Supplementary Materials

1) Pulse sequence

```
#include <Avance.incl>
#include <Delay.incl>

"p5=p1*2"
"p12=p11*2"
"d0=0u"
"d6=(l6)*(1s/cnst31)-(p1)"
"d8=(l8)*(1s/cnst31)-(p1)"
"d7=(l6-l16)*(1s/cnst31)-(p1)"
"d3=(l3)*(1s/cnst31)"
"d11=30m"

1 ze
  d11 pl3:f3
2 d1
        ; optional DFS enhancement
#ifdef dfs
        (p2:sp1 ph10):f1
        100u
#endif
        (p1 ph1)
        (center (d0) (p12 ph1):f3 )
        ; FIRST INEPT TRANSFER
        d6
        (center (p5 ph2) (p12 ph5):f3 )
        d6
        (p1 ph3)
        ; Z FILTER
        d3
        (p11 ph6):f3
        ; ECHO for the conversion of I1zSy into I2zSy
        d8
        (center (p5 ph2) (p12 ph5):f3)
        d8
        ;SECOND INEPT TRANSFER
        (p11 ph7):f3
        d3
        (p1 ph4)
        d6
        (center (p5 ph2) (p12 ph5):f3)
;OPTIONAL ACQUISITION OF THE WHOLE ECHO
#ifdef top
  d7
#endif
  go=2 ph31
  30m mc #0 to 2 F1PH(ip1, id0)
exit

ph1=  0
ph2=  {0}*8 {2}*8
ph3=  1
```

```
ph6=  0 2
ph5=  0 0 0 0 2 2 2 2
ph4=  1
ph7=  0 0 2 2
ph31= 0 2 2 0
ph11=1
#ifdef dfs
ph10=0
#endif

;pl1 : f1 channel - power level for pulse (default)
;pl3 : f3 channel - power level for pulse (default)
;p1 : f1 channel -  90 degree high power pulse
;p5 : f1 channel -  180 degree high power pulse
;p2 : dfs
;p11 : f3 channel -  90 degree high power pulse
;p12 : f3 channel - 180 degree high power pulse
;d0 : incremented delay (2D)                    [3 usec]
;d1 : relaxation delay; 1-5 * T1
;d6 : INEPT transfer
;d7 : INEPT transfer
;d8 : REFOCUSING DELAY
;nd0: 1
;FnMODE: States
```

2) Notes

Provided the 90°/180° pulses for nuclei I and S have been calibrated, the d6 and d8 delays (corresponding to τ and τ_2) can be optimized:
First, d8/l8 is set to a very small value (i.e. 3µs), in order to prevent the $I^1_zS_y \rightarrow I^2_zS_y$ conversion. The INEPT delay d6 is optimized to generate the highest observable signal. Then d8 is optimized in order to maximize the $I^1_zS_y \rightarrow I^2_zS_y$ transfer.