Laser spectroscopy at an in-flight production facility: BECOLA at NSCL

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Collinear laser spectroscopy (CLS) is a well–established technique for nuclear structure studies along isotopic chains [1]. Mean-square charge radii and electromagnetic nuclear moments can be determined from the hyperfine spectra obtained when a beam of atoms/ions with well-defined energy and spatial dimension is co-propagated with frequency-stabilized laser light. For many years, CLS has been successfully employed at isotope-separator on–line (ISOL) facilities, where rare isotopes are diffused from a thick production target, ionized, and extracted as a low energy, low emittance beam. The Beam Cooling and Laser Spectroscopy (BECOLA) facility [2] has been constructed and commissioned at the National Superconducting Cyclotron Laboratory (NSCL) at Michigan State University for CLS studies of rare isotopes produced via the in-flight method. The in-flight production method is independent of any chemistry in the production target due to the high momentum of the incoming heavy-ion projectile, and is complementary to the ISOL production method. However, the rare isotope beams from in-flight production typically have high energy (100s of MeV) and broad (few percent) momentum distribution that are not conducive to high-precision CLS measurements. NSCL has developed advanced beam thermalization techniques [3] to transform the poor quality, in-flight beams to high quality, low energy (<60 keV) beams for precision mass measurements [4] and the planned CLS program at BECOLA.

A summary and status of the BECOLA facility will be presented, along with the near- and long–term science objectives in low–energy nuclear structure and the testing of fundamental symmetries.

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