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Rydberg excitation in random and regular environments

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A Rydberg atom and a ground state atom can form trilobites, ultra long-range molecules with binding energies on the Giga Hertz scale or less and with bond length of the order of N^2 , when N is the Rydberg atom's principal quantum number. Do these fragile molecules survive in an environment? We will show that they even thrive among randomly placed atoms, the natural environment of an ultracold gas [1]. Secondly we discuss the behavior of a Rydberg atom immersed in a 2-dimensional lattice where the Rydberg atom occupies one site while the other sites are occupied with ground state atoms. Due to the degeneracy of highly excited Rydberg manifolds this composite Rydberg atom possesses a non trivial band structure which changes under variation of the lattice constant. Random filling of the lattice sites connects the Composite Rydberg Atom with the trilobite in an ultracold gas. ————— [1] PJJ Luukko and JM Rost, Phys. Rev. Lett. 119, 203001 (2017).