

Rydberg molecules

In this lecture, I will discuss two kinds of diatomic molecules involving highly excited electronic states. Of the first kind are dimers resulting from the interaction of two atoms in Rydberg states. As first predicted by Boisseau et al. [1], the long-range interaction potentials of two Rydberg atoms can exhibit local minima, supporting vibrational bound states of the two atoms. Because of the large bond-lengths of such dimers, which can easily exceed one micrometer, they are referred to as “macrodimers”.

Of the second kind are dimers, where one atom is in a Rydberg state and the binding results from the elastic scattering of the Rydberg electron off the ground-state atom within its orbit. As first predicted by Greene and coworkers [2], this scattering interaction leads to oscillatory interaction potentials between the two atoms which support vibrational bound states at long-range. For this kind of molecules, mostly the term “long-range Rydberg molecules” is used.

I will introduce the theoretical frameworks used to describe both kinds of molecules and experimental techniques that were developed to study their properties.

[1] C. Boisseau, I. Simbotin, and R. Côté, PRL 88, 133004 (2002)

[2] C. H. Greene, A.S. Dickinson, A. S., and H. R. Sadeghpour, PRL 85, 2458 (2000)