Abstract Submitted
for the DAMOP13 Meeting of
The American Physical Society

Highly-charged ions for atomic clocks, cosmology, and quantum information MARIANNA SAFRONOVA, University of Delaware and JQI, V.A. DZUBA, V.V. FLAMBAUM, UNSW, Australia, M.G. KOZLOV, UNSW, Australia and PNPI, Russia — Despite very large ionization energies, certain ions have transitions that lie in the optical range due to level crossing and are very sensitive to α-variation [Berengut et al., PRL105, 120801 (2011)]. Some of these systems have several long-lived metastable states representing a level structure and other properties that are not present in any neutral and low-ionization state systems and may be advantageous for the development of atomic clocks as well as provide new possibilities for quantum information storage and processing. One of the main obstacles for the experimental work in this direction is the lack of any experimental data for these systems. We carried out an exhaustive search of transitions in highly-charged ions that are particularly well suited for the experimental exploration, i.e. satisfy the following criteria: 1) existence of long-lived metastable states with transition frequencies between 170-3000 nm, 2) high sensitivity to α-variation, and 3) existence of stable isotopes. We find that only ions in four isoelectronic sequences, Ag-like, Cd-like, In-like, and Sn-like satisfy these criteria. We use state-of-the-art theoretical approaches to provide accurate predictions for the relevant wavelengths and lifetimes and evaluate their uncertainties.

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Date submitted: 28 Jan 2013 Electronic form version 1.4