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Coherent superposition of diatomic and triatomic molecules

Prof. Lev Khaykovich
Physics Department & Institute for Nanotechnology and Advanced Materials,
Bar Ilan University,
Israel

Abstract

One of the most basic but profound paradigms of quantum mechanics is superposition. It is an essential ingredient for quantum interference and can give rise to entanglement. In the prototypical experiment a particle (or an entire system) is cast into a superposition of internal or external states. Here we show that the notion of superposition reaches much further by creating a coherent superposition of diatomic and triatomic molecules – chemically different bound states. Since the three-body problem is intrinsically non-separable, i.e. it cannot be written in the form of one effective particle interacting with a potential, this goes beyond any previous superposition experiment. More specifically, by means of rf-modulation we cast a system of three Li-7 atoms in an ultracold atomic gas into a superposition state where either two atoms form a Feshbach dimer and one is free or all three form an Efimov trimer. By measuring the coherent evolution in an interferometer-like experiment we demonstrate the coherence of the superposition state. In its direct application we are able to use the well studied Feshbach molecules energy level as a reference to Efimov trimers in yet unexplored regime and with unprecedented precision. Further development of the method yields access to previously inaccessible parameters of the system such as the Efimov trimers' lifetime and the elastic processes between atoms and the constituents of the superposition state.

ההרצאה תתקיים ביום רביעי, ה-15.1.2020 בשעה 12:30*
באודיטוריום המכון למצב מוצק, קומת כניסה
The lecture will take place on Wednesday, 15.1.2020 at 12:30*
at the Solid State Institute auditorium, entrance floor

Host: Assistant Professor Yoav Sagi