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Nuclear techniques for studying soft matter at ISOLDE

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Due to the complexity of systems in living matter nuclear techniques are not commonly used in biology and biochemistry. The ISOLDE facility is, however, a perfect place for carrying out experiments with perturbed angular correlation of γ-rays (PAC) spectroscopy. This well established technique is suitable for addressing different biological topics, such as metalloprotein structure, dynamics of protein folding or protein –protein interaction, providing information on the molecular and electronic structure at the PAC probe site [1]. By approaching from simple inorganic complexes we aim to elucidate the fundamental chemistry of heavy metal ion interaction with proteins. This involves studies on de novo designed peptides, naturally occurring proteins, plants and recently also bacteria.
Currently we are also focused on setting up the first of its kind ßNMR system which will allow to carry out the first measurements ever performed on biological samples. ßNMR is a technique where NMR resonances are observed as changes in the ß decay anisotropy. It has already been successfully applied in solid state and nuclear physics and the technique holds great promise for successful applications in biology as well. The underlying physics of ßNMR is widely comparable to classical NMR using stable isotopes what is a considerable advantage since the large expertise gained within the last decades of using this method in the field of biophysics and chemistry can be easily projected to future ßNMR experiments. Moreover, this technique offers many advantages over NMR spectroscopy. Most notably, it is extremely sensitive, several orders of magnitude in comparison with standard NMR, and it may be applied for elements which are otherwise difficult to explore spectroscopically for certain biologically highly important oxidation states, such as Zn(II) or Cu(I).
In this way both, PAC spectroscopy and ßNMR spectroscopy, can contribute to studies of many important biological problems. This contribution will present numerous biological and biochemical applications at ISOLDE during recent years.

References:
[1] Hemmingsen L.; Sas K. N.; Danielsen E. Chem. Rev. 2004, 104, 4027.

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