

Abstract Submitted  
for the SES14 Meeting of  
The American Physical Society

**The calculation of few-body van der Waals interactions<sup>1</sup>** JIANING HAN, Univ of South Alabama, CHUNYAN HU, Hollins University — Few-body interactions offer the opportunity to study the isolated atom to few-body coupled molecules, and to condensed matter transitions. Atoms in molecules and in condensed matters are coupled by different orders of multipole-multipole interactions, which all stem from different orders of approximations from coulomb interactions between multiple charges. The lowest order multipole-multipole interaction is the dipole-dipole interaction, which is proportional to the size of the dipole. In this article, we use Rydberg atoms, which have more than 1000 times greater electric dipoles than the ground state atoms, to calculation the few-body interactions. In addition to the large dipoles, the kinetic energy of the atoms is significantly reduced by reducing the temperature, which makes these interactions stable and observable. Here we report on the 2D and 3D few-body interaction potentials and possible ways of creating semistable molecules in such an ultracold Rydberg gas with a temperature of  $\approx 100$  nK. The results reported here are useful for creating ultracold molecules.

<sup>1</sup>The support from University of South Alabama

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Date submitted: 18 Sep 2014

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