SFB/TRR 21 - Seminar

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Anisotropic many-body interaction with ultracold Rydberg molecules

We propose a novel experiment using the recently observed "butterfly " Rydberg molecules [1] to study long-range anisotropic interactions in an ultracold dipolar gas. These polar homonuclear molecules are form through single-photon photoassociation in a dense condensate of Rb atoms. The strong intermolecular interaction between two nearby molecules shifts their molecular states out of resonance with the photoassociation laser. When the molecules are prepared in a quasionedimensional trap, the interaction's strength can be tuned, due to its anisotropy, over a large range via a weak external field. The molecular density thus sensitively depends on the angle between the trap axis and the field. The choice of principle quantum number and molecular state provides a wide range of tuneability. This scheme bridges the otherwise disparate fields of Rydberg atoms and dipolar molecular gases and opens up the possibility to the study of exotic quantum phases in dipolar gases and polaron-polaron interaction, as we discuss in this work. ! [1] Observation of pendular butterfly Rydberg molecules, T. Niederprüm, O. Thomas, Tanita Eichert, C. Lippe, J. Pérez-Ríos, C. H Greene, H. Ott, Nat. Commun. 7, 12820 (2016).

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