Abstract Submitted
for the DAMOP06 Meeting of
The American Physical Society

First Application of Engineered Very-High-n Polarized Rydberg States JEFF MESTAYER, WEI ZHAO, JIM LANCASTER, BARRY DUNNING, Department of Physics and Astronomy, Rice University, CARLOS REINHOLD, Oak Ridge National Laboratory, SHUHEI YOSHIDA, JOACHIM BURGDORFER, Vienna University of Technology — Direct excitation of very-high-n quasi-one-dimensional (quasi-1D) Stark states in a weak dc field is problematic because stray fields and effective laser linewidths lead to creation of a range of states with no preferred orientation. We show, however, that very-high-n ($n \sim 600$) quasi-1D atoms can be engineered from lower-n quasi-1D atoms using a tailored sequence of half cycle pulses (HCPs). We exploit this to realize the high-scaled-frequency regime of the "kicked Rydberg atom" by subjecting the engineered atoms to a periodic train of HCPs, reaching scaled frequencies as high as $\nu_0 \equiv \nu_T/\nu_n \sim 15$, where ν_T is the frequency of the train and ν_n is the classical electron orbital frequency. Pronounced non-monotonic structure in the survival probability is observed as N, the number of HCPs in the train, is increased, the survival probability actually increasing with N over certain ranges of N. This behavior is very sensitive to the polarization of the Rydberg states and is explained using classical simulations. Research supported by NSF, DoE, the R. A. Welch foundation and the FWF (Austria).

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Date submitted: 25 Jan 2006

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