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Precise measurements of atomic structure in heavy atoms with undergraduates at Williams College¹

TIKU MAJUMDER, Physics Dept, Williams College

Low-energy atomic physics experiments have held an important historical role in probing fundamental physics questions more typically associated with accelerator-based experiments and particle physics. Independent atomic theory models for the heavy, complex atoms typically used in this work must exist in order to distinguish ordinary quantum mechanical effects from the fundamental physics being targeted. In our lab at Williams, we have pursued a series of measurements of the atomic properties of relevant heavy atomic species (thallium, indium, lead) which provide exacting tests of ongoing atomic theory calculations. Over 50 undergraduates at all stages of their education have contributed to this work, more than 20 of whom have become co-authors on journal publications. Students are involved in all aspects of this work, from laser and optical system design, to development and use of our high-flux atomic beam apparatus, to implementation of locking and servo control systems, to overall experimental and data collection design, and finally to sophisticated data analysis procedures to achieve high precision and facilitate the search for systematic errors. Recent laser spectroscopy measurements of atomic hyperfine structure and atomic polarizabilities in our group will be discussed.

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