Deborah S. Jin 1968–2016: Trailblazer of ultracold science

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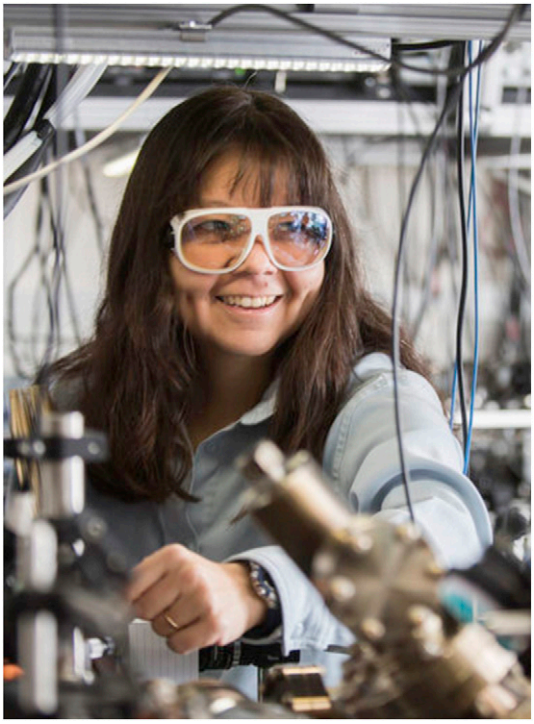
Deborah Jin, a pioneer in modern atomic and molecular physics, passed away on September 15, 2016, at age 47, after a courageous fight with cancer. She was a world renowned scientist at JILA (formerly known as the Joint Institute for Laboratory Astrophysics) in Boulder, Colorado, a joint institute of the National Institute for Standards and Technology (NIST) and the University of Colorado. Her research field was the world of atoms and molecules and their quantum mechanical behavior at temperatures close to absolute zero. Although she was a pioneer in her field, Jin was also humble and modest. She was a role model to many physicists worldwide through her enthusiastic and methodical approach to science.

Jin grew up in Indian Harbor Beach, Florida, where ocean waves and rocket launches were the backdrop to her childhood. She became interested in math and science already at a young age, inspired by her physicist parents, and studied physics at Princeton University. As a graduate student at the University of Chicago, Jin carried out research in condensed matter physics, and received a doctorate in 1995. Here, she met her husband, John Bohn, who also was pursuing a doctorate in physics. For her postdoctoral studies, Jin switched fields to atomic physics and joined the research group of Eric Cornell and Carl Wieman at JILA, just when they had prepared the first atomic Bose–Einstein-Condensate (BEC). In the following years Jin was instrumental in studying this novel quantum matter.

In 1997, Jin started her own group at JILA and began her road to stardom in a field that had traditionally been led by male scientists. Within two years, Jin and her team achieved the world's first quantum degenerate gas of fermionic atoms, in which the atoms form a Fermi sea. This required excellent scientific vision and intuition to identify feasible pathways forward, often resulting in the invention of new experimental methods. In 2003, Jin and her team were the first to condense pairs of fermionic atoms. In this work, Jin was able to directly observe the continuous transition from a Bardeen–Cooper–Schrieffer (BCS) state, in which the atoms form strongly correlated Cooper pairs, to a Bose–Einstein condensation of molecules. Her experiments gave unprecedented insight to this novel state of matter at the BCS–BEC crossover, which had never before been observed. Consequently, Jin's work opened a new field of research: fermionic quantum simulations. Jin showed how a precisely controllable gas of fermionic atoms can be used to explore the physics of strongly correlated electron gases as they appear in superconductors and other solid-state materials. This toolset she devised is now used all around the world.



Deborah Jin in her ultracold atom and molecule lab at JILA. Image courtesy of Dave Neligh (NIST).

And yet, this incredible success did not stop with atoms. In parallel (2008), Jin teamed up with her colleague, Jun Ye, to tackle the challenge of cooling diatomic molecules. In this "dream team," Jin and Ye applied their unique, complementary expertise in

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Deborah Jin, a trailblazer of ultracold fermions and molecules and an outstanding mentor to a generation of atomic physicists. Image courtesy of Glenn Asakawa (University of Colorado Boulder, Boulder, CO).

quantum gases and frequency metrology to achieve one of the most successful collaborations in the atomic physics community. The creation of ultracold polar molecules that possess a large electric dipole moment was sought after in the community for a range of exciting prospects. Instead of directly cooling molecules, which had turned out to be difficult, Jin and Ye formed a gas of ultracold ground-state molecules in a very different way: they transformed pairs of already cold atoms into dipolar molecules in a completely coherent fashion. By using magnetic fields and incredibly precise laser beams to suck out the energy released during the molecule formation, Jin and Ye were able to create molecules as cold as what had been achieved with atoms. With this new ability, the two collaborators generated new insights into the process of chemical reactions near absolute zero temperature, and their work opened a rich field for exploration of exotic phases of matter. Jin and her theorist husband Bohn, an expert on cold atom and molecule collisions, collaborated throughout many of these successes.

Jin was recognized with many prestigious national and international awards. These include a MacArthur "Genius" award, the Benjamin Franklin medal, the Isaac Newton medal, and the Comstock prize in physics. She was awarded the 2013 L'Oreal UNESCO Prize, which honors the most influential women in science. As a government scientist, Jin had received the Service to America medal. Her achievements propelled her elections to many advanced academic societies, including the National Academy of Sciences in 2005. At the time and for several years afterward, Jin was the youngest member of this group.

In the too short but exceedingly productive 19 years that she ran the "Jin school" at JILA, Jin was an outstanding mentor. She directly supervised two dozen doctoral students, two dozen undergraduate students, and a dozen postdoctoral fellows. One-third of these individuals were women, who were fortunate to have her as a role model and who are making great strides with their own successful careers in science and engineering. Jin cared deeply for her students' growth, both scientific and personal. To her students, Jin never seemed too busy and was never stressed. She was approachable and always had plenty of time for them, whether to work side-by-side in the laboratory or to give advice on all things. She seldom talked about herself, giving others the opportunity to voice their thoughts. When it came to science, Jin practiced it with the highest standards. She was both optimistic and rigorous, did not tolerate illogical work, had full confidence in herself, and was never afraid to ask seemingly simple questions, which were often quite insightful.

Deborah Jin was an extraordinary speaker. She had the unique gift to maximally simplify complex scientific problems. This gift was the basis for her scientific creativity. It allowed Jin to capture complex physical phenomena in the laboratory, to devise elegant solutions to experimental challenges, and to communicate science to the general public with surprising clarity. Many who were lucky to have attended one of her talks, usually entitled "Fun with ultracold atoms," experienced Jin as a messenger of science where her enthusiasm reached far beyond her words.

Debbie lived a full life. She loved living in Boulder with her extended family. She also traveled the world to professional conferences with John and their daughter, Jaclyn. It is amazing and inspiring that Debbie could accomplish so much in such a short amount of time, and yet balance this all so well with a good family life. At 5:00 PM each day, Debbie always had a big smile because she knew it was time to go home to be with her family.

Deborah Jin left us too soon. But her legacy will live on through every life she touched. Her bright radiating smiles will live in all of our memories.