New applications of radioactive ion beams at EURISOL

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According to the EURISOL road map, in 12-15 years from now, highly intense radioactive beams of a large panoply of isotopes should be available to different users and purposes. Aiming at an overwhelming 100kW proton power delivered on targets, the increased beam production should overtake by several orders of magnitude "intermediate-generation" ISOL facilities like - HIE-ISOLDE, SPES, and SPIRAL2 to perform research on new elements and isotopes, nuclear astrophysics and neutrino physics. There will be further dedicated lines of research to explore non-nuclear physics matters in material science, biophysics and medical applications. We can then expect such a facility to boost and demystify today's world panorama of applications of radioactive isotopes actually restricted to a limited number of radio-species due to the costs and easiness of production and delivery, where the half-life is one intrinsic but determinant factor.

Today's production and delivery constraints and difficult access to few large-scale facilities explain the limited number of nuclear techniques and places using radioactive isotopes worldwide, e.g. for materials science. A prominent exception is the well-known Mossbauer effect using long-lived ^{57}Co/^{57}Fe(272d), which is currently applied to materials and biomaterials research. On the other hand, reactors and, widely spread, cyclotrons exist but are quite specialized for delivering isotopes of few elements to be used in medical diagnosis and radiotherapy. It is clear that the common feature of today's separated worlds using radioisotopes is their specificity and limited number of radioactive "probes". For decades developments for daily applications concern rather the optimization of production, delivery and detection of traditional isotopes than innovation at the level of the (radio)active agents.

The situation is completely different at a facility like ISOLDE that provides a large variety of high yields of chemically clean ion beams of radioactive isotopes, produced from targets using the primary p-beam of CERN accelerators. There, new experiments are performed by a variety of researchers, which use nuclear spectroscopic techniques such as Mössbauer, Perturbed Angular Correlations, β-NMR and Emission Channeling with short lived isotopes not available elsewhere. Additionally, diffusion studies and traditionally non-radioactive techniques as Deep Level Transient Spectroscopy, Hall-effect and Photoluminescence measurements provide unique information when measuring radioactive doped samples, where the element transmutation half-life plays the essential role for signal identification. But the restrictive aspect of ISOLDE comes from its uniqueness and success, i.e. the limited access to an overcharged beam-time schedule adds to the fact that some of the potentially interesting radioactive species are not yet delivered with enough intensity. These are facts currently hindering new techniques and applications from becoming more visible and appealing worldwide.

In this talk we will present case examples of enhanced applications and new isotopes where EURISOL, with increased yields by several orders of magnitude, can boost characterization techniques of materials in general, and nano- and bio-materials in particular, as well as new diagnosis and therapy methods where the use of new isotopes with specific decay particles can effectively act at different ranges from mm to cm. This is the kind of boost that applications of radioactive isotopes require in order to interest a larger and diversified community worldwide, potentially creating a new paradigm.