Hyperfine-structures in a highly charged $^{127}I^{7+}$ ion observed by laser spectroscopy

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Optical transitions of highly charged ions (HCIs) are potential research targets to investigate fundamental physics. Prospects of a new type atomic clock using forbidden transitions in HCIs have further activated developments of HCI laser spectroscopy [1]. Here, we present laser induced fluorescence (LIF) spectra of palladium-like I^{7+} in an electron beam ion trap (EBIT) plasma [2]. The electric quadrupole (E2) emissions $((4d_{3/2}^{-1}\ 5s)_{J=2} \rightarrow (4d^{10})_{J=0})$ induced by a pulse laser excitation via the magnetic dipole (M1) transition $((4d_{5/2}^{-1}\ 5s)_{J=3} \rightarrow (4d_{3/2}^{-1}5s)_{J=2})$ were observed by a time-resolving extreme ultraviolet spectrometer directly coupled to the EBIT chamber. The collisional and radiative processes in the EBIT plasma provide a high population in the long-lived metastable state $(4d^{-1}5s)_{J=3}$ and make it possible to continuously induce the E2 emission with the pulse laser irradiation. The small natural width of the transition between the metastable states without electric dipole (E1) decay paths enables to perform the high precision wavelength measurement and reveal the hyperfine structure. Hyperfine structures were confirmed by theoretical calculations of hyperfine splittings and transition probabilities for $(4d_{5/2}^{-1}\ 5s)_{J=3}$ and $(4d_{3/2}^{-1}\ 5s)_{J=2}$ using the GRASP2018 [3].

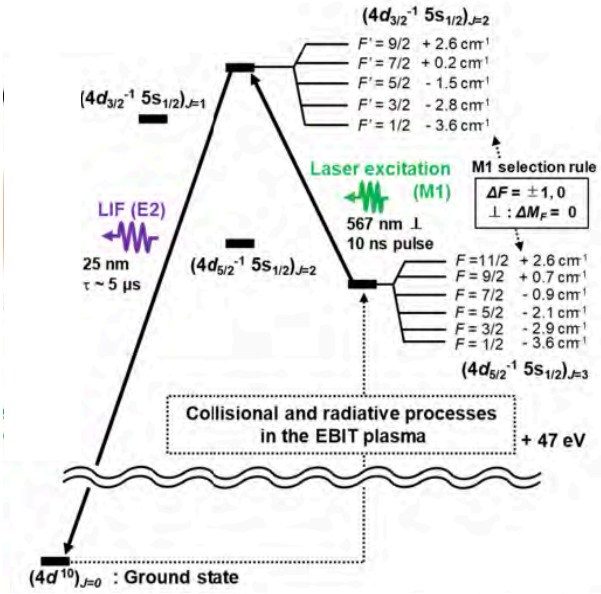

Figure 1. Schematic energy level diagram of $^{127}I^{7+}$ with the laser-induced transition.

References

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