

User Guide for SLAP pulse sequences

Tatsuya Matsunaga

Last updated on 2026/10/8

Corresponding papers

- *J. Biomol. NMR*, 75 (2021) 365-370, Doi: 10.1007/s10858-021-00384-8
- *J. Magn. Reson.* (Coming later)

Important Notes

These pulse sequences have been tested only in our NMR environment. **We assume no responsibility for any damage or adverse consequences resulting from their use in other experimental environments.**

When using these sequences, please take your specific environment into account and use them with due care.

In addition, these sequences are not the same as those used in the papers because we decided the original sequences were too heavily customized to be considered standard. Please contact me if you would like to see them.

Introduction of files

- SLAP_hCH2D.dcp.pp: 2D hCH double CP sequence with SLAP for TopSpin.*
- adrot-10k_360pt.sp: Shape of a pair of adiabatic inversion pulses
with an effective RF intensity of **10 kHz** for TopSpin.*
- adrot-14k_360pt.sp: Shape of a pair of adiabatic inversion pulses
with an effective RF intensity of **14 kHz** for TopSpin.*
- SLAP_double_cp_2d.jxp: 2D hCH double CP sequence with SLAP for Delta.
- adrot_PM.shape: Shape of a pair of adiabatic inversion pulses for Delta.
- SLAP_obs.jxi; Include file for SLAP parameter and macro for Delta.

*.pp and .sp are file extensions I use for my own identification purposes.

Explanation of the TopSpin sequence

SLAP_hCH2D.dcp.pp was built from an official sequence, hCH2D.dcp, modified for our HX probe. Only the MISSISSIPPI module has been replaced with the SLAP module. The related parameter and relevant section are as follows,

(ll. 56–64)

```
##### Inserted for SLAP (Matsunaga) #####
;cnst1 : H offset for SLAP (~1.5 ppm or ~5 ppm)
;p8    : H width of CW pulse (~10 ms)
;pl8   : H power of CW pulse (corresponds to 10kHz)
;p9    : H width of adiabatic rotation pulse (1 ms for 1 kHz adiabatic rotation)
;spnam9 : H adiabatic rotation (matsu_adrot-10k_360pt.sp or matsu_adrot-
14k_360pt.sp)
;spw9  : H power of adiabatic rotation pulse (corresponds to 10 or 14 kHz, which
conform to sp9)
;l9    : H loop number of adiabatic rotation pulse (total duration = p9*l9 ~ 3-5*p8, 30-
50 ms)
#####
```

(ll. 215–227)

```
#####
;#           Water suppression           #
;# Swapped original MISSISSIPPI to SLAP (Matsunaga)  #
;#####
      (p1 pl1 ph3):f2           ; brings magn. to z

      0.1u fq=cnst1 (bf ppm):f1
      (p8 pl8 ph8):f1
      label3, (p9:sp9 ph9):f1
      lo to label3 times l9
      0.1u fq=0 (sfo ppm):f1
;#####
```

cnst1 is an offset of the SLAP pulse in ppm. Please set it to a solvent peak: ~5 ppm for water and ~1.5 ppm for methyl ¹H of an organic solvent. p8 and pl8 are the CW-pulse parameters for SLAP. Generally, p8 is 10 ms, and pl8 is the power corresponding to RF

irradiation at 10 kHz. p9 and sp9 are the adiabatic-inversion-pulse trains. The pulse shapes, adrot-10k_360pt.sp and adrot-10k_360pt.sp, describe a pair of adiabatic-inversion pulses; that is, one rotation of the adiabatic pulse. Accordingly, set p9 to 1 ms when the adiabatic rotation frequency $\omega_{ad}/2\pi = 1$ kHz. When you use the adiabatic-inversion pulse with an effective field of 10 kHz, sp9 becomes adrot-10k_360pt.sp. Or, when you use a 14-kHz adiabatic-inversion pulse, please set adrot-14k_360pt.sp in sp9. l9 is the loop number of the adiabatic rotation; in other words, N in the SLAP papers. spw9 is set as a power corresponding to each effective-field intensity, 10 or 14 kHz. The phases of ph8 and ph9 are set to x. Other parameters match the original official sequence.

Explanation of the Delta sequence

SLAP_double_cp_2d.jxp was built from an official sequence, double_cp_2d.jxp. Only the MISSISSIPPI module is replaced with SLAP. The related parameter and relevant section are as follows,

(ll. 84-106)

----- constant of RF intensity -----

obs_nu = 0.25/x90;

----- SLAP (SLAP_obs.jxi)-----

block_slap =? "#SLAP#";

slap_ofs => 1.2[ppm]; --irradiation offset

obs_nu_CW => 10[kHz]; --intensity of CW

slap_ad_nu1 => obs_nu_CW*1.41; --intensity of adrot

slap_ad_nua => 1[kHz]; --rotation frequency of ad rot

obs_amp_CW =? obs_nu_CW / obs_nu * 100[%], 0[%]->100[%] : 0.01[%];

slap_ad_amp =? slap_ad_nu1 / obs_nu * 100[%], 0[%]->100[%] : 0.01[%];

obs_width_slap =? 1 / slap_ad_nua;

time_cw => 10[ms];

time_slap => 50[ms];

lp_slap =? upper (time_slap / obs_width_slap);

macro SLAP_obs (time_CW, lp_slap, obs_width_slap, obs_atn, obs_amp_CW, slap_ad_amp, slap_ofs) is

```

        time_cw, (OBS.GATE, OBS.ATN.obs_atn, OBS.AMP.obs_amp_CW,
OBS.PHS.{0}, OBS.OFFSET.slap_ofs);
        loop lp_slap times
            obs_width_slap, (OBS.GATE, OBS.ATN.obs_atn,
OBS.SHAPE.{"adrot_PM", "SLAP"}, OBS.PHS.{0}, OBS.OFFSET.slap_ofs);
        end loop;
end SLAP_obs;

```

(ll.197-199)

```

----- SLAP -----
SLAP_obs (time_CW, lp_slap, obs_width_slap, obs_atn, obs_amp_CW,
slap_ad_amp, slap_ofs);
-----

```

The parameter module is uploaded as an include file SLAP_obs.jxi. To calculate a proper amp parameter, I defined obs_nu as RF irradiation in kHz with an amp of 100%. slap_ofs is the offset frequency of the SLAP pulse, set to ~5 ppm for ¹H₂O and ~1.5 ppm for the methyl ¹H of an organic solvent. obs_nu_cw and time_cw are the RF intensity and width of the CW pulse, set to 10 kHz and 10 ms by default, respectively. slap_ad_nu1 and slap_ad_nua are the RF intensity and the adiabatic-rotation frequency, $\omega_{ad}/2\pi$, respectively. slap_ad_nu1 is set to one-time (10 kHz) or $\sqrt{2}$ -times (14.1 kHz) of obs_nu_cw. slap_ad_nua is 1 kHz. obs_width_slap is the duration of one adiabatic rotation cycle (1 ms). time_slap defines the total duration of the adiabatic-inversion-pulse trains. The number of adiabatic rotation loops, lp_slap and N , is calculated from time_slap. The description of the SLAP pulse is packaged as a macro, SLAP_obs. The amp parameters of the CW and adiabatic-inversion pulses are calculated from obs_nu_cw, obs_ad_nu1, and obs_nu, respectively. Other parameters match the original official sequence.

The shape file containing a pair of adiabatic inversion pulses (adrot_PM.shape) includes three adjustable parameters. ad_nu1 and ad_nua are the RF intensity and the adiabatic rotation frequency, $\omega_{ad}/2\pi$, respectively. ad_amp is the amp parameter of the adiabatic-inversion pulse.

This document was partially edited with assistance of generative AI
for phrasing/language corrections.