Physikalisches Institut
Fakultät für Mathematik und Physik
Albert-Ludwigs-Universität Freiburg

IRTG-Seminar

Dr. Florian Meinert

5. Physikalisches Institut and Center for Integrated Quantum Science and Technology, Universität Stuttgart

“Rydberg atoms in ultracold gases – from electron to ion impurities”

Rydberg atoms immersed in ultracold and degenerate atomic gases offer a rich experimental platform for studying giant impurities interacting with single, few, or many ground-state atoms from the host gas which reside within the Rydberg electron orbit. In this seminar, I will report on our endeavor to explore single Rydberg excitations with principal quantum number up to n=190 embedded in gases of different density regimes, ranging from comparatively dilute thermal ensembles to high-density Bose-Einstein condensates.

More specifically, a Rydberg atom interacts with an ultracold atomic gas via electron-neutral and ion-neutral interaction. Typically, the electron-neutral interaction constitutes the far dominant scattering process and, in a low-density sample, leads to the formation of ultralong-range Rydberg molecules. In this context, we have recently demonstrated photo-association of strongly polar “trilobite” molecules facilitated by the complex molecular spin-couplings. Differently, in the regime of a high-density Bose-Einstein condensate typically thousands of ground-state atoms collectively interact with the Rydberg impurity and the role of the Rydberg ionic core starts to play a role. By working with Rydberg electron orbits that by far exceed the size of the condensate, we suppress the typically dominant electron-neutral scattering and access the low-temperature ion-neutral interaction. These results may open up ways to enter the quantum regime of ion-atom scattering for the exploration of charged quantum impurities and associated polaron physics.

Finally, I will discuss very recent results demonstrating Rydberg excitation blockade induced by a single low-energy ion, which we directly produce from the ultracold ensemble via a novel two-photon ionization scheme.

Tuesday, October 16, 2018; 1:00 p.m., HSII
Physics high rise, Hermann-Herder-Str. 3

UNI FREIBURG

Contact:
Zofia Malachowska-Thiel
IRTG / Cold Controlled Ensembles in Physics and Chemistry
Phone: +49 761 203 97666
E-mail: irtg-coco-coordination@physik.uni-freiburg.de