



HAL
open science

Improving solid-state NMR sensitivity using instrumentation, fast acquisition and post-processing

Guillaume Laurent, Christian Bonhomme

► **To cite this version:**

Guillaume Laurent, Christian Bonhomme. Improving solid-state NMR sensitivity using instrumentation, fast acquisition and post-processing. EUROpean MAGnetic Resonance meeting, EUROMAR, Jul 2018, Nantes, France. hal-01832993

HAL Id: hal-01832993

<https://hal.sorbonne-universite.fr/hal-01832993v1>

Submitted on 9 Jul 2018

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Improving solid-state NMR sensitivity using instrumentation, fast acquisition and post-processing



G. LAURENT, C. BONHOMME

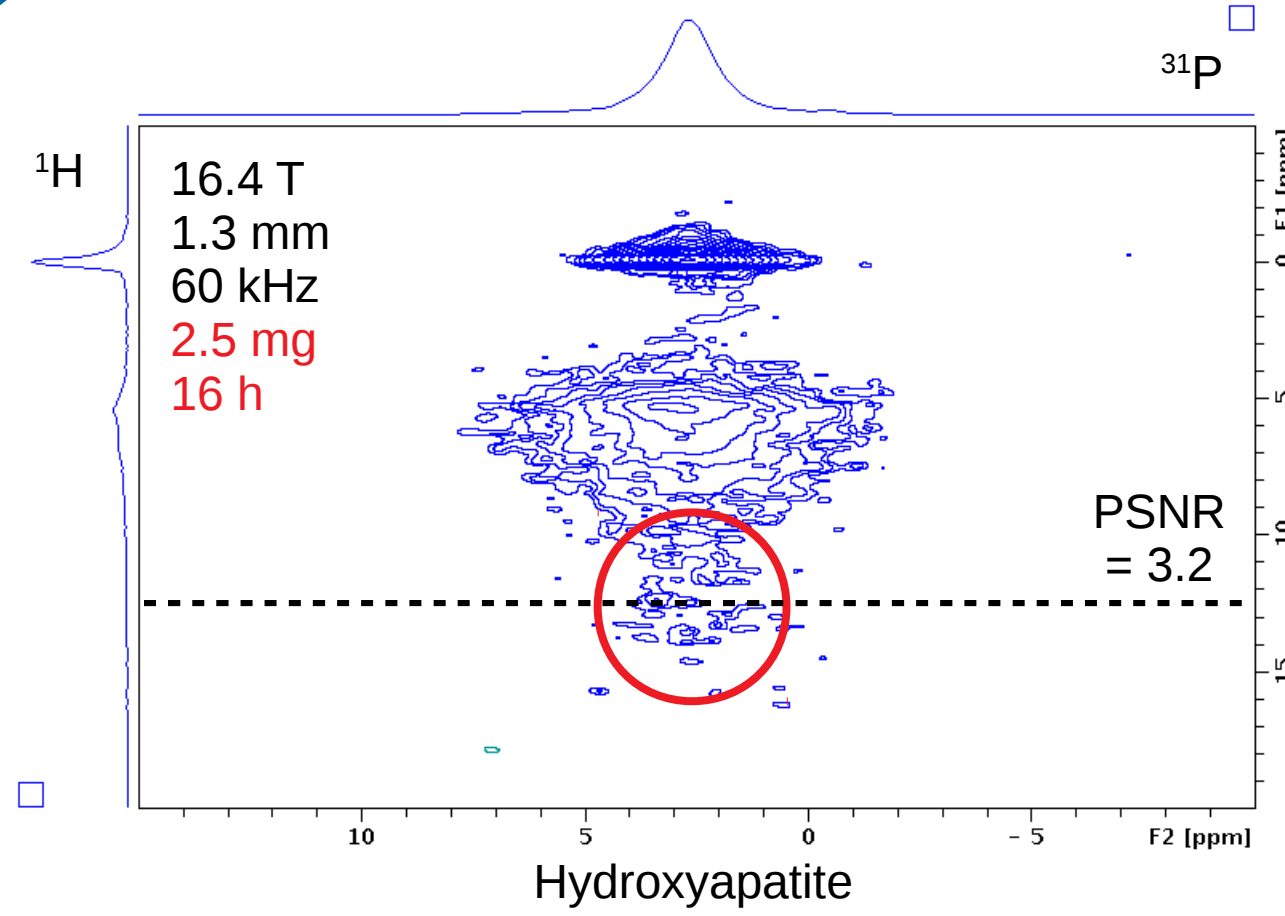


Laboratoire de Chimie de la Matière Condensée de Paris (LCMCP)
4 place Jussieu, 75005, Paris, France
guillaume.laurent@sorbonne-universite.fr

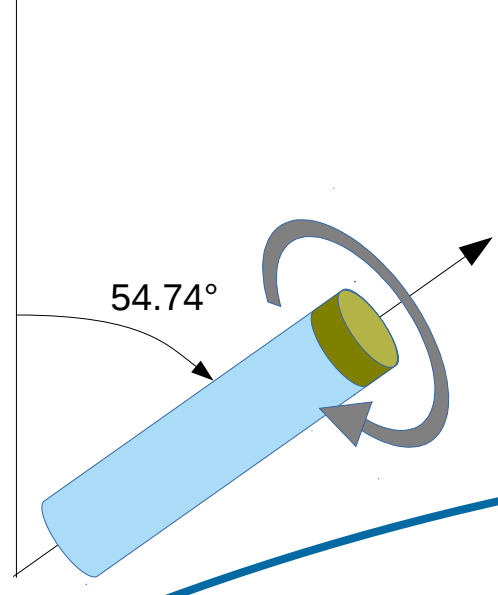


1 – Introduction

7 – References



Magic Angle Spinning (MAS)



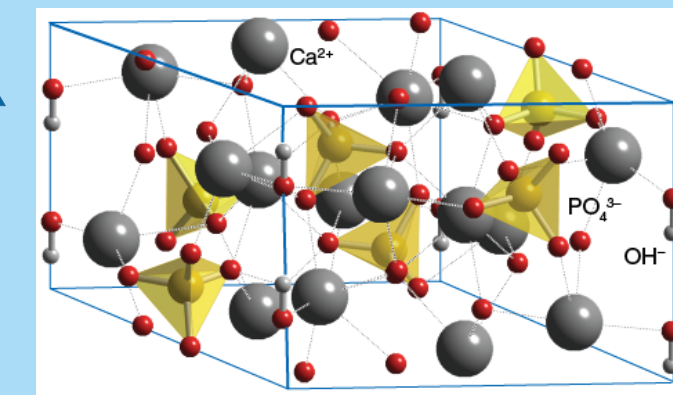
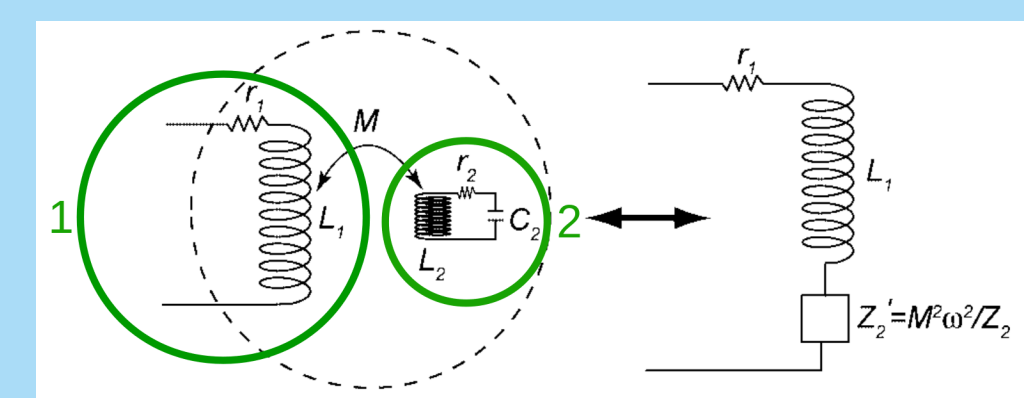
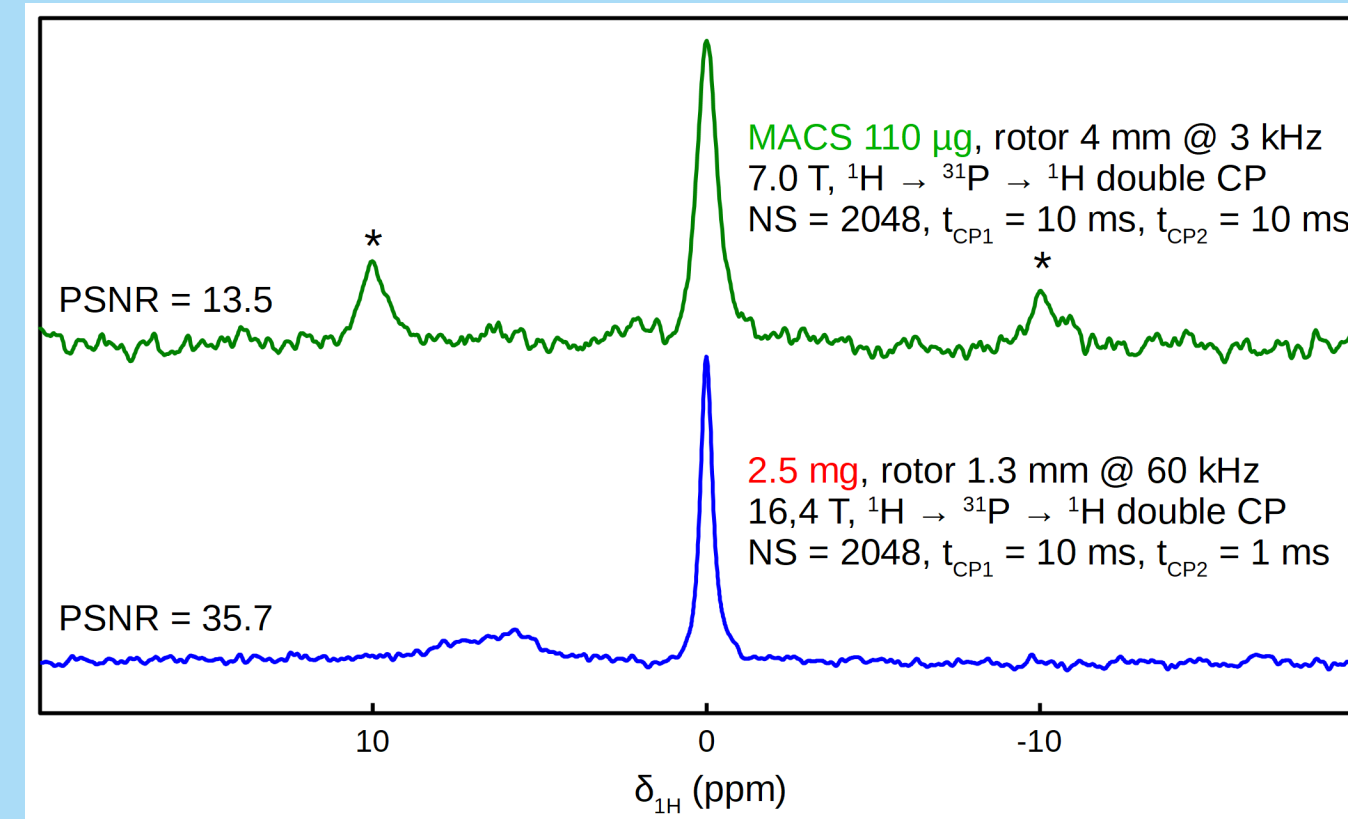
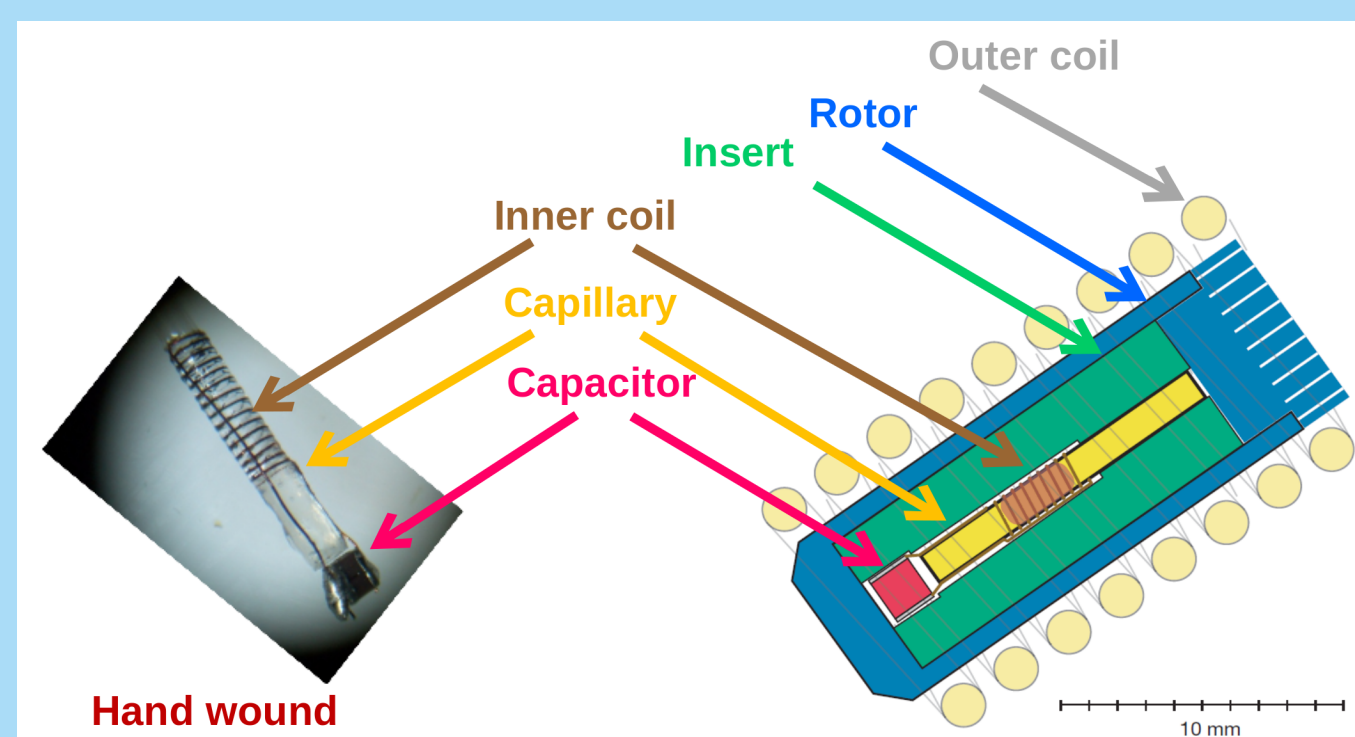
$$PSNR_{max} = \frac{H_{signal}}{h_{noise_peak_peak}} / 2$$

- Solid-state NMR:
- Broad peaks
 - Partial narrowing with MAS
 - Low sensitivity

- [1] D. Sakellariou *et al.*, *Nature*, vol. 447, no. 7145, pp. 694–697, Jul. 2007.
- [2] J.-F. Jacquinot and D. Sakellariou, *Concept. Magn. Reson. A*, vol. 38A, pp. 33–51, Mar. 2011.
- [3] G. Laurent, presented at the Instrumenter et innover en chimie physique pour préparer l'avenir, Paris, France, 22-Jan-2015.
- [4] K. Kazimierczuk and V. Y. Orekhov, *Angew. Chem. Int. Ed.*, vol. 50, no. 24, pp. 5556–5559, 2011.
- [5] G. Laurent, presented at the RMN structurale dans le Bassin Parisien, Orléans, France, 27-Mar-2018.
- [6] P. P. Man *et al.*, *Solid State Nucl. Mag.*, vol. 61–62, pp. 28–34, Jul. 2014.
- [7] G. Laurent, presented at the C2i-2016: 7ème colloque interdisciplinaire en instrumentation, Saint-Nazaire, France, 20-Jan-2016.
- [8] G. Laurent *et al.*, *Appl. Spectrosc. Rev.*, submitted.

Magic Angle Coil Spinning (MACS) [1-3]

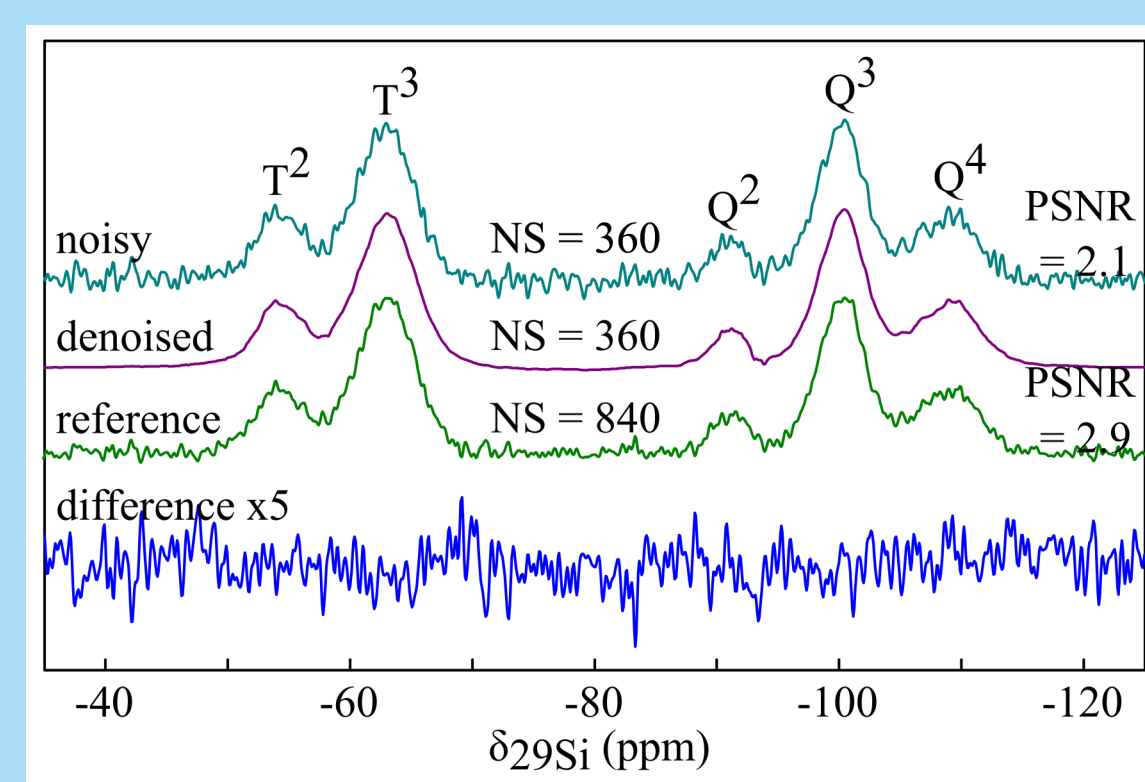
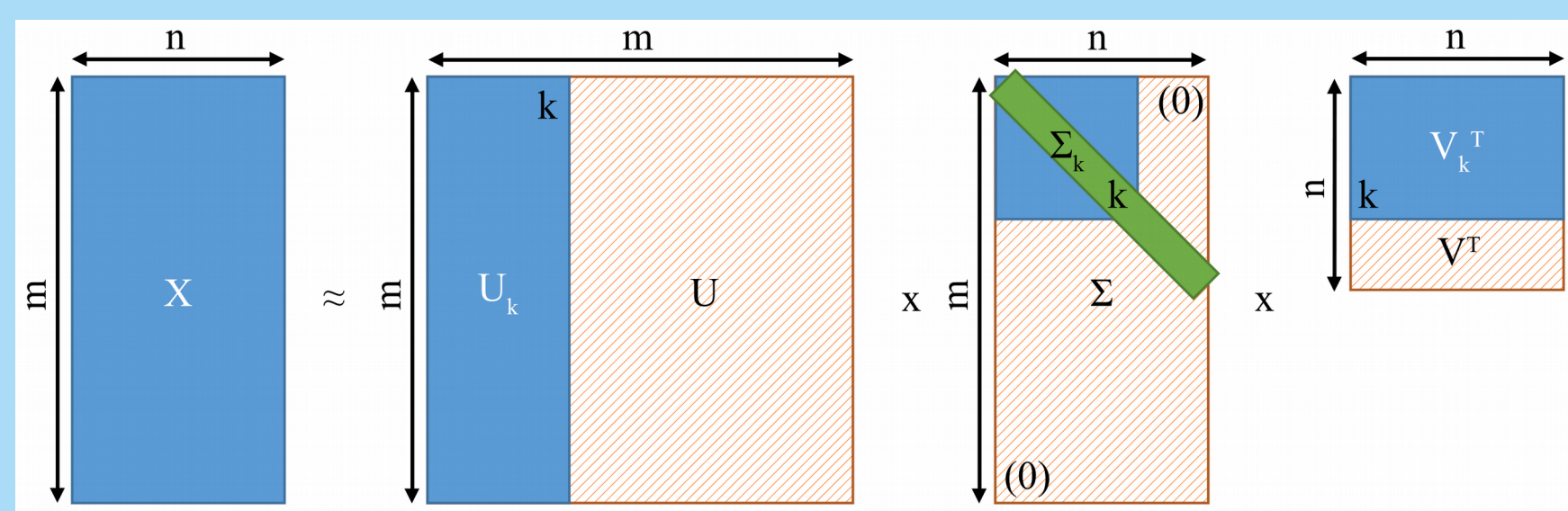
Micro-quantities (100 µg)
PSNR / sqrt(t) / g → x 8



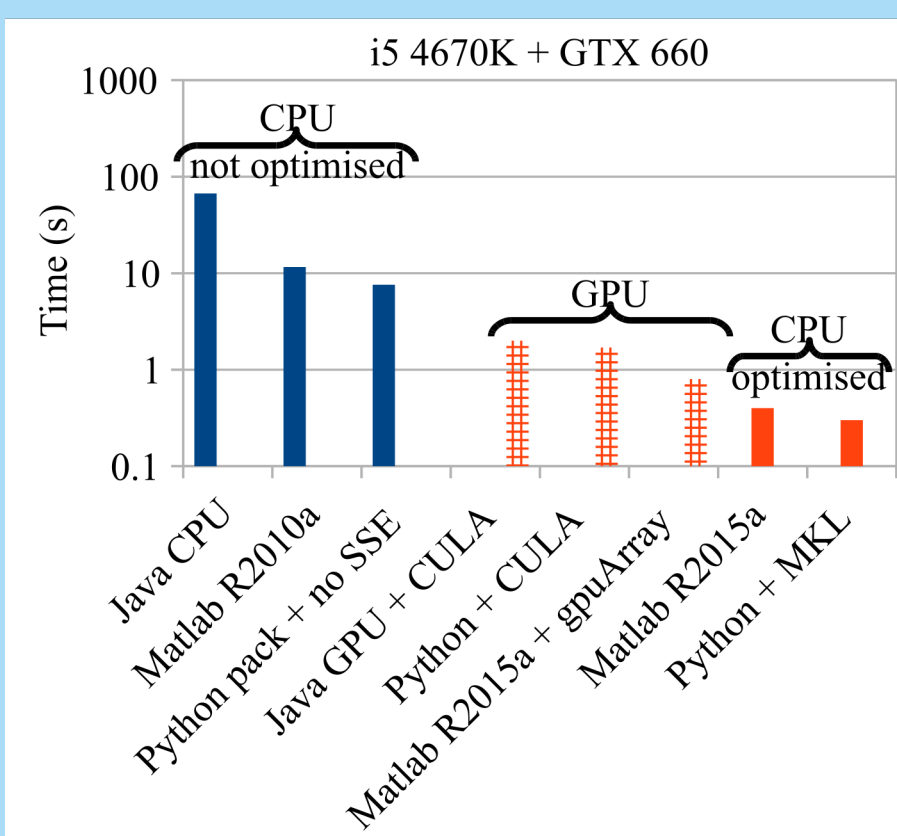
Hydroxyapatite
 $Ca_{10}(PO_4)_6(OH)_2$
Inorganic part of bone

Singular Value Decomposition (SVD) [6-8]

Denosing
PSNR / sqrt(t) → x 2
computation time / 100

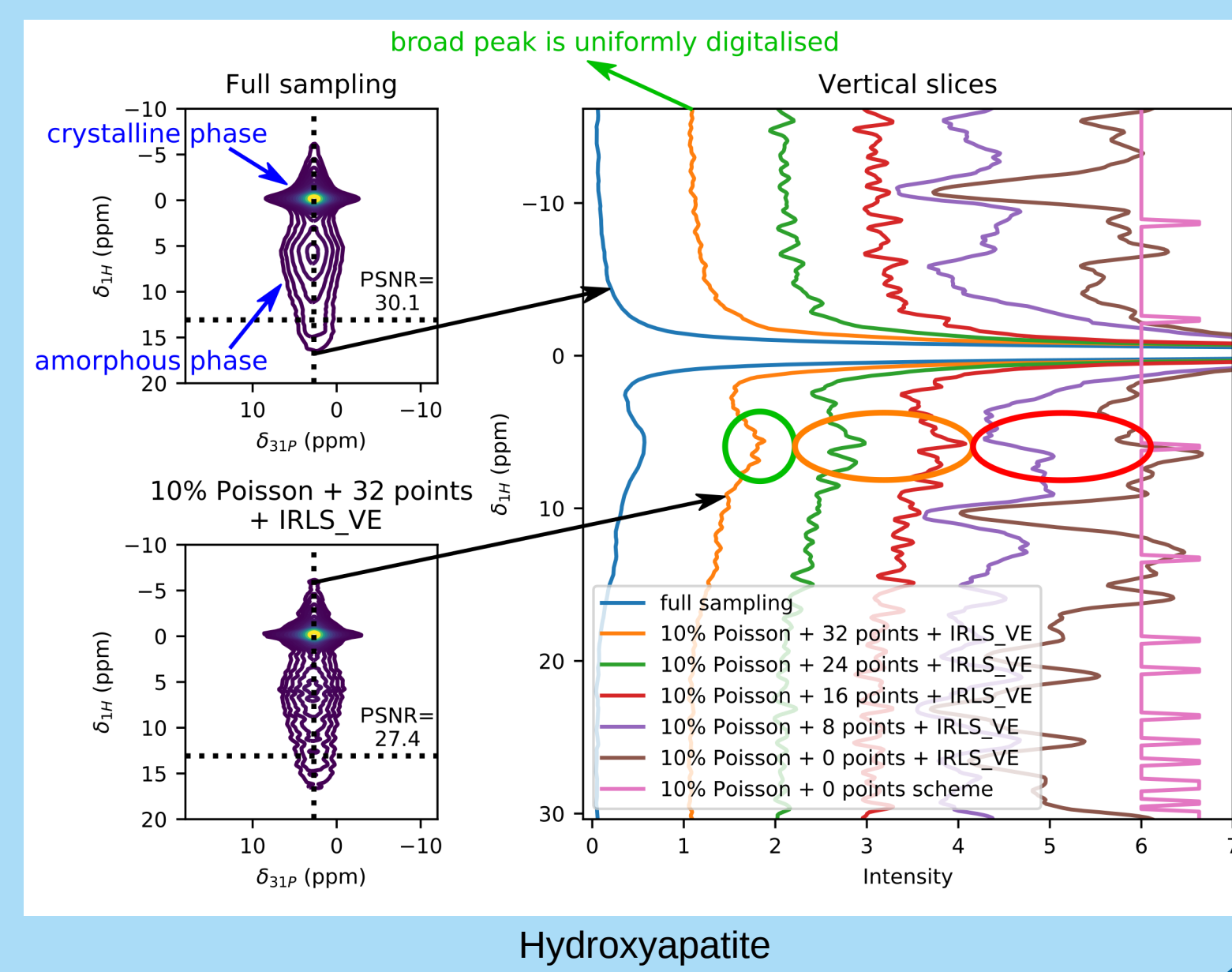
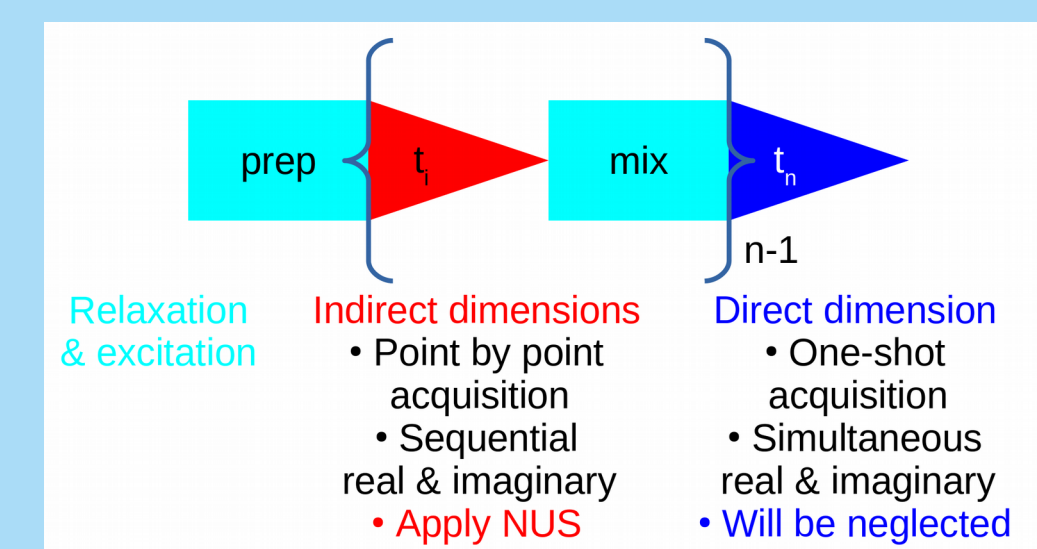


50 / 50, MTEOS (T) / TEOS (Q)
organic / inorganic hybrid material



Non-Uniform Sampling (NUS) [4-5]

Increase resolution
PSNR / sqrt(t) → x 2



Hydroxyapatite

Sensitivity

2 – Instrumentation

3 – Acquisition

4 – Processing

5 – Conclusion

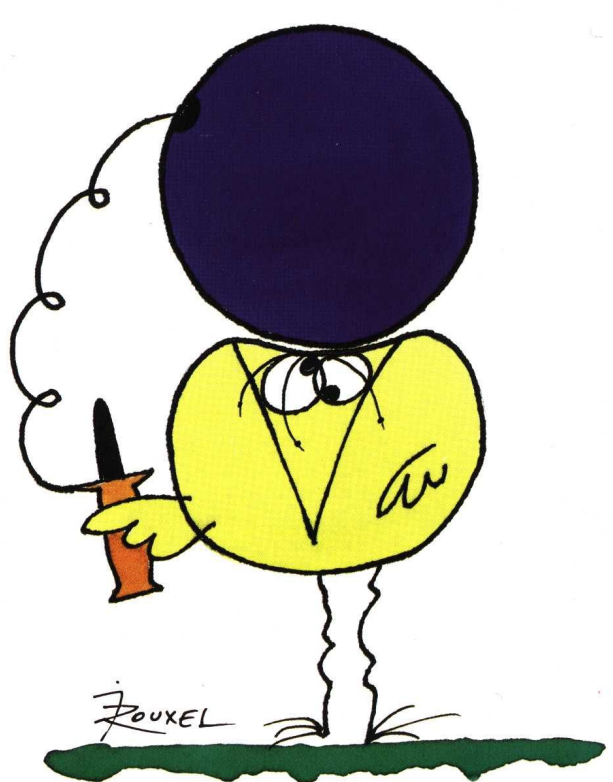
6 – Acknowledgements

- Complementary techniques:
- MACS: sensitivity increased by 8
 - NUS: sensitivity increased by 2
 - SVD: sensitivity increased by 2

- Next step:
- **Combining MACS + NUS + SVD: sensitivity increased by 32**

- Stanislas Von Euv and Virgile Barret-Vivin are thanked for providing the samples
- Laboratory head is acknowledged for its confidence
- Colleagues are recognized for their encouragements and fruitful discussions

Les devises Shadok



EN ESSAYANT CONTINUUELLEMENT ON FINIT PAR REUSSIR, DONC: PLUS ÇA RATE PLUS ON A DE CHANCES QUE ÇA MARCHE.

