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A novel SEXY approach to conquer poor resolution in Solid-State NMR

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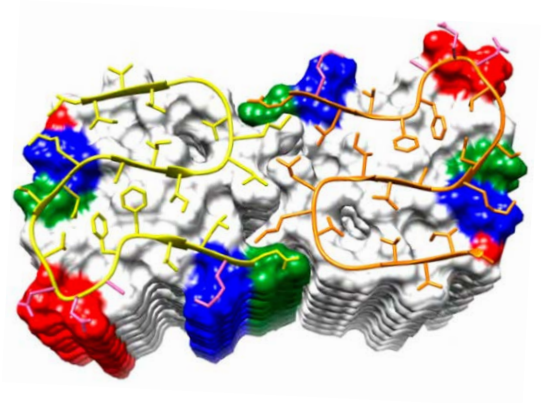
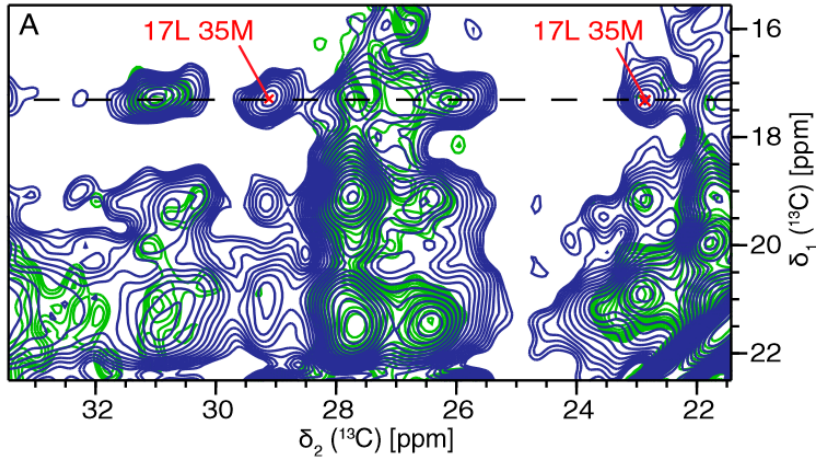
Why Solid-State NMR?

- Information on the structure and dynamics of biomolecules
- Large molecules tumble slowly in solution-state NMR

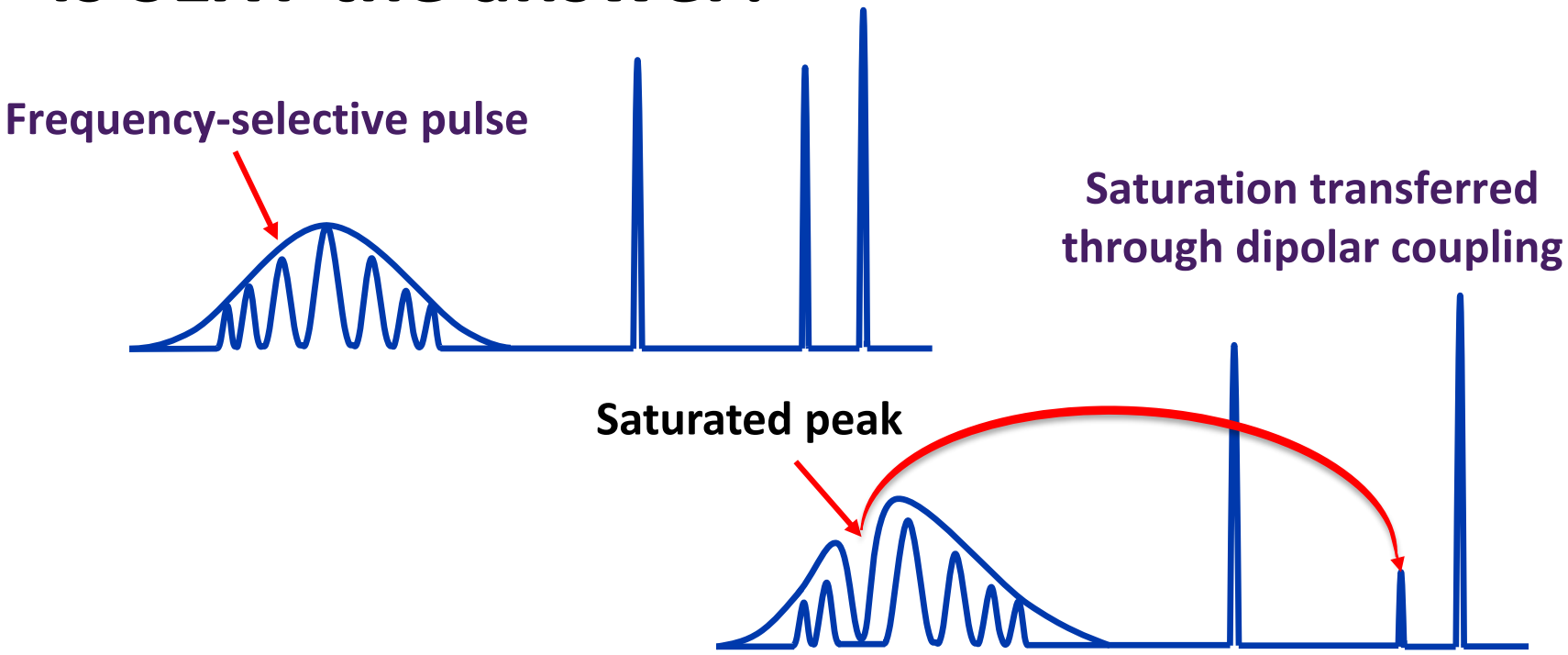




- Solid-state NMR also has issues

M. Wälti, *et al., PNAS*, 2016, 4976–4984.

Is SEXY the answer?

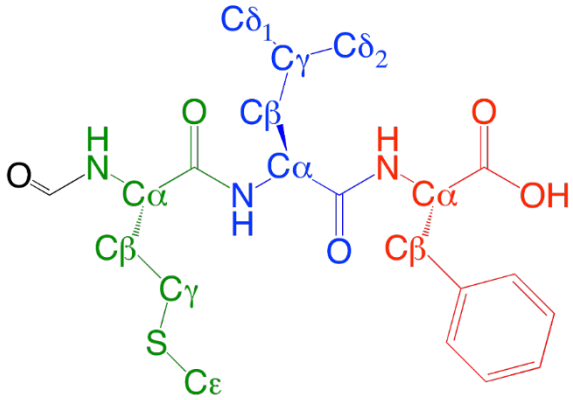


- Extraction of structural information from extensively broadened peaks

Methodology

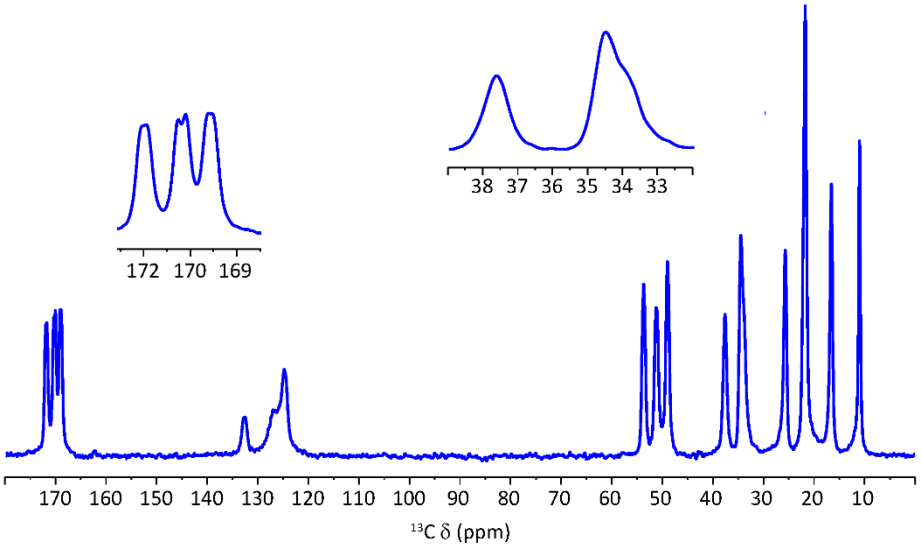
- Bruker Avance II+ spectrometer at a ^{1}H Larmor frequency of 600 MHz
- 1.3 mm triple-resonance magic angle spinning (MAS) probe
- MAS frequency of 60 KHz

Proof of Concept

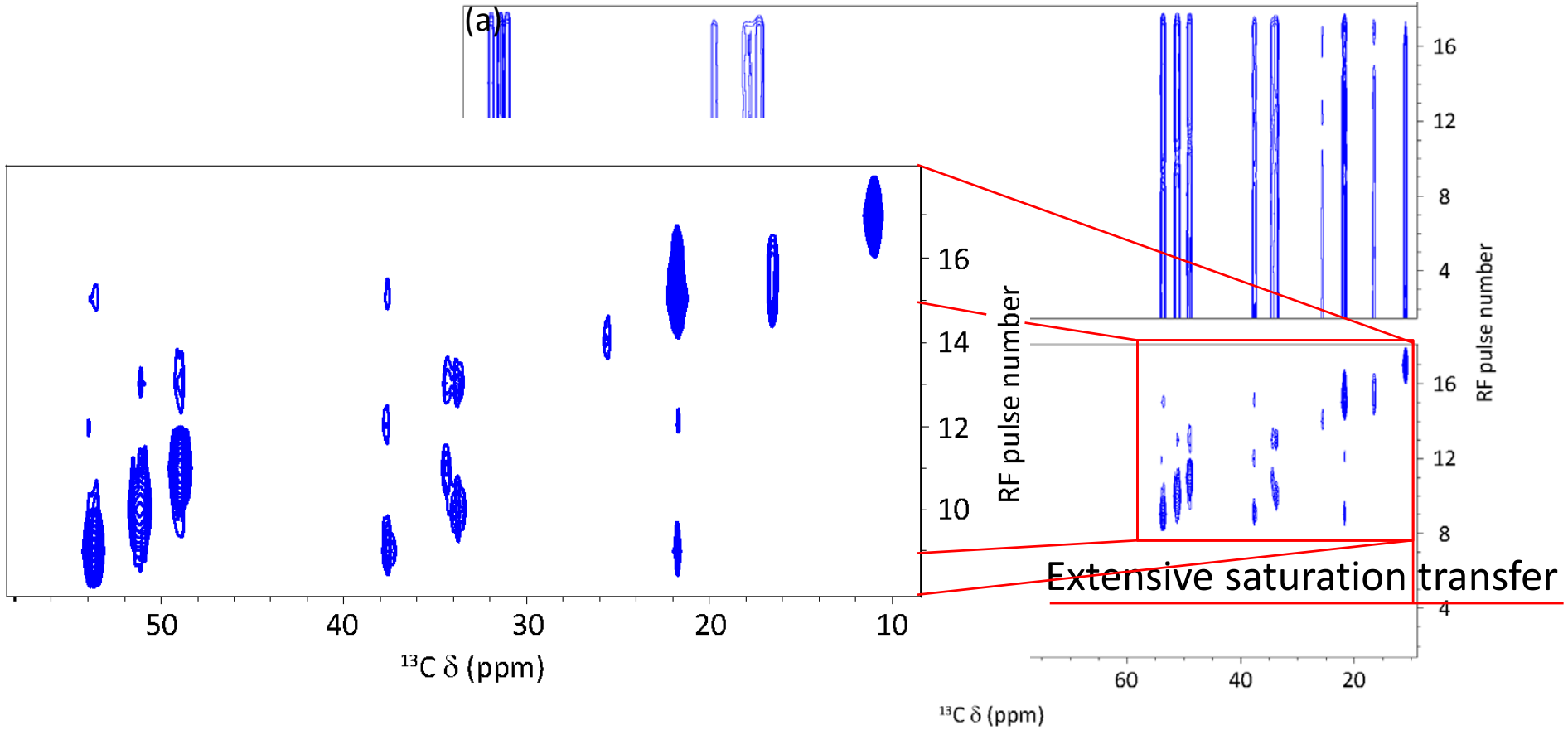


N-formyl-Met-Leu-Phe-OH (fMLF).

- Crystalline sample
- No inhomogeneous broadening

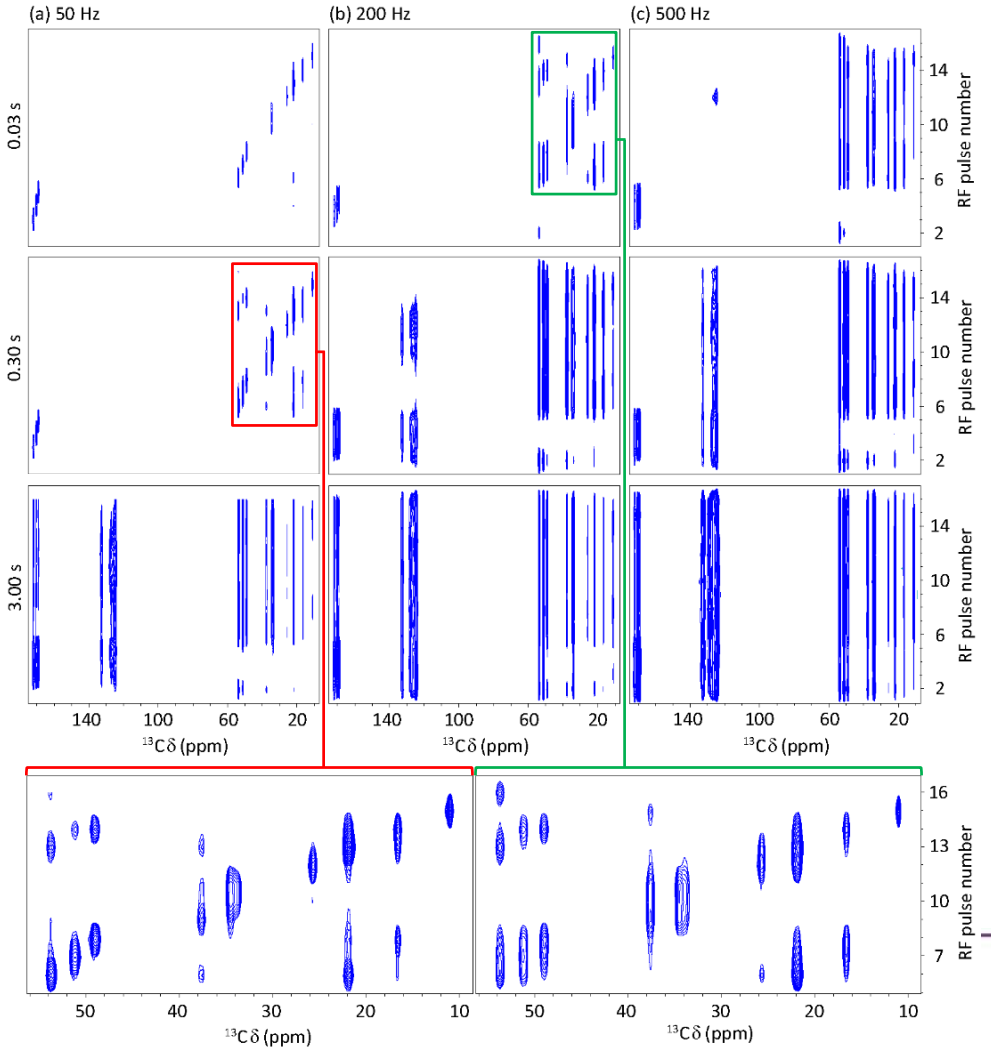


One-dimensional ^{13}C-spectrum of MLF

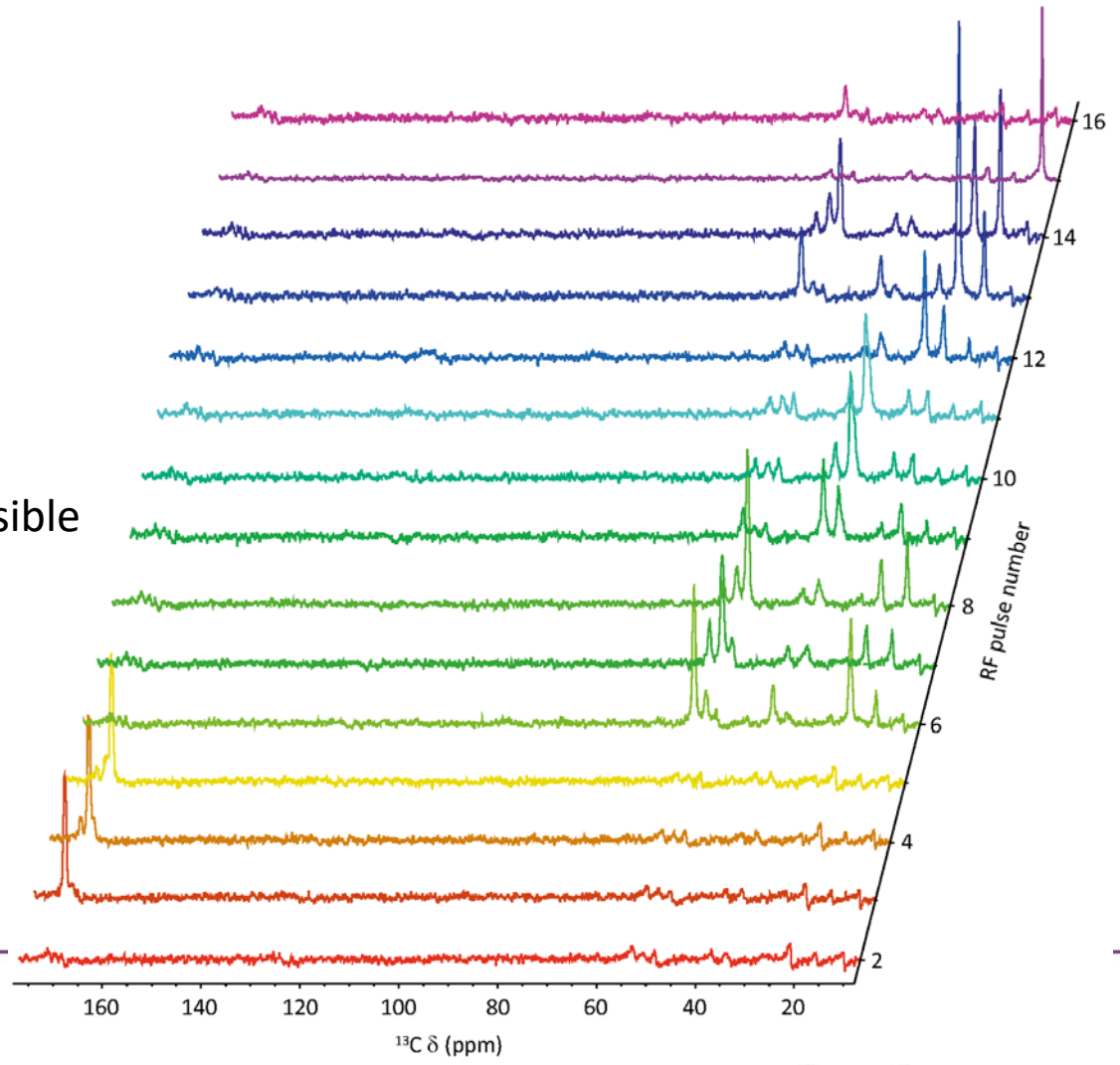

(a)
16
12
8
4
RF pulse number
16
14
12
10
RF pulse number
50
40
30
20
10
^{13}C δ (ppm)
16
12
8
4
RF pulse number
60
40
20
^{13}C δ (ppm)
Extensive saturation transfer

Optimisation

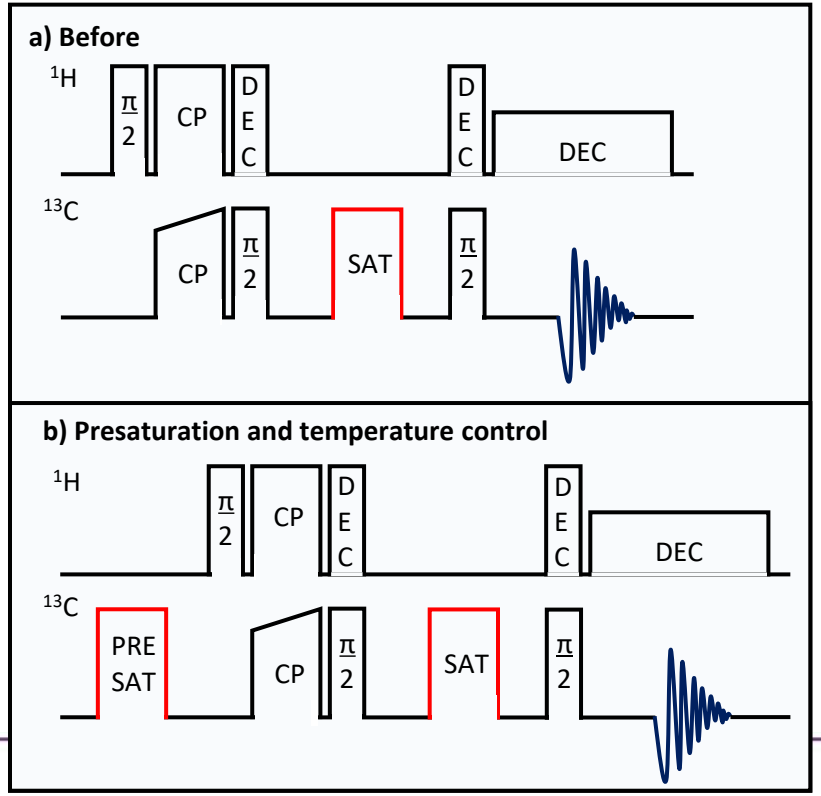
- 2D ^{13}C-SEXY difference spectra of MLF obtained at different nutation frequencies and pulse durations.

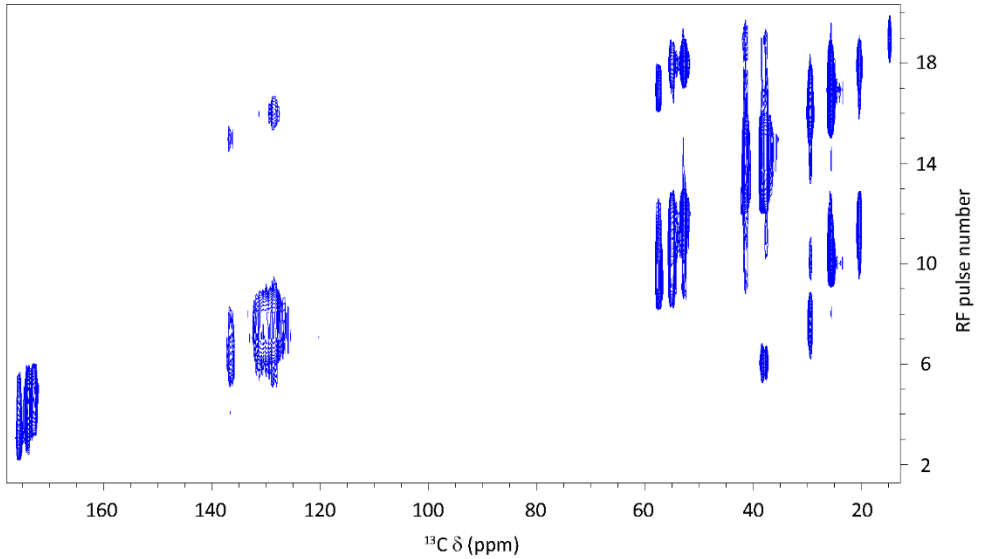


- Pulse number 2 and 16 are off-resonance pulses
- The difference spectra indicate possible heating issues or chemical shift anisotropy (CSA)



Temperature control

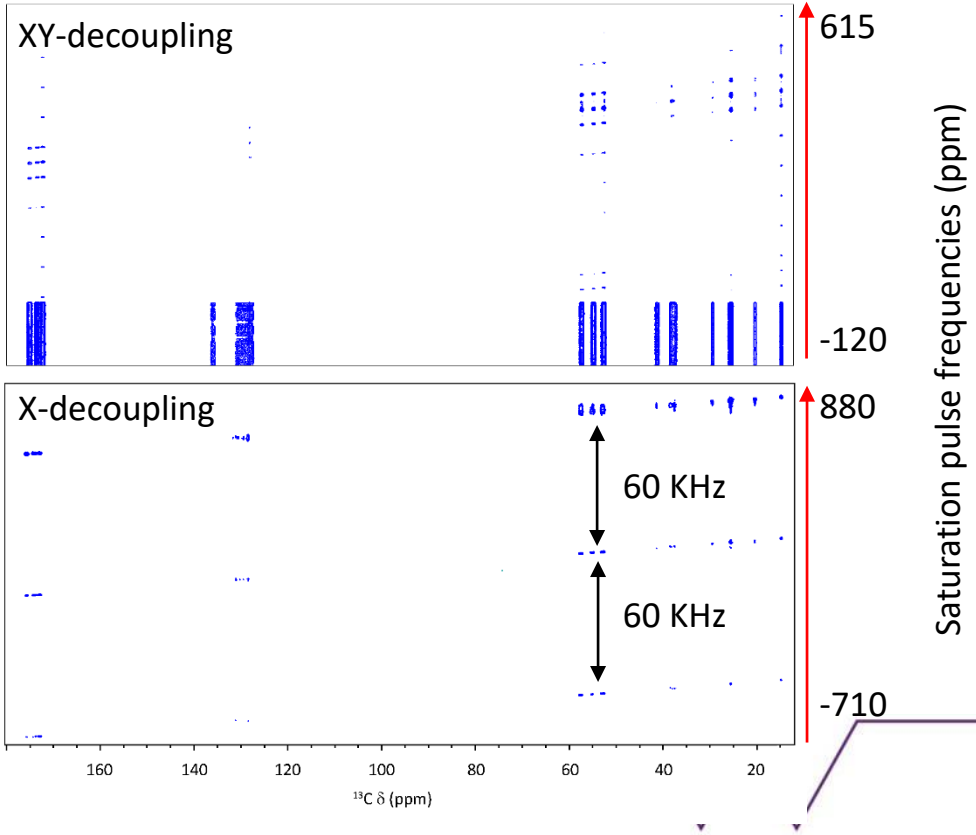




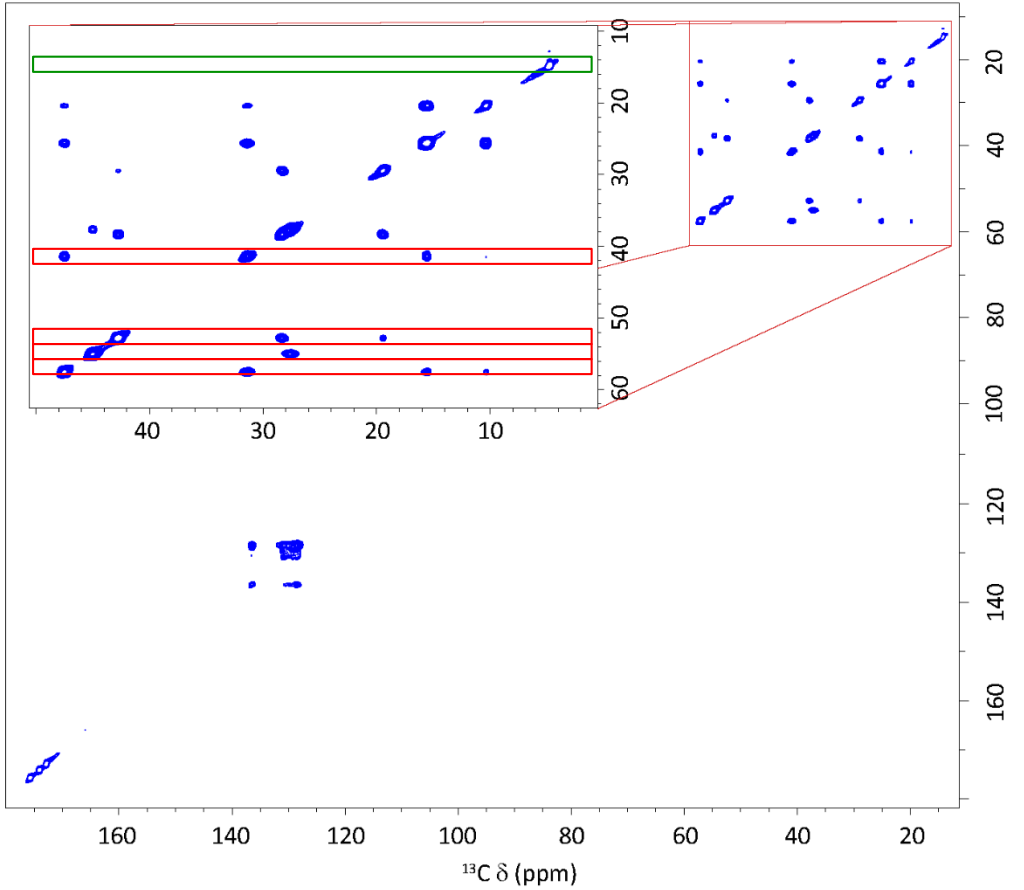
- 2D ^{13}C-SEXY spectrum with temperature control

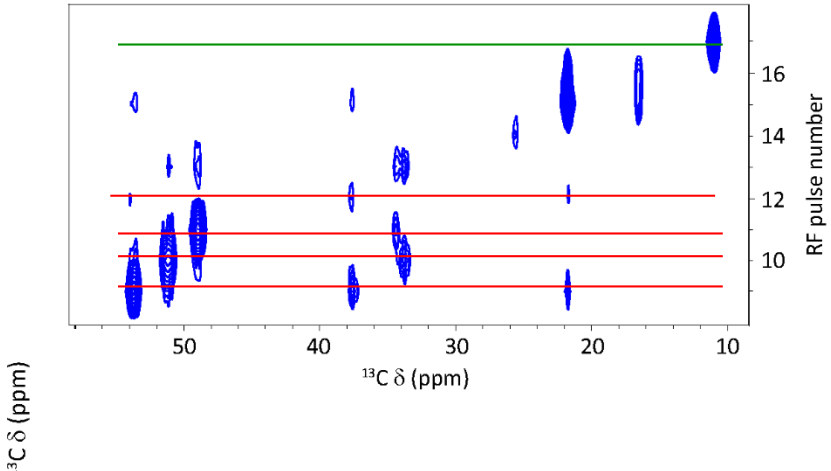
Chemical shift anisotropy

- Mapping of CSA was attempted using a ‘grid search’ method
- Saturation frequencies increased in 250 Hz increments



How does SEXY compare to PDSD?





- Both show key similarities
- Optimisation of SEXY is still required

Conclusions and future work

- SEXY presents a novel approach to tackle inhomogeneous broadening
- Analysis using MLF has provided proof-of-concept
- Future work is required to optimise this experiment
- Analysis of samples containing various degrees of inhomogeneous broadening is required

Acknowledgments

- Trent Franks
- Peter Gierth
- Józef Lewandowski

Thank you for listening!
Any questions?