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Applications of β -radiation Detected NMR in Wet Chemistry, Biochemistry and Medicine

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Many physiological processes in nature are governed by the interaction of biomolecules with metal ions. Some biologically highly relevant metal ions, such as Mg^{2+} , Cu^{+} and Zn^{2+} , are silent in most spectroscopic techniques leaving wide gaps in understanding their biological functions. Therefore, there is the need for finding new experimental approaches to directly study these metal ions.

Recently, β -radiation detected nuclear magnetic resonance (β -NMR) spectroscopy was successfully applied to liquid samples at the ISOLDE and ISAC facilities at CERN and at TRIUMF, Canada's national laboratory for particle and nuclear physics, respectively. This marks an achievement, which opens new opportunities in the fields of wet chemistry. In contrast to earlier measurements, the resonance spectra of $^{31}Mg^{+}$ implanted into different ionic liquid samples, recorded at ISAC, showed highly-resolved resonances originating from Mg ions occupying different coordination geometries, illustrating that β -NMR can in fact discriminate between different structures – the first and very important step towards the applications of this technique in biochemistry and medicine. Recorded resonance line widths are comparable or even narrower than the ones in conventional NMR spectroscopy on similar systems, underlining the complementarity and advantages of β -NMR. After these successful tests, a new spectrometer for bio- β -NMR experiments is currently under construction at TRIUMF's β -NMR facility, which will allow for experiments not only on different samples, such as gels, and liquids, but also at different vacuum environments (10⁻⁷ mbar - 50 mbar).

Results from the recent β -NMR experiments with $^{31}Mg^{+}$ ions performed at TRIUMF, the former tests at the ISOLDE, as well as future plans will be presented and discussed.

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