

Plenary Talk

PV V Wed 9:15 V53.01

Ultracold polar molecules — ●SILKE OSPELKAUS — Institut für Quantenoptik & QUEST, Universität Hannover, Germany — JILA, University of Colorado, Boulder, USA

Tremendous progress in the preparation and control of ultracold molecular gases in the quantum regime promises to open exciting new research opportunities. Molecules rotate and vibrate and therefore offer many more quantum degrees of freedom than their atomic counterparts. Polar molecules interact via strong and long-range anisotropic interactions. These unique molecular properties combined with precise control over external molecular quantum degrees of freedom at temperatures close to absolute zero promise to provide largely unexplored novel opportunities. These range from the control of ultracold

chemical reactions, precision measurements, strongly correlated novel quantum many-body systems and quantum phase transitions to novel systems for quantum information processing.

In this talk, I will take you on a tour through preparation and control of molecular quantum systems. We will see how ultracold all ground state molecular quantum systems can be efficiently created by means of a controlled chemical reaction at ultracold temperature; we will discuss how these molecular ensembles can be used to probe chemistry in a novel regime where even the smallest chemical reaction barrier exceeds the available thermal energy in the ensemble and how chemical reactions can then be controlled and understood by simple laws of quantum mechanics. Finally, we will discuss prospects of these systems as novel dipolar quantum many-body systems.