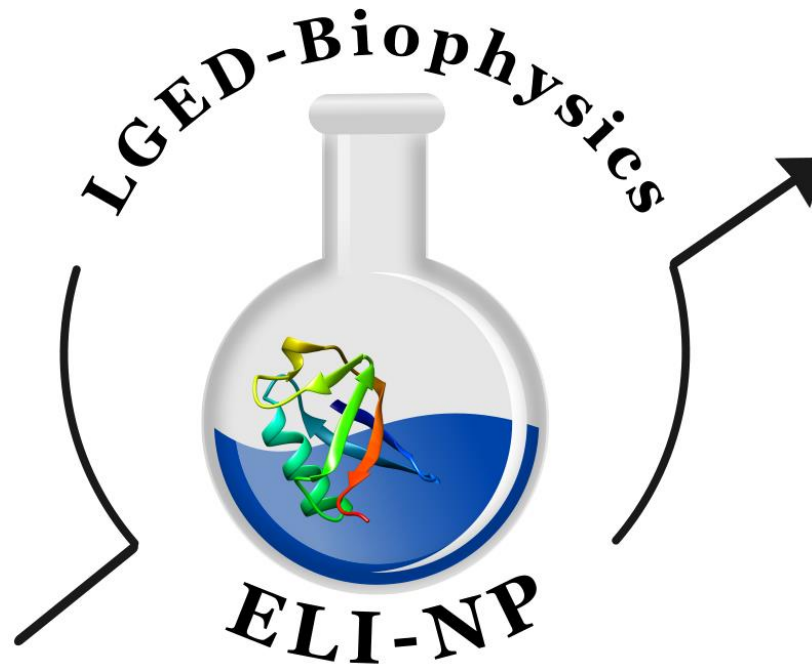




UNIVERSITATEA DIN
BUCUREȘTI
— VIRTUTE ET SAPIENTIA



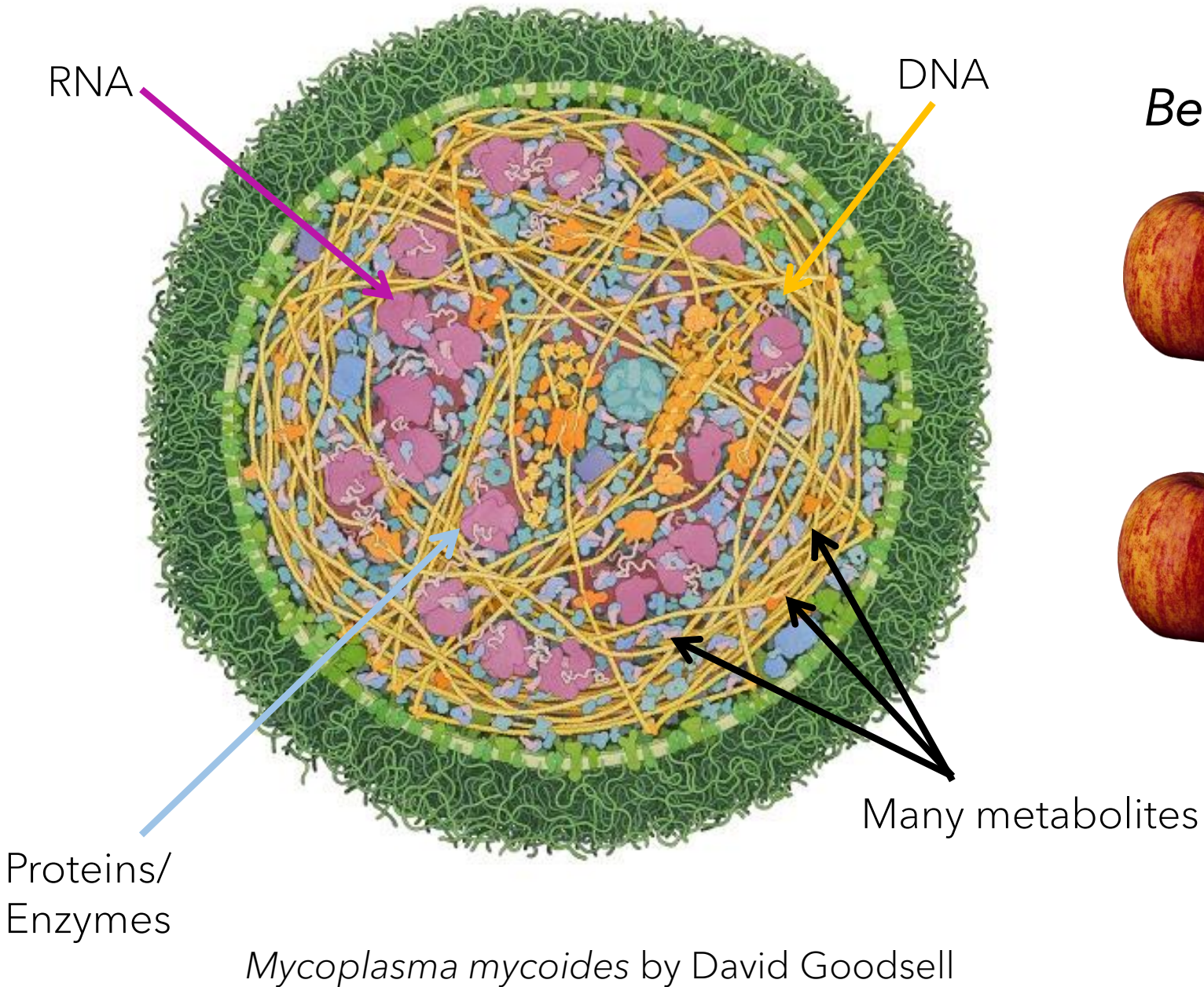
INTERDISCIPLINARY SCHOOL
OF DOCTORAL STUDIES

Magnetic Resonance methods for biomarkers detection and structural biology

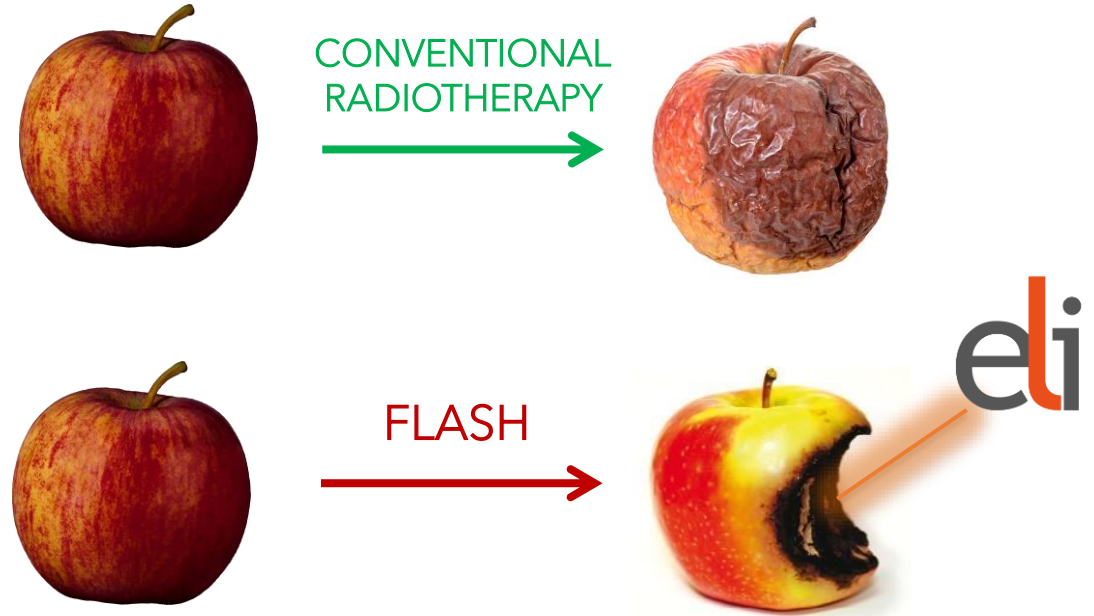
The life and work of a chemist at ELI-NP

Florin Teleanu
Ph.D. Supervisor: Prof. Paul R. Vasos

Strategy: BLITZKRIEG



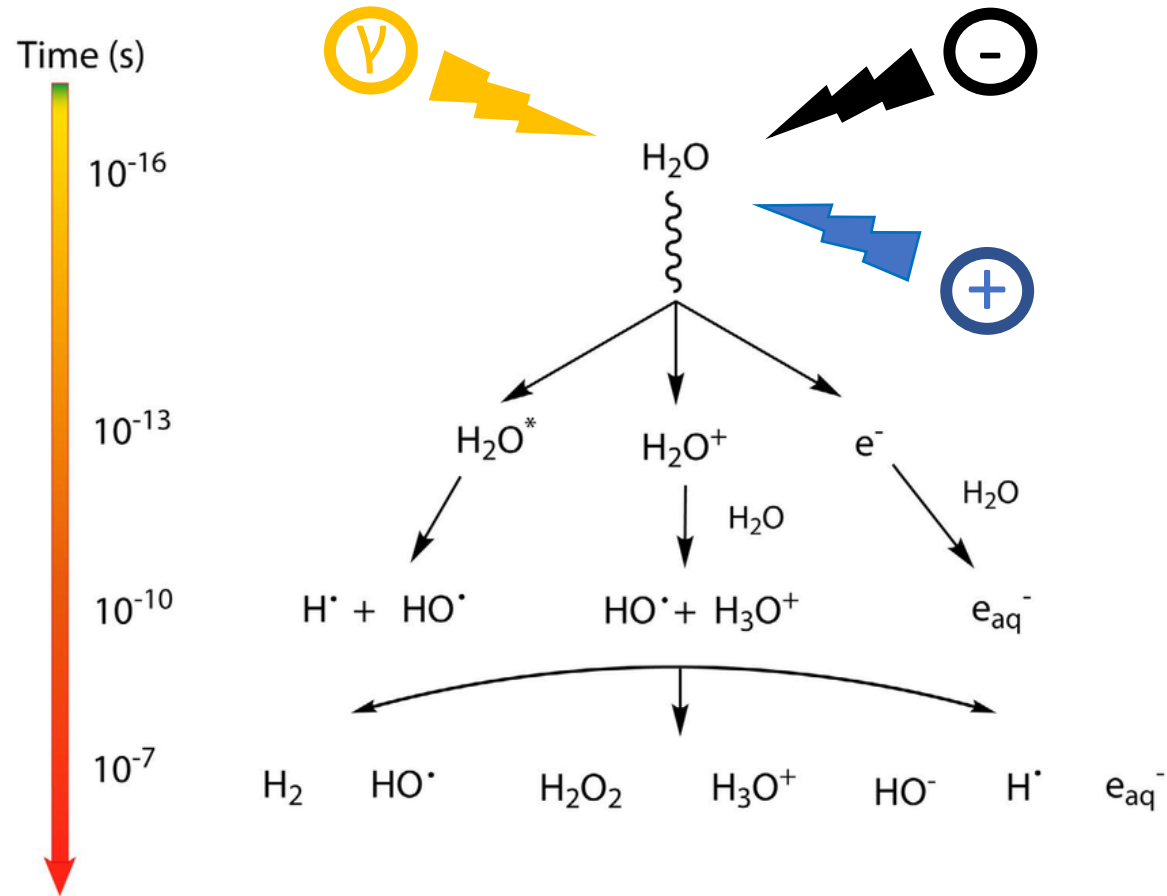
Benefits of FLASH radiotherapy



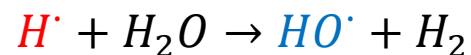
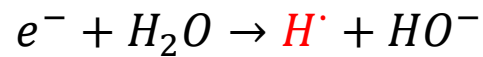
Montay- Gruel et al., PNAS, 2020
M-C Vozevin et al., Clin. Cancer Res., 2019

Asavei et al., Med. Phys. 2019

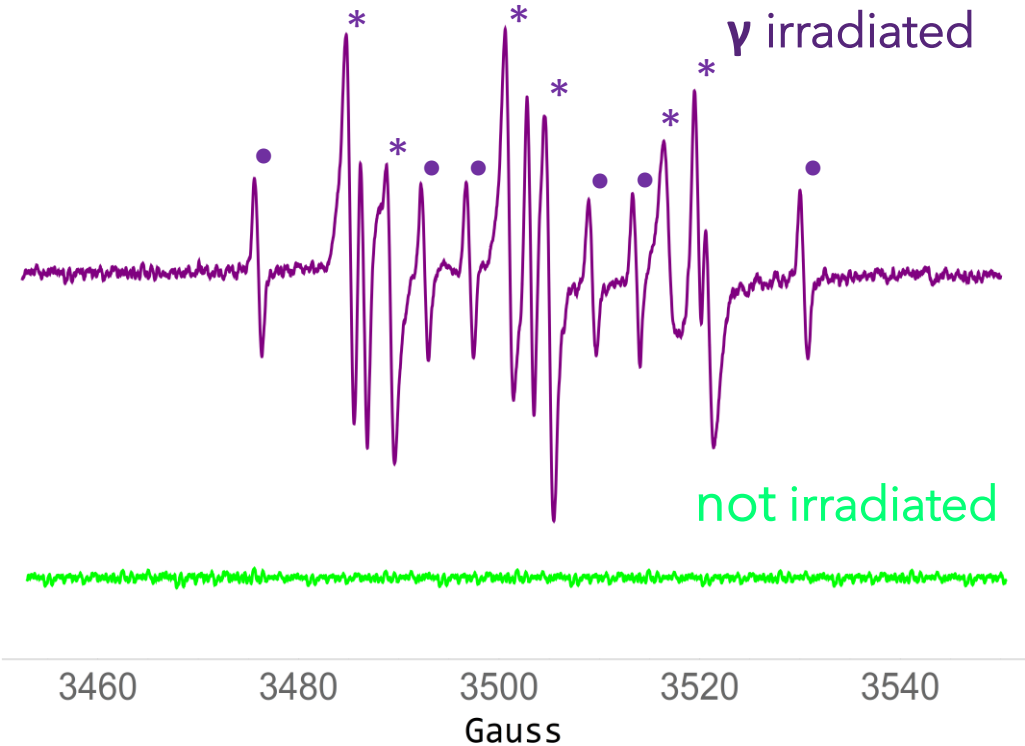
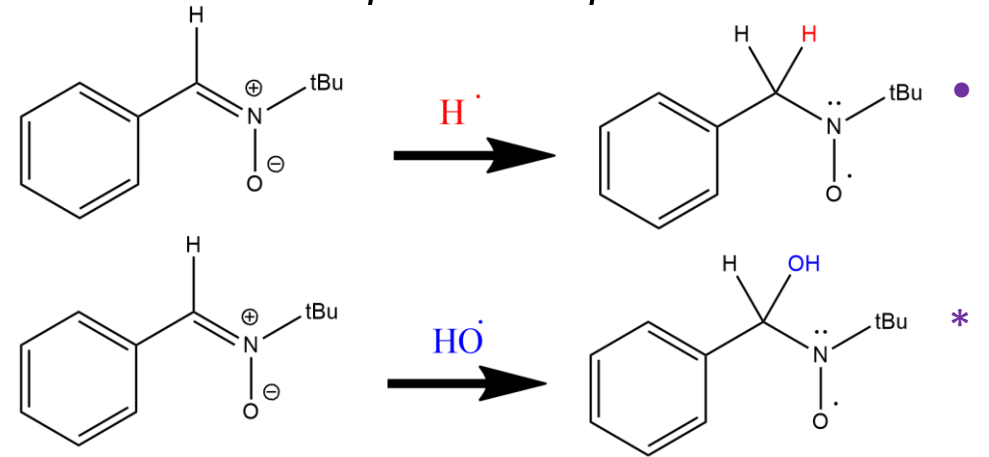
Reactive Oxygen Species generated by water radiolysis



$\gamma_{high\ energy} + target \rightarrow \gamma_{lower\ energy} + e^-$ (Compton scattering)



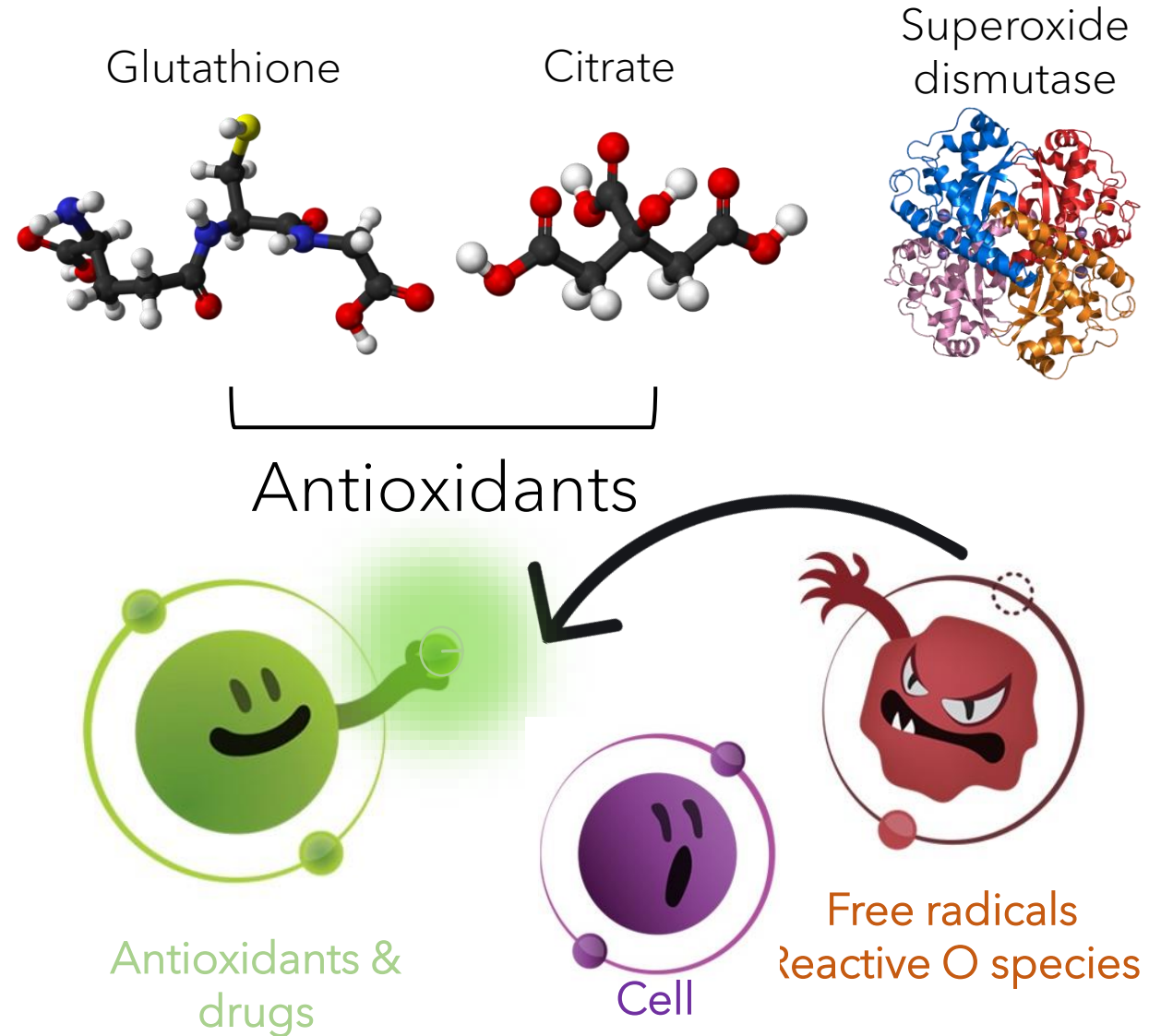
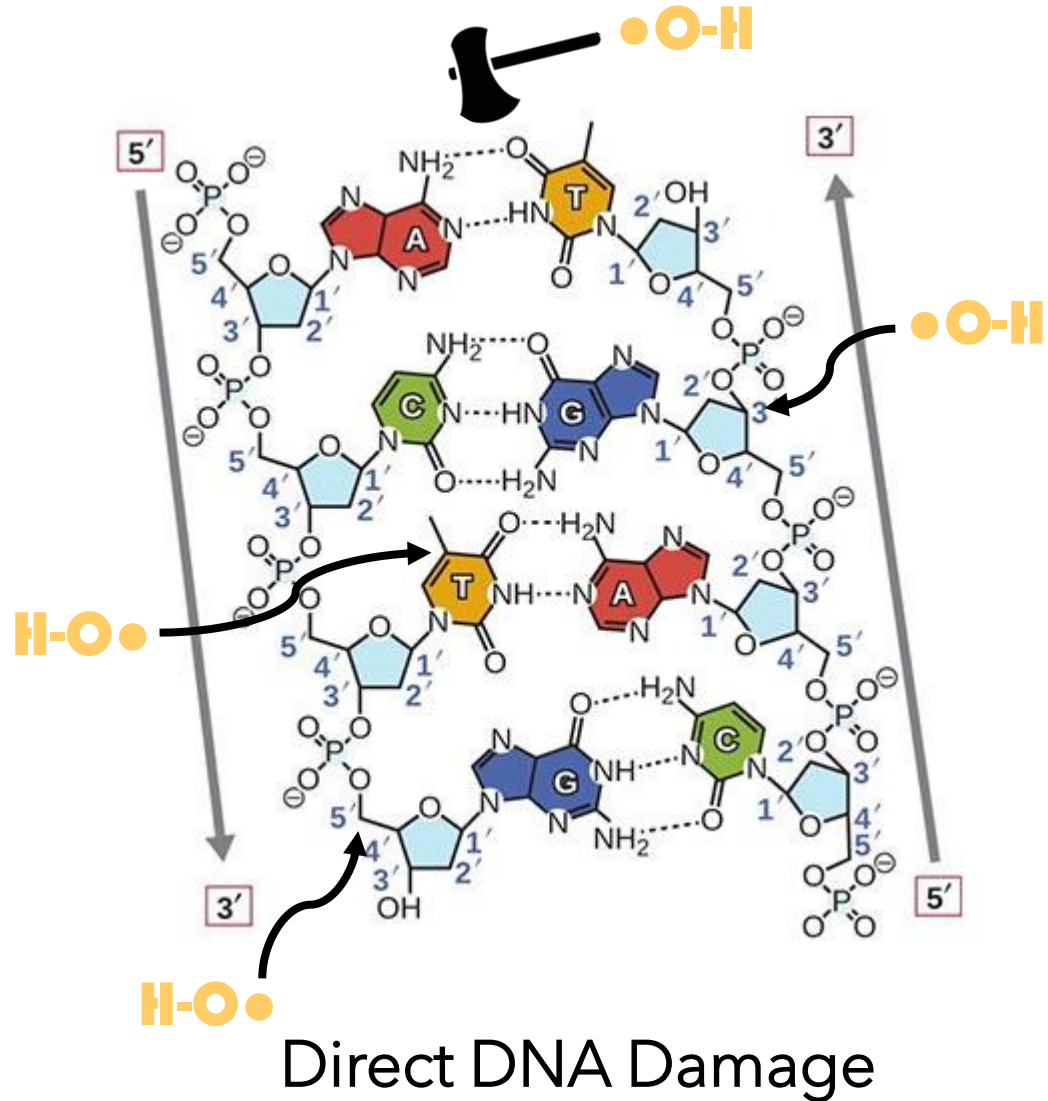
How do we see ROS? Spin Traps!



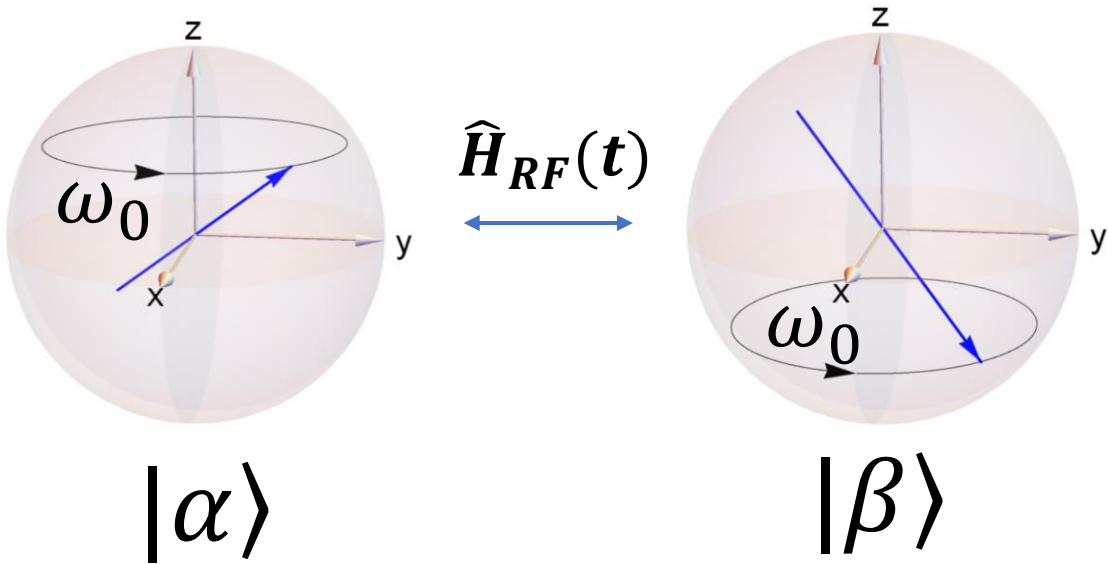
How do cells see ROS?
DANGER!



What do cells think about ROS?
Quench them!

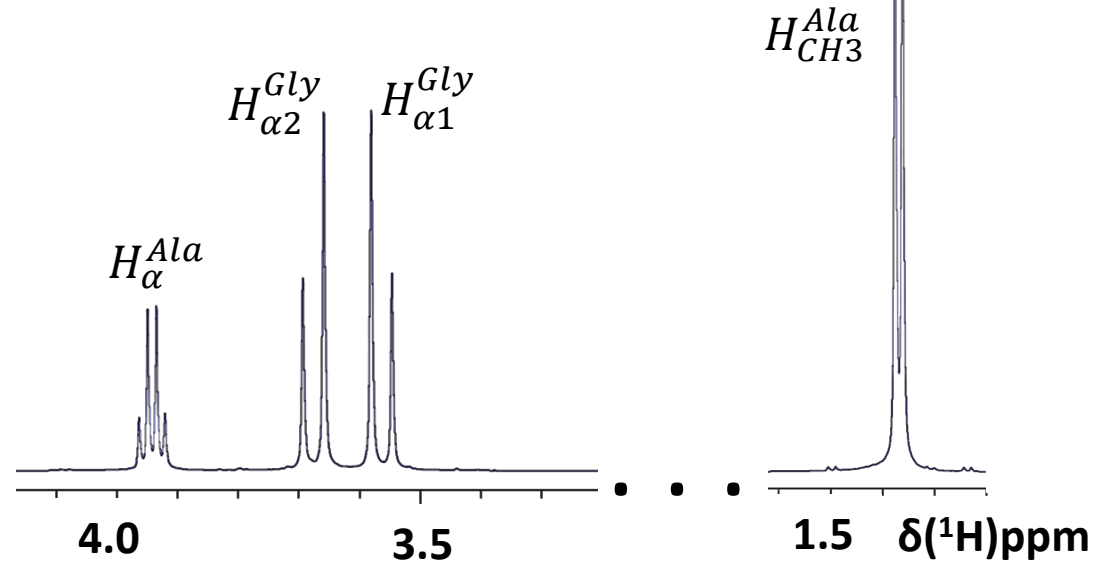
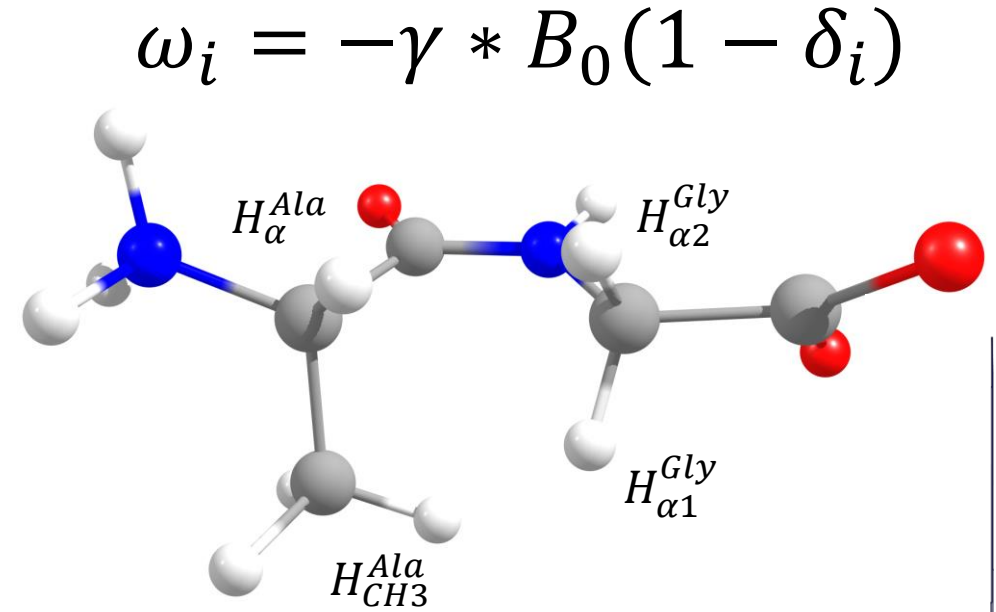
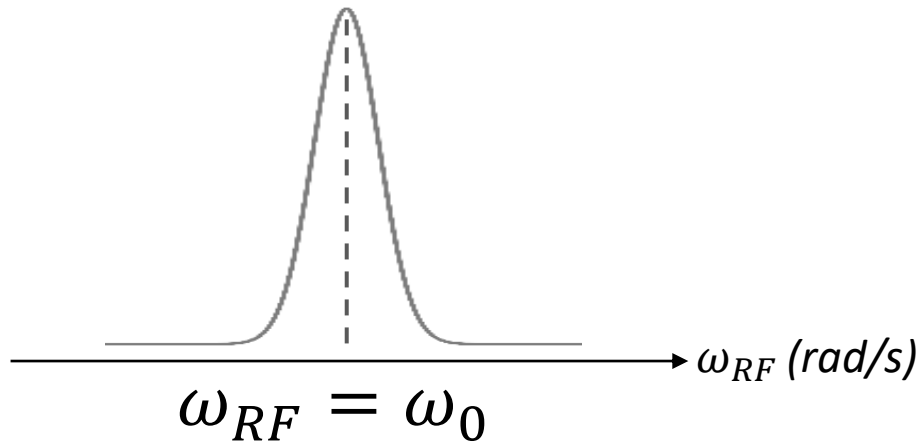


How can we know what happens in cells?

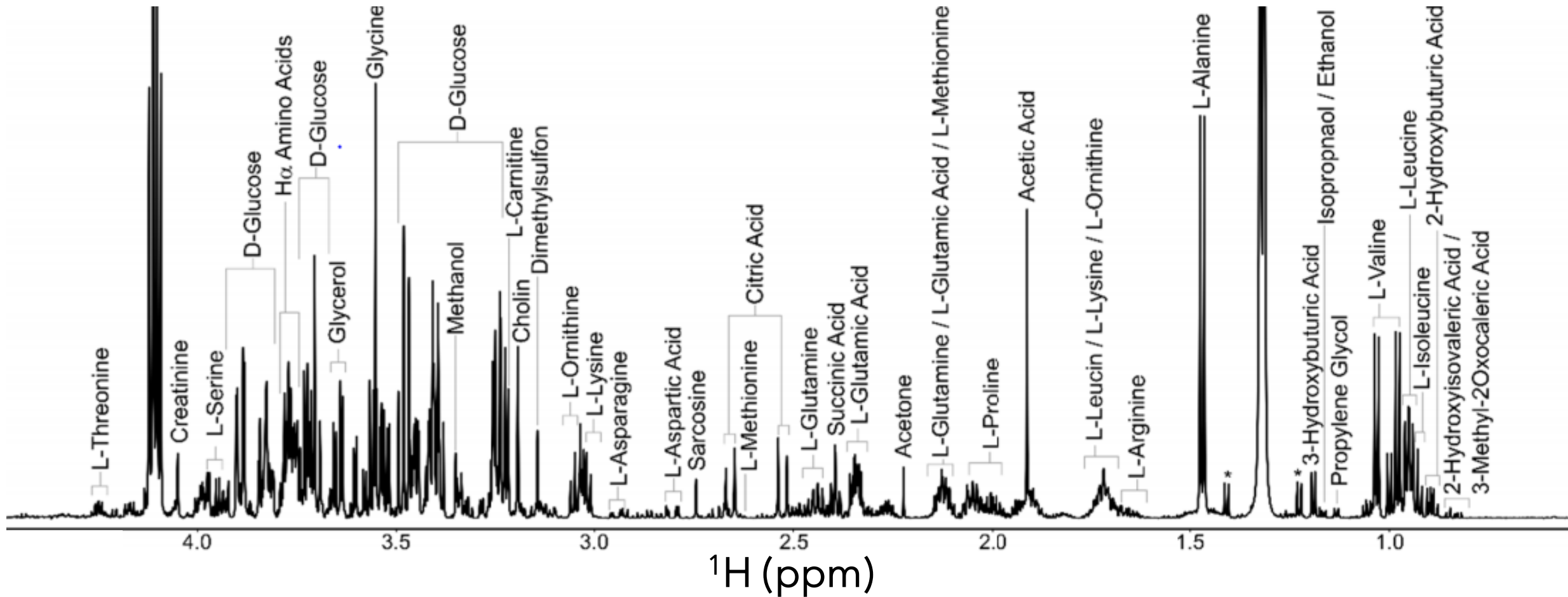


$$\omega_0 = -\gamma * B_0$$

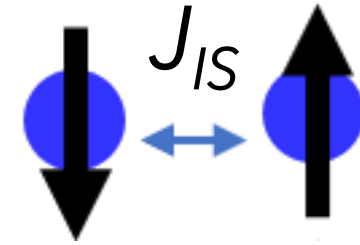
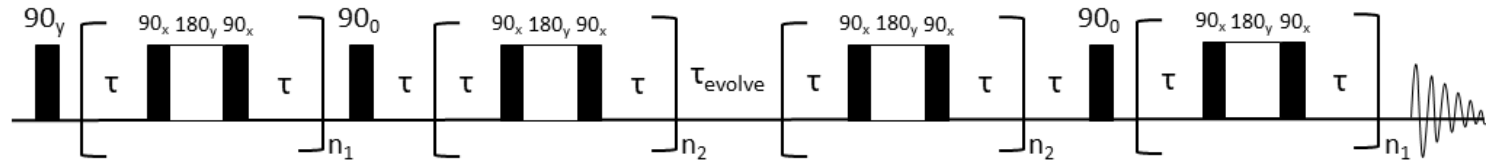
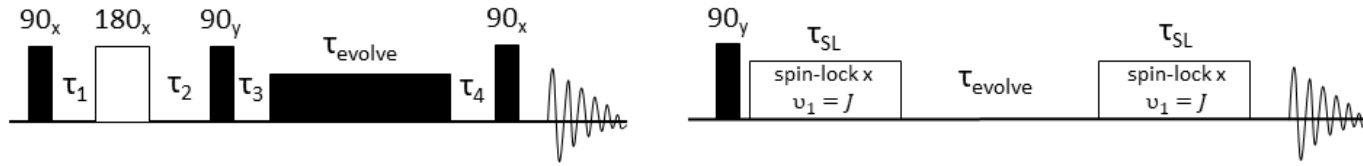
$$\hat{H}_{RF}(t) \propto B_1(\cos(\omega_{RF} * t) * \hat{I}_x + \sin(\omega_{RF} * t) * \hat{I}_y)$$



THE PROBLEM(s)

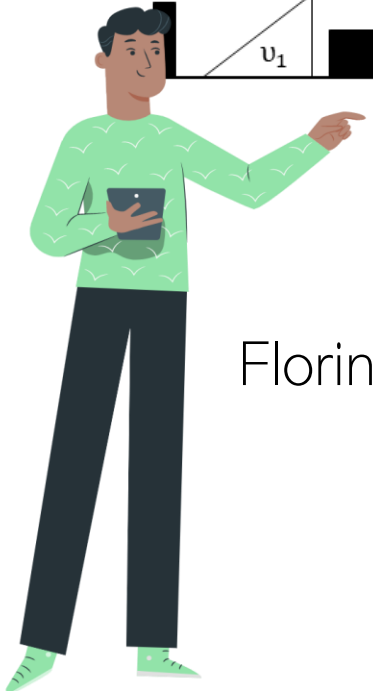


Long-lived states in Nuclear Magnetic Resonance



$$|S_0\rangle = \frac{1}{\sqrt{2}}(|\alpha\beta\rangle - |\beta\alpha\rangle)$$

$$|T_{+1}\rangle = |\alpha\alpha\rangle \quad |T_0\rangle = \frac{1}{\sqrt{2}}(|\alpha\beta\rangle + |\beta\alpha\rangle) \quad |T_{-1}\rangle = |\beta\beta\rangle$$



Florin



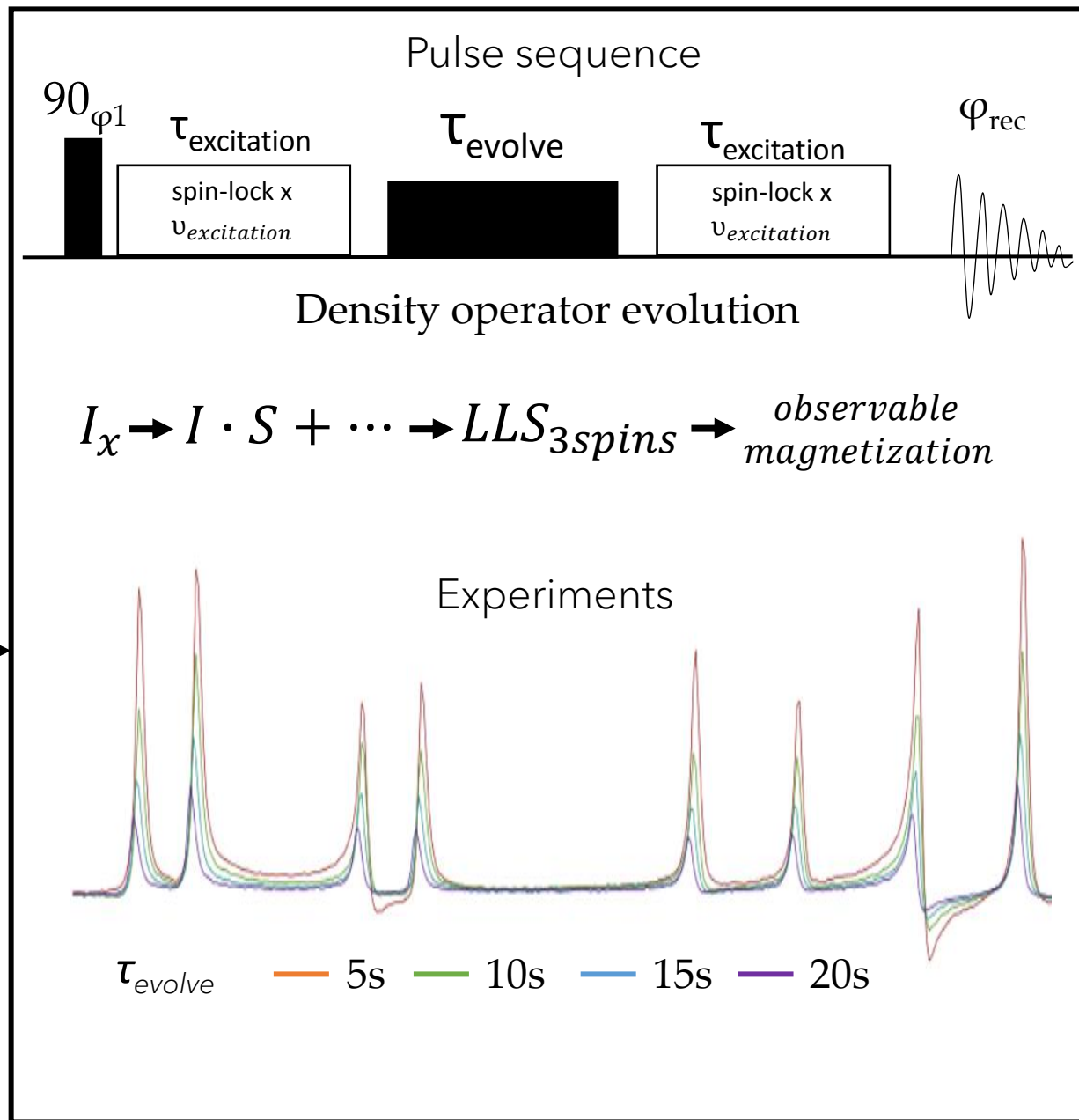
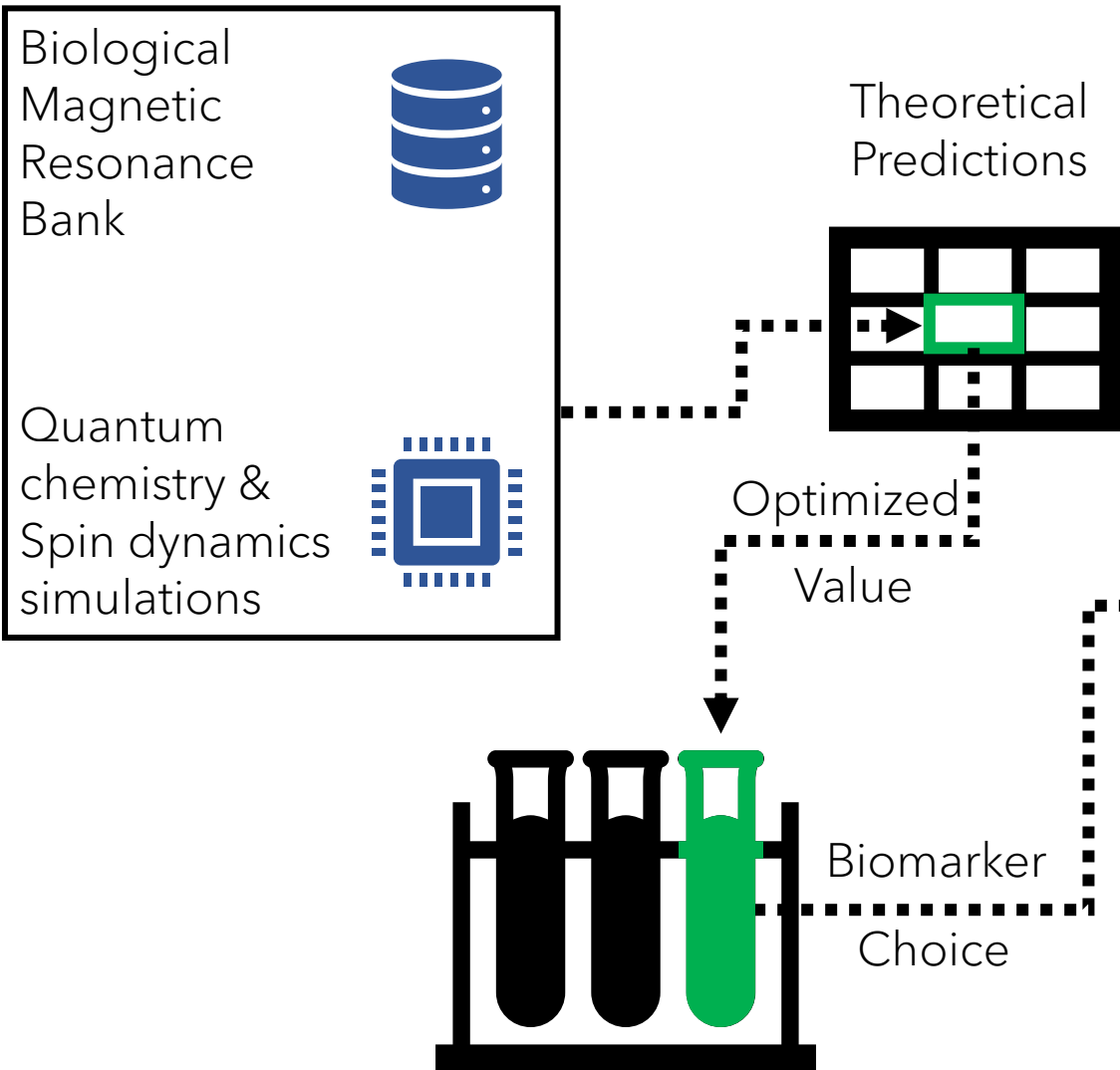
Paul

$$LLS_{2spins} = |S_0\rangle\langle S_0| - \frac{1}{3} \sum |T_i\rangle\langle T_i|$$

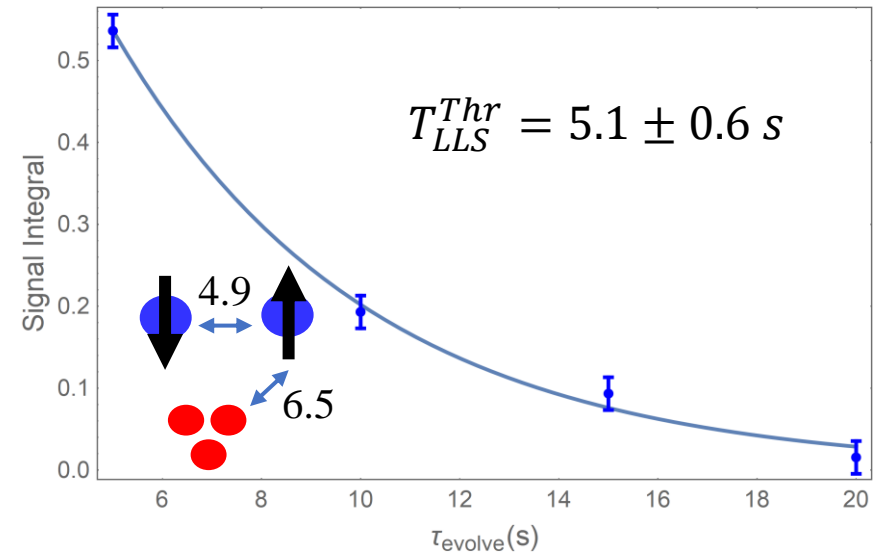
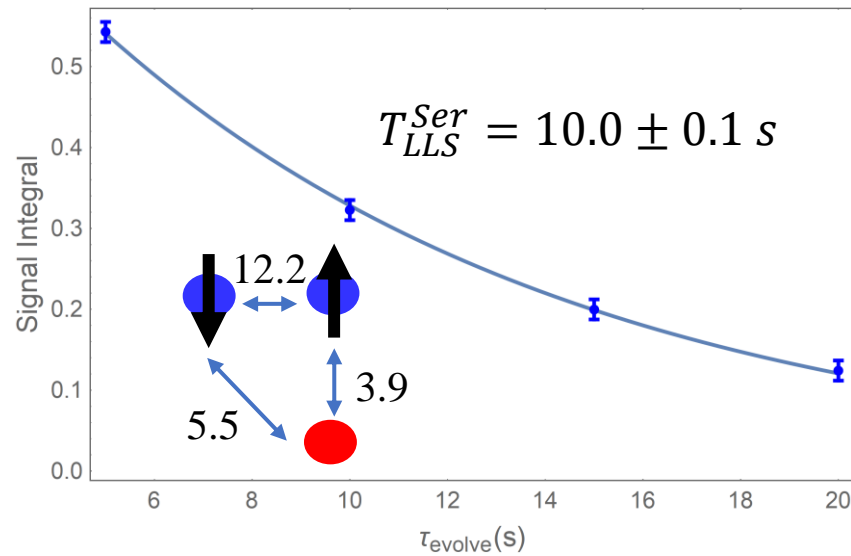
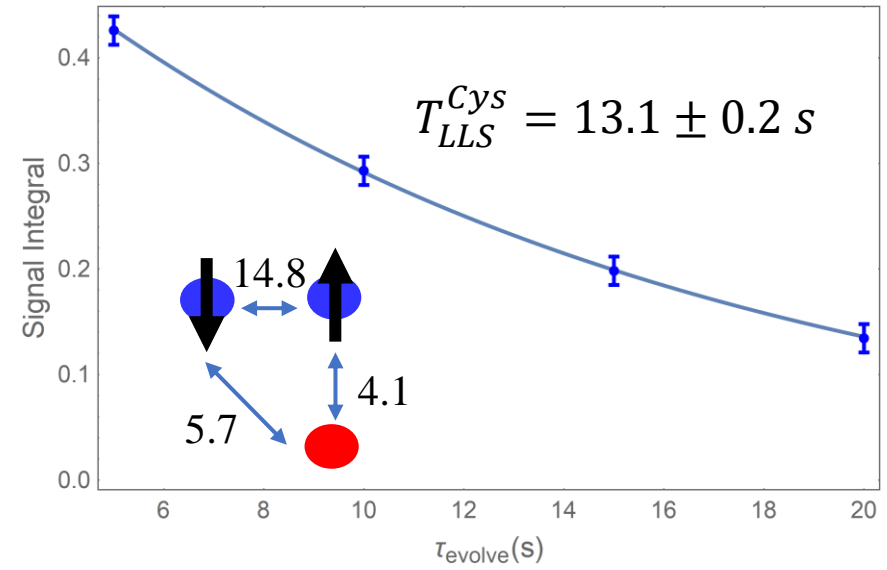
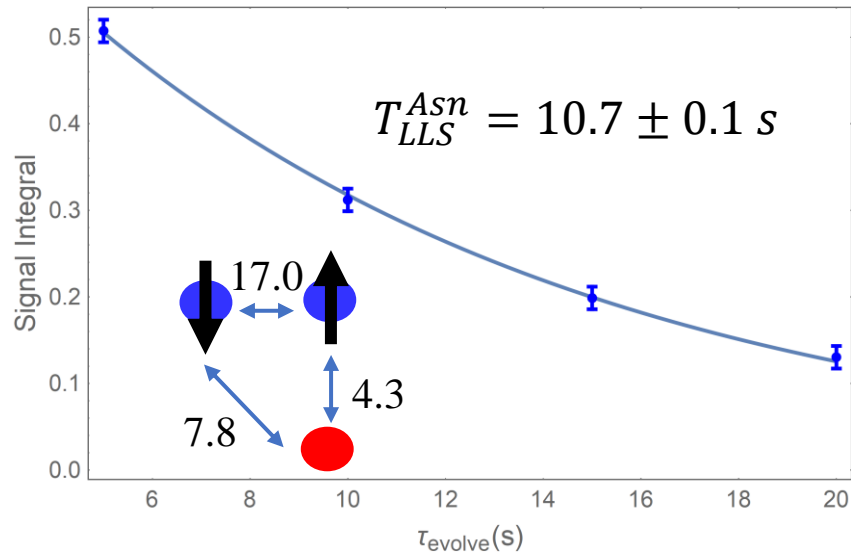
antisymmetric symmetric

This ↑ will decay last

Methodology

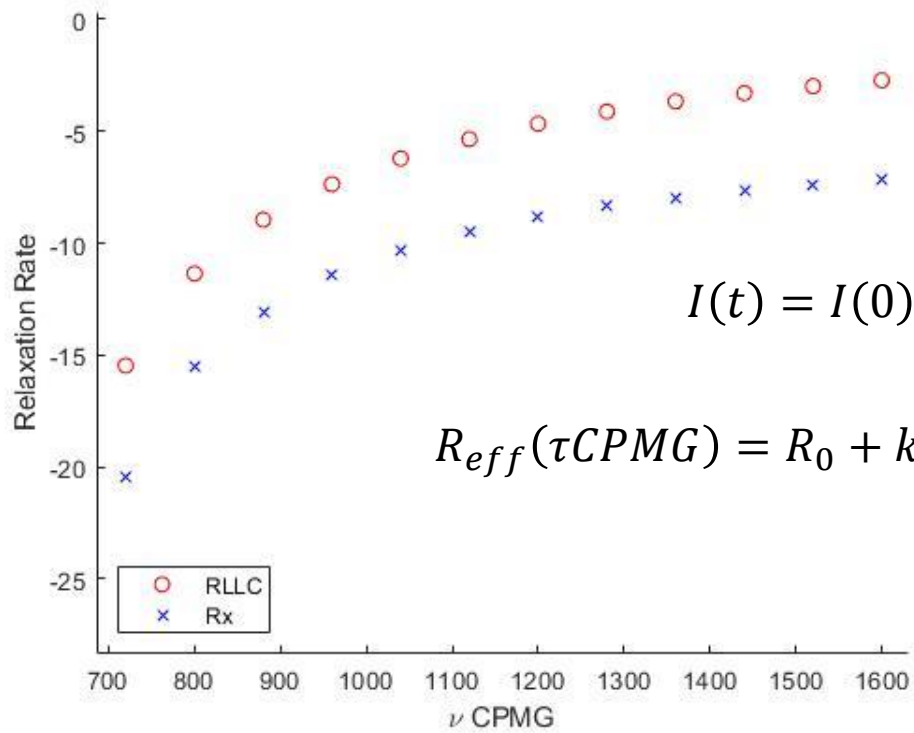


Results



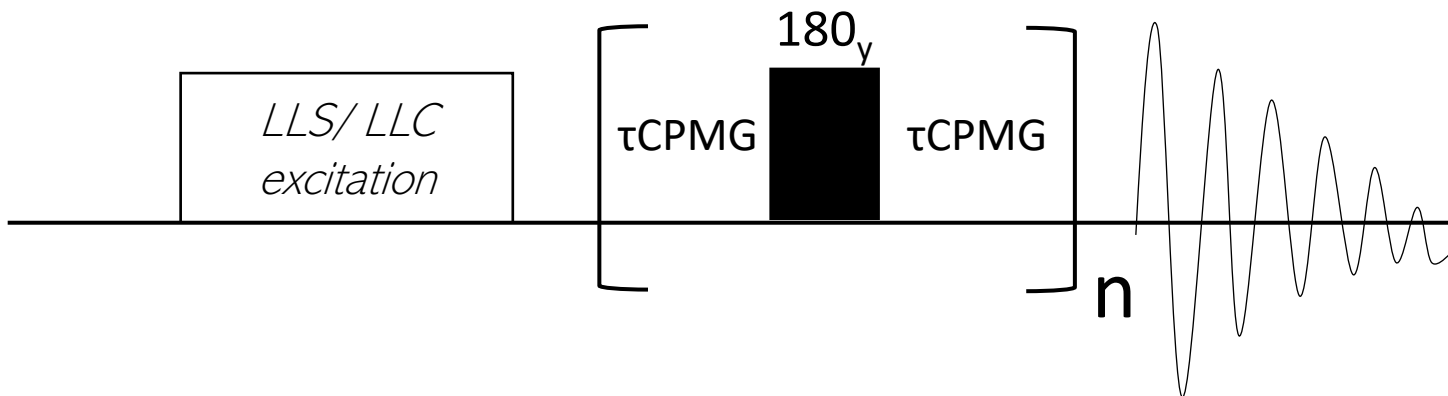
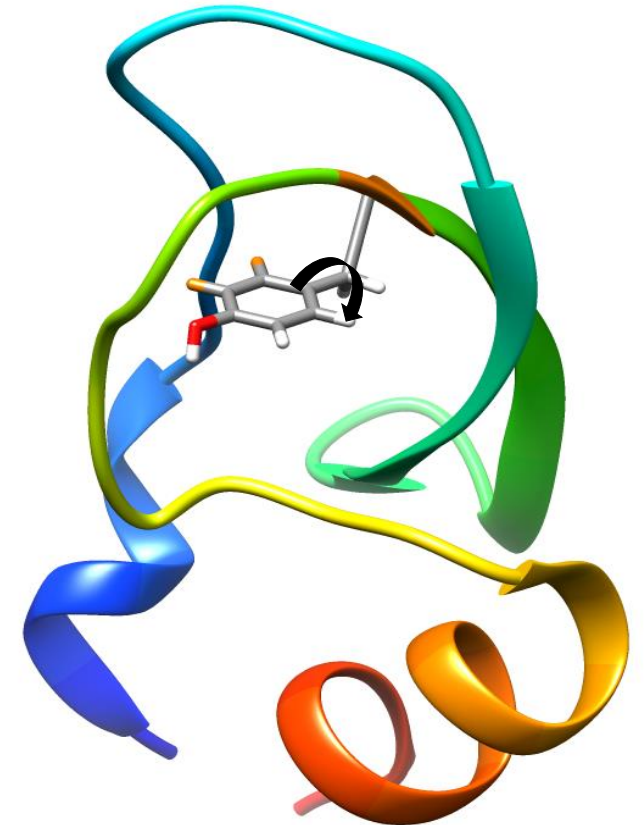
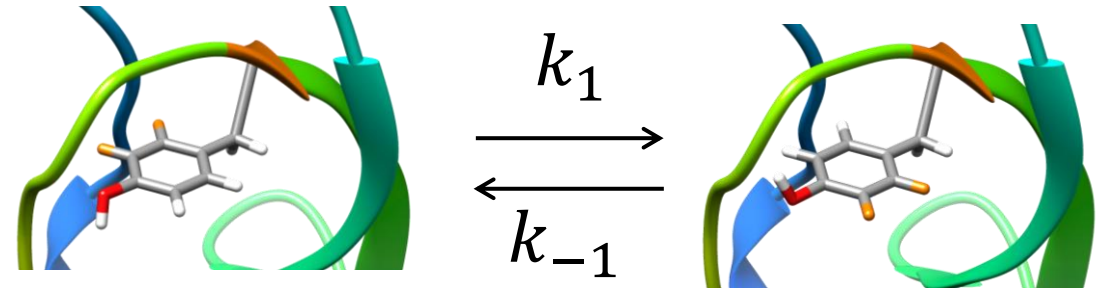
Teleanu, E., Tuță, C., Cucoanes, A., Vasilca, S. & Vasos, P. R. Magnetization Lifetimes Prediction and Measurements Using Long-Lived Spin States in Endogenous Molecules. *Molecules* **25**, 5495 (2020)

Work in progress: proteins' inner dynamics



$$I(t) = I(0) * e^{-R(\tau_{CPMG}) * t}$$

$$R_{eff}(\tau_{CPMG}) = R_0 + k_1 \left(1 - \frac{\sin \delta\omega * \tau_{CPMG}}{\delta\omega * \tau_{CPMG}} \right)$$



Published Papers

Thank you for your attention

1. Teleanu, F., Sadet, A. & Vasos, P. R. Symmetry versus entropy: Long-lived states and coherences. *Progress in Nuclear Magnetic Resonance Spectroscopy* **122**, 63–75 (2021) (IF=8.89).

2. Teleanu, F., Tuță, C., Cucoanes, A., Vasilca, S. & Vasos, P. R. Magnetization Lifetimes Prediction and Measurements Using Long-Lived Spin States in Endogenous Molecules. *Molecules* **25**, 5495 (2020) (IF=3.26)
3. Sadet, A., Stavarache, C., Teleanu, F. & Vasos, P. R. Water hydrogen uptake in biomolecules detected via nuclear magnetic phosphorescence. *Scientific Reports* **9**, 1–7 (2019) (IF=3.99).
4. Sadet, A., Sarkar, R., Teleanu, F., Bodenhausen, G. & Vasos, P. R. Chapter 20: Long-lived Coherences in *Long-lived Nuclear Spin Order* 371–388 (2020).
5. Moraru, I.-T., Teleanu, F. & Nemes, G. Theoretical Insights into the Structural Differences between Organic and Inorganic Amines/Ethers. *J. Phys. Chem. A* **124**, 8246–8253 (2020) (IF=2.60).

