Measurement of the fine-structure splitting in Co-like Yb, Re, Os, and Ir to study QED and Breit interaction effects

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With enhanced relativistic and quantum electrodynamics (QED) effects and reduced electron correlation at high Z, highly charged ions (HCI) offer a great test-bed to benchmark sophisticated atomic theory. Such ions can be reliably created in an electron beam ion trap (EBIT) by tuning the energy of the electron beam. Atomic spectroscopy of the EBIT plasmas can help explore the structure of unique electron configurations in multielectron atomic systems, and to better understand the atomic processes in laboratory and astrophysical plasma.

Recently, highly accurate Breit and QED effects have been analyzed for the so-called "Layzer-quenched" systems [1–4]. With minimized electron correlations, these systems are proposed for testing QED predictions [5–6] in high-Z HCI. Particularly interesting examples are the ground state configuration of $2p^5$ (F-like), $3d^9$ (Co-like), and $4f^{13}$ (Pr-like) ions. To further test the accuracy of atomic calculations for the Co-like case, we have measured the magnetic-dipole $3d^9\ ^2D_{3/2} \rightarrow\ ^2D_{5/2}$ fine-structure transition in Co-like Yb, Re, Os, and Ir using the National Institute of Standards and Technology EBIT facility. It is worth noting that forbidden transitions in Co-like ions may be used for density plasma diagnostics under various conditions. Details of the measurements and their comparison with theoretical results will be presented.

References

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