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Lineshapes of Dipole-Dipole Resonances in a Cold Rydberg Gas<sup>1</sup> B.G. RICHARDS, R.R. JONES, University of Virginia — We have examined the lineshapes associated with Stark tuned, dipole-dipole resonances involving Rydberg atoms in a cold gas. Rb atoms in a MOT are laser excited from the 5p level to  $32p_{3/2}$ in the presence of a weak electric field. A fast rising electric field pulse Stark tunes the total energy of two 32p atom pairs so it is (nearly) degenerate with that of the  $32s_{1/2} + 33s_{1/2}$  states. Because of the dipole-dipole coupling, atom pairs separated by a distance R, develop  $32s_{1/2} + 33s_{1/2}$  character. The maximum probability for finding atoms in s-states depends on the detuning from degeneracy and on the dipole-dipole coupling. We obtain the "resonance" lineshape by measuring, via state-selective field ionization, the s-state population as a function of the tuning field. The resonance width decreases with density due to  $R^{-3}$  dependence of the dipole-dipole coupling. In principle, the lineshape provides information about the distribution of Rydberg atom spacings in the sample. For equally spaced atoms, the lineshape should be Lorentzian while for a random nearest neighbor distribution it appears as a cusp. At low densities nearly Gaussian lineshapes are observed with widths that are too large to be the result of inhomogeneous electric or magnetic fields.

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B. G. Richards University of Virginia

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