CSU PHYSICS COLLOQUIUM

How Can you Cool a Molecule to Near Absolute Zero-and Why Would You Want To?

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University of Oklahoma

Colorado State University
4:00 PM Monday, October 30, 2017
Refreshments at 3:45 PM
Location: 120 Engineering (Hammond Auditorium)

Abstract

The advent of laser cooling and other ways to reduce the temperature of atoms to the “ultracold" (submilliKelvin) range revolutionized atomic physics. During the past decade, physicists have realized that if they could similarly cool molecules they could create quantum systems that have the potential for advances in a host of surprising areas. These include, for example, precision measurements previously accessible only to high-energy physics: the existence of a permanent electric dipole moment of the electron, the time-independence of electron-to-nuclear mass ratios and of the fine-structure constant, and more. Other proposed applications of ultracold molecules include quantum magnetism, molecular optical devices, quantum information, and quantum lattices as a bridge between gas-phase and condensed-matter physics.

Unfortunately, cooling molecules turns out to be really hard; methods that work for atoms don't work for molecules. So why not cool the atoms first, then use a laser to make them into a molecule? This is the method being used in an ongoing joint experimental/theoretical program at the University of Oklahoma of which I lead the theory part. The main difficulty is that molecules don't want to give up certain kinds of energy. So we trick them by using an external magnetic field to manipulate them into a special kind of quantum state called a Feshbach resonance.

Assuming no background in molecular physics, I'll explain and illustrate how this procedure works, what a Feshbach resonance state is, how one can be generated in the lab, and why doing so markedly increases the number of the coldest molecules one can create.

Bio

Michael A. Morrison is a theoretical physicist who works primarily in atomic, molecular, and optical physics. He joined the faculty at the University of Oklahoma in 1977 where, in 1993, he was named David Ross Boyd Professor of Physics and General Education. In addition to teaching in the Department of Physics and Astronomy, he was an Adjunct Professor in the English Department, where he created and taught a series of courses on “Science in Contemporary Culture." He is the author of numerous papers and several books and is now completing The Joy of Quantum Physics and Effective Scientific Writing: Recipes and Strategies for Students of Physics and other Sciences, both under contract at Oxford University Press. He formally retired in 2010 and moved to Fort Collins recently. Recently he was appointed an affiliate faculty member in the Department of Physics at CSU. He loves working with other scientists and is looking forward to developing collaborations here.