Joint ApPEC--ECFA--NuPECC Seminar

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Charge radii of short-lived radionuclides: The physics addressed by novel experimental techniques such as MIRACLS

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Short-lived radionuclides are intriguing probes for a diverse spectrum of physics topics such as the structure of atomic nuclei or nucleosynthesis, the formation of the chemical elements. Moreover, precision studies involving radionuclides impose stringent limits on physics beyond the standard model of particle physics which are complementary and competitive to associated constraints from the high-energy frontier at the LHC.

Among the many nuclear observables, charge radii of atomic nuclei are of particular importance. Since they can be accessed in a nuclear-model independent way from laser-spectroscopy work, nuclear rms charge radii Rc of nuclides far away from stability serve as critical benchmarks for modern nuclear structure theory. In combination with other observables, they relate to the nuclear equation of state which influences the size of neutron stars. Moreover, nuclear charge radii have become crucial ingredients in searches for physics beyond the standard model of particle physics. For instance, precise experimental data of Rc enters through isospin-symmetry-breaking corrections for superallowed nuclear ⊠ decays into the determination of the CKM matrix element Vud.

This poster will introduce the physics questions accessible via charge radii of short-lived radionuclides as a strong motivation to extend respective studies towards ‘uncharted territory’on the nuclear chart (as far as Rc is concerned). However, future work will require advances in experimental techniques, such as the novel, ERC supported Multi Ion Reflection Apparatus for Collinear Laser Spectroscopy (MIRACLS), in order to probe the most ‘exotic’radionuclides with high-resolution laser spectroscopy.

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