Resonance ionization spectroscopy on ^{253,254,255}Es and development of a new gas-jet based high-resolution spectroscopy setup

S. Nothhelfer[1,2,3] for the Einsteinium and Gas-Jet collaborations

[1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt

[2]Helmholtz-Institut Mainz, Mainz

[3]Johannes Gutenberg-Universität Mainz, Mainz

Experimental data from laser spectroscopy on hyperfine structure splittings and isotope shifts of spectral lines reveal valuable information of both atomic and nuclear structure of atomic nuclei. The exploration of these properties is of particular importance in the region of the heaviest actinides and superheavy elements (SHE), where atomic data are sparse. In the first part of the talk the concept and objective of a newly developed high-resolution setup [1,2] will be addressed briefly. Here, laser spectroscopy is performed in a well-collimated, supersonic gas-jet [3]. This improves the spectral resolution by an order or magnitude compared to laser spectroscopy in a gas-cell while maintaining a high efficiency. A short status update on the recent progress will be presented. The main focus of the talk is dedicated to laser spectroscopy performed on the rare einsteinium isotopes ^{253,254,255}Es at the RISIKO mass separator in Mainz [4]. In this talk, the focus will be on the nuclear structure studies, while the information on the atomic structure studies is summarized in [5]. With small sample sizes ranging down to femtograms, ground-state transitions were investigated in ^{253,254,255}Es. Besides the isotope shifts, the magnetic dipole moments μ_I and the spectroscopic electric quadrupole moments Q_s were derived from hyperfine structure analysis. Additionally, the so far only tentatively assigned nuclear spins were experimentally determined to $I(^{254}\text{Es}) = 7$ and $I(^{255}\text{Es}) = 7/2$.

[1] S. Raeder et al., Nucl. Instrum. Methods Phys. Res. B 463, 2020, 272-276.

[2] S. Nothhelfer, Dissertation, 2022.

[3] R. Ferrer et al., Nat. Commun. 8, 2017, 1-9.

[4] S. Nothhelfer et al., Phys. Rev. C 105, 2022, L021302.

[5] F. Weber et al, Phys. Rev. Res., submitted.