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Scheme for Launching and Observing Dynamics of Cold Atoms in Rydberg States ANNE GOODSELL, ERIK WEIDNER, MATTIAS FITZPATRICK, Middlebury College — We are assembling a source of laser-cooled Rb atoms that can be launched at slow, controlled velocities and excited into Rydberg states. We assess the feasibility of detecting the motion of cold Rydberg atoms around a macroscopic charged wire. The capture and ionization of cold ground-state atoms in a $1/r$-electric field has been observed previously [1], using a nanowire to ensure that captured atoms could move in free space at small radial distances before impacting the wire or field-ionizing near the surface. Using highly-excited atoms instead, we suggest that a macroscopic wire offers a robust system with magnified effects. The capture cross-section increases for incident atoms in high-n states. For a 20-micron-diameter wire charged to +300 V, the critical impact parameter for atoms traveling at 2 m/s with $n = 50$ is 30 μm, 10 times larger than for ground-state atoms. We propose that aspects of this model can be realized experimentally. Using an estimated lifetime of 40 ns for the $n = 50$ state, we calculate that excitation must occur at r=100 μm, significantly beyond the wire's surface. In this way, we are preparing to promote launched atoms into high-n states and study their dynamics.

[1] PRL 104, 133002 (2010).

Anne Goodsell
Middlebury College

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