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The SPES RIB facility and program for physics beyond the SM and DM search

The search for physics beyond the Standard Model (SM) is presently a major issue. Despite its spectacular success, it is recognized that the SM could be incomplete and could eventually be incorporated into a more fundamental framework. As an example the excess of matter over antimatter in the Universe indicates the presence of baryon-number-violating interactions and most likely of new sources of charge conjugation-parity (CP) violation.

The existence of a finite permanent electric dipole moment (EDM) of a particle or an atom would violate time-reversal symmetry (T), and would also imply violation of the combined charge conjugation and parity symmetry (CP) through the CPT theorem [1,2,3]. EDMs are suppressed in the SM of particle physics, lying many orders of magnitude below current experimental sensitivity. Additional sources of CP violation are needed to account for baryo-genesis and many theories beyond the SM, such as supersymmetry [4,5], predict EDMs within experimental reach.

Experimental searches for EDMs have so far yielded no results. The most significant limits have been set on the EDM of the neutron [6], the electron [7] and on the ^{199}Hg atom [8], leading to tight constraints on extensions of the SM [5].

Nuclear structure can strongly amplify the sensitivity of nuclear EDM measurements. In particular the occurrence of octupole correlations in nuclei lead to closely spaced parity doublets and considerably larger Schiff moments. Enhancements factor of 102-104 have been calculated for nuclei with octupole deformation [11,12] or soft octupole vibrations [13]. Actinides atoms as Ra and Pa are among the best candidate in the search for atomic EDM.

These studies are among the objectives of the SPES radioactive ion beam project of INFN. The SPES Radioactive Ion Beam (RIB) facility at INFN-LNL is presently in the construction phase. The aim of the SPES project is to provide high intensity and high-quality beams of neutron-rich nuclei to perform forefront research in nuclear structure, reaction dynamics and interdisciplinary fields like medical, biological and material sciences. The status and the perspectives of the project will be presented together with the program for physics beyond the SM and DM search.

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