SFB/TRR 21 - Seminar

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Hyperfine effects in Rydberg molecules

Cold atomic systems have opened new frontiers at the interface of atomic and molecular physics. Of particular interest are a class of long-range, homonuclear Rydberg molecules that were first predicted in [1] and observed in [2]. In rubidium, these molecules are formed via low-energy electron scattering of the Rydberg electron from a 5S1/2 ground-state atom that is present within the Rydberg atom's volume. The binding mostly arises from S-wave and P-wave triplet scattering. In our analysis [3], we use a Fermi model that includes S-wave and P-wave singlet and triplet scattering, the fine structure coupling of the Rydberg atom and the hyperfine structure coupling of the 5S1/2 atom. In this talk it will be discussed how the hyperfine structure gives rise to mixed singlet-triplet potentials for both low-L and high-L Rydberg molecules [3]. Further, I will discuss results on 87Rb nD+5S1/2 Rydberg molecules that undergo a transition from a molecular-binding-dominant regime at low n to a fine-structure-dominant regime at high n, akin to a transition from Hund's case (a) to (c) [4] (related results, see [5]).

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[4] D. A. Anderson, S. A. Miller, and G. Raithel, Phys. Rev. Lett. 112, 163201 (2014).
[5] A. T. Krupp, A. Gaj, J. B. Balewski, P. Ilzhöfer, S. Hofferberth, R. Löw, T. Pfau, M. Kurz, and P. Schmelcher, Phys. Rev. Lett 112, 143008 (2014).

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