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Spin-polarized exotic nuclei and beta-NMR: from fundamental interactions, via nuclear structure, to material science, biology and medicine.

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This talk is devoted to versatile studies with spin-polarized radioactive nuclei, which make use of asymmetric emission of decay radiation. This feature is often combined with nuclear magnetic resonance, resulting in the beta-NMR technique, which is up to 10 orders of magnitude more sensitive than conventional NMR. In my CERN-ISOLDE experiment we have just used it to determine magnetic dipole moments of short-lived nuclei with part-per million accuracy.

In this talk I will introduce the principles of laser polarisation, asymmetric beta decay, and beta-NMR. I will then concentrate on recent highlights from different fields of research: mirror decays for CKM-matrix unitarity studies, beta-NMR in solids for material science and in liquids to determine accurate nuclear magnetic moments, and to perform studies in chemistry and biology. I will also mention the gamma-MRI approach, which can combine the high sensitivity of PET and SPECT techniques with high spatial resolution of MRI.

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