Super-Cold Molecules Answer Fundamental Physical Questions

Tanya Zelevinsky
Assistant Professor, Physics

CURRENT RESEARCH

Dr. Zelevinsky uses laser-cooled and trapped atoms in optical lattices to study ultracold chemistry and quantum optics

Imagine if someone asked you to count the passengers in a car that is whizzing by on a highway, and then to do the same when the car is stopped. Without question one could more precisely study the car that is not moving. In the same way, when scientists precisely study tiny atoms and molecules, they do so when the particles are almost perfectly still at temperatures near the absolute zero. Recently, using this technique, physicists have been focusing on studying the atom-molecule threshold regime, where the molecular bond between two atoms gets so long that the molecule is about to split. Particularly, they are able to observe and study an elusive phenomenon of subradiance, or collective suppression of light emission, which occurs because of the quantum physics of identical particles.

Dr. Tanya Zelevinsky's experimental group in atomic, molecular, and optical physics at Columbia University uses laser-cooled and trapped atoms in optical lattices to study ultracold chemistry and quantum optics. Her research goals include developing low-energy precision measurement techniques for quantum systems such as molecules that so far have been difficult to produce and manipulate with a high degree of control. She is therefore interested in applying the methods of quantum measurement to fundamental physical questions. In the near future, Dr. Zelevinsky will be studying simple diatomic molecules in a more strongly bound regime, that scientists call 'molecular clock'. This could shed light on whether the fundamental constants are truly constant, and whether there might be tiny forces that deviate from Newton's gravitational law at nanometer scales.

Dr. Zelevinsky currently has two main projects:

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AFFILIATION

Columbia University

EDUCATION

- Ph.D. in Physics 2004, Harvard University
- B.S. in Physics & Math 1999, Massachusetts Institute of Technology

RESEARCH AREAS

Technology, Chemistry

FUNDING REQUEST

Your contributions will support the research of Dr. Zelevinsky to develop low-energy precision measurement techniques for quantum systems, that have historically been difficult to produce and manipulate with a high degree of control. Her research is an alternative to more costly, higher-energy approaches and a window into learning about quantum physics and chemistry. Your donations will provide stipends to graduate students and other personnel and in securing the necessary equipment.