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Ultra-long-range Rydberg molecules in electric and crossed electric and magnetic fields PETER SCHMELCHER, MARKUS KURZ, Centre for Optical Quantum Technologies, University of Hamburg, Luruper Chaussee 149, 22761 Hamburg — We explore the behaviour of ultra-long range molecules in electric fields and combined crossed electric and magnetic field. First the main properties of the pure electric field case are summarized, including the possibility to shift intersections of potential energy surfaces due to p-wave and s-wave interactions, and the tunability of the overall potential energy curves as well as its individual wells. We then proceed by showing the existence of ultra-long-range giant dipole molecules formed by a neutral alkali ground state atom that is bound to the decentered electronic wave function of a giant dipole atom. The adiabatic potential surfaces emerging from the interaction of the ground state atom with the giant dipole electron posses a rich topology depending on the degree of electronic excitation. Binding energies and the vibrational motion in the energetically lowest surfaces are analyzed by means of perturbation theory and exact diagonalization techniques. The resulting molecules are truly giant with internuclear distances up to several μm. Finally, we demonstrate the existence of intersection manifolds of excited electronic states that potentially lead to a vibrational decay of the ground state atom dynamics.

Peter Schmelcher
Centre for Optical Quantum Technologies,
University of Hamburg, Luruper Chaussee 149, 22761 Hamburg

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