DAMOP19-2019-000114

Abstract for an Invited Paper
for the DAMOP19 Meeting of
the American Physical Society

**Highly excited states of small molecules and negative atomic ions**

MATTHEW EILES, Max Planck Institute for the Physics of Complex Systems

The interactions of electrons with other quantum particles, despite over a century of intense study, still yield rich physical surprises today. In this talk I will discuss some of these surprises as revealed by electron-atom and electron-electron interactions in two differentsystems: Long-range Rydberg molecules and atomic negative ions. A Rydberg atom bonds to a ground state atom to form a molecule colloquially called a "trilobite." I will show how the intricate details of the electron-atom interaction, including the diverse spin couplings present in alkali atoms, manifest themselves in the molecular properties probed in spectroscopy. Another line of research focuses on the formation of polymers, in both symmetric and disordered atomic environments, and on the strong dipolar interaction between Rydberg dimers. In atoms with two active electrons the Rydberg electron may interact strongly and become correlated with the other valence electron. We exploit this to form molecules with favorable properties. This correlation is also critical in explaining doubly excited resonances observed in a different two-active-electron process: negative ion photodetachment. We show that the unexpected threshold laws observed in recent experiments stem from the correlated electronic behavior.* *This work was supervised by and performed in collaboration with Prof. Chris H. Greene at Purdue University, West Lafayette, IN, USA.