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Beta-NMR as a novel technique using radioactive beams for biophysical studies

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Beta-NMR is a technique which has been successfully applied at ISOLDE in solid state and nuclear physics for several decades [Arn87, Cho03, Kee08]. Due to physical-technical boundaries this technique has never been applied to soft matter investigation, although it holds great promise for numerous applications.

Beta-NMR is based on the implantation of a radioactive ion beam carrying a polarized nuclear spin; hence it requires vacuum conditions to maintain the ion beam, its energy, charge and polarization. By use of a sophisticated instrumentation we are able to maintain a liquid target of controlled temperature and pH, in order to simulate the physical conditions of chemical processes in nature. We then pump from around 5 mbar in the liquid sample surrounding down to 10-6 mbar in the beam line on a distance as short as 40 cm. Thus we achieve radioactive beam transmissions of approx. 25% at 30 keV. Higher transmissions can be expected at 60 keV, usually provided from ISOLDE.
This fulfils the conditions to make the beta-NMR technique available for life science aspects.

Thanks to the COLLAPS collaboration, the bio-beta-NMR project (I88) will take advantage of an already existing online setup at ISOLDE to carry out the world's first beta-NMR measurements on a liquid aqueous sample. Later experiments on metal ion containing complexes and subsequently on metal ion binding proteins are planed.

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