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Atomic ionization due to dark matter scattering on electrons: Implications for DAMA and XENON interpretation BENJAMIN ROBERTS, Univ of Nevada - Reno, YEVGENY STADNIK, VLADIMIR DZUBA, VICTOR FLAMBAUM, UNSW Australia, GLEB GRIBAKIN, Queen's University, Belfast, MAXIM POSPELOV, University of Victoria, Canada; Perimeter Institute — Atoms can become ionized during the scattering of a particle off a bound electron. Such interactions involving WIMP dark matter are a potential explanation for the anomalous 9σ annual modulation in the DAMA direct detection experiment 1. Conventional wisdom has it that the amplitude for such a process should be exponentially small. We show, however, that due to nonanalytic, cusp-like behaviour of Coulomb functions close to the nucleus this suppression is removed, leading to an effective atomic structure enhancement. Crucially, we show that due to this behavior, the electron relativistic effects give the dominant contribution to such a process, enhancing the cross section by orders of magnitude 2. Ab initio relativistic calculations are therefore necessary for the proper analysis of such a problem. Therefore, we perform high-accuracy relativistic calculations of atomic ionization. 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 3.
1. Bernabei et al., Eur.Phys.J.C 73, 2648 (2013); 2. Roberts et al., Phys.Rev.Lett. 116, 023201 (2016); 3. Roberts et al., In Prep.

Benjamin Roberts
Univ of Nevada - Reno

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