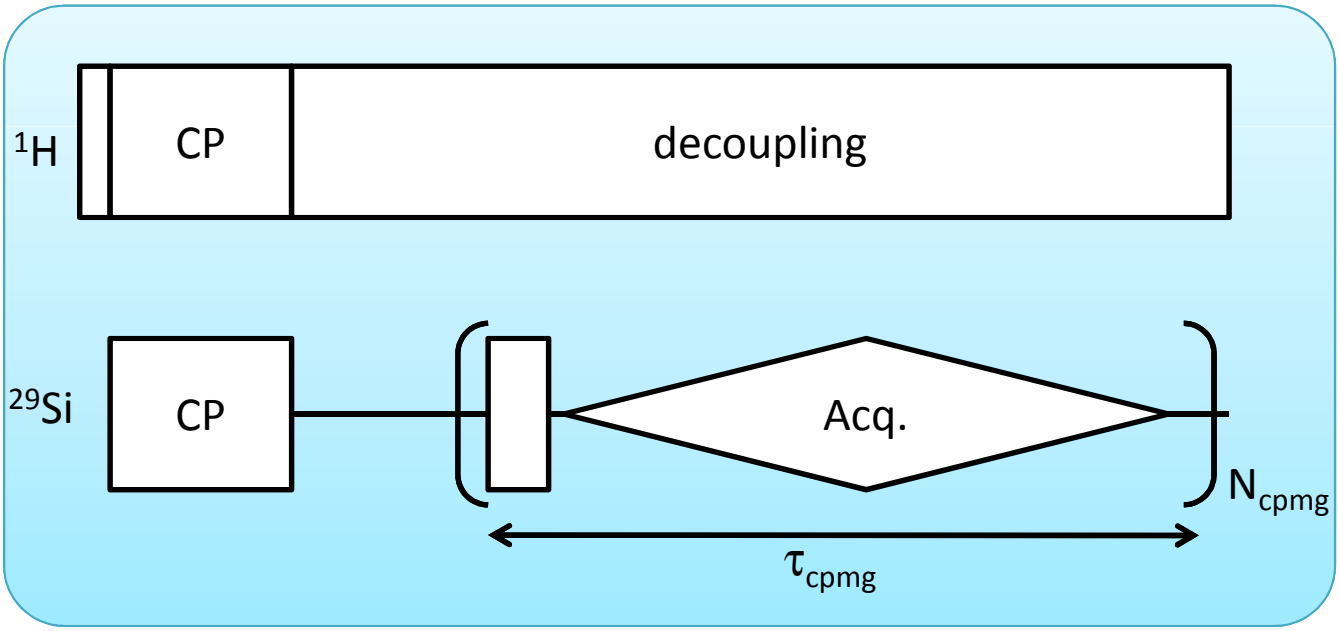
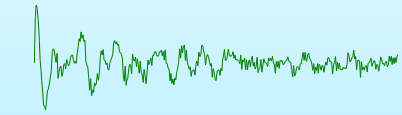
Sensitivity enhancement in ^{29}Si solid-state NMR signals by CPMG detection

The sensitivity in ^{29}Si NMR spectroscopy is greatly enhanced with a factor of 5 to 10 by utilizing a Carr-Purcell-Meiboom-Gill (CPMG) echo train. It is possible to detect multiple echoes even with a single excitation pulse if the T_2* relaxation time is sufficiently shorter than the T_2' relaxation time; T_2* is the life time of an FID calculated from an apparent linewidth, while T_2' is the coherence life time under the CPMG sequence. While the ^{29}Si T_2* of most silicate compounds is typically short, resulting from structural distributions, the T_2' is the order of seconds, governed by ^{1}H-^{29}Si heteronuclear dipolar interactions as well as ^{29}Si-^{29}Si homonuclear interactions. The former interactions can be removed by ^{1}H decoupling, whereas the latter reduced by fast MAS. A series of CPMG echoes thus obtained are summed up, leading to the remarkable sensitivity enhancement.

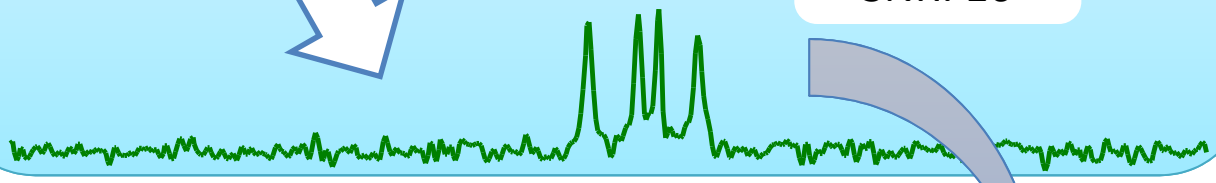


F. H. Larsen, I. Farnan, Chem. Phys. Lett. 357 (2002) 403-408.
S. S. Hou, F. L. Beyer, K. Schmidt-Rohr, Solid State Nucl. Magn. Reson. 22 (2002) 110-127.
J. W. Wiench, V. S. -Y. Lin, M. Pruski, J. Magn. Reson. 193 (2008) 233-242.

^{29}Si CPMAS with conventional detection
(A single FID per scan is detected)

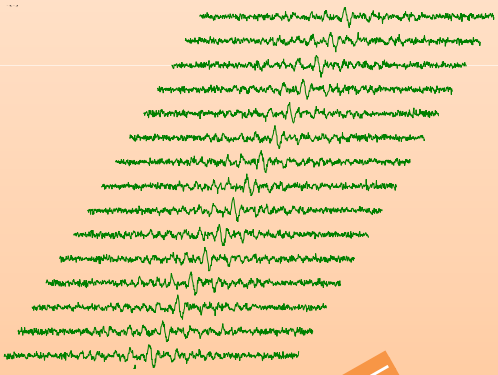


4 scans
SNR: 16



^{29}Si CPMAS with CPMG detection
(48 echoes per scan are detected)

1/33 time saving !



4 scans
SNR: 92!

JNM-ECA600 with 3.2 mm HXMAS probe at 20 kHz MAS.
Sample: zeolite sigma-2 (SGT)
Sample courtesy of Prof. Toshiyuki Yokoi of Tokyo Institute of Technology

JEOL RESONANCE