Abstract Submitted
for the DAMOP08 Meeting of
The American Physical Society

Transform-limited Rydberg-Rydberg Collisions in a Thermal Atomic Beam M.R. KUTTERUF, R.R. JONES, Department of Physics, University of Virginia — The expansion of a localized volume of Rydberg atoms in a thermal atomic beam allows us to reduce the relative velocities of atoms undergoing resonant dipole-dipole collisions. Three collinear 5 ns dye laser pulses are tightly focused at right angles to a thermal potassium beam, exciting atoms to the $29s_{1/2}$ and $27d_{3/2}$ Rydberg states. Following the excitation, the excited volume expands and the relative velocities between nearby atoms decrease to a small fraction of the average velocity of the beam. A fast rising electric field pulse then Stark tunes the excited atoms into collisional resonance, 29s+27d => 29p+28p. The collision probability is determined by measuring the 29p yield using state-selective field ionization. The energy width of the collisional resonance is found to be independent of the field-pulse duration provided this duration is much longer than the time required to complete a typical collision. By reducing the field-pulse duration to less than this collision time, we specify the precise times for starting and stopping the collisions, and observe a broadening of the coherent collisional resonance as previously seen [Thomson et al., PRL 65, 3273 (1990)] using a considerably more complicated velocity selection approach. This work has been supported by NSF.

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Date submitted: 01 Feb 2008

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