量子材料科学中心
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Seminar

Ultralong range Rydberg molecules

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- **Time: 10:30am, Nov. 22. 2010 (Monday)**
- **Venue: Science Building 5, Room 607**

Abstract

The low energy collisions of a electron with ground state atoms, well approximated by Fermi's pseudo-potential, will give rise to repulsive or attractive interactions depending on the incident energy. As an atom penetrates the wave function of another Rydberg atom adiabatically, extremely structured potential curves are constructed due to Rydberg electron and ground-state-atom interaction. For highly excited Rydberg state, shallow potential wells, extending to several thousand Bohr radii, could weakly bound the ground state atom as a giant molecule. Recently, spectroscopical evidences of these ultralong range Rydberg molecules have been reported recently. Although the physics picture is straightforward, a conventional diagonalization procedure yields no convergence when attempting to explain the measured spectra, resulting from the ill-defined short-range potential. Instead, a nontrivial Green's function approach, avoiding the divergence, reproduces most of the molecular lines. We will show that the vibrational ground state is bound mainly by s-wave scattering while p-wave scattering play crucial roles for excited states. Nevertheless, a novel binding mechanism where excited states are bound essentially by quantum reflection due to p-wave resonance, is revealed and thoroughly examined, by investigating the internal reflection via stationary calculation and dynamic simulation. One of the most interesting properties of the molecules is its permanent dipole moment, as shown by recent experiment. It results from the electron-atom interaction and our calculationexplains the origin properly.

References:

[1] V. Bendkowsky et al., Nature (London) 458, 1005 (2009).

[2] PRL,105,163201(2010).