

Across the Tree of Life: Radiation Resistance Gauged by High-Field EPR



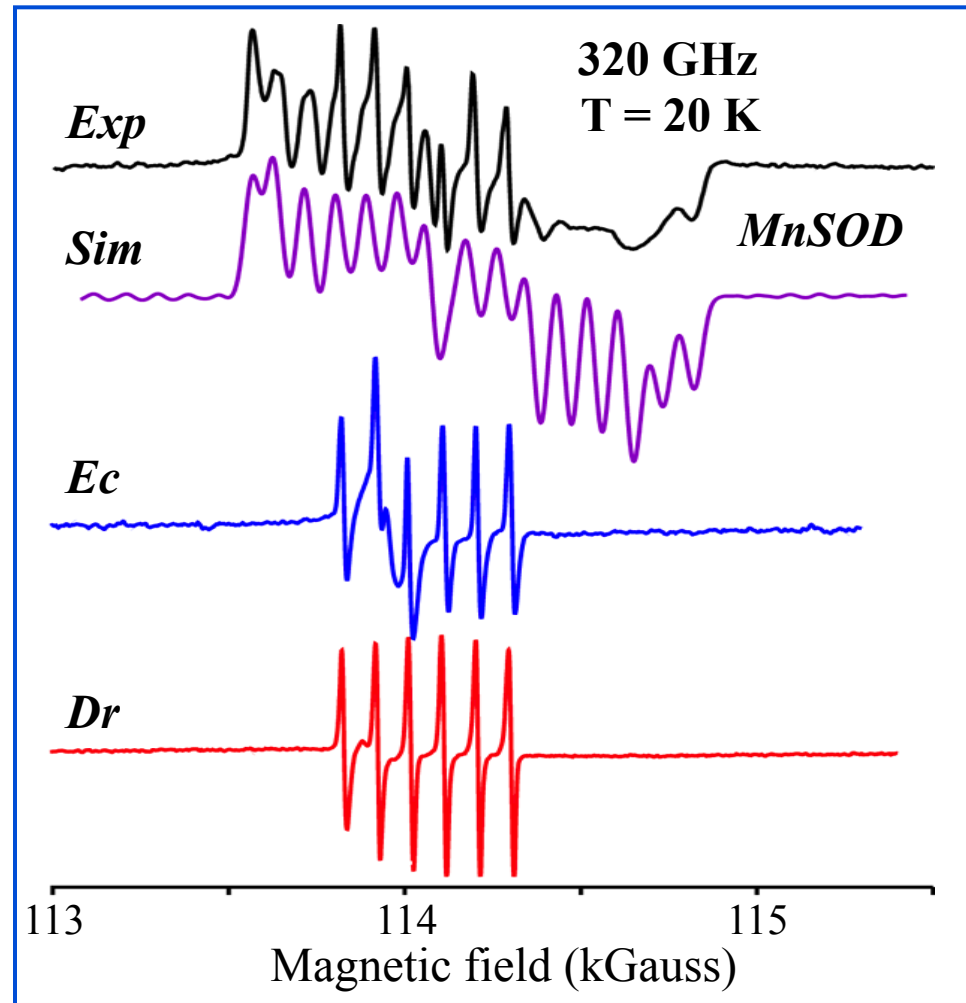
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Decades of research have failed to predict the ability of cells to survive ionizing radiation (IR). Evidence is mounting that small high-symmetry antioxidant complexes of manganous ions with metabolites (H-Mn²⁺) are responsible for cellular IR resistance, and that H-Mn²⁺ protects the proteome, not the genome, from IR-induced reactive oxygen species.

This collaborative study shows that the amount of H-Mn²⁺ in non-irradiated living cells is readily gauged by electron paramagnetic resonance (EPR) spectroscopy and is highly diagnostic of DNA repair efficiency and survival after gamma radiation exposure. Importantly, the high resolving power of high-field EPR is essential for proving that the enzyme manganese superoxide dismutase (MnSOD) is present in negligible amounts in the bacterium *Deinococcus Radiodurans* (*Dr*), which is capable of surviving radiation doses 20-fold greater than *Escherichia coli* (*Ec*), thereby disproving previous assertions that MnSOD is critical in the IR survival of *Dr*. Indeed, the narrow 6-line EPR spectrum of *Dr* (see Fig.) is characteristic of the high symmetry H-Mn²⁺.

This spectroscopic study of H-Mn²⁺ content is the strongest known biological indicator of cellular IR resistance between and within the three domains of the tree of life, with potential applications including optimization of radiotherapy.



Facilities and instrumentation used: Electron Magnetic Resonance, 15/17 T Broadband Transmission Spectrometer

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