PFC Web Site Now On Line

The Physics Frontier Center now has its own web site at http://pfc.umd.edu.

The site will feature research news and PFC developments as they occur, and offers frequently requested information in user-friendly form.

In addition, specific requests for information can now be made by e-mail to info@pfc.umd.edu.

The site contains an

Clark Named AAAS Physics Chair

JQI Fellow Charles Clark, Chief of the Electron and Optical Physics Division at the National Institute of Standards and Technology, has been elected Chair-Elect of the Section on Physics of the American Association for the Advancement of Science.

Clark, a AAAS Fellow who has worked previously on the annual meeting and other events, will serve as Chair-Elect until February 22, 2010, Chair until February 21, 2011 and Retiring Chair until February 20, 2012.

continued, p 3

Charles W. Clark

Recipe for Supersolids in BECs

Entangled States: Papers, Talks and Foreign Affairs

Page 2

Page 4
Supersolids from a BEC

NEWS from the National Institute of Standards and Technology’s TechBeat: Physicists at the Joint Quantum Institute have proposed a recipe for turning ultracold bosonic atoms—the ingredients of Bose-Einstein condensates—into a supersolid, an exotic state of matter that behaves simultaneously as a solid and a friction-free superfluid. While scientists have found evidence for supersolids in complex liquid helium mixtures, a supersolid formed from such weakly interacting gas atoms would be simpler to understand, potentially providing clues for making a host of new quantum materials whose bizarre properties could expand physicists’ notions of what is possible with matter.

First theorized in 1970, a supersolid displays the essential characteristics of a solid, with atoms arranged in regularly repeating patterns like that of a crystal lattice, and of a superfluid, with the particles flowing frictionlessly and without losing any energy. Able to exist only at low temperatures, a supersolid behaves very differently from objects in the everyday world.

“If you add more clothing to a spinning washing machine, you increase the mass of its rim, and the machine needs to exert a greater force to make the wheel reverse direction;” explains lead author Ludwig Mathey. “But in a supersolid washing machine, some of the clothes would mysteriously hover in space, staying stationary as the washer spins and making it easier for the wheel to reverse direction. Moreover, these hovering, frictionless clothes would form a predictable pattern—such as frictionless socks alternating with frictionless shirts—just as atoms arrange themselves in a repeating pattern in a crystal.”

In 2004, Moses Chan and Eun-Seong Kim of Pennsylvania State University published a groundbreaking experiment on helium at low temperatures and gathered evidence for a supersolid phase. However, the interpretation of their observations has considerable uncertainties due to the complex nature of the particular system used in their experiments.

Now physicists Ludwig Mathey, Ippei Danshita and Charles Clark have identified a technique for making a simpler-to-understand supersolid, using two species of ultracold atoms confined in an optical lattice, a “web of light” that traps atoms in regular positions. In a paper* to be published in Physical Review A, the JQI team identifies conditions under which a cloud of ultracold atoms of two species (such as rubidium and sodium, or two slightly different forms of rubidium) can spontaneously condense into a state in which there is crystalline structure in the relative positions of atoms, e.g. a chain in which the two different types of atoms alternate regularly, but in which the entire cloud
BEC Supersolid, continued from previous page

exhibits the frictionless, superfluid properties of a Bose-Einstein condensate (BEC). This remains hard to visualize in familiar terms—the accompanying image shows an artist’s conception of it—but the team identified clear experimental signatures (essentially photographs of the cloud), which could verify the simultaneous existence of these two seemingly incompatible properties.

The underlying technologies of optical lattices and Bose-Einstein condensation were pioneered at NIST and have sparked a renaissance in atomic physics with applications to NIST’s fundamental measurement missions, such as time and frequency standards and improved sensors of magnetic and gravitational forces. The supersolid is an example of a further direction of research in ultracold atomic physics: the design of quantum materials with fundamental properties not previously found in familiar matter.


Media Contact: Ben Stein, bstein@nist.gov, (301) 975-3097

PFC web site, from p. 1

enhanced events listing, adapted from the widely used Google calendar, which offers "pop-up" information about coming events, and the option of seeing future seminars and the like on a weekly or monthly basis.

The new site, designed and constructed by IT consultant Mark Burr, incorporates an interactive form for submitting information about future events. JQI Fellows, PFC participants and other authorized persons can use the form at http://pfc.umd.edu/index.php/events/event-submission.html to post coming events, abstracts, seminars and the like to the web site through the password-protected form.

The PFC welcomes comments about the site contents and suggestions for additional material and links.

Teleportation Media Frenzy

Last month, JQI reached a new milestone in recognition by the news media. A paper published in Science* by JQI Fellow Chris Monroe and colleagues prompted dozens of news reports worldwide in print, electronic and broadcast sources.


Many other news organizations, including The New York Times, have stories in preparation.

Awards and Presentations:

In a ceremony at the Institute of Physics, University of São Paulo, in São Carlos, Brazil, on 14 January 2009, **Bill Phillips** was awarded the Medal of Honor of the Institute and was made an Honorary Professor of the Institute. The Medal of Honor and the Honorary Professorship are in recognition of significant contributions to the Institute of Physics through collaborations or visits that improve scientific understanding. Phillips was the first to be awarded this medal and professorship. At the same time, he was presented with the Janus award of the Institute of Advanced Studies in São Carlos. Phillips was in Brazil as part of the celebration of the 75th anniversary of the University of São Paulo, and delivered public lectures at the University campuses in São Carlos and São Paulo.

**Alessandro Restelli** gave an invited talk at the SPIE Photonics West Conference in San Diego, CA on January 29, 2009: "Quantum key distribution at GHz transmission rates."

**Paul Julienne** contributed a paper on "Ultracold molecules from ultracold atoms: a case study with the KRb molecule" (http://arxiv.org/abs/0812.1233) for the Discussions of the Faraday Society, Number 142: Cold and Ultracold Molecules, to be held April 15-17, 2009, Durham University, UK (photo, right) under the auspices of the Royal Society of Chemistry.

Publications:

