Laser Spectroscopic Investigation of the heaviest actinides at GSI

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Precision measurements of optical transitions of the heaviest elements is a versatile tool to probe the electronic shell structure which is strongly influenced by electron-electron correlations, relativistic and QED effects. Optical studies of transfermium elements with Z>100 are hampered by low production rates and the fact that any atomic information is initially available only from theoretical predictions. Using the sensitive RAdiation Detected Resonance Ionization Spectroscopy (RADRIS) technique coupled to the SHIP separator at GSI, a strong optical $^1S_0 \rightarrow {}^1P_1$ ground-state transition in the element nobelium (Z=102) was identified and characterized [1]. Furthermore, the isotopes $^{252\text{ - }255}$No was measured, revealing the isotope shift and a hyperfine splitting for the odd mass nucleus ^{253,255}No [2]. From these measurements, nuclear information on the shapes and sizes were inferred. In addition, several high-lying Rydberg levels were observed, which enabled the extraction of the first ionization potential with high precision [3]. Recently, several isotopes of fermium (Fm, Z=100) was also measured.

These results will be discussed as well as the prospects for future investigations involving the study of additional nobelium and fermium isotopes and the exploration of the atomic structure of the next heavier element, lawrencium (Z=103).

References

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[2] S. Raeder et al., PRL **120**, 232503 (2018).
[3] P. Chhetri et al., PRL **120**, 263003 (2018).