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Spectroscopy of radioactive ^{221}Fr and RaF^- in ISOLDE facility at CERN

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*On behalf of CRIS collaboration

Isotope Separator On Line DEvice (ISOLDE) at CERN is a unique source of low-energy beams of radioactive nuclides. Collinear Resonance Ionization Spectroscopy (CRIS) is one of the ongoing experiments located at the ISOLDE facility and one of the frontiers in the search for physics beyond standard model.

Francium, (particularly its $7S_{1/2} \rightarrow 6D_{3/2,5/2}$ transitions) is a promising object of study for atomic parity violation. $^{221}\text{Fr}^+$ was produced from a pre-irradiated uranium carbide source and was neutralized in a charge exchange cell. $9P_{1/2,3/2}$, $10P_{1/2,3/2}$ and $6D_{3/2,5/2}$ states in ^{221}Fr were characterized via laser spectroscopy and a novel, background-free detection scheme was successfully implemented for the first time.

Radioactive molecules are extremely exciting prospect of study to explore major questions about the universe, but so far, they have not been extensively studied due to technical difficulties of their production and measurement. RaF ions were produced from the same uranium carbide source, whereafter it was fluorinated. The initially produced RaF^+ ions were converted to RaF^- by double charge exchange. Photodetachment of a radioactive molecule (RaF^-) was successfully demonstrated in ISOLDE facility for the first time. In future studies, it is planned to use the photodetachment of negative molecular ions to produce neutral molecules with controlled excitation levels. This would enable much more precise probing of energy states, compared to molecules produced directly from a hot source, or charge exchange cell, where the population is distributed over many energy levels.

Type of contribution

Talk

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