Abstract Submitted
for the APR17 Meeting of
The American Physical Society

Dark matter scattering on electrons: Accurate calculations of atomic excitations and implications for the DAMA and XENON experiments BENJAMIN ROBERTS, Univ of Nevada - Reno, VLADIMIR DZUBA, VICTOR FLAMBAUM, UNSW Australia, GLEB GRIBAKIN, Queen's University, Belfast, UK, MAXIM POSPELOV, University of Victoria, BC, Canada, and Perimeter Institute for Theoretical Physics, YEVGENY STADNIK, UNSW Australia — Atoms can become ionised during the scattering of a slow, heavy particle off a bound electron. Such an interaction involving leptophilic WIMP dark matter is a potential explanation for the anomalous 9 sigma annual modulation in the DAMA direct detection experiment. We show that due to non-analytic, cusp-like behavior of Coulomb functions close to the nucleus leads to an effective atomic structure enhancement. Crucially, we also show that electron relativistic effects are important. With this in mind, we perform high-accuracy relativistic calculations of atomic ionisation. We scan the parameter space: the DM mass, the mediator mass, and the effective coupling strength, to determine if there is any region that could potentially explain the DAMA signal. While we find that the modulation fraction of all events with energy deposition above 2 keV in NaI can be quite significant, reaching ˜50%, the relevant parts of the parameter space are excluded by the XENON10 and XENON100 experiments. B. M. Roberts, V. V. Flambaum, and G. F. Gribakin, Phys. Rev. Lett. 116, 023201 (2016). B. M. Roberts, V. A. Dzuba, V. V. Flambaum, M. Pospelov, and Y. V. Stadnik, Phys. Rev. D 93 115037 (2016).

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Date submitted: 26 Sep 2016 Electronic form version 1.4