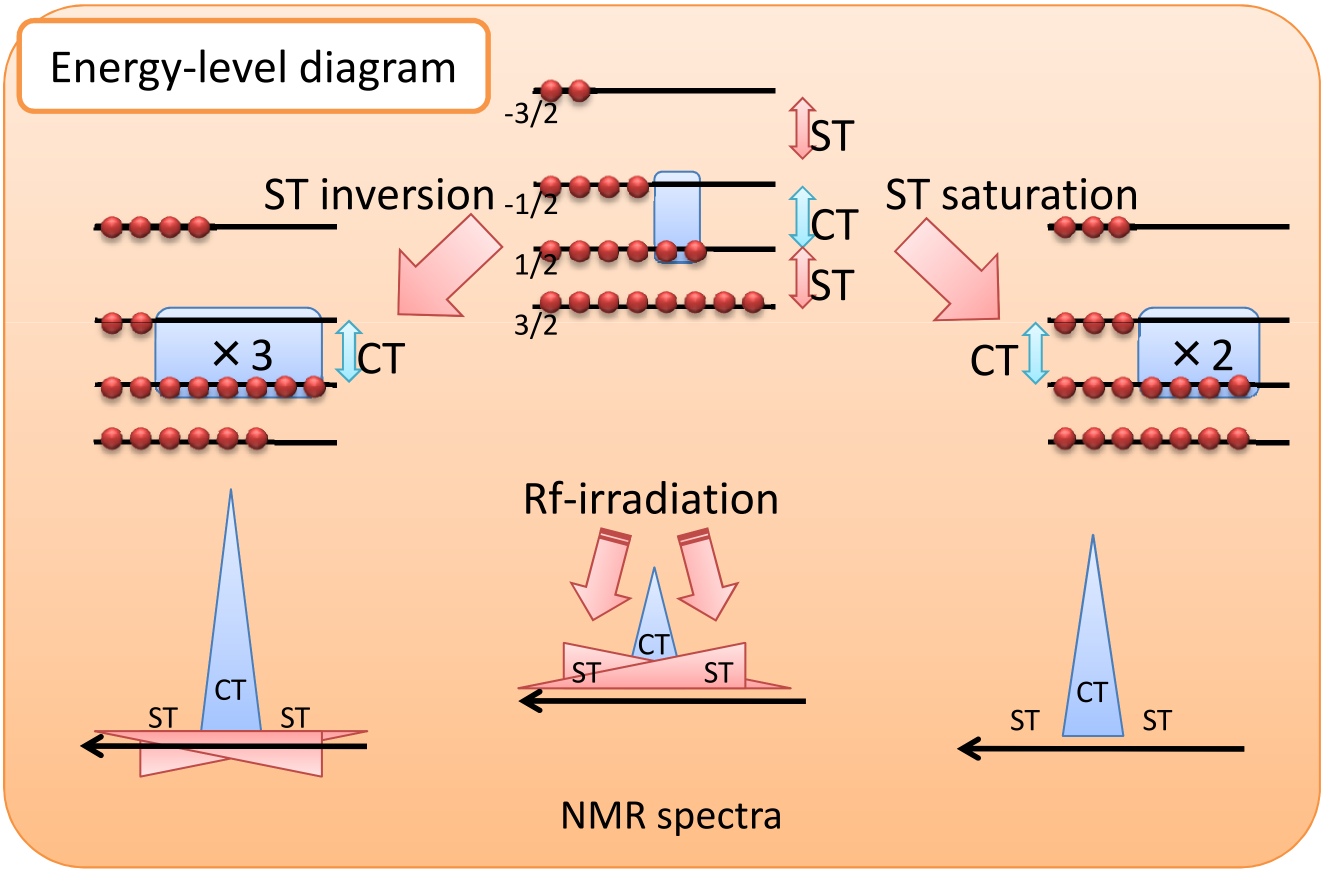
Sensitivity enhancement of half-integer quadrupolar nuclei: DFS and RAPT

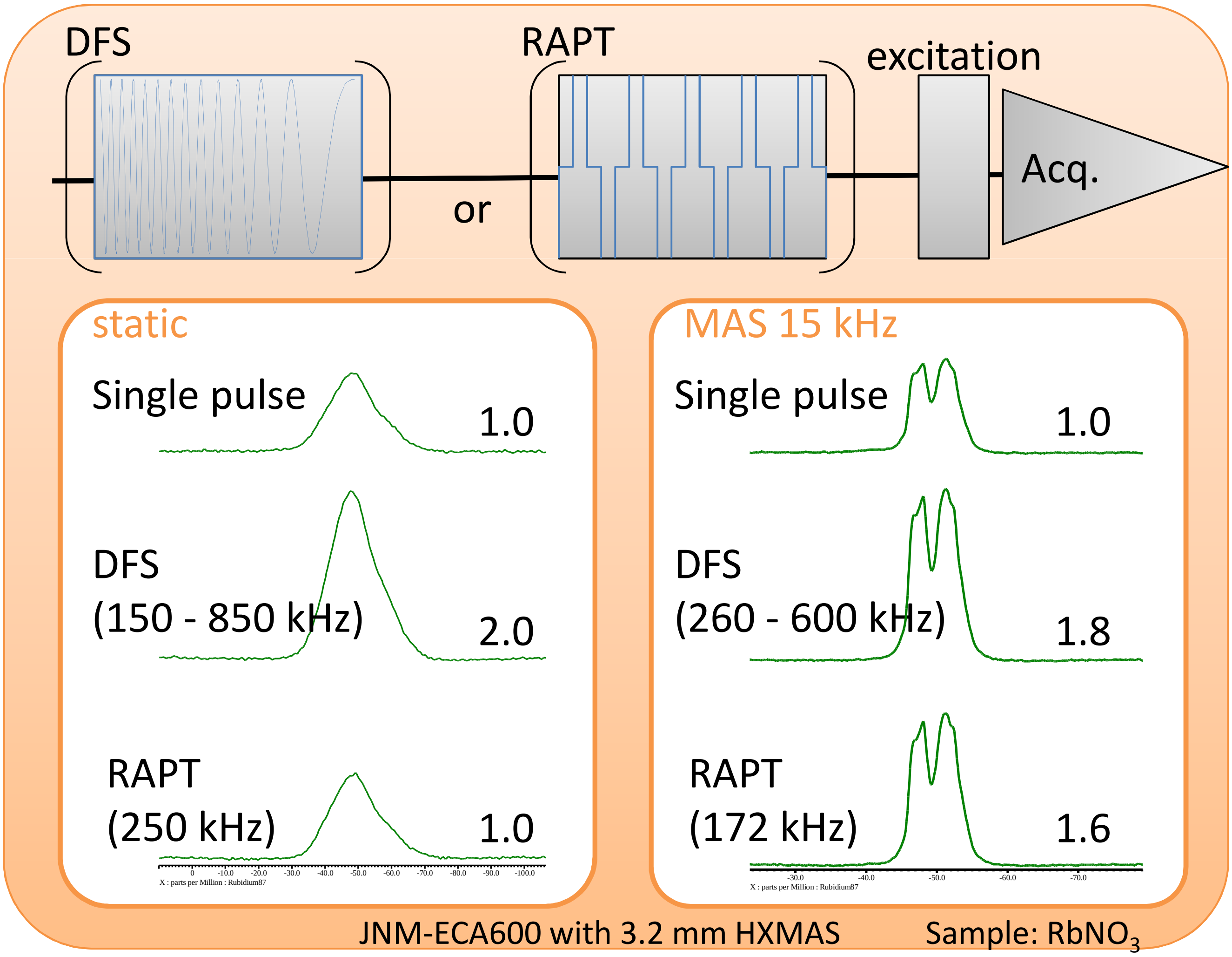
The intensity of central transition (CT) resonance can be improved by selectively manipulating satellite transitions (ST) of the half-integer quadrupolar nuclei. The allowed fundamental transitions ($\Delta m = \pm 1$) of the half-integer quadrupolar nuclei can be classified into two categories, CT and ST, where the first order quadrupolar broadening is absent and present, respectively. The STs can be manipulated by irradiating the CT off-resonance. Saturation or inversion of the ST population lead to the CT population enhancement, transferring the population from ST to CT.



DFS: A.P.M. Kentgens, R. Verhagen, Chem. Phys. Lett. 300 (1999) 435-443.
RAPT: Z. Yao, H.T. Kwak, D. Sakellariou, L. Emsley, P.J. Grandinetti, Chem. Phys. Lett. 327 (2000) 85-90.

JEOL RESONANCE

The ST inversion can efficiently be achieved by an adiabatic frequency sweep. The ST resonances on the both sides of the CT resonance are simultaneously manipulated by the amplitude modulated rf-field sweep called dual frequency sweep (DFS). Two-fold sensitivity enhancement of ^{87}Rb (I = 3/2) is achieved on a static sample of $RbNO_3$. The DFS works well even under MAS and gives 1.8-fold enhancement. MAS induces the time-dependence of ST frequencies, opening another way to manipulate STs. The time-dependence allows for saturation of ST by a single frequency amplitude modulation (RAPT: rotor-assisted population transfer), giving 1.6-fold sensitivity enhancement under MAS. It should be noted that RAPT can saturate only a limited number of ST resonances in the absence of MAS, leading to almost no sensitivity enhancement at the static conditions. RAPT provides slightly lower sensitivity enhancement than DFS at MAS but is easy to use in terms of smaller number of parameters to optimize.



JEOL RESONANCE