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Spectra Denoising using Graphic Cards

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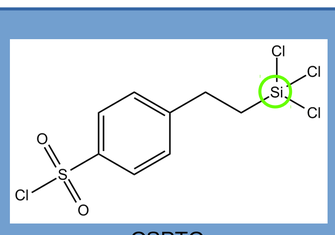
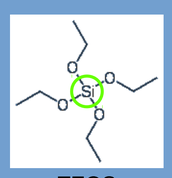
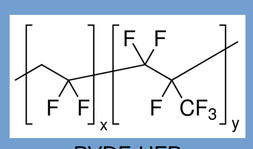
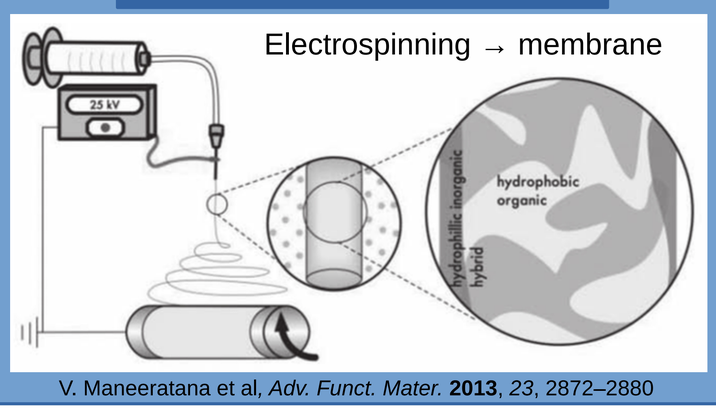
b Institut des Matériaux de Paris Centre

Context


CSPTC

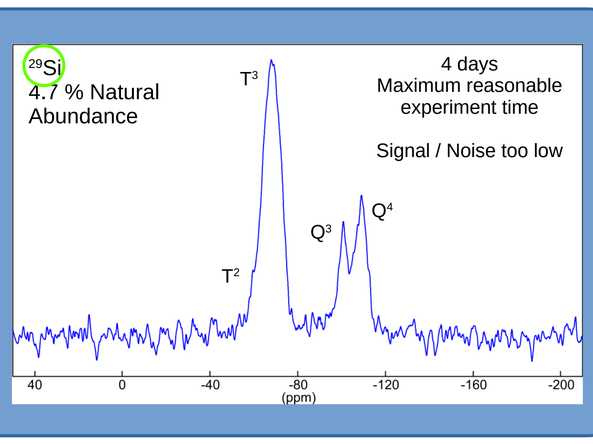

TEOS


PVDF-HFP



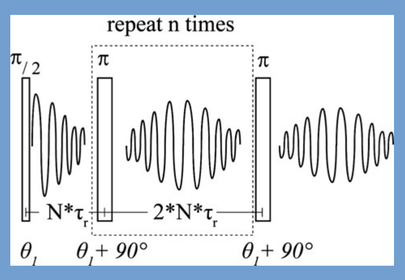
V. Maneeratana et al, *Adv. Funct. Mater.* **2013**, *23*, 2872–2880

MAS 7 mm → MAS 4 mm

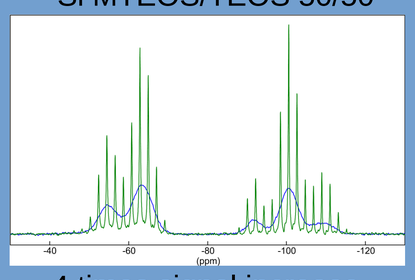


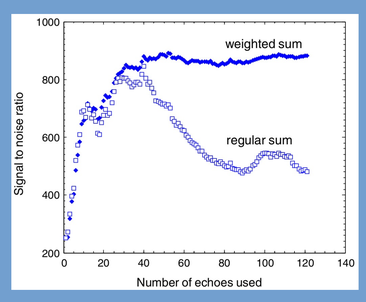
Tools

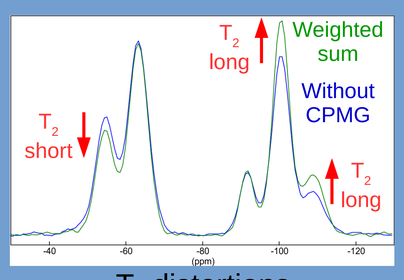
CPMG Echoes



^{29}Si MTEOS/TEOS 50/50


4 times signal increase

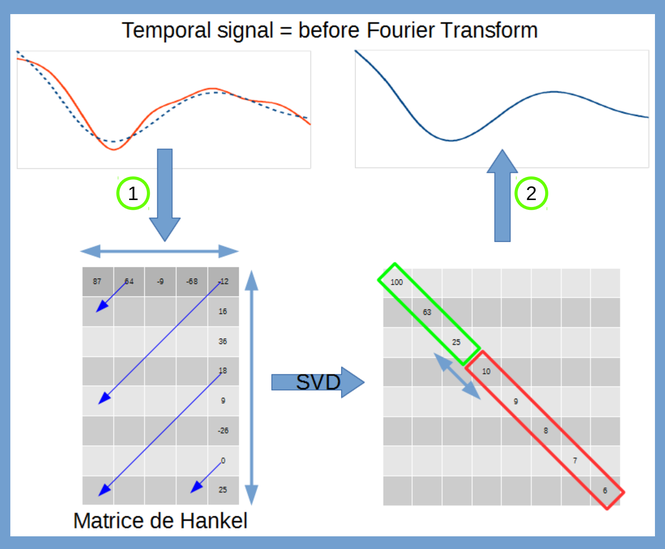


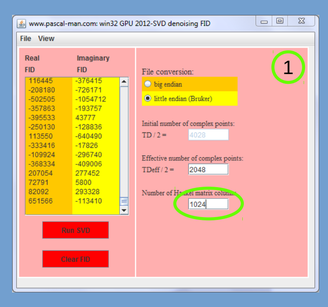


T_2 distortions

H. Y. Carr and E. M. Purcell, *Phys. Rev.*, **1954**, 94, 3, 630–638
S. Meiboom and D. Gill, *Rev. Sci. Instrum.*, **1958**, 29, 8, 688–691
W. J. Malfait and W. E. Halter, *J. of Non-Cryst. Solids*, **2008**, 354, 34, 4107–4114

SVD denoising



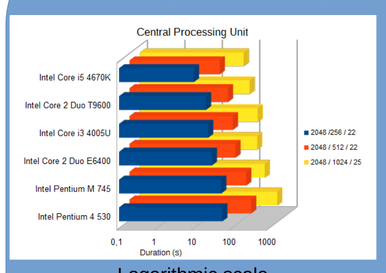


J.A. Cadzow, *IEEE Trans. Acoust. Speech Signal Process*, **1988**, 36, 49–62
P. Man, C. Bonhomme, F. Babonneau, *Solid State Nucl. Mag.*, **2014**, 61-62, 28-34

Results

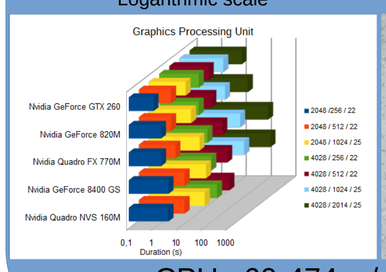
CPU vs GPU

CPU : Central Processing Unit
GPU : Graphics Processing Unit



Logarithmic scale

- CPU : poor parallelization
- GPU : Massively parallel
- Technology CUDA (Compute Unified Device Architecture)
- All NVIDIA cards since 2006

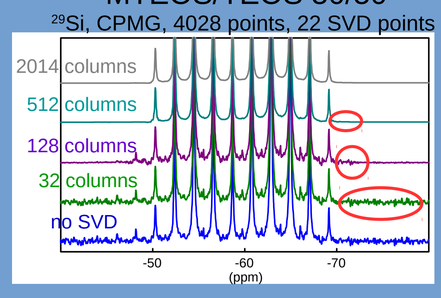


CPU : 60-474 s / GPU : 3-20 s
20 times speeder

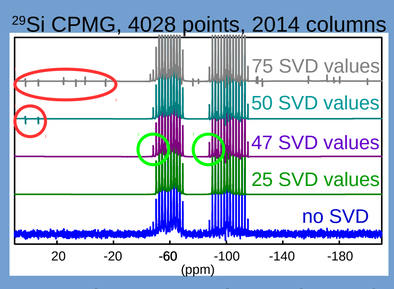
S. Lahabar, and P. J. Narayanan, *IEEE International Symposium on Parallel Distributed Processing, IPDPS,* 2009, 1-10

SVD Parameters

MTEOS/TEOS 50/50
^{29}Si, CPMG, 4028 points, 22 SVD points



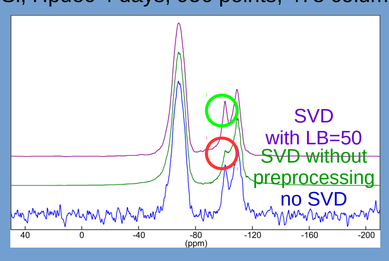
^{29}Si CPMG, 4028 points, 2014 columns



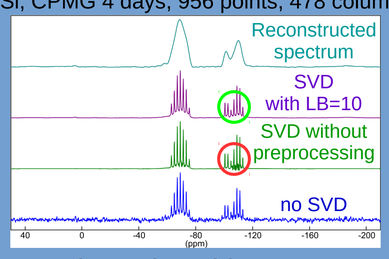
Square matrix, manual number of values
Minimum signal / noise = 2

Real samples

CSPTC/TEOS/PVDF-HFP
29Si, Hpdec 4 days, 956 points, 478 columns



29Si, CPMG 4 days, 956 points, 478 columns



Improved results with preprocessing

Highlights

- Possible analysis of highly noisy spectra
- Short denoising time with GPU
- Easy to use
- Low cost (Nvidia GTX 750 = 120 €)

Future work

- Automatic number of SVD values
- NMRlab with Matlab
- Sparse matrix
- T_2 corrections

Acknowledgements

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- Severine ROSE
- Virgile BARRET

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