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Towards On-Line High-resolution In-source Laser Spectroscopy: A Perpendicular Laser –Atom Beam Upgrade for the Laser Ion Source and Trap LIST

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Highly selective and efficient laser ion sources are of fundamental importance to study atomic and nuclear properties along the nuclear chart. Upgrading the well-established, highly element-selective laser resonance ionization technique with additional suppression of isobaric contaminations immediately at the exit of the hot ion source cavity led to the development of the Laser Ion Source and Trap LIST. In the past few years it was successfully used e.g. for investigations on neutron-rich polonium isotopes which were previously not experimentally accessible due to the overwhelming fraction of surface ionized francium [1, 2].
For highest precision in spectroscopic studies and isomer-selective ionization, a perpendicular laser -atom beam interaction geometry based on robust metal mirrors was integrated into the LIST's RFQ ion guide structure. This reduces the experimentally realized spectral linewidth dominated by the Doppler broadening in the hot atom vapor from a few GHz down to below 100 MHz. At the ISOLDE-like off-line RISIKO mass separator at Mainz University, hyperfine structure studies were performed on the long-lived radioisotopes 163,166mHo using frequency-doubled narrow band-width radiation of an injection-locked high repetition rate titanium:sapphire laser. Measurements and first results as well as opportunities and constraints for a future on-line implementation of this novel PI-LIST (Perpendicularly Illuminated) design are discussed.

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