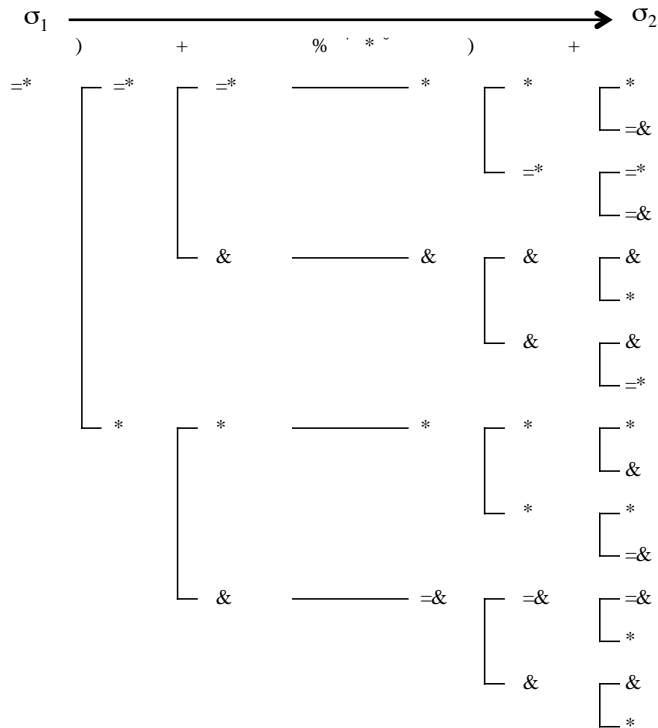


I-spin
180°パルス



```

* / / + / / +
=& / / + / 7 +
=* / / + 7 / +
=& / / + 7 7 +
& / / 7 + / / +
* / / 7 + / 7 +
& / / 7 + 7 / +
=* / / 7 + 7 7 +
* 7 / / + / / +
& 7 / / + / 7 +
* 7 / / + 7 / +
=& 7 / / + 7 7 +
=& 7 / 7 + / / +
* 7 / 7 + / 7 +
& 7 / 7 + 7 / +
* 7 / 7 + 7 7 +

```

```

-
=* / / + 7 / +
=* / / 7 + 7 7 +
* 7 / / + / / +
* 7 / 7 + / / 7 +
* / / + / / / +
* / / 7 + / / 7 +
* 7 / / + 7 / +
* 7 / 7 + 7 7 +
=& / / + / 7 +
& / / 7 + / / +
=& 7 / / + 7 7 +
& 7 / 7 + 7 / +
=& / / + 7 7 +
& / / 7 + 7 / +
& 7 / / + / 7 +
=& 7 / 7 + / / +

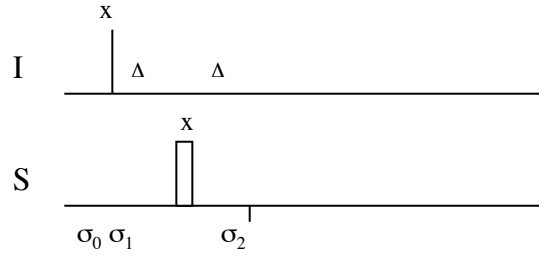
```

```

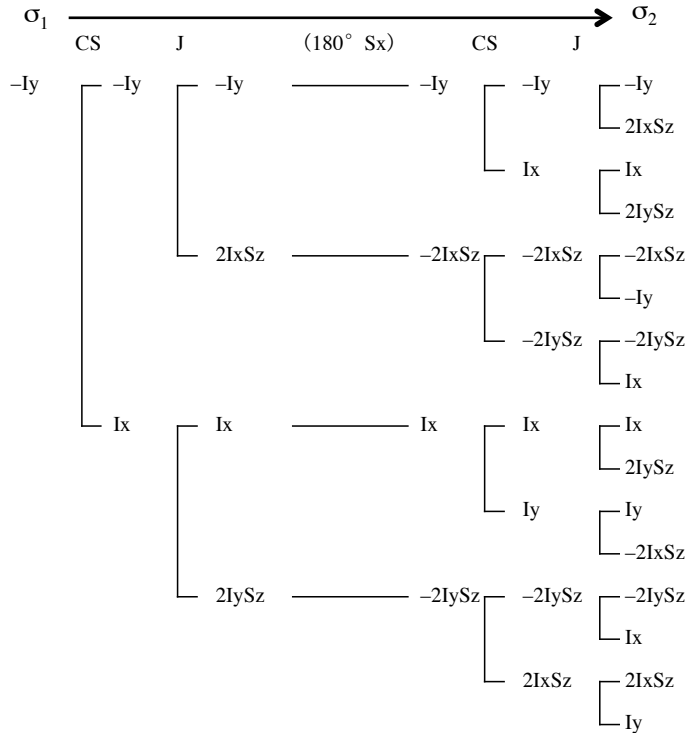
-
=* / / 7 / ! & + # 7 & + = / & + = 7 & + "( $
* ! & # 7 & " & + # 7 & + "( *
=& ! & # 7 & "! / + 7 + = / + 7 + "( $
=& / / 7 / ! / + 7 + = 7 + / + = / + 7 + # 7 + / + "( $

```

CS-term J-term refocused



S-spin
180°パルス



Ordered

$-Iy \cos\omega\Delta \cos\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $2IxSz \cos\omega\Delta \cos\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $Ix \cos\omega\Delta \cos\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $2IySz \cos\omega\Delta \cos\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
 $-2IxSz \cos\omega\Delta \sin\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $-Iy \cos\omega\Delta \sin\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $-2IySz \cos\omega\Delta \sin\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $Ix \cos\omega\Delta \sin\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
 $Ix \sin\omega\Delta \cos\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $2IySz \sin\omega\Delta \cos\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $Iy \sin\omega\Delta \cos\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $-2IxSz \sin\omega\Delta \cos\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
 $-2IySz \sin\omega\Delta \sin\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $Ix \sin\omega\Delta \sin\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $2IxSz \sin\omega\Delta \sin\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $Iy \sin\omega\Delta \sin\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$

Sorted

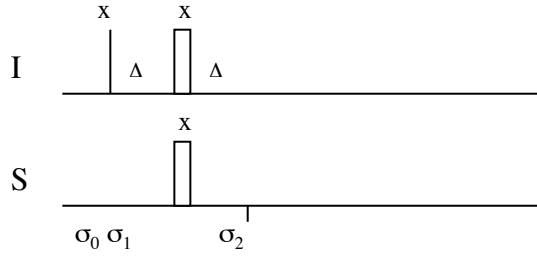
$Ix \cos\omega\Delta \cos\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $Ix \cos\omega\Delta \sin\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
 $Ix \sin\omega\Delta \cos\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $Ix \sin\omega\Delta \sin\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $-Iy \cos\omega\Delta \cos\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $-Iy \cos\omega\Delta \sin\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $Iy \sin\omega\Delta \cos\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $Iy \sin\omega\Delta \sin\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
 $2IxSz \cos\omega\Delta \cos\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $-2IxSz \cos\omega\Delta \sin\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $-2IxSz \sin\omega\Delta \cos\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
 $2IxSz \sin\omega\Delta \sin\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $2IySz \cos\omega\Delta \cos\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
 $-2IySz \cos\omega\Delta \sin\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $2IySz \sin\omega\Delta \cos\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $-2IySz \sin\omega\Delta \sin\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$

Summarized

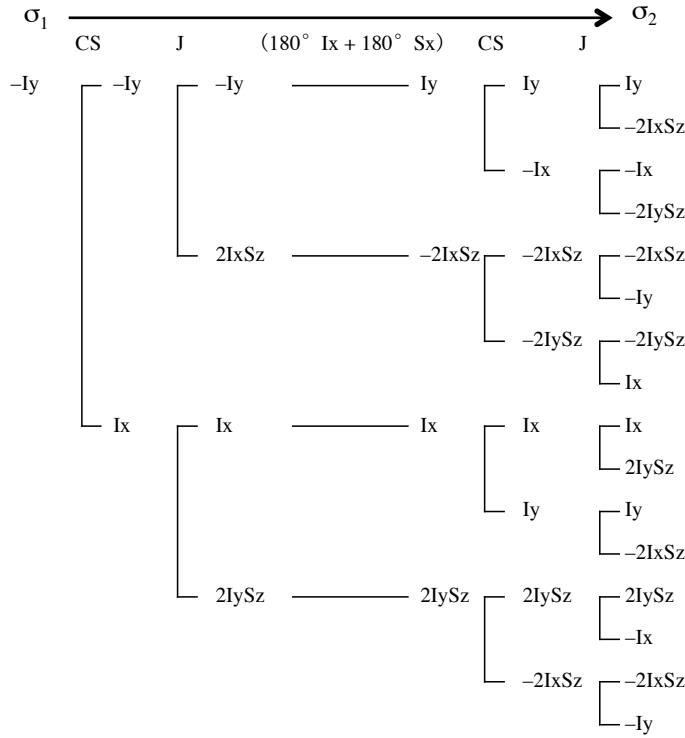
$Ix 2 \cos\omega\Delta \sin\omega\Delta (\cos^2\pi J\Delta + \sin^2\pi J\Delta) = Ix \sin 2\omega\Delta$
 $-Iy (\cos^2\omega\Delta - \sin^2\omega\Delta)(\cos^2\pi J\Delta + \sin^2\pi J\Delta) = -Iy \cos 2\omega\Delta$
 $2IxSz (\cos^2\omega\Delta - \sin^2\omega\Delta) (\cos\pi J\Delta \sin\pi J\Delta - \cos\pi J\Delta \sin\pi J\Delta) = 0$
 $2IySz 2 \cos\omega\Delta \sin\omega\Delta (\cos\pi J\Delta \sin\pi J\Delta - \sin\pi J\Delta \cos\pi J\Delta) = 0$

J-term refocused

CS-term not-refocused
 CS-term not-refocused



I-spin/S-spin
180°ハパルス



Ordered

$I_y \cos\omega\Delta \cos\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $-2I_x S_z \cos\omega\Delta \cos\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $-I_x \cos\omega\Delta \cos\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $-2I_y S_z \cos\omega\Delta \cos\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
 $-2I_x S_z \cos\omega\Delta \sin\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $-I_y \cos\omega\Delta \sin\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $-2I_y S_z \cos\omega\Delta \sin\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $I_x \cos\omega\Delta \sin\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
 $I_x \sin\omega\Delta \cos\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $2I_y S_z \sin\omega\Delta \cos\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $I_y \sin\omega\Delta \cos\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $-2I_x S_z \sin\omega\Delta \cos\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
 $2I_y S_z \sin\omega\Delta \sin\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $-I_x \sin\omega\Delta \sin\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $-2I_x S_z \sin\omega\Delta \sin\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $-I_y \sin\omega\Delta \sin\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$

Sorted

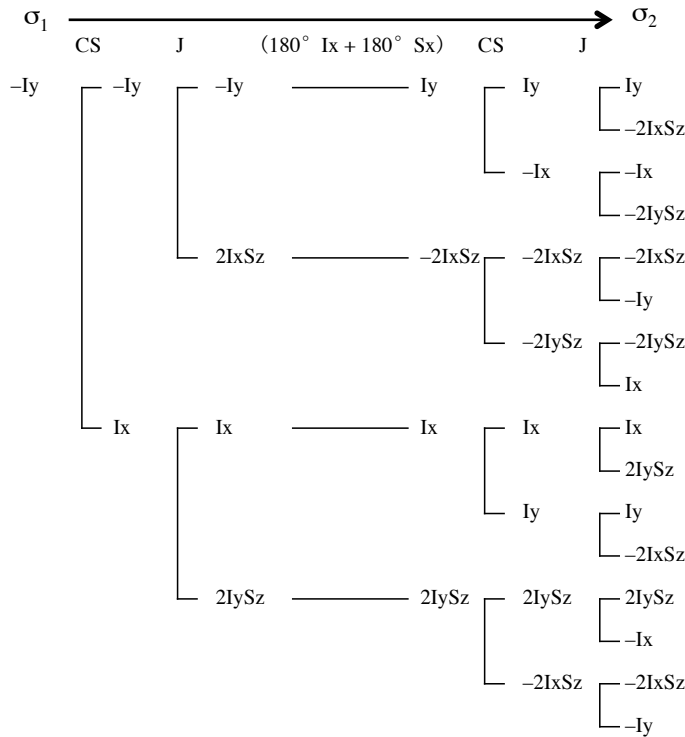
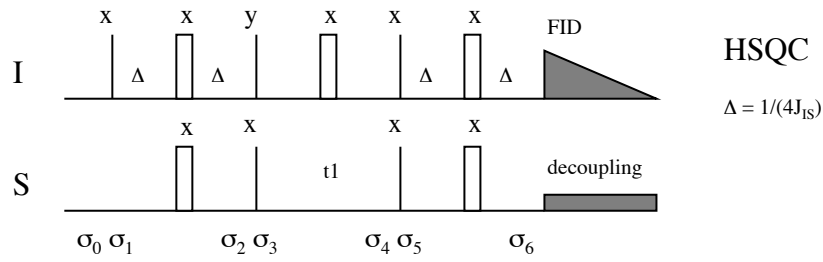
$-I_x \cos\omega\Delta \cos\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $I_x \cos\omega\Delta \sin\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
 $I_x \sin\omega\Delta \cos\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $-I_x \sin\omega\Delta \sin\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $I_y \cos\omega\Delta \cos\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $-I_y \cos\omega\Delta \sin\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $I_y \sin\omega\Delta \cos\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $-I_y \sin\omega\Delta \sin\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
 $-2I_x S_z \cos\omega\Delta \cos\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $-2I_x S_z \cos\omega\Delta \sin\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $-2I_x S_z \sin\omega\Delta \cos\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
 $-2I_x S_z \sin\omega\Delta \sin\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $-2I_y S_z \cos\omega\Delta \cos\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
 $-2I_y S_z \cos\omega\Delta \sin\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $2I_y S_z \sin\omega\Delta \cos\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $2I_y S_z \sin\omega\Delta \sin\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$

Summarized

$-I_x \cos\omega\Delta \sin\omega\Delta (\cos^2\pi J\Delta - \sin^2\pi J\Delta - \cos^2\pi J\Delta + \sin^2\pi J\Delta) = 0$
 $I_y (\cos^2\omega\Delta + \sin^2\omega\Delta)(\cos^2\pi J\Delta - \sin^2\pi J\Delta) = I_y \cos 2\pi J\Delta$
 $-2I_x S_z (\cos^2\omega\Delta + \sin^2\omega\Delta) 2 \sin\pi J\Delta \cos\pi J\Delta = -2I_x S_z \sin 2\pi J\Delta$
 $-2I_y S_z 2 \cos\omega\Delta \sin\omega\Delta (\cos\pi J\Delta \sin\pi J\Delta - \cos\pi J\Delta \sin\pi J\Delta) = 0$

CS-term refocused

J-term not-refocused
J-term not-refocused



Ordered

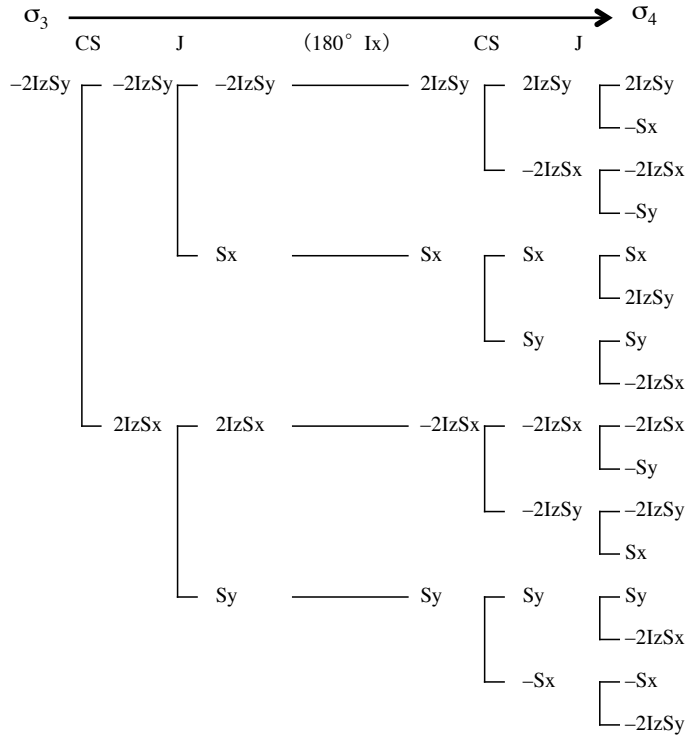
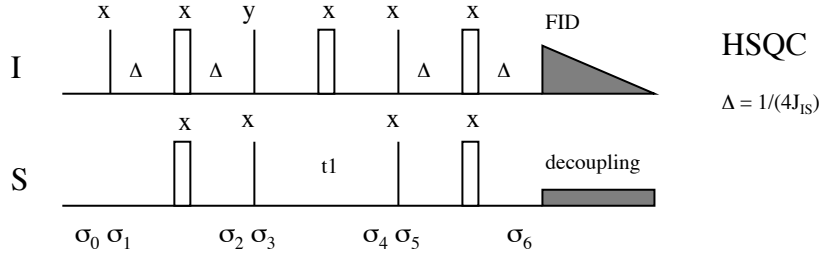
- $Iy \cos\omega\Delta \cos\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
- $-2IxSz \cos\omega\Delta \cos\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
- $-Ix \cos\omega\Delta \cos\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
- $-2IySz \cos\omega\Delta \cos\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
- $-2IxSz \cos\omega\Delta \sin\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
- $-Iy \cos\omega\Delta \sin\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
- $-2IySz \cos\omega\Delta \sin\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
- $Ix \cos\omega\Delta \sin\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
- $Ix \sin\omega\Delta \cos\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
- $2IySz \sin\omega\Delta \cos\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
- $Iy \sin\omega\Delta \cos\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
- $-2IxSz \sin\omega\Delta \cos\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
- $2IySz \sin\omega\Delta \sin\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
- $-Ix \sin\omega\Delta \sin\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
- $-2IxSz \sin\omega\Delta \sin\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
- $-Iy \sin\omega\Delta \sin\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$

Sorted

- $-Ix \cos\omega\Delta \cos\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
- $Ix \cos\omega\Delta \sin\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
- $Ix \sin\omega\Delta \cos\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
- $-Ix \sin\omega\Delta \sin\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
- $Iy \cos\omega\Delta \cos\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
- $-Iy \cos\omega\Delta \sin\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
- $Iy \sin\omega\Delta \cos\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
- $-Iy \sin\omega\Delta \sin\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
- $-2IxSz \cos\omega\Delta \cos\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
- $-2IxSz \cos\omega\Delta \sin\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
- $-2IxSz \sin\omega\Delta \cos\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
- $-2IxSz \sin\omega\Delta \sin\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
- $-2IySz \cos\omega\Delta \cos\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
- $-2IySz \cos\omega\Delta \sin\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
- $2IySz \sin\omega\Delta \cos\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
- $2IySz \sin\omega\Delta \sin\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$

Summarized

- $-Ix \cos\omega\Delta \sin\omega\Delta (\cos^2\pi J\Delta - \sin^2\pi J\Delta - \cos^2\pi J\Delta + \sin^2\pi J\Delta) = 0$
- $Iy (\cos^2\omega\Delta + \sin^2\omega\Delta)(\cos^2\pi J\Delta - \sin^2\pi J\Delta) = Iy \cos 2\pi J\Delta = 0$ ($\Delta = 1/4J$)
- $-2IxSz (\cos^2\omega\Delta + \sin^2\omega\Delta) 2 \sin\pi J\Delta \cos\pi J\Delta = -2IxSz \sin 2\pi J\Delta = -2IxSz$ ($\Delta = 1/4J$)
- $-2IySz 2 \cos\omega\Delta \sin\omega\Delta (\cos\pi J\Delta \sin\pi J\Delta - \cos\pi J\Delta \sin\pi J\Delta) = 0$



Ordered

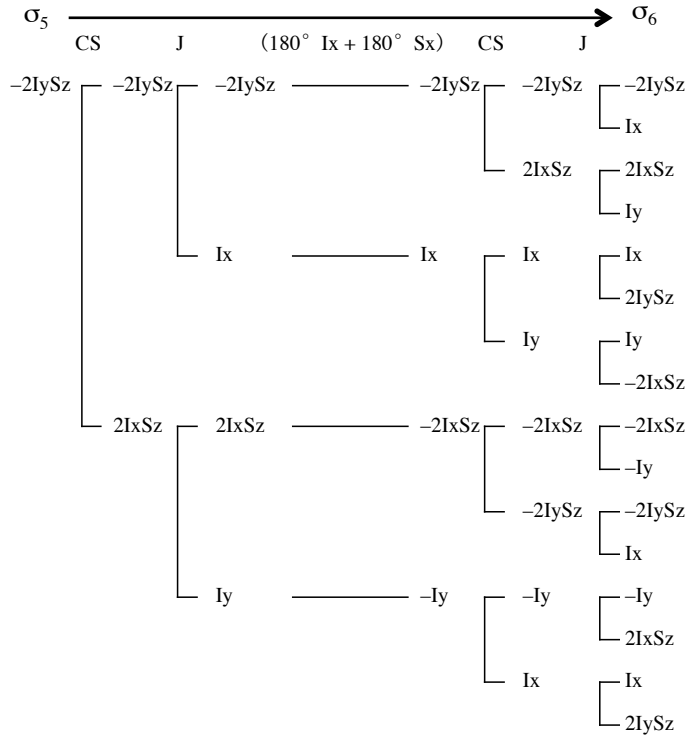
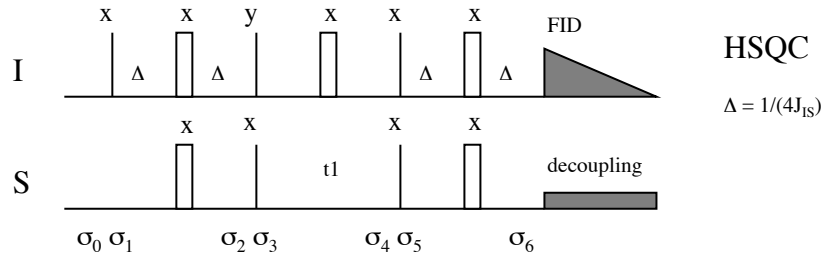
- $2IzSy \cos\omega\Delta \cos\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
- $-Sx \cos\omega\Delta \cos\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
- $-2IzSx \cos\omega\Delta \cos\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
- $-Sy \cos\omega\Delta \cos\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
- $Sx \cos\omega\Delta \sin\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
- $2IzSy \cos\omega\Delta \sin\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
- $Sy \cos\omega\Delta \sin\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
- $-2IzSx \cos\omega\Delta \sin\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
- $-2IzSx \sin\omega\Delta \cos\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
- $-Sy \sin\omega\Delta \cos\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
- $-2IzSy \sin\omega\Delta \cos\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
- $Sx \sin\omega\Delta \cos\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
- $Sy \sin\omega\Delta \sin\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
- $-2IzSx \sin\omega\Delta \sin\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
- $-Sx \sin\omega\Delta \sin\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
- $-2IzSy \sin\omega\Delta \sin\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$

Sorted

- $-Sx \cos\omega\Delta \cos\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
- $Sx \cos\omega\Delta \sin\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
- $Sx \sin\omega\Delta \cos\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
- $-Sx \sin\omega\Delta \sin\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
- $-Sy \cos\omega\Delta \cos\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
- $Sy \cos\omega\Delta \sin\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
- $-Sy \sin\omega\Delta \cos\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
- $Sy \sin\omega\Delta \sin\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
- $-2IzSx \cos\omega\Delta \cos\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
- $-2IzSx \cos\omega\Delta \sin\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
- $-2IzSx \sin\omega\Delta \cos\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
- $-2IzSx \sin\omega\Delta \sin\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
- $2IzSy \cos\omega\Delta \cos\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
- $2IzSy \cos\omega\Delta \sin\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
- $-2IzSy \sin\omega\Delta \cos\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
- $-2IzSy \sin\omega\Delta \sin\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$

Summarized

- $-Sx (\cos^2\omega\Delta - \sin^2\omega\Delta) (\cos\pi J\Delta \sin\pi J\Delta - \sin\pi J\Delta \cos\pi J\Delta) = 0$
- $-Sy 2 \cos\omega\Delta \sin\omega\Delta (\cos\pi J\Delta \sin\pi J\Delta - \sin\pi J\Delta \cos\pi J\Delta) = 0$
- $-2IzSx 2 \cos\omega\Delta \sin\omega\Delta (\cos^2\pi J\Delta + \sin^2\pi J\Delta) = -2IzSx \sin 2\omega\Delta = -2IzSx \sin\omega t1 \quad (\Delta = t1/2)$
- $2IzSy (\cos^2\omega\Delta - \sin^2\omega\Delta)(\cos^2\pi J\Delta + \sin^2\pi J\Delta) = 2IzSy \cos 2\omega\Delta = 2IzSy \cos\omega t1 \quad (\Delta = t1/2)$



Ordered

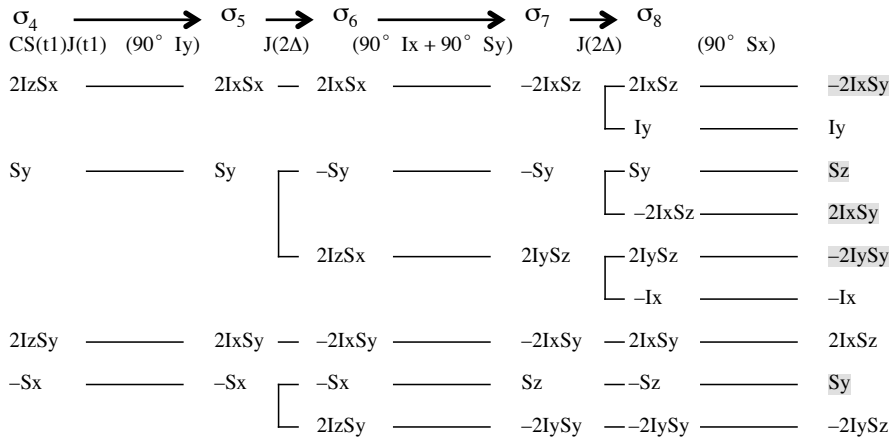
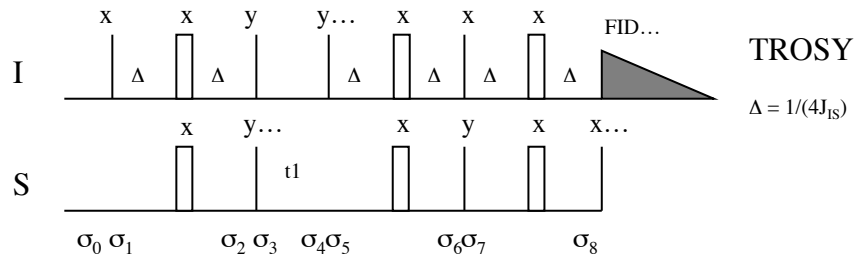
$-2IySz \cos\omega\Delta \cos\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $Ix \cos\omega\Delta \cos\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $2IxSz \cos\omega\Delta \cos\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $Iy \cos\omega\Delta \cos\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
 $Ix \cos\omega\Delta \sin\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $2IySz \cos\omega\Delta \sin\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $Iy \cos\omega\Delta \sin\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $-2IxSz \cos\omega\Delta \sin\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
 $-2IxSz \sin\omega\Delta \cos\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $-Iy \sin\omega\Delta \cos\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $-2IySz \sin\omega\Delta \cos\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $Ix \sin\omega\Delta \cos\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
 $-Iy \sin\omega\Delta \sin\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $2IxSz \sin\omega\Delta \sin\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $Ix \sin\omega\Delta \sin\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $2IySz \sin\omega\Delta \sin\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$

Sorted

$Ix \cos\omega\Delta \cos\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $Ix \cos\omega\Delta \sin\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $Ix \sin\omega\Delta \cos\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
 $Ix \sin\omega\Delta \sin\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $Iy \cos\omega\Delta \cos\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
 $Iy \cos\omega\Delta \sin\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $-Iy \sin\omega\Delta \cos\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $-Iy \sin\omega\Delta \sin\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $2IxSz \cos\omega\Delta \cos\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $-2IxSz \cos\omega\Delta \sin\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$
 $-2IxSz \sin\omega\Delta \cos\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $2IxSz \sin\omega\Delta \sin\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $-2IySz \cos\omega\Delta \cos\pi J\Delta \cos\omega\Delta \cos\pi J\Delta$
 $2IySz \cos\omega\Delta \sin\pi J\Delta \cos\omega\Delta \sin\pi J\Delta$
 $-2IySz \sin\omega\Delta \cos\pi J\Delta \sin\omega\Delta \cos\pi J\Delta$
 $2IySz \sin\omega\Delta \sin\pi J\Delta \sin\omega\Delta \sin\pi J\Delta$

Summarized

$Ix (\cos^2\omega\Delta + \sin^2\omega\Delta) 2 \sin\pi J\Delta \cos\pi J\Delta = Ix \sin 2\pi J\Delta = Ix \quad (\Delta = 1/4J)$
 $Iy 2 \cos\omega\Delta \sin\omega\Delta (\cos\pi J\Delta \sin\pi J\Delta - \cos\pi J\Delta \sin\pi J\Delta) = 0$
 $2IxSz \cos\omega\Delta \sin\omega\Delta (\cos^2\pi J\Delta - \sin^2\pi J\Delta - \cos^2\pi J\Delta + \sin^2\pi J\Delta) = 0$
 $-2IySz (\cos^2\omega\Delta + \sin^2\omega\Delta)(\cos^2\pi J\Delta - \sin^2\pi J\Delta) = -2IySz \cos 2\pi J\Delta = 0 \quad (\Delta = 1/4J)$



Observed
 $Iy \cos\omega t1 \cos\pi Jt1 \sin\pi J2\Delta = Iy \cos\omega t1 \cos\pi Jt1$
 $-Ix \cos\omega t1 \sin\pi Jt1 \sin\pi J2\Delta \sin\pi J2\Delta = -Ix \cos\omega t1 \sin\pi Jt1$
 $2IxSz \sin\omega t1 \cos\pi Jt1$
 $-2IySz \sin\omega t1 \sin\pi Jt1 \sin\pi J2\Delta = -2IySz \sin\omega t1 \sin\pi Jt1$

Phase cycling is necessary for TROSY!

I / S 2-spin system

Product Operator Calculation Guide

Pulses

I 核のパルス項は I-spin にのみ、S-spin とは独立に作用する

$(\beta^\circ \text{ Ix})$ $\text{Iz} \begin{cases} \text{Iz} \cos\beta \\ -\text{Iy} \sin\beta \end{cases}$ $(\beta^\circ \text{ Ix})$ $\text{Ix} \text{ --- Ix}$ $(\beta^\circ \text{ Ix})$ $\text{Iy} \begin{cases} \text{Iy} \cos\beta \\ \text{Iz} \sin\beta \end{cases}$	$(\beta^\circ \text{ Iy})$ $\text{Iz} \begin{cases} \text{Iz} \cos\beta \\ \text{Ix} \sin\beta \end{cases}$ $(\beta^\circ \text{ Iy})$ $\text{Ix} \begin{cases} \text{Ix} \cos\beta \\ -\text{Iz} \sin\beta \end{cases}$ $(\beta^\circ \text{ Iy})$ $\text{Iy} \text{ --- Iy}$
--	--

Chemical Shift

I 核の化学シフト項は I-spin にのみ、S-spin とは独立に作用する

$(\omega_I t \text{ Iz})$ $\text{Iz} \text{ --- Iz}$	$(\omega_I t \text{ Iz})$ $\text{Ix} \begin{cases} \text{Ix} \cos\omega_I t \\ \text{Iy} \sin\omega_I t \end{cases}$	$(\omega_I t \text{ Iz})$ $\text{Iy} \begin{cases} \text{Iy} \cos\omega_I t \\ -\text{Ix} \sin\omega_I t \end{cases}$
--	--	---

J-coupling

J 項は I-spin、S-spin 同時に作用する

$(\pi J_{IS} t \text{ IzSz})$ $\text{Iz} \text{ --- Iz}$ $2\text{IxSx} \text{ --- } 2\text{IxSx}$ $2\text{IxSy} \text{ --- } 2\text{IxSy}$ $2\text{IySx} \text{ --- } 2\text{IySx}$ $2\text{IySy} \text{ --- } 2\text{IySy}$ $2\text{IxSx} \text{ --- } 2\text{IxSx}$ $2\text{IzSz} \text{ --- } 2\text{IzSz}$	$(\pi J_{IS} t \text{ IzSz})$ $\text{Ix} \begin{cases} \text{Ix} \cos\pi J_{IS} t \\ 2\text{IySz} \sin\pi J_{IS} t \end{cases}$ $2\text{IxSz} \begin{cases} 2\text{IxSz} \cos\pi J_{IS} t \\ \text{Iy} \sin\pi J_{IS} t \end{cases}$ $\text{Sx} \begin{cases} \text{Sx} \cos\pi J_{IS} t \\ 2\text{IzSy} \sin\pi J_{IS} t \end{cases}$ $2\text{IzSx} \begin{cases} 2\text{IzSx} \cos\pi J_{IS} t \\ \text{Sy} \sin\pi J_{IS} t \end{cases}$	$(\pi J_{IS} t \text{ IzSz})$ $\text{Iy} \begin{cases} \text{Iy} \cos\pi J_{IS} t \\ -2\text{IxSz} \sin\pi J_{IS} t \end{cases}$ $2\text{IySz} \begin{cases} 2\text{IySz} \cos\pi J_{IS} t \\ -\text{Ix} \sin\pi J_{IS} t \end{cases}$ $\text{Sy} \begin{cases} \text{Sy} \cos\pi J_{IS} t \\ -2\text{IzSx} \sin\pi J_{IS} t \end{cases}$ $2\text{IzSy} \begin{cases} 2\text{IzSy} \cos\pi J_{IS} t \\ -\text{Sx} \sin\pi J_{IS} t \end{cases}$
--	---	---