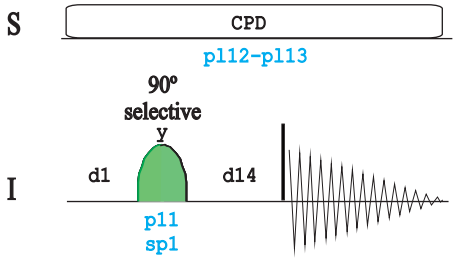

16
80 ms
15a
40 ms
15b
20 ms
22
10 ms
5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0
ppm


Four-spin effect
{15a}
Three-spin effect
{20b}
Three-spin effect
{15b}
{16}
12
23
16
8
20b
18a
14
11a
18b
20a
11b
15b
17
15a
13
4.5 4.0 3.5 3.0 2.5 2.0
ppm

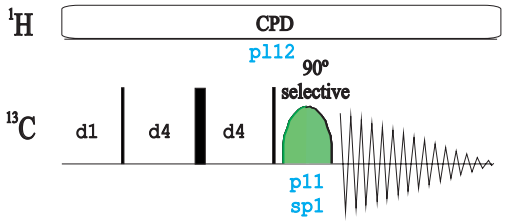
selzgpg



selcopg



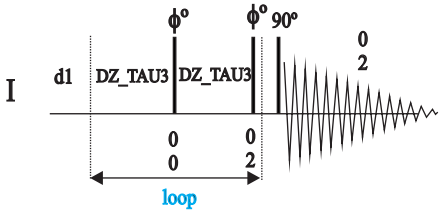
selina



dazzg

daz11zg

daz363zg



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1D SOLVENT SUPPRESSION

1D Solvent suppression

Classical:

1D water presaturation:
- Conventional (**zgpr** / **zg0pr** | **ZGPR**)
- Using composite pulses (**zgcppr** | **ZGCPPR**)
- Using spoil gradient (**zggppr**)
- Using composite pulse and spoil gradient (**zgcpggppr**)
- From f2 channel (**zgf2pr** / **zg0f2pr**)
- Using shaped pulse for off-resonance presaturation (**zgps**)

Jump and return:
- 1-1 scheme (**p11**)
- 1-3-3-1 scheme (**p1331**)

Gradient-based:

1D WATERGATE:
- Using 3-9-19 scheme (**p3919gp** | **P3919GP**)
- Using 3-9-19 and flip back pulse (**p3919fpgp**)
- Using 90º water-selective pulses (**zggpwg** | **ZGGPWG**)

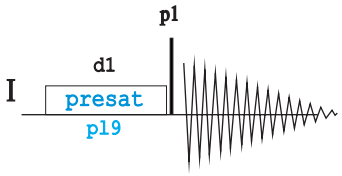
1D Excitation Sculpting:
- Using 180º water-selective pulses (**zgesgp**)
- Using 180º water-selective and flip back pulse (**zgesfpgp**)
- Using W5 pulse train (**zggpw5**)

1D WET scheme:
- Conventional (**wet**)
- With ^{13}C decoupling on f2 during WET and AQ (**wetdc** | **LC1DWTDC**)
- With ^{13}C decoupling on f2 during WET (**wetdw**)

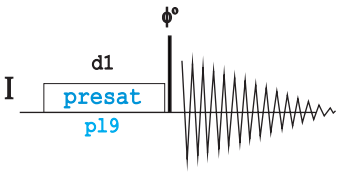
Related Experiments:

- All these 1D experiments can be incorporated in any multidimensional NMR experiment. Please refer to each chapter to check the different possibilities for 2D and 3D solvent-suppressed experiments
- LC-NMR Experiments

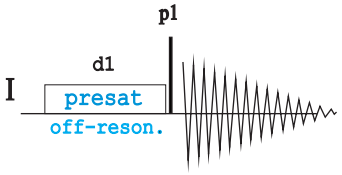
zgpr



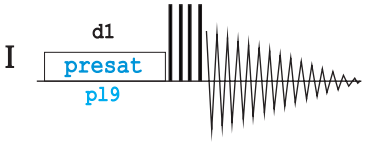
zg0pr



zgps

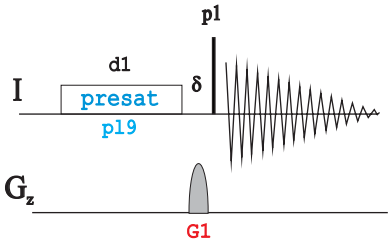


zgcppr

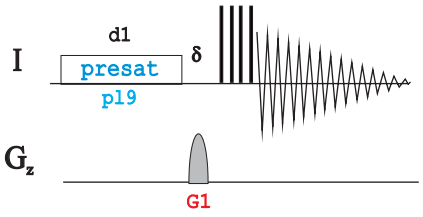


Also see: LC-NMR experiments

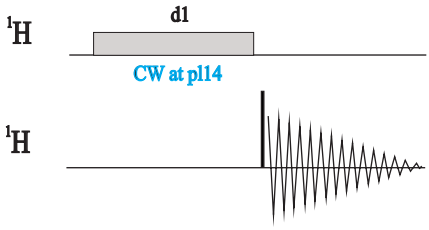
zggppr



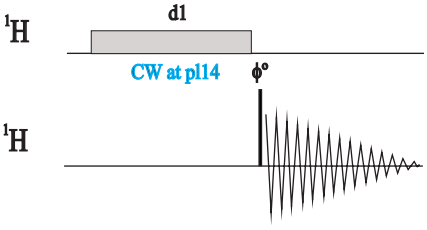
zgcpggpr



zgf2pr

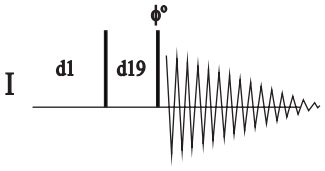


zg0f2pr

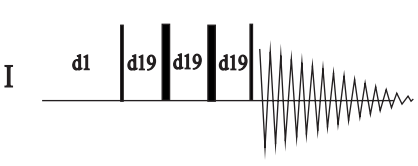


Also see: noediff

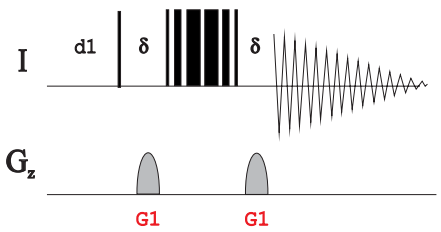
p11



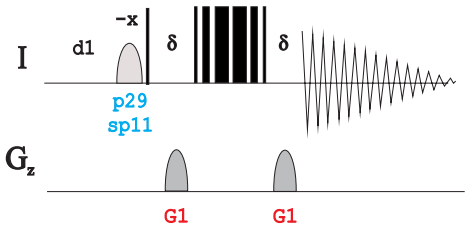
p1331



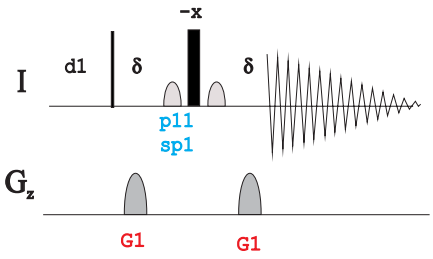
p3919gp



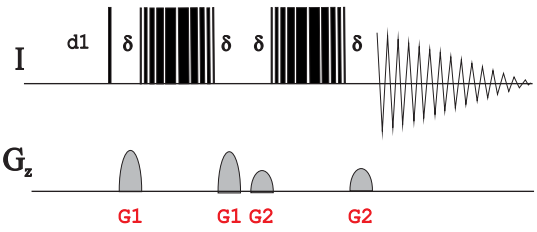
p3919fpgp



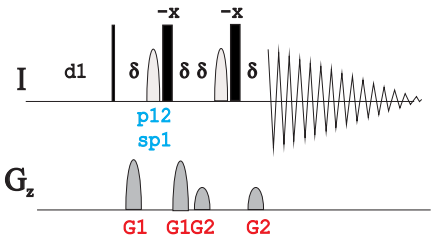
zggpwg



zggpw5



zgesgp



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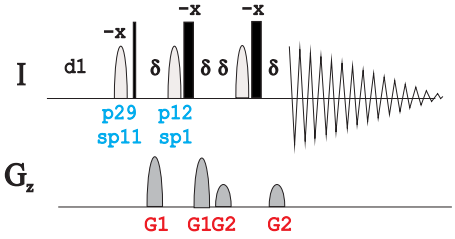

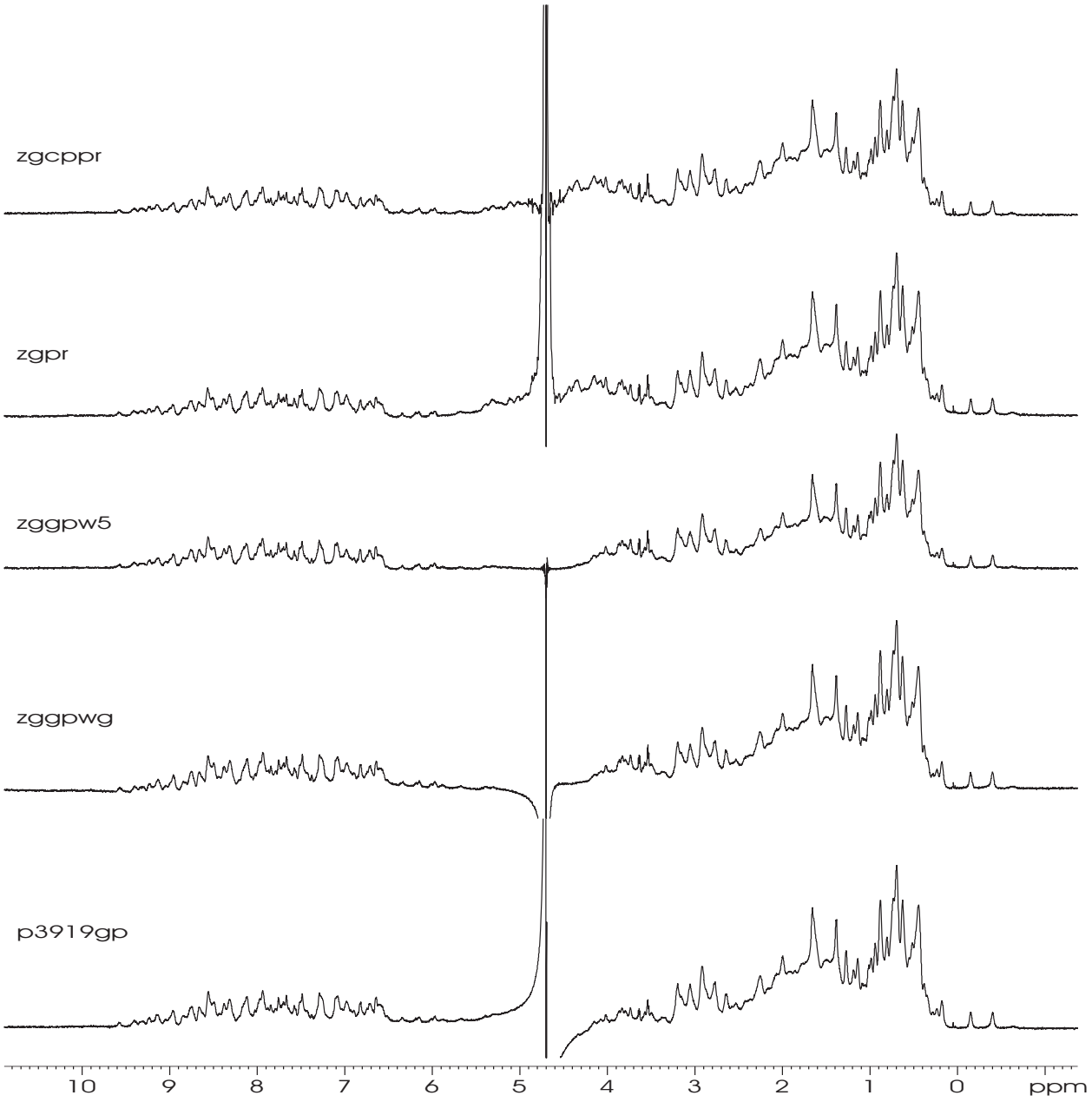
zgcppr
zgpr
zggpw5
zggpwg
p3919gp
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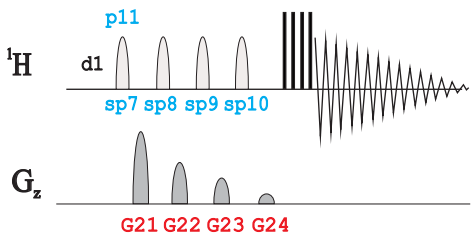
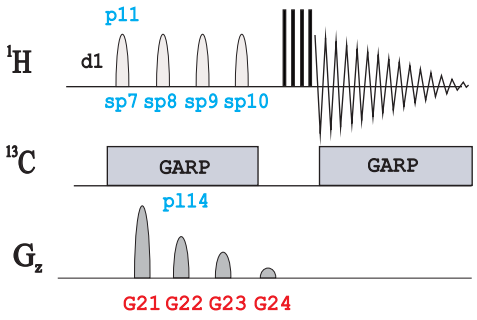
7
6
5
4
3
2
1
0
ppm

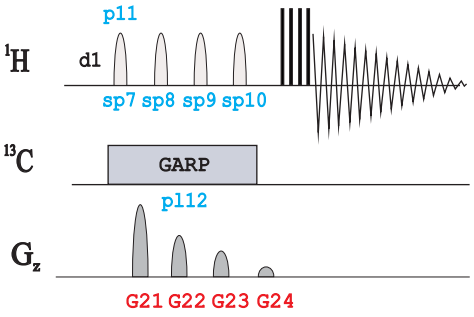
wet



lc2wetdcus
lc2wetdc
wetdc



wetdw



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^{19}F SPECIFIC EXPERIMENTS

^{19}F Experiments

1D spectra:

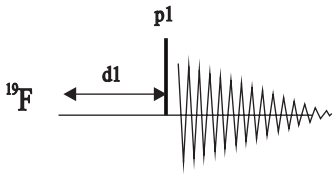
^{1}H-decoupled ^{19}F spectrum (**zgfhigqn** / **zgfhigqn.2** | **F19CPD**)
^{1}H-coupled ^{19}F spectrum (**zgflqn** | **F19**)
^{19}F-homodecoupled ^{19}F spectrum (**zhflhdqn**)

^{19}F-decoupled 1D ^{1}H spectrum (**zghfigqn** / **zghfigqn30** | **PROF19DEC**)
^{1}H spectrum with ^{19}F-presaturation (**zgf2hfpr**)

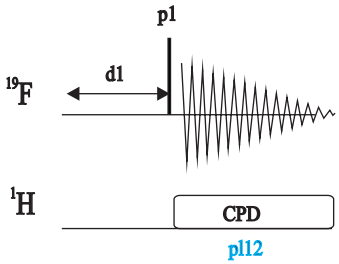
2D spectra:

2D ^{19}F-^{1}H HETCOR experiment (**hfcoqfqn**)
2D ^{19}F-^{1}H HOESY experiment (**hoesyfhqfqnrv**)

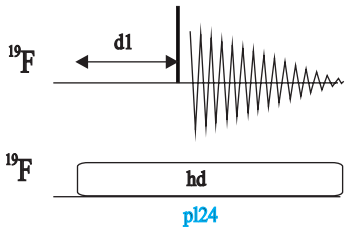
zgflqn



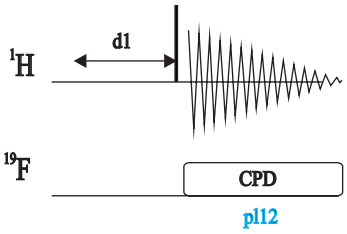
zgfhigqn.2
zgfhigqn



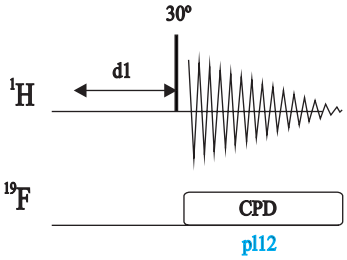
zhflhdqn



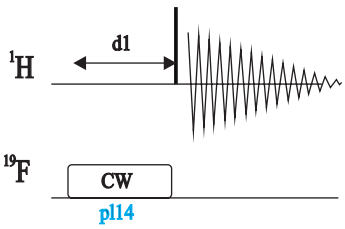
zghfigqn



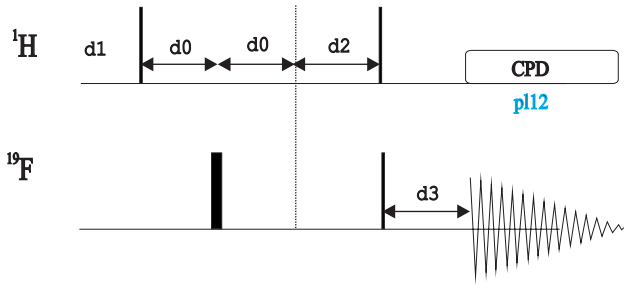
zghfigqn30



zgf2hfpr



hfcoqfqn



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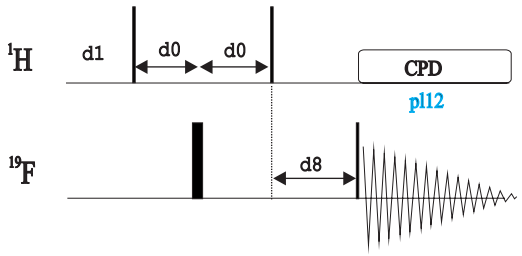

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^{2}H SPECIFIC EXPERIMENTS

- **1D spectra:**

  1D ^{2}H spectrum (**zg2h**)
  1D X-decoupled ^{2}H spectrum (**zgig2h**, **zgig2hf4**)

- **2D spectra:**

  Magnitude-mode 2D HETCOR with ^{2}H-decoupling (**hxcoqf2h**)

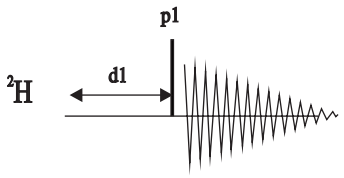
- **Miscellaneous:**

  High-power 90º ^{2}H decouple pulse calibration (**decp902h**, **decp902hf4**)

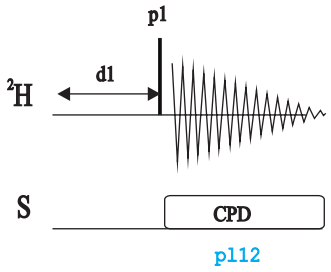
  Related Experiments:

  - Also see: 2H-decoupled 3D triple-resonance experiments

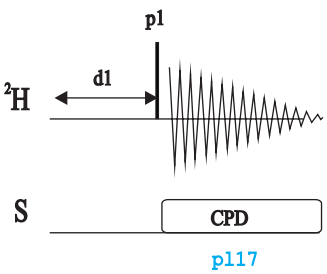
zg2h



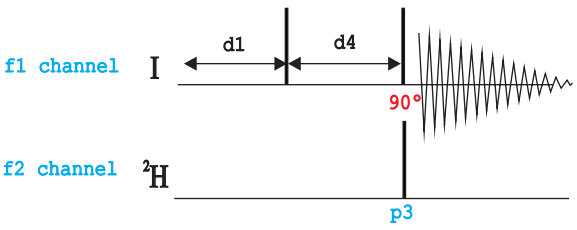
zgig2h



zgig2hf4



decp902h



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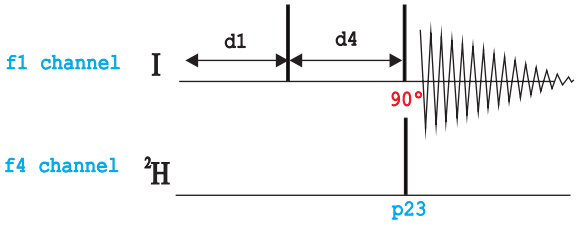
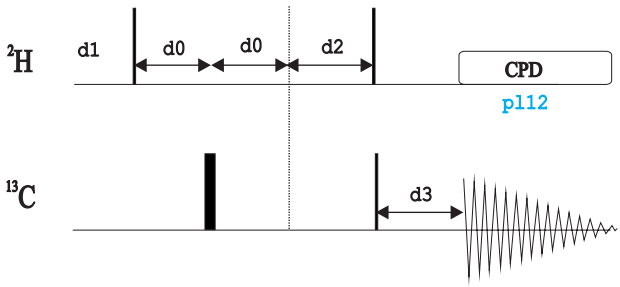


hxcoqf2h



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BASIC 1D GRADIENTS

- **Standard:**

  Gradient-enhanced 1D Echo experiment (**zggegp**)
  Gradient-enhanced 1D Spin-Echo experiment (**zggpse**)

- **Gradient Calibration:**

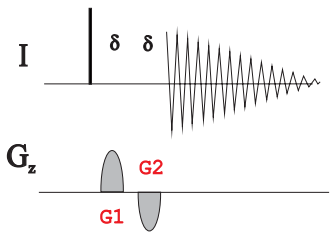
  Gradient Strength Calibration (**calibgp**)
  Gradient Preemphasis Adjustament. Gradient Recovery Test (**preempgp2**)

- **Gradient shimming:**

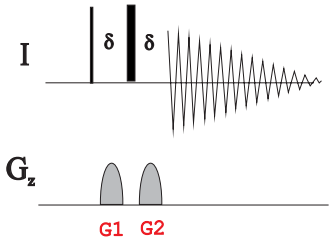
  1D Gradient Echo for gradshim-procedure (**imgegp1d**)
  1D Gradient Echo for gradshim-procedure using 2H (**imgegp1d2h**)
  1D Gradient Echo for gradshim-procedure using selective pulse (**imgegpsp1d**)

  3D Gradient Echo for gradshim-procedure (**imgegp3d**)
  3D Gradient Echo for gradshim-procedure with BSMS RCB board(**imrcbgegp3d**)

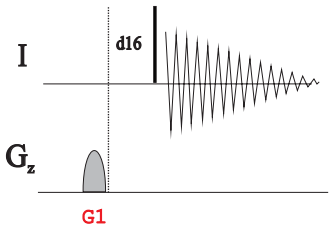
zggegp



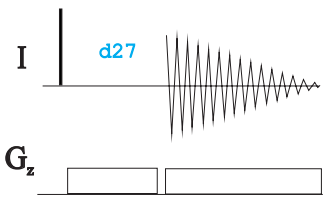
zggpse



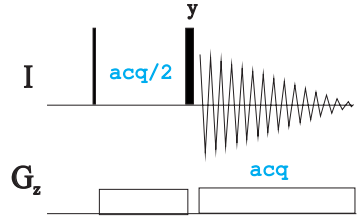
preempgp2



imgegp1d



callbgp



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2D COSY EXPERIMENTS

Phase-cycled:

Magnitude-mode 2D COSY (**cosyqf** | COSY45SW / COSY90SW)
Magnitude-mode 2D COSY using a 45 pulse (**cosyqf45** | COSY45SW)
Magnitude-mode 2D COSY using a 90 pulse (**cosyqf90** | COSY90SW)
Magnitude-mode 2D COSY using purge pulses before d1 (**cosyppqf**)
Phase-sensitive 2D COSY (**cosyph**)

Magnitude-mode Long-Range optimized 2D COSY (**cosylrqf**)

Constant-Time 2D COSY (**cosyjdqf**)

Phase-cycled and solvent suppression:

Magnitude-mode 2D COSY with presaturation (**cosyprqf**)
Phase-sensitive 2D COSY with presaturation (**cosyphpr** | COSYPHPR)

Gradient-based:

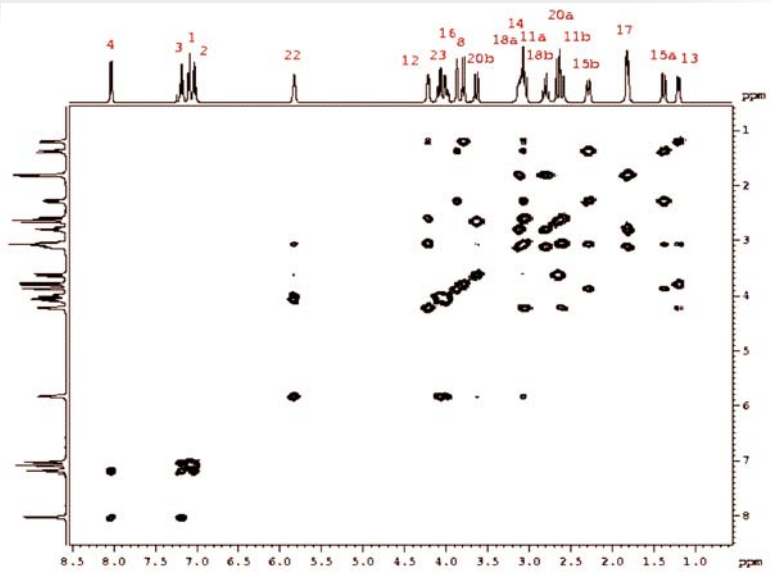
Magnitude-mode ge-2D COSY (**cosygpqf** | COSYGPSW)
Magnitude-mode ge-2D COSY using purge pulses before d1 (**cosygpppqf**)
Phase-sensitive ge-2D COSY using echo-antiecho (**cosyetgp**)

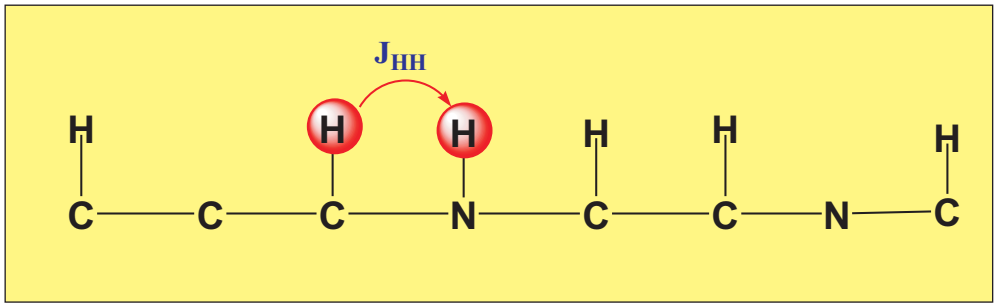
Miscellaneous:

Phase-sensitive w_1-region-selective 2D COSY (**scosyph**)
Phase-sensitive w_1-region-selective 2D COSY with refocusing (**scosyphrd)**

Phase-sensitive 2D COSY with off-resonance single or multiple presaturation (**cosycwphps** | COSYCWPHPS)

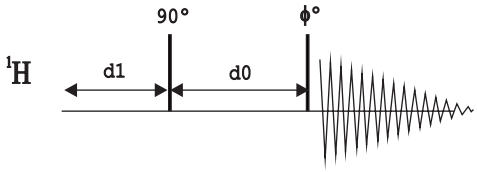
Magnitude-mode 2D ^{13}C-^{13}C COSY (**cosydcqf**)
Magnitude-mode long-range optimized 2D ^{13}C-^{13}C COSY (**cosydclrqf**)
Phase-sensitive 2D ^{13}C-^{13}C COSY **(cosydcph)**



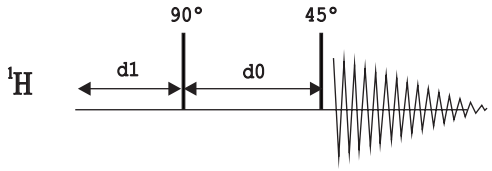


cosyph

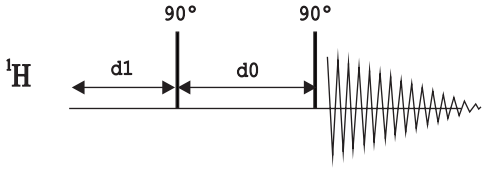
cosyqf



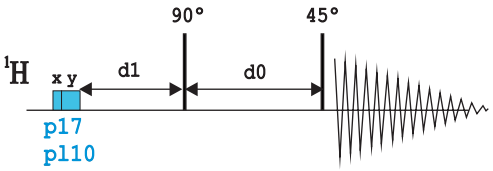
cosyqf45



cosyqf90

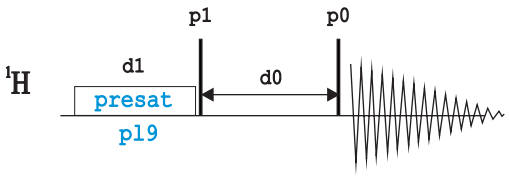


cosyppqf

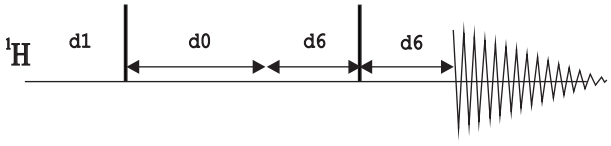


cosyphpr

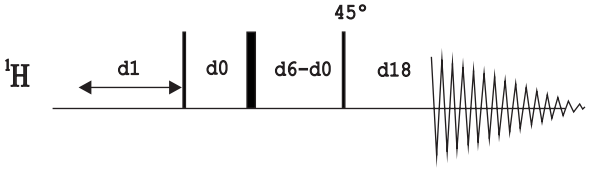
cosyprqf



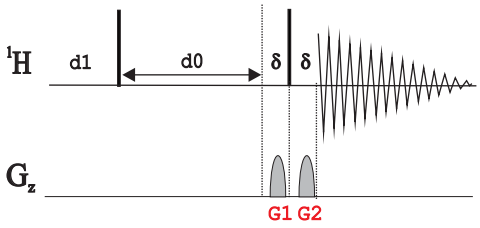
cosyIrqf



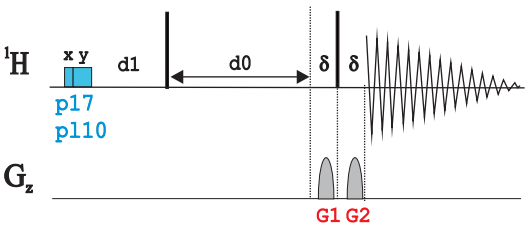
cosyjdqf



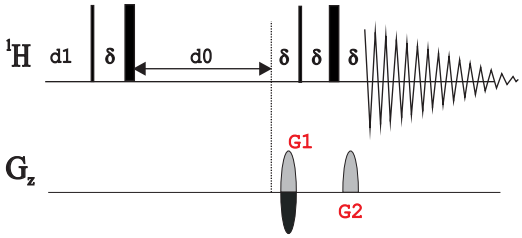
cosygpqf



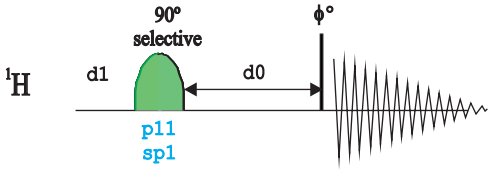
cosygpppqf



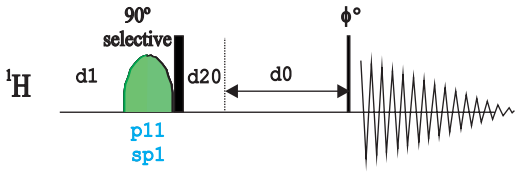
cosyetgp



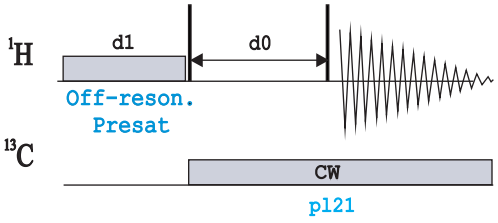
scosyph



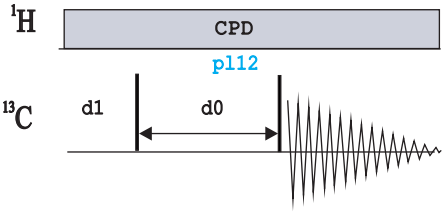
scosyphrd



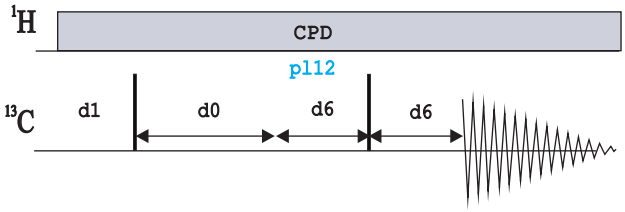
cosycwphps



cosydcqf
cosydcph



cosydclrqf



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2D COSY-DQF EXPERIMENTS

• **Phase-cycled:**

Magnitude-mode 2D COSY with DQF (**cosydfqf**)
Magnitude-mode 2D COSY with TQF (**cosyqftf**)
Phase-sensitive 2D COSY with DQF (**cosydfph** | COSYDQFPHSW)
Phase-sensitive 2D COSY with TQF (**cosyphtf**)

Phase sensitive 2D E.COSY -KcMAX=3 (**ecos3nph**)
Complementary Phase sensitive 2D E.COSY - KcMAX=3 (**ecos3cph**)

• **Phase-cycled and solvent suppression:**

Phase-sensitive 2D COSY with DQF & presaturation (**cosydfphpr**)

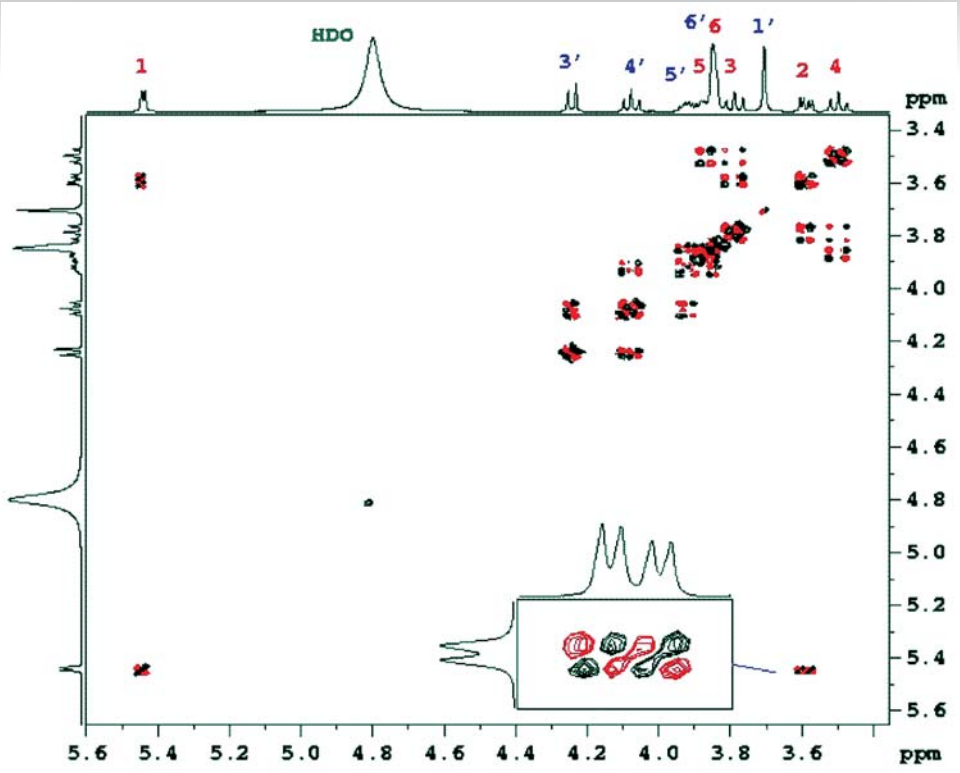
• **Gradient-based:**

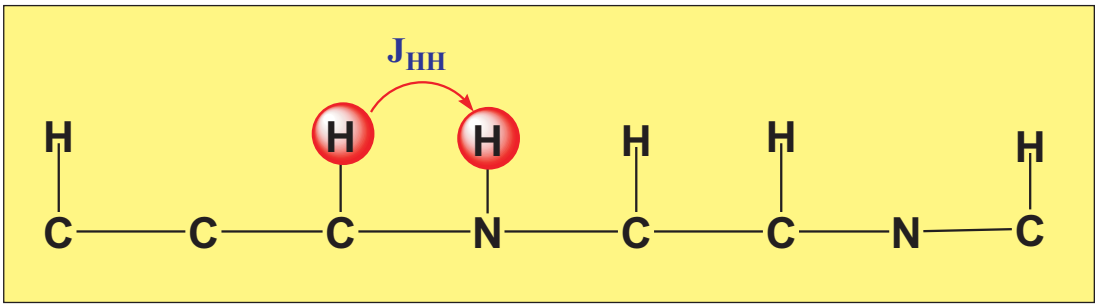
Magnitude-mode ge-2D COSY with multiple-quantum filter (**cosygpmfqf** | COSYGPMFSW)
Phase-sensitive ge-2D COSY with multiple-quantum filter (**cosygpmfph** | COSYGPDFPHSW)
Phase-sensitive ge-2D COSY with DQF using echo-antiecho (**cosydfetgp.1**)
Phase-sensitive ge-2D COSY with gradient-based DQF using echo-antiecho (**cosydfetgp.2**)

Gradient E.COSY (**ecosygpph**)

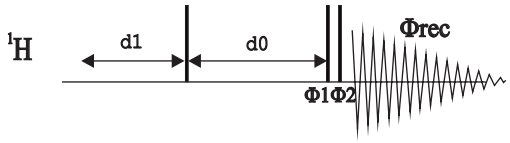
• **Gradient-based and solvent supression:**

Phase-sensitive 2D COSY-DQF with WATERGATE using 3-9-19 (**cosydfgpph19**)
Phase-sensitive 2D COSY-DQF with Excitation Sculpting using 180 water-selective pulse (ES element) (**cosydfesgpph**)

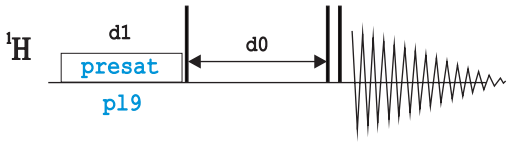




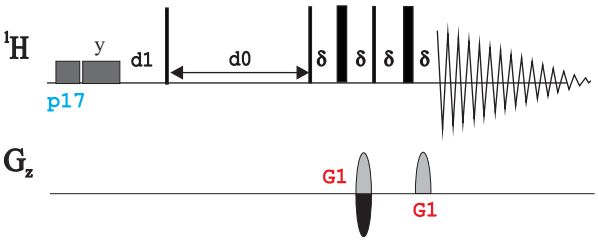
cosydfph cosyphtf ecos3cph
cosydfqf cosyqftf ecos3nph



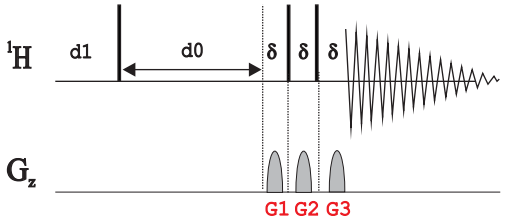
cosydfphpr



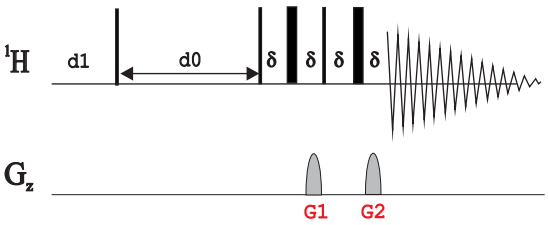
ecosygpph



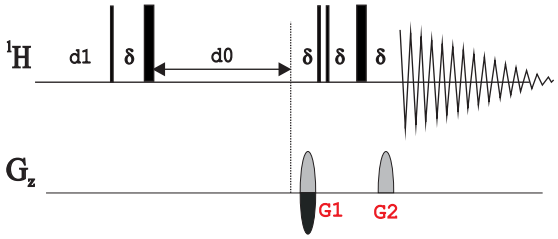
cosygpmfqf



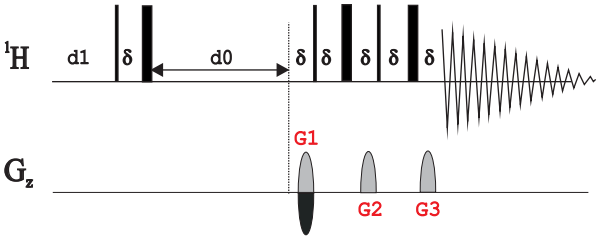
cosygpmfph



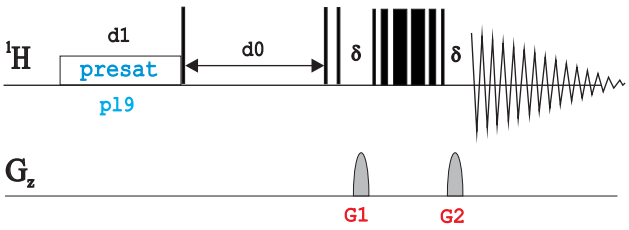
cosydfetgp.1



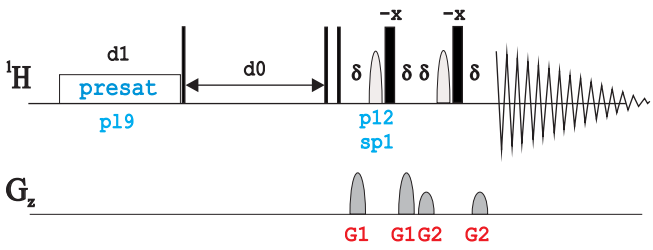
cosydfetgp.2



cosydfgpph19



cosydfesgpph



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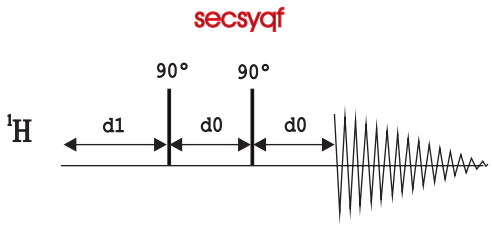
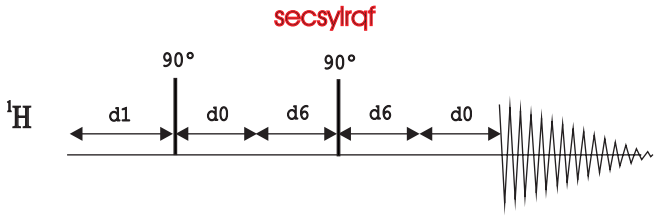
2D SECSY EXPERIMENTS

Magnitude-mode 2D SECSY (**secsyqf**)
Magnitude-mode long-range optimized 2D SECSY (**secsylrqf**)





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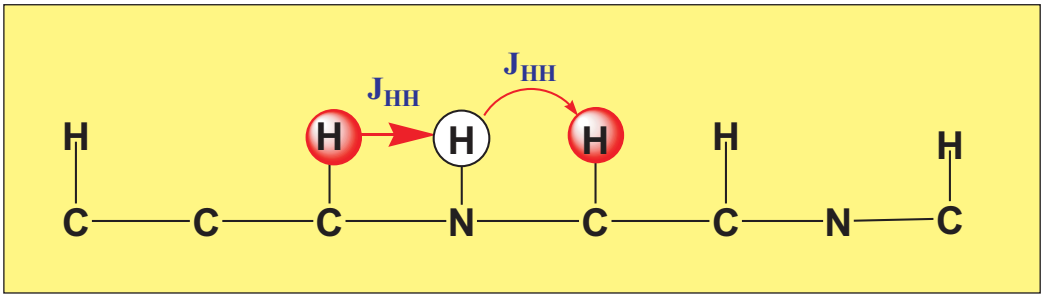
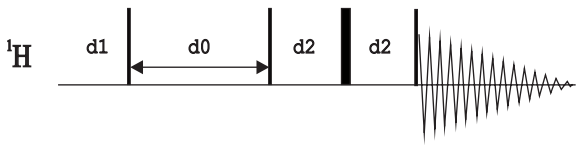
2D RELAYED EXPERIMENTS

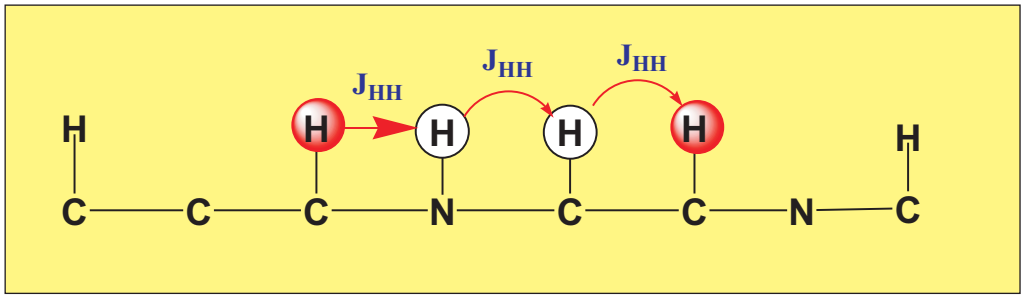
Magnitude-mode one-step 2D RELAY (**cosyqfrl**)
Magnitude-mode one-step 2D RELAY with incremented mixing times (**cosyimqfrl**)
Magnitude-mode two-step 2D RELAY (**cosyqfr2**)
Magnitude-mode two-step 2D RELAY wit h incremented mixing times (**cosyimqfr2**)
Magnitude-mode three-step 2D RELAY (**cosyqfr3**)



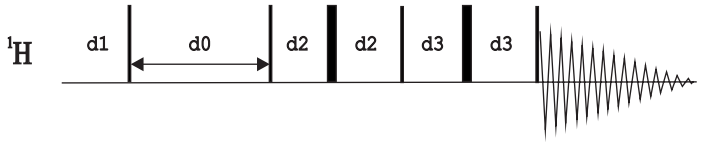
cosyqfrl



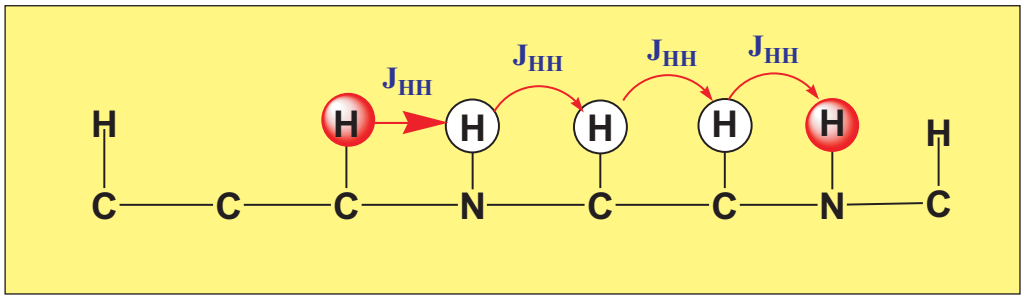
cosyimqfrl



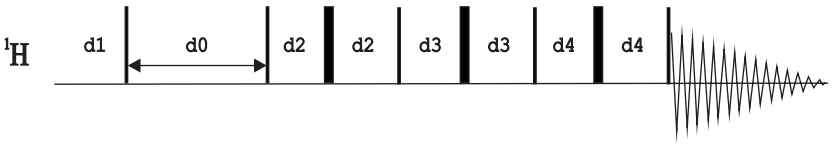
cosyqfr2



cosylmqfr2



cosyqfr3



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2D TOCSY EXPERIMENTS

Phase-cycled

Phase-sensitive 2D TOCSY using MLEV (**mlevph** | **MLEVPHSW**)
Phase-sensitive 2D TOCSY using MLEV with purge pulses before d1 (**mlevphpp**)
Phase-sensitive 2D TOCSY using DIPSI-2 (**dipsi2ph**)

Phase-cycled and solvent suppression

Phase-sensitive 2D TOCSY with presaturation using MLEV (**mlevphpr** | **MLEVPHPR**)
Phase-sensitive 2D TOCSY with presaturation using MLEV only using first trim pulse (**mlevphpr.2** | **H2OSUPMLEV**)
Phase-sensitive 2D TOCSY with presaturation using DIPSI-2 (**dipsi2phpr**)
Phase-sensitive 2D Clean-TOCSY with presaturation using MLEV (**clmlevphpr**)

Gradient-based

Phase-sensitive ge-2D TOCSY with MLEV using echo-antiecho (**mlevetgp**)
Phase-sensitive ge-2D TOCSY with DIPSI-2 using echo-antiecho (**dipsi2etgp**)
Phase-sensitive ge-2D TOCSY with DIPSI-2 using PEP (**dipsi2etgpsi**)

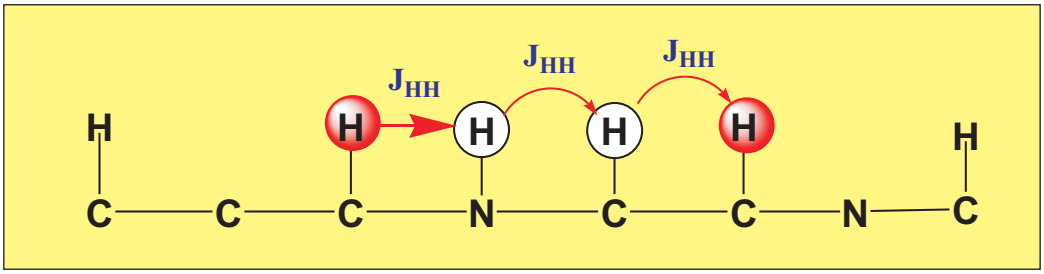
Gradient-based and solvent suppression

Phase-sensitive 2D TOCSY with WATERGATE (3-9-19) using MLEV (**mlevgpph19** | **MLEVGPPH19SW**)
Phase-sensitive 2D TOCSY with WATERGATE (3-9-19) using DIPSI-2 (**dipsi2gpph19**)
Phase-sensitive sensitivity-improved 2D TOCSY with WATERGATE (3-9-19) and using DIPSI-2 (**dipsi2etgpsi19**)
Phase-sensitive 2D Adiabatic TOCSY with WATERGATE (3-9-19) using X_M16 sequence (**atocsygpph19**)

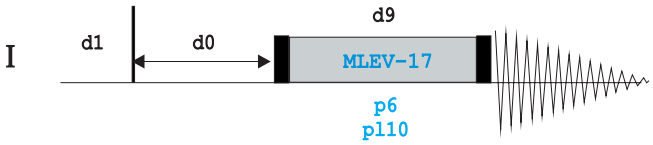
Phase-sensitive 2D TOCSY with excitation sculpting (W5) using MLEV (**mlevgpphw5**)
Phase-sensitive 2D TOCSY with excitation sculpting (180 water-selective pulse-ES element) using MLEV (**mlevesgpph**)
Phase-sensitive 2D TOCSY with excitation sculpting (180 water-selective pulse-ES element) using DIPSI-2 (**dipsi2esgpph**)

Related Experiments:

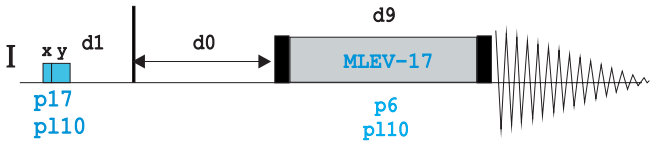
- LC-NMR Experiments



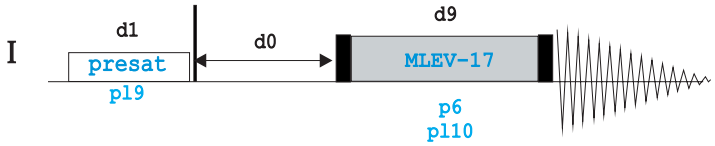
mlevph



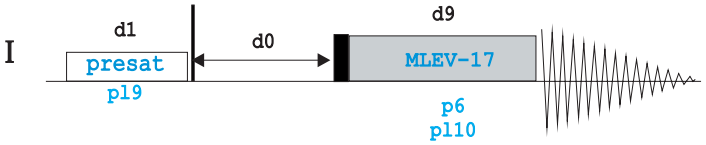
mlevphpp



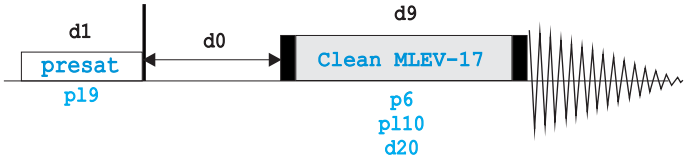
mlevphpr



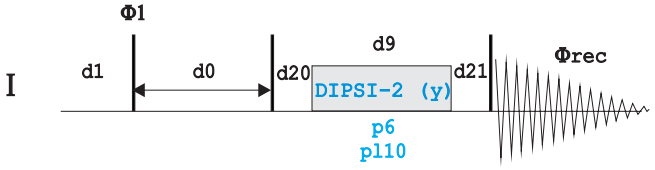
mlevphpr.2



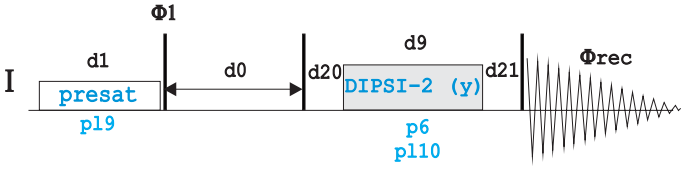
clmlevphpr



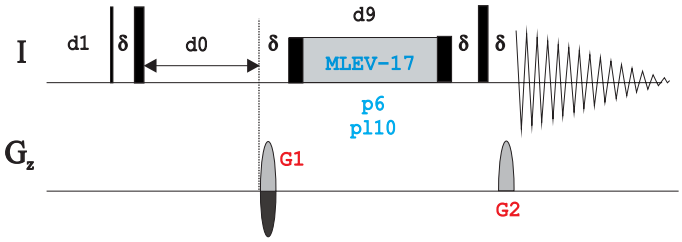
dipsi2ph



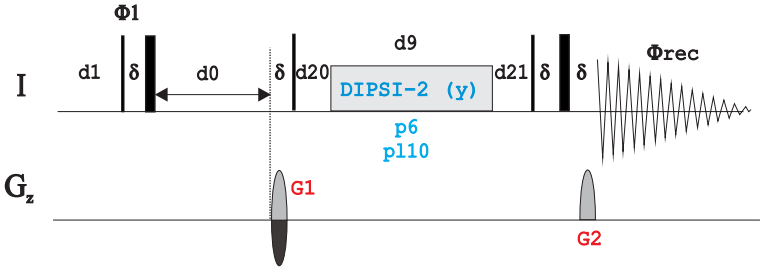
dipsi2phpr



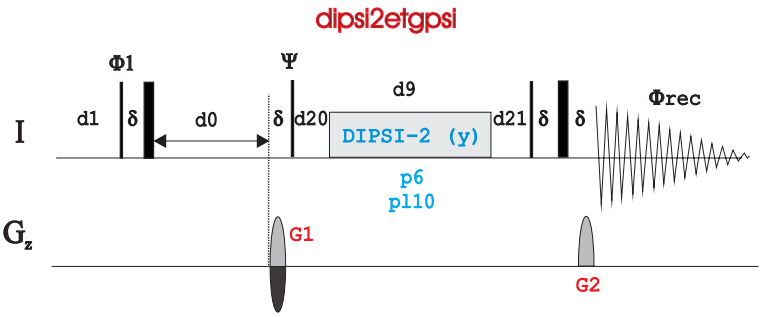
mlevetgp

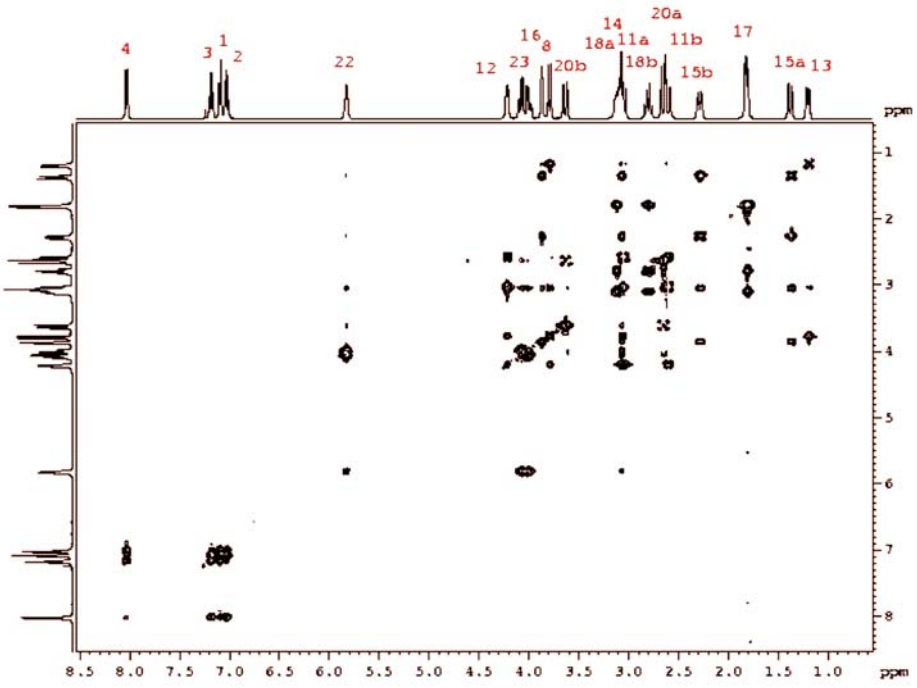


dipsi2etgp



dipsi2etgpsi





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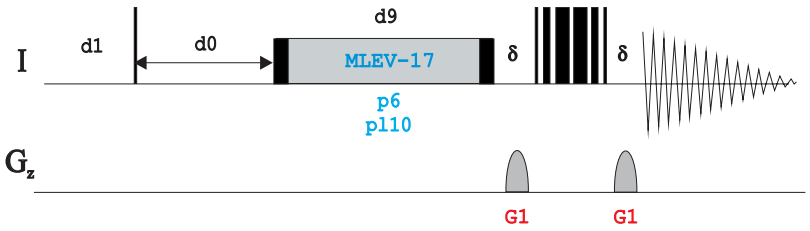

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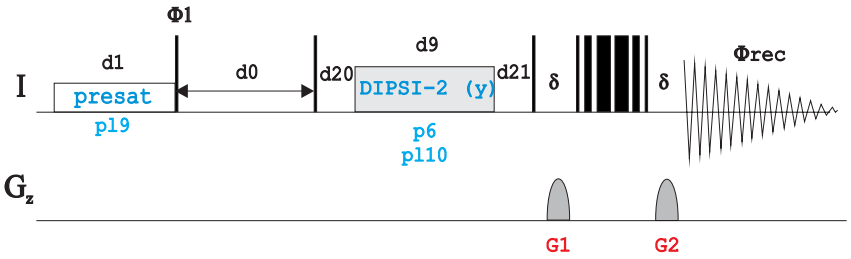

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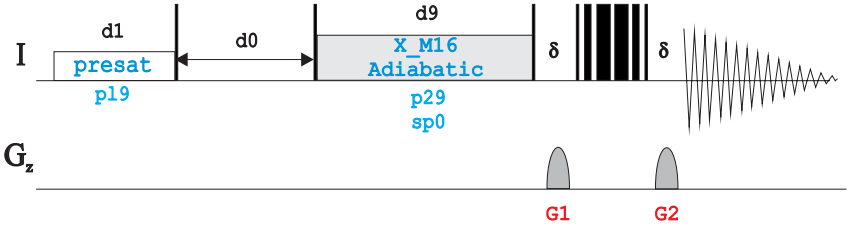

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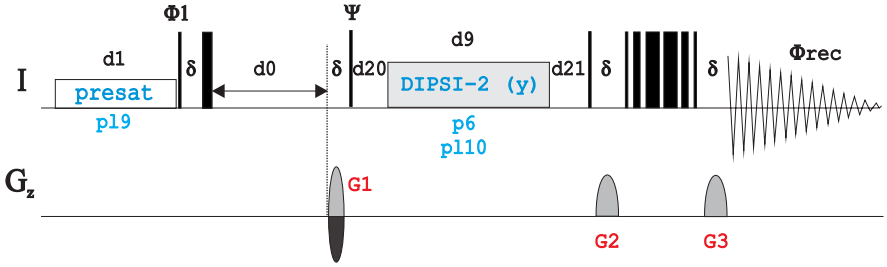

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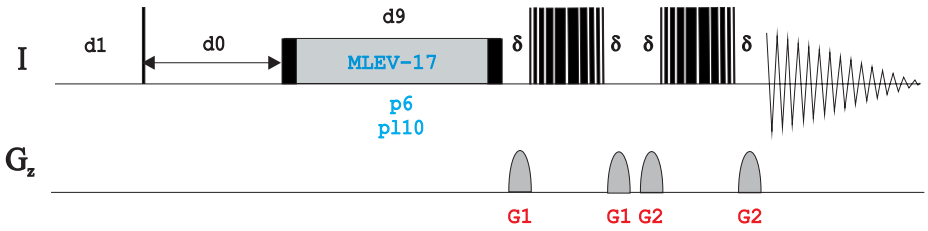

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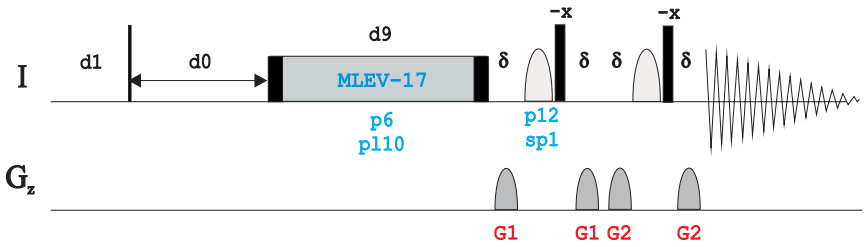

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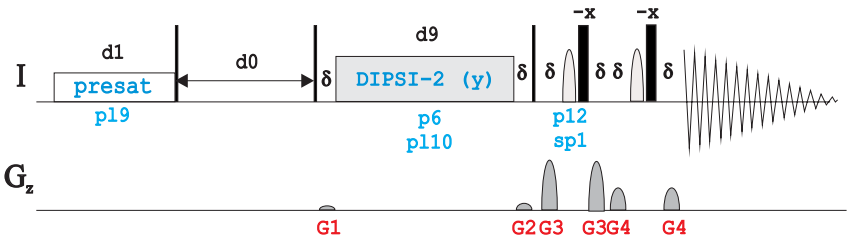

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2D ROESY EXPERIMENTS

Phase-cycled:

Phase-sensitive 2D ROESY (**roesyph** | **ROESYPHSW**)
Phase-sensitive 2D ROESY using purgue pulses before d1 (**roesyphpp**)
Phase-sensitive 2D T-ROESY (**roesyph.2**)
Phase-sensitive 2D T-ROESY using purgue pulses before d1 (**roesyphpp.2**)
Phase-sensitive 2D ROESY with compensation (**croesyph**)
Phase-sensitive off-resonance 2D ROESY (**troesyph**)

Phase-cycled and solvent suppression:

Phase-sensitive 2D ROESY with presaturation (**roesyphpr** | **ROESYPHPR**)
Phase-sensitive 2D T-ROESY with presaturation (**roesyphpr.2**)
Phase-sensitive 2D ROESY with compensation and presaturation (**croesyphpr**)
Phase-sensitive off-resonance 2D ROESY with presaturation (**troesyphpr**)

Gradient-based:

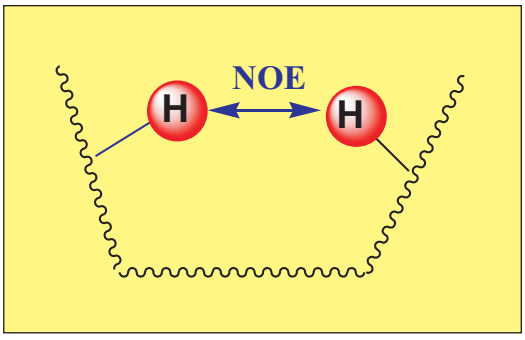
Phase-sensitive ge-2D ROESY using echo-antiecho (**roesyetgp**)
Phase-sensitive ge-2D ROESY with T-ROESY using echo-antiecho (**roesyetgp.2**)

Gradient-based and solvent suppression:

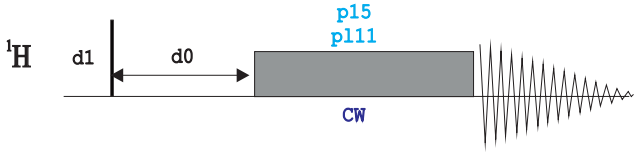
Phase-sensitive 2D ROESY with WATERGATE using 3-9-19 (**roesygpph19**)
Phase-sensitive 2D T-ROESY with WATERGATE using 3-9-19 (**roesygpph19.2**)
Phase-sensitive 2D ROESY with excitation sculpting using 180 water-selective pulse (ES element) (**roesyesgpph**)

Related Experiments:

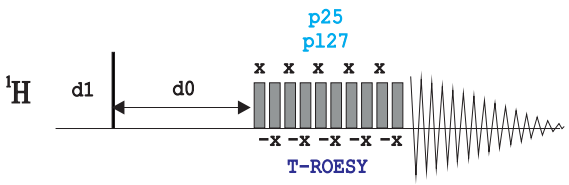
- Selective 1D ROESY Experiments
- 2D NOESY Experiments
- 2D HSQC-ROESY Experiments



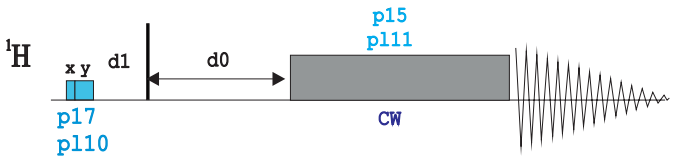
roesyph



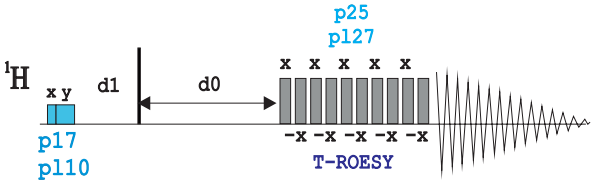
roesyph.2



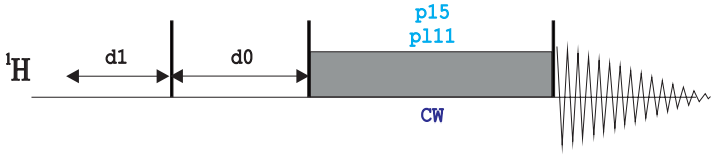
roesyphpp



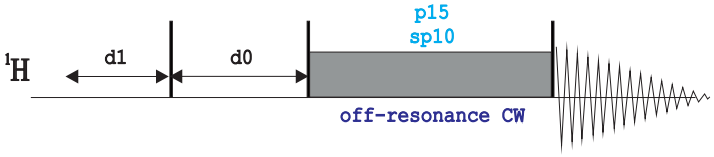
roesyphpp.2



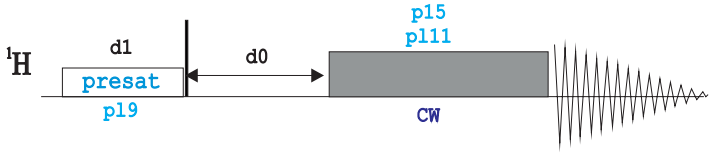
croesyph



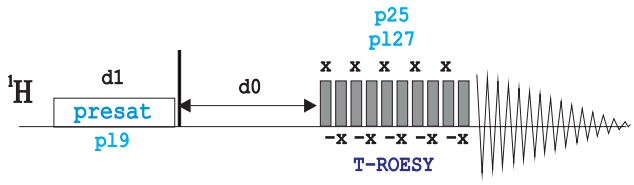
troesyph



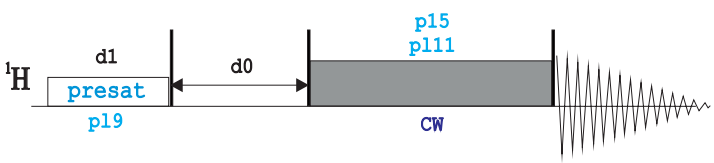
roesyphpr



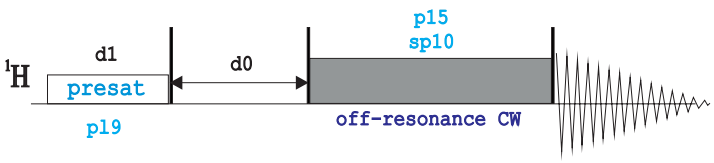
roesyphpr.2



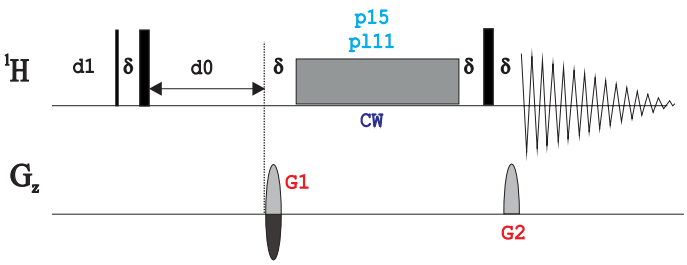
croesyphpr



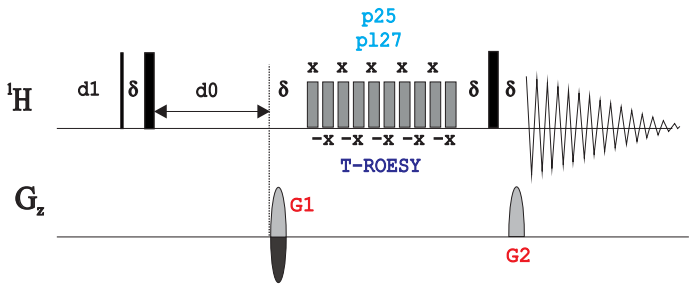
troesyphpr



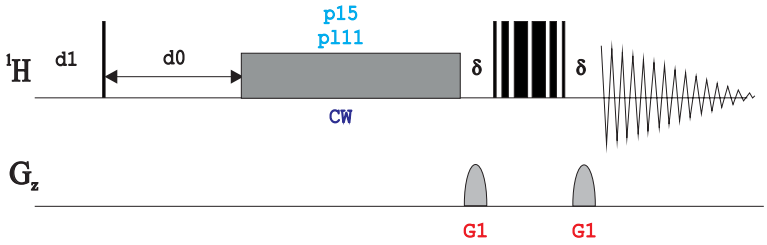
roesyetgp



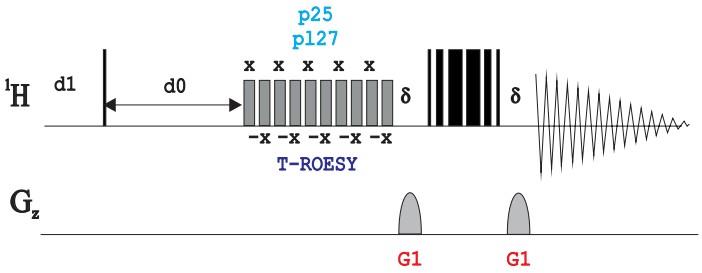
roesyetgp.2



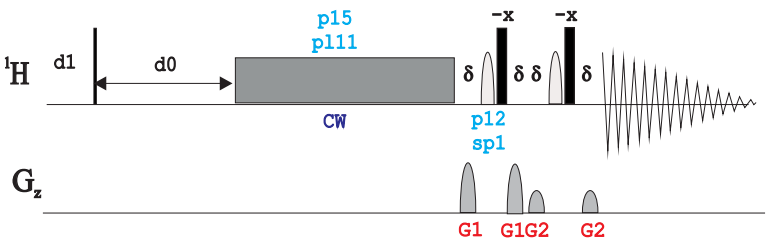
roesygpph19



roesygpph19.2



roesyesgpph



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2D NOESY EXPERIMENTS

2D NOESY Experiments

1D Version:

1D NOESY with presaturation **(noesypr1d)**
1D NOESY with presaturation and spoil gradients **(noesygppr1d)**

Phase-cycled:

Phase-sensitive 2D NOESY (**noesyph** | **NOESYPHSW**)
Phase-sensitive 2D NOESY using purgue pulses before d1 (**noesyphpp**)
Phase-sensitive 2D NOESY using random mixing time (**noesyphrv**)

Phase-cycled and solvent suppression:

Phase-sensitive 2D NOESY with presaturation (**noesyphpr** | **H2OSUPNOESY**)
Phase-sensitive 2D NOESY with presaturation using random mixing time (**noesyphprrv**)
Phase-sensitive 2D NOESY with 1-1 solvent suppression (**noesyph11**)

Gradient-based:

Phase-sensitive ge-2D NOESY (**noesygpph**)
Phase-sensitive ge-2D NOESY using purgue pulses before d1 (**noesygpphpp**)
Phase-sensitive ge-2D NOESY with z-spoil (**noesygpphzs**)
Phase-sensitive ge-2D NOESY using echo-antiecho (**noesyetgp**)

Gradient-based and solvent suppression:

Phase-sensitive 2D NOESY using jump-and-return and optional ^{13}C and ^{15}N decoupling during acquisition (**noesygpphjrrs**)

Phase-sensitive 2D NOESY with WATERGATE:
- Using 3-9-19 (**noesygpph19** | **NOESYGPPH19SW**)
- Using water flip-back and 3-9-19 (**noesyfpgpph19**)
- Using water flip-back and water-selective 90 pulses (**noesyfpgpphwg**)
- Using water flip-back, 3-9-19 and PFG in t_1 (**noesyfpgpphrs19**)
- Using water flip-back, water-selective 90 pulses and PFG in t_1 (**noesyfpgpphrswg**)

Phase-sensitive 2D NOESY with excitation sculpting:
- Using W5 (**noesygpphw5**)
- Using 180 water-selective pulse (ES element) (**noesyesgpph**)

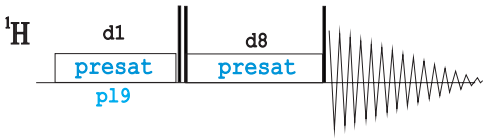
Related Experiment:

Phase-sensitive 2D NOESY with RELAY and DQF (NOESY-RELAY experiment) (**noesydfphrl**)

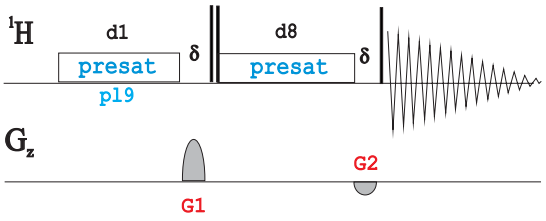
Related Experiments:

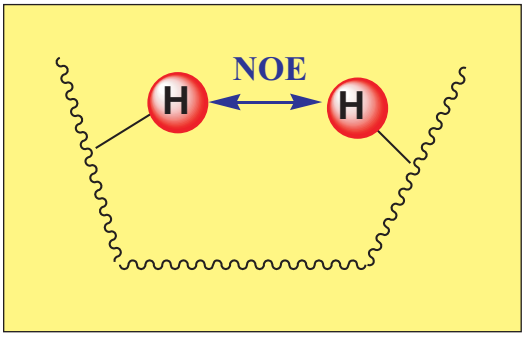
- Selective 1D NOESY
- 2D ROESY Experiments
- 2D HSQC-NOESY & 2D HMQC-NOESY
- 3D NOESY-HSQC & 3D HSQC-NOESY-HSQC
- 2D & 3D X-filtered NOESY experiments

noesypr1d



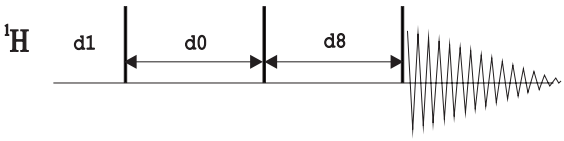
noesygppr1d





noesyph

noesyphrv



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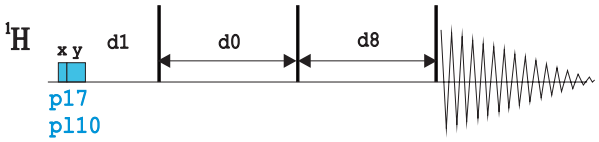
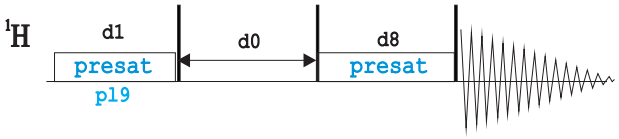
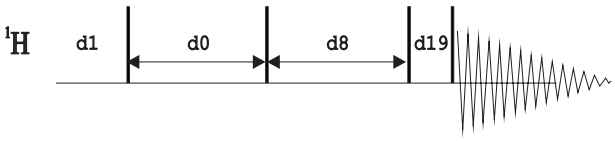


noesyphpr

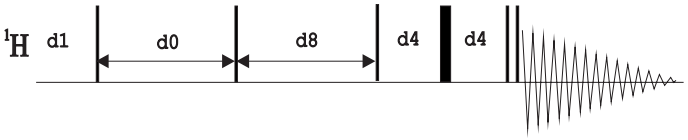
noesyphprrv

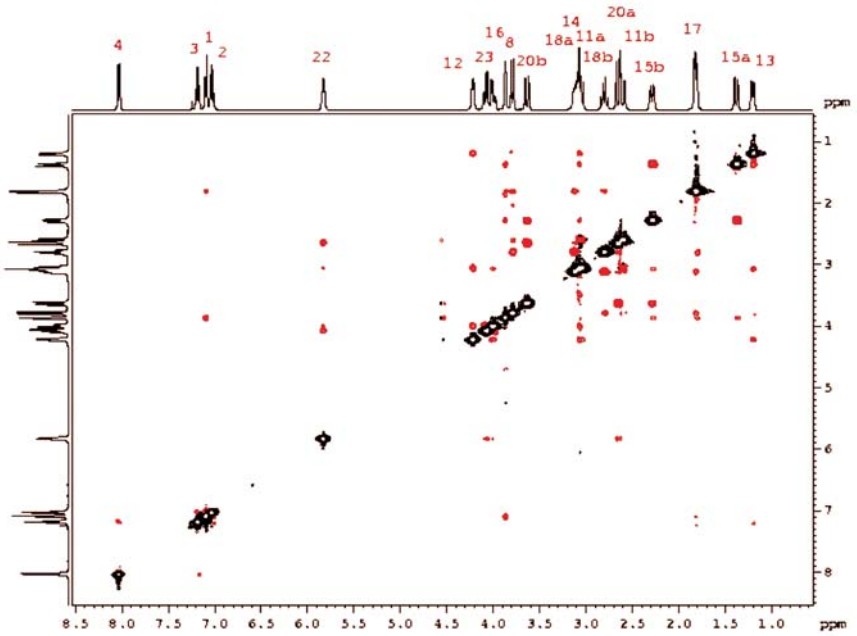


noesyph11



noesydfphrl





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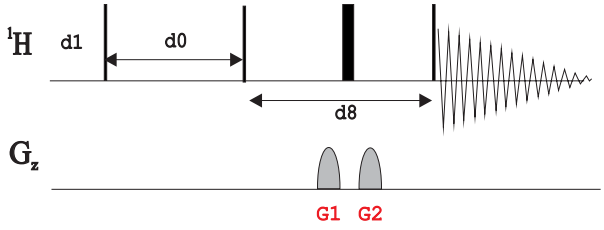

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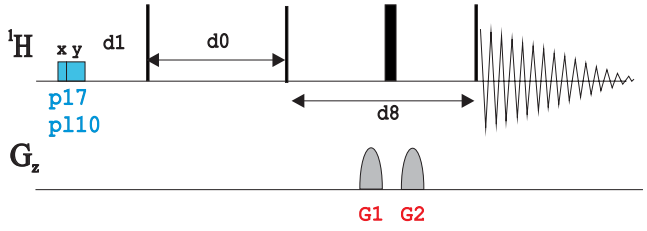
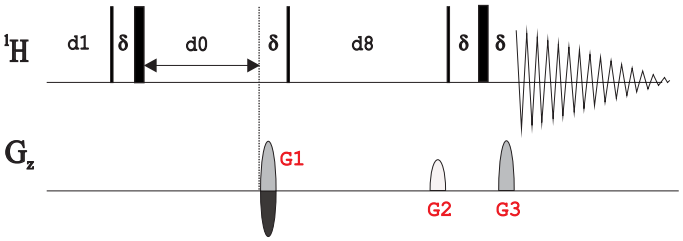
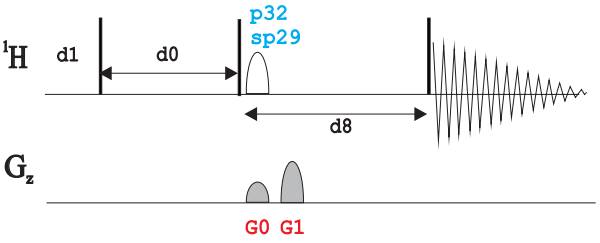


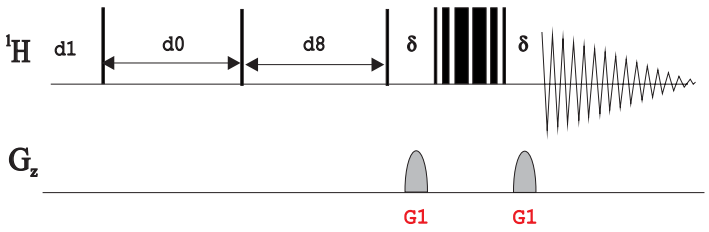
noesyetgp



noesygpphzs



noesygpph19



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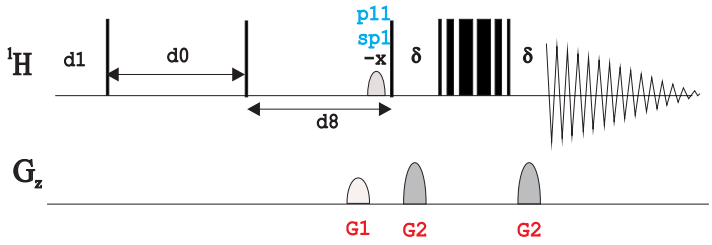

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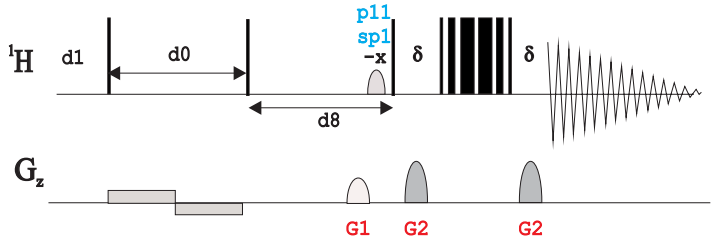

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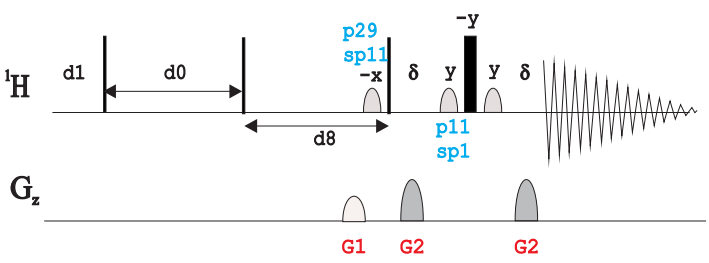

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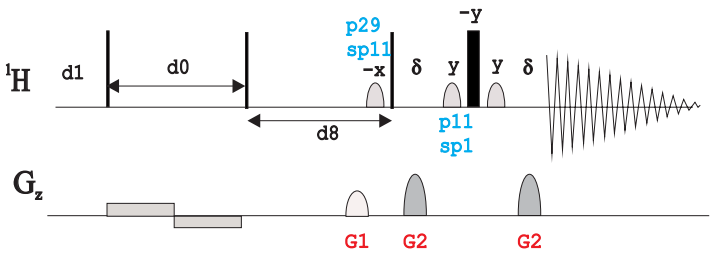

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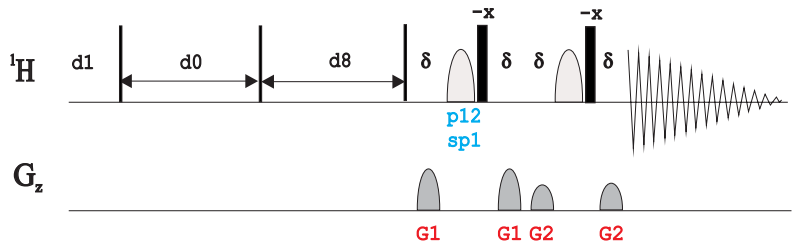

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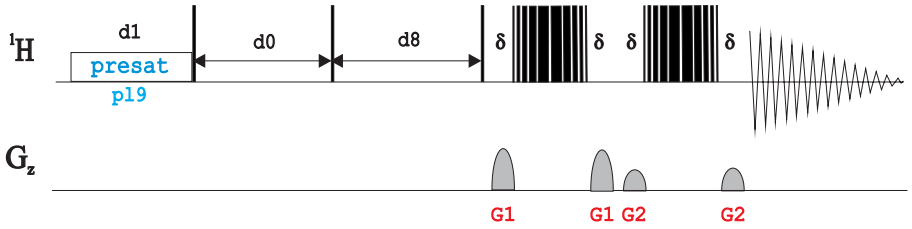

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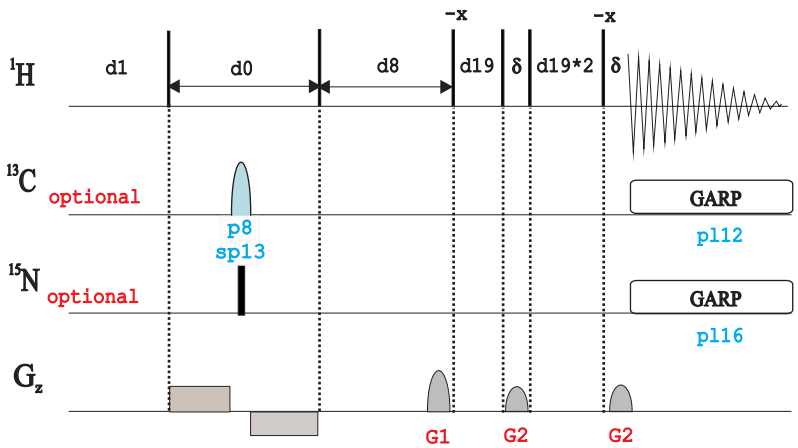

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1D & 2D DOUBLE-QUANTUM EXPERIMENTS

- **1D Double-Quantum (DQ)**

  1D Double-Quantum experiments (**dqs1d**)
  1D Multiple Quantum Filter (**mqsgp1d** | **mqsgp1d2**)

- **2D Phase-cycled Double-Quantum (DQ)**

  Magnitude-mode 2D Double-Quantum (DQ) (**dqsqf**)
  Phase-sensitive Double-Quantum (DQ)(**dqsph**)
  Phase-sensitive 2D Double-Quantum (DQ) with presaturation (**dqsphpr**)

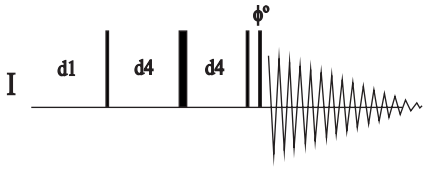
- **2D Gradient-based Double-Quantum (DQ)**

  Phase-sensitive ge-2D Double-quantum using echo-antiecho, 45/135 degree conversion pulse for better sensitivity and remote peak minimisation (**dqseagp135**)
  Phase-sensitive ge-2D Double-quantum using echo-antiecho (**dqseagp90**)

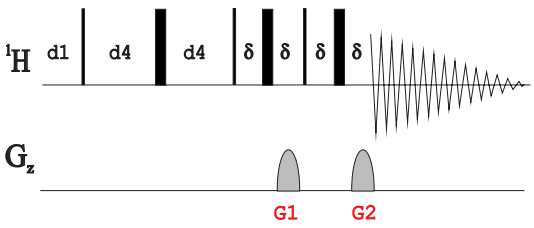
  Related Experiments:

  - 1D & 2D INADEQUATE

dqs1d



mqsgp1d



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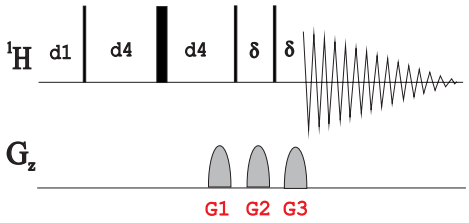
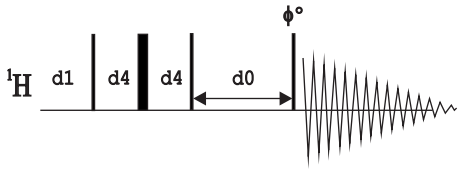
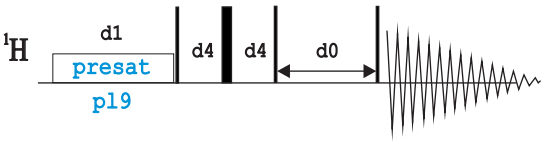


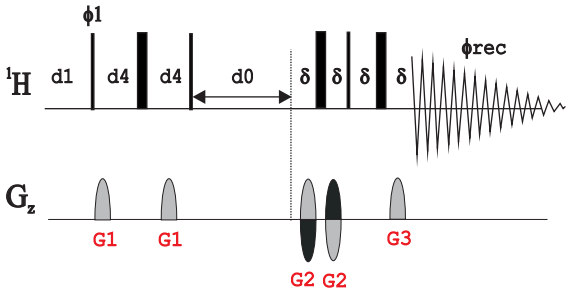
dqsph
dqsqf



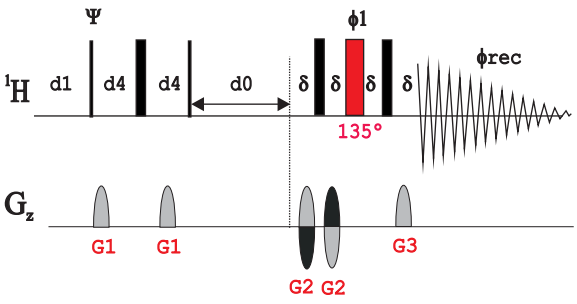
dqsphpr



dqseagp90



dqseagp135



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2D J-RESOLVED EXPERIMENTS

- **Classical:**

  Magnitude-mode 2D J-Resolved (**jresqf**)
  Magnitude-mode 2D J-Resolved with f2 decoupling (**jresdcqf**)

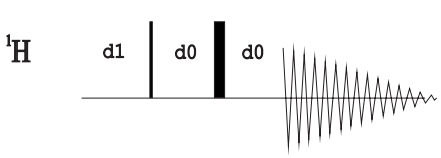
- **With solvent suppression:**

  2D J-Resolved with presaturation (**lcjresprqf**)
  2D J-Resolved with presaturation using shape pulse (**lcjrespsqf**)

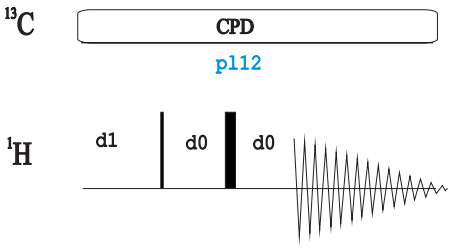
  Also see:

  LC-NMR Experiments

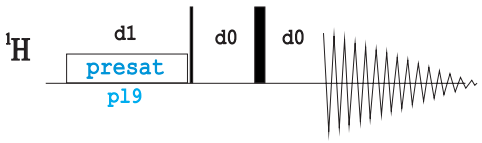
jresqf



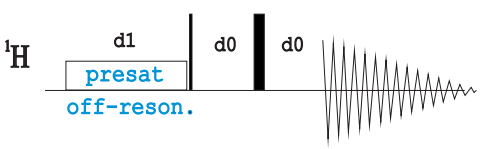
jresdcqf

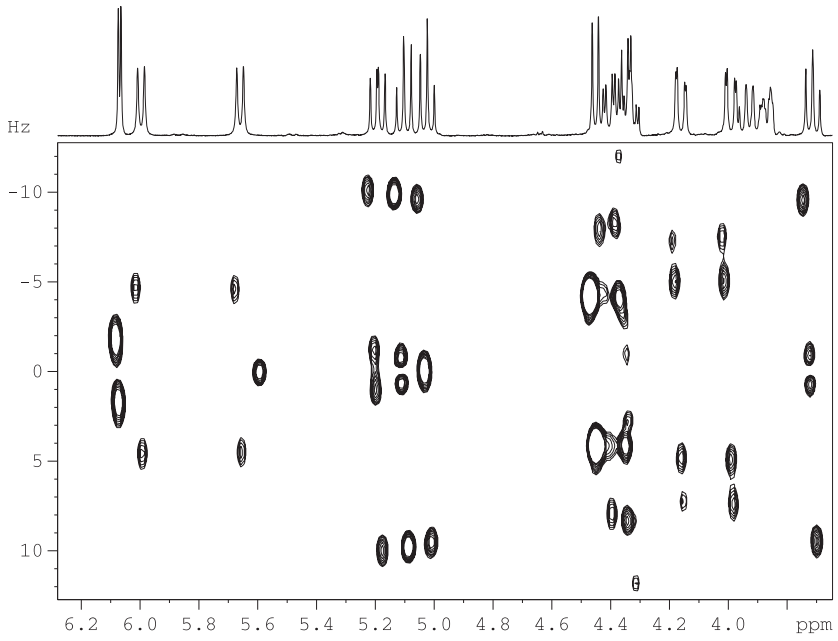


lcjresprqf



lcjrespsqf





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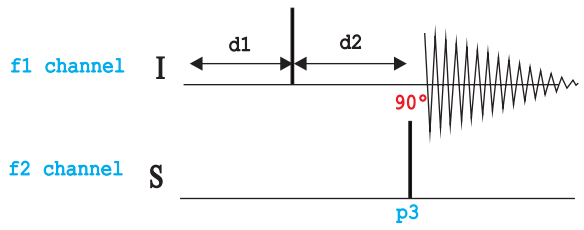
DECOUPLER PULSE CALIBRATION

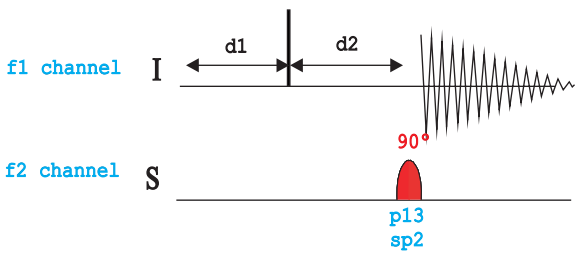
Calibration of the 90 decoupler pulse (**decp90**, **decp90f3**)
Calibration of the 90 decoupler shaped pulse (**decp90sp**)

Calibration of the 180 decoupler pulse (**dec180**)
Calibration of the shaped 180 decoupler pulse (**dec180sp**)
Calibration of the 180 decoupler pulse using presaturation (**dec180pr**, **dec180f3pr**)

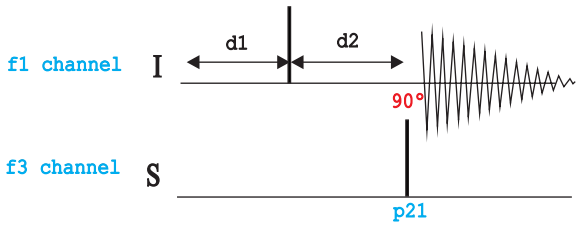
decp90

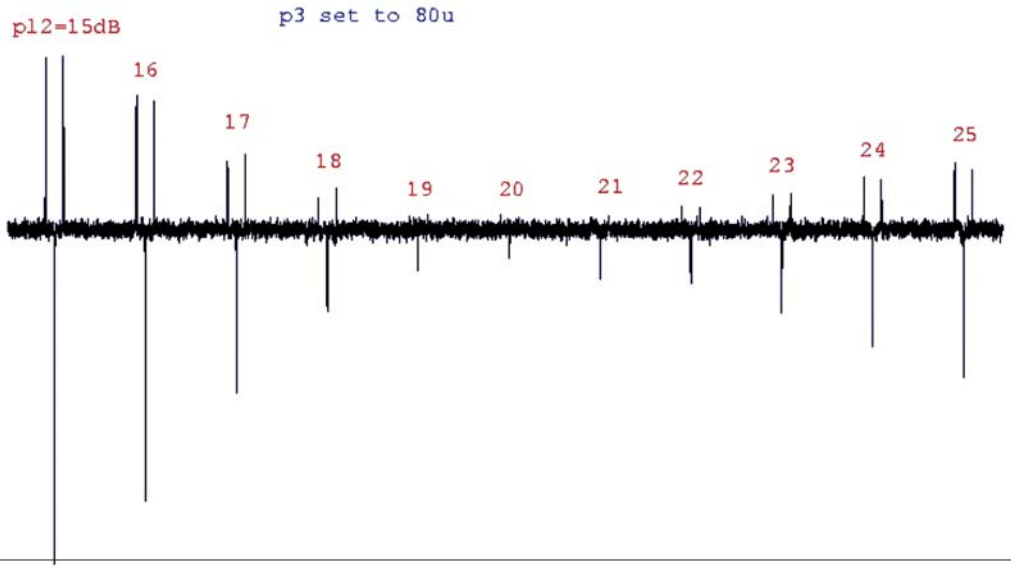


decp90sp

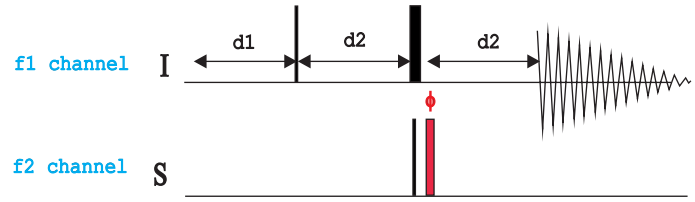


decp90f3

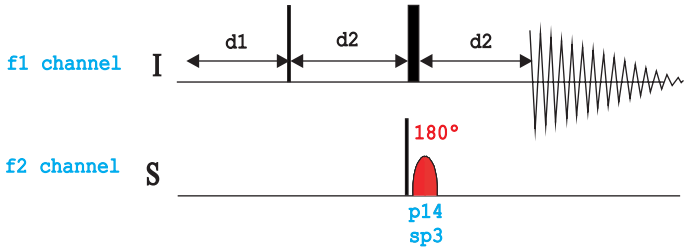




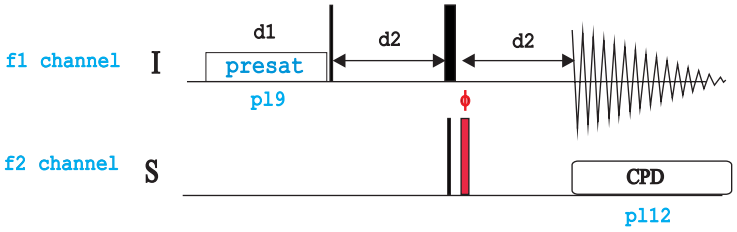
dec180



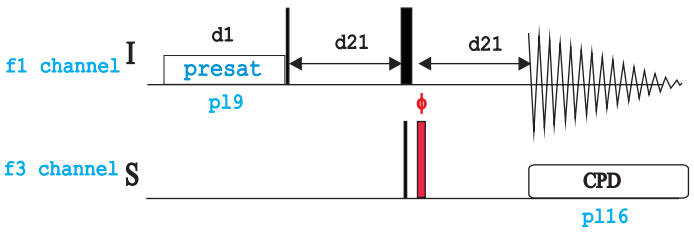
dec180sp



dec180pr



dec180f3pr



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1D DEPT & INEPT EXPERIMENTS

- **DEPT Experiments:**

  DEPT (**dept**)
  DEPT-45 (**dept45** | **C13DEPT45**)
  DEPT-90 (**dept90** | **C13DEPT90**)
  DEPT-135 (**dept135** | **C13DEPT135**)
  DEPT-45 with adiabatic pulses (**deptsp45** / **deptsp**)
  DEPT-90 with adiabatic pulses (**deptsp90**)
  DEPT-135 with adiabatic pulses (**deptsp135**)
  DEPT with composite pulses (**deptcp**)
  DEPT-45 with composite pulses (**deptcp45**)
  DEPT-90 with composite pulses (**deptcp90**)
  DEPT-135 with composite pulses (**deptcp135**)

  DEPT without ^{1}H-decoupling (**deptnd**)
  DEPT++ without ^{1}H-decoupling (**deptppnd**)

- **INEPT Experiments:**

  INEPT without refocusing (**ineptnd**)
  Refocused INEPT with decoupling (**ineptrd**)
  Refocused INEPT with decoupling using adiabatic pulses (**ineptrdsp**)
  INEPT+ without decoupling (**ineptpnd**)

  Non-refocused ^{1}H-coupled ^{15}N spectrum using INEPT (**ineptnd**)
  ^{1}H-decoupled ^{15}N spectrum using INEPT (**ineptrd** | **N15INEPT**)
  Refocused ^{1}H-coupled ^{15}N spectrum using INEPT+ (**ineptpnd**)

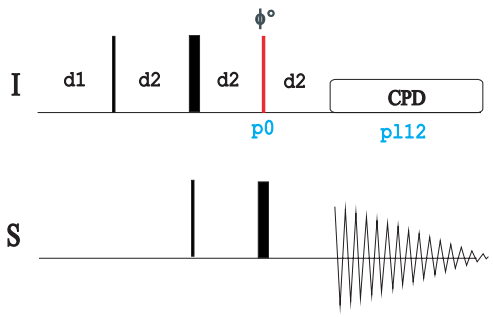
  1D X-relayed H,X-COSY (**ineptrl1** / **ineptrl2**)

- **Other editing experiments:**

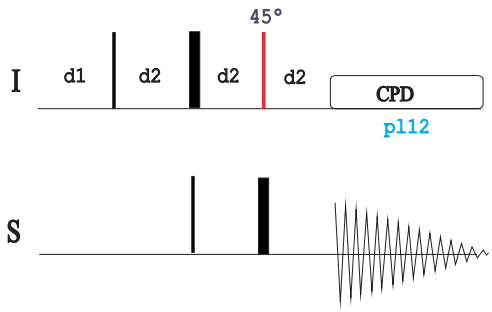
  Spin-Echo or SEFT (**jmod**)
  Conventional APT (**apt** | **C13APT**)
  APT with J-compensation (**aptjc**)

  Quaternary-carbons with decoupling (**quatd**)
  Quaternary-carbons without decoupling (**quat**)

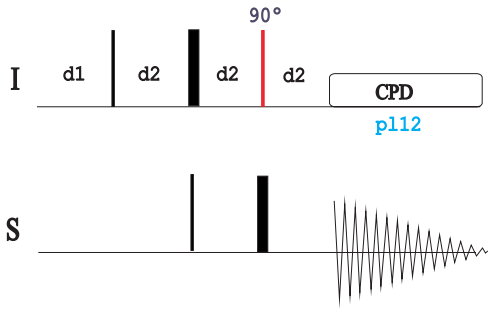
dept



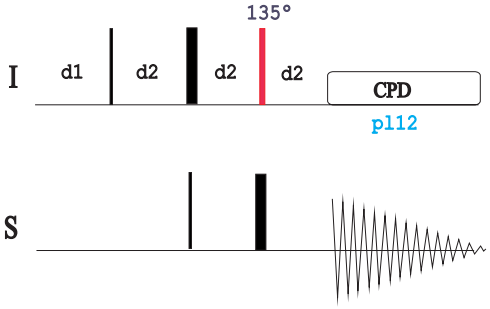
dept45



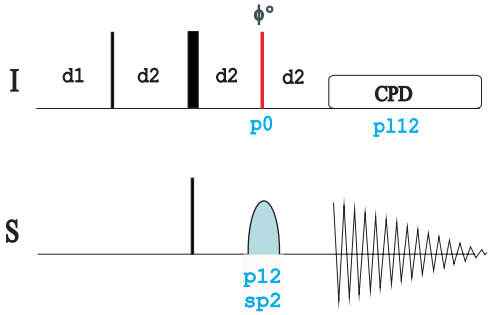
dept90



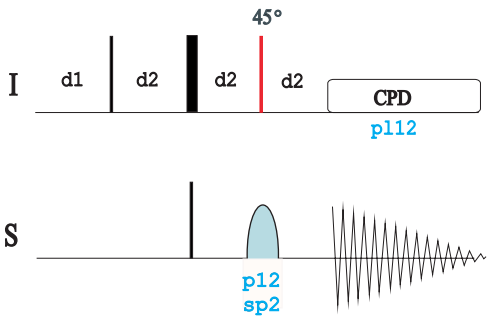
dept135



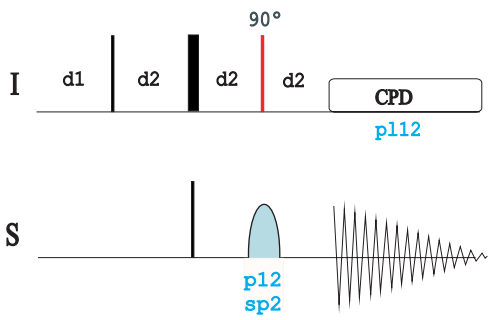
deptsp



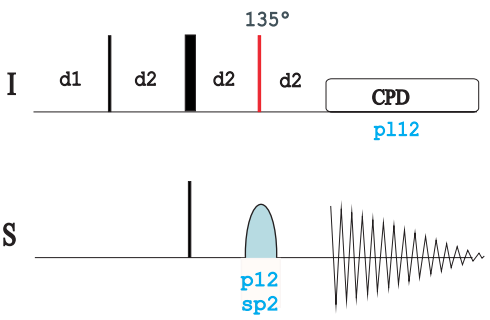
deptsp45



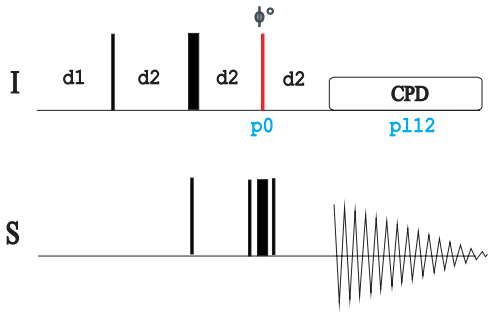
deptsp90



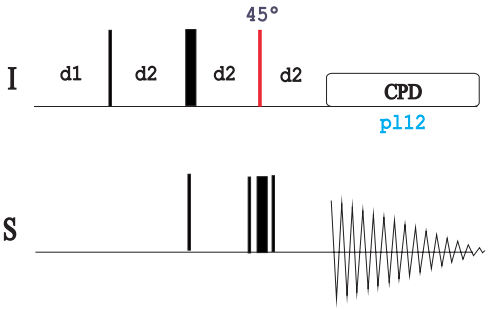
deptsp135



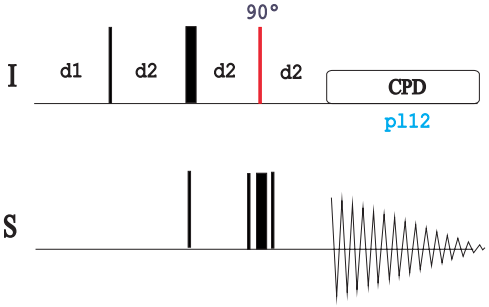
deptcp



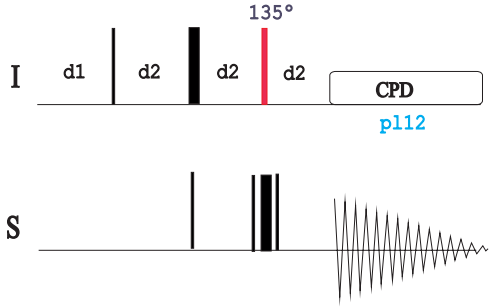
deptcp45



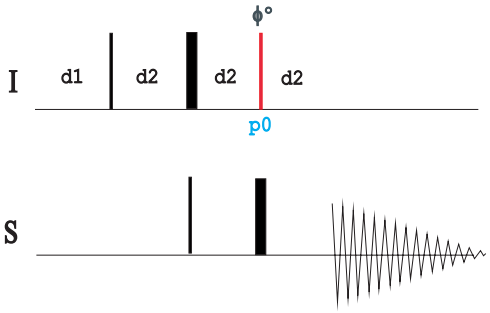
deptcp90



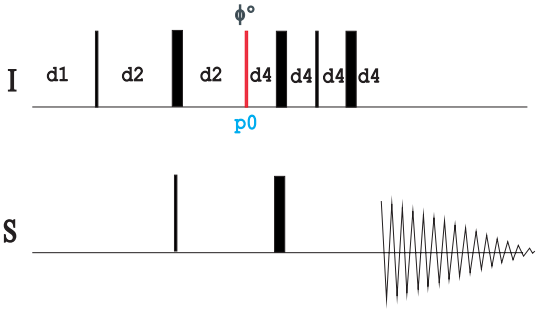
deptcp135



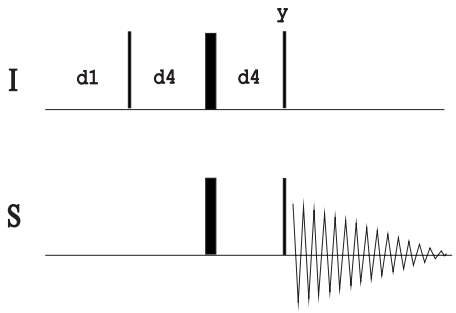
deptnd



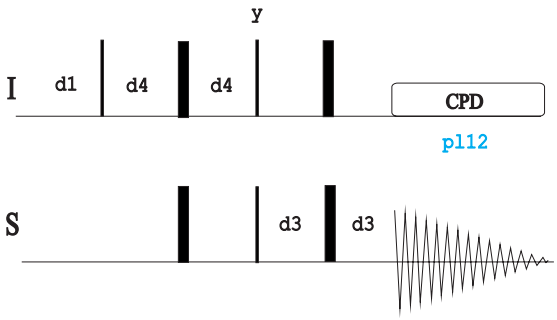
deptppnd



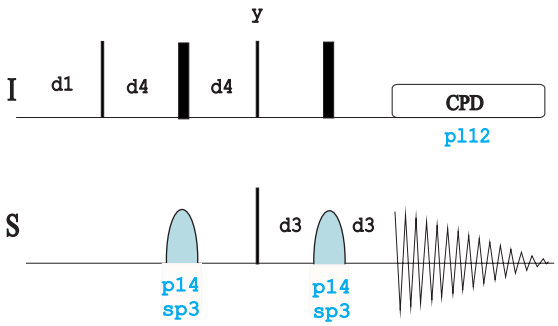
ineptnd



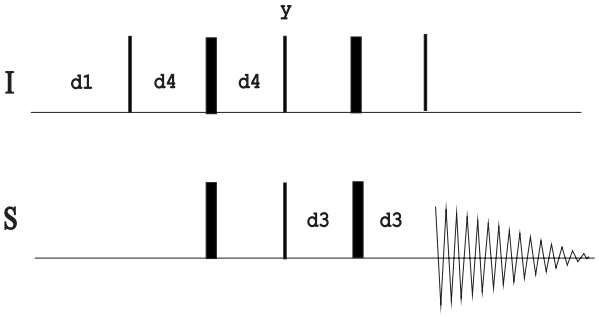
ineptrd

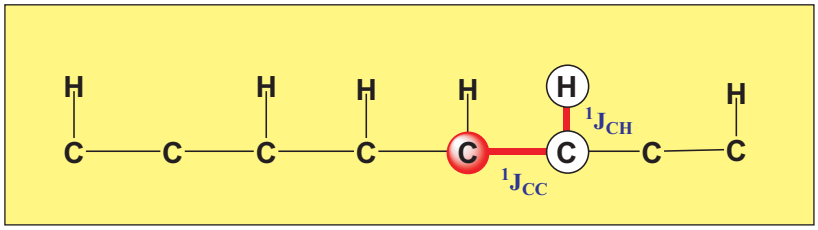


ineptrdsp

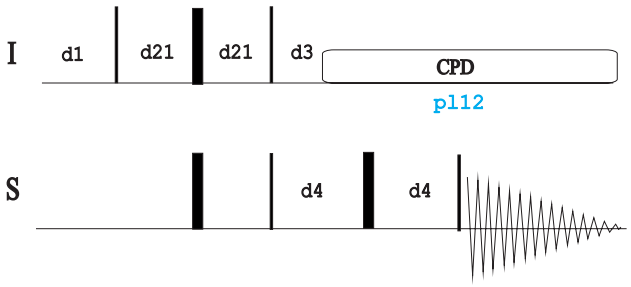


ineptpnd



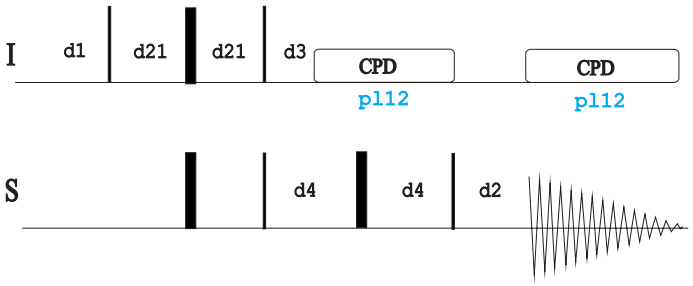


ineptrl1

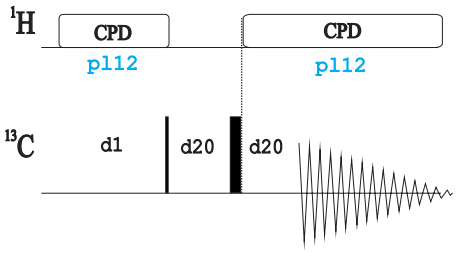


Also see inepin

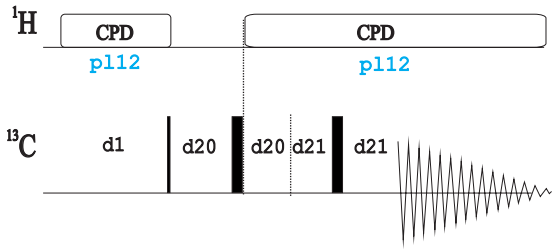
ineptrl2



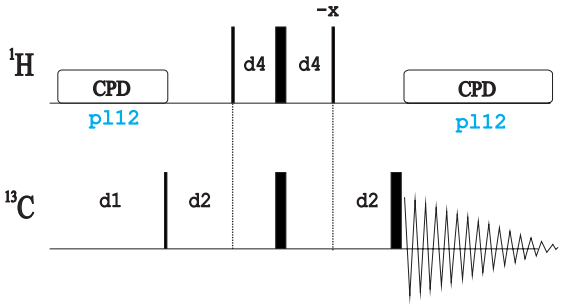
jmod



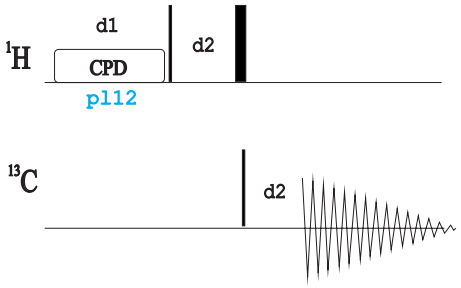
apt



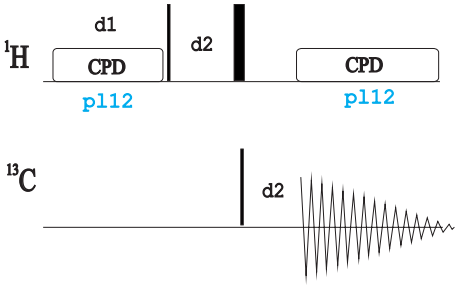
aptjc

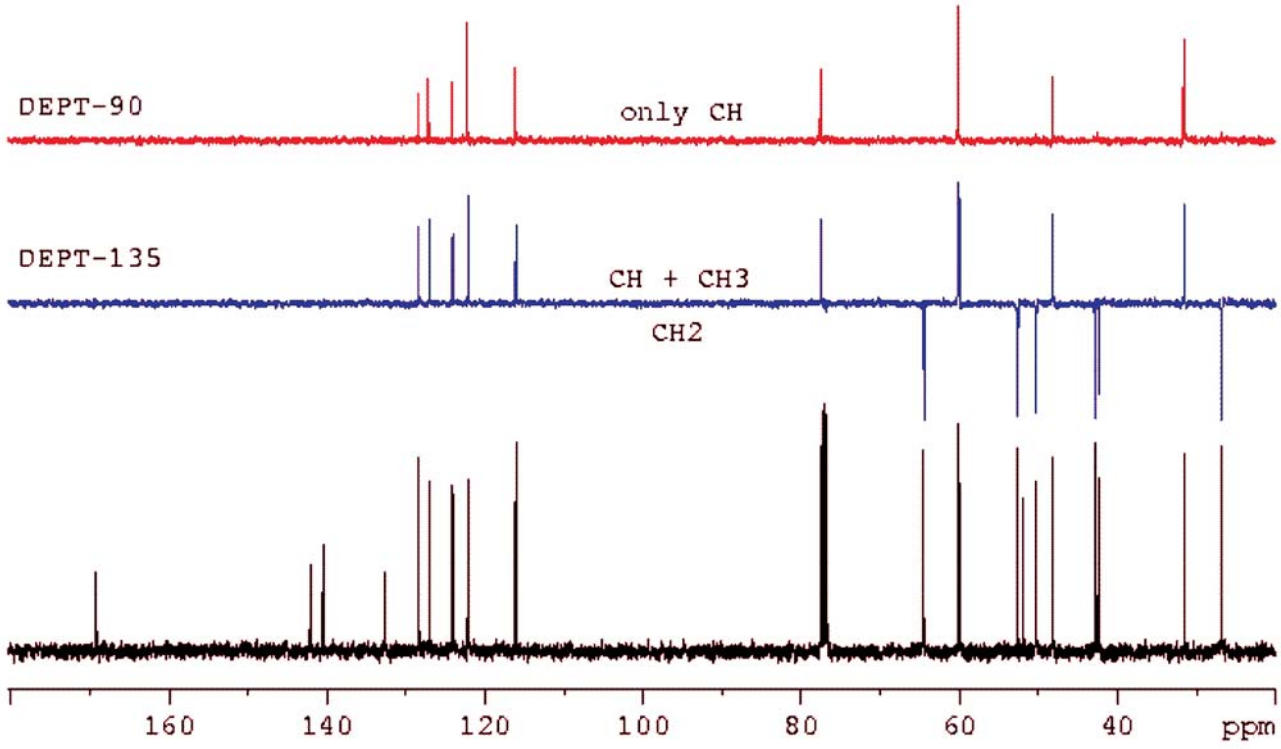


quat



quatd




DEPT-90
only CH
DEPT-135
CH + CH3
CH2
160
140
120
100
80
60
40
ppm

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2D X-DETECTED HETCOR EXPERIMENTS

- **INEPT-Based HETCOR**

    - Magnitude-mode 2D HETCOR (**hxcoqf** | **HCCOSW**)
    - Magnitude-mode 2D HETCOR with 2H-decoupling (**hxcoqf2h**)
    - Magnitude-mode 2D HETCOR using composite pulses (**hxcocpqf**)
    - Magnitude-mode 2D HETCOR with ^{1}H-^{1}H decoupling in F1 using BIRD (**hxcobiqf**)
    - Magnitude-mode 2D HETCOR with ^{1}H-^{1}H decoupling in F1 using BIRD and composite pulses (**hxcobicpqf**)
    - Magnitude-mode 2D HETCOR with refocusing of chemical shifts (**hxinepqf**)
    - Phase-sensitive 2D HETCOR with refocusing of chemical shifts (**hxinepph**)

- **DEPT-based HETCOR**

    - Magnitude-mode DEPT-based 2D HETCOR (**hxdeptqf**)
    - Phase-sensitive DEPT-based 2D HETCOR (**hxdeptph**)
    - Magnitude-mode DEPT-based 2D HETCOR with ^{1}H-^{1}H decoupling in F1 using BIRD (**hxdeptbiqf**)
    - Phase-sensitive DEPT-based 2D HETCOR with ^{1}H-^{1}H decoupling in F1 using BIRD (**hxdeptbiph**)

    - Phase-sensitive DEPT-based TOCSY-HETCOR experiment (**hxdeptmlph**)

- **2D H-relayed HETCOR experiment**

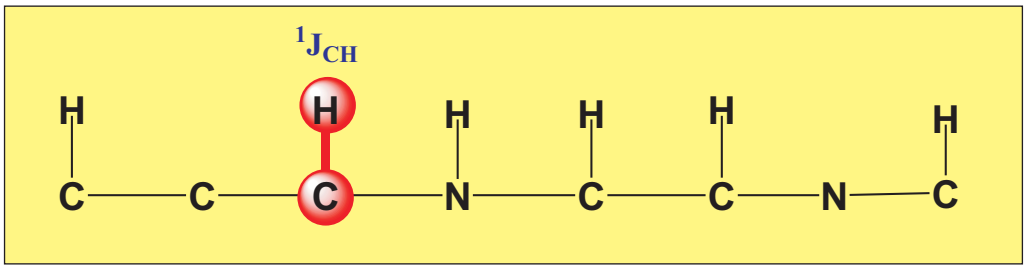
    - Magnitude-mode 2D H-relayed HETCOR (**hhxcoqf** / **hhxcoqf.2**)

- **2D X-relayed HETCOR experiment**

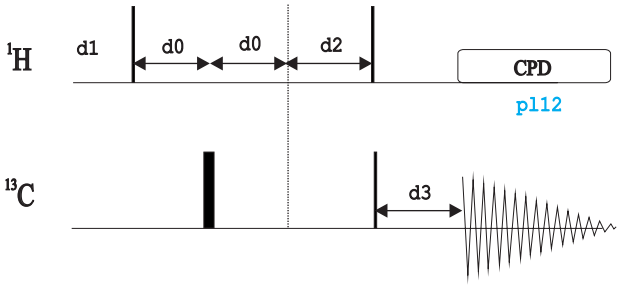
    - Magnitude-mode 2D X-relayed HETCOR (**hxxcoqf**)

Related Experiments:

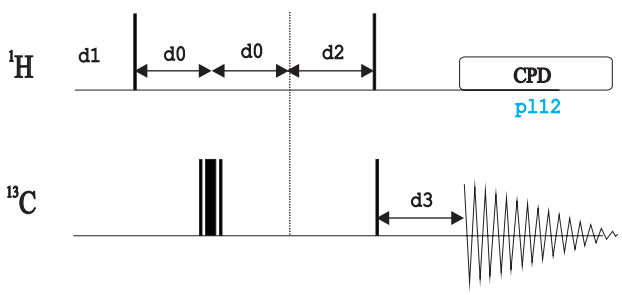
- 2D HMQC
- 2D HSQC



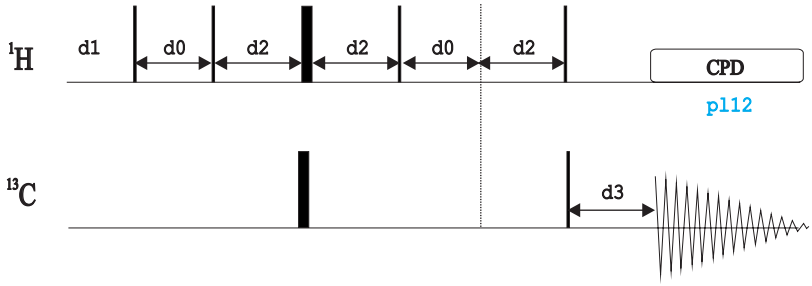
hxcoqf



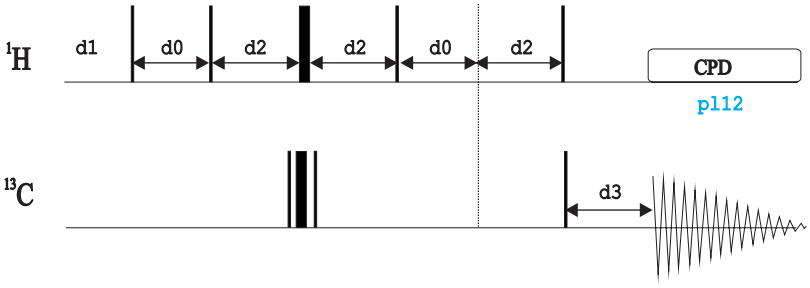
hxcocpqf



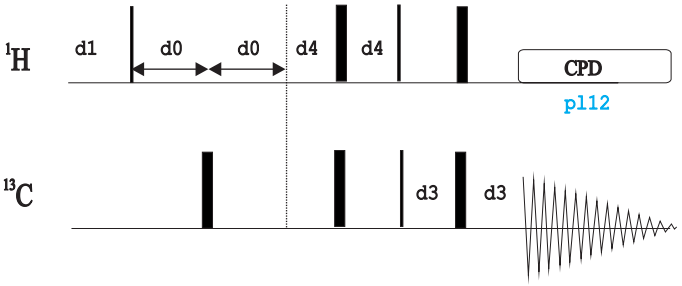
hxcobiqf

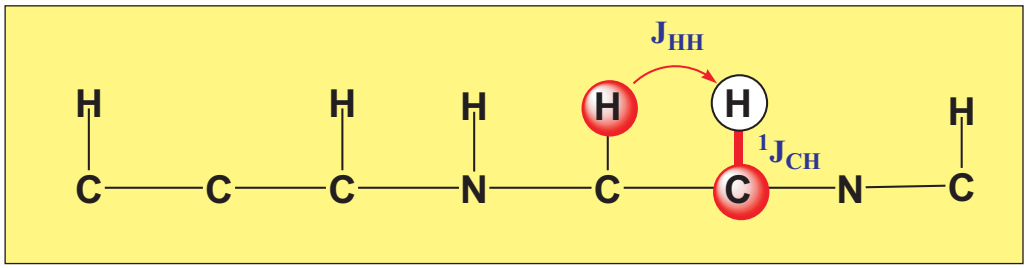


hxcobicpqf

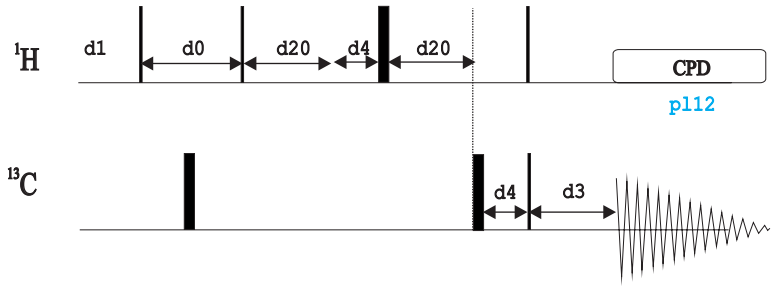


hxinepqf
hxinepph





hhxcoqf



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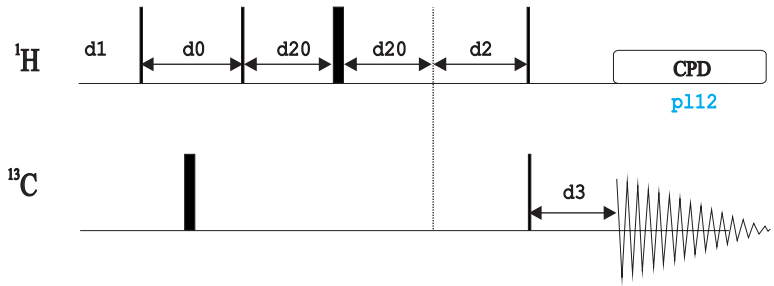
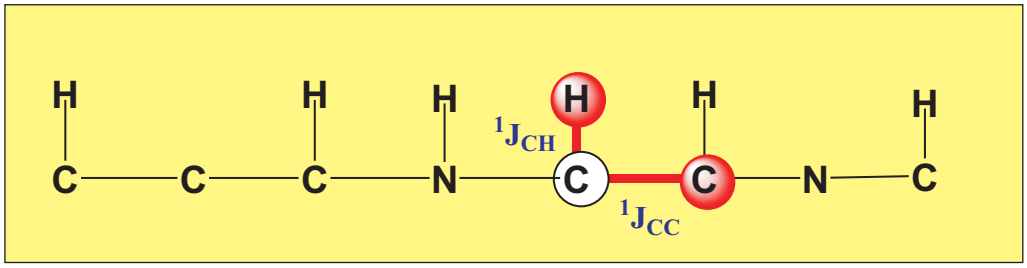
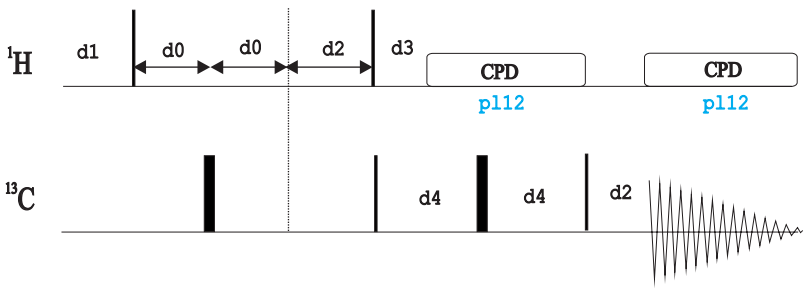
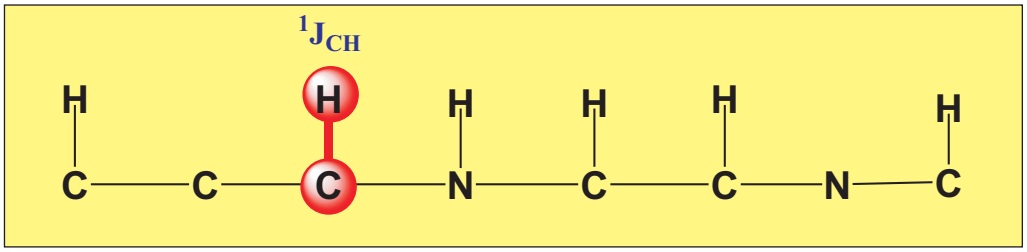


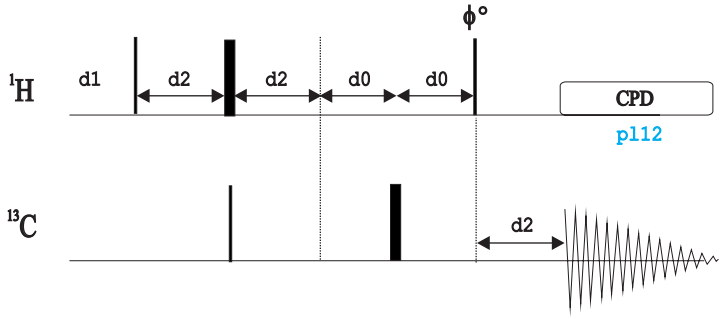


hxxcoqf

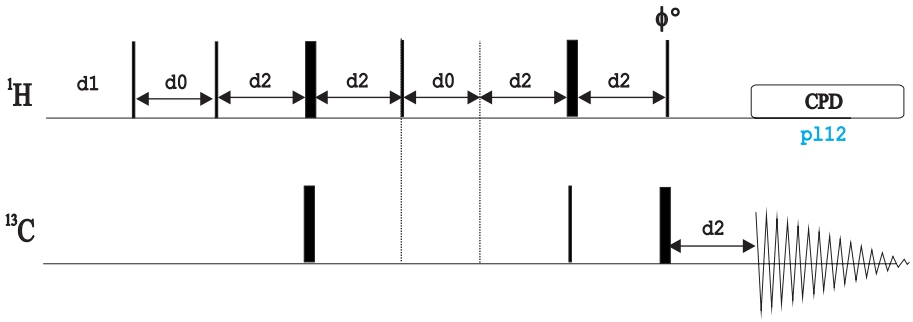


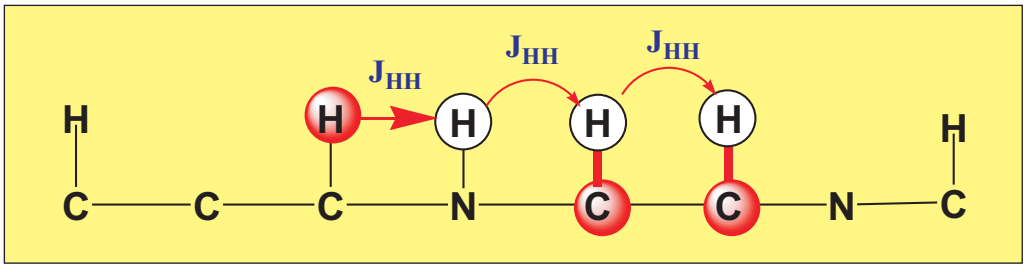


hxdeptph
hxdeptqf

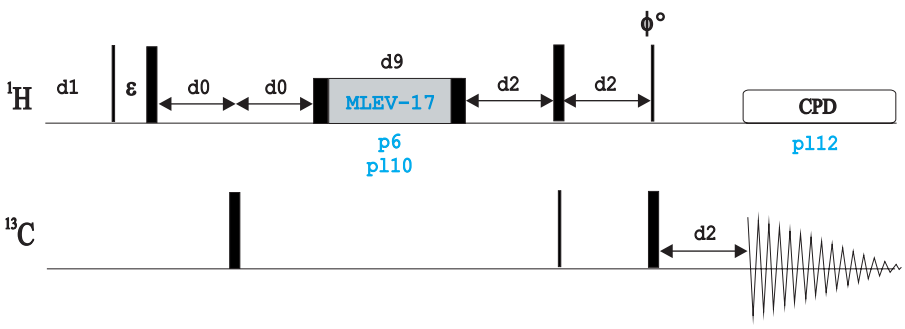


hxdeptbiph
hxdeptbiqf





hxdeptmlph



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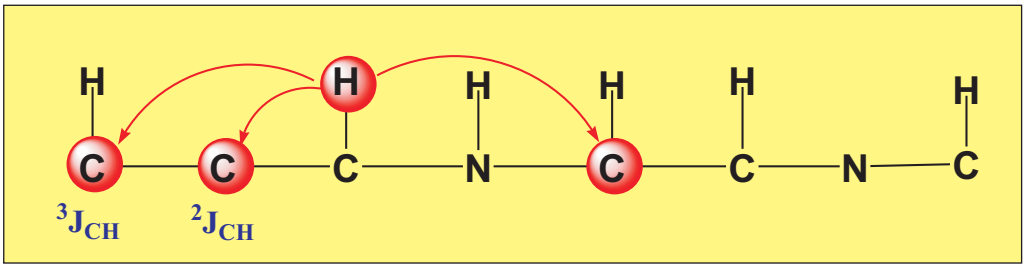
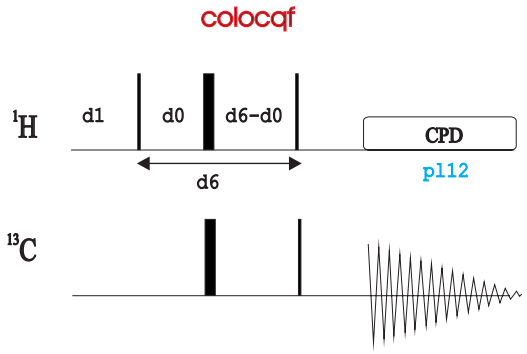
2D COLOC EXPERIMENT

- Magnitude-mode 2D COLOC (**colocqf** | **HCCOLOCSW**)

Related Experiments:

- 2D HETCOR
- 2D HMBC





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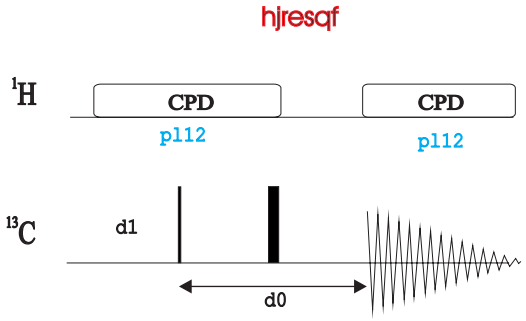
2D HETERONUCLEAR
J-RESOLVED EXPERIMENT

Magnitude-mode 2D Heteronuclear J-Resolved (**hjresqf**)



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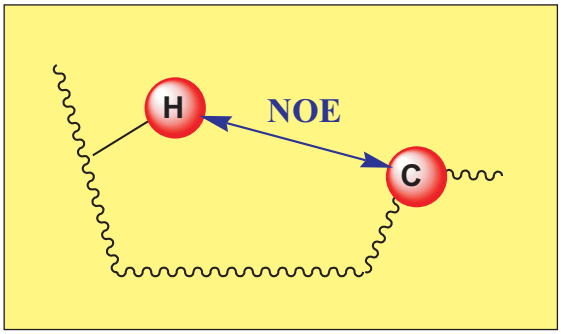
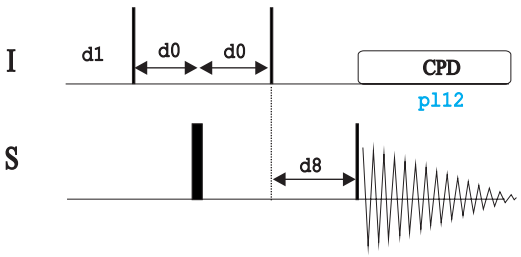
2D HOESY EXPERIMENTS

Magnitude-mode 2D ^{1}H-^{13}C HOESY(**hoesyqfrv**)
Phase-sensitive 2D ^{1}H-X HOESY (**hoesyph**)

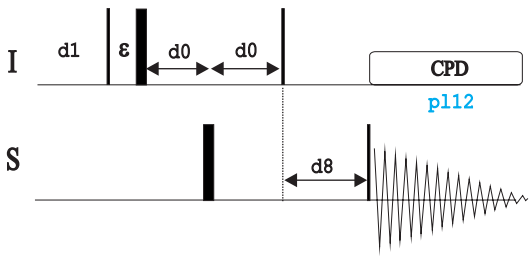
Also see 19F experiments
(hoesyfhqfqnrv)



hoesyqfrv



hoesyph



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1D & 2D INADEQUATE EXPERIMENTS

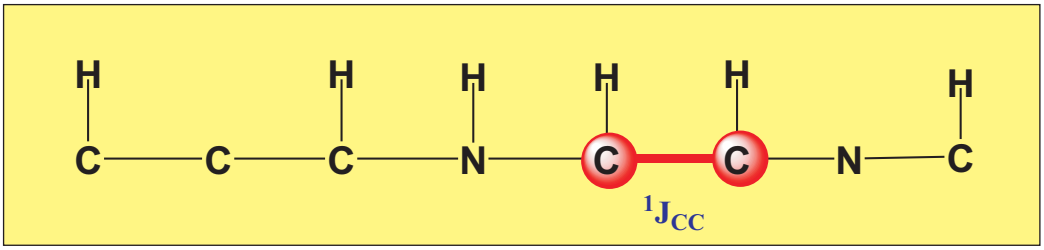
- **1D INADEQUATE**

  1D INADEQUATE without refocusing (**inad1d**)
  1D INADEQUATE using composite pulses (**inadcp1d**)
  1D INADEQUATE with refocusing (**inadrd1d**)
  1D INADEQUATE using initial INEPT (**inepin**)

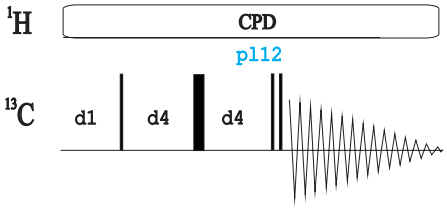
- **2D INADEQUATE**

  Magnitude-mode 2D INADEQUATE (**inadqf**/ **inadqf.2** | **INAD**)
  Phase sensitive 2D INADEQUATE(**inadph**)
  Magnitude-mode symmetric 2D INADEQUATE(**inadqfsy**)

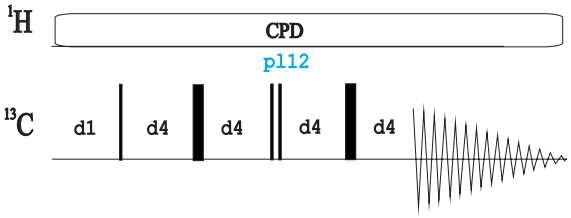
Also see 1D & 2D DQ Experiments



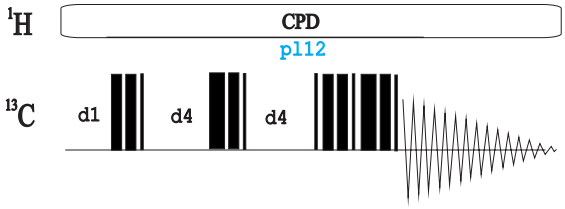
inad1d

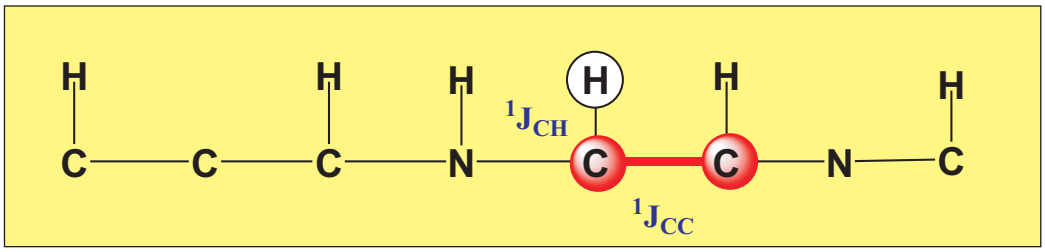


inadrd1d

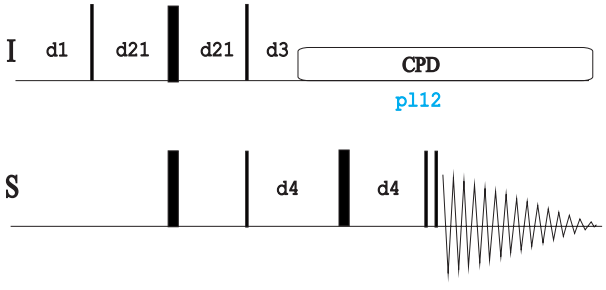


inadcp1d

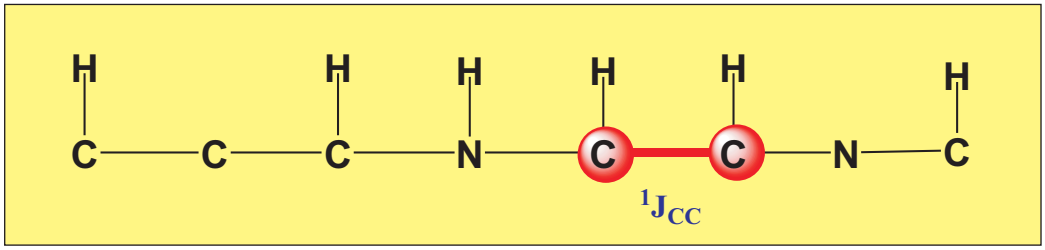




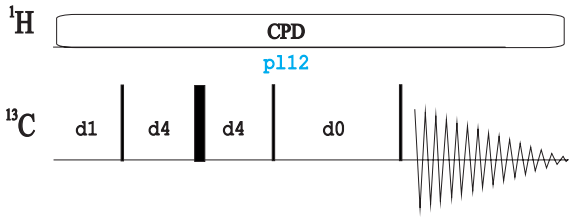
inepin



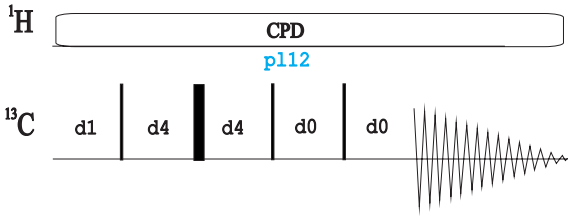
Also see ineptrl1



inadqf.2
inadph
inadqf



inadqfsy



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1D INVERSE EXPERIMENTS

- **Phase-Cycled:**

  1D inverse DEPT with refocusing and no decoupling (**ideptnd**)
  1D inverse INEPT without refocusing and without decoupling (**iineptnd**)
  1D inverse INEPT with refocusing and decoupling (**iineptrd**)

  1D HMQC with refocusing but not decoupling (**hmqcndrd1d** | HMQC1D)
  1D HMQC without refocusing and without decoupling (**inv3nd1d**/ **hmqcnd1d**)
  1D HMQC with refocusing and decoupling (**hmqcrd1d**)
  1D HMQC using BIRD without refocusing and without decoupling (**hmqcbind1d**)
  1D HMQC using BIRD with refocusing and without decoupling (**hmqcbindrd1d**)
  1D HMQC using BIRD with refocusing and decoupling (**hmqcbird1d**)

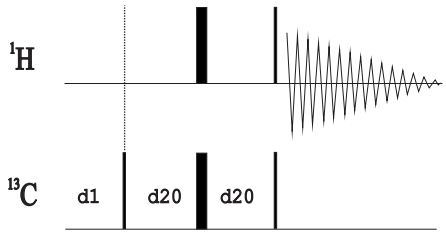
  1D DEPT-HMQC with refocusing and decoupling (**indecord1d**)
  1D DEPT-HMQC using BIRD with refocusing and decoupling (**indecobird1d**)

- **Gradient-based:**

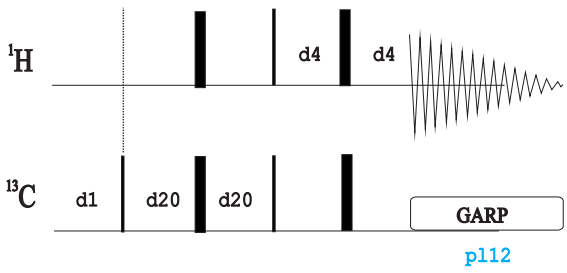
  ge-1D HMQC with refocusing but not decoupling (**hmqcgpnd1d**)
  ge-1D HSQC with refocusing and no decoupling (**hsqcgpnd1d**)

  Any 2D or 3D pulse sequence can be used for 1D acquisition (mc commands)

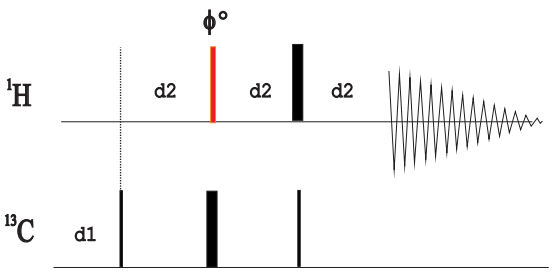
iineptnd



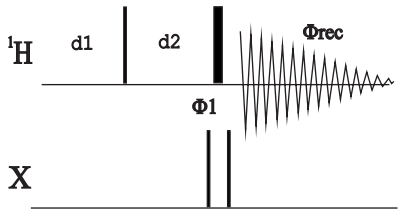
iineptrd



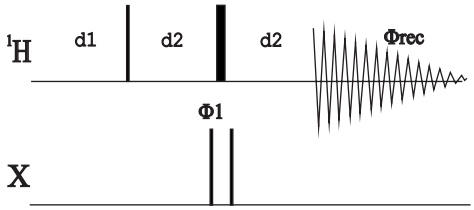
ideptnd



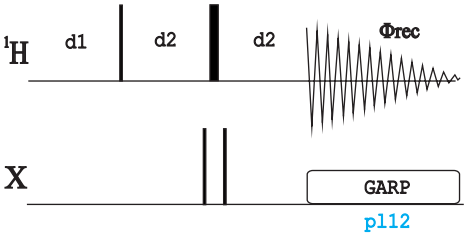
hmqcnd1d



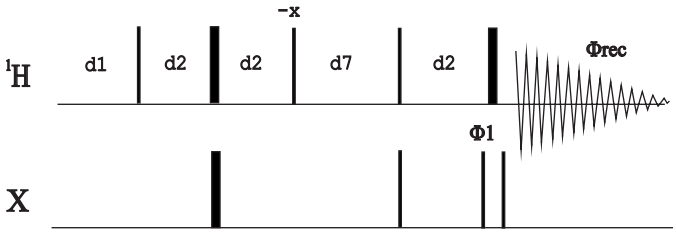
hmqcndrd1d



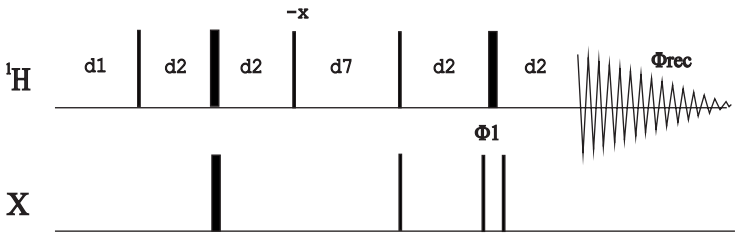
hmqcrd1d



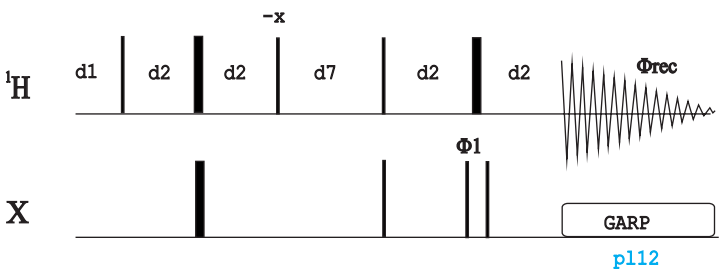
hmqcbind1d



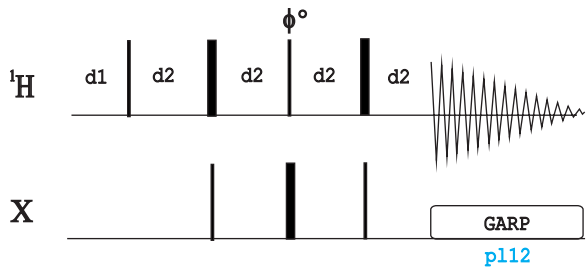
hmqcbindrd1d



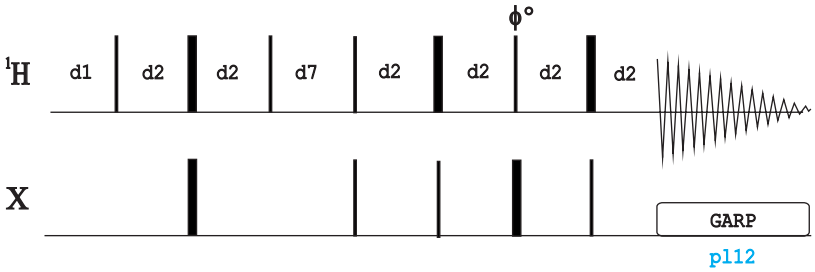
hmqcbird1d



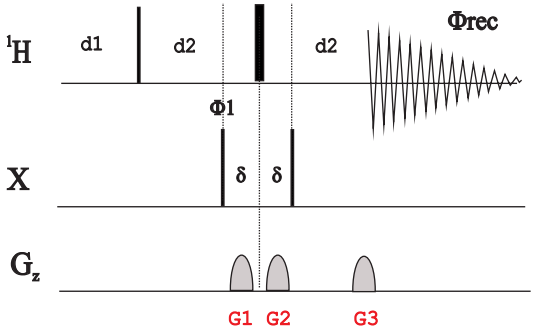
indecord1d



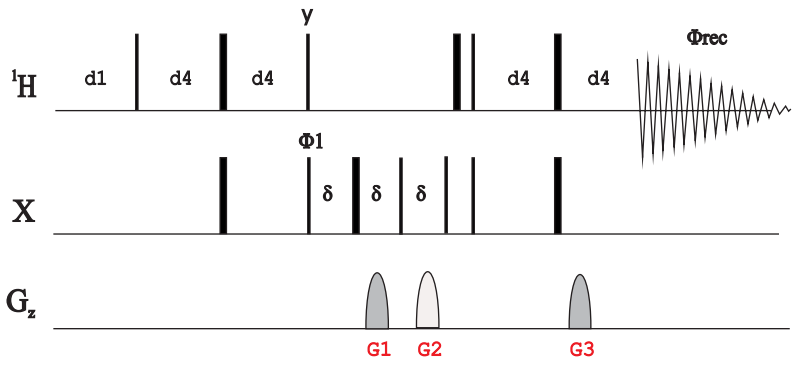
indecobird1d



hmqcgpnd1d



hsqcgpnd1d



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2D HMQC EXPERIMENTS

Phase-cycled:

Magnitude-mode 2D HMQC (**hmqcqf** | **HMQC**)
Magnitude-mode 2D HMQC without decoupling (**hmqcndqf**)
Magnitude-mode 2D HMQC using BIRD (**hmqcbiqf** | **HMQCBI**)
Magnitude-mode 2D HMQC using BIRD without decoupling (**hmqcbindqf**)
Phase-sensitive 2D HMQC (**hmqcph** | **HMQCPH**)
Phase-sensitive 2D HMQC without decoupling (**hmqcndph**)
Phase-sensitive 2D HMQC using BIRD (**hmqcbiph** | **HMQCBIPH**)
Phase-sensitive 2D HMQC using BIRD without decoupling (**hmqcbindph**)

Phase-cycled and solvent suppression

From f2 channel:
Phase-sensitive 2D HMQC with presaturation (**hmqcphpr** | **HMQCPHPR**)
Phase-sensitive 2D HMQC using BIRD and presaturation (**hmqcbiphpr**) / **hmqcbiphpr2**)
Phase-sensitive 2D HMQC with 1-1 water suppression (**hmqcph11**)

From f3 channel:
Phase-sensitive 2D ^{1}H-^{15}N HMQC (**hmqcf3ph**)
Phase-sensitive 2D ^{1}H-^{15}N HMQC using presaturation (**hmqcf3phpr**)
Phase-sensitive 2D ^{1}H-^{15}N HMQC using BIRD (**hmqcbif3ph**)
Phase-sensitive 2D ^{1}H-^{15}N HMQC using decoupling in a third f2 channel (**hmqcfbph**)

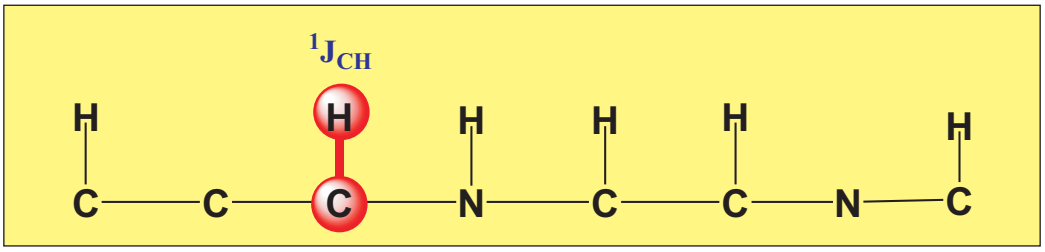
Gradient-based:

From f2 channel:
Magnitude-mode ge-2D HMQC (**hmqcgpqf** | **HMQCGP**)
Phase-sensitive ge-2D HMQC using z-filter (**hmqcgpph**)
Phase-sensitive ge-2D HMQC using echo-antiecho (**hmqcetgp**)
Phase-sensitive ge-2D HMQC using echo-antiecho with adiabatic refocusing (**hmqcetgp.2**)
Phase-sensitive ge-2D HMQC using PEP (**hmqcetgpsi**)
Phase-sensitive ge-2D HMQC using PEP and shorter overall timing (**hmqcetgpsi.2**)

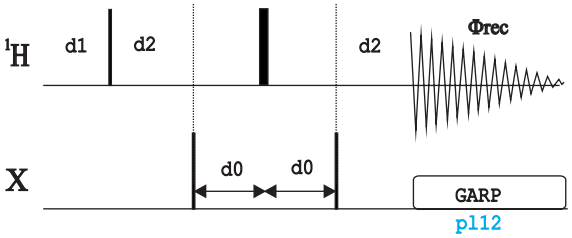
From f3 channel:
Phase-sensitive ge-2D ^{1}H-^{15}N HMQC using echo-antiecho (**hmqcetf3gp**)
Phase-sensitive ge-2D ^{1}H-^{15}N HMQC using PEP (**hmqcetf3gpsi**)
Phase-sensitive ge-2D ^{1}H-^{15}N HMQC using PEP and shorter overall timing(**hmqcetf3gpsi.2**)

Gradient-based and solvent suppression

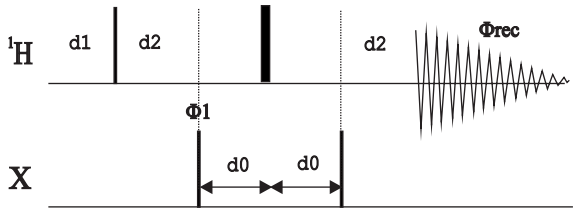
Phase-sensitive ge-2D ^{1}H-^{15}N HMQC using WATERGATE (3-9-19) (**hmqcf3gpph19**)



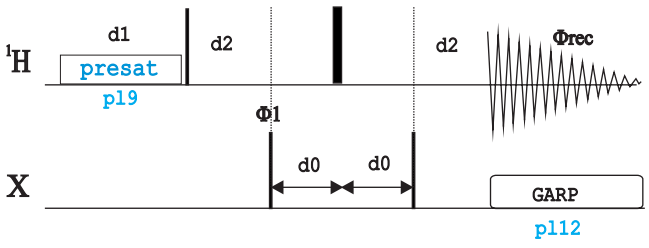
hmqcqf
hmqcph



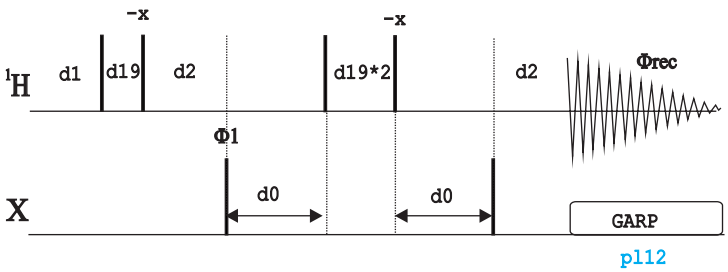
hmqcndph
hmqcndqf



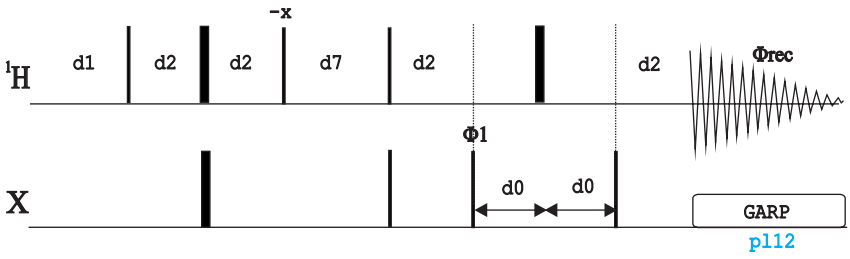
hmqcphpr



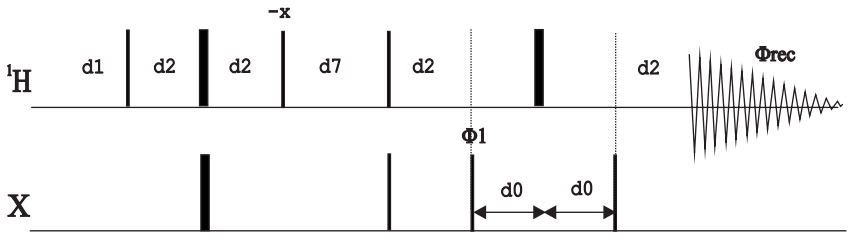
hmqcph11



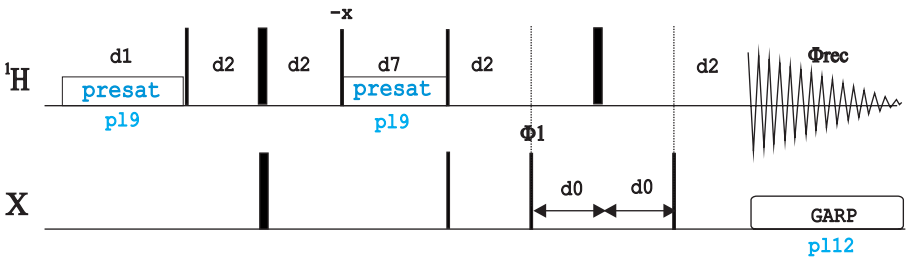
hmqcbiph
hmqcbiqf



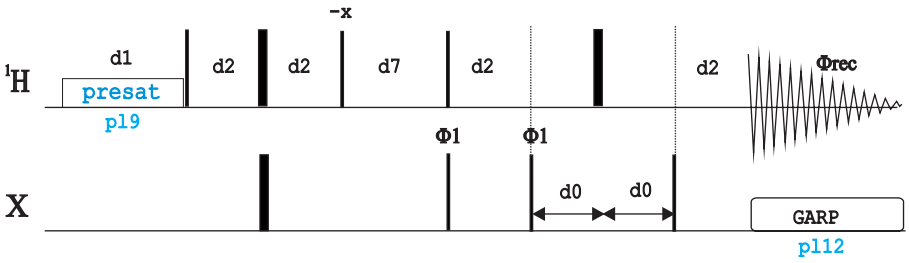
hmqcbindph
hmqcbindqf

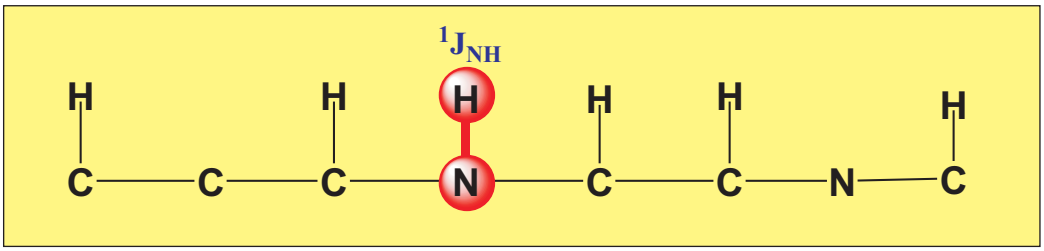


hmqcbiphpr



hmqcbiphpr2





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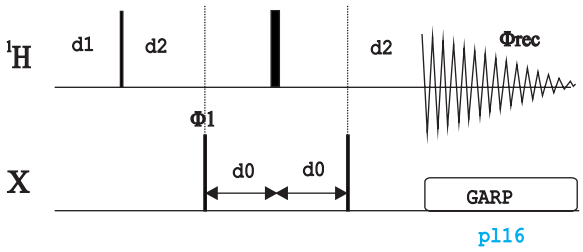

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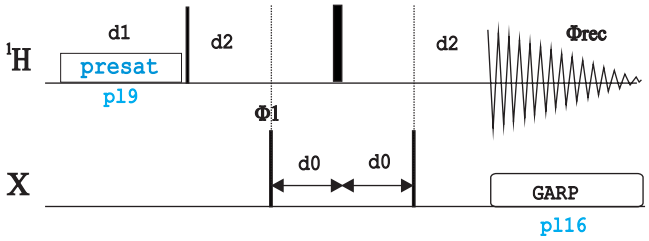

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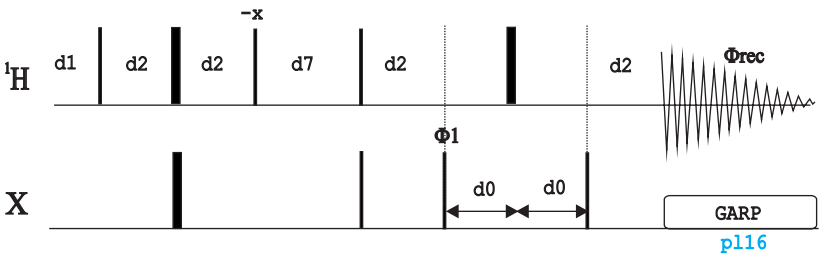

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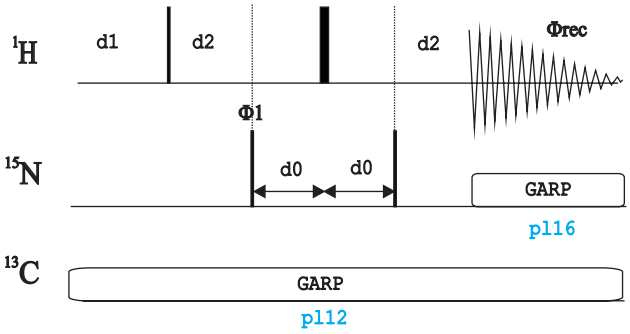

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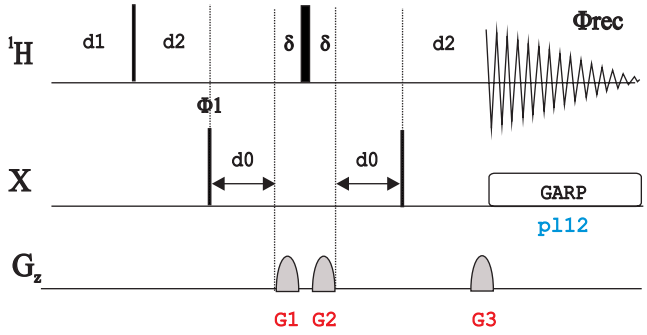

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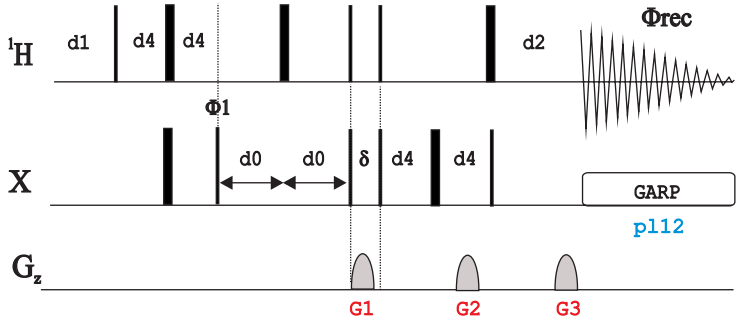

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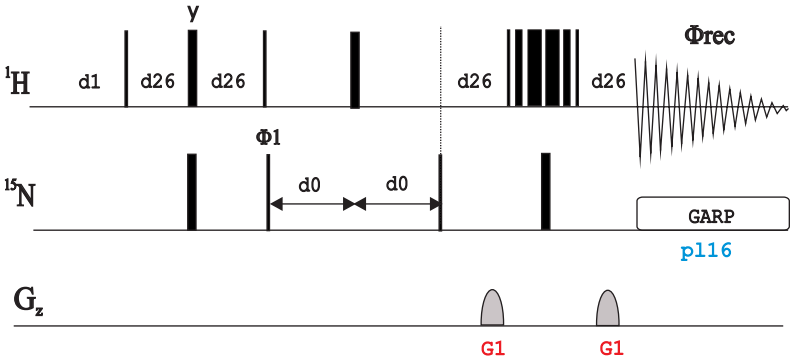

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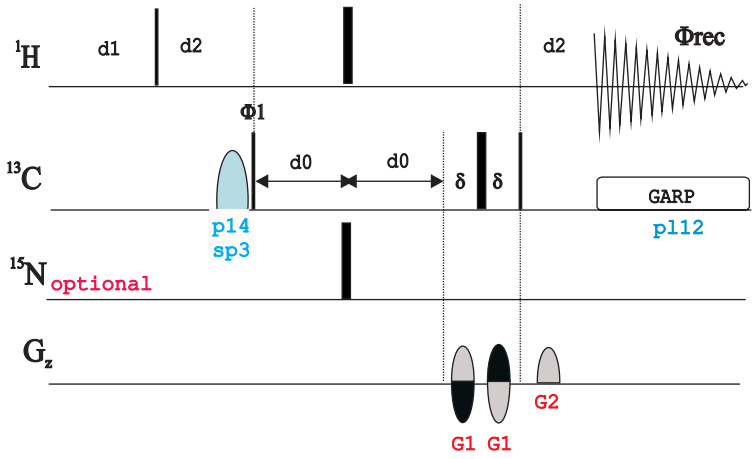

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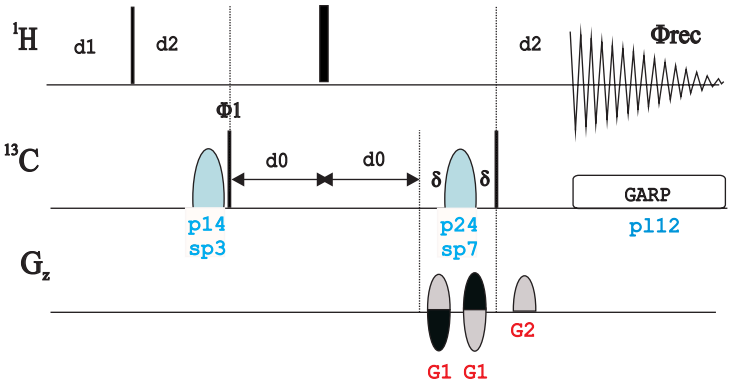

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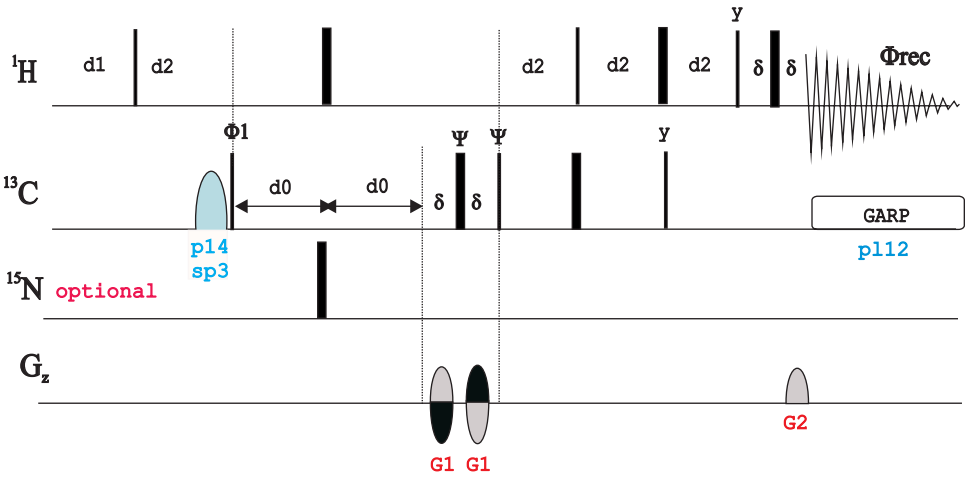

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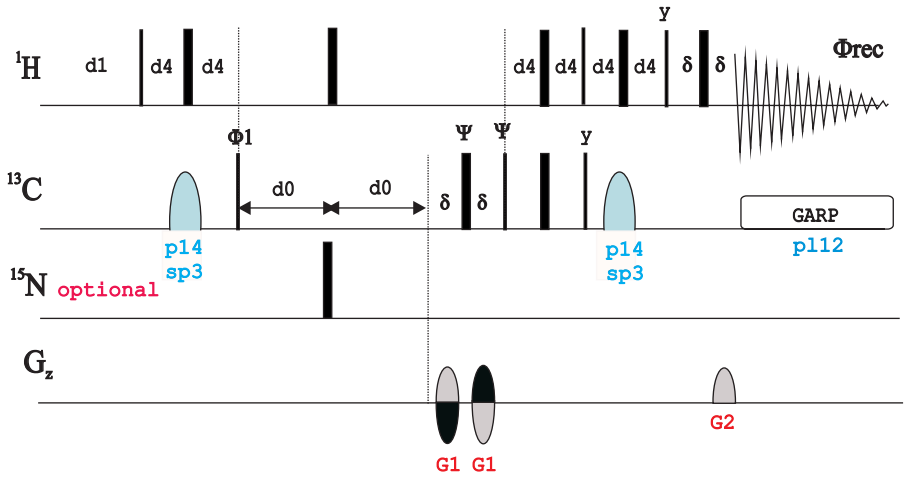

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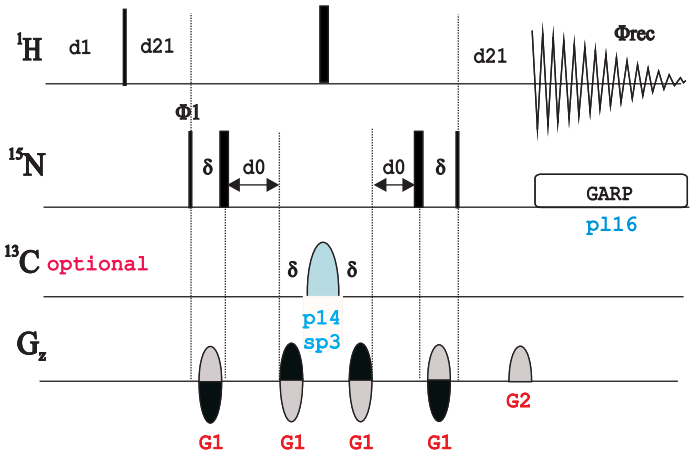

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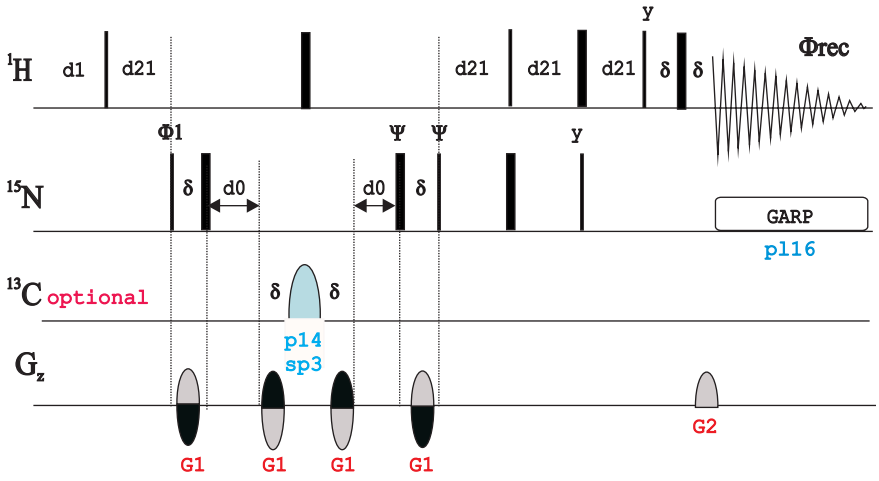

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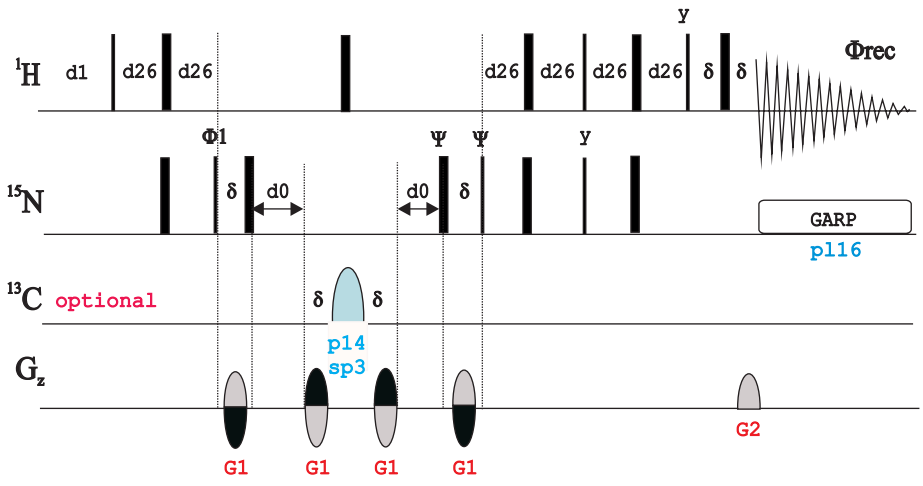

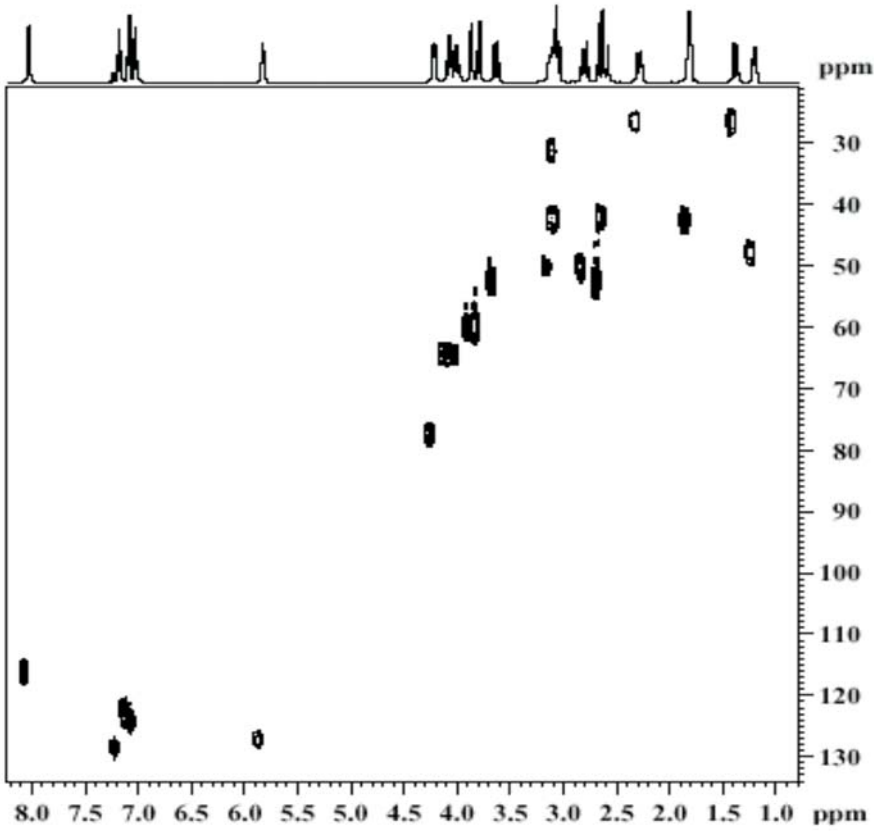
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70
80
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100
110
120
130
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 ppm

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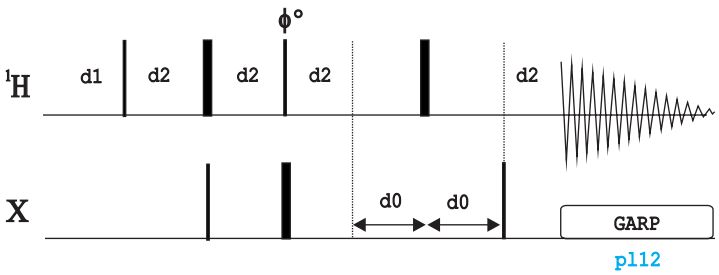
NMRGuide

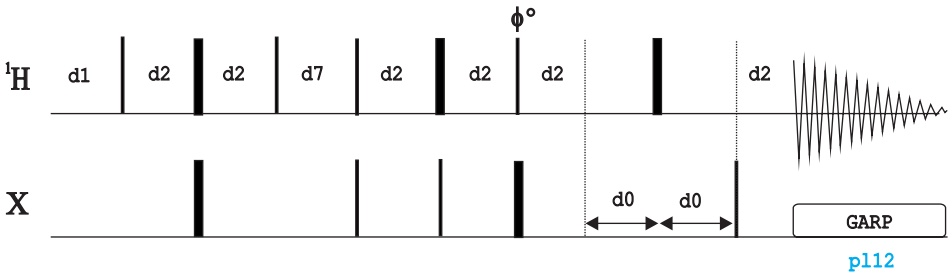
2D DEPT-HMQC EXPERIMENTS

Phase-sensitive 2D DEPT-HMQC (**indecoph**)
Phase-sensitive 2D DEPT-HMQC using BIRD (**indecobiph**)
Phase-sensitive 2D DEPT-HMQC-TOCSY using BIRD (**indecobimlph**)

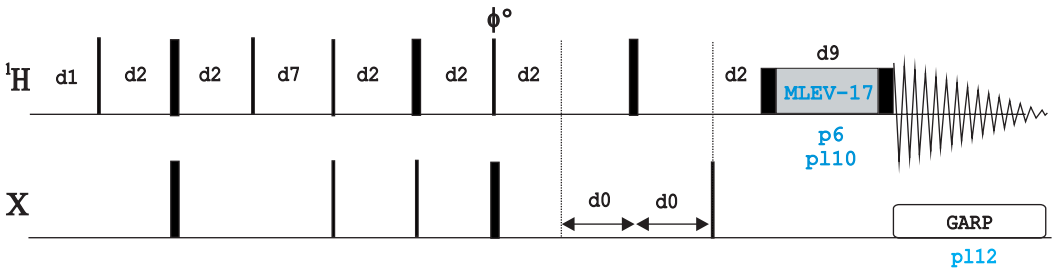
indecoph



indecobiph



indecobimlph



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PULSE PROGRAM
CATALOGUE

NMRGuide

2D HSQC EXPERIMENTS

FROM F2 CHANNEL

- **Phase-cycled:**

  Phase-sensitive 2D HSQC (**hsqcph**)

- **Phase-cycled and solvent suppression:**

  Phase-sensitive 2D HSQC with presaturation (**hsqcphpr**)
  Phase-sensitive 2D HSQC with off-resonance presaturation (**hsqcphps**)

- **Gradient-based:**

  Phase-sensitive ge-2D HSQC using z-filter and selection before t1 (**hsqcgpph** | **HSQCGP**)
  Phase-sensitive ge-2D HSQC using z-filter and selection after t1 (**hsqcgpph2**)
  Phase-sensitive ge-2D HSQC using echo-antiecho (**hsqcetgp** | **HSQCETGP**)
  Phase-sensitive ge-2D HSQC using echo-antiecho and adiabatic pulses for inversion (**hsqcetgpsp**)
  Phase-sensitive ge-2D HSQC using echo-antiecho and adiabatic pulses for inversion and refocusing(**hsqcetgpsp.2**)
  Phase-sensitive ge-2D HSQC using echo-antiecho and adiabatic pulses for inversion and refocusing and BS effects(**hsqcetgpsp.3**)
  Phase-sensitive ge-2D HSQC using PEP (**hsqcetgpsi**)
  Phase-sensitive ge-2D HSQC using PEP with gradients in back-inept (**hsqcetgpsi2**)
  Phase-sensitive ge-2D HSQC using PEP and adiabatic pulses for inversion(**hsqcetgpsisp** | **HSQCETGPSISP**)
  Phase-sensitive ge-2D HSQC using PEP and adiabatic pulses for inversion with gradients in back-inept (**hsqcetgpsisp2**)
  Phase-sensitive ge-2D HSQC using PEP and adiabatic pulses for inversion and refocusing (**hsqcetgpsisp.2** | **HSQCETGPSISP.2**)
  Phase-sensitive ge-2D HSQC using PEP and adiabatic pulses for inversion and refocusing with gradients in back-inept (**hsqcetgpsisp2.2**)

  ge-2D ^{1}H-X HSQC experiment with X-Y-decoupling during acquisition and with selective Cb/C=O decoupling. (**hsqcdhetgpsp**)

FROM F3 CHANNEL

- **Phase-cycled:**

  Phase-sensitive 2D ^{1}H-^{15}N HSQC (**hsqcf3ph**)

- **Phase-cycled and solvent suppression:**

  Phase-sensitive 2D ^{1}H-^{15}N HSQC using presaturation (**hsqcf3phpr**)

- **Gradient-based:**

  Phase-sensitive ge-2D ^{1}H-^{15}N HSQC using echo-antiecho (**hsqcetf3gp** | **HSQCETF3GP**)
  Phase-sensitive ge-2D ^{1}H-^{15}N HSQC using PEP (**hsqcetf3gpsi** | **HSQCETF3GPSI**)
  Phase-sensitive ge-2D ^{1}H-^{15}N HSQC using PEP with gradients in back-inept (**hsqcetf3gpsi2**)

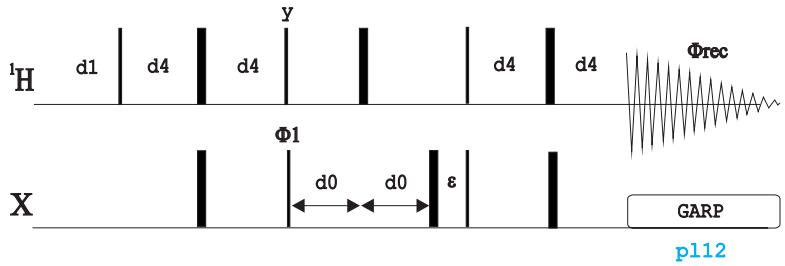
  Phase-sensitive ge-2D ^{1}H-^{15}N HSQC using XY16-CPMG(**hsqcetf3gpxy, hsqcetf3gpxy.2**)

- **Gradient-based and solvent suppression**

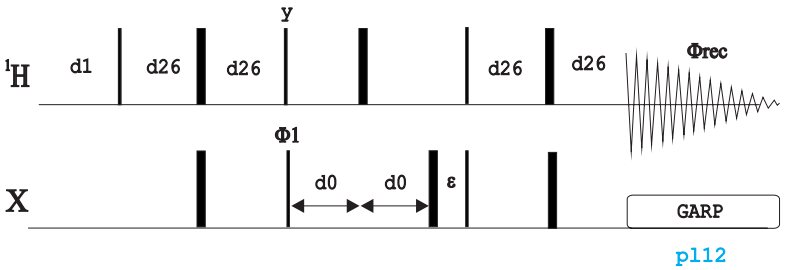
  Phase-sensitive ge-2D ^{1}H-^{15}N HSQC using water flip-back and echo-antiecho (**hsqcetfpf3gp** | **HSQCETFPF3GP**)
  Phase-sensitive ge-2D ^{1}H-^{15}N HSQC using water flip-back and PEP (**hsqcetfpf3gpsi** | **HSQCETFPF3GPSI**)
  Phase-sensitive ge-2D ^{1}H-^{15}N HSQC using water flip-back and PEP with gradients in back-inept (**hsqcetfpf3gpsi2**)

  Phase-sensitive ge-2D ^{1}H-^{15}N HSQC using WATERGATE (3-9-19) (**hsqcf3gpph19**)
  Fast-HSQC, Phase-sensitive ge-2D ^{1}H-^{15}N HSQC using WATERGATE (3-9-19) (**fhsqcf3gpph** | **FHSQCF3GPPH**)
  Phase-sensitive ge-2D ^{1}H-^{15}N HSQC using water flip-back and WATERGATE (selective pulse) (**hsqcfpf3gpphwg** | **HSQCFPF3GPPHWG**)

hsqcph



hsqcf3ph



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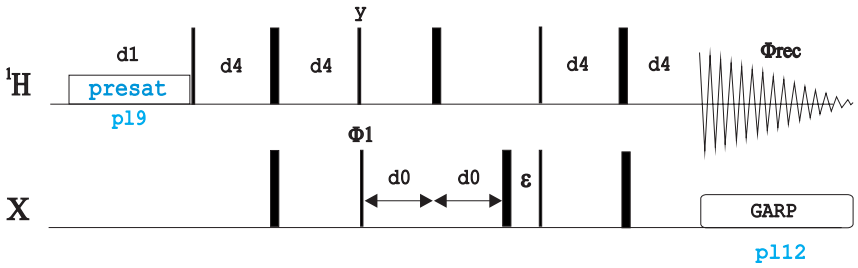

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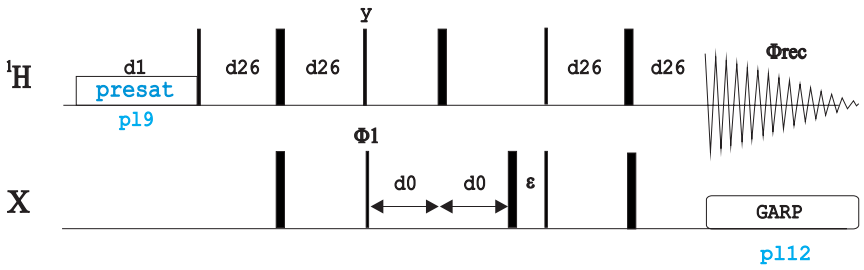
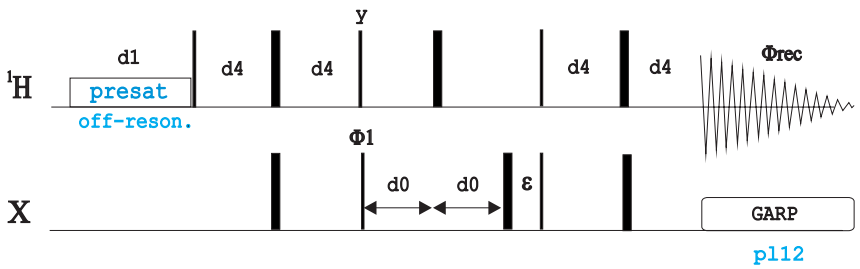
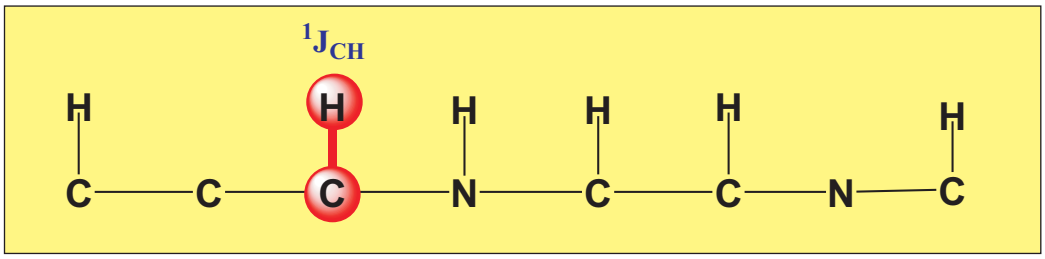


hsqcphps





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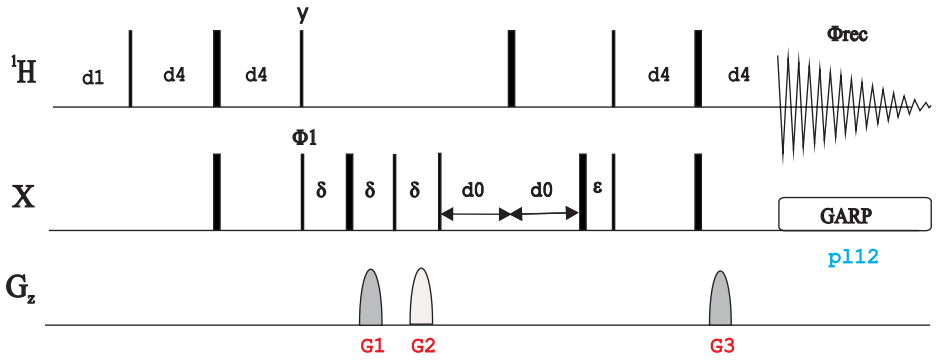

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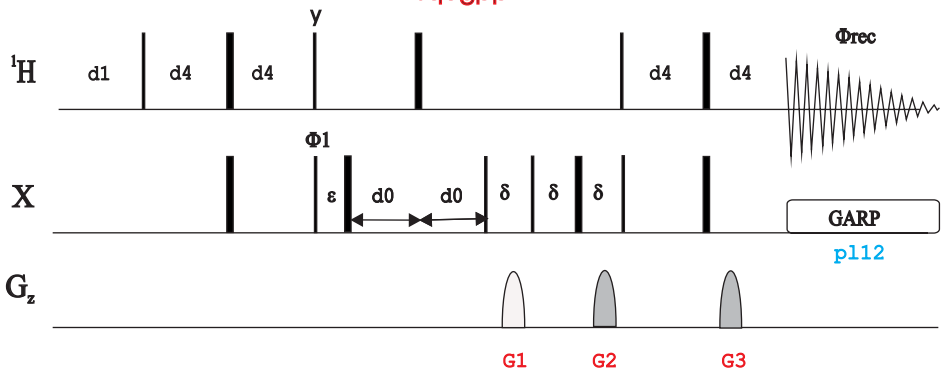

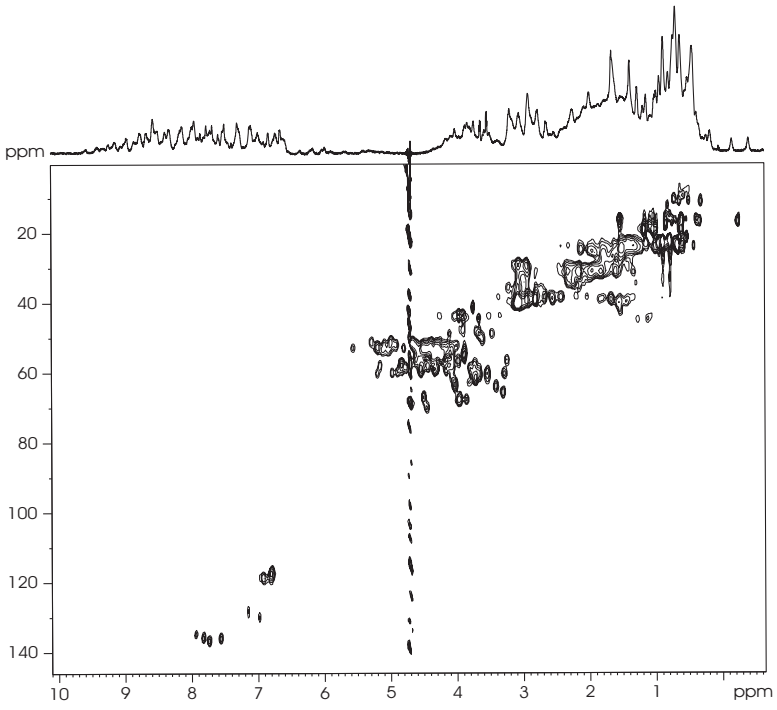

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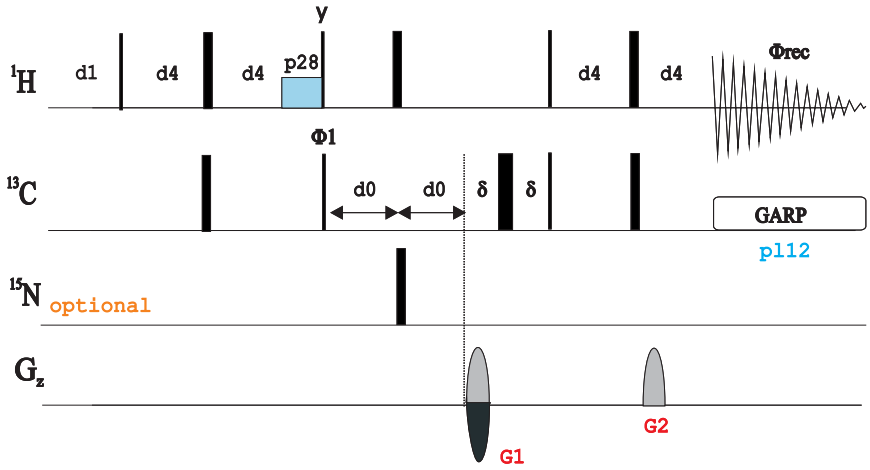

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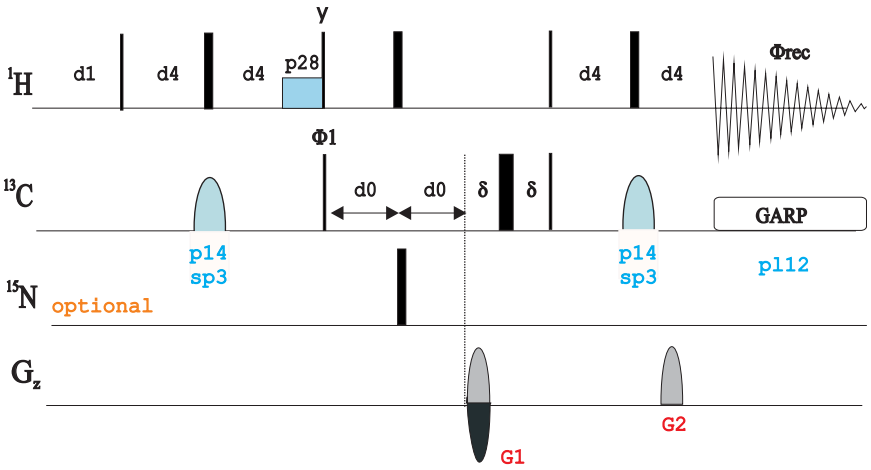

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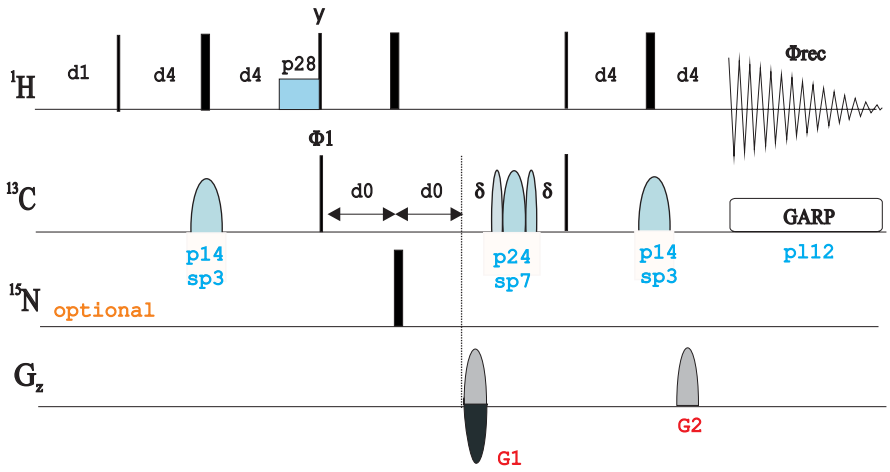

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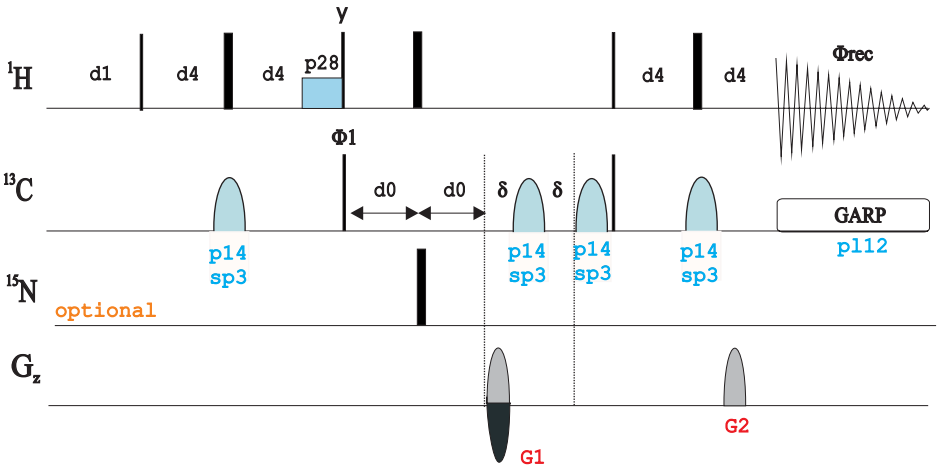

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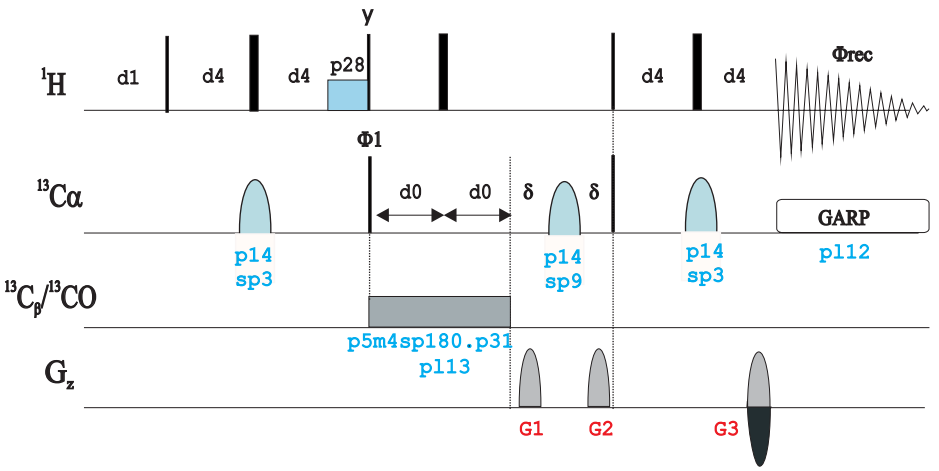

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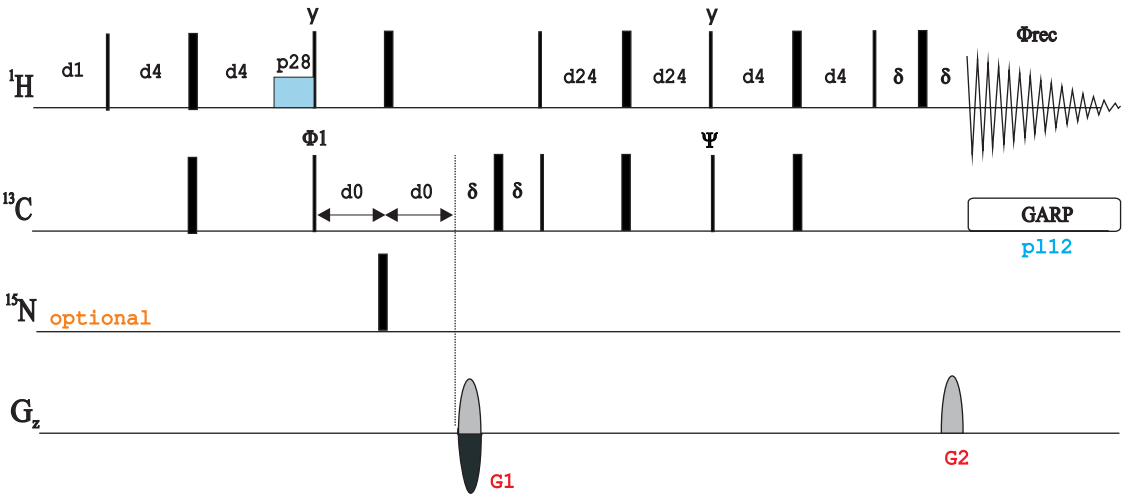

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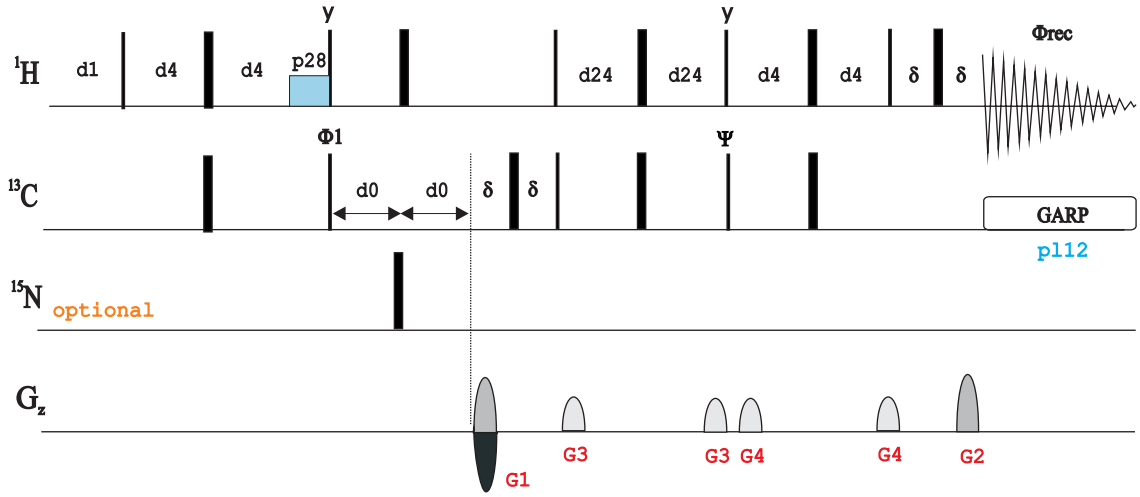

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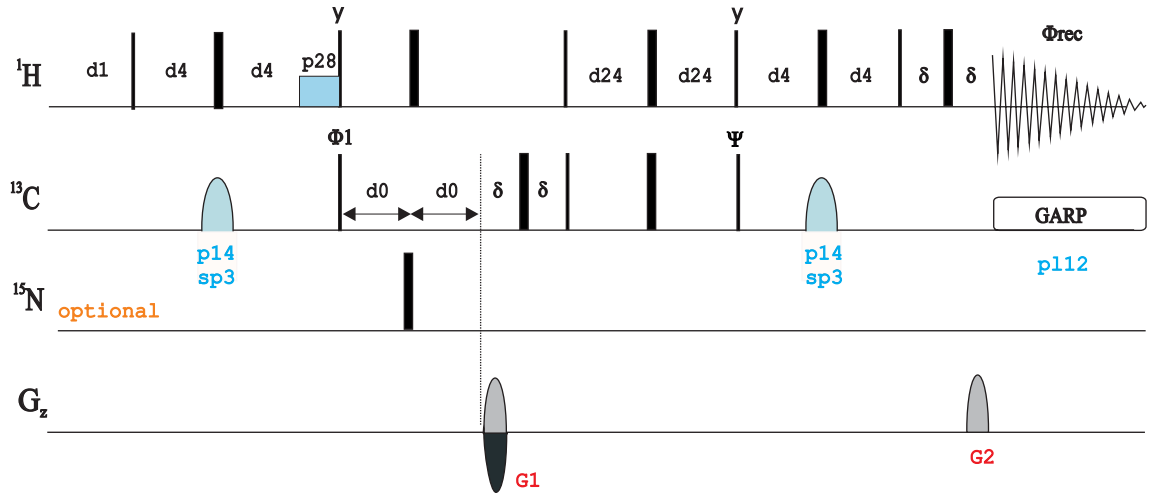

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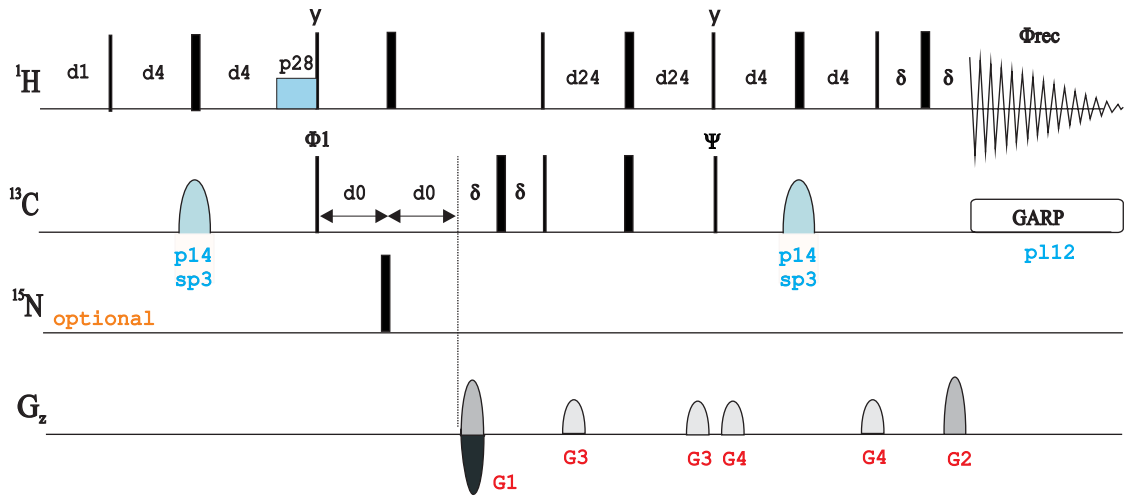

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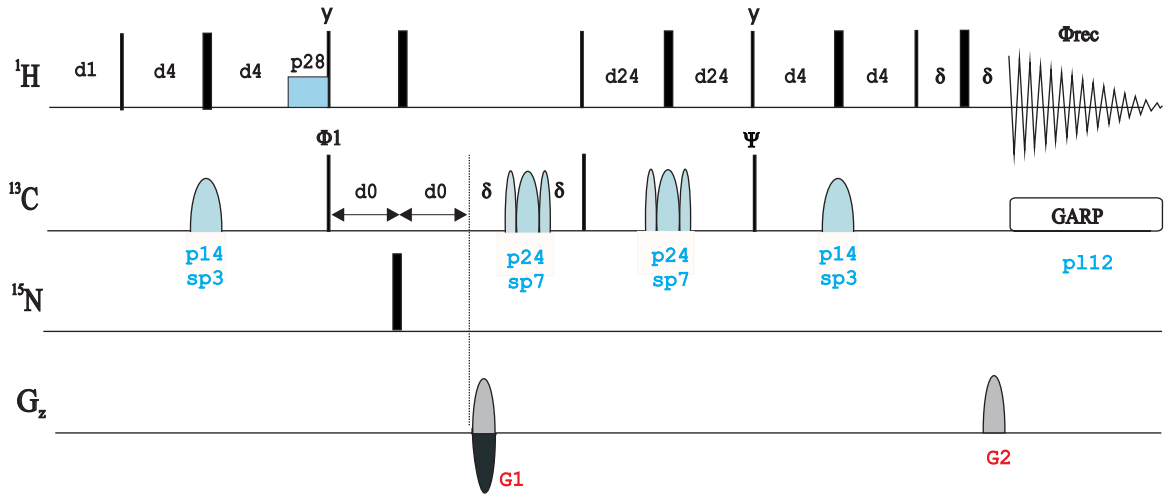

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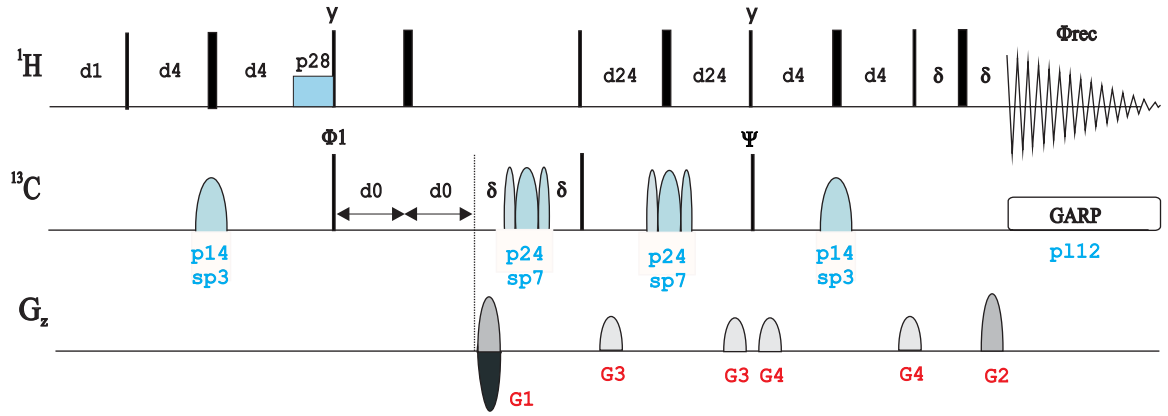

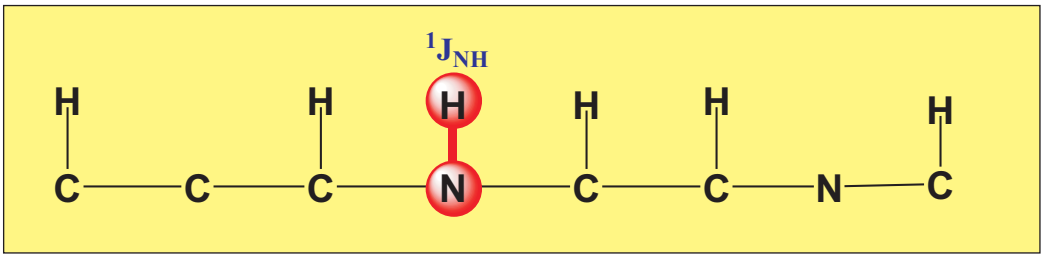
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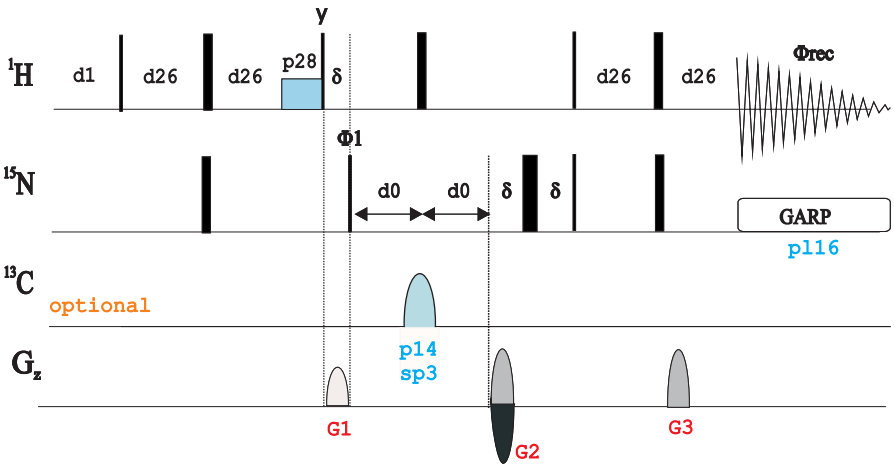
C
C
H

hsqcetf3gp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d26
Φrec
Φ1
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δ
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GARP
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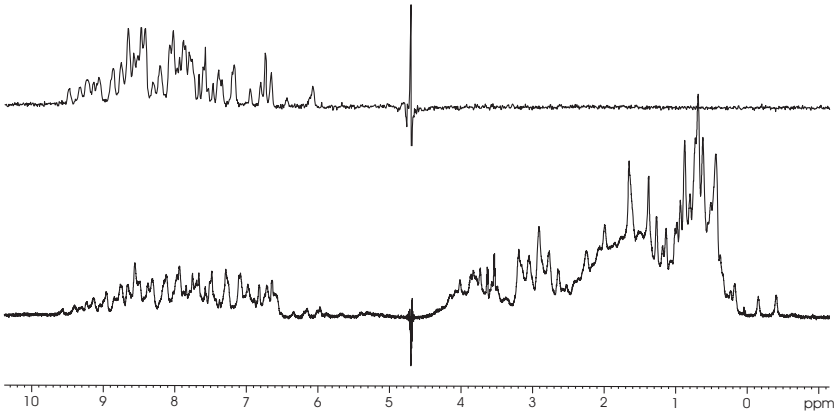
13C
optional
p14
sp3
Gz
G1
G2
G3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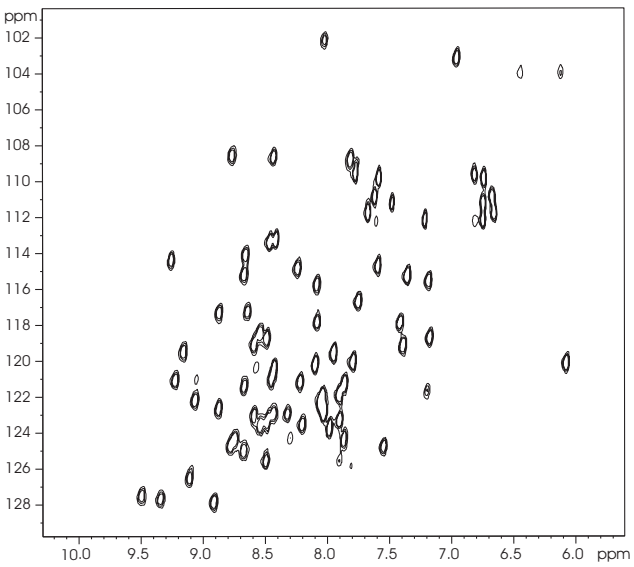
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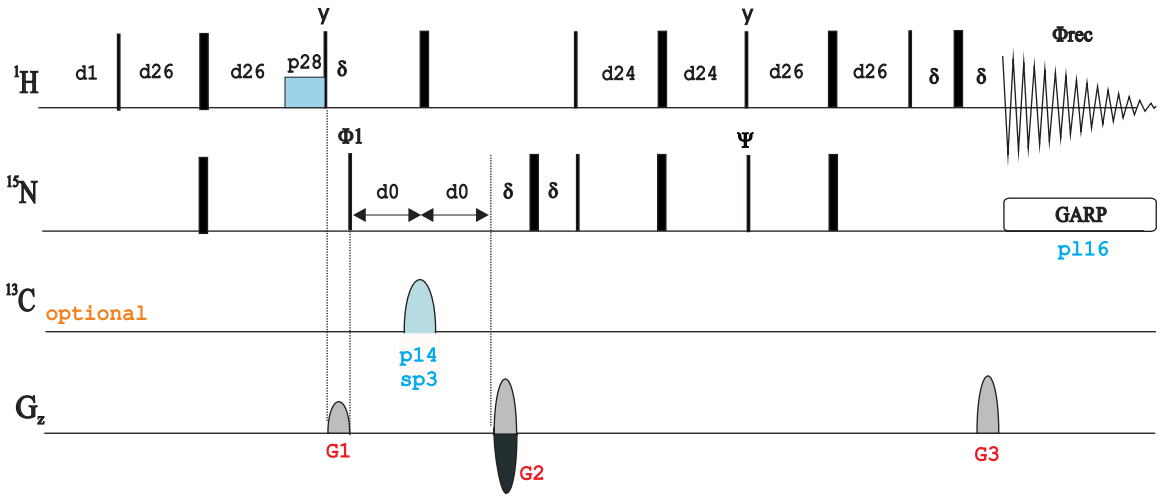
hsqcetf3gpsi



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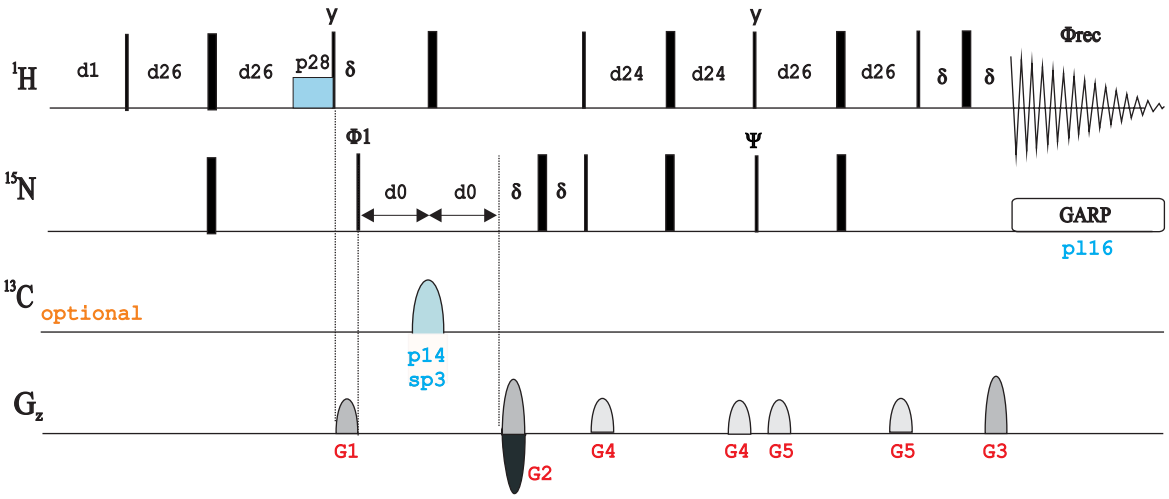
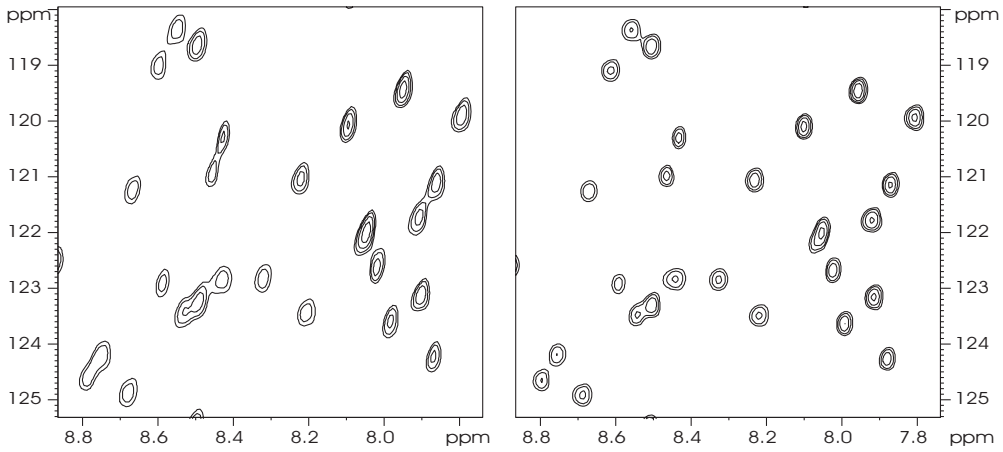


1H-15N HSQC Ubiquitina 1mM 500 MHz
Optional 13C decoupling during t1
in doubly-labeled proteins

zgoptns -DLABEL_CN in eda



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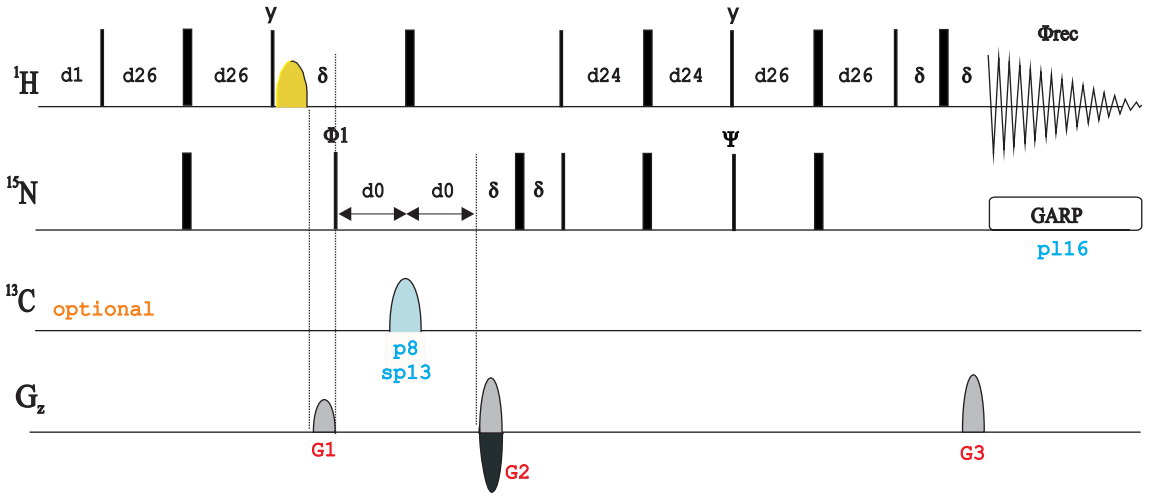

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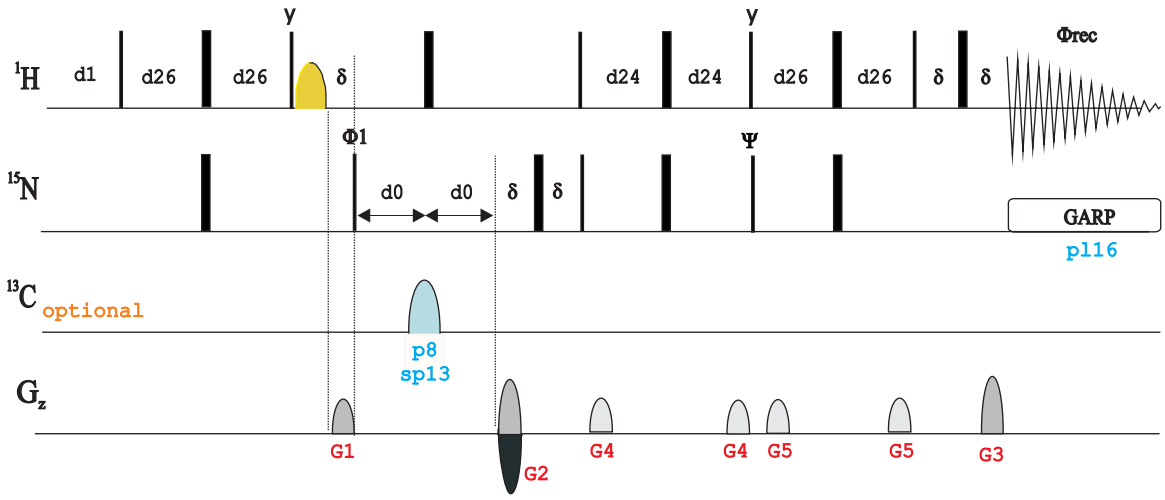

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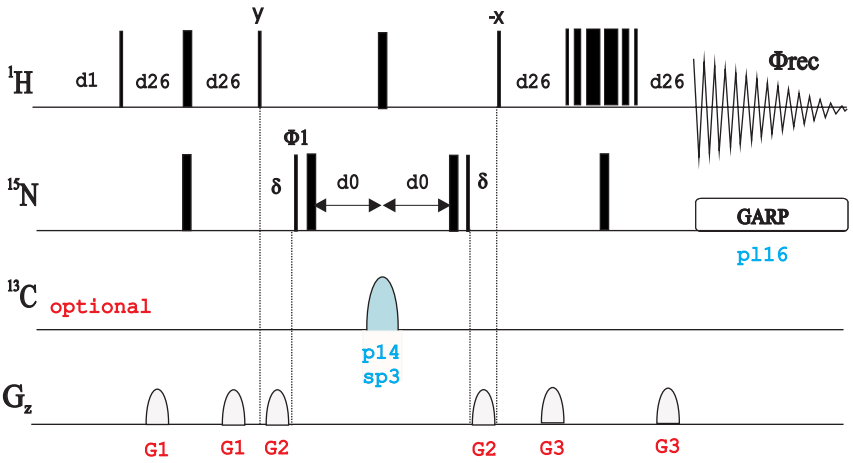

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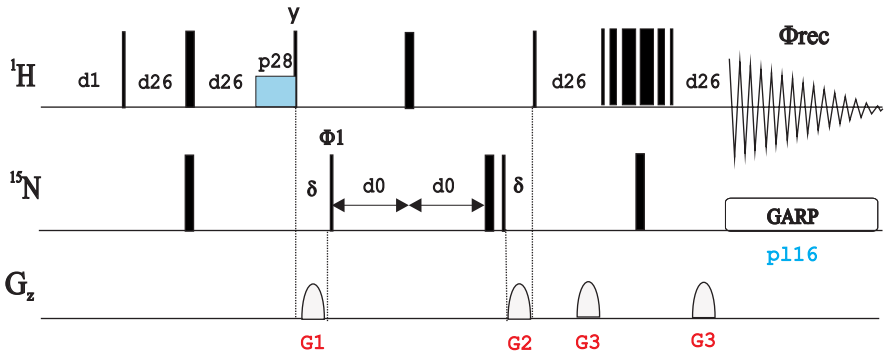

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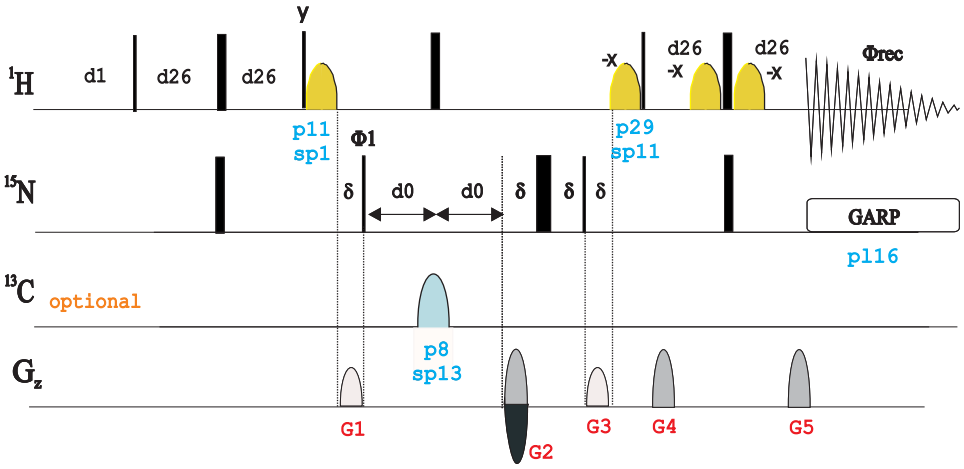

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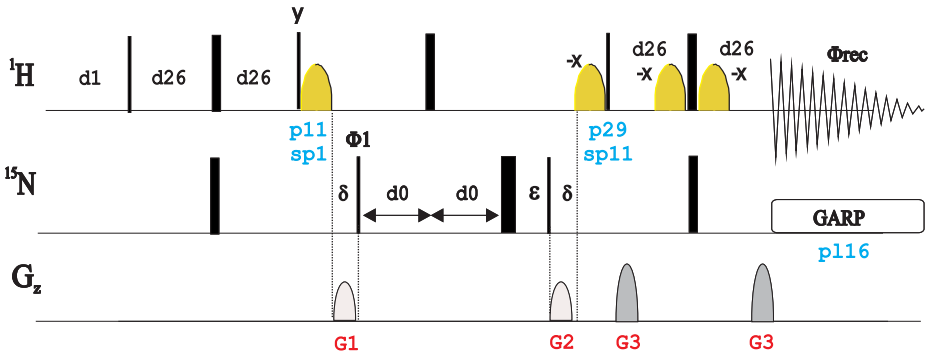

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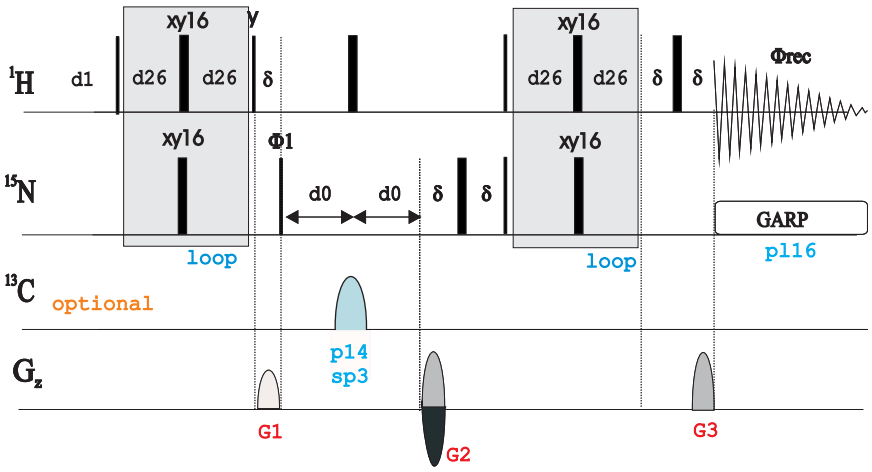

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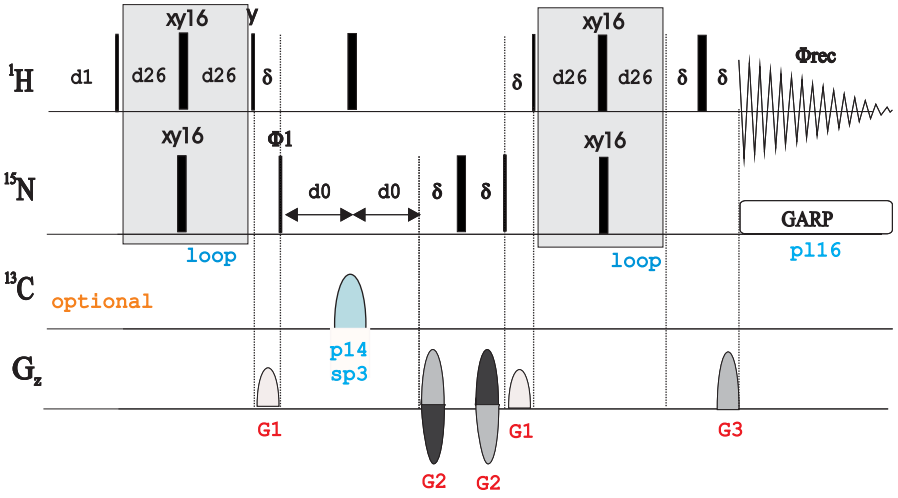

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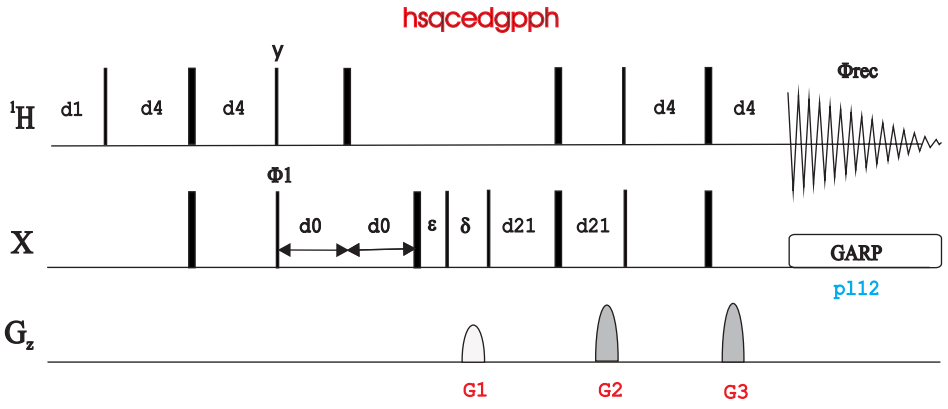
2D MULTIPLICITY-EDITED HSQC EXPERIMENTS

Gradient-enhanced form f2 channel

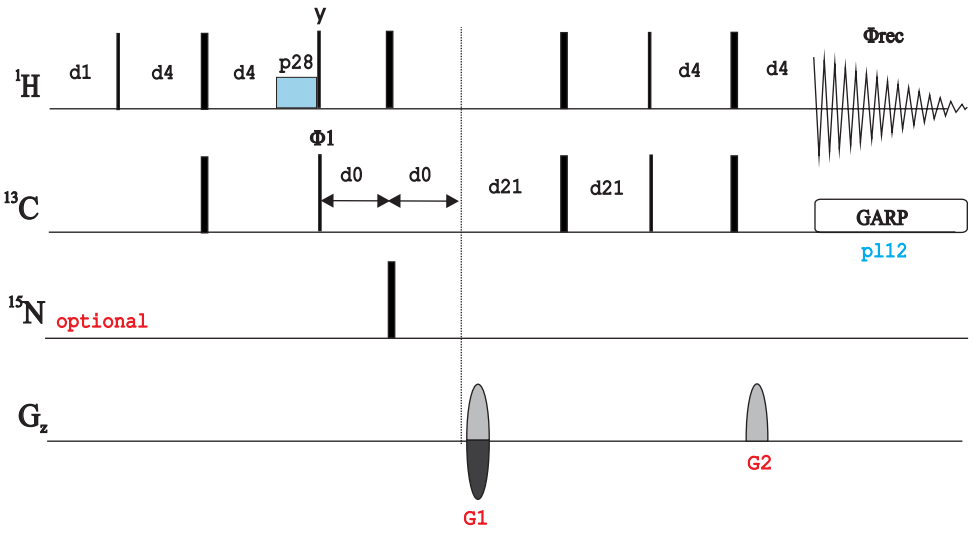
Phase-sensitive ge-2D multiplicity-edited HSQC using z-filter (**hsqcedgpph** | **HSQCEDGPPH**)
Phase-sensitive ge-2D multiplicity-edited HSQC using echo-antiecho (**hsqcedetgp** | **HSQCEDETGP**)
Phase-sensitive ge-2D multiplicity-edited HSQC using echo-antiecho and adiabatic pulses (**hsqcedetgpsp**)
Phase-sensitive ge-2D multiplicity-edited HSQC using echo-antiecho and inversion and matched sweep adiabatic pulses (**hsqcedetgpsp.3**)
Phase-sensitive ge-2D multiplicity-edited HSQC using PEP and adiabatic inversion pulses (**hsqcedetgpsisp**)
Phase-sensitive ge-2D multiplicity-edited HSQC using PEP and adiabatic inversion and refocusing pulses (**hsqcedetgpsisp.2**)
Phase-sensitive ge-2D multiplicity-edited HSQC using PEP and adiabatic inversion pulses with gradients in back-inept (**hsqcedetgpsisp2**)
Phase-sensitive ge-2D multiplicity-edited HSQC using PEP and adiabatic inversion and refocusing pulses with gradients in back-inept (**hsqcedetgpsisp2.2**)
Phase-sensitive ge-2D multiplicity-edited HSQC using PEP and inversion, refocusing and matched sweep adiabatic pulses with gradients in back-inept (**hsqcedetgpsisp2.3**)

Gradient-enhanced form f3 channel

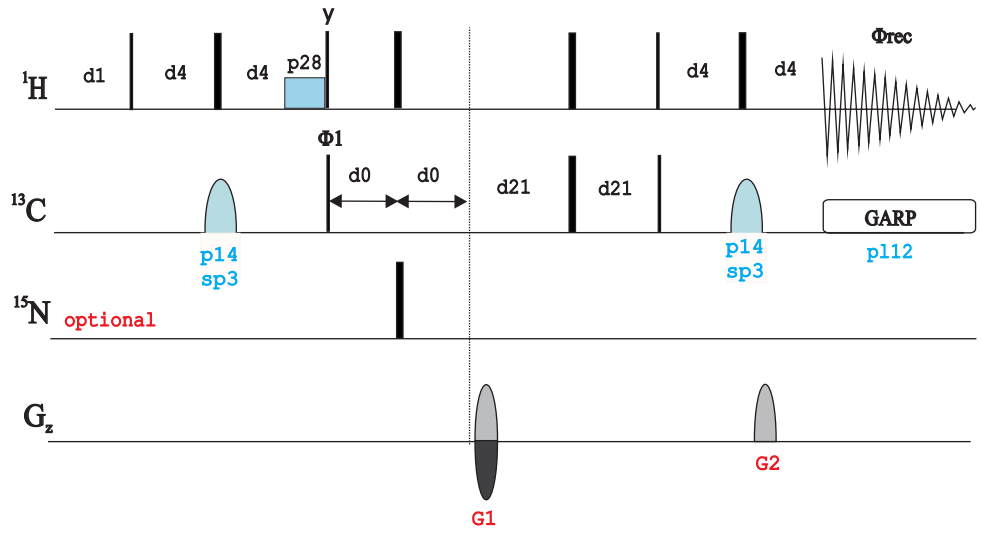
Phase-sensitive ge-2D ^{1}H-^{15}N HSQC-edited using PEP (**hsqcedetf3gpsi**)
Phase-sensitive ge-2D ^{1}H-^{15}N HSQC-edited using PEP with gradients in back-inept (**hsqcedetf3gpsi2**)



hsqcedetgp



hsqcedetgpsp



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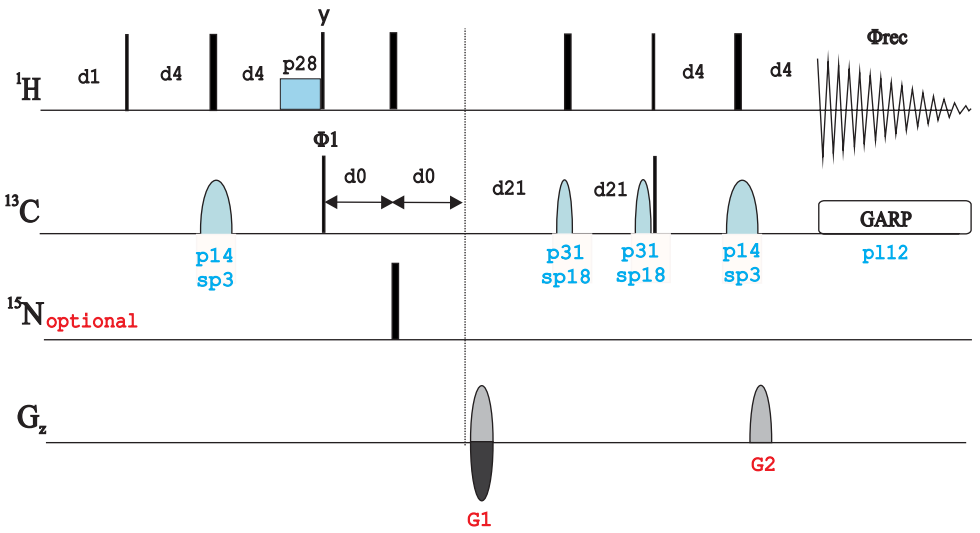
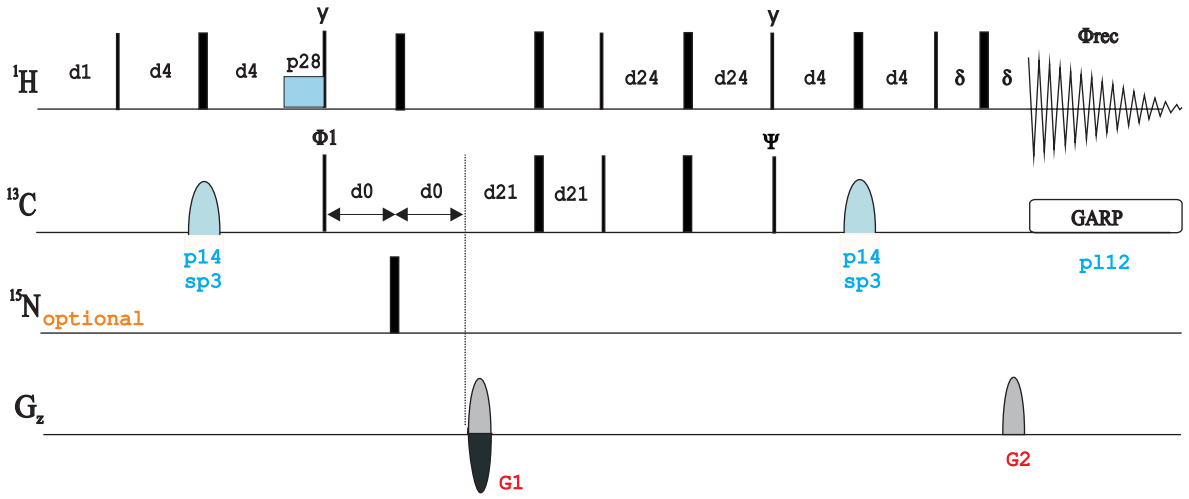
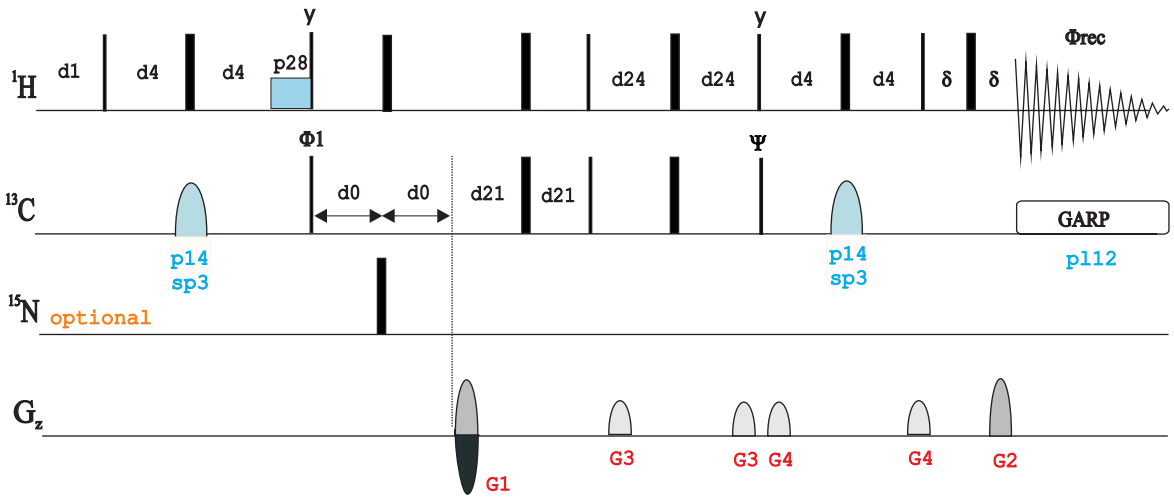
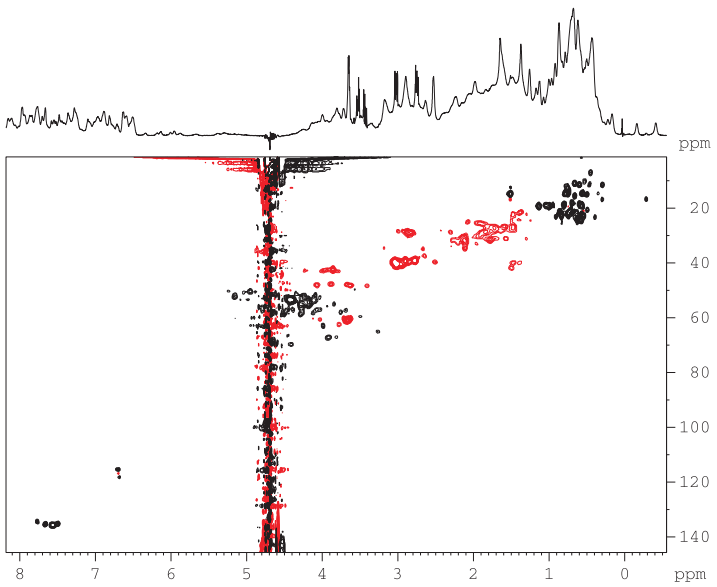


hsqcedetgpsisp



hsqcedetgpsisp2





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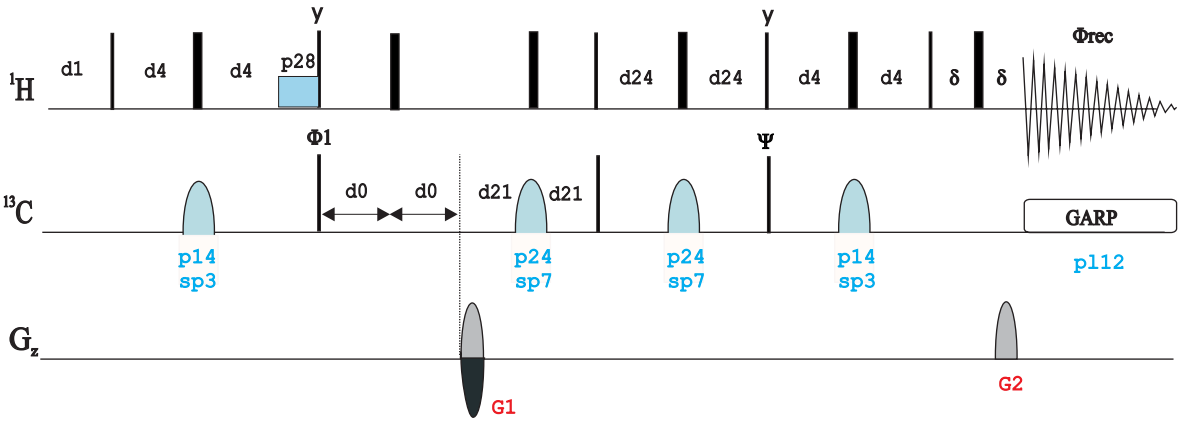
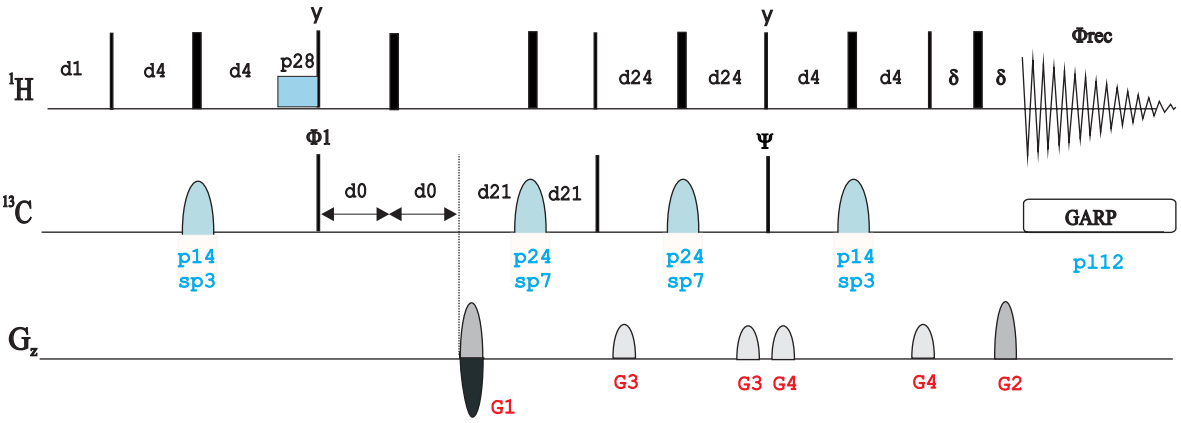
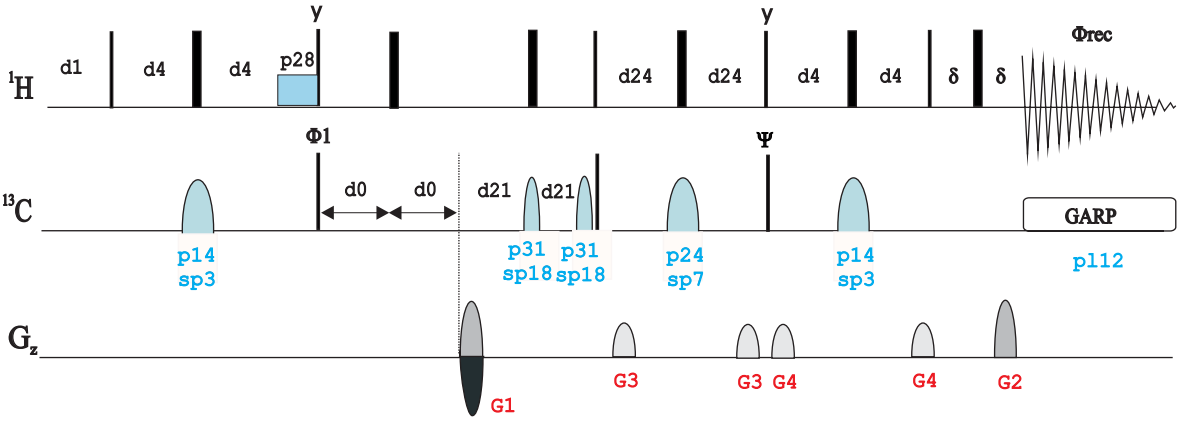


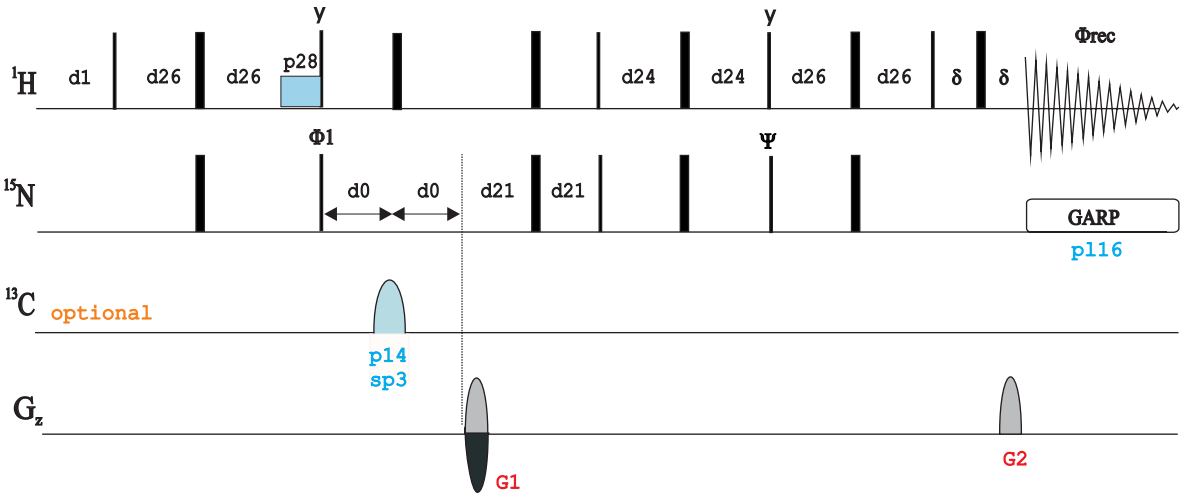
hsqcedetgpsisp2.2



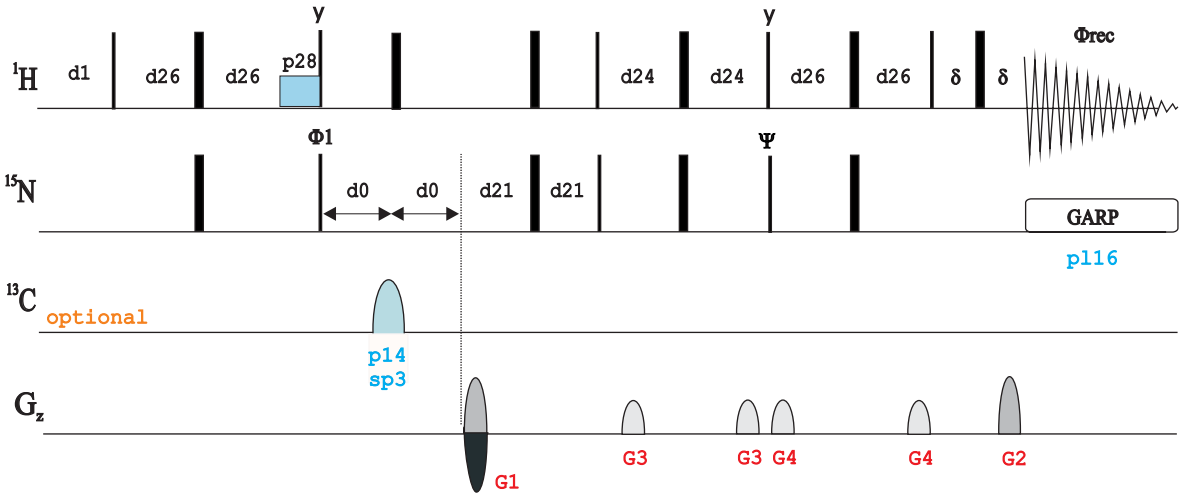
hsqcedetgpsisp2.3

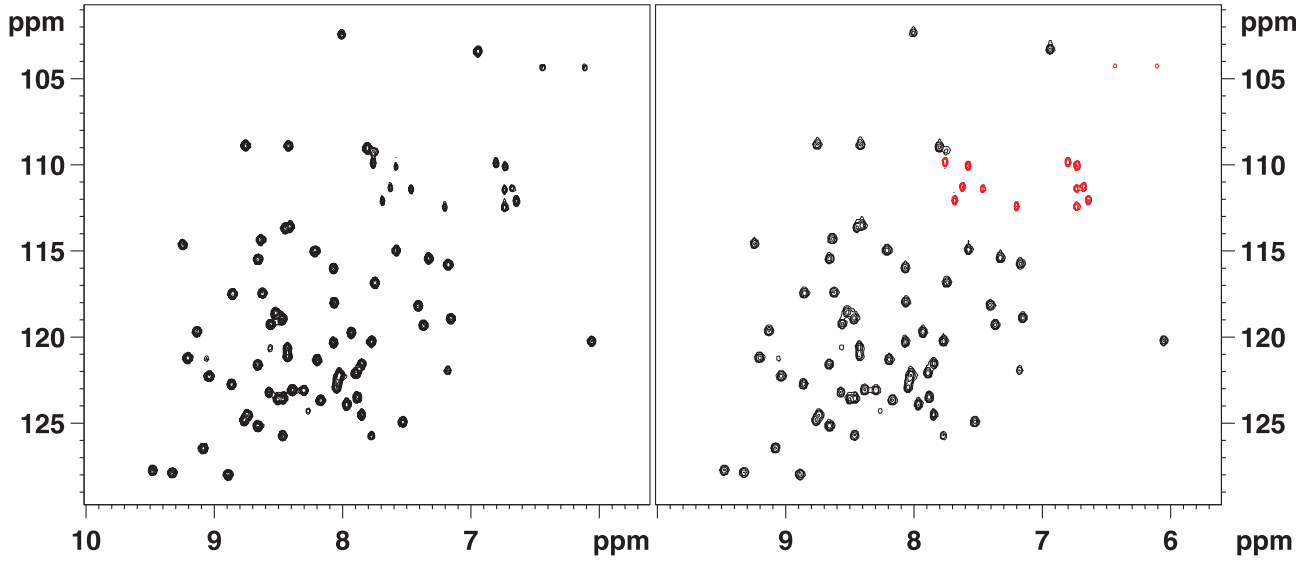


hsqcedetf3gpsi



hsqcedetf3gpsi2





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2D CONSTANT-TIME HSQC AND HMQC EXPERIMENTS

2D Constant-time Correlations

Phase-sensitive Constant-time ge-2D HSQC

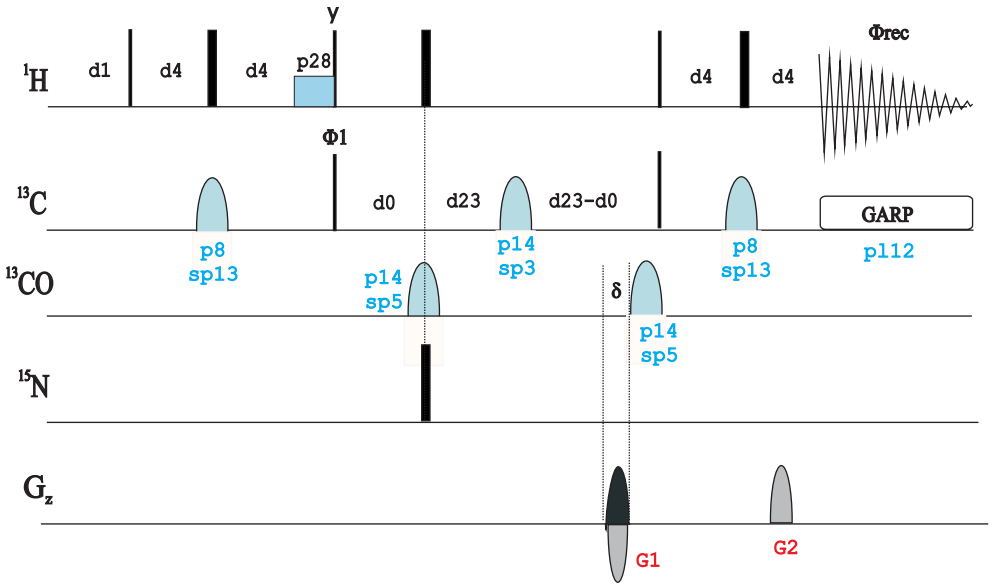
- Using adiabatic pulses (**hsqcctetgpsp**)
- Using adiabatic pulses without CO refocusing (**hsqcctetgpsp.2**)
- Using adiabatic pulses and PEP (**hsqcctetgpsisp**)

Phase-sensitive Constant-time ge-2D HMQC

- Using adiabatic pulses (**hmqcctetgp**)
- For correlating CH_2 groups (**hsqcctetgp.2**)

Also see hsqcctetgpjc and hsqcctetgpjclr

hsqcctetgpsp



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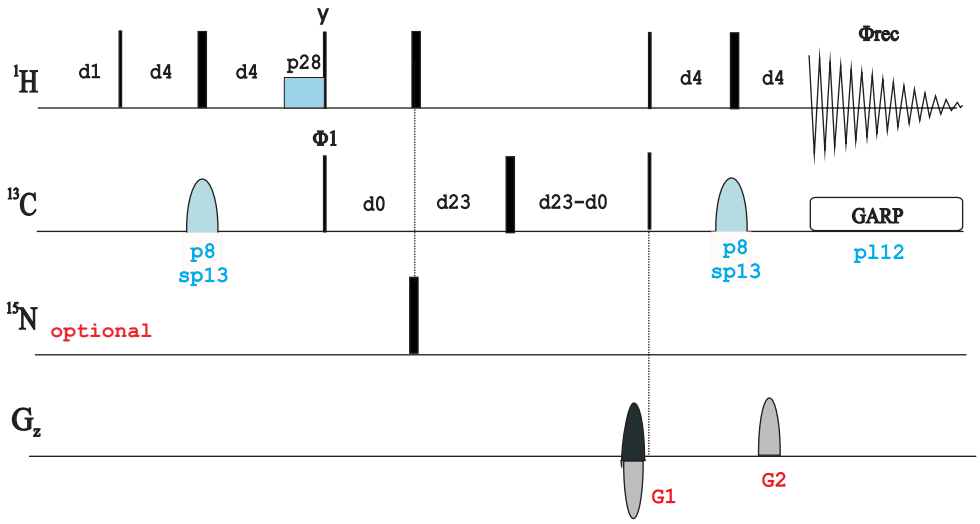
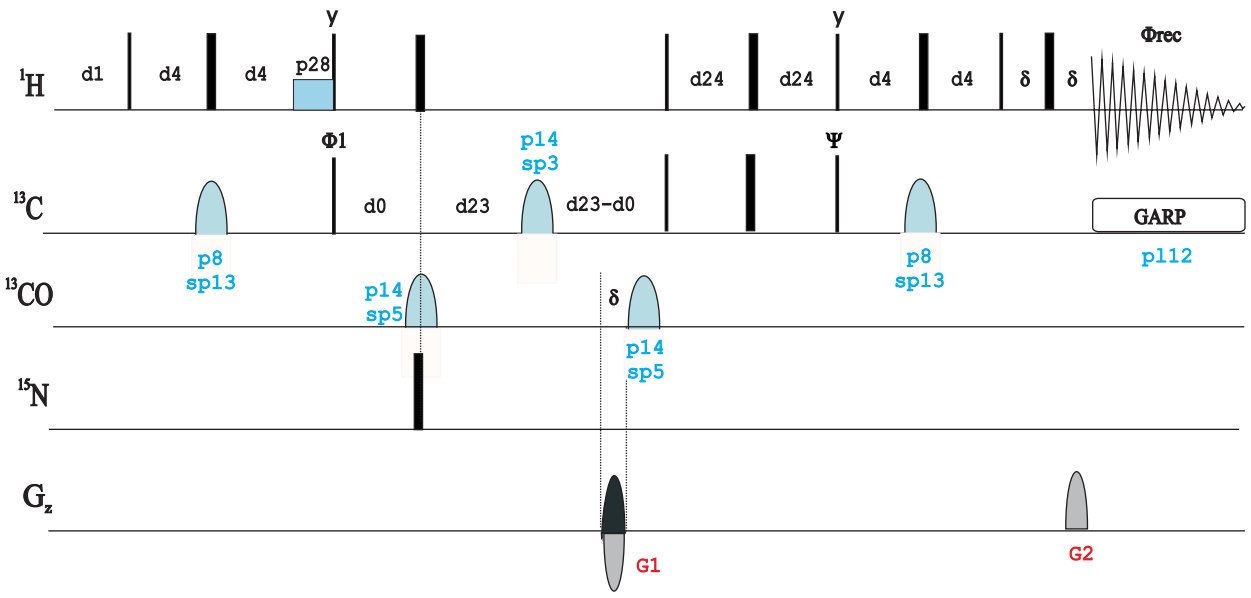
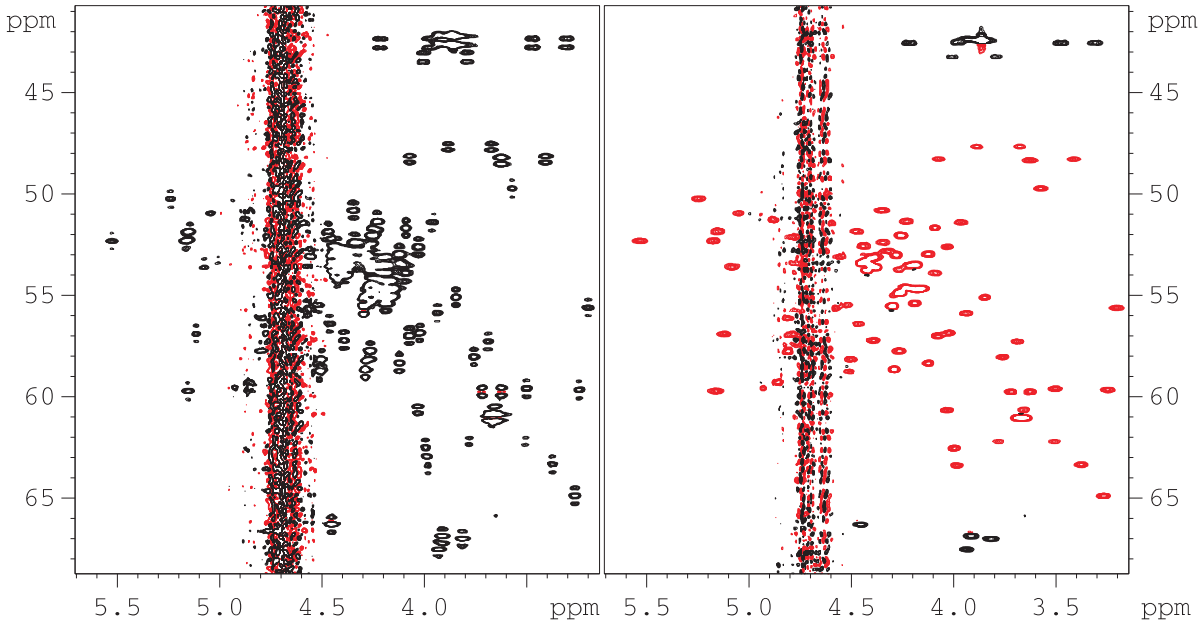
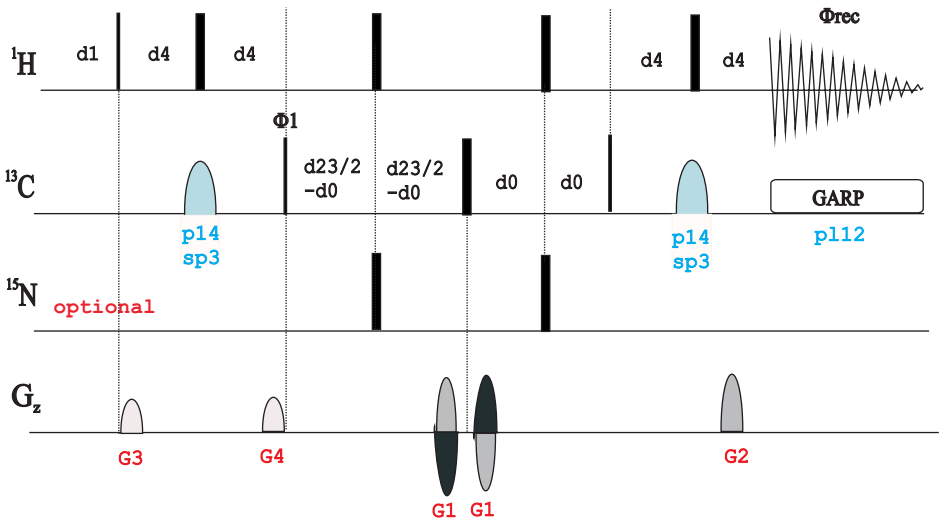


hsqcctetgpsisp





hmqcctetgp



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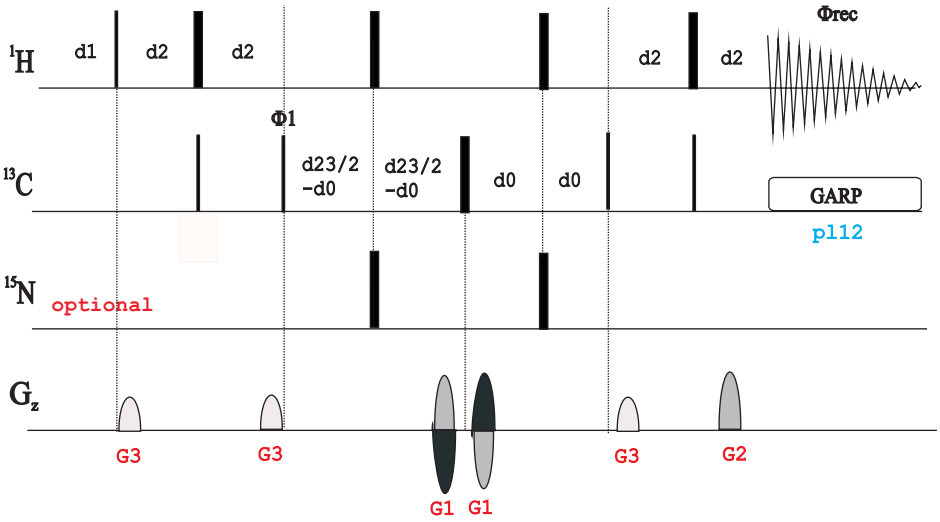

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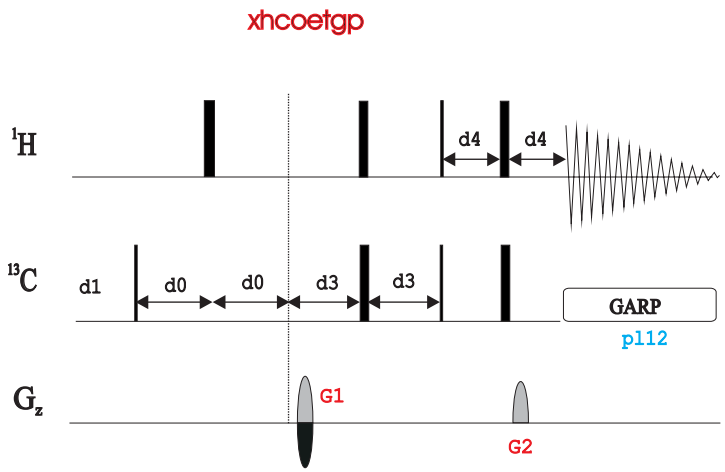
2D INVERSE-INEPT EXPERIMENT

Phase-sensitive ge-2D Inverse INEPT using echo-antiecho (**xhcoetgp**)



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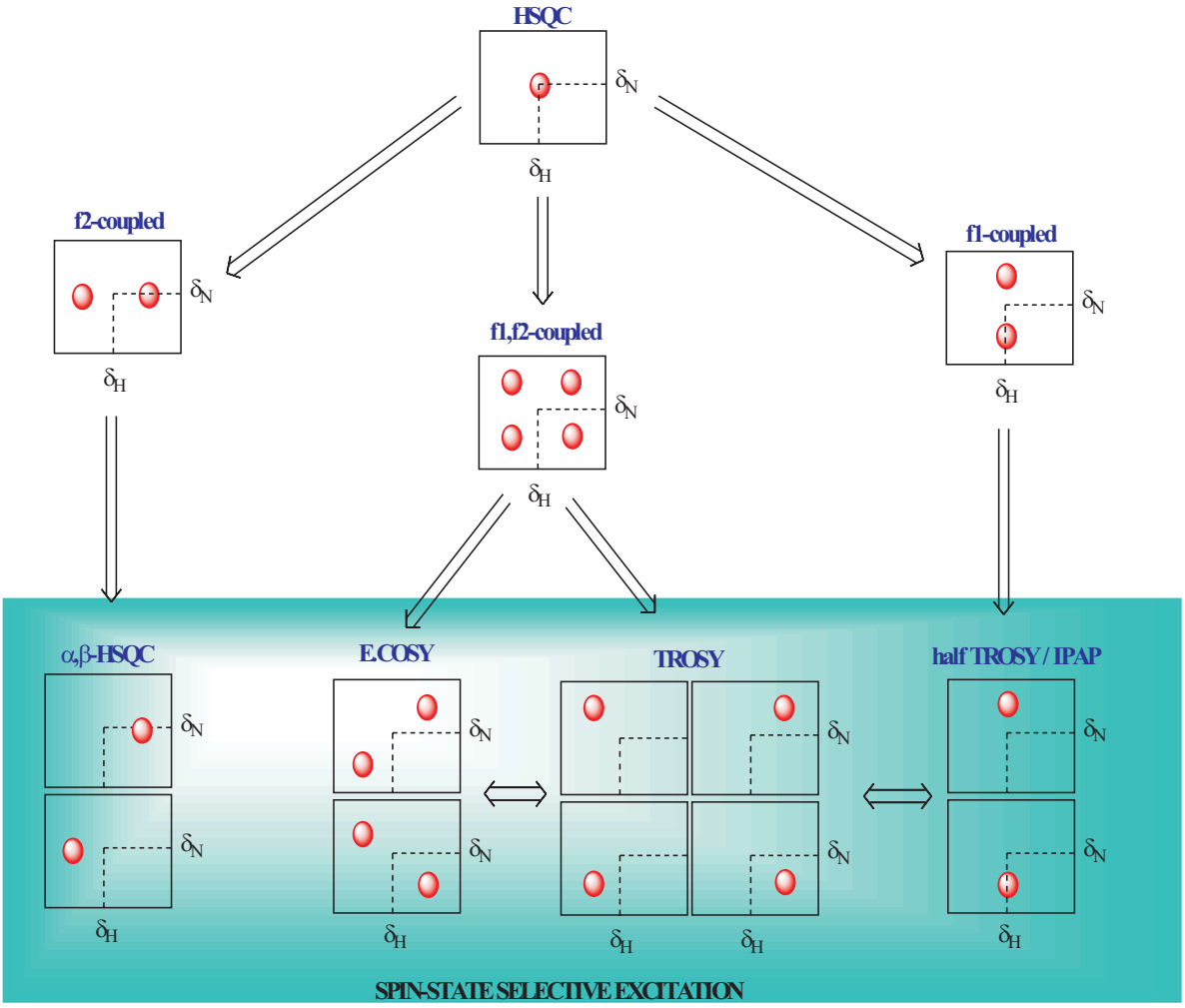
2D SPIN-EDITED
HSQC EXPERIMENTS

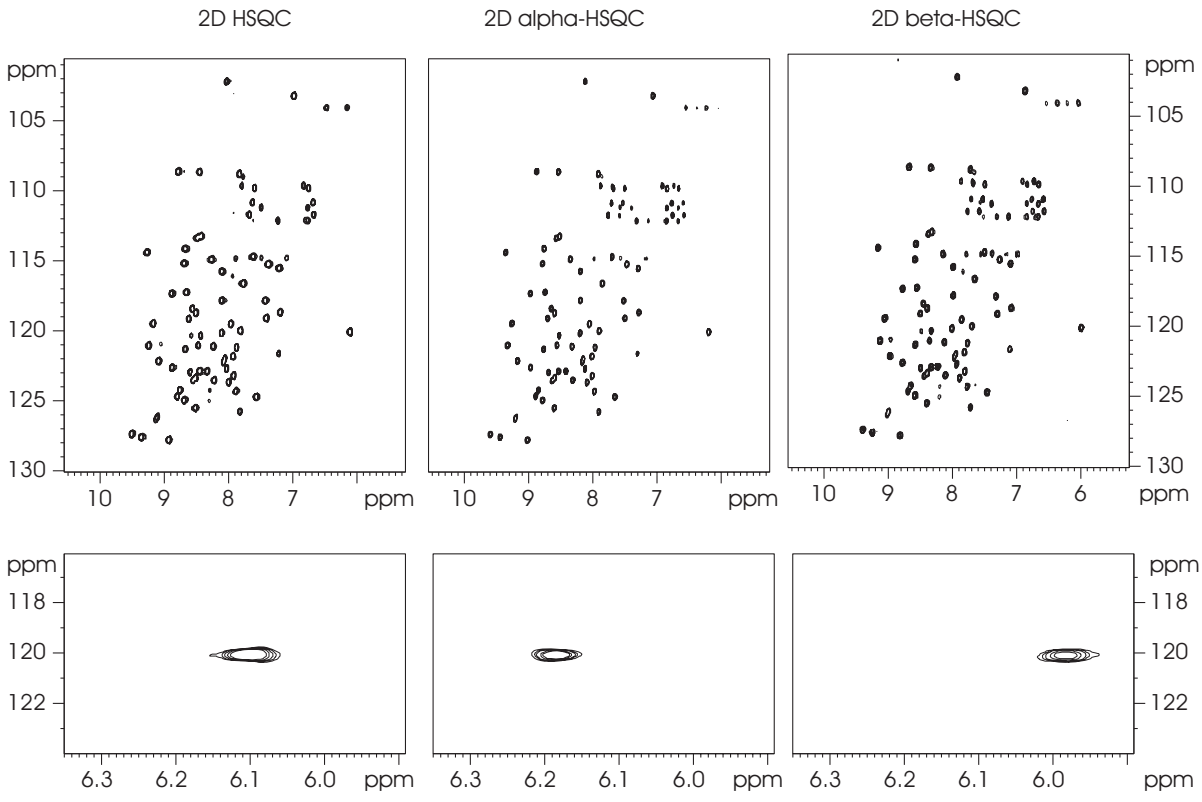
One-bond ^{1}H-^{15}N Couplings

- ge-2D ^{1}H-^{15}N α,β-HSQC (**hsqcetf3gpss)**
  - ge-2D ^{1}H-^{15}N HSQC-IPAP using watergate (**hsqcf3gpiaphwg**)
  - ge-2D ^{1}H-^{15}N HSQC-IPAP using watergate and sensitivity improvement (**hsqcf3gpiaphsiwg**)

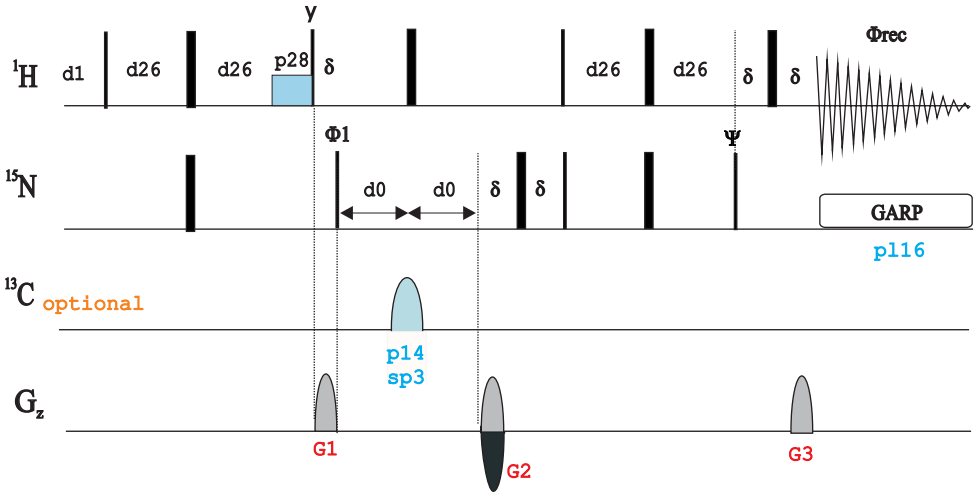
One-bond ^{1}H-^{13}C Couplings

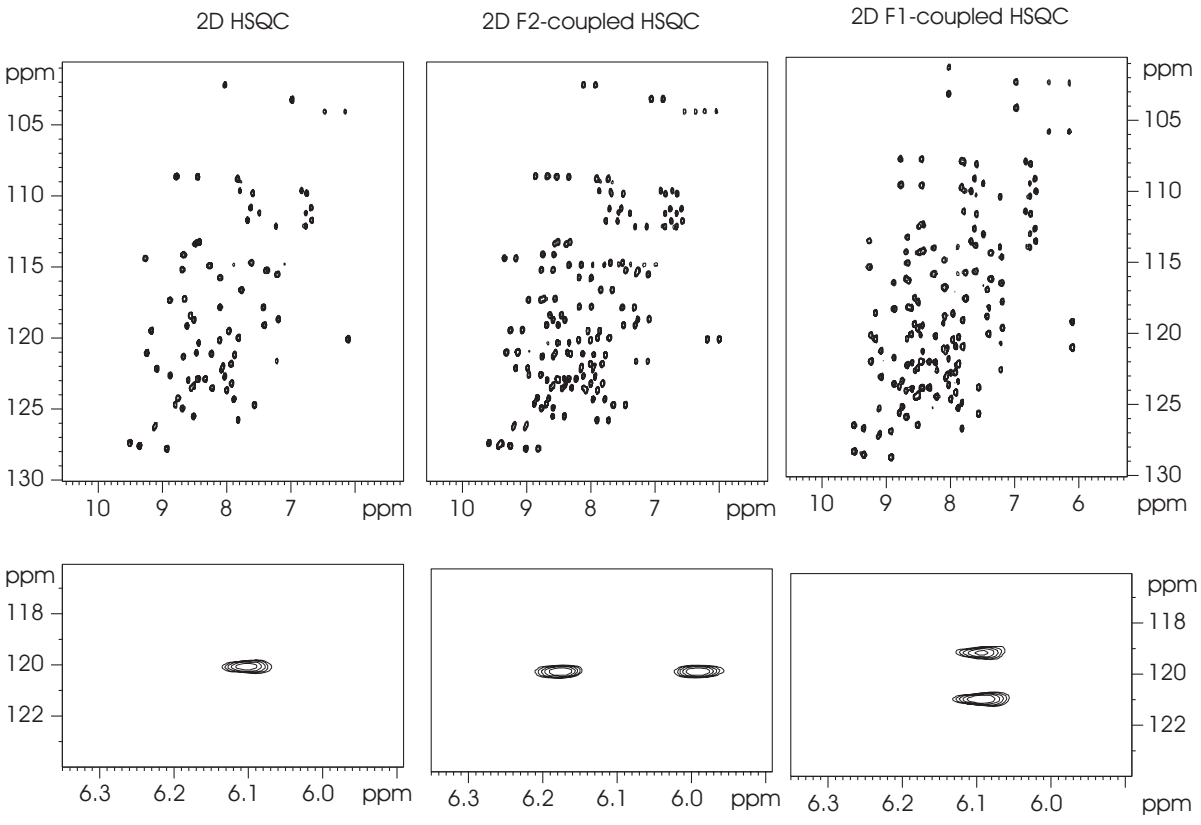
- 2D H-1/C-13 CT-HSQC (**hsqcctetgpjc**)


HSQC
f2-coupled
f1-coupled
f1,f2-coupled
α,β-HSQC
E.COSY
TROSY
half TROSY / IPAP
SPIN-STATE SELECTIVE EXCITATION

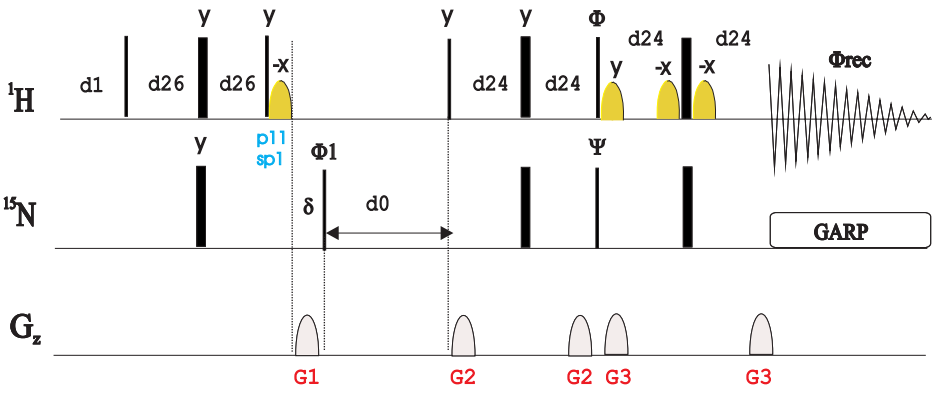

2D HSQC
2D alpha-HSQC
2D beta-HSQC
ppm

hsqcetf3gpss

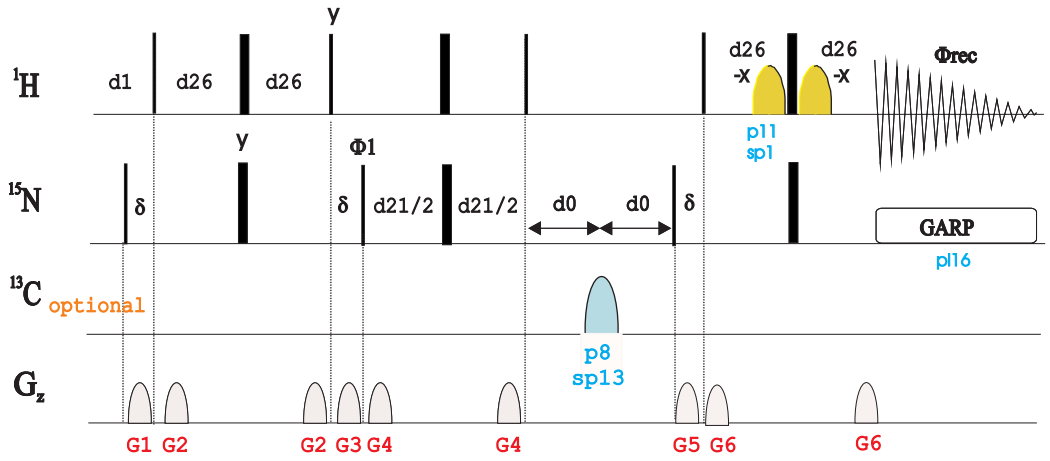


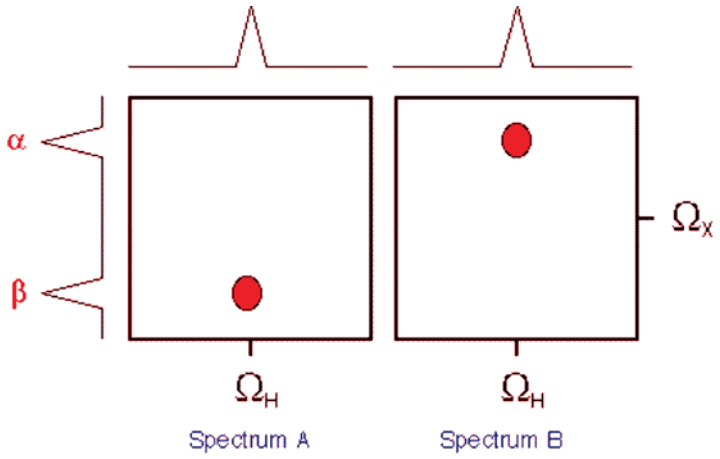


hsqcf3gpiaphsiwg

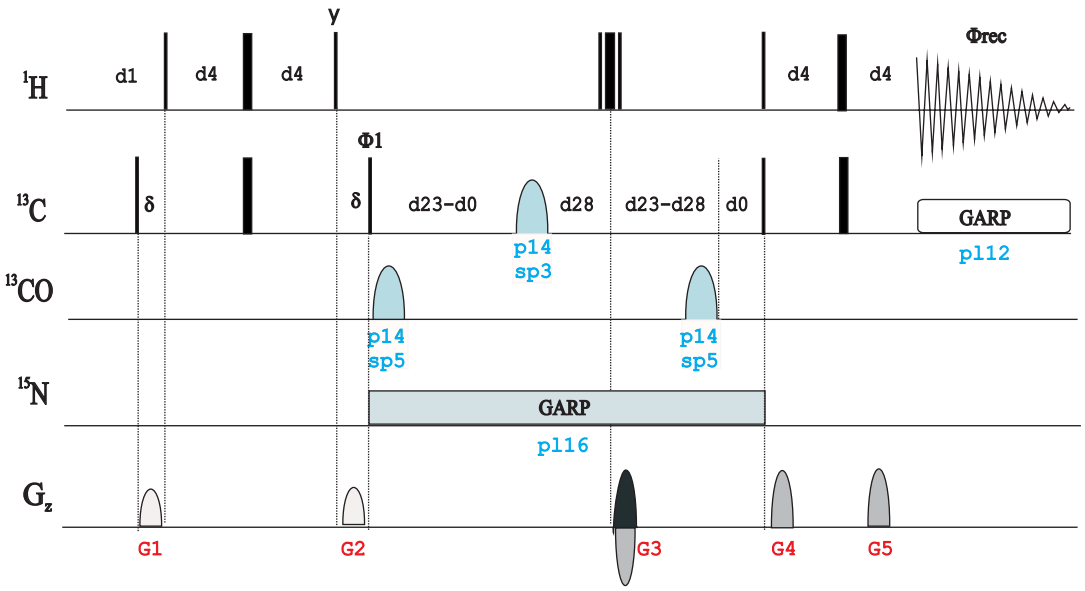


hsqcf3gpiaphwg





hsqcctetgpjc



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2D TROSY EXPERIMENTS

2D TROSY Experiments

From f2 channel:

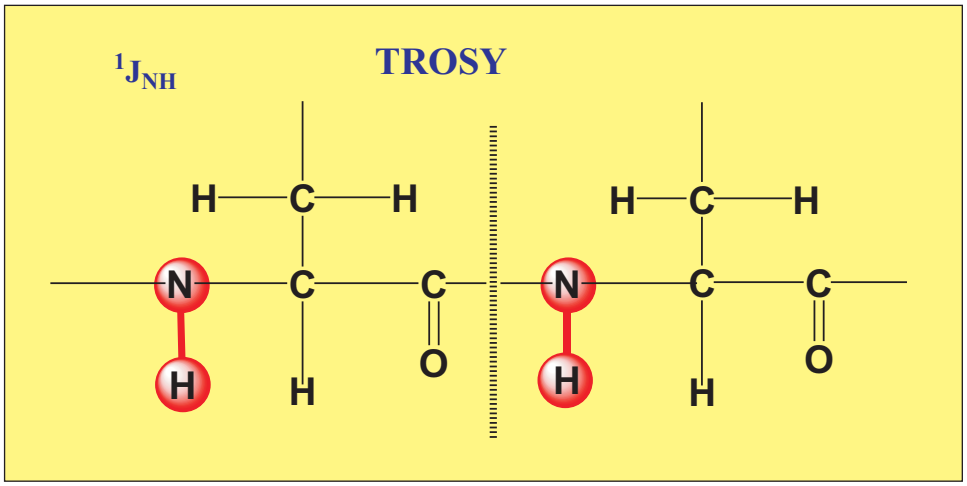
Phase-sensitive ge-2D TROSY with presaturation (**trosygpphpr**)
ge-2D TROSY for aromatic residues with WATERGATE (**trosyargpphwg**)

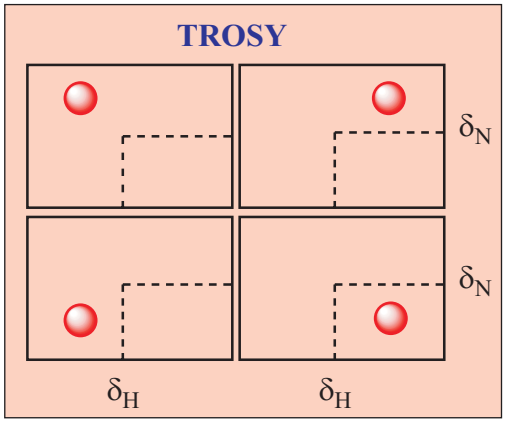
From f3 channel:

Phase-sensitive ge-2D ^{1}H-^{15}N TROSY

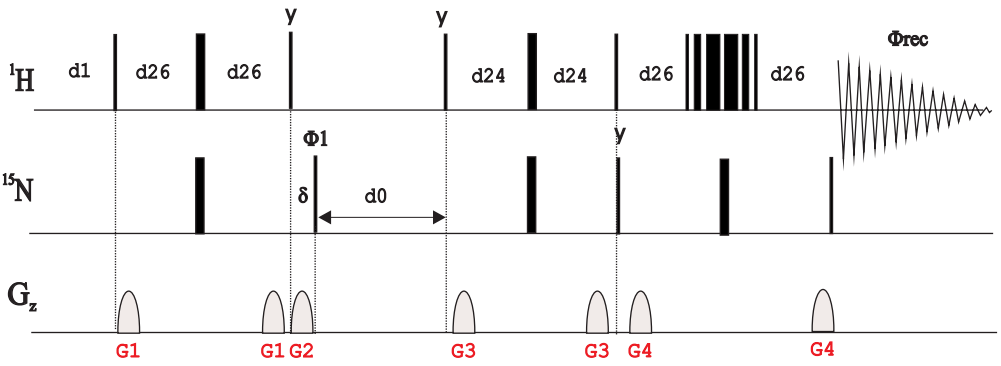
- Using echo-antiecho (**trosyetf3gpsi** | **TROSYETF3GPSI**)
- Using echo-antiecho and different phase cycling (**trosyetf3gpsi2**)
- Using echo-antiecho and different phase cycling to give IPAP TROSY (**trosyetf3gpiasi**)
- Using WATERGATE (3-9-19) (**trosyf3gpph19** | **TROSYF3GPPH19**)
- Using WATERGATE and improved sensitivity (**trosyf3gpphsi19** | **TROSYF3GPPHSI19**)

Phase-sensitive ge-2D ^{1}H-^{15}N ZQ-TROSY using WATERGATE (**trosyzqgpphwg**)

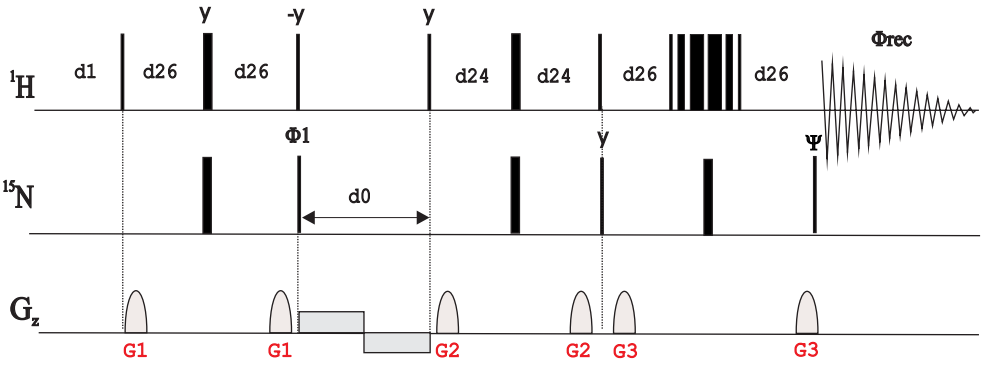




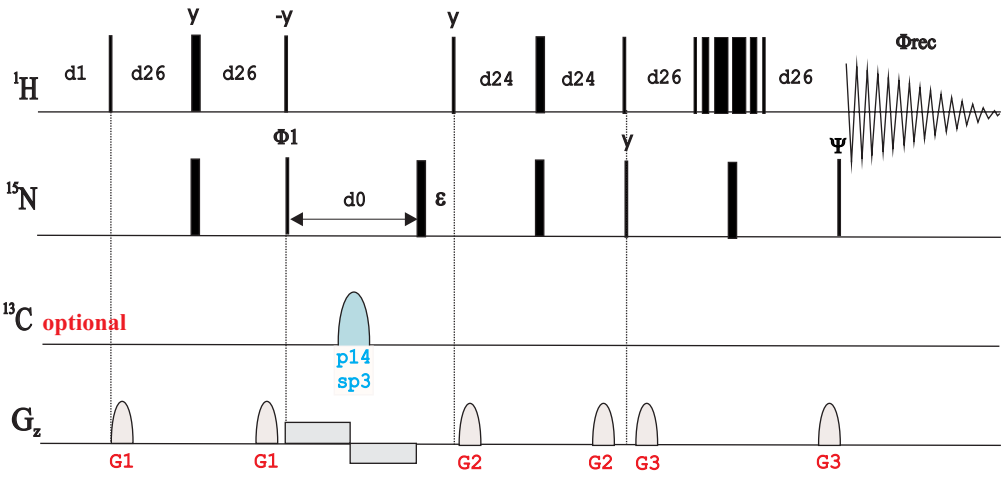
trosyf3gpph19

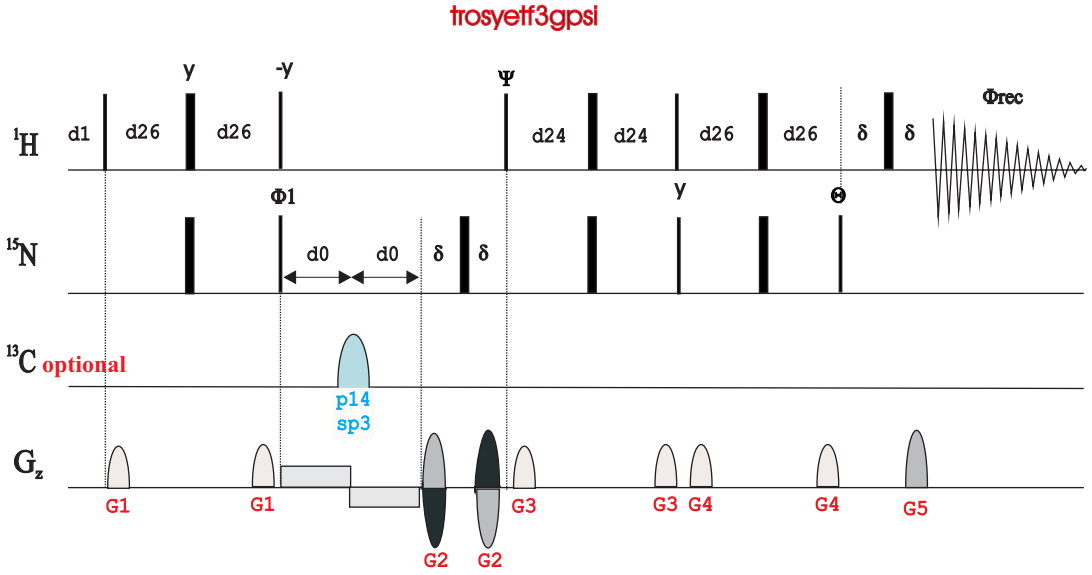


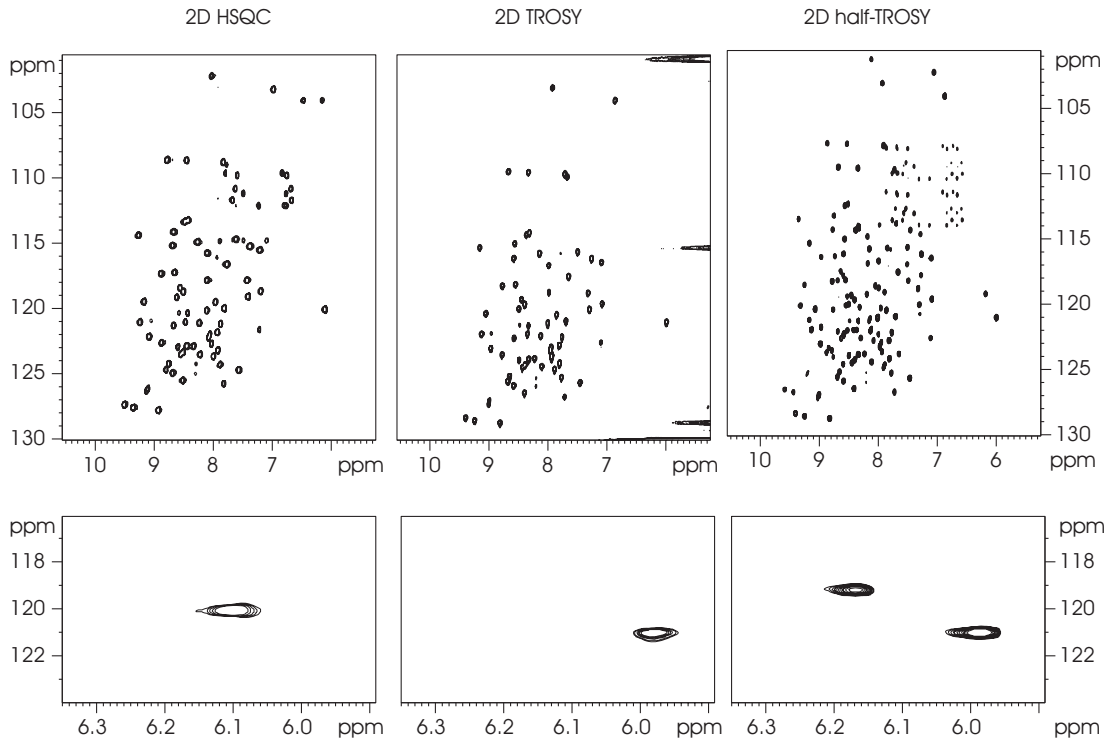
trosyf3gpphsi19



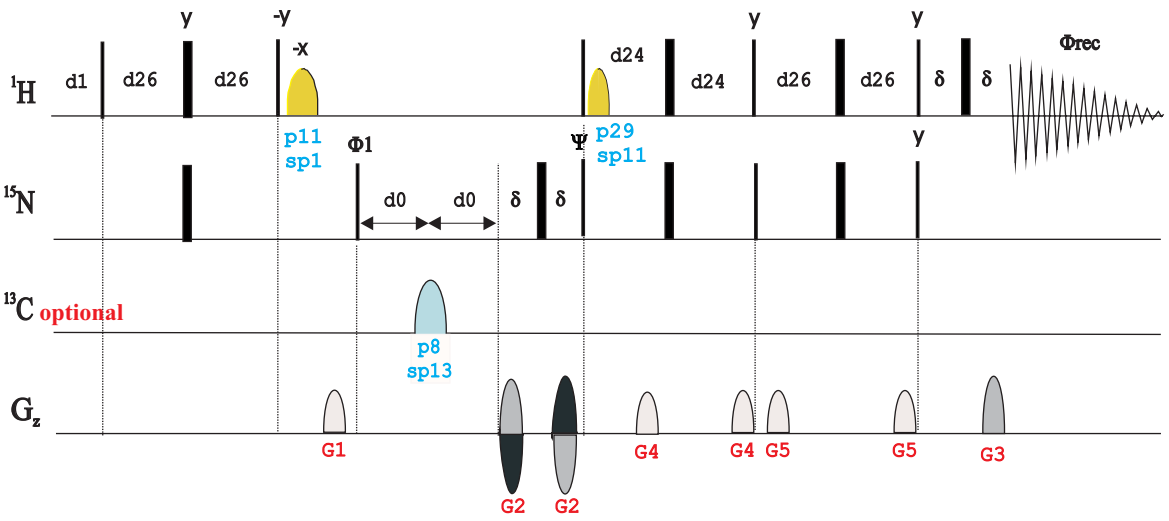
trosyf3gpphsi19.2



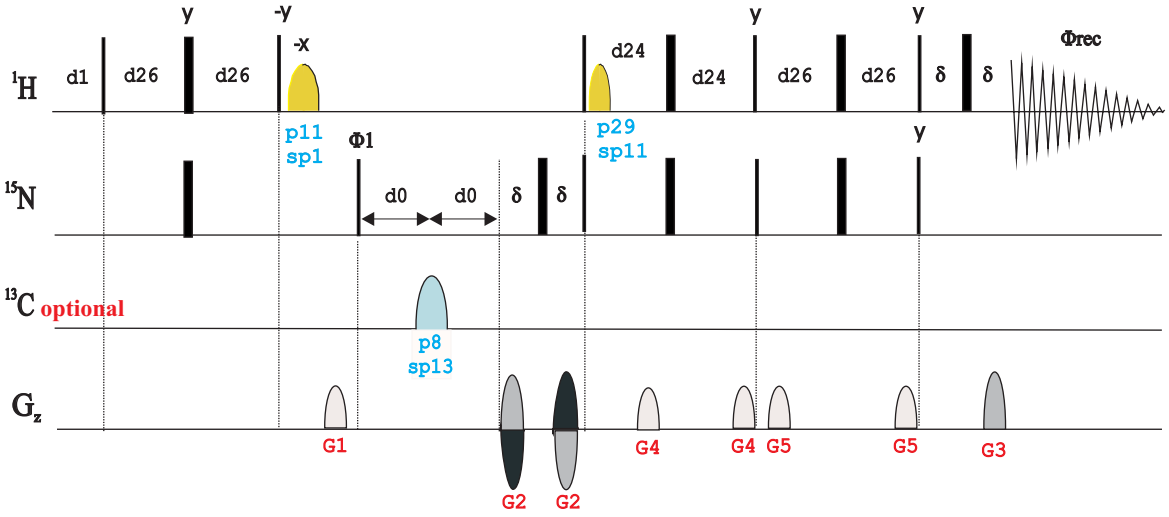

trosyetf3gpsi
y
-y
Ψ
Φrec
¹H
d1
d26
d26
d24
d24
d26
d26
δ
δ
Φ1
y
Θ
¹⁵N
d0
d0
δ
δ
¹³C optional
p14
sp3
Gz
G1
G1
G2
G2
G3
G3
G4
G4
G5


2D HSQC
2D TROSY
2D half-TROSY
ppm
105
110
115
120
125
130
10
9
8
7
6
118
122
6.3
6.2
6.1
6.0

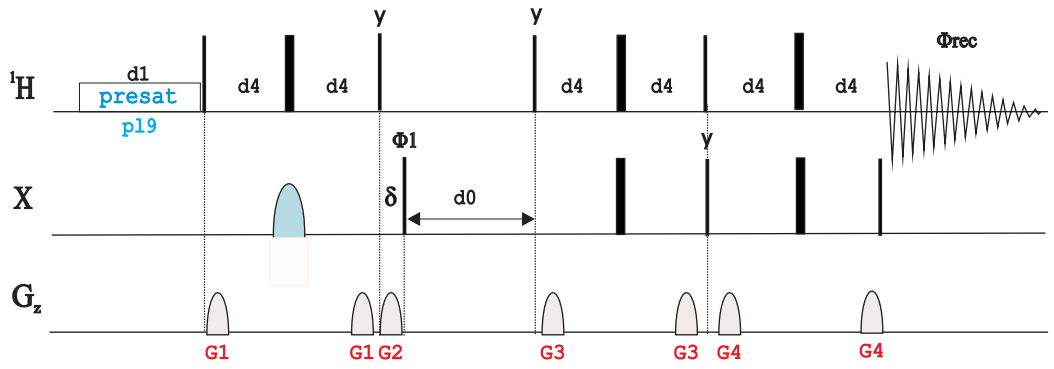
trosyetf3gpsi2



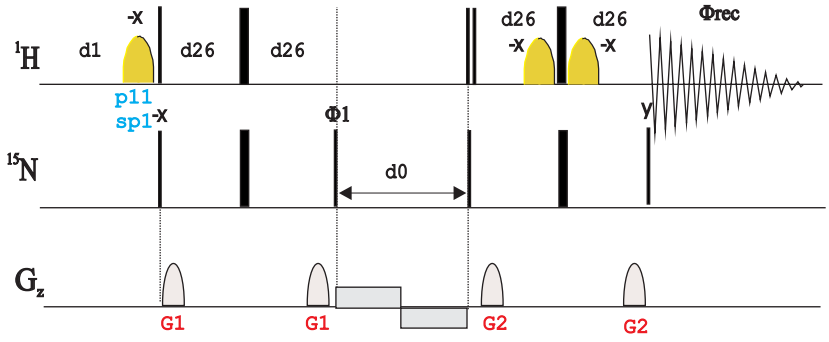
trosyetf3gpiasi



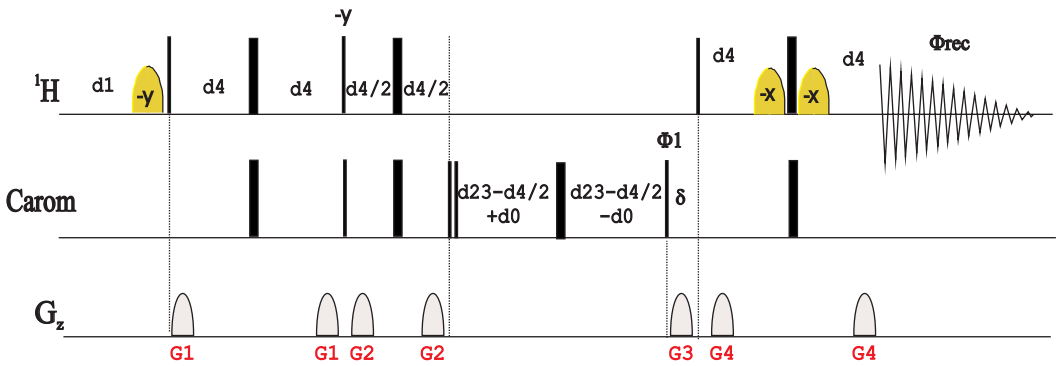
trosygpphpr



trosyzqgpphwg



trosyargpphwg



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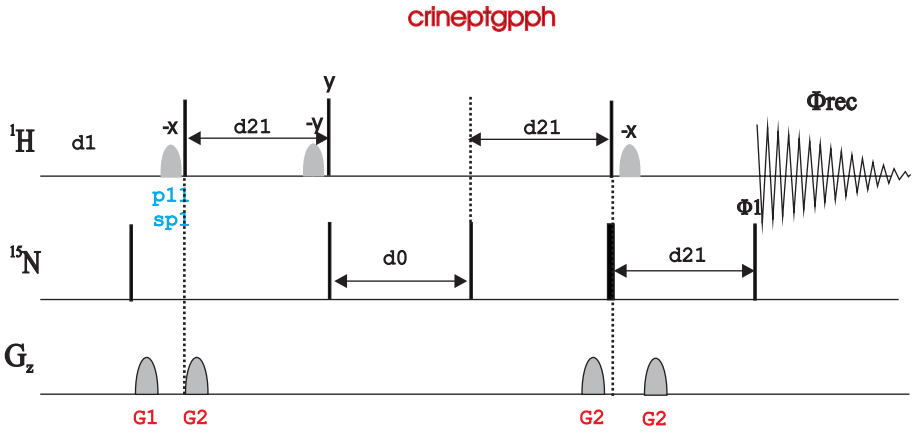
2D CRINEPT EXPERIMENT

ge-2D ^{1}H-^{15}N CRINEPT using flip-back (**crineptgpph**)



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2D HMQC-COSY EXPERIMENTS

2D HMQC-COSY Experiments

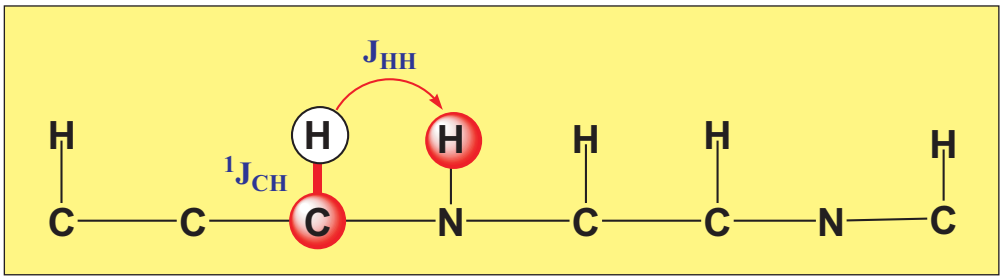
Phase cycled:

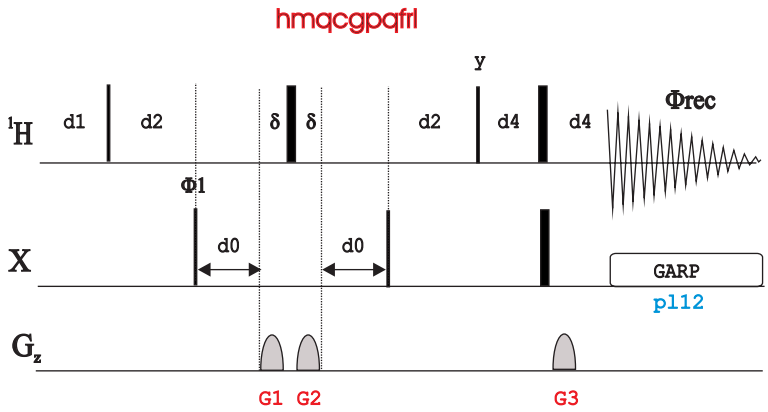
Magnitude-mode 2D HMQC-COSY using BIRD (**hmqcbindqfrl**)
Phase-sensitive 2D HMQC-COSY using BIRD with decoupling (**hmqcbiphrl**)
Phase-sensitive 2D HMQC-COSY using BIRD without decoupling (**hmqcbindphrl**)
Phase-sensitive 2D HMQC-COSY-DQF using BIRD (**hmqcbidfphrl**)

Gradient-enhanced:

Magnitude-mode ge-2D HMQC-COSY (**hmqcgpqfrl**)
H2BC experiment with a three-low-pass filter (**h2bcetgpl3**)

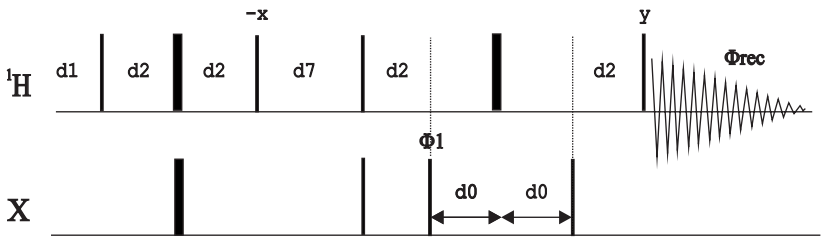
Also see HMQC and HMQC-TOCSY experiments



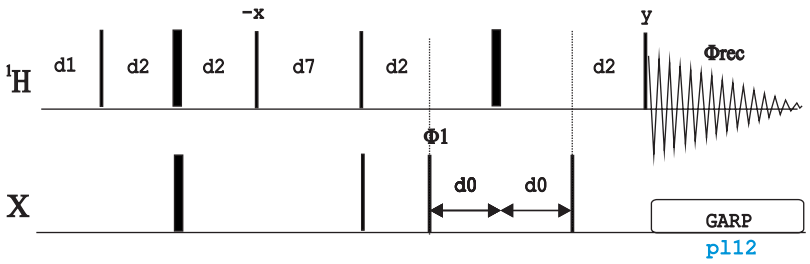


hmqcbindqfrl

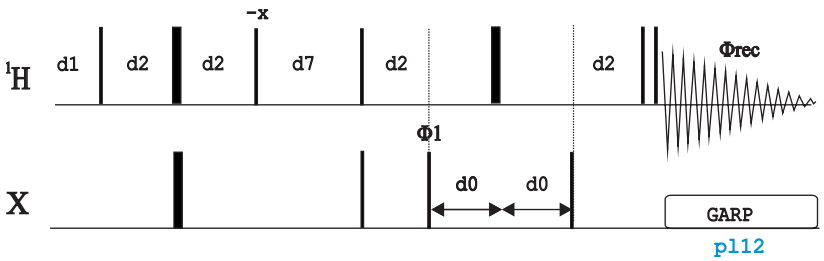
hmqcbindphrl

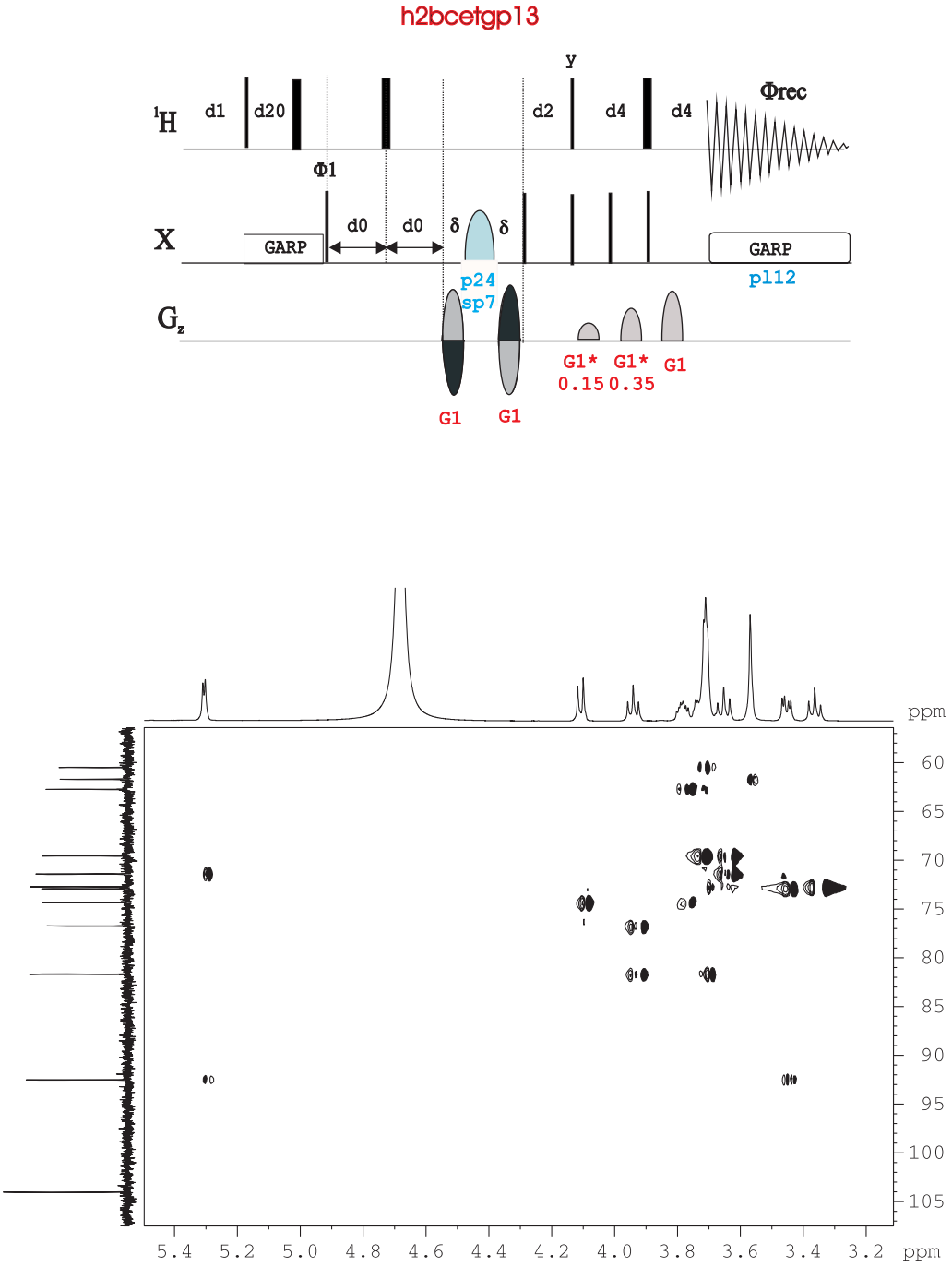


hmqcbiphrl



hmqcbidfphrl




h2bcetgp13
y
Φrec
^{1}H
d1
d20
d2
d4
d4
Φ1
X
GARP
d0
d0
δ
δ
GARP
p24
sp7
p112
G$_z$
G1*
G1*
G1
0.15
0.35
G1
G1
ppm
60
65
70
75
80
85
90
95
100
105
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
ppm

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2D HMQC-TOCSY EXPERIMENTS

- **Phase-cycled:**

  Phase-sensitive 2D HMQC-TOCSY (**hmqcmlph**)
  Phase-sensitive 2D HMQC-TOCSY without decoupling (**hmqcmlndph**)
  Magnitude-mode 2D HMQC-TOCSY using BIRD (**hmqcbimlqf**)
  Magnitude-mode 2D HMQC-TOCSY using BIRD without decoupling (**hmqcbimlndqf**)

  Phase-sensitive 2D HMQC-TOCSY using BIRD (**hmqcbimlph**)
  Phase-sensitive 2D HMQC-TOCSY using BIRD without decoupling (**hmqcbimlndph**)

- **Phase-cycled and solvent suppression:**

  Phase-sensitive 2D HMQC-TOCSY with presaturation (**hmqcmlphpr**)
  Phase-sensitive2D HMQC-TOCSY with presaturation and without decoupling (**hmqcmlndphpr**)

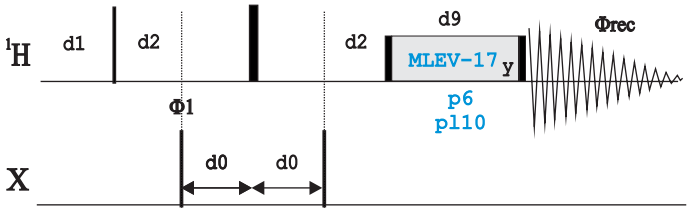
- **Gradient-enhanced from f2 channel:**

  Magnitude-mode ge-2D HMQC-TOCSY with MLEV (**hmqcgpmlqf** | HMQCGPML)
  Phase-sensitive ge-2D HMQC-TOCSY with DIPSI-2 using echo-antiecho (**hmqcdietgp**)
  Phase-sensitive ge-2D HMQC-TOCSY with DIPSI-2 using PEP (**hmqcdietgpsi**)
  Phase-sensitive ge-2D HMQC-TOCSY with DIPSI-2 using PEP using shorter overall timing (**hmqcdietgpsi.2**)

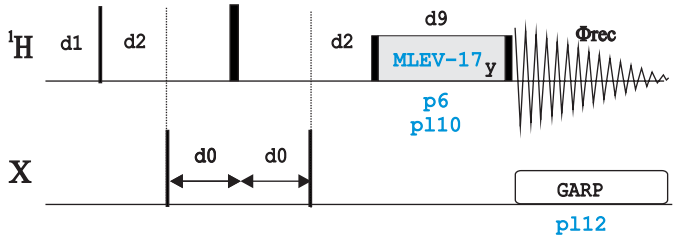
- **Gradient-enhanced from f3 channel:**

  Phase sensitive ge-2D ^{1}H-^{15}N HMQC-TOCSY with DIPSI-2 using echo-antiecho (**hmqcdietf3gp**)
  Phase sensitive ge-2D ^{1}H-^{15}N HMQC-TOCSY with DIPSI-2 using PEP (**hmqcdietf3gpsi**)
  Phase sensitive ge-2D ^{1}H-^{15}N HMQC-TOCSY with DIPSI-2 using PEP and shorther overall timing(**hmqcdietf3gpsi.2**)

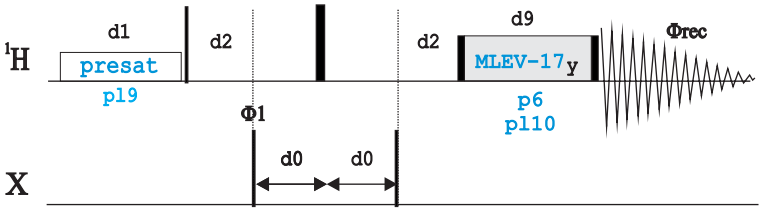
hmqcmlndph



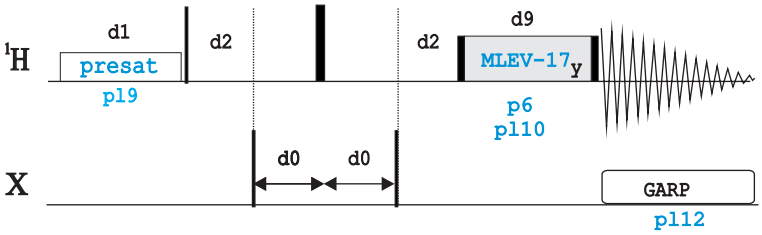
hmqcmlph



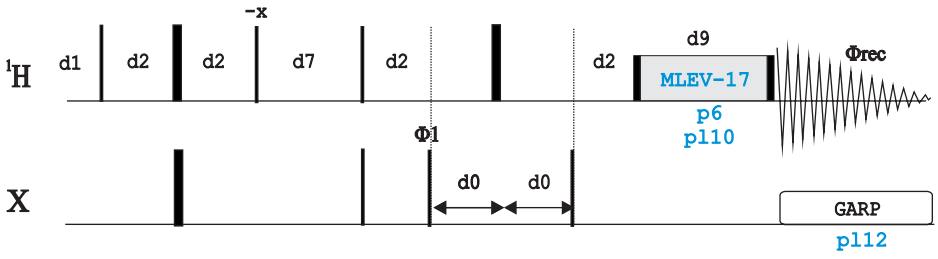
hmqcmlndphpr



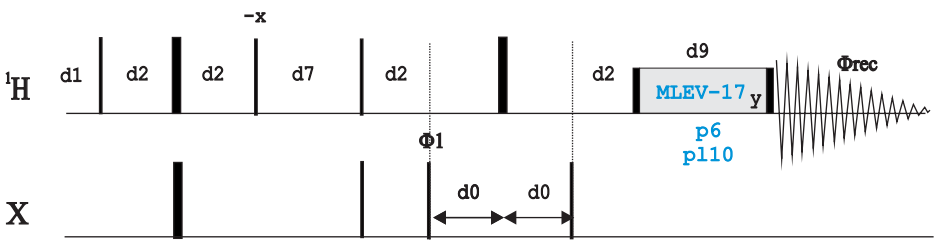
hmqcmlphpr

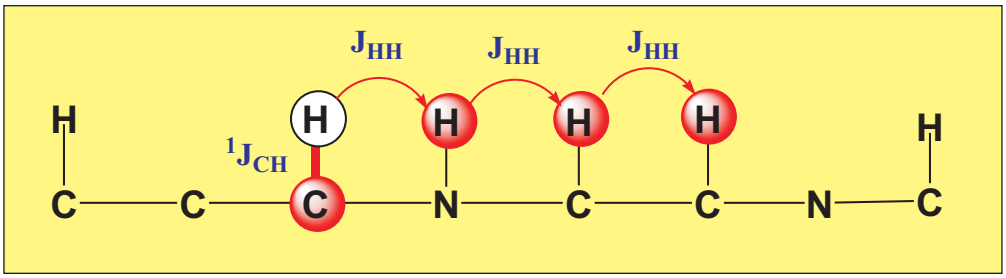


hmqcbimlqf
hmqcbimlph



hmqcbimlndqf
hmqcbimlndph

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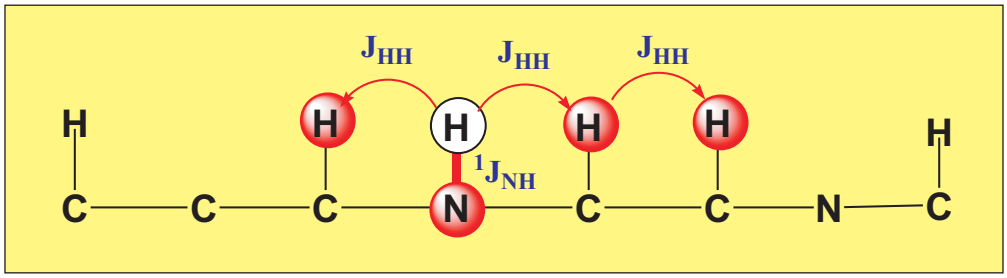
C
N
C
C
N
C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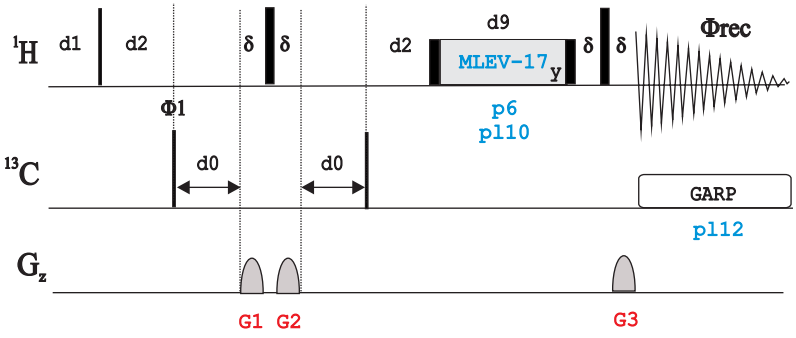
C

hmqcgpmlqf


1H
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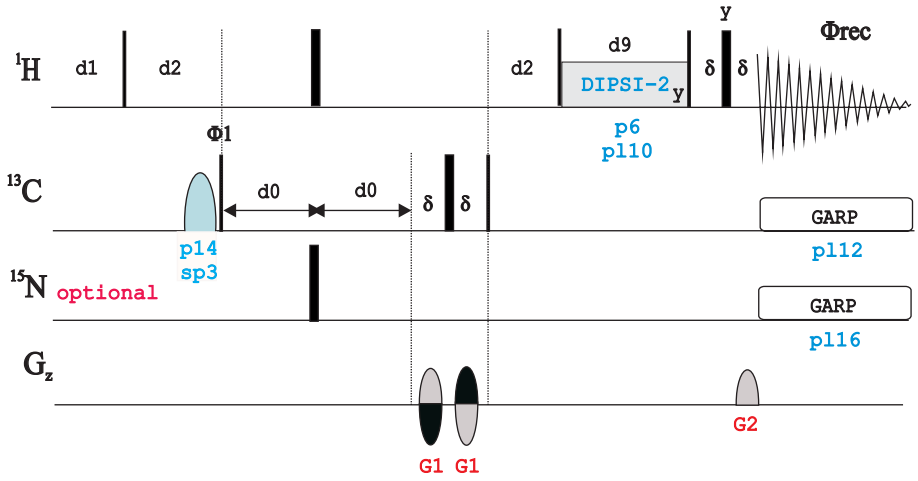
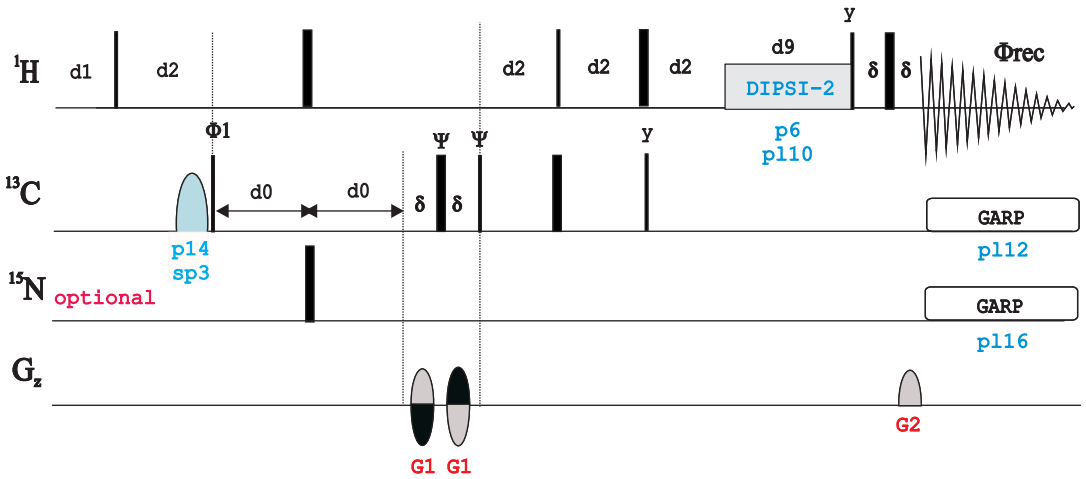
d2
δ
δ
d2
d9
MLEV-17y
δ
δ
Φrec
Φ1
p6
p110
13C
d0
d0
GARP
p112
Gz
G1
G2
G3

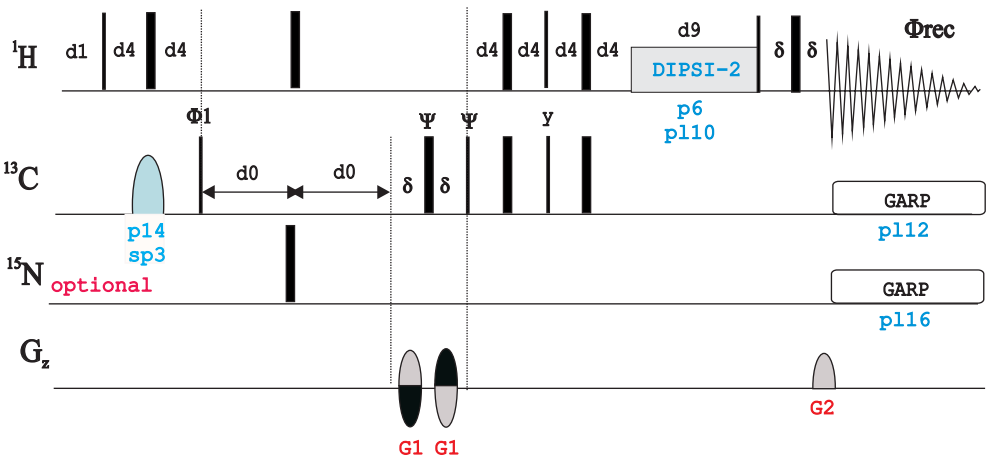
hmqcdletgp



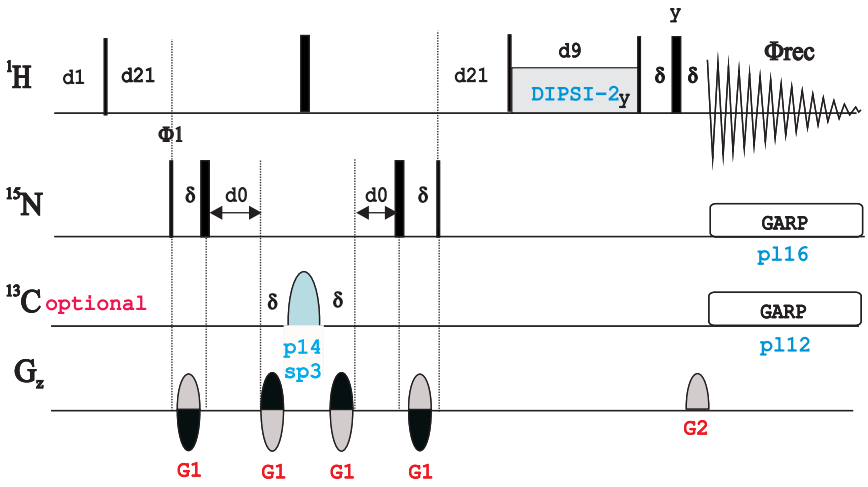
hmqcdletgpsi



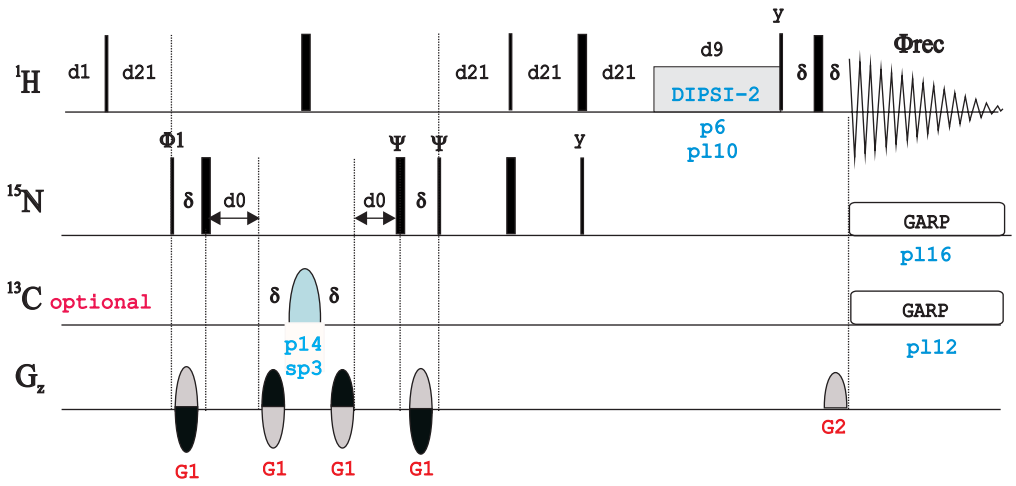
hmqcdletgpsi.2



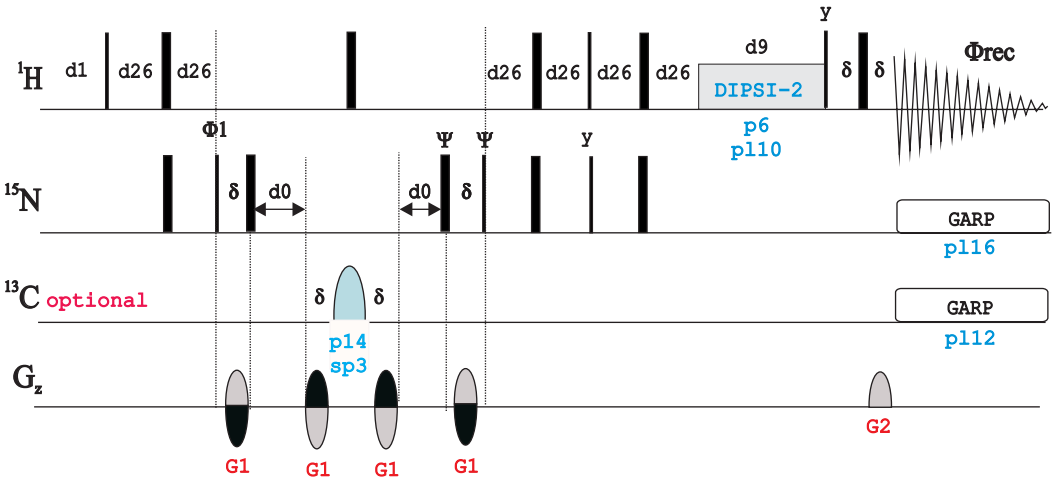
hmqcdletf3gp



hmqcdletf3gpsi



hmqcdletf3gpsi.2



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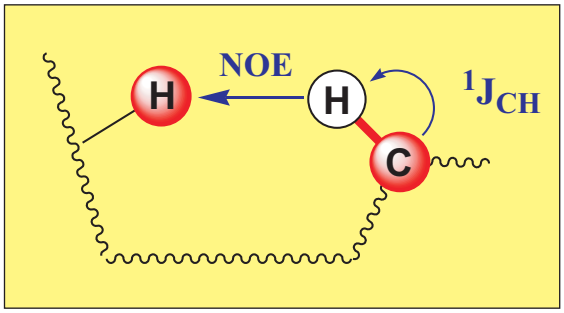
2D HMQC-ROESY EXPERIMENTS

- **Gradient-enhanced from the f2 channel**

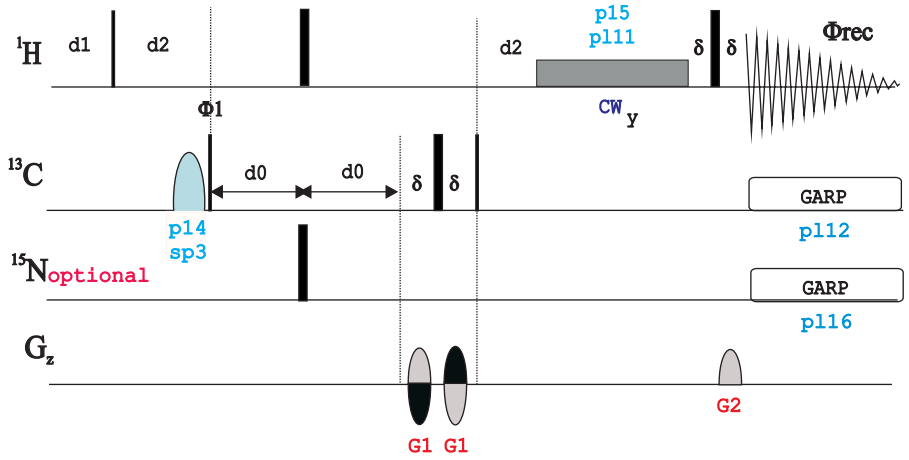
  Phase-sensitive ge-2D HMQC-ROESY using echo-antiecho (**hmqcetgpro**)
  Phase-sensitive ge-2D HMQC-ROESY with T-ROESY using echo-antiecho (**hmqcetgpro.2**)

- **Gradient-enhanced from the f3 channel**

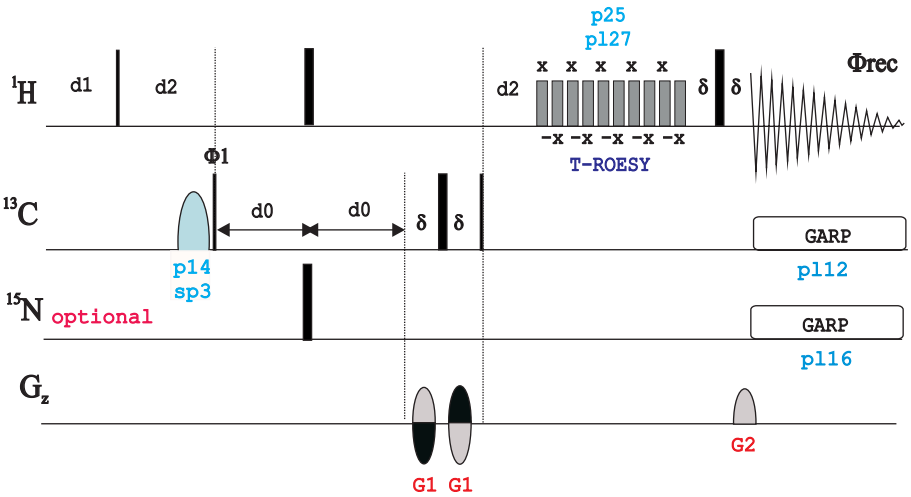
  Phase-sensitive ge-2D ^{1}H-^{15}N HMQC-ROESY using echo-antiecho (**hmqcetf3gpro**)
  Phase-sensitive ge-2D ^{1}H-^{15}N HMQC-ROESY with T-ROESY using echo-antiecho (**hmqcetf3gpro.2**)

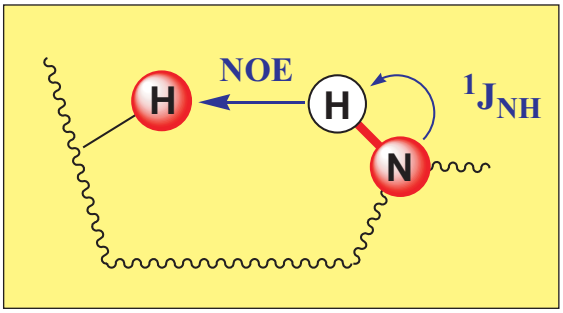


hmqcetgpro

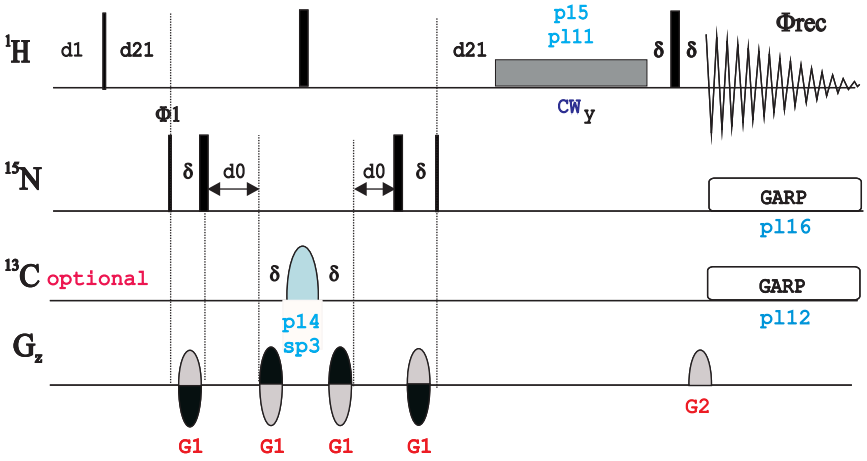


hmqcetgpro.2

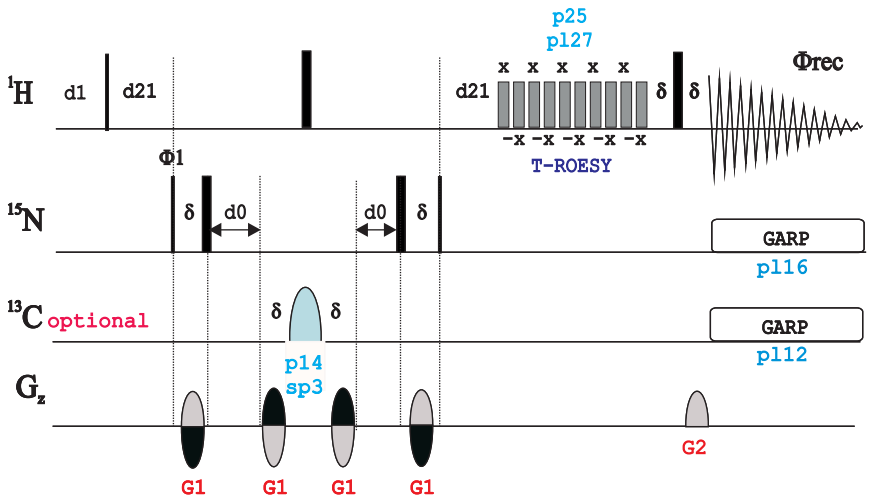




hmqcetf3gpro



hmqcetf3gpro.2



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2D HMQC-NOESY EXPERIMENTS

- **Phase cycled:**

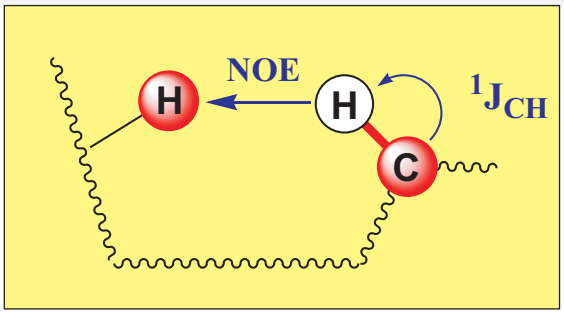
  Phase-sensitive 2D HMQC-NOESY with presaturation (**hmqcnophpr**)
  Phase-sensitive 2D HMQC-NOESY using BIRD (**hmqcbinoph**)

- **Gradient-enhanced from the f2 channel:**

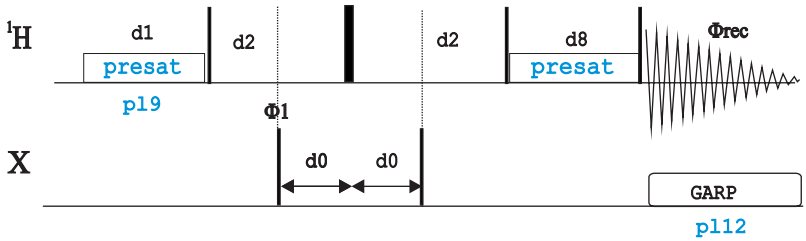
  Phase-sensitive ge-2D HMQC-NOESY using echo-antiecho (**hmqcetgpno**)

- **Gradient-enhanced from the f3 channel:**

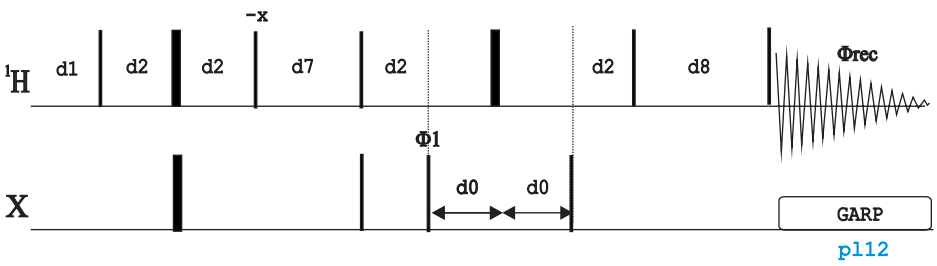
  Phase-sensitive ge-2D ^{1}H-^{15}N HMQC-NOESY using echo-antiecho (**hmqcetf3gpno**)

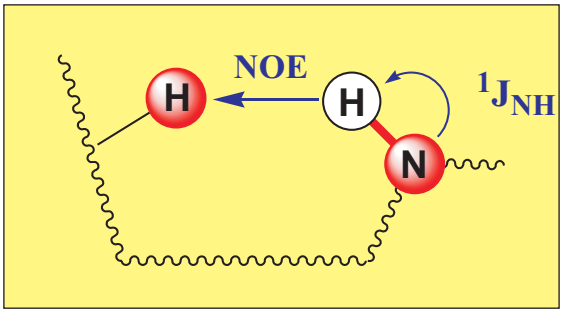


hmqcnophpr

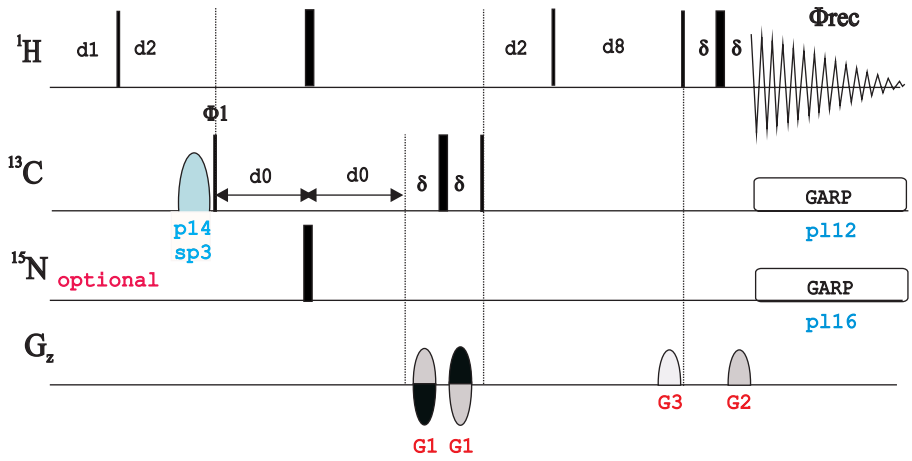


hmqcbinoph

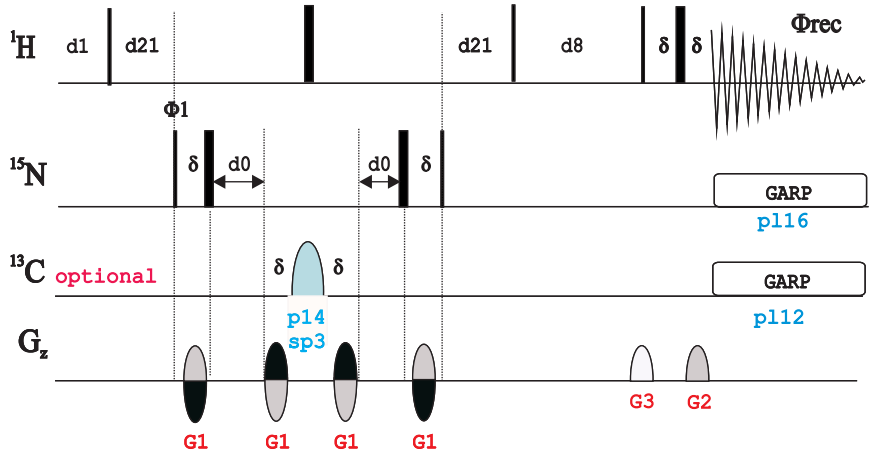




hmqcetgpno



hmqcetf3gpno



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2D HSQC-TOCSY EXPERIMENTS

Gradient-enhanced from the f2 channel

Phase sensitive ge-2D HSQC-TOCSY with MLEV using z-filter (**hsqcgpmlph** | **HSQCGPMLPH**)
Phase-sensitive ge-2D HSQC-TOCSY with MLEV using echo-antiecho (**hsqcetgpml** | **HSQCETGPML**)
Phase-sensitive ge-2D HSQC-TOCSY with DIPSI-2 using PEP (**hsqcdietgpsi**)
Phase-sensitive ge-2D HSQC-TOCSY with DIPSI-2 using PEP and adiabatic inversion pulses (**hsqcdietgpsisp** | **HSQCDIETGPSISP**)
Phase-sensitive ge-2D HSQC-TOCSY with DIPSI-2 using PEP and adiabatic inversion and refocusing pulses (**hsqcdietgpsisp.2**)

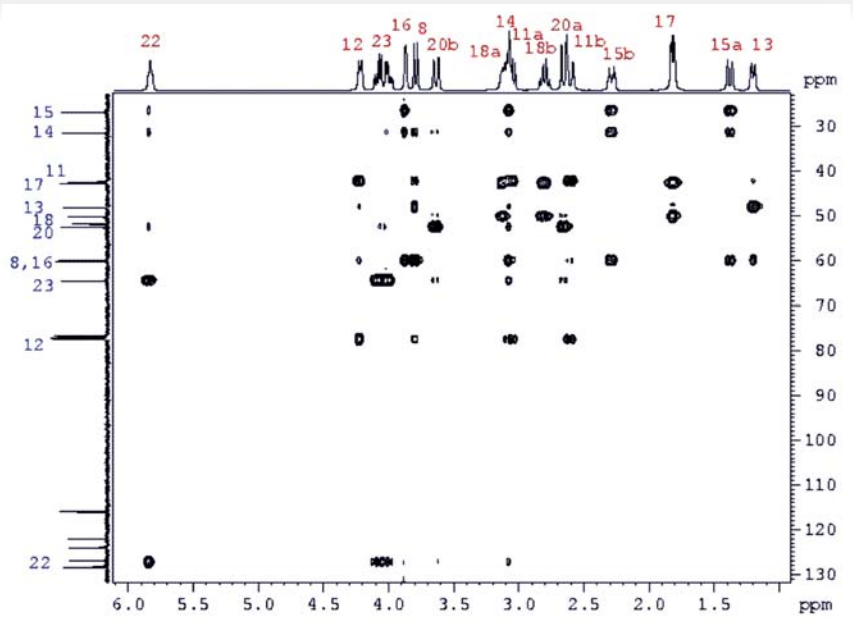
Gradient-enhanced with editing from the f2 channel

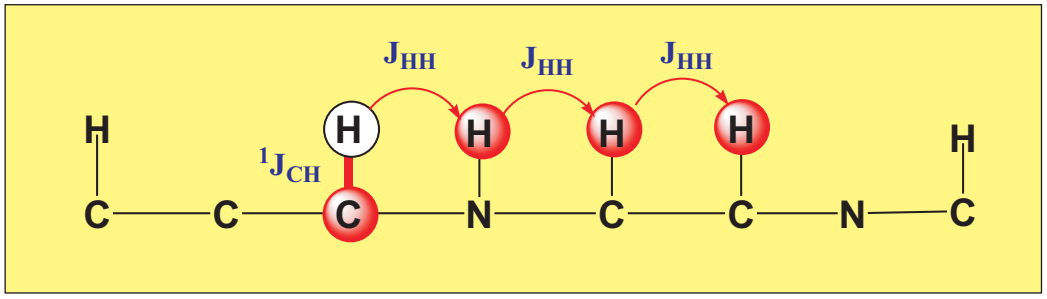
Phase sensitive ge-2D HSQC-TOCSY using PEP with editing of multiplicity (**hsqcdiedetgpsisp.1**)
Phase sensitive ge-2D HSQC-TOCSY using PEP with editing of direct responses (**hsqcdiedetgpsisp.2**)
Phase sensitive ge-2D HSQC-TOCSY using PEP with editing of multiplicity and direct responses (**hsqcdiedetgpsisp.3**)

Gradient-enhanced from the f3 channel

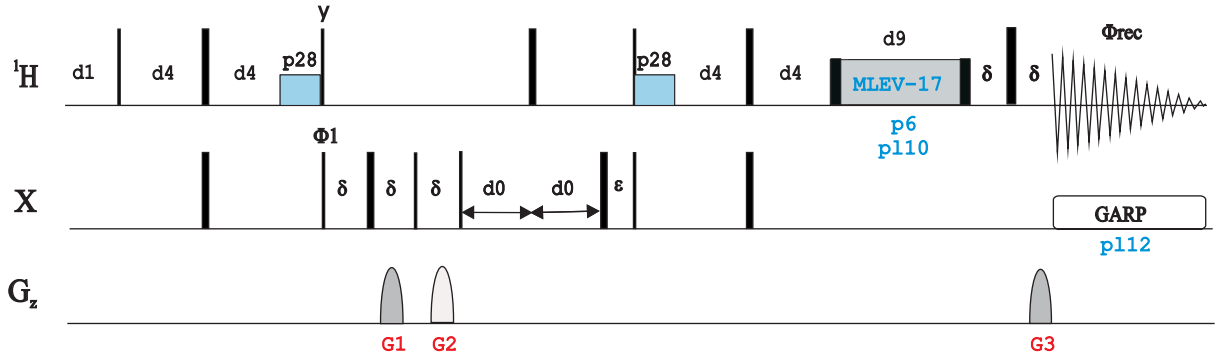
Phase sensitive ge-2D ^{1}H-^{15}N HSQC-TOCSY with MLEV using echo-antiecho (**hsqcetf3gpml**)
Phase sensitive ge-2D ^{1}H-^{15}N HSQC-TOCSY with DIPSI-2 using PEP (**hsqcdietf3gpsi** | **HSQCDIETF3GPSI**)

Also see HSQC-TOCSY type experiments for $^{n}J_{CH}$ measurements

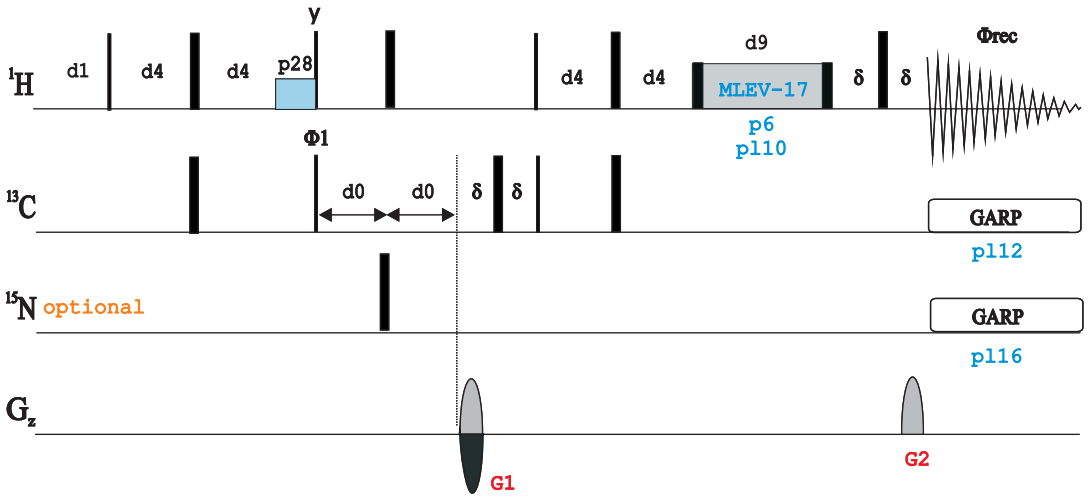




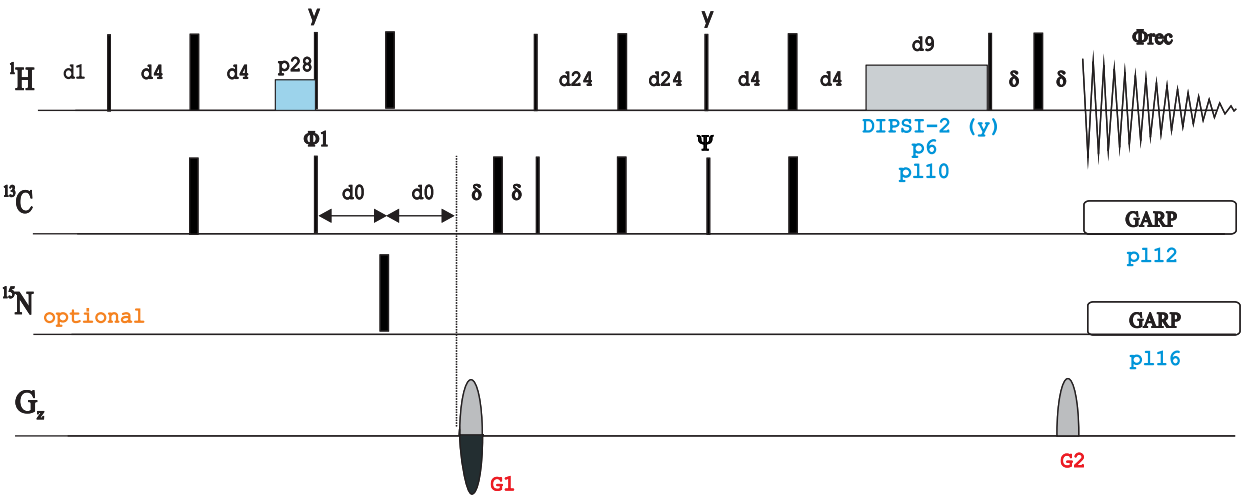
hsqcgpmlph

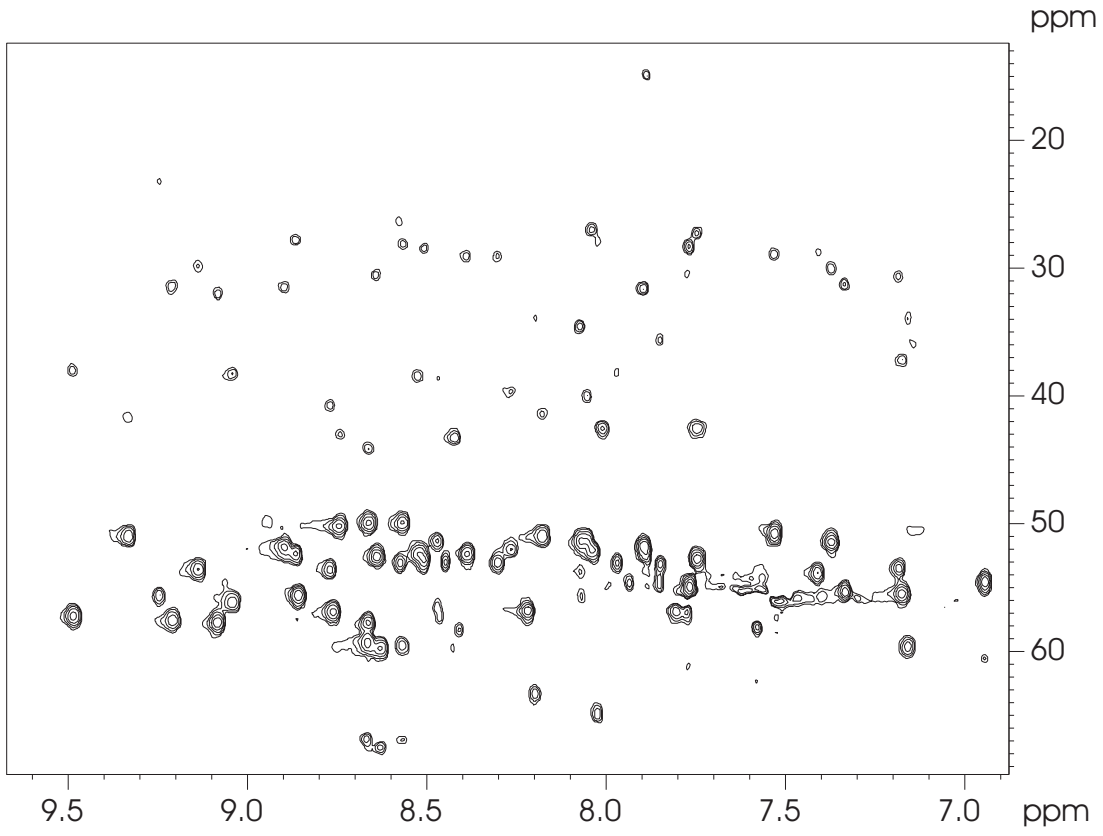


hsqcetgpml

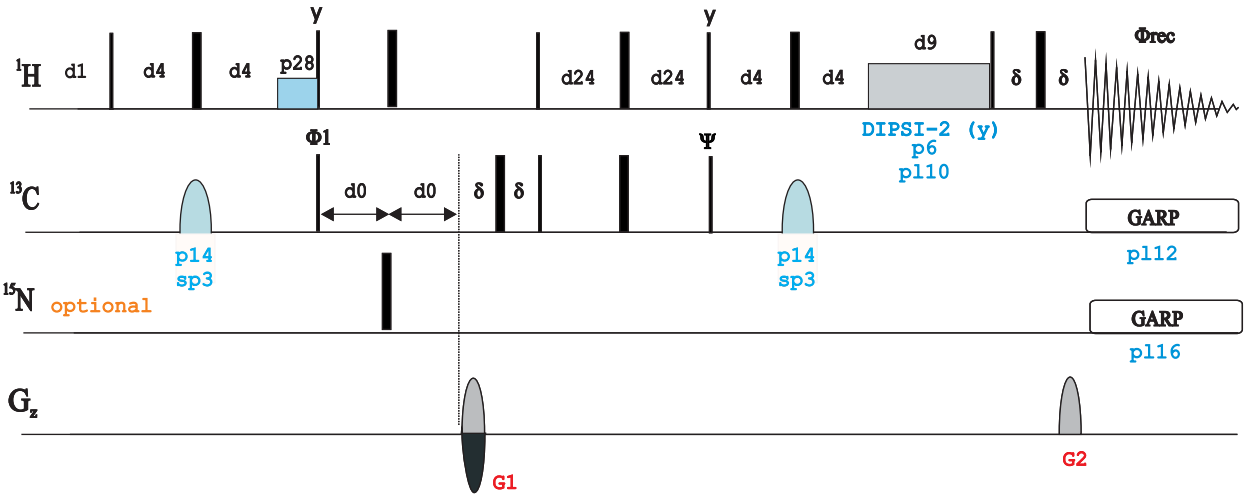


hsqcdietgpsi





hsqcdletgpsisp



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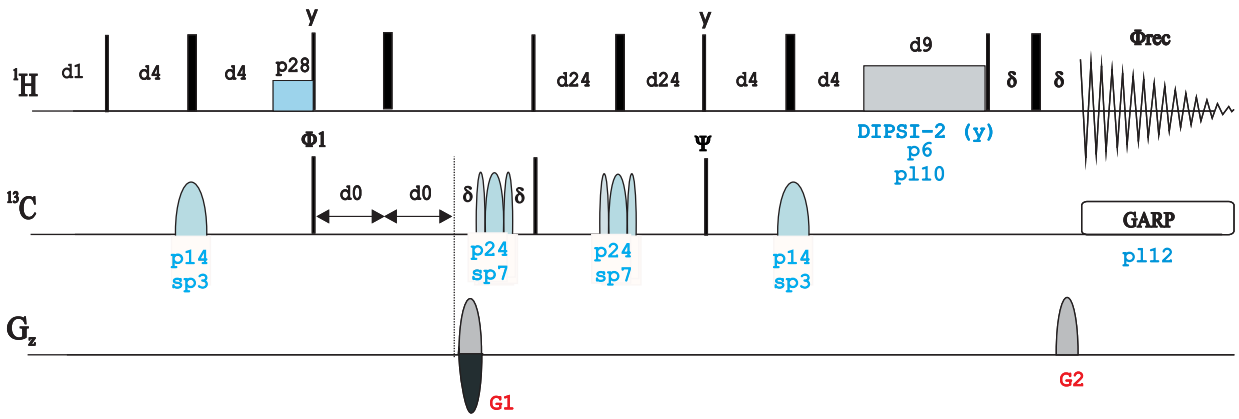

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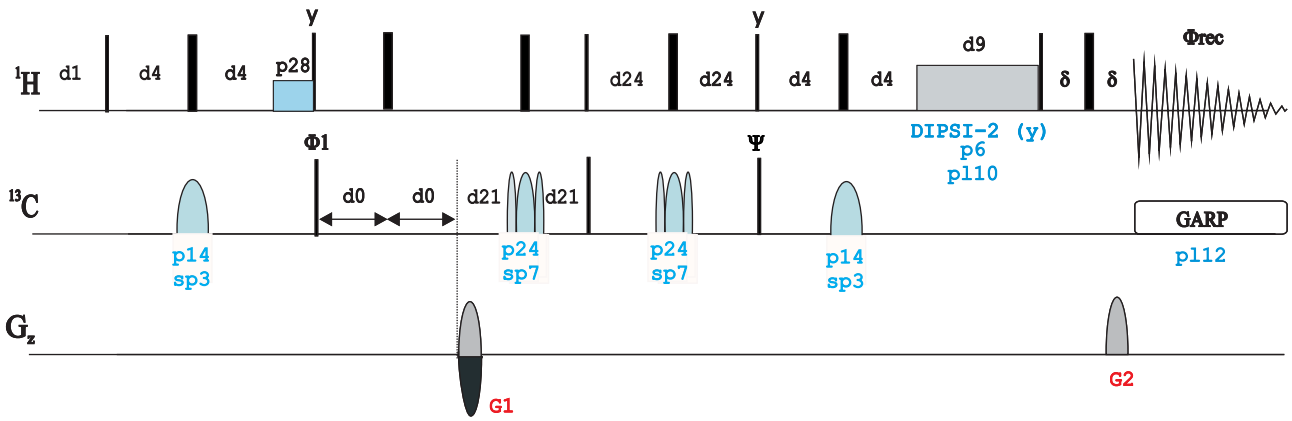
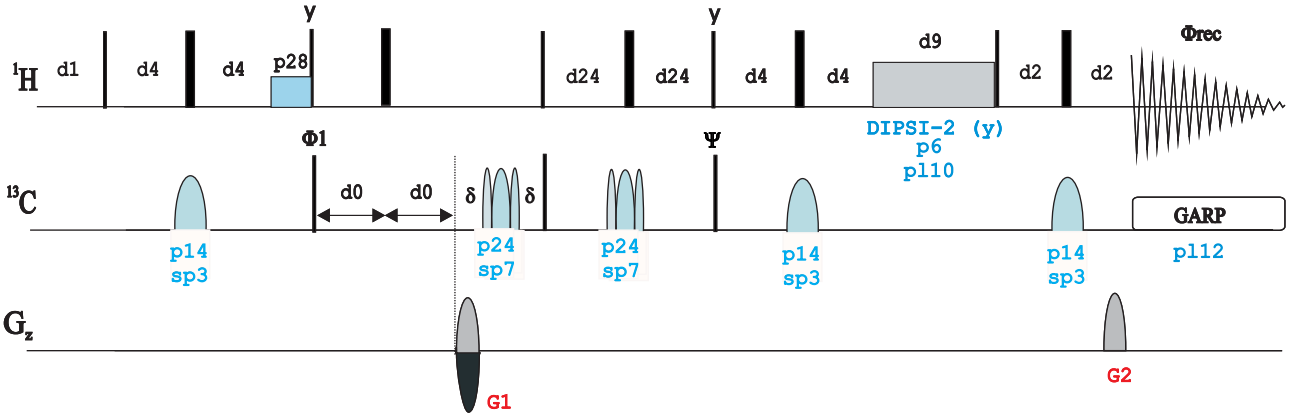


hsqcdiedetgpsisp.2



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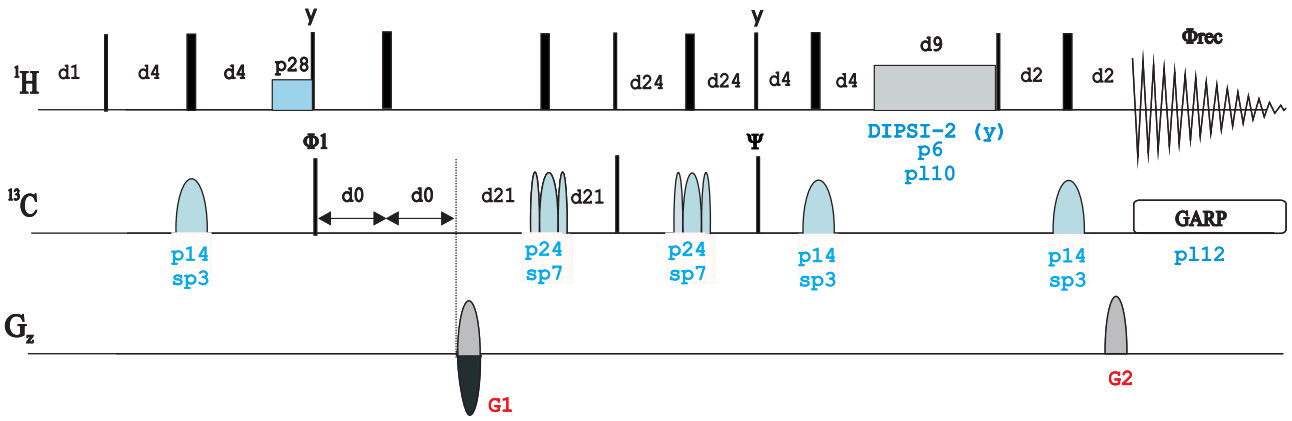

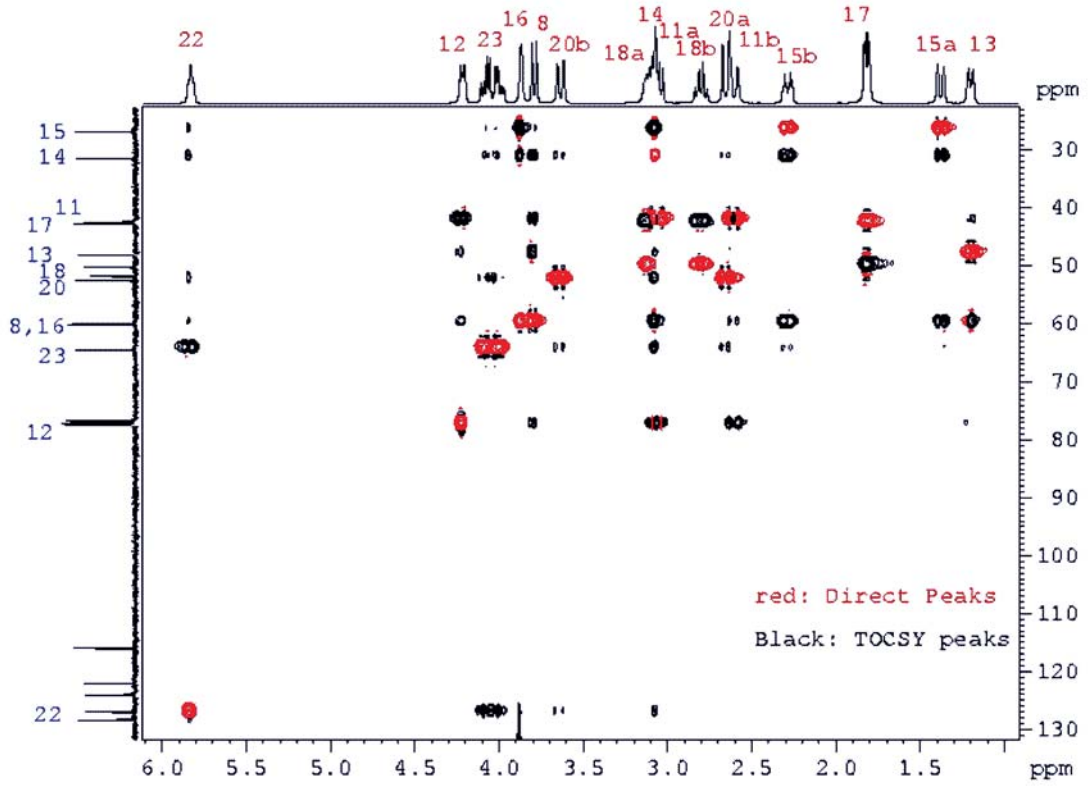
22
12
23
16
8
20b
18a
14
11a
18b
20a
11b
15b
17
15a
13
ppm
15
14
11
17
13
18
20
8,16
23
12
22
red: Direct Peaks
Black: TOCSY peaks
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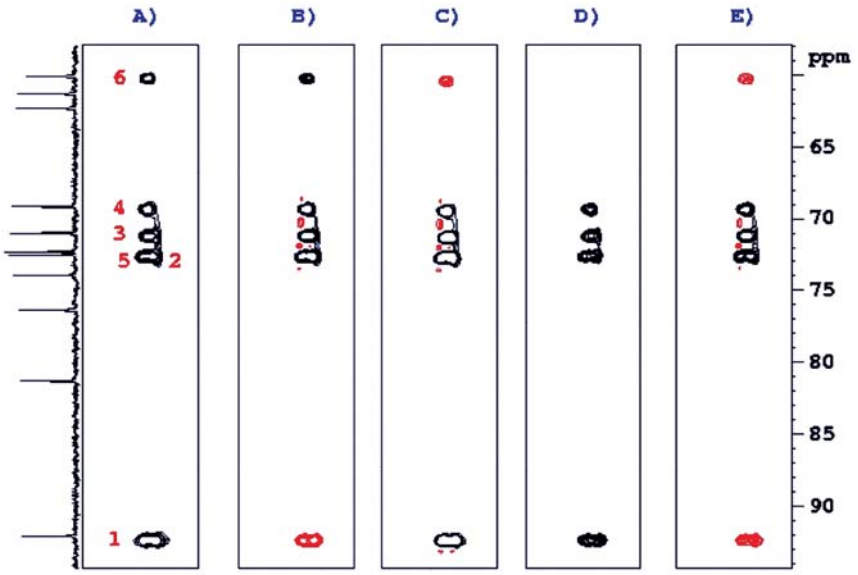
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
ppm


A)
B)
C)
D)
E)
ppm
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4
3
5
2
1
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75
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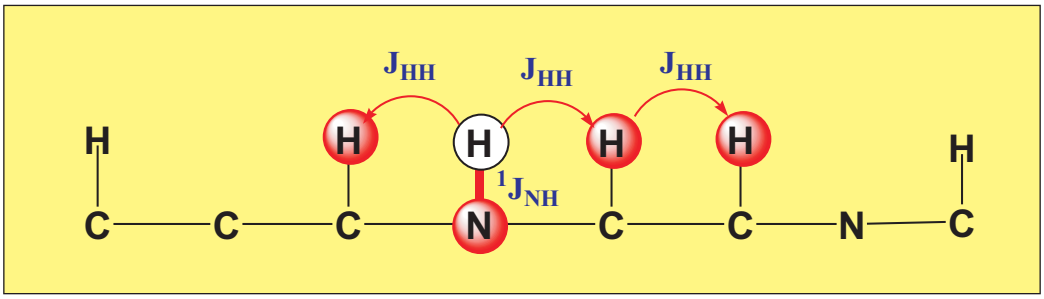
90



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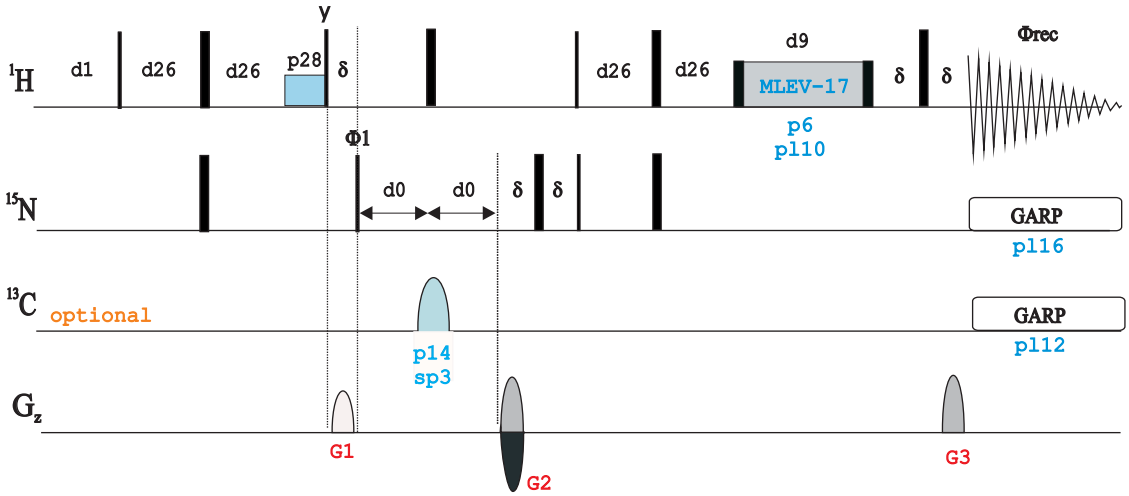

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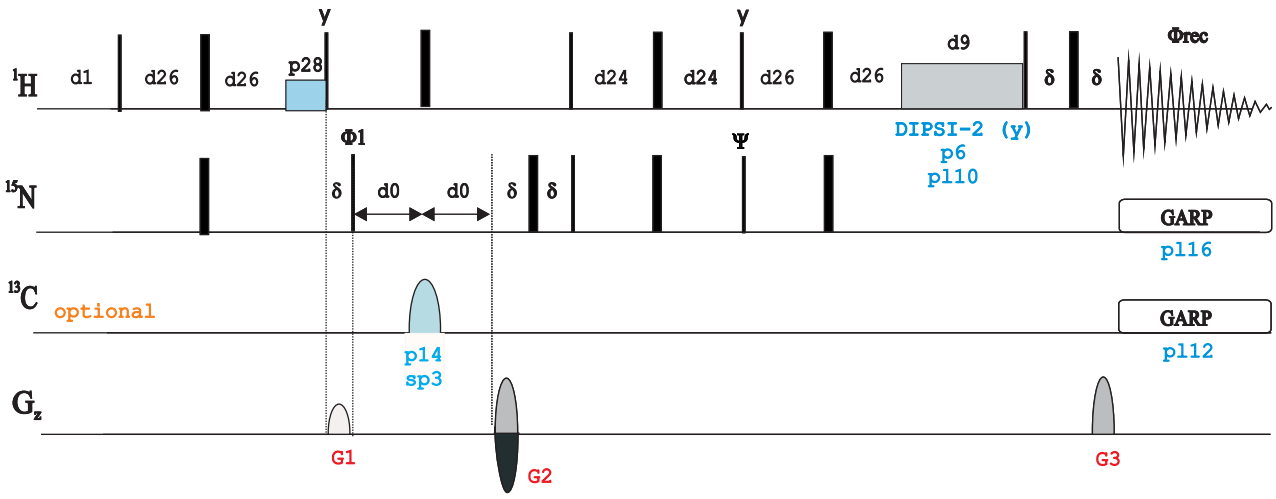

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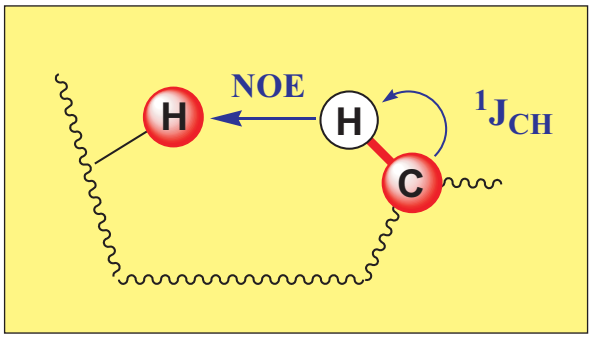
2D HSQC-ROESY EXPERIMENTS

- **Gradient-enhanced from the f2 channel**

  Phase-sensitive ge-2D HSQC-ROESY using echo-antiecho and adiabatic pulses (**hsqcetgprosp | HSQCETGPROSP**)
  Phase-sensitive ge-2D HSQC-ROESY using echo-antiecho and adiabatic pulses with T-ROESY(**hsqcetgprosp.2**)

- **Gradient-enhanced from the f3 channel**

  Phase-sensitive ge-2D ^{1}H-^{15}N HSQC-ROESY using echo-antiecho (**hsqcetf3gpro**)
  Phase-sensitive ge-2D ^{1}H-^{15}N HSQC-ROESY with T-ROESY using echo-antiecho (**hsqcetf3gpro.2**)



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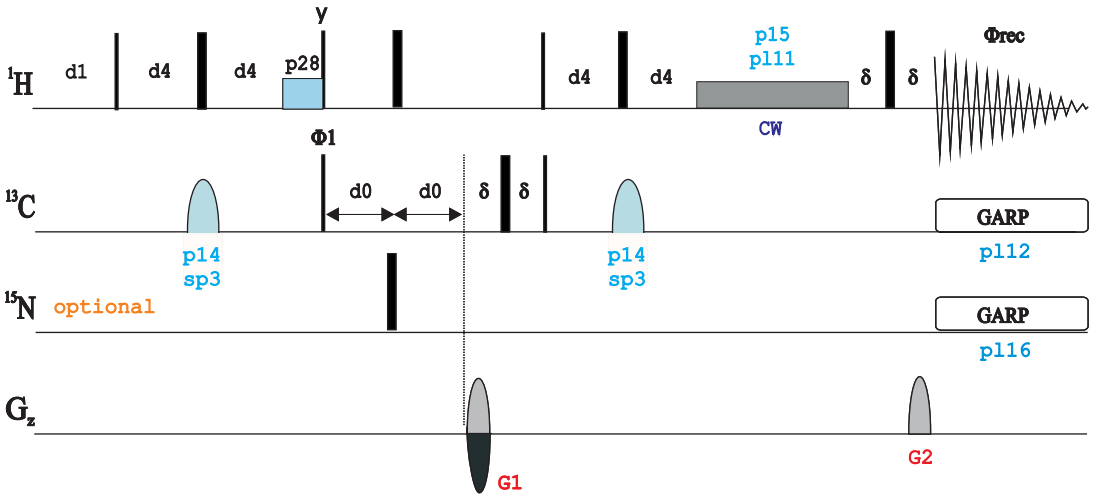
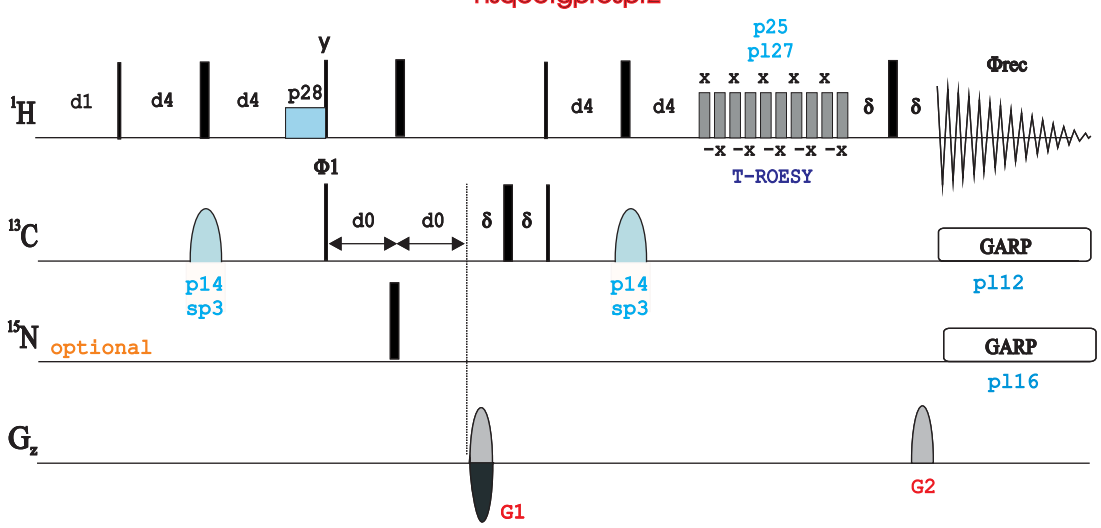
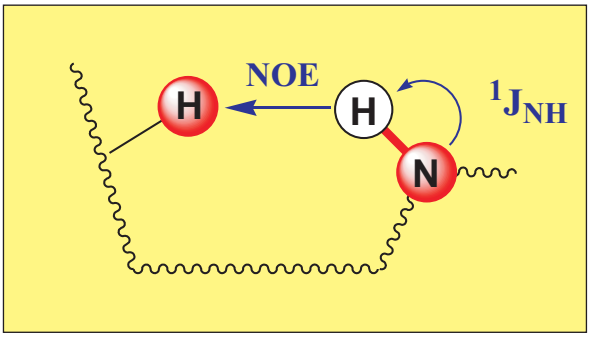


hsqcetgprosp.2





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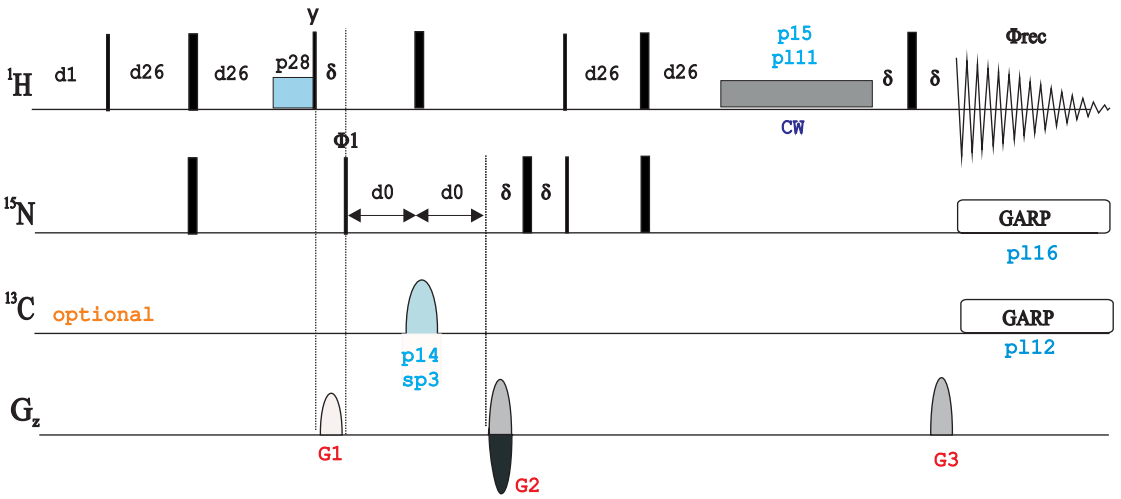

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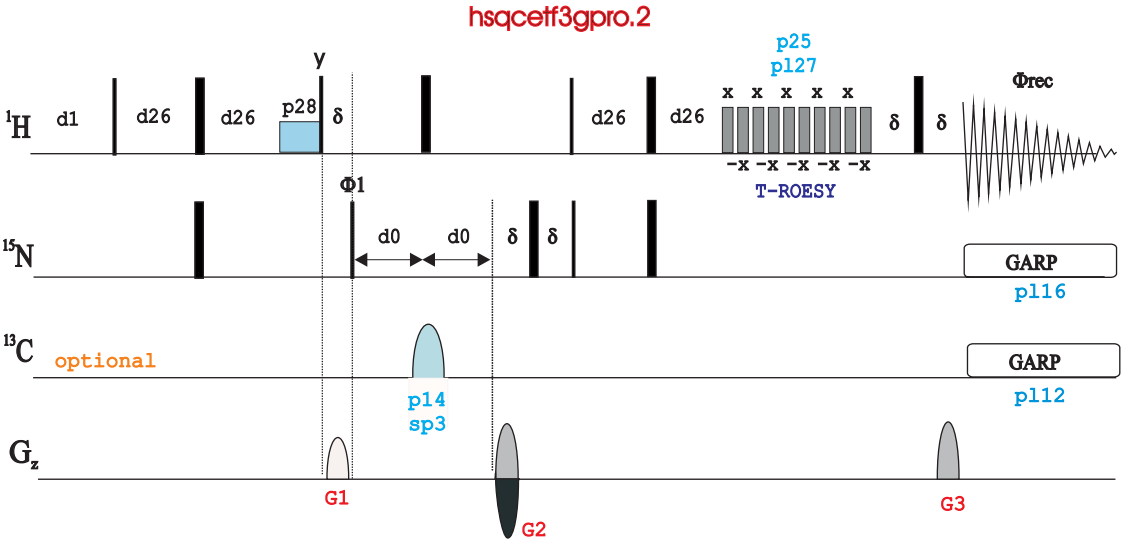

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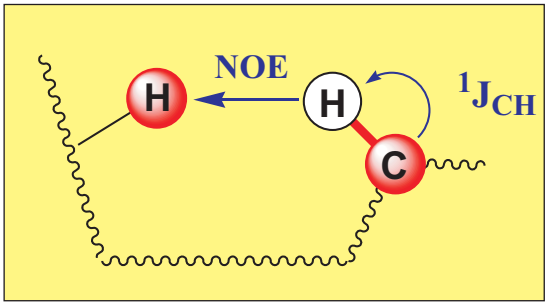
2D HSQC-NOESY EXPERIMENTS

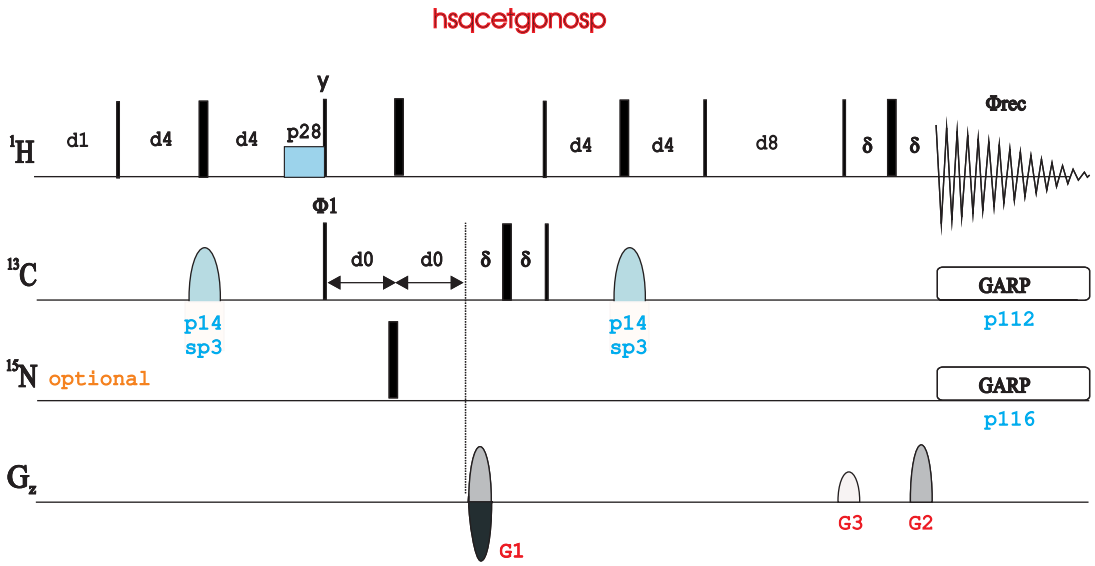
- **Gradient-enhanced from the f2 channel**

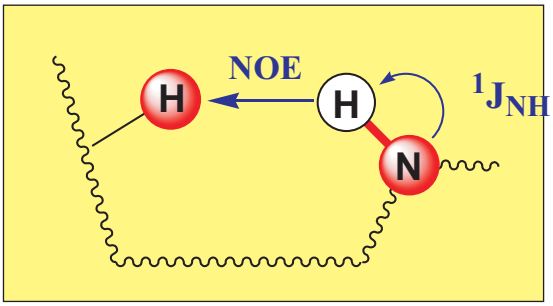
  Phase-sensitive ge-2D HSQC-NOESY using echo-antiecho and adiabatic pulses (**hsqcetgpnosp** | **HSQCETGPNOSP**)

- **Gradient-enhanced from the f3 channel**

  Phase-sensitive ge-2D ^{1}H-^{15}N HSQC-NOESY using echo-antiecho (**hsqcetf3gpno** | **HSQCETF3GPNO**)
  Phase-sensitive ge-2D ^{1}H-^{15}N HSQC-NOESY using XY16 and WATERGATE (**hsqcf3gpnowgxy**)







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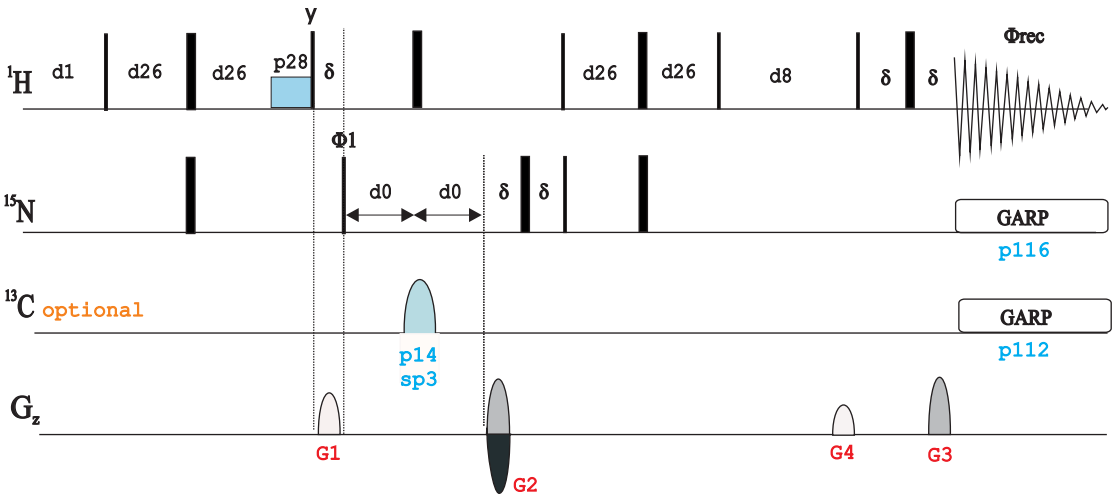

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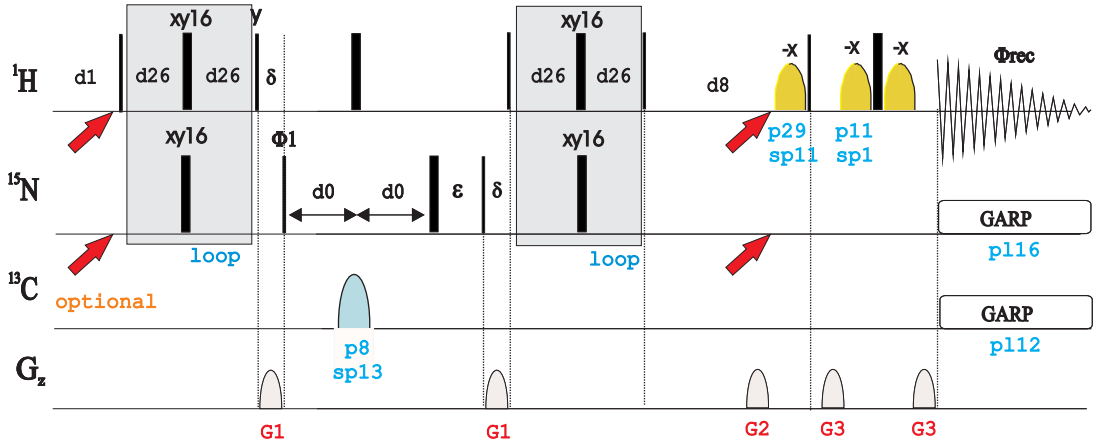

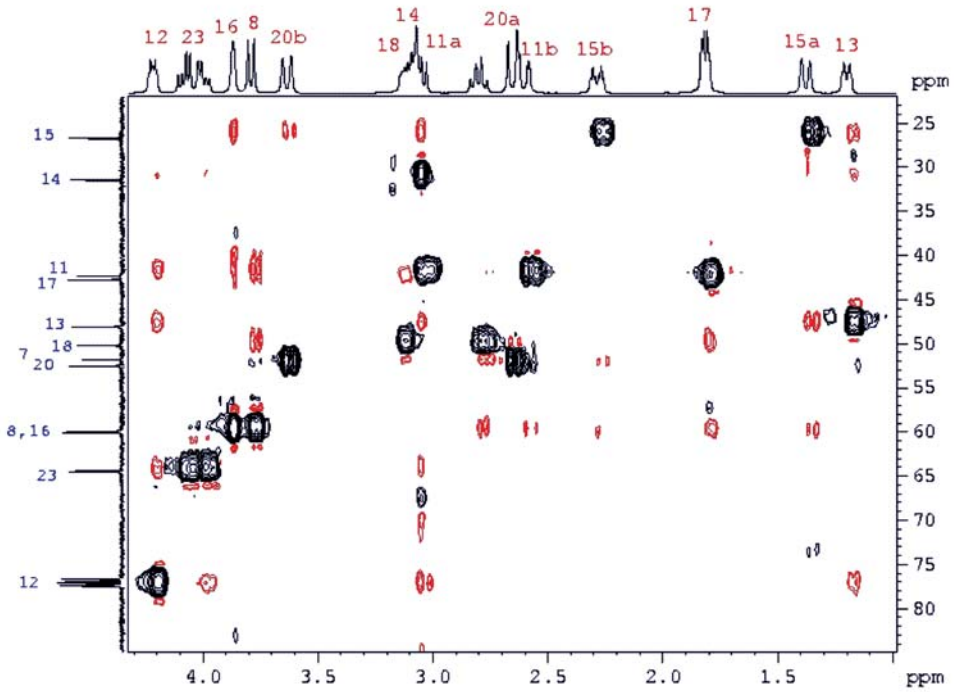
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ppm
15
14
11
17
13
18
7
20
8,16
23
12
4.0 3.5 3.0 2.5 2.0 1.5
ppm
25 30 35 40 45 50 55 60 65 70 75 80

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2D HMBC EXPERIMENTS

Phase cycled:

Magnitude-mode 2D HMBC using low-pass J-filter (**hmbclpndqf** | **HMBCLPND**)
Magnitude-mode 2D HMBC with presaturation (**hmbcndprqf**)
Magnitude-mode 2D HMBC with off-resonance presaturation (**hmbcndpsqf**)

Gradient-based:

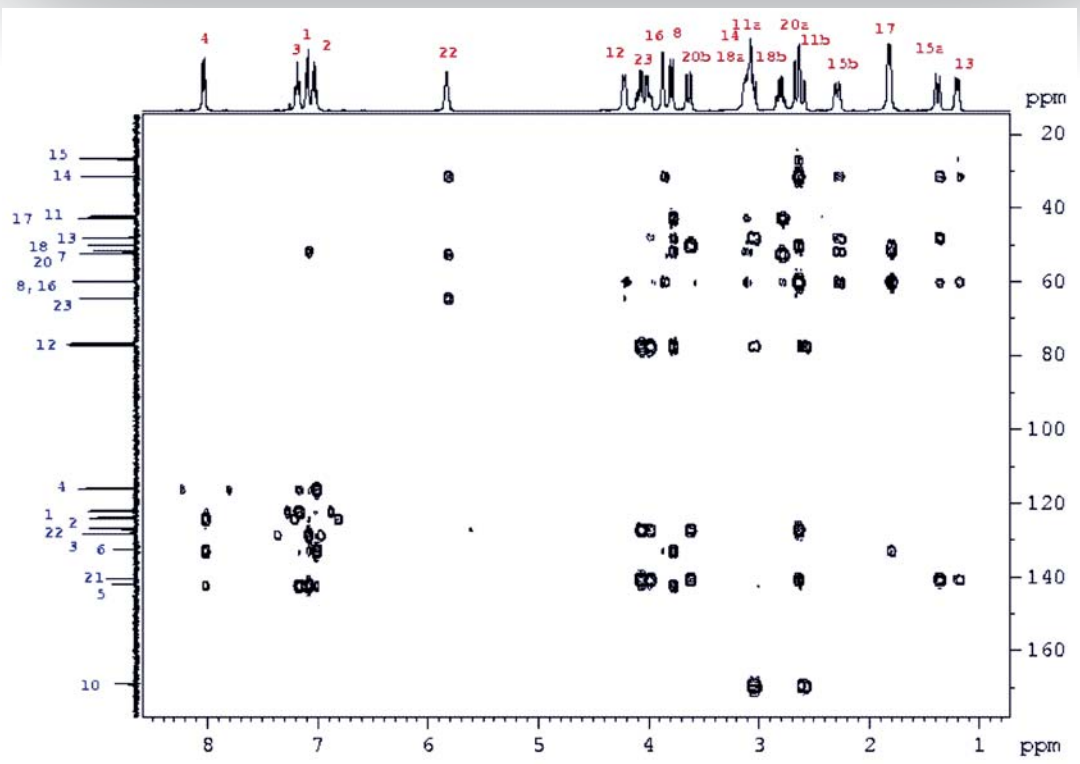
Magnitude-mode ge-2D HMBC (**hmbcgpndqf** | **HMBCGPND**)
Magnitude-mode ge-2D HMBC using low-pass J-filter (**hmbcgplpndqf** | **HMBCGPLPND**)
Magnitude-mode ge-2D HMBC using double low-pass J-filter (**hmbcgpl2ndqf**)

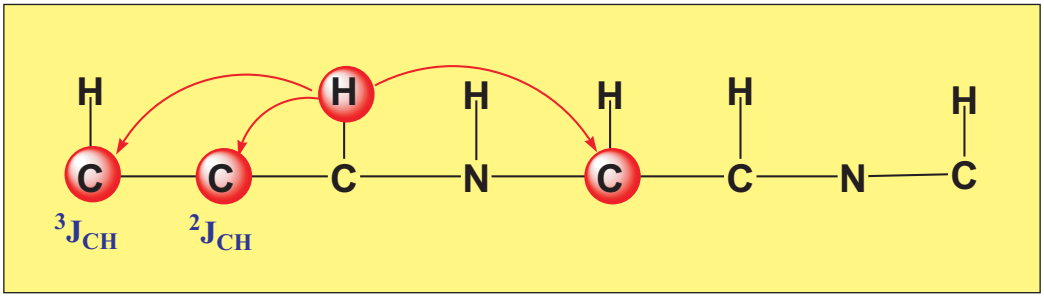
Magnitude-mode band-selective ge-2D HMBC without decoupling (**shmbcgpndqf**)

Magnitude-mode CIGAR-HMBC without decoupling (**hmbcacgplpndqf**)
Magnitude-mode CIGAR-HMBC with decoupling (**hmbcacgplpqf**)
ge-2D 2J,3J HMBC, STAR-HMBC (**hmbcacbigpl2ndqf**)
ge-2D HSMC (**hmscetgpnd**)

Also see:

- Measurement of long-range proton-carbon coupling constants
- 2D COLOC Experiment
- ADEQUATE Experiments





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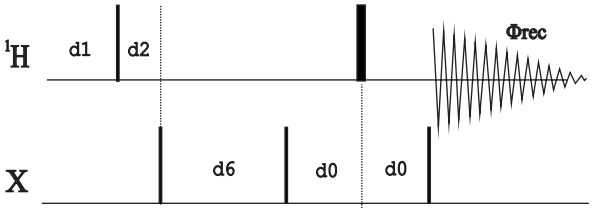

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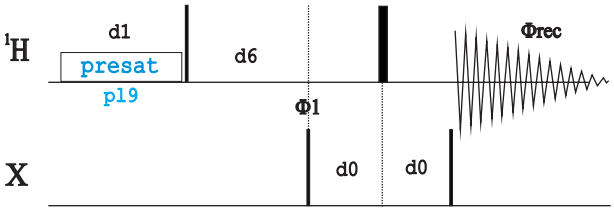

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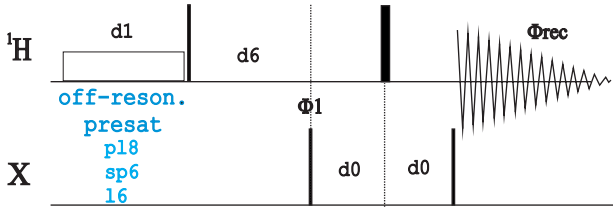

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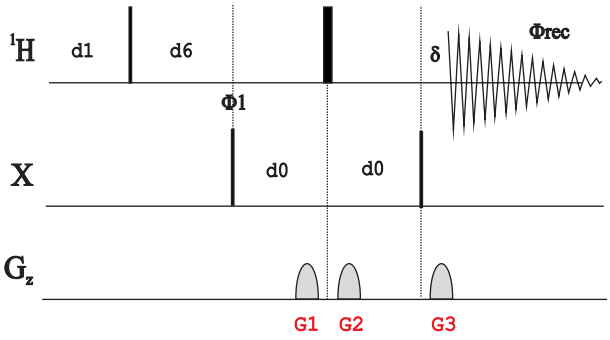

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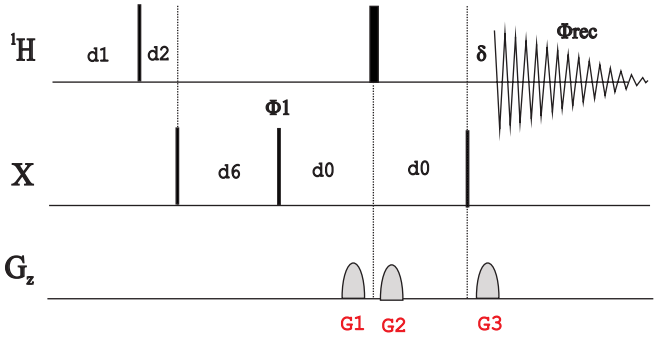

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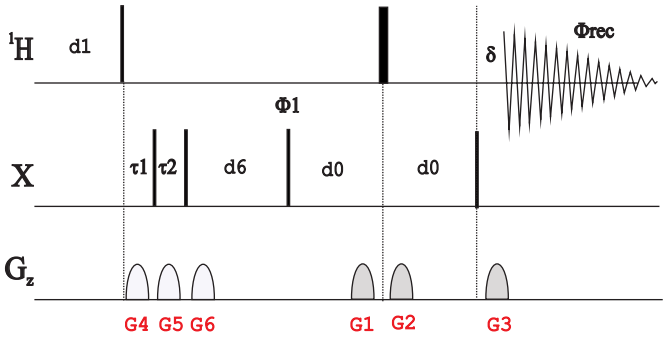

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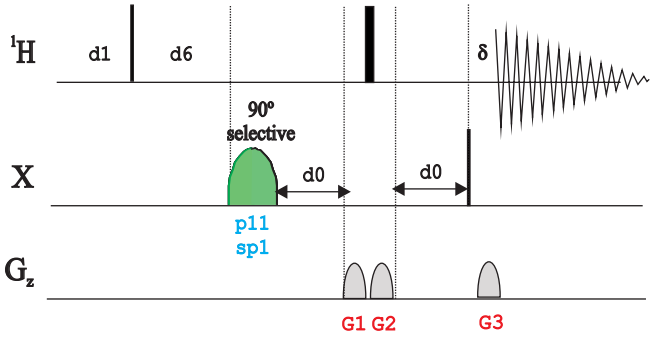

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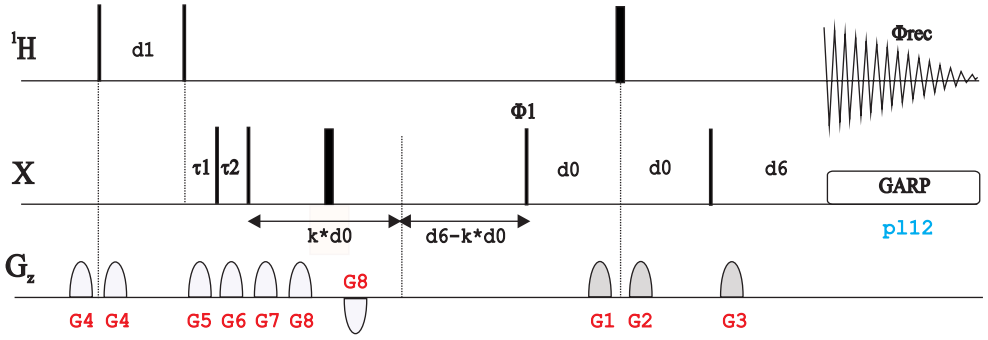

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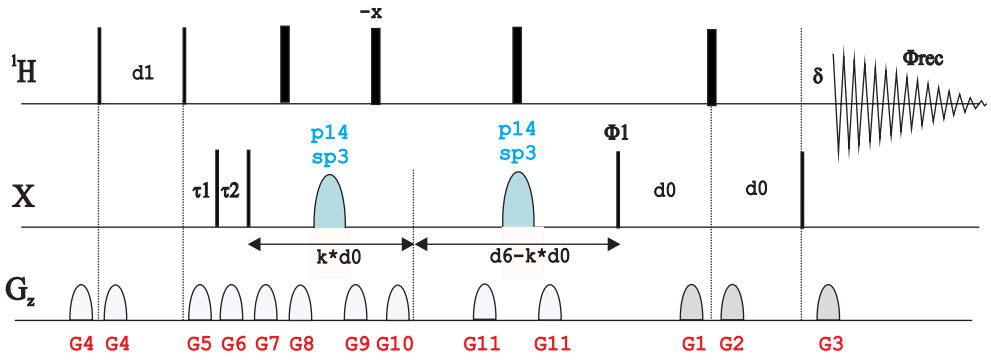

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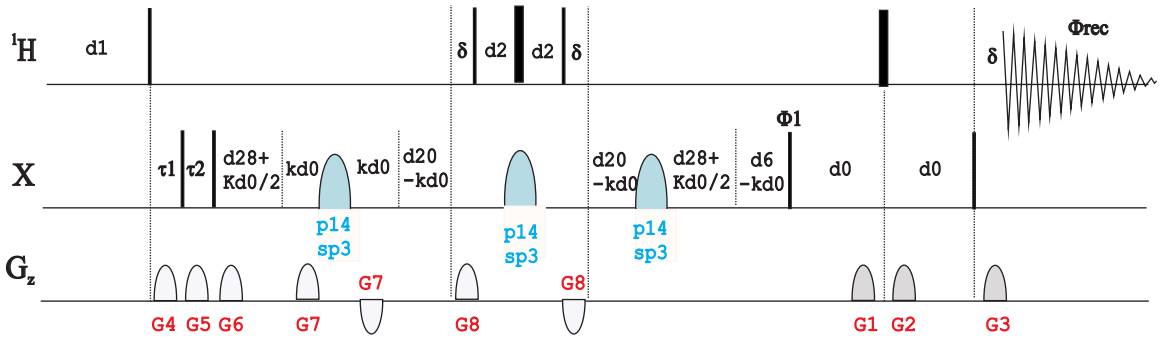

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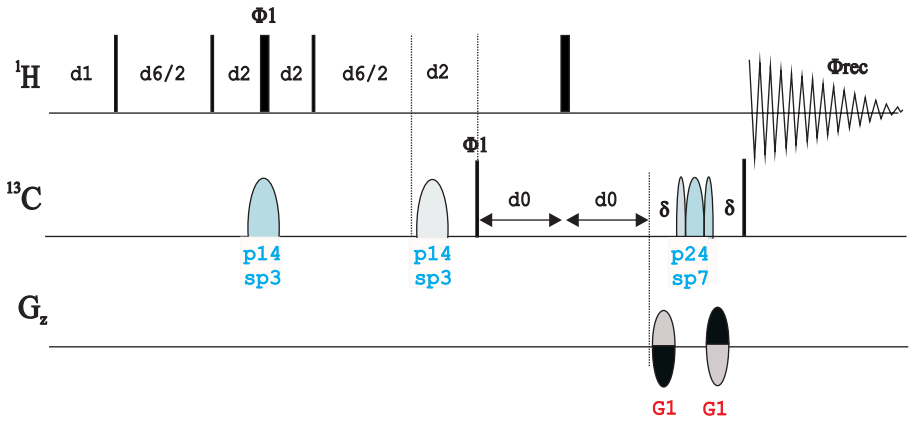
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1H
d1
d6/2
d2
d2
d6/2
d2
Φrec
Φ1
13C
d0
d0
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δ
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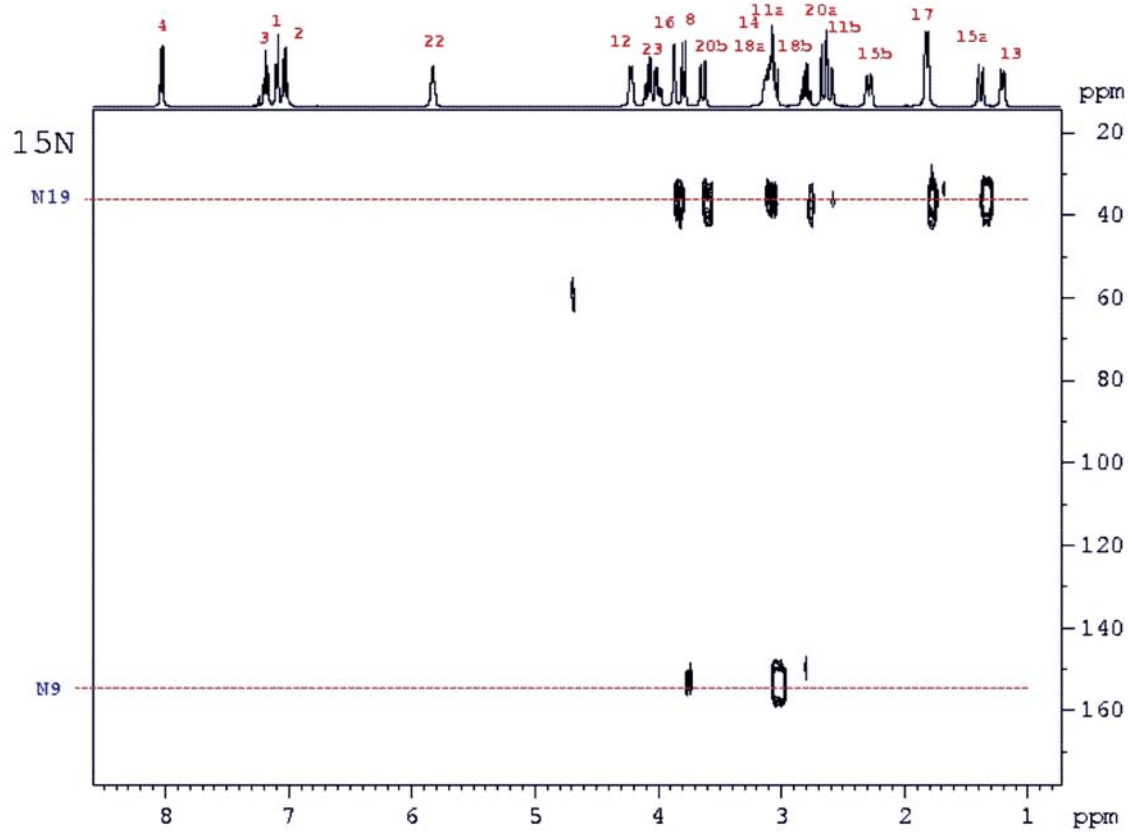
sp3
p14
sp3
p24
sp7
Gz
G1
G1


15N
N19
N9
ppm
20
40
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80
100
120
140
160
8
7
6
5
4
3
2
1
ppm

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2D EXPERIMENTS TO MEASURE LONG-RANGE PROTON-CARBON COUPLING CONSTANTS

ge-2D HMBC-type experiments

Phase-sensitive ge-2D HMBC using echo-antiecho (**hmbcetgpnd**)
Phase-sensitive ge-2D HMBC using a two-fold low-pass J-filter (**hmbcetgpl2nd**)

Phase-sensitive ge-2D CT-HMBC using echo-antiecho (**hmbcctetgpnd**)

ge-2D J-HMBC using a two-fold low-pass J-filter (**hmbcetgpjcl2nd**)

Long-range optimized ge-2D HSQC

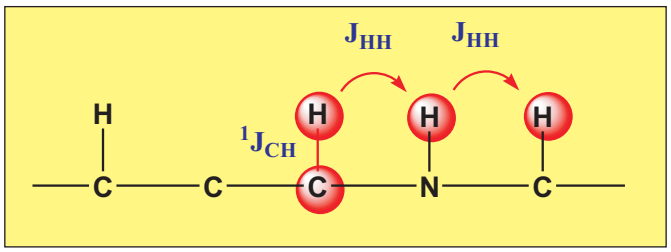
Phase-sensitive ge-2D long-range optimized HSQC (HSQMBC) (**hsqcetgplrsp**)
Phase-sensitive ge-2D long-range optimized HSQC using G-BIRD (GBIRD-HSQMBC) (**hsqcetgpjclrnd**)
ge-2D long-range optimized J-HSQC (EXSIDE) (**hsqcetgplrjcsp**)

ge-2D HSQC-TOCSY type experiments

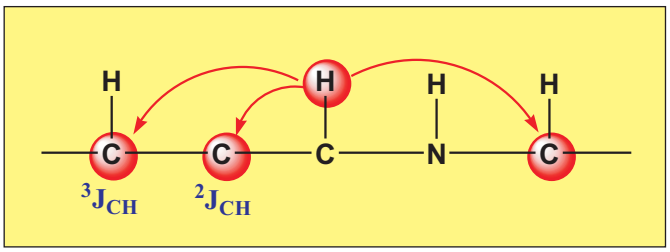
ge-2D w1-filtered TOCSY using DIPSI-2 (HETLOC) (**dipsi2etgpjcsix1**)
Phase-sensitive ge-2D HSQC-HECADE (**hsqcdietgpjcndsisp**)

Also see 2D HMBC and 2D HSQC-TOCSY experiments

HSQC-TOCSY



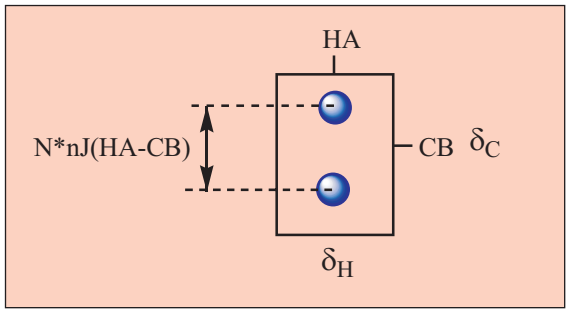
HMBC



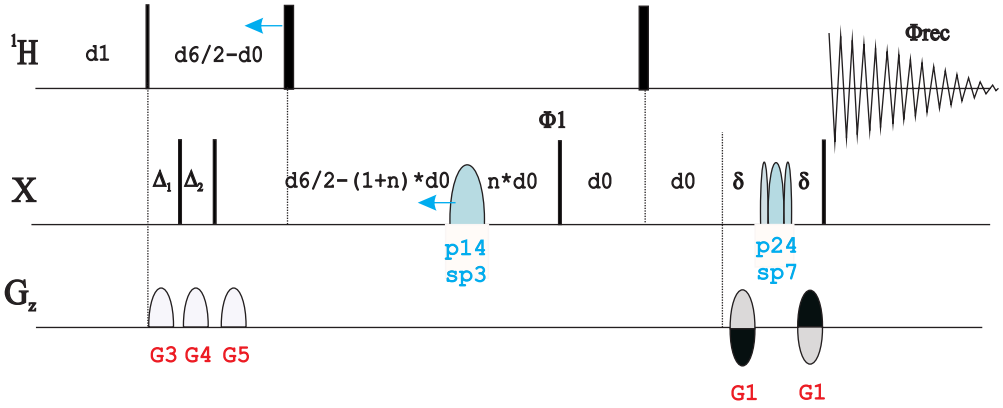
Others: HMQC-TOCSY, HECADE, HETLOC
Two steps: ^{1}JCH + JHH
Only for protonated carbons
In-phase Magnetization

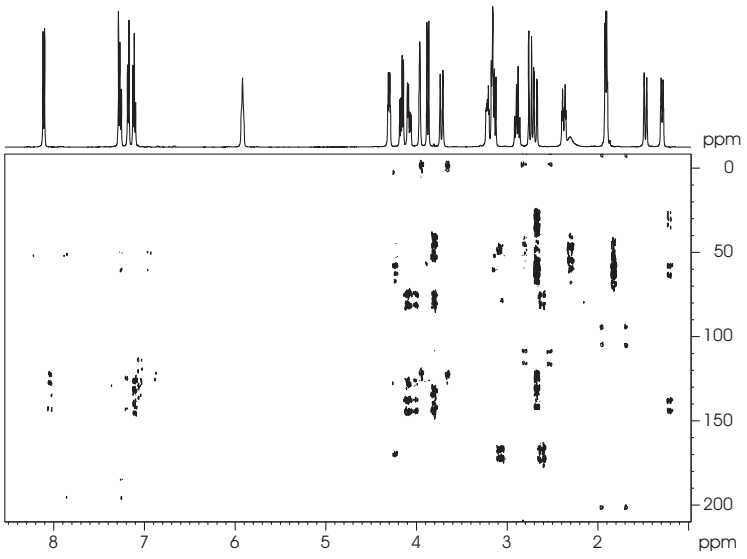
Others: HSQMBC, EXSIDE, J-HMBC
A single step: ^{n}JCH
For all carbons
Anti-phase Magnetization

J-scaling factor of N

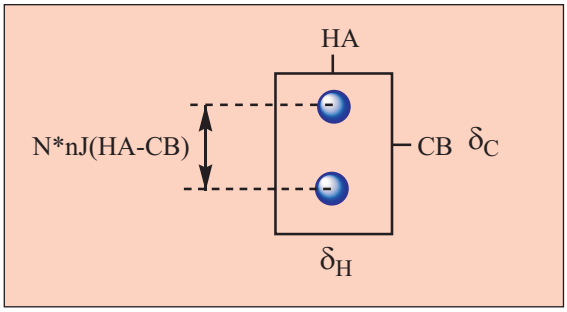


hmbcetgpjcl2nd





J-scaling factor of N



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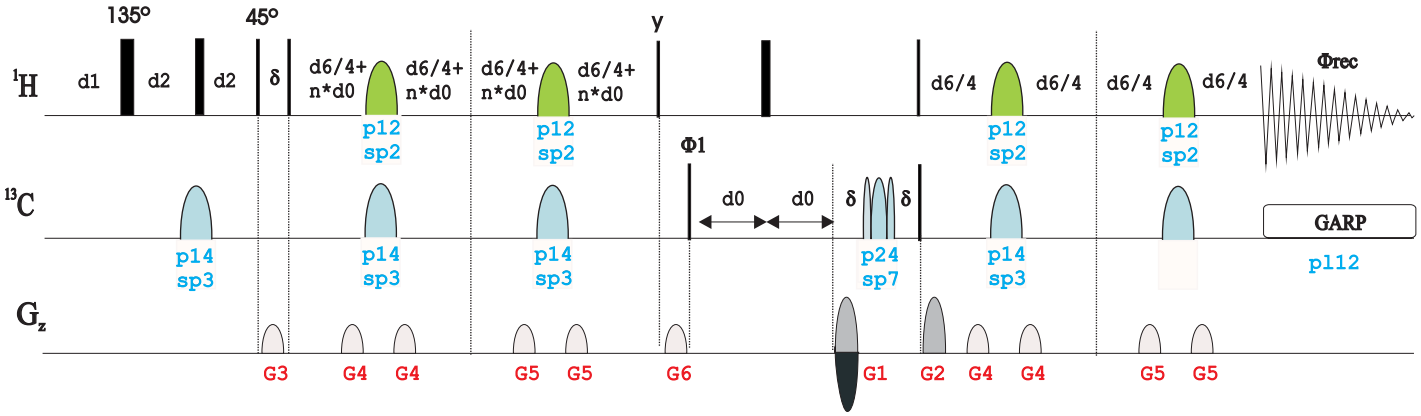

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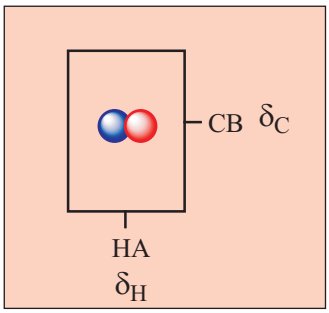

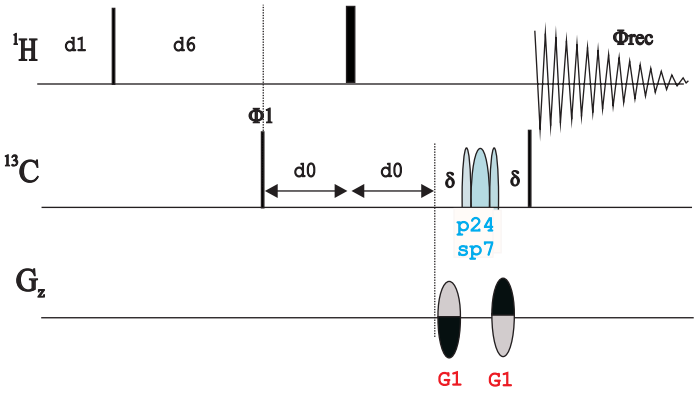

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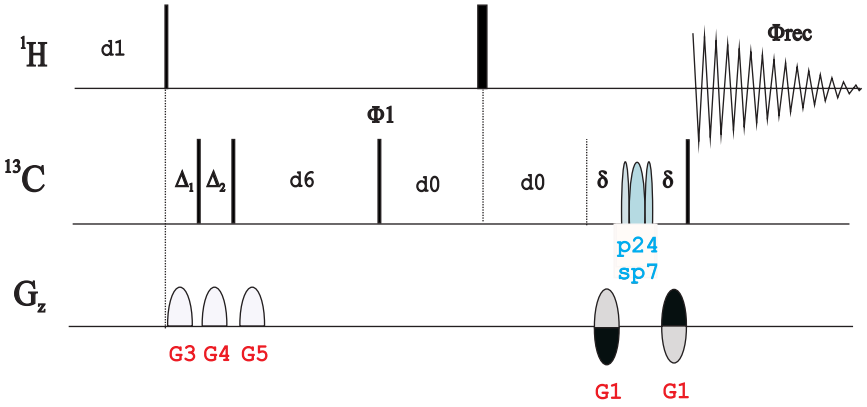

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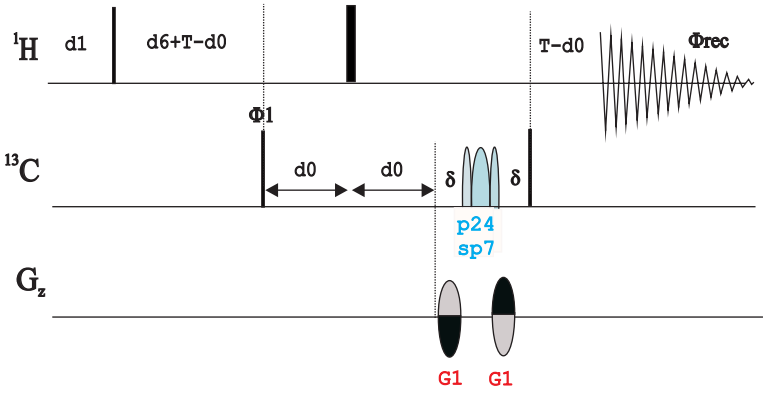

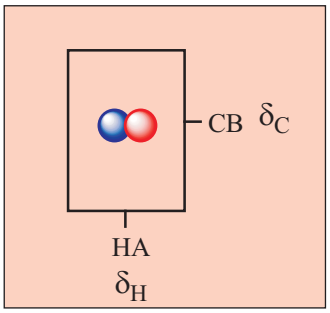

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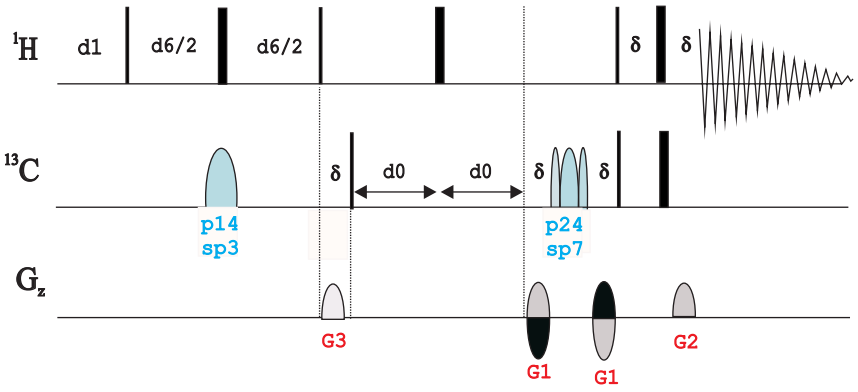

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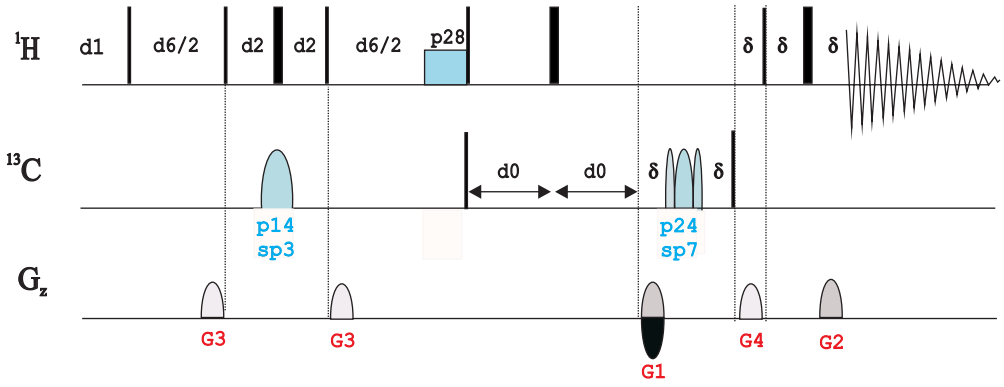
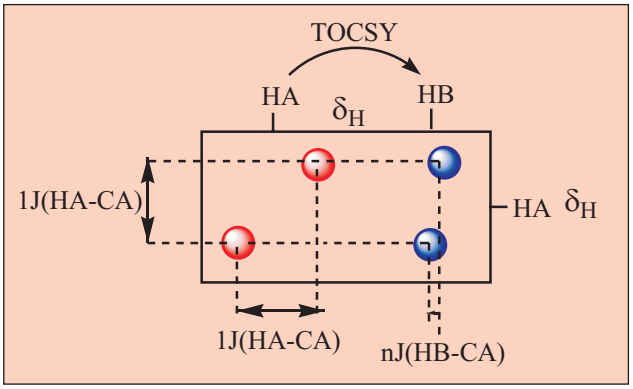


J-scaling factor of N



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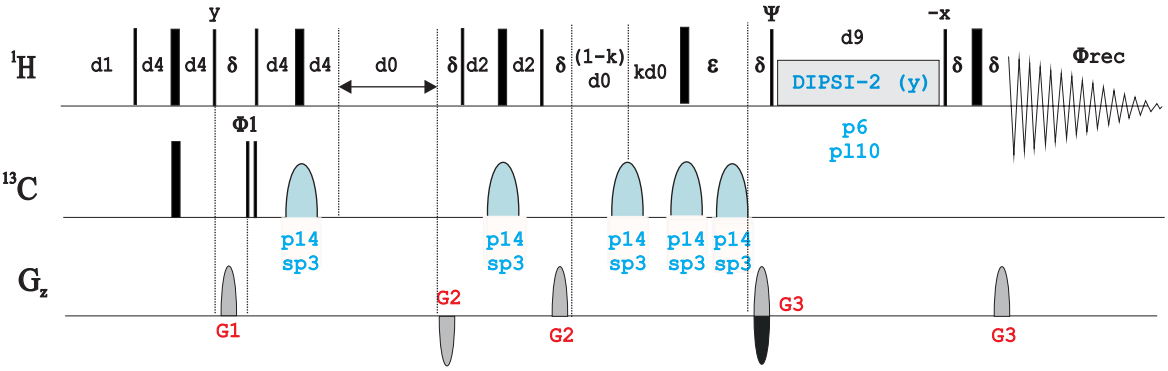
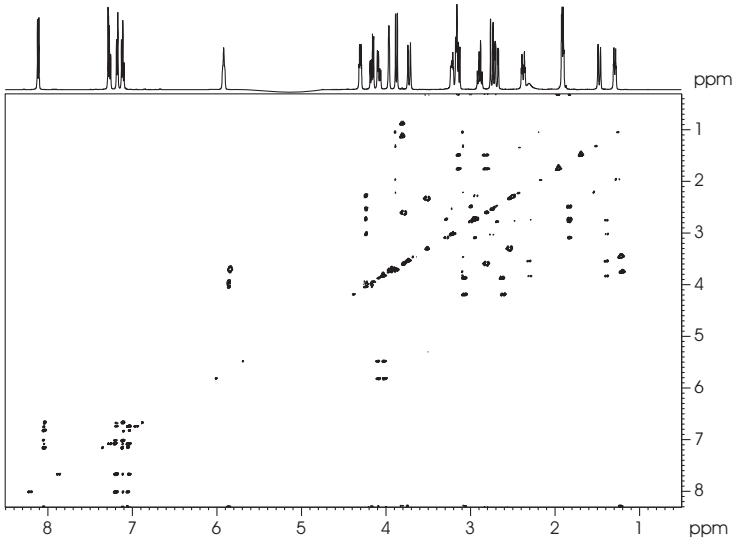
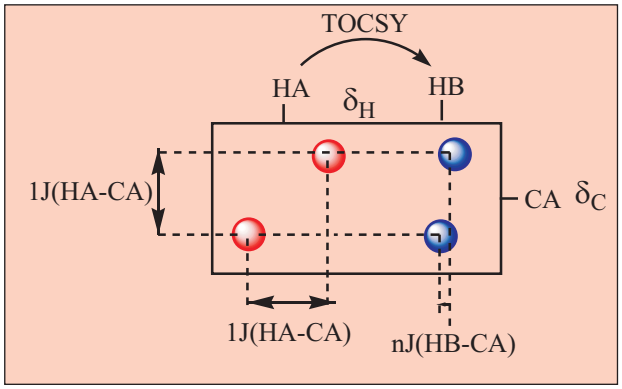




J-scaling factor of N



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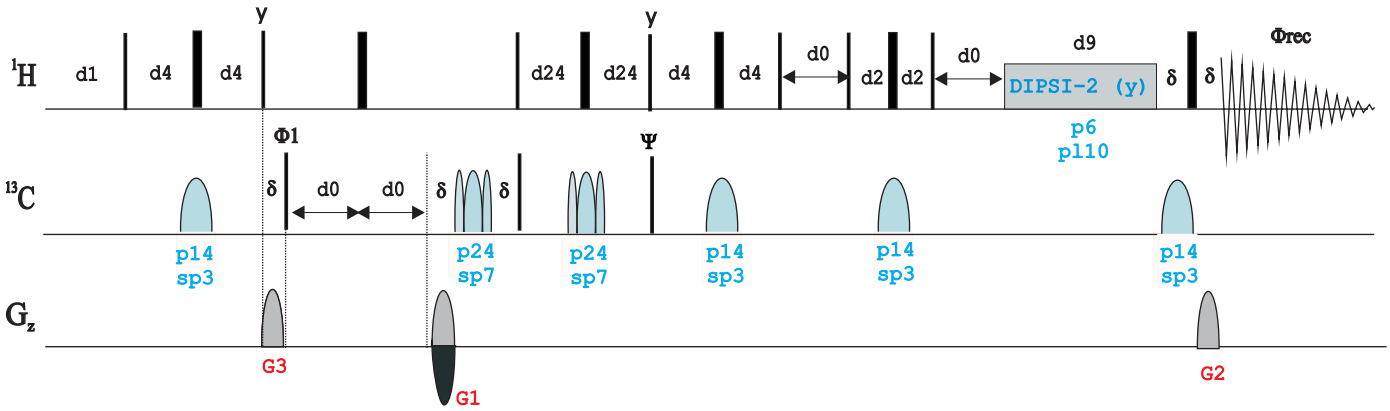

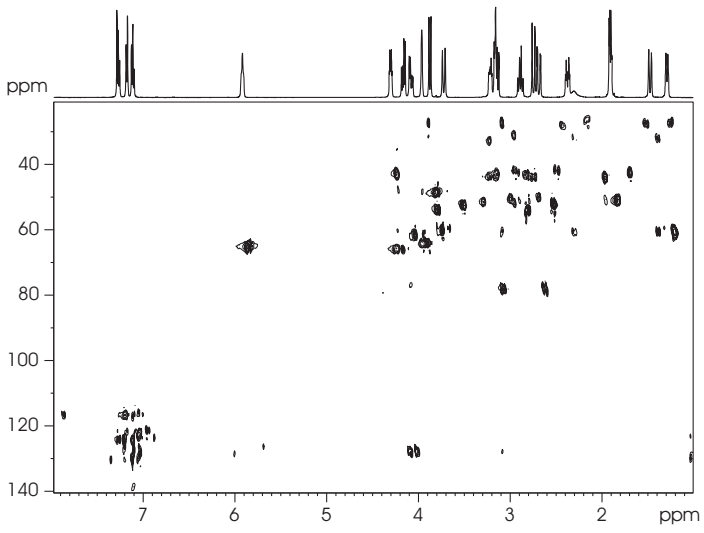

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2D ADEQUATE EXPERIMENTS

- **1,1-ADEQUATE:**

  Phase-sensitive 1,1 ADEQUATE (**adeq11etgp**)
  Phase-sensitive 1,1 ADEQUATE using adiabatic pulse (**adeq11etgpsp**)
  Phase-sensitive 1,1 ADEQUATE with refocusing (**adeq11etgprd**)
  Phase-sensitive 1,1 ADEQUATE with refocusing using adiabatic pulse (**adeq11etgprdsp**)

- **1,n-ADEQUATE:**

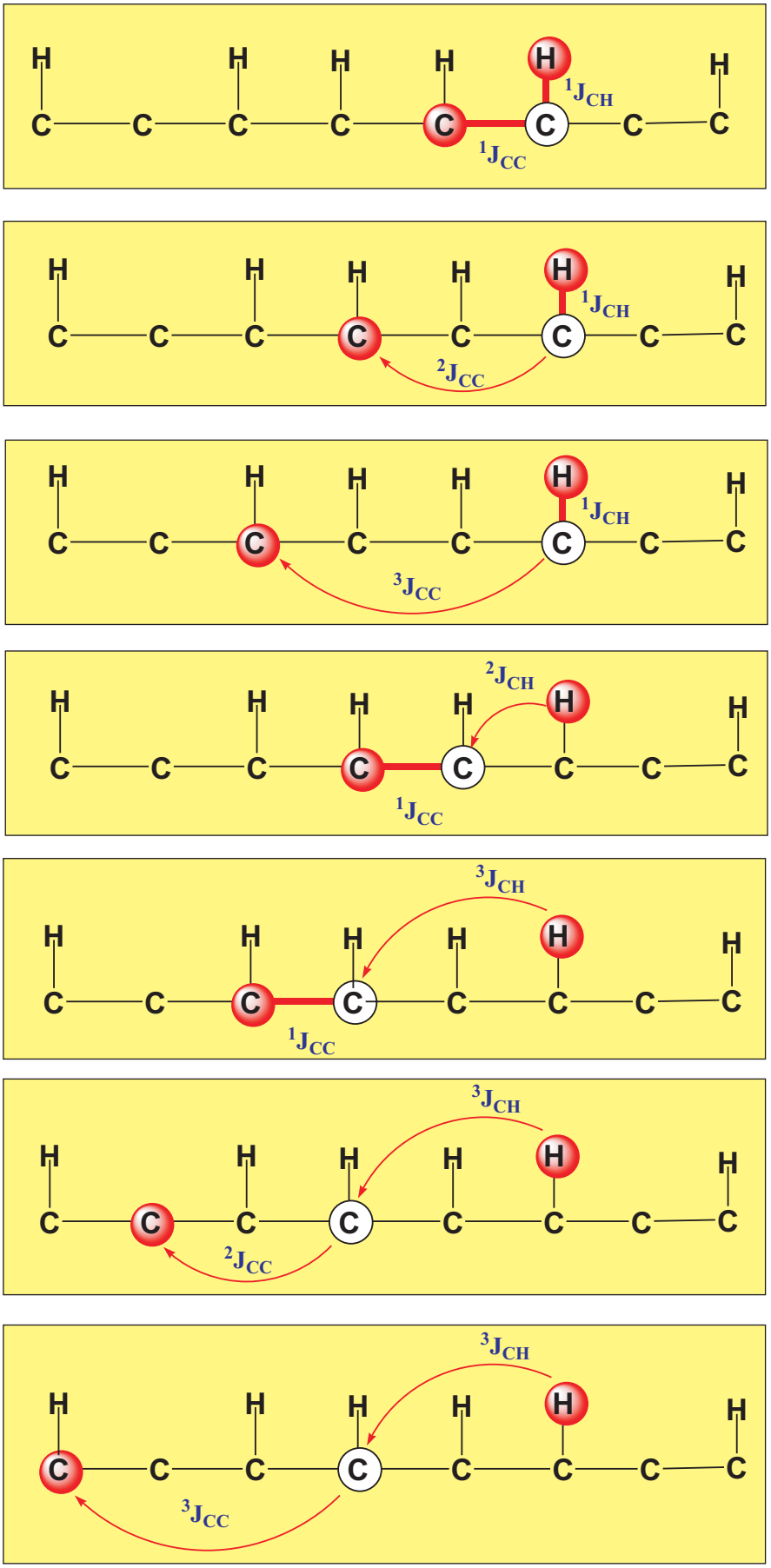
  Phase-sensitive 1,n ADEQUATE (**adeq1netgp**)

- **n,1-ADEQUATE:**

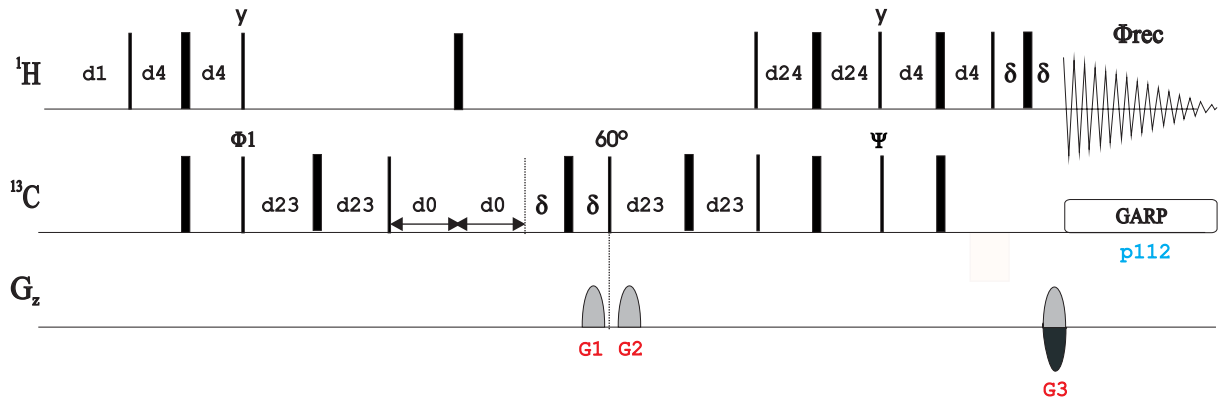
  Phase-sensitive n,1 ADEQUATE (**adeqn1etgp**)

- **n,n-ADEQUATE:**

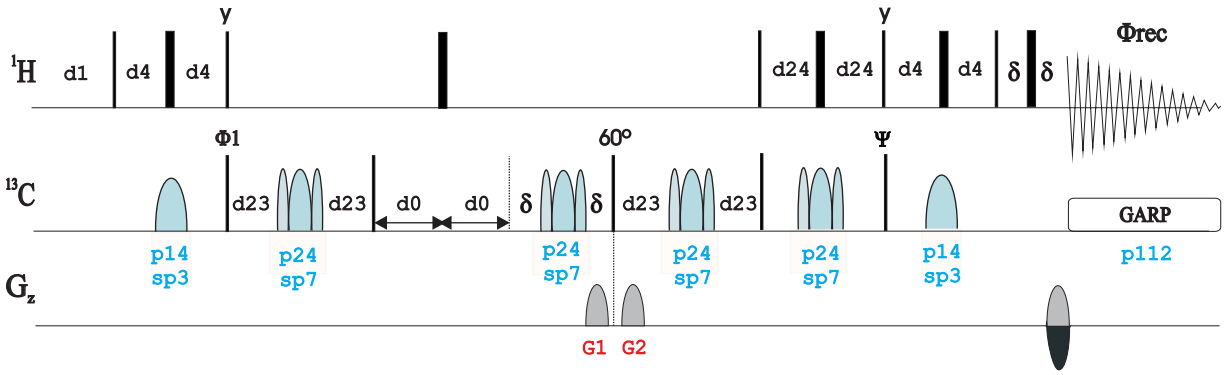
  Phase-sensitive n,n ADEQUATE (**adeqnnetgp**)

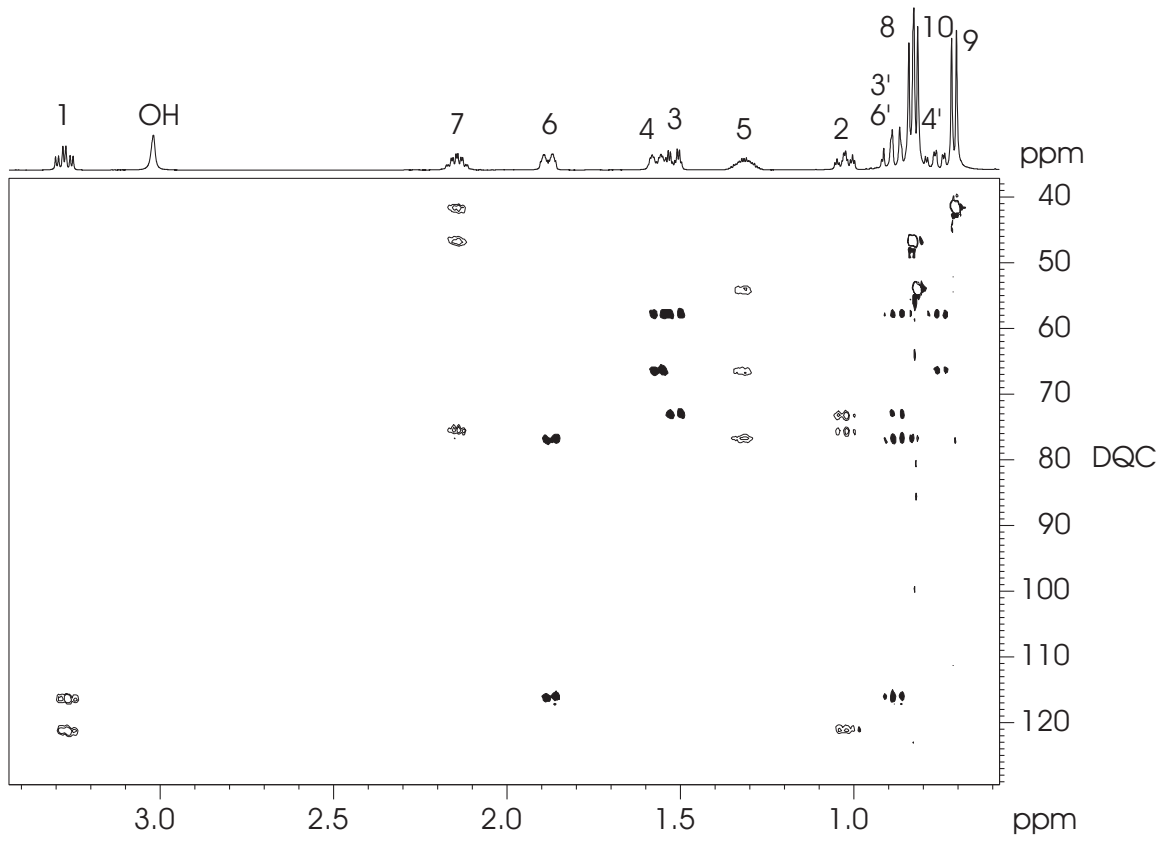

1JCH
1JCC
2JCC
1JCH
3JCC
2JCH
1JCC
3JCH
1JCC
3JCH
2JCC
3JCH
3JCC

adeq11etgp

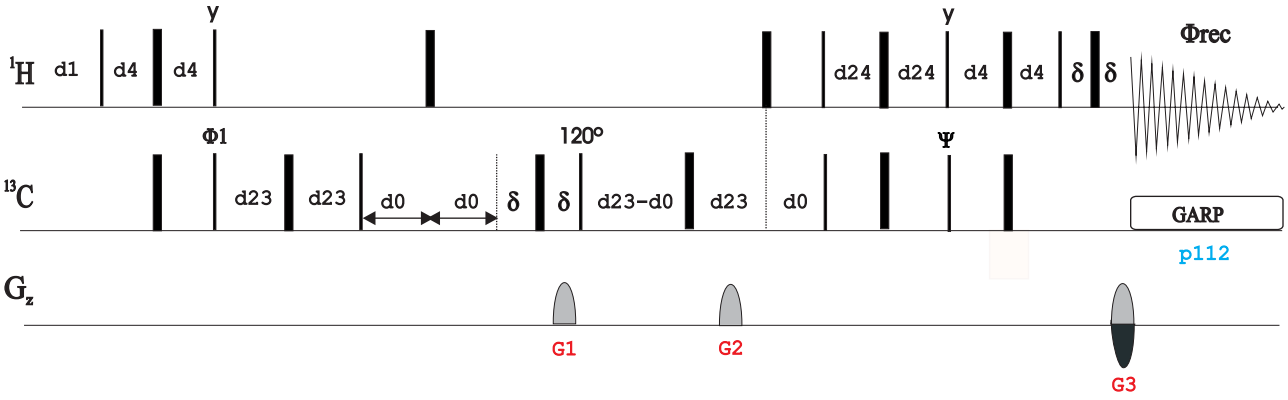


adeq11etgpsp

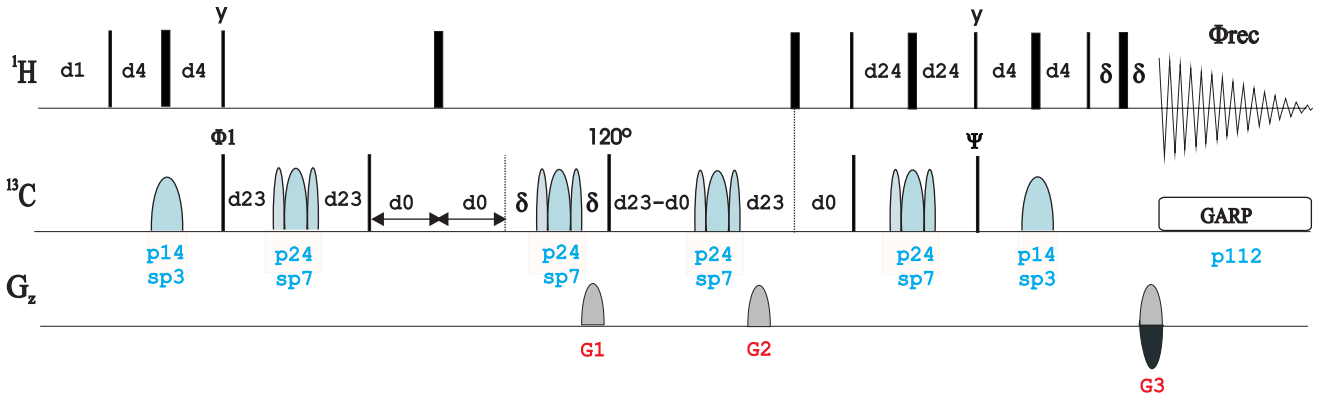


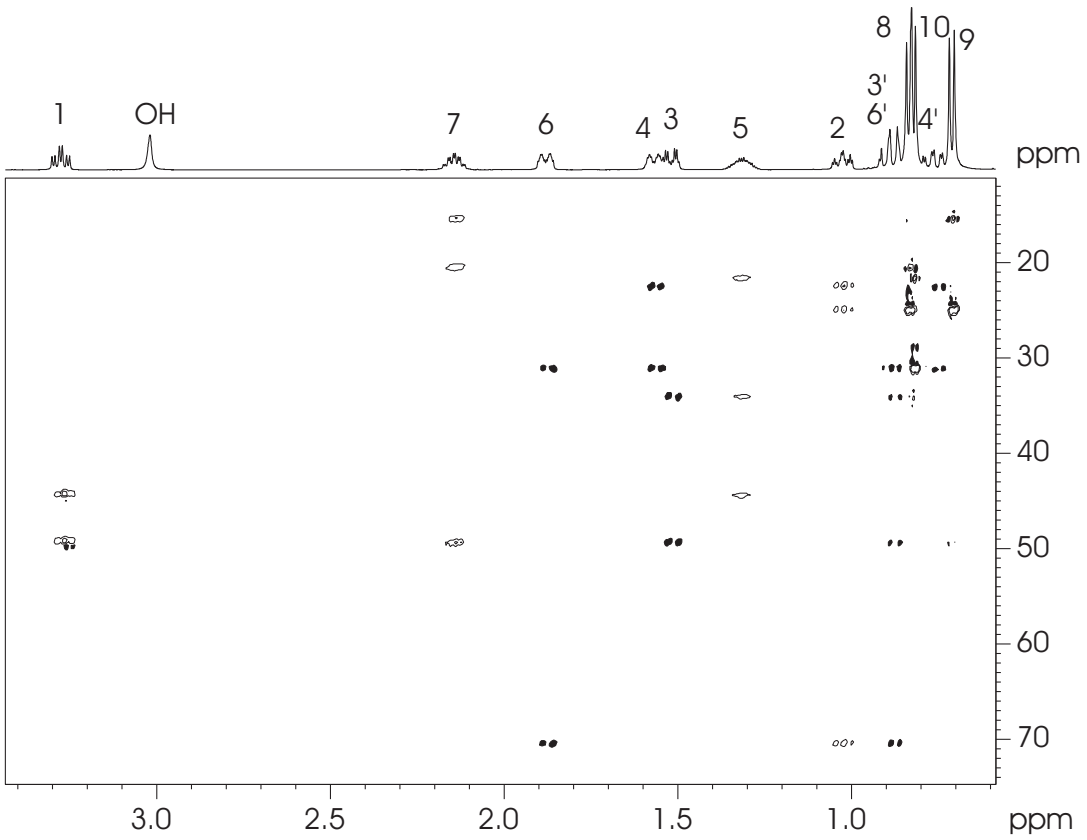


adeq11etgprd

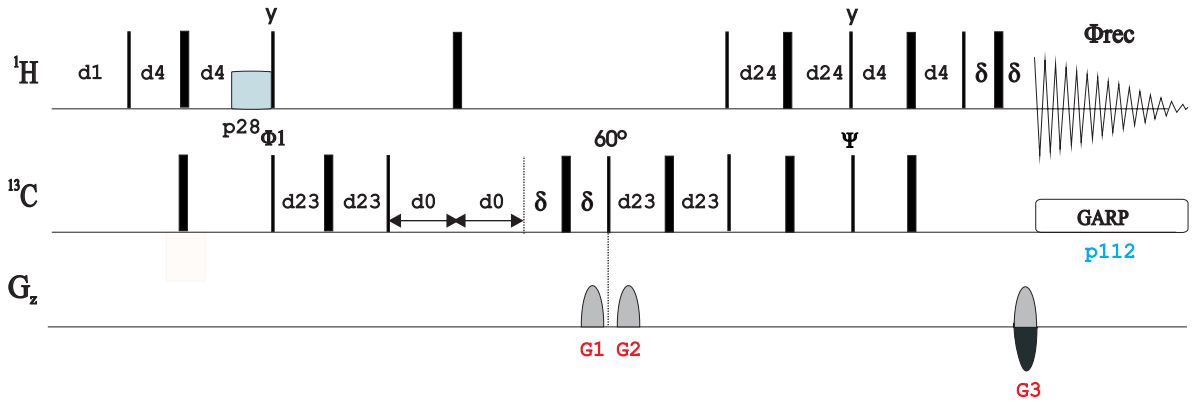


adeq11etgprdsp

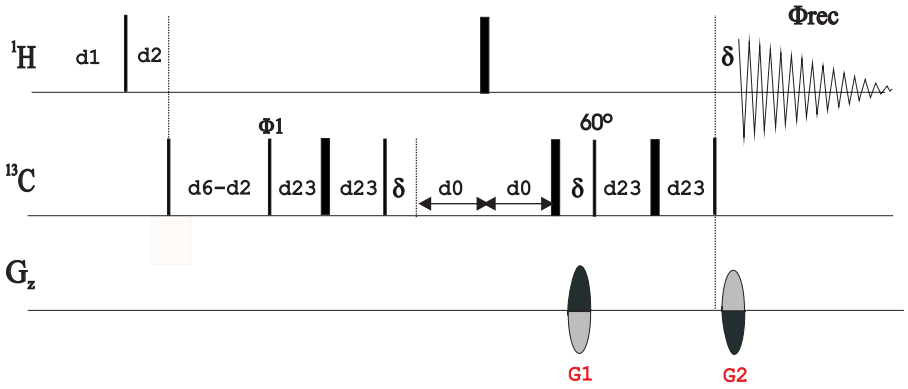




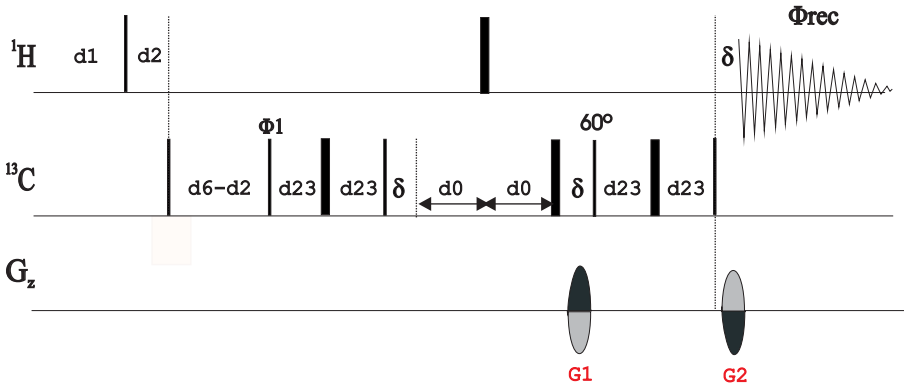
adeq1netgp



adeqn1etgp



adeqnnetgp



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DIFFUSION/DOSY EXPERIMENTS

Conventional 1D:

1D Stimulated Echo experiment (STE) (**stegp1s1d**)
1D Stimulated Echo experiment using bipolar gradients (**stebpgp1s1d**)
1D LED experiment (**ledgp2s1d**)
1D LED experiment using bipolar gradients (**ledbpgp2s1d**)
1D Double-Stimulated Echo Experiment (DSTE) (**dstegp3s1d**)
1D Double-Stimulated Echo Experiment (DSTE) using bipolar gradients (**dstebpgp3s1d**)

1D Stimulated Echo experiment using bipolar gradients and WATERGATE (**stebpgp1s191d**)

1D STE-INEPT experiment (**stebpgpin1s1d**)

2D DOSY maps:

2D Stimulated Echo experiment (STE) (**stegp1s**)
2D Stimulated Echo experiment using bipolar gradients (**stebpgp1s**)

2D Double-Stimulated Echo Experiment (DSTE) (**dstegp3s**)
2D Double-Stimulated Echo Experiment (DSTE) using bipolar gradients (**dstebpgp3s**)
2D LED experiment (**ledgp2s**)
2D LED experiment using bipolar gradients (**ledbpgp2s**)

2D Stimulated Echo experiment using bipolar gradients and WATERGATE (**stebpgp1s19**)

2D STE-INEPT experiment (**stebpgpin1s**)

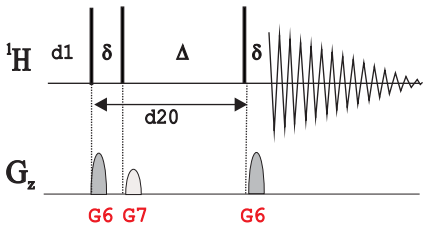
2D & 3D DOSY related experiments:

3D DOSY-COSY using LED with bipolar gradients (**ledbpgpco2s3d**)

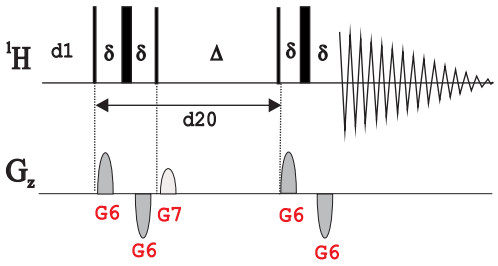
2D DOSY-TOCSY with LED using bipolar gradients (**ledbpgpml2s2d**)
2D DOSY-TOCSY with LED using bipolar gradients and WATERGATE (**ledbpgpml2s192d**)
3D DOSY-TOCSY using LED with bipolar gradients (**ledbpgpml2s3d**)

3D DOSY-NOESY using LED with bipolar gradients (**ledbpgpno2s3d**)

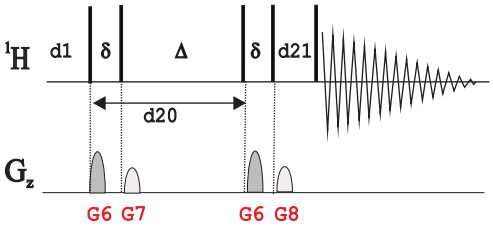
stegp1s
stegp1s1d



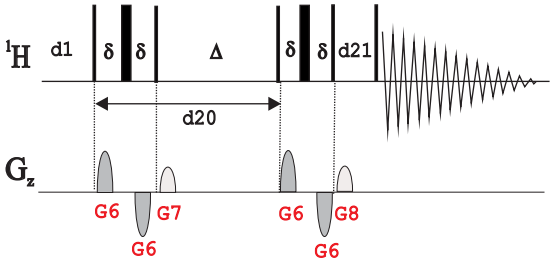
stebpgp1s
stebpgp1s1d



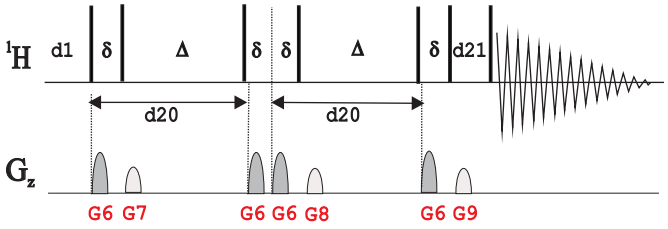
ledgp2s
ledgp2s1d



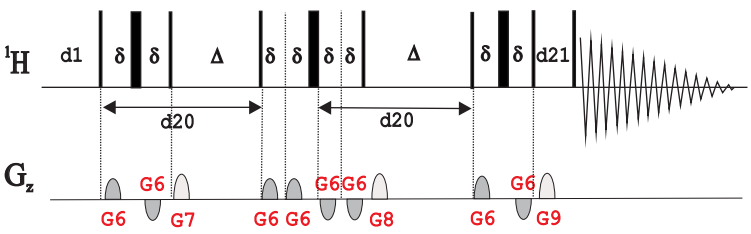
ledbpgp2s
ledbpgp2s1d



dstegp3s
dstegp3s1d



dstebpgp3s
dstebpgp3s1d



Peak intensity

Gyromagnetic Constant

Diffusion Time (d20)

Gradient Duration (p30)

$$I=I_o\exp(-D\gamma^2g^2\delta^2(\Delta-\delta/3))$$

Initial Peak intensity

Diffusion Coefficient

Applied Gradient

$g=G_{max}$*gpz6

$$\ln(I/I_o)=-D\gamma^2g^2\delta^2(\Delta-\delta/3)$$

Stokes-Einstein Equation

Diffusion Coefficient

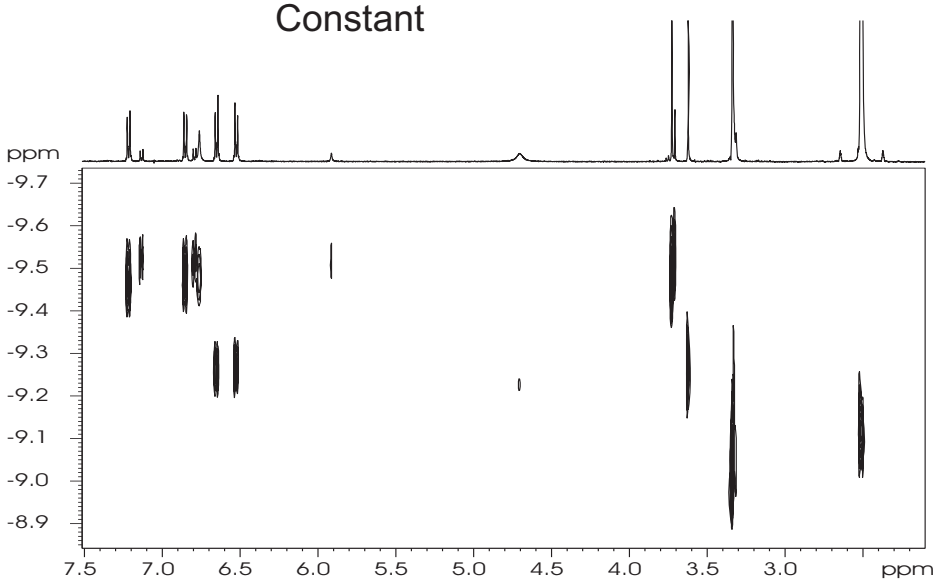
$$D=KT/6\pi\eta R_H$$

Hydrodinamic radius

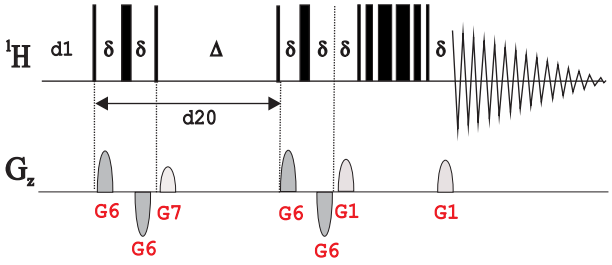
Boltzmann Constant

Temperature

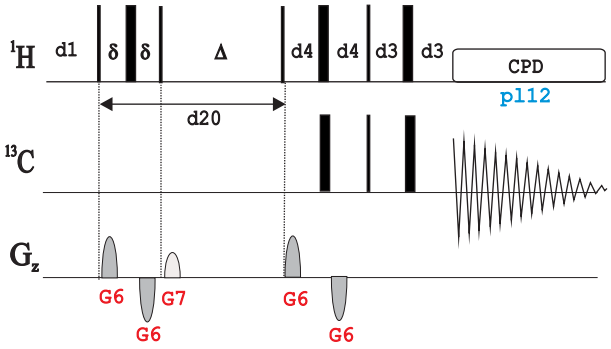
Viscosity



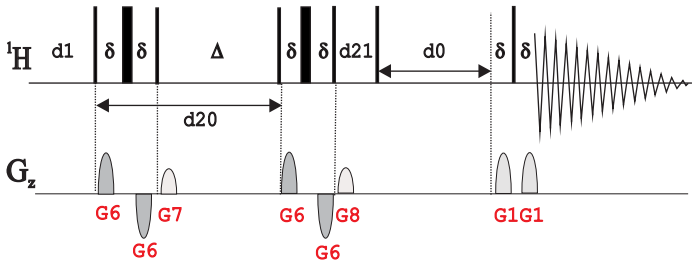
stebpgp1s19
stebpgp1s191d



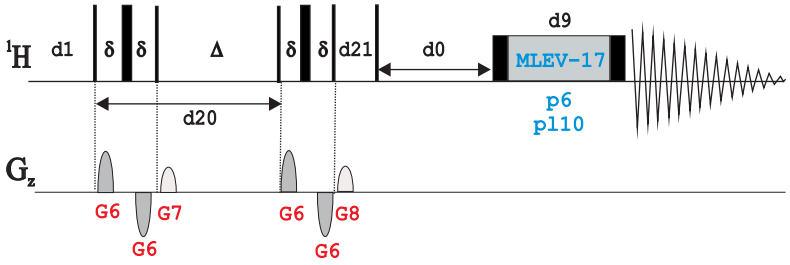
stebpgpin1s1d
stebpgpin1s



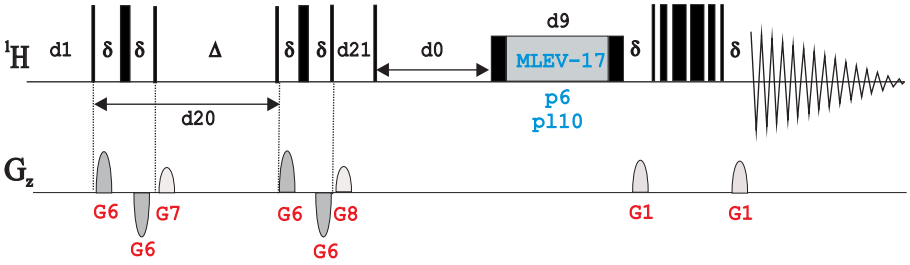
ledbpgpco2s3d



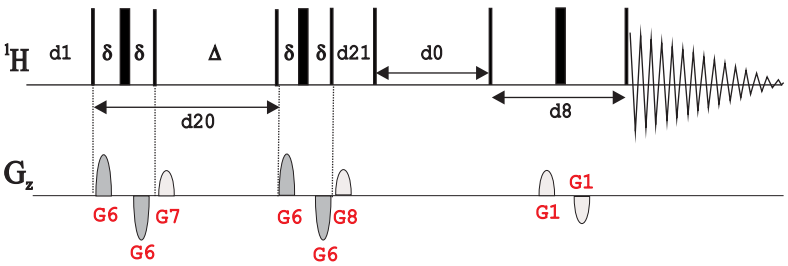
ledbpgpml2s3d
ledbpgpml2s2d



ledbpgpml2s192d



ledbpgpno3s3d



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1D & 2D SATURATION TRANSFER DIFFERENCE (STD) EXPERIMENTS

- **1D STD:**

  1D STD **(stddiff)**
  1D STD with spoil **(stddiff.2)**
  1D STD with spoil and T2 filter **(stddiff.3)**

- **1D STD with solvent suppression:**

  1D STD using 3-9-19 WATERGATE **(stddiffgp19)**
  1D STD with spoil using 3-9-19 WATERGATE **(stddiffgp19.2)**
  1D STD with spoil and T2 filter using 3-9-19 WATERGATE **(stddiffgp19.3)**
  1D STD using excitation scultping **(stddiffesgp)**
  1D STD with spoil using excitation scultping **(stddiffesgp.2)**
  1D STD with spoil and T2 filter using excitation scultping **(stddiffesgp.3)**

- **2D STD-TOCSY:**

  2D STD-TOCSY **(stdmlevph)**
  2D STD-TOCSY using 3-9-19 WATERGATE **(stdmlevgpph19)**
  2D STD-TOCSY using excitation sculpting **(stdmlevesgpph)**

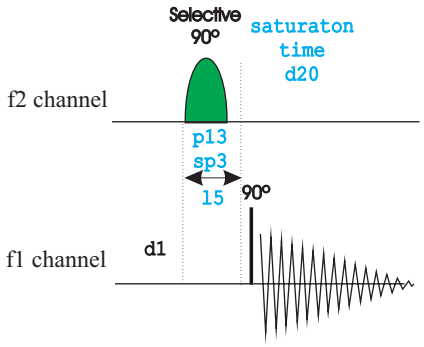
- **2D STD-NOESY:**

  2D STD-NOESY with T2 filter in F2 **(stdnoesygpph)**
  2D STD-NOESY with T2 filter in F1 and F2 **(stdnoesygpph.2)**
  2D STD-NOESY using 3-9-19 WATERGATE with T2 filter in F2 **(stdnoesygpph19)**
  2D STD-NOESY using 3-9-19 WATERGATE with T2 filter in F1 and F2 **(stdnoesygpph19.2)**
  2D STD-NOESY using excitation sculpting with T2 filter in F2 **(stdnoesyesgpph)**
  2D STD-NOESY using excitation sculpting with T2 filter in F1 and F2 **(stdnoesyesgpph.2)**

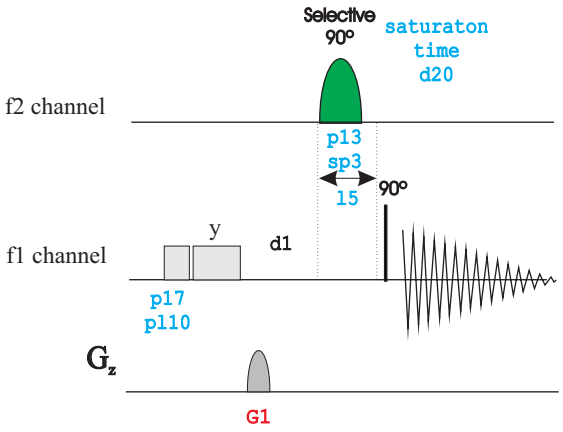
- **2D STD-HSQC:**

  2D STD-HSQC using echo-antiecho **(stdhsqcetgpsp)**
  2D STD-HSQC with sensitivity-improvement **(stdhsqcetgpsisp)**

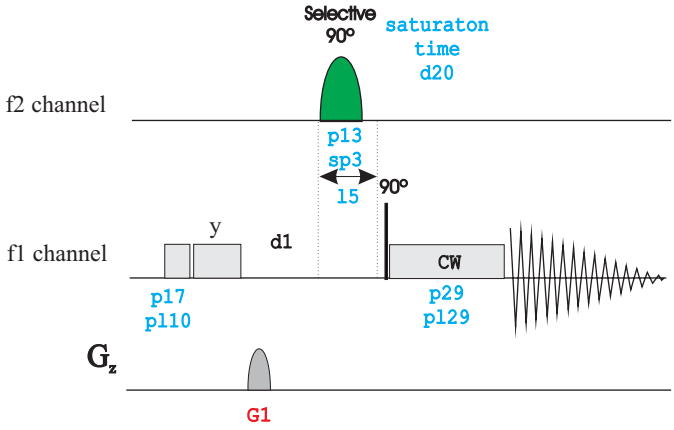
stddiff

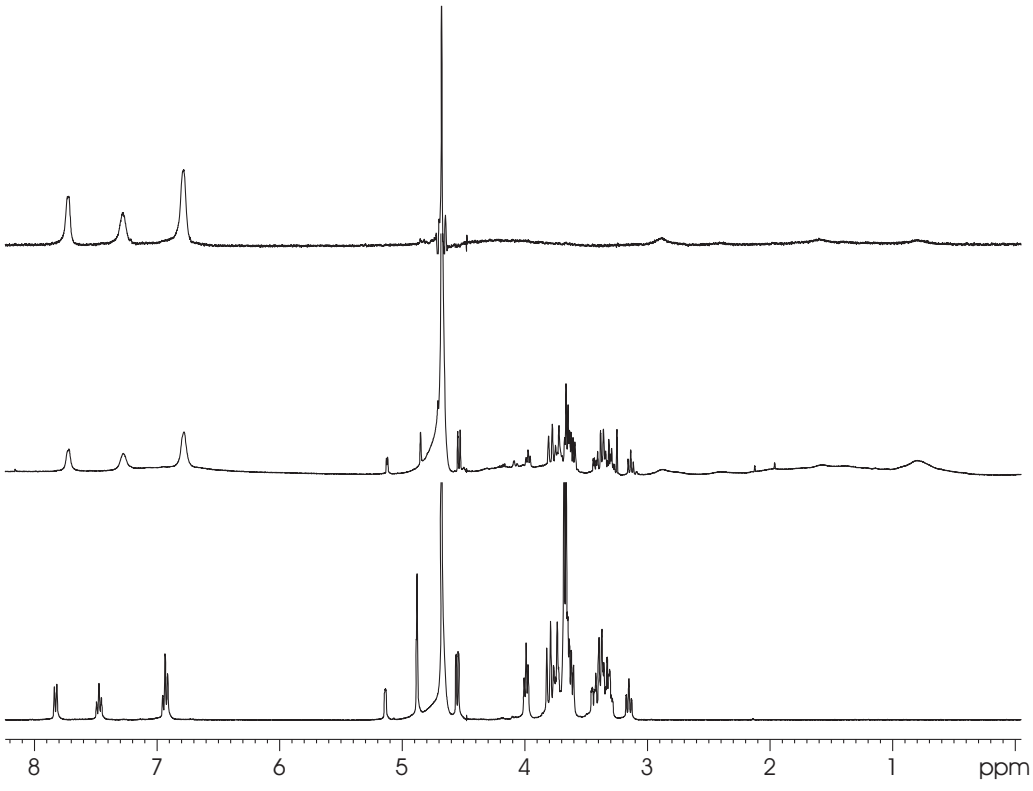


stddiff.2

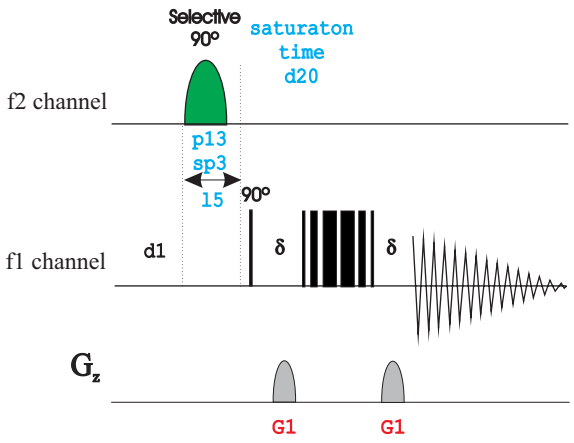


stddiff.3

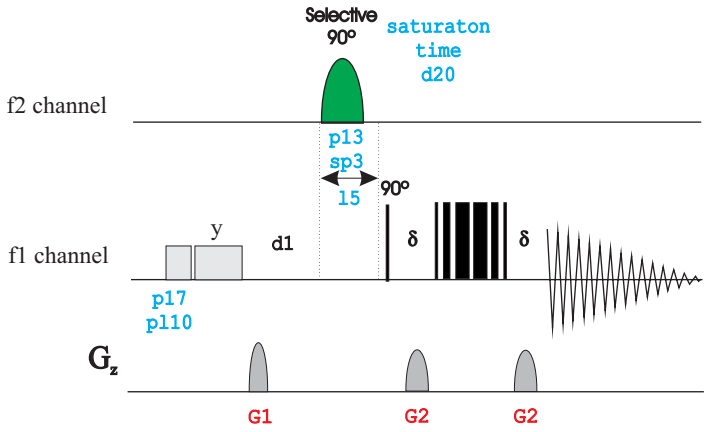




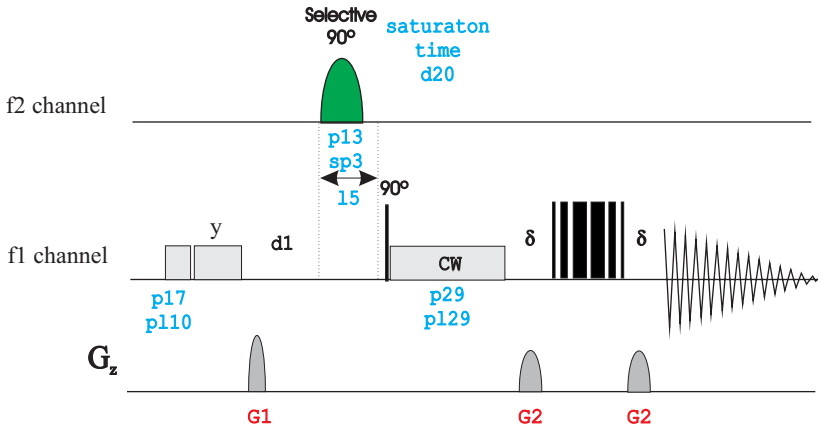
stddiffgp19



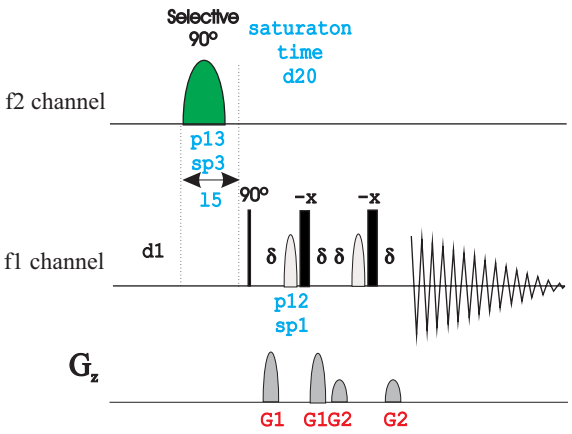
stddiffgp19.2



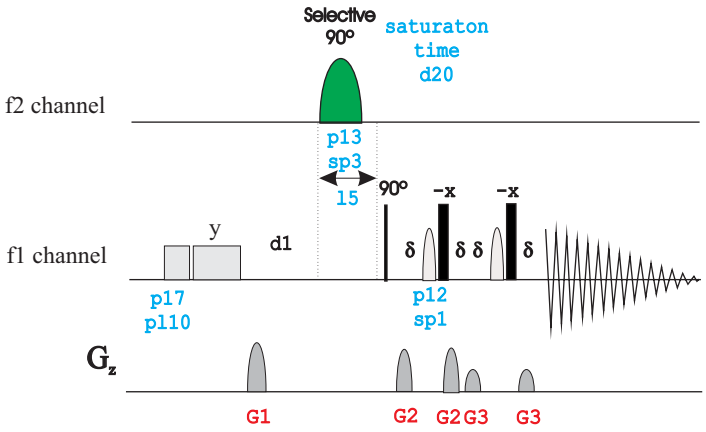
stddiffgp19.3



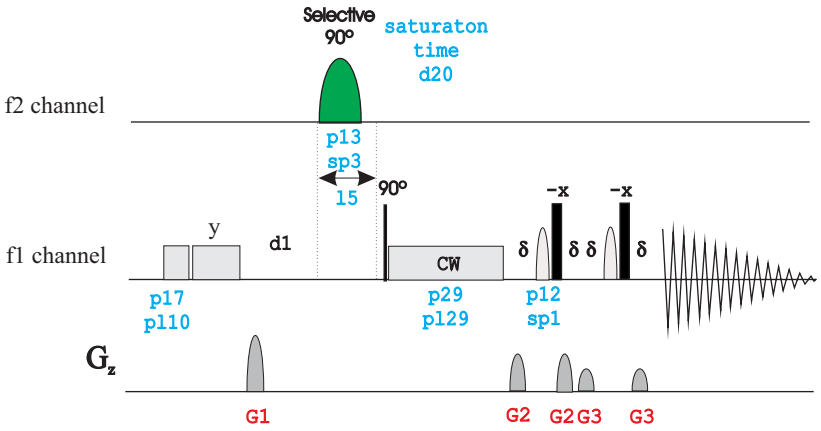
stddiffesgp



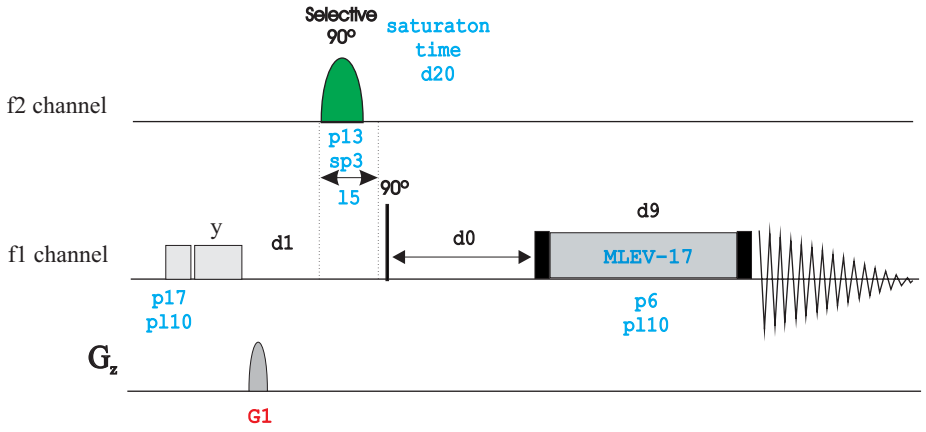
stddiffesgp.2



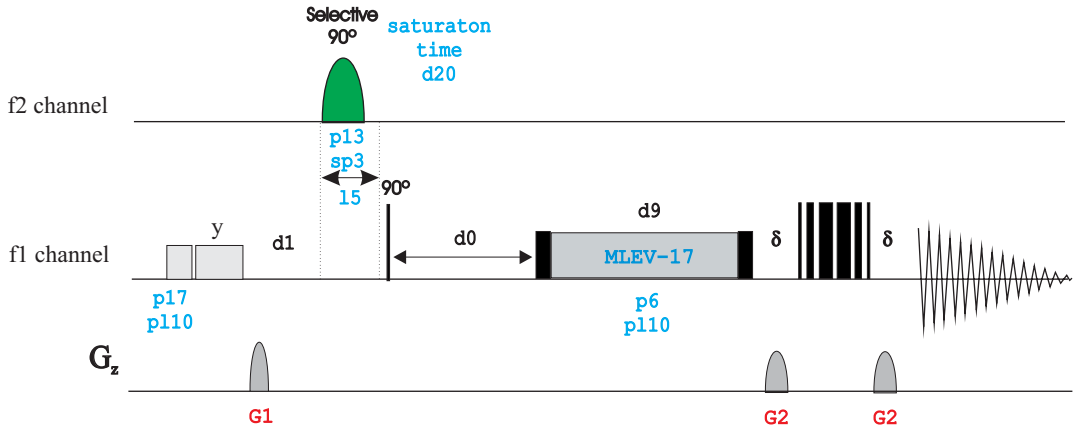
stddiffesgp.3



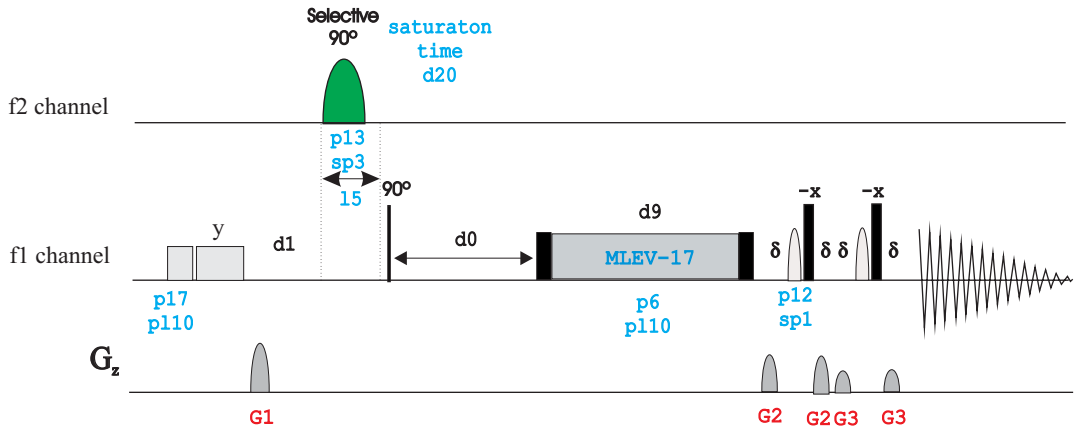
stdmlevph



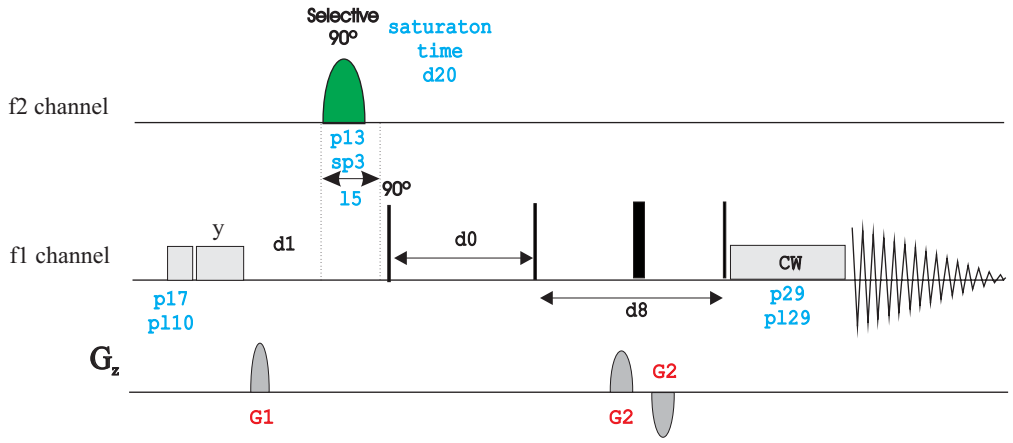
stdmlevgpph19



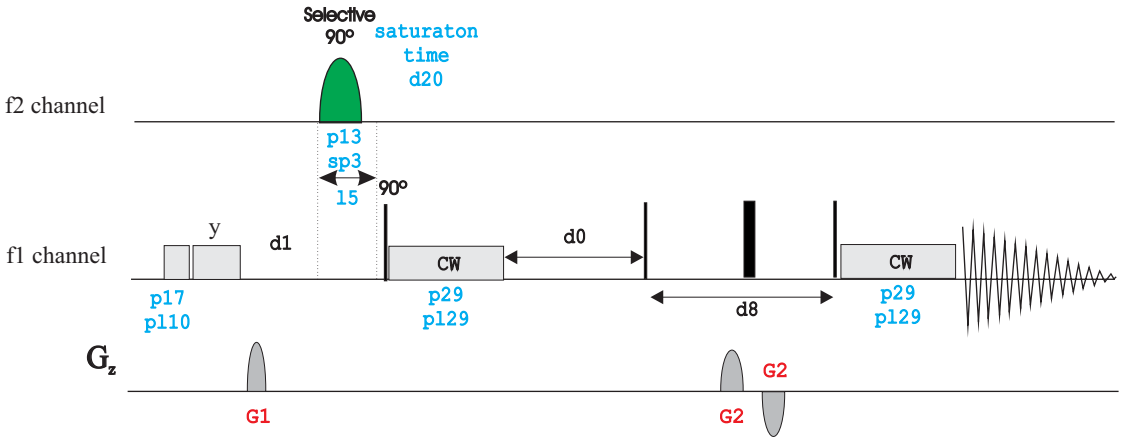
stdmlevesgpph



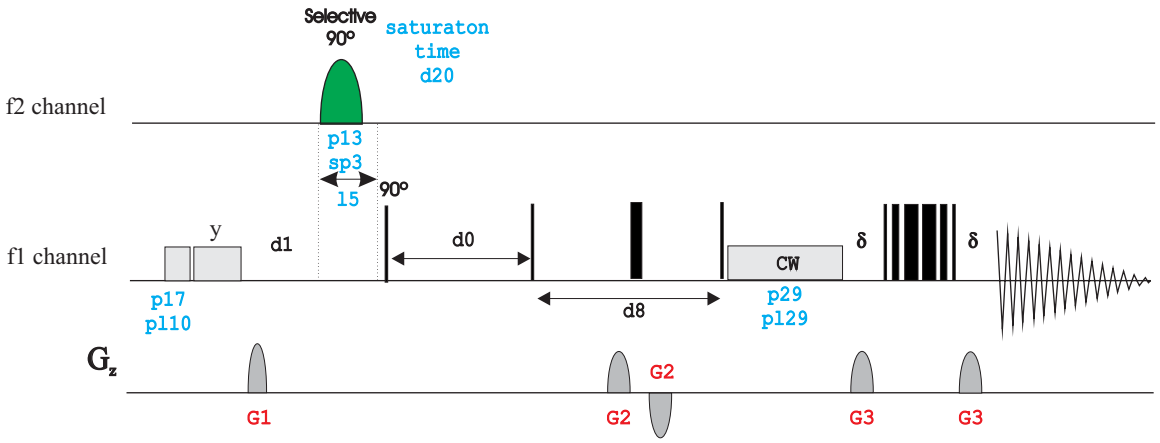
stdnoesygpph



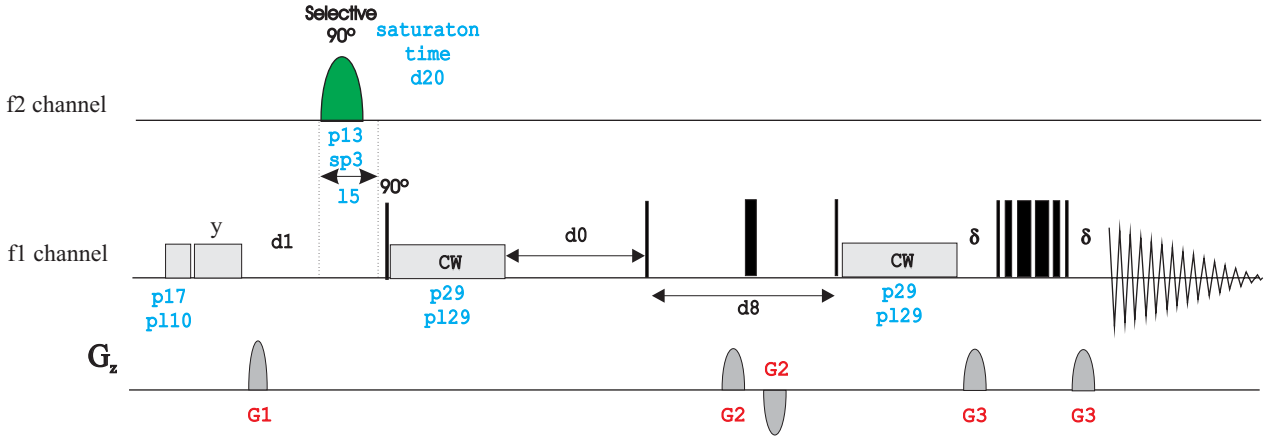
stdnoesygpph.2



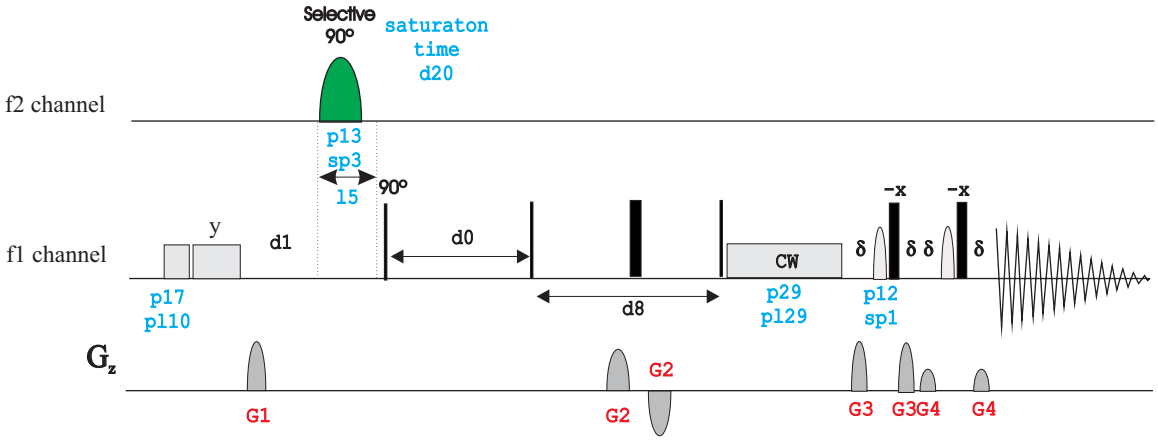
stdnoesygpph19



stdnoesygpph19.2



stdnoesyesgpph



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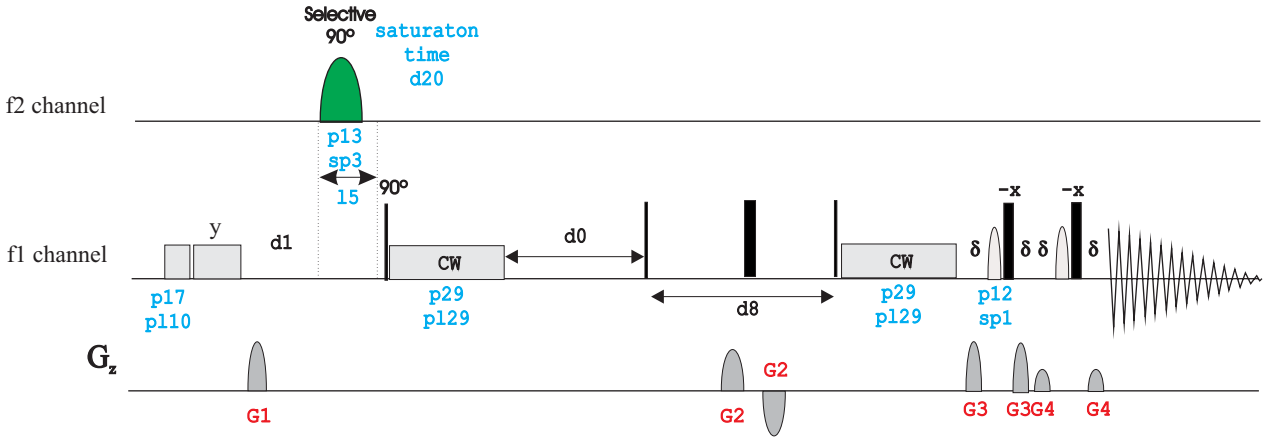

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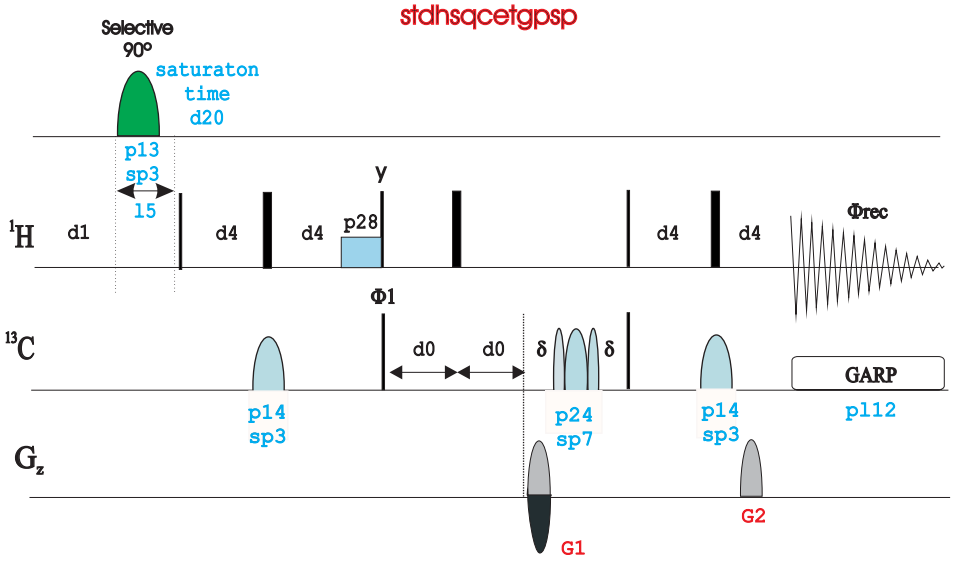

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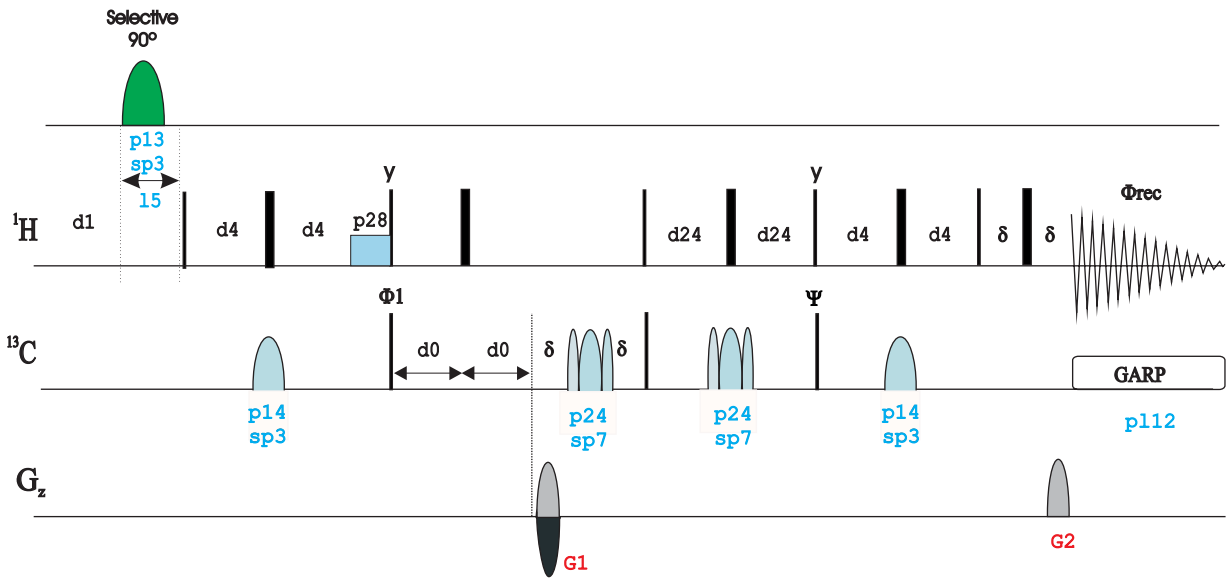

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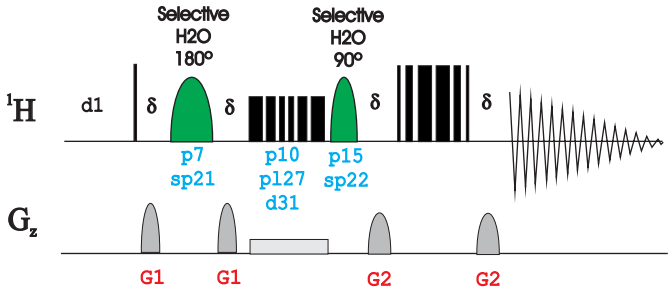
CLEANEX EXPERIMENTS

1D CLEANEX using 3-9-19 WATERGATE **(zgcxgp19)**
1D CLEANEX using excitation sculpting **(zgcxesgp)**
2D CLEANEX-Fast HSQC using 3-9-19 WATERGATE **(fhsqccxf3gpph)**
2D CLEANEX-TROSY using 3-9-19 WATERGATE **(trosycxf3gpphsi19)**

zgcxgp19



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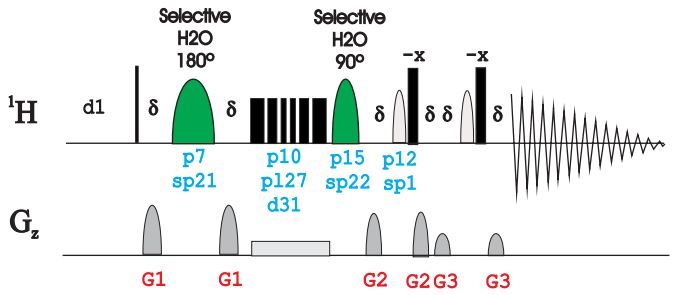
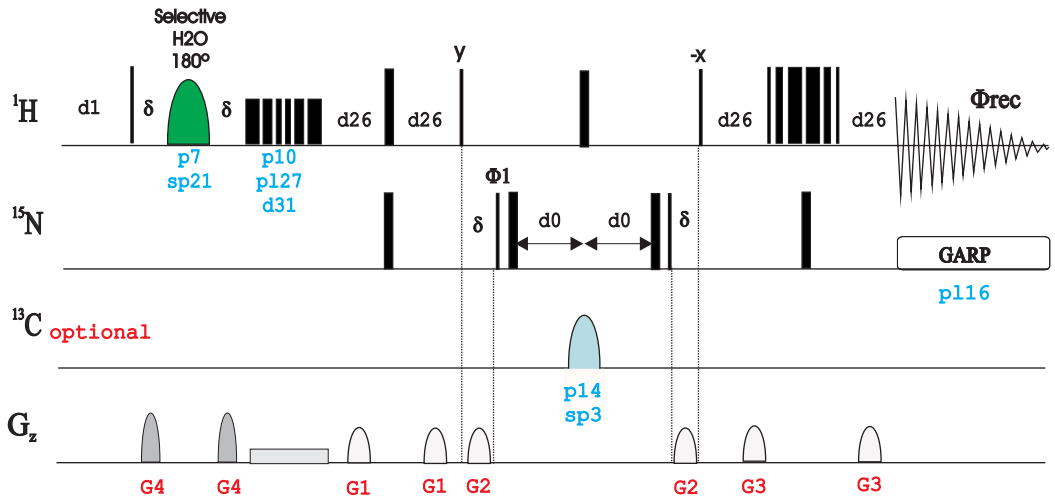
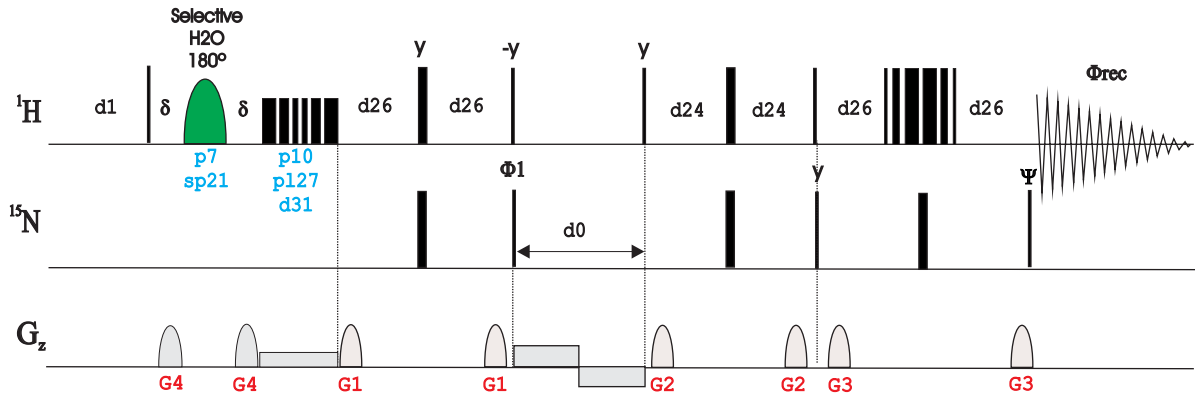


fhsqccxf3gpph



trosycxf3gpphsi19



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LC-NMR EXPERIMENTS

1D ^{1}H spectrum

- 1D ^{1}H with double presaturation (**lc1prf2** | LC1D12)
- 1D ^{1}H with triple presaturation (**lc1prft**)
- 1D ^{1}H with WET (**wet**)
- 1D ^{1}H with WET and CW decoupling on f2 during WET and ACQ (**wetdc** | LC1DWTDC)
- 1D ^{1}H with WET and CW decoupling on f2 during WET (**wetdw**)
- 1D ^{1}H WET solvent suppression with shape pulse and C-13 decoupling on f2 during WET and AQ for LC isocratic runs (**lc2wetdc**)
- 1D ^{1}H WET solvent suppression with shape pulse and C-13 decoupling on f2 during WET and AQ with intermediate preparation scan into second dataset for LC gradient runs with updated shapes (**lc2wetdcus** | LC2DWTUS)

1D NOESY

- 1D NOESY with presaturation (**noesypr1d**)
- 1D NOESY with presaturation and CW decoupling on f2 (**lc1pncw**)
- 1D NOESY with double presaturation and CW decoupling on f2 (**lc1pncwfd**)
- 1D NOESY with presaturation using shaped pulse and CW decoupling on f2 (**lc1pncwps**)
- 1D NOESY with double presaturation (**lc1pnf2**)
- 1D NOESY with multiple presaturation (**lc1pnfr**)
- 1D NOESY with triple presaturation (**lc1pnft**)
- 1D NOESY with presaturation using shaped pulse (**lc1pnps**)

Pseudo-2D-sequence

- Pseudo-2D-sequence for lc-nmr on flow detection (**lc2**)
- Pseudo-2D-sequence for lc-nmr on flow detection with power-gated decoupling (**lc2pg**)
- Pseudo-2D-sequence for lc-nmr on flow detection with presaturation (**lc2pn**)
- Pseudo-2D-sequence for lc-nmr on flow detection with double presaturation (**lc2pnf2**)
- Pseudo-2D-sequence for lc-nmr on flow detection with solvent gradients (**lc2pnf2ul**)
- Pseudo-2D-sequence for lc-nmr on flow detection with solvent gradients (**lc2pnpl**)
- Pseudo-2D-sequence for lc-nmr on flow detection (**lc2pnps**)
- Pseudo-2D-sequence for lc-nmr on flow detection with solvent gradients (**lc2pnul**)
- Pseudo-2D-sequence for lc-nmr on flow detection with presaturation (**lc2pr**)
- Pseudo-2D-sequence for lc-nmr on flow detection with double presaturation (**lc2prf2**)
- Pseudo-2D-sequence for lc-nmr on flow detection with presaturation using shape pulse (**lc2ps**)

2D homonuclear J-resolved

- 2D J-resolved with double presaturation and cw-decoupling on f2 (**lcjrescwfdprqf**)
- 2D J-resolved with presaturation and cw-decoupling on f2 (**lcjrescwprqf**)
- 2D J-resolved with presaturation using shape pulse and cw-decoupling on f2 (**lcjrescwpsqf**)
- 2D J-resolved with double presaturation (**lcjresf2prqf**)
- 2D J-resolved with presaturation (**lcjresprqf**)
- 2D J-resolved with presaturation using shape pulse (**lcjrespsqf**)

2D TOCSY

- 2D TOCSY with double presaturation and cw-decoupling on f2 (**lcmlevcwfdpcph**)
- 2D TOCSY with presaturation and cw-decoupling on f2 (**lcmlevcwpcphps**)
- 2D TOCSY with double presaturation using composite pulse (**lcmlevf2pcph**)
- 2D TOCSY with double presaturation (**lcmlevf2phpr** | LCML12)

- 2D TOCSY with presaturation using shape pulse and composite pulse (**lcmlevpcphps**)
- 2D TOCSY with presaturation using composite pulse (**lcmlevpcph**)

2D Experiments using WET

- 2D COSY using WET (**cosydcphwt** | **COSYDCPHWT**)
- 2D TOCSY using WET (**mlevdcphwt** | **MLEVDCPHWT**)
- 2D HSQC using WET (**hsqcetgpsiwt** | **HSQCETGPSIWT**)

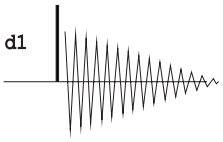
2D Experiments using single/multiple presaturation using shape pulse

- Phase-sensitive 2D COSY using using single/multiple presaturation (**cosycwphps** | **COSYCWPHPS**)
- Phase-sensitive 2D HSQC using using single/multiple presaturation (**hsqcphps**)
- 2D HMBC using using single/multiple presaturation (**hmbcndpsqf**)

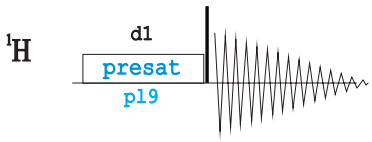
Related experiments:

- Also see 1D Solvent suppression

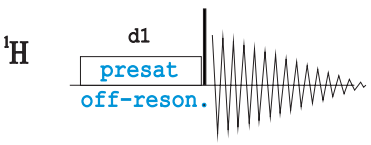
lc2



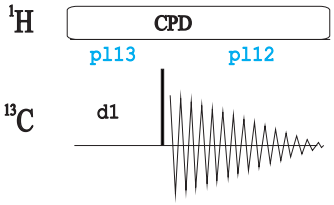
lc2pr



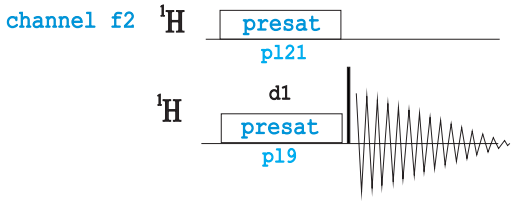
lc2ps



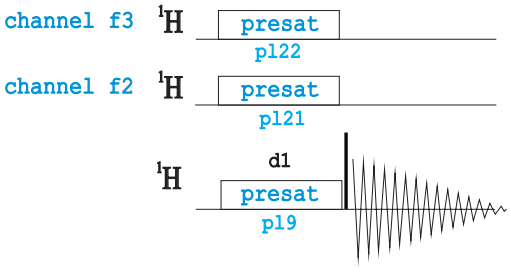
lc2pg



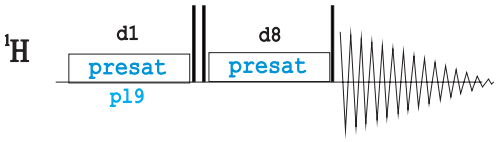
lc1prf2
lc2prf2



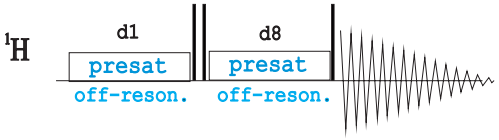
lc1prft



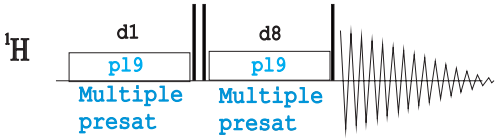
lc2pn
lc2pnul



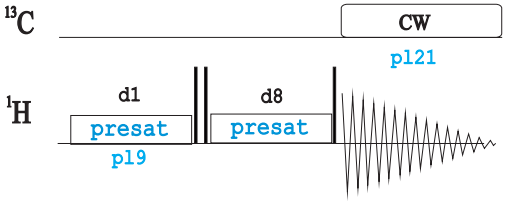
lc2pnps
lc1pnps



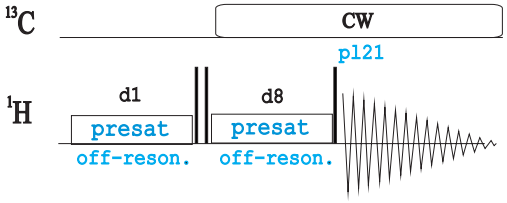
lc1pnfr



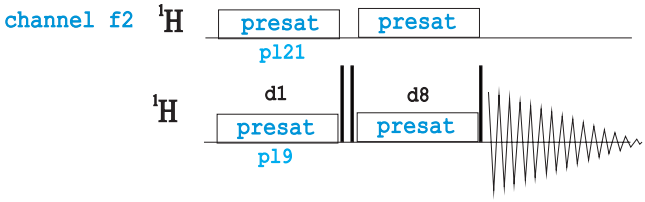
lc1pncw



lc1pncwps



lc2pnf2
lc1pnf2
lc2pnf2ul



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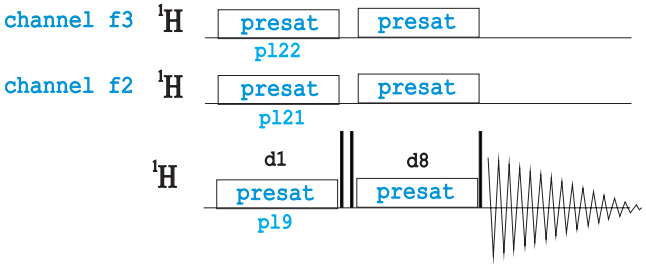

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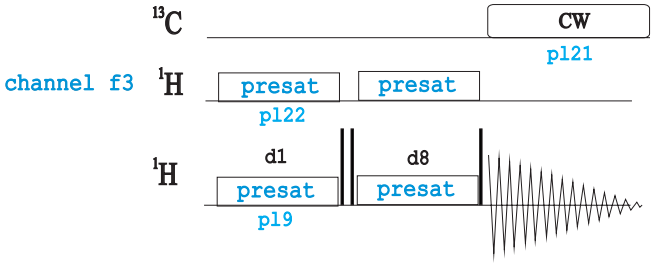

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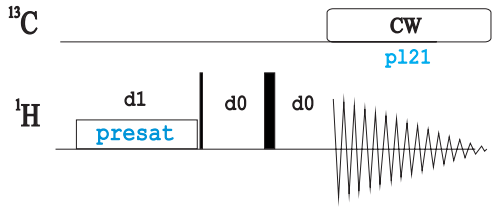

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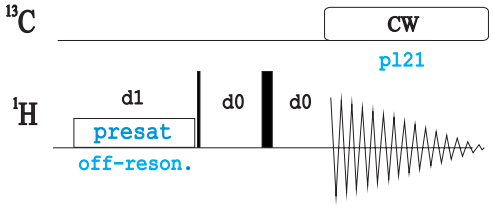
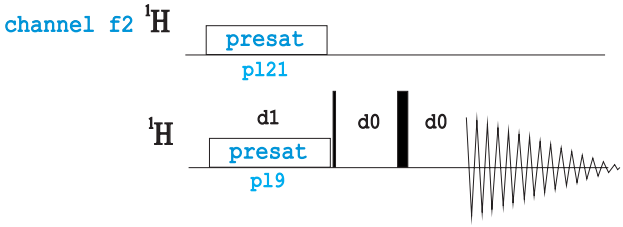
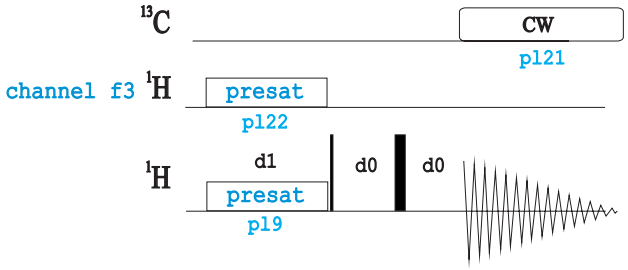


lcjresf2prqf



lcjrescwfdprqf



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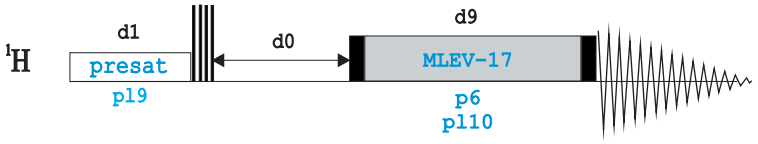
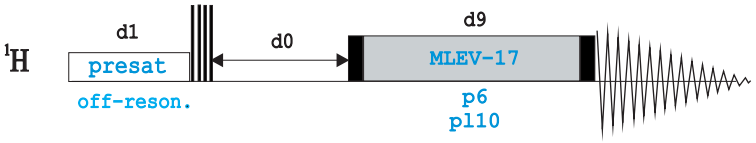


lcmlevpcphps



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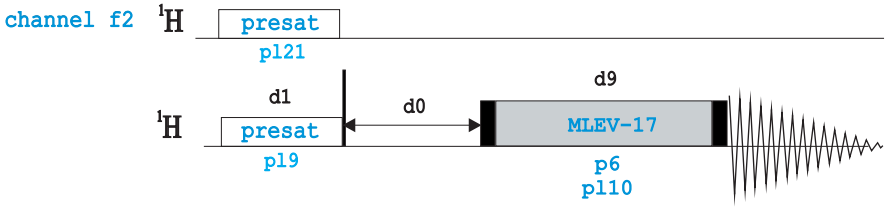

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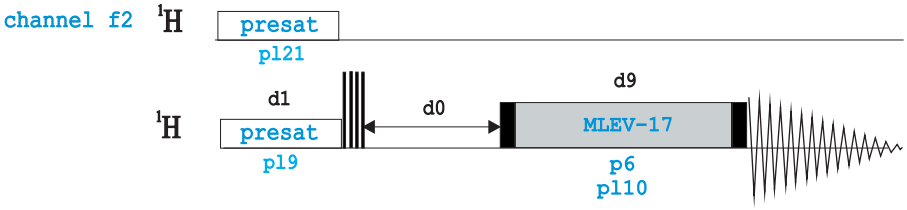

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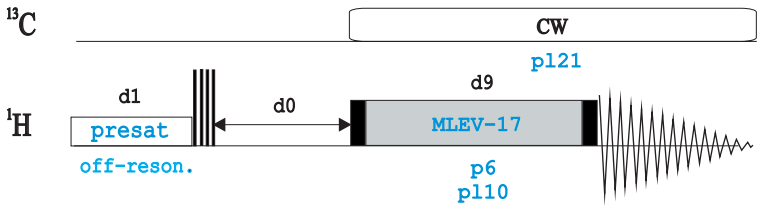

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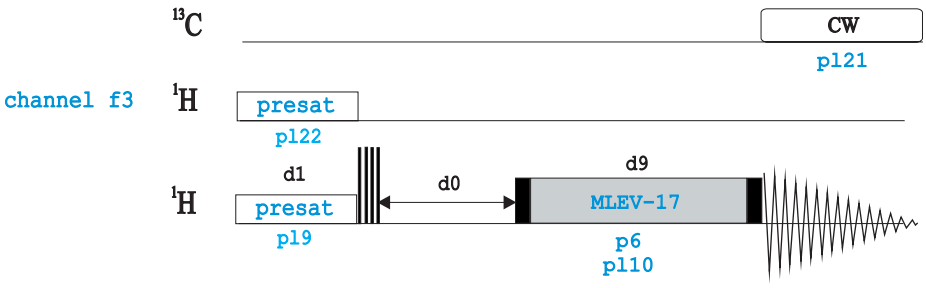

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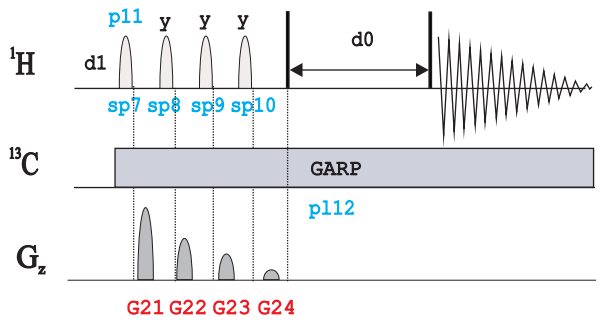
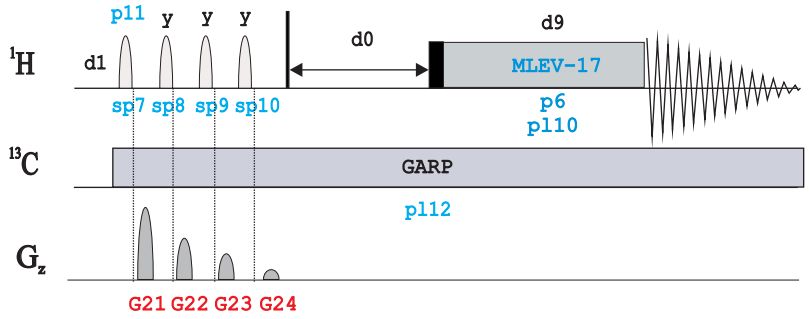


mlevdcphwt



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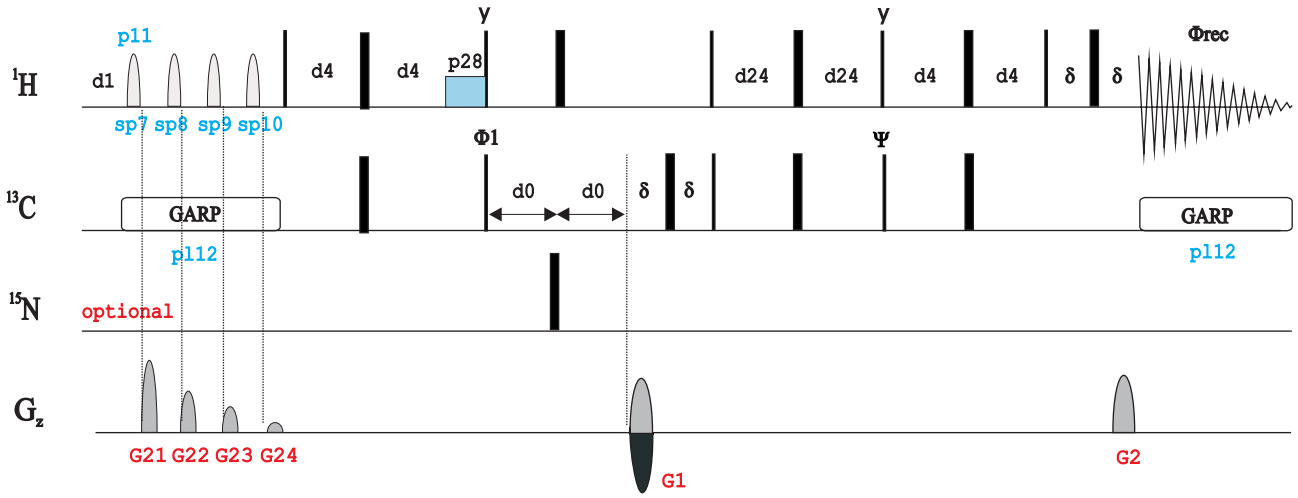

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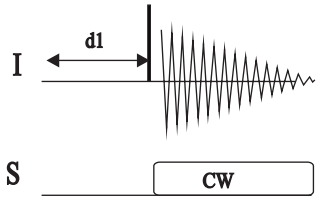
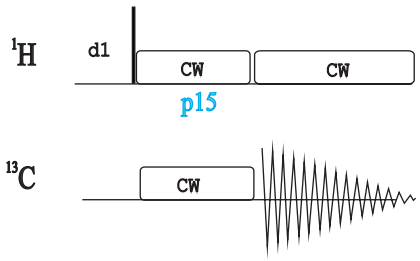
BASIC SOLID-STATE
NMR EXPERIMENTS

1D one-pulse High power decoupling (**hpdec**)
1D CP (**cp**)
1D CP (**cpnqs**)
1D Sideband suppression with SELTICS (**cpseltics**)
1D CPMAS with total sideband suppression using TOSS (**cptossa**)
1D CPMAS with total sideband suppression using TOSS (**cptossb**)

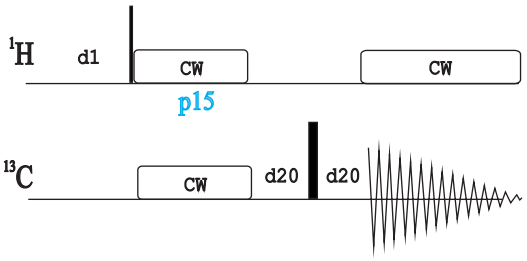
hpdec



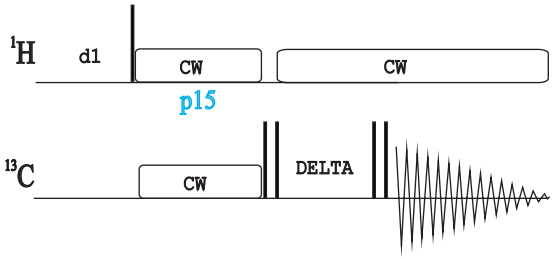
cp



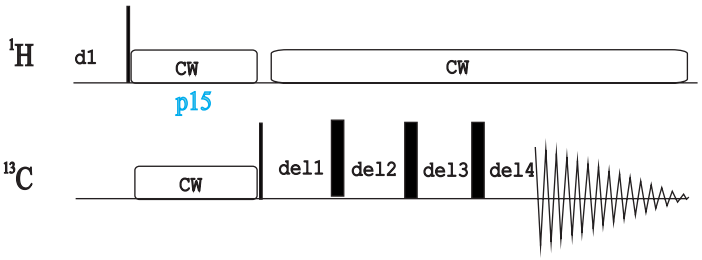
cpnqs



cpseltics



cptossb
cptossa



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APPENDIX

```
;Pulprog.info
;avance-version (05/05/02)
;
;$CLASS=HighRes Info
;$COMMENT=


;For a pulseprogram the first characters (usually up to 6, but
;sometimes more) specify the type of experiment, e.g. DEPT, COSY,
;NOESY etc.. Further properties of the pulseprogram are
;indicated by a two-character code, which is added to the name
;in alphabetical order. For 2D experiments the mode (absolute value,
;phase sensitive or echo-antischo) is always indicated. H- or X-
;decoupling is assumed to be default for heteronuclear experiments,
;but not for homonuclear ones (except inad).
;In case of redundant information some two-character codes may be
;ommitted.
;
;The two-character codes used are the following:


;ar     experiment for aromatic residues
;at     adiabatic TOCSY
;bi     with bird pulse for homonuclear J-decoupling
;bp     using bipolar gradients
;cc     cross correlation experiment
;cp     with composite pulse
;ct     constant time
;cw     decoupling using cw command
;cx     using CLEANEX_PM
;dc     decoupling using cpd command
;df     double quantum filter
;di     with DIPSI mixing sequence
;dh     homonuclear decoupling in indirect dimension
;dw     decoupling using cpd command only during wet sequence
;dq     double quantum coherence
;ea     phase sensitive using Echo/Antiecho method
;ec     with E.COSY transfer
;ed     with multiplicity editing
;es     excitation sculpting
;et     phase sensitive using Echo/Antiecho-TPPI method
;fb     using f2 - and f3 - channel
;fd     using f1 - and f3 - channel (for presaturation)
;fr     with presaturation using a frequency list
;ft     using f1 -, f2 - and f3 - channel (for presaturation)
;fh     F-19 observe with H-1 decoupling
;fp     using a flip-back pulse
;fl     for F-19 ecoupler
;f2     using f2 - channel (for presaturation)
;f3     using f3 - instead of f2 - channel
;f4     using f4 - instead of f2 - channel
;gd     gated decoupling using cpd command
;ge     gradient echo experiment
;gp     using gradients with ":gp" syntax
;gr     using gradients
;gs     using shaped gradients
;hb     hydrogen bond experiment
;hc     homodecoupling of a region using a cpd-sequence
;hd     homodecoupling
;hf     H-1 observe with F-19 decoupling
;hs     with homospoil pulse
;ia     InPhase-AntiPhase (IPAP) experiment
;ig     inverse gated
;ii     using inverse (invi/HSQC) sequence
;im     with incremented mixing time
;i4     using inverse (inv4/HMQC) sequence
;jc     for determination of J coupling constant
;jd     homonuclear J-decoupled
;jr     with jump-return pulse
;lp     with low-pass J-filter
;lq     with Q-switching (low Q)
;lr     for long-range couplings
;l2     with two-fold low-pass J-filter
;mf     multiple quantum filter
;ml     with MLEV mixing sequence
```

```
;mq     using multiple quantum
;nd     no decoupling
;no     with NOESY mixing sequence
;pc     with presaturation and composite pulse
;pg     power-gated
;ph     phase sensitive using States-TPPI, TPPI, States or QSEC
;pl     preparing a frequency list
;pn     with presaturation using a 1D NOESY sequence
;pp     using purge pulses
;pr     with presaturation
;ps     with presaturation using a shaped pulse
;qf     absolute value mode
;qn     for QNP-operation
;qs     phase sensitive using qseq-mode
;rd     refocussed
;rl     with relay transfer
;rs     with radiation damping suppression using gradients
;ru     using radiation damping compensation unit
;rv     with random variation
;r2     with 2 step relay transfer
;r3     with 3 step relay transfer
;se     spin echo experiment
;sh     phase sensitive using States et al. method
;si     sensitivity improved
;sm     simultaneous evolution of X and Y chemical shift
;sp     using a shaped pulse
;sq     using single quantum
;ss     spin-state selective experiment
;st     phase sensitive using States-TPPI method
;sy     symmetric sequence
;s3     S3E experiment
;tf     triple quantum filter
;tp     phase sensitive using TPPI
;tr     using TROSY sequence
;tz     zeroquantum (ZQ) TROSY
;ul     using a frequency list
;us     updating shapes
;wg     watergate using a soft-hard-soft sequence
;wt     with WET watersuppression
;w5     watergate using W5 pulse
;xf     x-filter experiments
;xy     with XY CPMG sequence
;x1     x-filter in F1
;x2     x-filter in F2
;x3     x-filter in F3
;zf     with z-filter
;zq     zero quantum coherence
;zs     using a gradient/rf spoil pulse
;1d     1D version
;1s     using 1 spoil gradients
;11     using 1-1 pulse
;19     using 3-9-19 pulse
;2h     using 2H lockswitch unit
;2s     using 2 spoil gradients
;3d     3D sequence
;3s     using 3 spoil gradients
;30     using a 30 degree flip angle
;45     using a 45 degree flip angle
;90     using a 90 degree flip angle
;135    using a 135 degree flip angle


;Typical experiment names would be:
;   cosy, dept, dipsi2, hmbc, hmqc, hoesy, hsqc, inad, inept,
;   mlev, noesy, roesy or trosy.


;Inverse correlations are denoted as hmbc, hmqc or hsqc.
;   Experiments with a BIRD sequence in the beginning
;   also contain a bi in the name.


;1D experiments, which are analogues of 2D experiments by virtue of
;   a selective pulse, start with sel.
;Semiselective 2D experiments have the same name as the unselective
```

```
;   version but with an s at the beginning:
;
;   scosyph <-> cosyph.


;A phase-sensitive (States-TPPI, TPPI etc.) NOESY experiment with
;   presaturation would then be:
;
;       noesy + ph + pr  =    noesyphpr.


;In the other direction the pulseprogram hmbcgplpndqf would be
;
;         hmbc + gp + lp + nd + qf
;
;       and therefor an:
;
;       inverse correlation for long-range couplings (HMBC) with
;            coherence selection using gradients with ":gp" syntax,
;            low-pass J-filter,
;            no decoupling
;            in absolute value mode.



;The nomenclature of parameters is described in Pulprog.info.


;Comments like:
;
;       ;avance-version
;       ;begin ____
;       ;end ____
;
;       with (____ = MLEV17, DIPSI2, ...)
;
;are evaluated by NMRSIM for the pulseprogram display and should
;therefor not be removed. The syntax for begin/end statements allows
;characters, numbers and '_'. Arithmetic operators must not be used.
;
;
;The comments:
;                        ;preprocessor-flags-start
;                           ;preprocessor-flags-end
;
;are also evaluated to identify flags used in the pulseprogram and
;must also not be removed.


;$Id: $
```

```
;Param.info
;avance-version (05/10/24)
;
;The following convention is used for power levels, pulses, delays
;and loop counters throughout the microprograms:
;
;$CLASS=HighRes Info
;$COMMENT=


;pl0 :
;pl1 : f1 channel - power level for pulse (default)                    {all, PL90[F1]}
;pl2 : f2 channel - power level for pulse (default)                    {all, PL90[F2]}
;pl3 : f3 channel - power level for pulse (default)                    {all, PL90[F3]}
;pl4 : f4 channel - power level for pulse (default)                    {all, PL90[F4]}
;pl5 : f5 channel - power level for pulse (default)                    {}
;pl6 : f6 channel - power level for pulse (default)                    {}
;pl7 : f7 channel - power level for pulse (default)                    {}
;pl8 : f8 channel - power level for pulse (default)                    {}
;pl9 : f1 channel - power level for presaturation
{default+lcnmr+triple+triple2+triple_na, PLCW[F1]}
;pl10: f1 channel - power level for TOCSY-spinlock                     {all, PLTOC[F1]}
;pl11: f1 channel - power level for ROESY-spinlock                     {all, PLROE[F1]}
;pl12: f2 channel - power level for CPD/BB decoupling                  {all, PLCPDP[F2]}
;pl13: f2 channel - power level for second CPD/BB decoupling           {default+lcnmr+triple_c,
PLCPD2[F2]}
; or   f2 channel - power level for Cbeta/CO decoupling                {triple+triple2, PLSH13[F2]}
;pl14: f2 channel - power level for cw saturation                      {default, PLNOE[F2]}
; or   f2 channel - power level for cw saturation                      {triple+triple2, PLCW[F2]}
; or   f2 channel - power level for low power decoupling               {lcnmr, PLUSER1[F2]}
;pl15: f2 channel - power level for TOCSY-spinlock                     {all, PLTOC[F2]}
;pl16: f3 channel - power level for CPD/BB decoupling                  {all, PLCPDP[F3]}
;pl17: f4 channel - power level for CPD/BB decoupling                  {all, PLCPDP[F4]}
;pl18: f1 channel - power level for 3-9-19-pulse (watergate)
{default+lcnmr+triple+triple2+triple_na, PL90[F1]}
;pl19: f1 channel - power level for CPD/BB decoupling
{default+lcnmr+triple+triple2+triple_na, PLCPDP[F1]}
;pl20: f1 channel - power level for Dante-z pulse                      {}
; or   f2 channel - power level for TOCSY-spinlock (higher sel.)       {triple_na, PLUSER5[F2]}
;pl21: f2 channel - power level for presaturation                      {default+lcnmr, PLCW[F2]}
;pl22: f3 channel - power level for presaturation                      {lcnmr, PLCW[F3]}
; or   f3 channel - power level for TOCSY-spinlock (higher sel.)       {triple_na, PLUSER4[F3]}
;pl23: f3 channel - power level for TOCSY-spinlock
{default+lcnmr+triple+triple_c, PLTOC[F3]}
; or   f3 channel - power level for Rexchange spinlock                 {triple2, PLUSER2{[F3]}
; or   f3 channel - power level for TOCSY-spinlock                     {triple_na, PLUSER3[F3]}
;pl24: f2 channel - power level for hd/hc decoupling                   {all, PLHD[F2]}
;pl25: f1 channel - power level for TOCSY spinlock (higher sel.)       {triple_na, PLUSER3[F1]}
; or   f3 channel - power level for T1rho spinlock                     {triple+triple2, PLUSER1[F3]}
;pl26: f2 channel - power level for cw decoupling                      {lcnmr, PLCPDP[F2]-18}
; or   f2 channel - power level for TOCSY spinlock (higher sel. II)    {triple_na, PLUSER3[F2]}
;pl27: f1 channel - power level for pulsed ROESY-spinlock              {default, PLROE[F1]}
; or   f1 channel - power level for cleanex spinlock                   {triple2, PLUSER1[F1]}
; or   f2 channel - power level for TOCSY spinlock (higher sel. III)   {triple_na, PLUSER4[F2]}
;pl28: f2 channel - power level for selective Ca or CO decoupling      {triple+triple2, PLSH10[F2]}
; or   f2 channel - power level for selective decoupling               {triple_na, PLSH6U[F2]}
;pl29: f2 channel - power level for simultaneous Ca and CO decoupling  {triple2, PLSH14[F2]}
;pl30: f2 channel - power level for bilev decoupling
{default+triple+triple2+triple_na, PLCPDP[F2]}
;pl31: f2 channel - power level for bilev decoupling
{default+triple+triple2+triple_na, PLUSER2[F2]}


;sp0 : f1 channel - shaped pulse 180 degree  (adiabatic TOCSY)            {}
; or   f2 channel - shaped pulse 180 degree  (two-fold modulated)         {triple_na, PLSH7U[F2]}
;sp1 : f1 channel - shaped pulse for selective excitation                 {default, PLSH1[F1]}
; or   f1 channel - shaped pulse for water flipback
{triple+triple2+triple_na, PLSH8[F1]}
;sp2 : f1 channel - shaped pulse 180 degree                               {default, PLSH2[F1]}
; or   f2 channel - shaped pulse  90 degree  (on resonance)               {triple+triple2,
PLSH4[F2]}
; or   f2 channel - shaped pulse  90 degree  (on resonance)               {triple_na, PLSH1U[F2]}
;sp3 : f2 channel - shaped pulse 180 degree  (adiabatic)                  {default, PLSH3[F2]}
; or   f2 channel - shaped pulse 180 degree  (on resonance)               {triple+triple2,
PLSH6[F2]}
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; or   f2 channel - shaped pulse 180 degree  (on resonance)              {triple_na, PLSH3U[F2]}
;sp4 : f2 channel - shaped pulse  90 degree  (off resonance)             {triple+triple2,
PLSH4[F2]}
;sp5 : f2 channel - shaped pulse 180 degree  (off resonance)             {triple+triple2,
PLSH6[F2]}
; or   f2 channel - shaped pulse 180 degree  (off resonance)             {triple_na, PLSH3U[F2]}
;sp6 : f1 channel - shaped pulse for presaturation
{default+lcnmr+triple+triple2+triple_na, PLSH7[F1]}
;sp7 : f1 channel - shaped pulse for wet                                 {lcnmr, PLSH3[F1]+0.87}
; or   f1 channel - shaped pulse 180 degree  (adiabatic)                 {triple_c, PLSH13[F1]}
; or   f2 channel - shaped pulse 180 degree  (adiabatic)                 {default, PLSH2[F2]}
; or   f2 channel - shaped pulse 180 degree  (off resonance2)            {triple+triple2,
PLSH6[F2]}
; or   f2 channel - shaped pulse 180 degree  (off resonance2)            {triple_na, PLSH3U[F2]}
;sp8 : f1 channel - shaped pulse for wet                                 {lcnmr, PLSH3[F1]-1.04}
; or   f2 channel - shaped pulse  90 degree  (on res., time reversed)    {triple+triple2,
PLSH5[F2]}
; or   f2 channel - shaped pulse  90 degree  (on res., time reversed)    {triple_na, PLSH2U[F2]}
;sp9 : f1 channel - shaped pulse for wet                                 {lcnmr, PLSH3[F1]+2.27}
; or   f2 channel - shaped pulse 180 degree  (higher selectivity)        {triple+triple2,
PLSH9[F2]}
; or   f3 channel - shaped pulse 180 degree  (on resonance)              {triple_na, PLSH1U[F3]}
;sp10: f1 channel - shaped pulse for tilted ROESY                        {}
; or   f1 channel - shaped pulse for wet                                 {lcnmr, PLSH3[F1]-5.05}
; or   f2 channel - shaped pulse  90 degree  (higher selectivity)        {triple+triple2,
PLSH7[F2]}
; or   f2 channel - shaped pulse  90 degree  (higher selectivity)        {triple_na, PLSH4U[F2]}
;sp11: f1 channel - shaped pulse for wet2                                {}
; or   f1 channel - shaped pulse for water flipback                      {default, PLSH8[F1]}
; or   f1 channel - shaped pulse for water flipback2
{triple+triple2+triple_na, PLSH9[F1]}
; or   f2 channel - shaped pulse for water flipback                      {triple_c, PLSH16[F2]}
;sp12: f1 channel - shaped pulse for wet2                                {}
; or   f2 channel - shaped pulse  90 degree  (higher sel., time rev.)    {triple+triple2,
PLSH8[F2]}
; or   f2 channel - shaped pulse  90 degree  (higher sel., time rev.)    {triple_na, PLSH5U[F2]}
;sp13: f1 channel - shaped pulse for wet2                                {}
; or   f1 channel - shaped pulse 180 degree  (adiabatic)                 {triple_c, PLSH12[F1]}
; or   f2 channel - shaped pulse 180 degree  (adiabatic)
{triple+triple2+triple_na, PLSH3[F2]}
;sp14: f1 channel - shaped pulse for wet2                                {}
; or   f2 channel - shaped pulse 180 degree  (adiabatic bilev decoupling) {default+triple+triple2,
PLSH12[F2]}
; or   f3 channel - shaped pulse 180 degree  (adiabatic)                 {triple_na, PLSH2U[F3]}
;sp15: f2 channel - shaped pulse 180 degree for decoupling (Ca or CO)    {triple, PLSH10[F2]}
; or   f2 channel - shaped pulse 180 degree for decoupling (Cbeta)       {triple2, PLSH13[F2]}
; or   f2 channel - shaped pulse 180 degree for decoupling (C')          {triple_na, PLSH6U[F2]}
;sp16: f2 channel - shaped pulse 180 degree  (higher sel., off res.)    {triple+triple2,
PLSH9[F2]}
;sp17: f2 channel - shaped pulse 180 degree  (higher sel., off res.)    {triple+triple2,
PLSH9[F2]}
;sp18: f2 channel - shaped pulse 180 degree  (adiabatic matched sweep)  {default+triple,
PLSH15[F2]}
;sp19: f1 channel - shaped pulse for wet                                 {default, PLSH3[F1]+0.87}
; or   f2 channel - shaped pulse  90 degree  (NH)                        {triple_c, PLSH14[F2]}
; or   f3 channel - shaped pulse  90 degree  (T1rho, adiabatic ramp up)  {triple2, PLSH1[F3]}
;sp20: f1 channel - shaped pulse for wet                                 {default, PLSH3[F1]-1.04}
; or   f2 channel - shaped pulse  90 degree  (NH, time reversed)         {triple_c, PLSH15[F2]}
; or   f3 channel - shaped pulse  90 degree  (T1rho, adiabatic ramp down) {triple2, PLSH2[F3]}
;sp21: f1 channel - shaped pulse for wet                                 {default, PLSH3[F1]+2.27}
; or   f1 channel - shaped pulse 180 degree  (cleanex, H2O)              {triple2, PLSH11[F1]}
;sp22: f1 channel - shaped pulse for wet                                 {default, PLSH3[F1]-5.05}
; or   f1 channel - shaped pulse  90 degree  (cleanex, H2O)              {triple2, PLSH10[F1]}
; or   f1 channel - shaped pulse 180 degree  (off resonance)             {triple_c, PLSH6[F1]}
;sp23: f1 channel - shaped pulse  90 degree  (on resonance)             {triple_c, PLSH4[F1]}
; or   f1 channel - shaped pulse 180 degree  (off resonance)             {triple_na, PLSH1U[F1]}
;sp24: f1 channel - shaped pulse 180 degree  (on resonance)             {triple_c, PLSH6[F1]}
; or   f1 channel - shaped pulse 180 degree  (off resonance2)            {triple_na, PLSH1U[F1]}
;sp25: f1 channel - shaped pulse  90 degree  (on res., time reversed)    {triple_c, PLSH5[F1]}
; or   f2 channel - shaped pulse 180 degree  (higher selectivity)        {triple_na, PLSH6U[F2]}
;sp26: f1 channel - shaped pulse 180 degree  (off resonance)             {triple_c, PLSH6[F1]}
;sp27: f1 channel - shaped pulse 180 degree  (off resonance)             {triple_c, PLSH6[F1]}
;sp28: f1 channel - shaped pulse 180 degree  (higher selectivity)        {triple_c, PLSH14[F1]}
;sp29: f1 channel - shaped pulse 180 degree  (off resonance)             {triple_c, PLSH6[F1]}
; or   f1 channel - shaped pulse 180 degree  (adiabatic sweep: z-spoil)  {default, PLSH16[F1]}
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;sp30: f1 channel - shaped pulse 180 degree  (sim. Ca + CO)                {triple_c, PLSH15[F1]}
; or   f2 channel - shaped pulse 180 degree for decoupling (sim. Ca + CO)  {triple2, PLSH14[F2]}
;sp31: f2 channel - shaped pulse 180 degree  (adiabatic bilev decoupling)
{default+triple+triple2+triple_na, PLSH11[F2]}


;p0 :                                                                      {all, P90[F1]}
;p1 : f1 channel -  90 degree high power pulse                             {all, P90[F1]}
;p2 : f1 channel - 180 degree high power pulse                             {all, P90[F1]*2}
;p3 : f2 channel -  90 degree high power pulse                             {all, P90[F2]}
;p4 : f2 channel - 180 degree high power pulse                             {all, P90[F2]*2}
;p5 : f1 channel -  60 degree low power pulse                              {all, PTOC[F1]*0.66}
;p6 : f1 channel -  90 degree low power pulse                              {all, PTOC[F1]}
;p7 : f1 channel - 180 degree low power pulse
{default+lcnmr+triple+triple_c, PTOC[F1]*2}
; or  f1 channel - 180 degree shaped pulse (cleanex sel. H2O)              {triple2, PSH11[F1]}
; or  f2 channel -  90 degree pulse at pl20 (TOCSY, higher sel.)           {triple_na, PUSER5[F2]}
;p8 : f2 channel -  60 degree low power pulse                              {}
; or  f1 channel -  90 degree shaped pulse (wet)                           {default, PSH3[F1]}
; or  f1 channel - 180 degree shaped pulse (adiabatic)                     {triple_c, PSH12[F1]}
; or  f2 channel - 180 degree shaped pulse (adiabatic)                     {triple+triple2+triple_na,
PSH3[F2]}
;p9 : f2 channel -  90 degree low power pulse (TOCSY)                      {all, PTOC[F2]}
;p10: f1 channel -  90 degree low power pulse (cleanex spinlock)           {triple2, PUSER1[F1]}
; or  f2 channel - 180 degree low power pulse
{default+lcnmr+triple+triple_c, PTOC[F2]*2}
; or  f2 channel - 180 degree shaped pulse (higher selectivity)            {triple_na, PSH6U[F2]}
;p11: f1 channel -  90 degree shaped pulse (selective excitation)          {default, PSH1[F1]}
; or  f1 channel -  90 degree shaped pulse (selective excitation)          {triple_c, PSH4[F1]}
; or  f1 channel -  90 degree shaped pulse (wet)                           {lcnmr, PSH3[F1]}
; or  f1 channel -  90 degree shaped pulse (water flipback/watergate)      {triple+triple2+triple_na,
PSH8[F1]}
;p12: f1 channel - 180 degree shaped pulse (H, selective)                  {default+lcnmr, PSH2[F1]}
; or  f1 channel - 180 degree shaped pulse (C, adiabatic)                  {default+lcnmr, PSH2[F1]}
; or  f1 channel - 180 degree shaped pulse (C, selective)                  {triple_c, PSH6[F1]}
; or  f1 channel - 180 degree shaped pulse (excitation sculpting)          {triple+triple2, PSH8[F1]*2}
; or  f1 channel - 180 degree shaped pulse (H, selective)                  {triple_na, PSH1U[F1]}
;p13: f2 channel -  90 degree shaped pulse                                 {triple+triple2, PSH4[F2]}
; or  f2 channel -  90 degree shaped pulse                                 {triple_na, PSH1U[F2]}
; or  f2 channel -  90 degree shaped pulse (H, selective)                  {triple_c, PSH15[F2]}
;p14: f2 channel - 180 degree shaped pulse (adiabatic)                     {default+lcnmr, PSH3[F2]}
; or  f2 channel - 180 degree shaped pulse (selective)                     {triple+triple2, PSH6[F2]}
; or  f2 channel - 180 degree shaped pulse (selective)                     {triple_na, PSH3U[F2]}
;p15: f1 channel - pulse for ROESY spinlock                                {default+lcnmr, TROE[F1]}
; or  f1 channel -  90 degree shaped pulse (cleanex sel. H2O)              {triple2, PSH10[F1]}
; or  f2 channel - 180 degree shaped pulse (adiabatic matched sweep)       {triple, PSH15[F2]}
; or  f2 channel -  90 degree shaped pulse (higher selectivity)            {triple_na, PSH4U[F2]}
;p16: homospoil/gradient pulse                                             {all, P_grad1}
;p17: f1 channel - trim pulse at pl10 or pl15                              {all, P_mlev}
;p18: f1 channel - shaped pulse (off resonance presaturation)
{default+lcnmr+triple+triple2+triple_na, PSH7[F1]}
;p19: homospoil/gradient pulse 2                                          {all, P_grad2}
;p20: f2 channel - trim pulse                                             {all, P_mlev}
;p21: f3 channel -  90 degree high power pulse                            {all, P90[F3]}
;p22: f3 channel - 180 degree high power pulse                            {all, P90[F3]*2}
;p23: f2 channel -  90 degree shaped pulse (higher selectivity)           {triple+triple2, PSH7[F2]}
; or  f2 channel -  90 degree shaped pulse (twofold modulated)            {triple_na, PSH7U[F2]}
; or  f4 channel -  90 degree high power pulse                            {default, P90[F4]}
;p24: f1 channel - 180 degree shaped pulse (adiabatic)                    {triple_c, PSH13[F1]}
; or  f2 channel - 180 degree shaped pulse (adiabatic)                    {default+lcnmr, PSH2[F2]}
; or  f2 channel - 180 degree shaped pulse (higher selectivity)           {triple+triple2, PSH9[F2]}
; or  f3 channel -  90 degree pulse at pl22 (TOCSY, higher sel.)          {triple_na, PUSER4[F3]}
; or  f4 channel - 180 degree high power pulse                            {}
;p25: f1 channel -  90 degree pulse at pl27 (pulsed ROESY)                {default+lcnmr, PROE[F1]*2}
; or  f1 channel -  90 degree shaped pulse (higher selectivity)           {triple_c, PSH14[F1]}
; or  f3 channel - pulse for t1rho experiment                              {pp}
; or  f3 channel - pulse for TOCSY-spinlock experiment                     {triple}
; or  f3 channel -  90 degree pulse at pl23 (TOCSY)                       {triple_na, PUSER3[F3]}
; or  f3 channel - 180 degree low power pulse (Rexchange)                 {triple2, PUSER2[F3]*2}
;p26: f1 channel -  90 degree pulse at pl19                               {triple*, PCPDP[F1]}
;p27: f1 channel -  90 degree pulse at pl18 (3-9-19 watergate)
{default+lcnmr+triple+triple2+triple_na, P90[F1]}
;p28: f1 channel -  trim pulse at pl1                                     {all, P_hsqc}
;p29: f1 channel -  90 degree shaped pulse (water flipback)               {default, PSH8[F1]}
; or  f1 channel -  90 degree shaped pulse (water flipback2)              {triple+triple_na, PSH9[F1]}
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; or  f2 channel -  90 degree shaped pulse (water flipback)           {triple_c, PSH16[F2]}
; or  f3 channel -  90 degree shaped pulse (T1rho adiabatic ramp)     {triple2, PSH1[F3]}
; or  homospoil/gradient pulse 3                                      {pp}
;p30: f1 channel - 180 degree shaped pulse (sim. Ca + CO)            {triple_c, PSH15[F1]}
; or  f2 channel - 180 degree shaped pulse (sim. Ca + CO decoupling)  {triple2, PSH14[F2]}
; or  f3 channel - 180 degree pulse at pl23                          {triple, PTOC[F3]*2}
; or  f3 channel - 180 degree shaped pulse                           {triple_na, PSH1U[F3]}
; or  homospoil/gradient pulse 4                                     {pp}
; or  gradient pulse for diffusion (dosy)                            {}
;p31: f2 channel - 180 degree shaped pulse (adiabatic matched sweep) {default, PSH15[F2]}
; or  f2 channel - 180 degree shaped pulse (sel. Ca or CO decoupling) {triple, PSH10[F2]}
; or  f2 channel - 180 degree shaped pulse (Cbeta decoupling)        {triple2, PSH13[F2]}
; or  f2 channel - 180 degree shaped pulse (sel. C decoupling)       {triple_na, PSH6U[F2]}
; or  f2 channel - 180 degree pulse (low power decoupling)           {lcnmr, PUSER1[F2]}
; or  homospoil/gradient pulse 5                                     {pp}
;p32: f1 channel - 180 degree shaped pulse (adiabatic sweep: z-spoil) {default, PSH16[F1]}
; or  f3 channel - 180 degree shaped pulse (adiabatic)               {triple_na, PSH2U[F3]}
;p33: f3 channel - trim pulse                                        {triple_na, P_mlev}
;p63: f2 channel - 180 degree shaped pulse (adiabatic bilev sweep)
{default+triple+triple2+triple_na, PSH11[F2]}


;d0 : incremented delay (2D or 3D)                  [3 usec]
;d1 : relaxation delay; 1-5 * T1
;d2 : 1/(2J)
;d3 : 1/(3J) or 1/(6J)
;d4 : 1/(4J)
;d5 : DE/2
;d6 : delay for evolution of long range couplings
;d7 : delay for inversion recovery
;d8 : NOESY mixing time
;d9 : TOCSY mixing time                                              {all, TTOC[F1]}
;d10: incremented delay (3D)
;d11: delay for disk I/O                            [30 msec]
;d12: delay for power switching                     [20 usec]
;d13: short delay                                   [4 usec]
;d14: delay for evolution after shaped pulse
;d15: TOCSY mixing time (CC)                                         {triple*, TTOC[F2]}
;d16: delay for homospoil/gradient recovery                          {all, D_grad}
;d17: delay for DANTE pulse-train
;d18: delay for evolution of long range couplings
;d19: delay for binomial water suppression
;d20: for different applications
;d21: for different applications
;d22: 1/(2J(XY))
;d23: 1/(4J(XY)) or 1/(2J(XY))
;d24: for different applications
;d25: 1/(6J(YH)) or 1/(8J(XY))
;d26: 1/(4J(YH))
;d27: for different applications
;d28: for different applications
;d29: for different applications
;d30: for different applications
;d31: for different applications


;cnst0 : for protein experiments - N chemical shift (offset, in ppm)
; or     for na experiments - calculated chemical shift (offset, in ppm)
; or     for na experiments - N(aro) chemical shift (offset, in ppm)        [195 ppm]
;cnst1 : J (HH)
;cnst2 : J (XH)
;cnst3 : J (XX)
;cnst4 : J (YH)
;cnst5 : J (XY)
;cnst6 : J (XH)min
;cnst7 : J (XH)max
;cnst8 : bandwidth of excitation for Dante-z pulse
;cnst9 : for different applications as J
;cnst10: for different applications as J
;cnst11: for multiplicity selection
;cnst12: for multiplicity selection
;cnst13: J (XH) long range
;cnst14: J (XH) long range (min)
;cnst15: J (XH) long range (max)
;cnst16: J-scale factor
```

```
; or     for na experiments - H6/8 and/or H1' chemical shift (offset, in ppm)
;cnst17: factor to compensate for coupling evolution during a pulse
; or     for na experiments - H1' chemical shift (offset, in ppm)
;cnst18: for protein experiments - H2O chemical shift (offset, in ppm)
; or     for na experiments - H2O chemical shift (offset, in ppm)
;cnst19: for protein experiments - H(N) chemical shift (offset, in ppm)
; or    : for na experiments - H(N) chemical shift (offset, in ppm)
;cnst20: for protein experiments - Haliphatic chemical shift (offset, in ppm)
;cnst21: for na experiments - C1' chemical shift (offset, in ppm)            [90 ppm]
; or     for protein experiments - CO chemical shift (offset, in ppm)
;cnst22: for protein experiments - Calpha chemical shift (offset, in ppm)
; or     for na experiments - C6/8 chemical shift (offset, in ppm)           [137 ppm]
;cnst23: for protein experiments - Caliphatic chemical shift (offset, in ppm)
; or     for na experiments - C2' chemical shift (offset, in ppm)            [72 ppm]
;cnst24: for protein experiments - Caromatic chemical shift (offset, in ppm)
; or     for na experiments - C4 (C/U) chemical shift (offset, in ppm)       [169 ppm]
;cnst25: for protein experiments - flag for cross peak / reference experiments
; or     for na experiments - C6 (A) chemical shift (offset, in ppm)         [160 ppm]
;cnst26: for protein experiments - Call chemical shift (offset, in ppm)
; or     for na experiments - C5 (G) chemical shift (offset, in ppm)         [119 ppm]
;cnst27: for protein experiments - ( Cgamma chemical shift (offset, in ppm) )
; or     for na experiments - C2/4 chemical shift (offset, in ppm)           [152 ppm]
;cnst28: for protein experiments - Haromatic chemical shift (offset, in ppm)
; or     for na experiments - C5 (C/U) chemical shift (offset, in ppm)       [105 ppm]
;cnst29: for protein experiments - N(H) chemical shift (offset, in ppm)
; or     for na experiments - C(aro) chemical shift (offset, in ppm)         [145 ppm]
;cnst30: for protein experiments - Cbeta chemical shift (offset, in ppm)
; or     for na experiments - N(H) chemical shift (offset, in ppm)           [151 ppm]
;cnst31: scaling factor
; or     for na experiments - N(H2) chemical shift (offset, in ppm)          [81 ppm]


;vc : variable loop counter, taken from vc-list
;vd : variable delay, taken from vd-list

;l1 : loop for spinlock cycle
;l2 : loop for GARP cycle: l2 * 31.75 * 4 * p9 => AQ
;l3 : loop for phase sensitive 2D or 3D using
;       States et al. or States-TPPI method: l3 = td1/2
;l4 : for different applications
;l5 : for different applications
;l6 : loop for shaped pulse presaturation during relaxation delay
;l7 : loop for shaped pulse presaturation during mixing time
;l8 : number of frequencies for multiple presaturation
;l11: loop for spinlock cycle 2



;$Id: $
```

```
;Relations.info
;avance-version (05/10/24)
;
;$CLASS=HighRes Info
;$COMMENT=


;The following convention is used for power levels, pulses, delays
;and loop counters in the different relation files for prosol:
;
;all = default + lcnmr + triple + triple2 + triple_c + triple_na
;triple* = triple + triple2 + triple_c + triple_na
;!__ = except
;
;prosol par.     rel. file        pulseprogram parameter
;
;D_grad          all              d16: delay for homospoil/gradient recovery
;
;P90[F1]         all                      p0 :
;P90[F1]         all                      p1 : f1 channel -  90 degree high power pulse
;P90[F1]         all(!triple_c)           p27: f1 channel -  90 degree pulse at pl18 (3-9-19
watergate)
;P90[F1]*2       all                      p2 : f1 channel - 180 degree high power pulse
;P90[F2]         all                      p3 : f2 channel -  90 degree high power pulse
;P90[F2]*2       all                      p4 : f2 channel - 180 degree high power pulse
;P90[F3]         all                      p21: f3 channel -  90 degree high power pulse
;P90[F3]*2       all                      p22: f3 channel - 180 degree high power pulse
;P90[F4]         default                  p23: f4 channel -  90 degree high power pulse
;
;PCPDP[F1]       triple+triple2+triple_na p26: f1 channel -  90 degree pulse at pl19
;
;PL90[F1]        all                      pl1 : f1 channel - power level for pulse (default)
;PL90[F1]        all(!triple_c)           pl18: f1 channel - power level for 3-9-19-pulse
(watergate)
;PL90[F2]        all                      pl2 : f2 channel - power level for pulse (default)
;PL90[F3]        all                      pl3 : f3 channel - power level for pulse (default)
;PL90[F4]        all                      pl4 : f4 channel - power level for pulse (default)
;
;PLCPDP[F1]      all(!triple_c)           pl19: f1 channel - power level for CPD/BB decoupling
;PLCPDP[F2]      all                      pl12: f2 channel - power level for CPD/BB decoupling
;PLCPDP[F2]      default+triple+triple2    pl30: f2 channel - power level for CPD/BB decoupling
;                   +triple_na
;PLCPDP[F2]-18   lcnmr                    pl26: f2 channel - power level for cw decoupling
;PLCPDP[F3]      all                      pl16: f3 channel - power level for CPD/BB decoupling
;PLCPDP[F4]      all                      pl17: f4 channel - power level for CPD/BB decoupling
;PLCPD2[F2]      default+lcnmr+triple_c    pl13: f2 channel - power level for second CPD/BB
decoupling
;
;PLCW[F1]        all(!triple_c)           pl9 : f1 channel - power level for presaturation
;PLCW[F2]        default+lcnmr            pl21: f2 channel - power level for presaturation
;PLCW[F2]        triple+triple2           pl14: f2 channel - power level for cw saturation
;PLCW[F3]        lcnmr                    pl22: f3 channel - power level for presaturation
;
;PLHD[F2]        all                      pl24: f2 channel - power level for hd/hc decoupling
;
;PLNOE[F2]       default                  pl14: f2 channel - power level for cw saturation
;
;PLROE[F1]       all                      pl11: f1 channel - power level for ROESY-spinlock
;PLROE[F1]       default                  pl27: f1 channel - power level for pulsed ROESY-spinlock
;
;PLSH1[F1]       default                  sp1 : f1 channel - shaped pulse for selective excitation
;PLSH1[F3]       triple2                  sp19: f3 channel - shaped pulse  90 degree (T1rho,
adiab. ramp up)
;PLSH2[F1]       default                  sp2 : f1 channel - shaped pulse 180 degree
;PLSH2[F2]       default                  sp7 : f2 channel - shaped pulse 180 degree  (adiabatic)
;PLSH2[F3]       triple2                  sp20: f3 channel - shaped pulse  90 degree (T1rho,
adiab. ramp down)
;PLSH3[F1]       lcnmr                    sp1 : f1 channel - shaped pulse for wet
;PLSH3[F1]       lcnmr                    sp2 : f1 channel - shaped pulse for wet
;PLSH3[F1]+0.87  lcnmr                    sp7 : f1 channel - shaped pulse for wet
;PLSH3[F1]+0.87  default                  sp19: f1 channel - shaped pulse for wet
;PLSH3[F1]-1.04  lcnmr                    sp8 : f1 channel - shaped pulse for wet
;PLSH3[F1]-1.04  default                  sp20: f1 channel - shaped pulse for wet
;PLSH3[F1]+2.27  lcnmr                    sp9 : f1 channel - shaped pulse for wet
;PLSH3[F1]+2.27  default                  sp21: f1 channel - shaped pulse for wet
;PLSH3[F1]-5.05  lcnmr                    sp10: f1 channel - shaped pulse for wet
;PLSH3[F1]-5.05  default                  sp22: f1 channel - shaped pulse for wet
```



```
;PLSH3[F2]       default                  sp3 : f2 channel - shaped pulse 180 degree  (adiabatic)
;PLSH3[F2]       triple+triple2+triple_na sp13: f2 channel - shaped pulse 180 degree  (adiabatic)
;PLSH4[F1]       triple_c                 sp23: f1 channel - shaped pulse  90 degree  (on
resonance)
;PLSH4[F2]       triple+triple2           sp2 : f2 channel - shaped pulse  90 degree  (on
resonance)
;PLSH4[F2]       triple+triple2           sp4 : f2 channel - shaped pulse  90 degree  (off
resonance)
;PLSH5[F1]       triple_c                 sp25: f1 channel - shaped pulse  90 degree  (on
resonance)
;PLSH5[F2]       triple+triple2           sp8 : f2 channel - shaped pulse  90 degree  (on res.,
time reversed)
;PLSH6[F1]       triple_c                 sp22: f1 channel - shaped pulse 180 degree  (off
resonance)
;PLSH6[F1]       triple_c                 sp24: f1 channel - shaped pulse 180 degree  (on
resonance)
;PLSH6[F1]       triple_c                 sp26: f1 channel - shaped pulse 180 degree  (off
resonance)
;PLSH6[F1]       triple_c                 sp27: f1 channel - shaped pulse 180 degree  (off
resonance)
;PLSH6[F1]       triple_c                 sp29: f1 channel - shaped pulse 180 degree  (off
resonance)
;PLSH6[F2]       triple+triple2           sp3 : f2 channel - shaped pulse 180 degree  (on
resonance)
;PLSH6[F2]       triple+triple2           sp5 : f2 channel - shaped pulse 180 degree  (off
resonance)
;PLSH6[F2]       triple+triple2           sp7 : f2 channel - shaped pulse 180 degree  (off
resonance2)
;PLSH7[F1]       all(!triple_c)           sp6 : f1 channel - shaped pulse for presaturation
;PLSH7[F2]       triple*                  sp10: f2 channel - shaped pulse  90 degree  (higher
selectivity)
;PLSH8[F1]       triple+triple2+triple_na sp1 : f1 channel - shaped pulse for water flipback
;PLSH8[F1]       default                  sp11: f1 channel - shaped pulse for water flipback
;PLSH8[F2]       triple+triple2           sp12: f2 channel - shaped pulse  90 degree  (higher
sel., time rev.)
;PLSH9[F1]       triple+triple2+triple_na sp11: f1 channel - shaped pulse for water flipback2
;PLSH9[F2]       triple+triple2           sp9 : f2 channel - shaped pulse 180 degree  (higher
selectivity)
;PLSH9[F2]       triple+triple2           sp16: f2 channel - shaped pulse 180 degree  (higher
selectivity)
;PLSH9[F2]       triple+triple2           sp17: f2 channel - shaped pulse 180 degree  (higher
selectivity)
;PLSH10[F1]      triple2                  sp22: f1 channel - shaped pulse  90 degree (H2O on
resonance)
;PLSH10[F2]      triple                   sp15: f2 channel - shaped pulse 180 degree for
decoupling (Ca or CO)
;PLSH10[F2]      triple+triple2           pl28: f2 channel - power level for selective Ca or CO
decoupling
;PLSH11[F1]      triple2                  sp21: f1 channel - shaped pulse 180 degree (H2O on
resonance)
;PLSH11[F2]      default+triple+triple2   sp31: f2 channel - shaped pulse 180 degree (adiabatic
decoupling)
;                   +triple_na
;PLSH12[F1]      triple_c                 sp13: f1 channel - shaped pulse 180 degree  (adiabatic)
;PLSH12[F2]      default+triple+triple2   sp14: f2 channel - shaped pulse 180 degree (adiabatic
bilev decoupling)
;PLSH13[F1]      triple_c                 sp7 : f2 channel - shaped pulse 180 degree  (adiabatic)
;PLSH13[F2]      triple+triple2           pl13: f2 channel - power level for Cbeta/CO decoupling
;PLSH13[F2]      triple2                  sp15: f2 channel - shaped pulse 180 degree for
decoupling (Cbeta)
;PLSH14[F1]      triple_c                 sp28: f1 channel - shaped pulse 180 degree  (higher
selectivity)
;PLSH14[F2]      triple2                  pl29: f2 channel - power level for simultaneous Ca and
CO decoupling
;PLSH14[F2]      triple2                  sp30: f2 channel - power level for simultaneous Ca and
CO decoupling
;PLSH14[F2]      triple_c                 sp19: f2 channel - shaped pulse  90 degree (HN)
;PLSH15[F1]      triple_c                 sp30: f1 channel - shaped pulse 180 degree  (sim. Ca +
CO decoupling)
;PLSH15[F2]      default+triple           sp18: f2 channel - shaped pulse 180 degree  (adiabatic
matched sweep)
;PLSH15[F2]      triple_c                 sp20: f2 channel - shaped pulse  90 degree (HN tr)
;PLSH16[F1]      default                  sp29: f1 channel - shaped pulse 180 degree  (adiabatic:
z-spoil)
;PLSH16[F2]      triple_c                 sp11: f2 channel - shaped pulse  90 degree (water
flipback)
;
```



```
;PLSH1U[F1]      triple_na                sp23: f1 channel - shaped pulse 180 degree (_NA: H)
;PLSH1U[F1]      triple_na                sp24: f1 channel - shaped pulse 180 degree (_NA: H)
;PLSH1U[F2]      triple_na                sp2 : f2 channel - shaped pulse  90 degree (_NA: C)
;PLSH1U[F3]      triple_na                sp9 : f3 channel - shaped pulse 180 degree (_NA: N)
;PLSH2U[F2]      triple_na                sp8 : f2 channel - shaped pulse  90 degree (_NA: C, tr)
;PLSH2U[F3]      triple_na                sp14: f3 channel - shaped pulse 180 degree (_NA: N,
adiabatic)
;PLSH3U[F2]      triple_na                sp3 : f2 channel - shaped pulse 180 degree (_NA: C)
;PLSH3U[F2]      triple_na                sp5 : f2 channel - shaped pulse 180 degree (_NA: C)
;PLSH3U[F2]      triple_na                sp7 : f2 channel - shaped pulse 180 degree (_NA: C)
;PLSH4U[F2]      triple_na                sp10: f2 channel - shaped pulse  90 degree (_NA: C,
higher sel.)
;PLSH5U[F2]      triple_na                sp12: f2 channel - shaped pulse  90 degree (_NA: C,
higher sel., tr)
;PLSH6U[F2]      triple_na                sp15: f2 channel - shaped pulse 180 degree (_NA: C,
decoupling)
;PLSH6U[F2]      triple_na                sp25: f2 channel - shaped pulse 180 degree (_NA: C,
higher sel.)
;PLSH6U[F2]      triple_na                pl28: f2 channel - shaped pulse 180 degree (_NA: C,
decoupling)
;PLSH7U[F2]      triple_na                sp0 : f2 channel - shaped pulse 180 degree (_NA: C,
twofold mod)
;
;PLTOC[F1]       all                      pl10: f1 channel - power level for TOCSY-spinlock
;PLTOC[F2]       all                      pl15: f2 channel - power level for TOCSY-spinlock
;PLTOC[F3]       all(!triple2+triple_na)  pl23: f3 channel - power level for TOCSY-spinlock
;
;PLUSER1[F1]     triple2                  pl27: f1 channel - power level for CLEANEX spinlock
;PLUSER1[F2]     lcnmr                    pl14: f2 channel - power level for low power decoupling
;PLUSER1[F3]     triple*                  pl25: f3 channel - power level for T1rho spinlock
;PLUSER2[F2]     default+triple+triple2   pl31: f2 channel - power level for bilev dec. (cw part)
;                  +triple_na
;PLUSER2[F3]     triple2                  pl23: f3 channel - power level for Rexchange
;PLUSER3[F1]     triple_na                pl25: f1 channel - power level for hetero TOCSY
;PLUSER3[F2]     triple_na                pl26: f2 channel - power level for hetero TOCSY
;PLUSER3[F3]     triple_na                pl23: f3 channel - power level for hetero TOCSY
;PLUSER4[F2]     triple_na                pl27: f2 channel - power level for hetero TOCSY higher
sel.
;PLUSER4[F3]     triple_na                pl22: f3 channel - power level for hetero TOCSY higher
sel.
;PLUSER5[F2]     triple_na                pl20: f2 channel - power level for TOCSY higher sel.
;
;PROE[F1]*2      default+lcnmr            p25: f1 channel -  90 degree pulse at pl27 (pulsed
ROESY)
;
;PSH1[F1]        default                  p11: f1 channel -  90 degree shaped pulse (selective
excitation)
;PSH1[F3]        triple2                  p29: f3 channel - shaped pulse for adiabatic ramping
;PSH2[F1]        default+lcnmr            p12: f1 channel - 180 degree shaped pulse (C, adiabatic)
;PSH2[F1]        default+lcnmr            p12: f1 channel - 180 degree shaped pulse (H, selective)
;PSH2[F2]        default+lcnmr            p24: f2 channel - 180 degree shaped pulse (adiabatic)
;PSH3[F1]        lcnmr                    p11: f1 channel -  90 degree shaped pulse (wet)
;PSH3[F1]        default                  p8 : f1 channel -  90 degree shaped pulse (wet)
;PSH3[F2]        default+lcnmr            p14: f2 channel - 180 degree shaped pulse (adiabatic)
;PSH3[F2]        triple+triple2+triple_na p8 : f2 channel - 180 degree shaped pulse (adiabatic)
;PSH4[F1]        triple_c                 p11: f1 channel -  90 degree shaped pulse
;PSH4[F2]        triple+triple2           p13: f2 channel -  90 degree shaped pulse
;PSH6[F1]        triple_c                 p12: f1 channel - 180 degree shaped pulse (selective)
;PSH6[F2]        triple+triple2           p14: f2 channel - 180 degree shaped pulse (selective)
;PSH7[F1]        all(!triple_c)           p18: f1 channel - shaped pulse (off resonance
presaturation)
;PSH7[F2]        triple+triple2           p23: f2 channel -  90 degree shaped pulse (higher
selectivity)
;PSH8[F1]        triple+triple2+triple_na p11: f1 channel -  90 degree shaped pulse (water
flipback/watergate)
;PSH8[F1]*2      triple+triple2           p12: f1 channel - 180 degree shaped pulse (excitation
sculpting)
;PSH8[F1]        default                  p29: f1 channel -  90 degree shaped pulse (water
flipback)
;PSH9[F1]        triple+triple_na         p29: f1 channel -  90 degree shaped pulse (water
flipback2)
;PSH9[F2]        triple+triple2           p24: f2 channel - 180 degree shaped pulse (higher
selectivity)
;PSH10[F1]       triple2                  p15: f1 channel -  90 degree shaped pulse (H2O on
resonance)
;PSH10[F2]       triple                   p31: f2 channel - 180 degree shaped pulse (sel. Ca or CO
decoupling)
```



```
;PSH11[F1]       triple2                 p7 : f1 channel - 180 degree shaped pulse (H2O on
resonance)
;PSH11[F2]       default+triple+triple2  p63 : f2 channel - 180 degree shaped pulse (adiabatic
decoupling)
;                   +triple_na
;PSH12[F1]       triple_c                p8 : f1 channel - 180 degree shaped pulse (adiabatic)
;PSH13[F1]       triple_c                p24: f1 channel - 180 degree shaped pulse (adiabatic)
;PSH13[F2]       triple*                 pcpd8: f2 channel - 180 degree shaped pulse (Cbeta
decoupling)
;PSH13[F2]       triple2                 p31: f2 channel - 180 degree shaped pulse (Cbeta
decoupling)
;PSH14[F1]       triple_c                p25: f1 channel - 180 degree shaped pulse (higher
selectivity)
;PSH14[F2]       triple2                 p30: f2 channel - 180 degree shaped pulse (sim. Ca + CO
decoupling)
;PSH15[F1]       default                 p31: f1 channel - 180 degree shaped pulse for inversion
(adiabatic matched sweep)
;PSH15[F1]       triple_c                p30: f1 channel - 180 degree shaped pulse (sim. Ca + CO
decoupling)
;PSH15[F2]       triple                  p15: f2 channel - 180 degree shaped pulse for inversion
(adiabatic matched sweep)
;PSH15[F2]       triple_c                p13: f2 channel -  90 degree shaped pulse (H, selective)
;PSH16[F1]       default                 p32: f1 channel - 180 degree shaped pulse for inversion
(adiabatic: z-spoil)
;PSH16[F2]       triple_c                p29: f2 channel -  90 degree shaped pulse for inversion
(water flipback)
;
;PSH1U[F1]       triple_na               p12: f1 channel - 180 degree shaped pulse (_NA: H)
;PSH1U[F2]       triple_na               p13: f2 channel -  90 degree shaped pulse (_NA: C)
;PSH1U[F3]       triple_na               p30: f3 channel - 180 degree shaped pulse (_NA: N)
;PSH2U[F3]       triple_na               p32: f3 channel - 180 degree shaped pulse (_NA: N,
adiabatic)
;PSH3U[F2]       triple_na               p14: f2 channel - 180 degree shaped pulse (_NA: C)
;PSH4U[F2]       triple_na               p15: f2 channel -  90 degree shaped pulse (_NA: C,
higher sel.)
;PSH6U[F2]       triple_na               p10: f2 channel - 180 degree shaped pulse (_NA: C,
higher sel.)
;PSH6U[F2]       triple_na               p31: f2 channel - 180 degree shaped pulse (_NA: C,
decoupling)
;PSH7U[F2]       triple_na               p23: f2 channel - 180 degree shaped pulse (_NA: C,
twofold mod)
;
;PTOC[F1]        all                     p6 : f1 channel -  90 degree low power pulse
;PTOC[F1]*0.66   all(!triple_na)         p5 : f1 channel -  60 degree low power pulse
;PTOC[F1]*2      all(!triple2+triple_na) p7 : f1 channel - 180 degree low power pulse
;PTOC[F2]        all                     p9 : f2 channel -  90 degree low power pulse
;PTOC[F2]*2      all(!triple2+triple_na) p10: f2 channel - 180 degree low power pulse
;PTOC[F3]        triple                  p25: f3 channel -  90 degree pulse at pl23
;PTOC[F3]*2      triple                  p30: f3 channel - 180 degree pulse at pl23
;
;PUSER1[F1]      triple2                 p10: f1 channel - 180 degree low power pulse (CLEANEX
spinlock)
;PUSER1[F2]      lcnmr                   p31: f2 channel -  90 degree low power pulse
(decoupling)
;PUSER2[F3]*2    triple2                 p25: f3 channel - 180 degree low power pulse (Rexchange)
;PUSER3[F3]      triple_na               p25: f3 channel -  90 degree low power pulse (hetero
TOCSY)
;PUSER4[F3]      triple_na               p24: f3 channel -  90 degree low power pulse (hetero
TOCSY higher sel.)
;PUSER5[F2]      triple_na               p7 : f2 channel -  90 degree low power pulse (TOCSY
higher sel.)
;
;P_grad1         all                     p16: homospoil/gradient pulse
;P_grad2         all                     p19: homospoil/gradient pulse 2
;P_hsqc          all                     p28: f1 channel -  trim pulse at pl1
;P_mlev          all                     p17: f1 channel - trim pulse at pl10
;P_mlev          all(!lcnmr)             p20: f2 channel - trim pulse at pl15
;P_mlev          triple_na               p33: f3 channel - trim pulse at pl23
;
;TROE[F1]        default+lcnmr           p15: f1 channel - pulse for ROESY spinlock
;
;TTOC[F1]        all                     d9 : TOCSY mixing time
;TTOC[F2]        triple*                 d15: TOCSY mixing time (CC)


;$Id: $
```