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Abstract = The structure of heavy and highly ionized atoms is studied through the use of experimental measurements, data-based semiempirical systematizations, and theoretical calculations. Properties such as transition probabilities, energy levels, fine structure splittings, electric polarizabilities, and ionization potentials are determined through time-resolved fast ion beam measurements, and are combined with wavelength data obtained from conventional light sources as well as laser- and tokamak-produced plasmas and astrophysical sources. As examples, during the past year lifetime measurements were made for levels in Be I, B II, Si II, Ta II, W II, Re II and Hg III at the Toledo Heavy Ion Accelerator, and in Br XXV at the Argonne ATLAS accelerator. Supporting theoretical calculations were performed for Ta II, W II, and Re II. Data-based predictions were made of branching fractions in Si I, Ge I, Sn I and Pb I, and compared with existing arc emission data. Measurements were made of the electric field quenching of metastable Ar XVIII atoms, of the two-photon spectral distribution of the decay of the 1s2s \( ^1S \) level in Ni XXVI, and of the production of alignment of highly ionized Ar atoms using multiple tilted foil excitation. Methods have been applied to accurately account for relativistic and intermediate coupling effects in data-based isoelectronic systematizations, and to enhance the precision of lifetimes extracted from measured decay curves.
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