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Life sciences at ISOLDE

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The understanding of the function of metalloproteins and metal-containing enzymes is usually based on the detailed knowledge of the structure of these macromolecules obtained by X-ray diffraction. In many cases, crystals of sufficient quality are not available and one has to rely on spectroscopy such as, e.g., Nuclear Magnetic Resonance (NMR) or Electron Paramagnetic Resonance EPR). Another particularly interesting technique is Time Differential Perturbed Angular Correlation of -Rays (TDPAC) which has the highest possible sensitivity due to the use of radioactive - emitters. Experiments under physiological conditions with picomolar concentrations are feasible.
The nuclear quadrupole interaction (NQI) turns out to be an extremely sensitive tool to study, e.g., the structure and dynamics at metal ion binding sites, protein-protein interactions in solutions, and the metal binding site structure during catalytic action. The basic reason for this sensitivity is the strong inverse cubed dependence of the NQI on nearest-neighbour distance. Very subtle changes in rigidity/flexibility in isomorphous replacements of metal ions are detectable.
A drawback is the fact that only a limited number of suitable radioisotopes is available which happen to be rather short-lived. In all cases an extremely high specific activity is required. Therefore an on-line isotope separator such as ISOLDE is indispensable.
Examples from recent work at ISOLDE and from the group of the late Rogert Bauer in Copenhagen will be presented. Future applications such as, e.g., the combination of freeze-quench techniques with TDPAC for the study of enzymatic reactions will be discussed.

Primary author: Prof. BUTZ, Tilman (University of Leipzig)

Presenter: Prof. BUTZ, Tilman (University of Leipzig)

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