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Cold Cs Rydberg Gas Interactions

Ultracold (T<1mK) Rydberg atoms (n>20) have been proposed as a laboratory for quantum computation, the study and generation of ultracold plasmas, and many body physics. All of these research directions rely on precise knowledge of the Rydberg atom interaction potentials involved in an experiment. Rydberg atom- Rydberg atom interactions are unique because they are extremely long ranged (3-10 µm) and tunable via electric fields and principal quantum number selection. However, the potential energy curves of high n Rydberg atoms are complicated and have many avoided crossings that lead to inelastic collisions. We will describe experiments done in our laboratory on many body interactions, energy transfer collisions and the detection of ultracold Rydberg molecules that probe Rydberg atom interactions. Our experimental results are compared to non-perturbative calculations (fig. 1) of the interaction potentials between the Rydberg atoms.

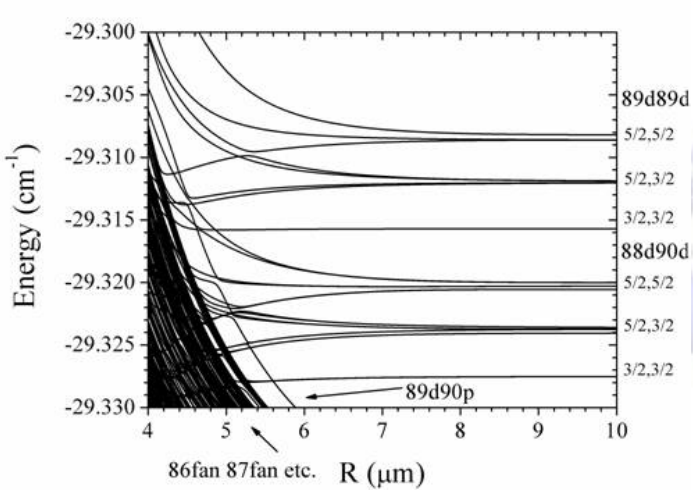

Figure 1: Potentials of Cs Rydberg Atom pairs for M=mj1+mj2=3. Energies were calculated with a background electric field of ~30 mV/cm along the internuclear axis R. Several avoided crossings can be seen.

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