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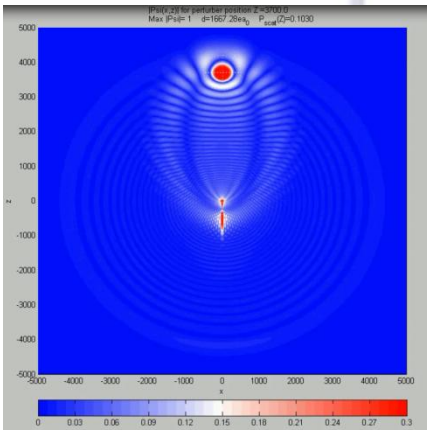
Universal Faraday rotation in topological insulators

Cold atomic systems have opened new frontiers at the interface of atomic and molecular physics. These include research on novel types of Rydberg molecules. In this talk, three types of molecules will be reviewed. Long-range, homonuclear Rydberg molecules, first predicted in [1] and observed in [2], are formed via low-energy electron scattering of the Rydberg electron from a 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 rubidium). The hyperfine structure gives rise to mixed singlet-triplet potentials for both low-L and high-L Rydberg molecules [3]. A classification scheme into Hund's cases [3,4,5] will be discussed. In the talk I will also present results on adiabatic potentials and adiabatic states of Rydberg-Rydberg molecules in Rb and Cs. These molecules, which have even larger bonding length than Rydberg-ground molecules, are formed via electrostatic multipole interactions. The leading interaction term of neutral Rydberg-Rydberg molecules is between two dipoles, with a scaling ~ bond length^(-3), while for ionic Rydberg-Rydberg molecules it is between a dipole and a monopole, which has a scaling ~bond length^(-2).



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