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PHYSICS TODAY

Deborah Jin FREE

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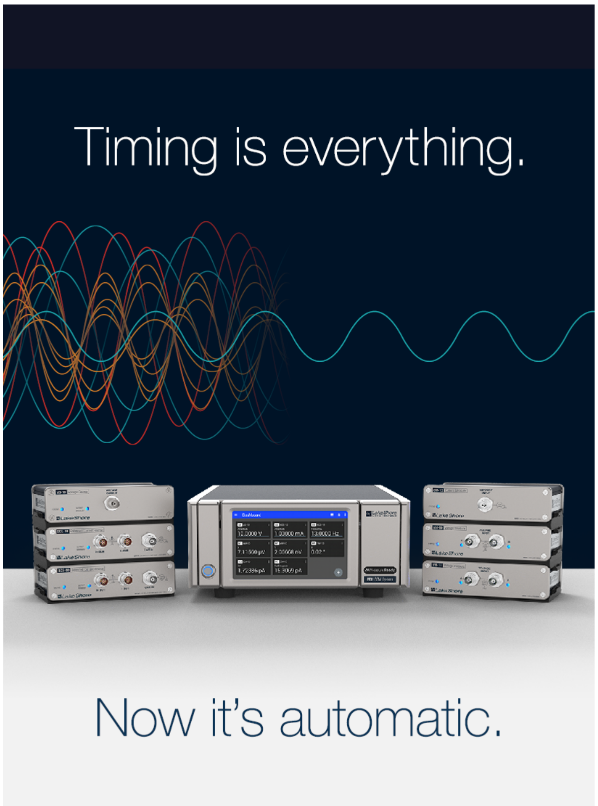
John Bohn

Physics Today **70** (1), 69–70 (2017);
https://doi.org/10.1063/PT.3.3435



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Deborah Jin

Deborah Jin—"Debbie" to everybody—was a bright star in the field of experimental atomic, molecular, and optical (AMO) physics. She died on 15 September 2016 in Boulder, Colorado, after battling cancer. She was 47.

Born in Stanford, California, on 15 November 1968, Debbie was raised in Florida, in a home with physics in the air. Her parents and her older brother studied physics; only her younger sister, an attorney, escaped untouched by the bug.

Debbie pursued physics as an undergraduate at Princeton University and showed remarkable skill for doing both actual and class work, which earned her the university's 1990 Allen G. Shenstone Prize in experimental physics. In 1995 she received her PhD, under the guidance of Tom Rosenbaum, from the University of Chicago. For her thesis, she explored the nature of anisotropies in heavy-fermion superconductors such as UPt_3. That experience also taught her important life skills, such as hanging through the floor of the laboratory above in order to load her samples into a dilution refrigerator.

Debbie was lured away from solid-state physics by the siren call of JILA at the University of Colorado, where Eric Cornell was "confident" that the first experimental achievement of Bose–Einstein condensation was around the corner. Having no experience in lasers or optics, Debbie nevertheless boldly changed fields and learned a new skill set on the job. In the end, Cornell was right, and Debbie led the first critical studies of the nature of Bose–Einstein condensates. To reward her success, Cornell sent Debbie to deliver a plenary talk at the American Physical Society's division of AMO physics meeting in 1996. As a first-year postdoc, in front of an audience of some 800 scientists, Debbie went, in a half hour, from being unknown to embodying the future of cold-atom physics.


Deborah Jin

Although she was flooded with job offers, Debbie decided to remain at JILA, in a permanent position with NIST. That not only would give her access to a great research facility with outstanding colleagues, it would also solve a two-body problem by allowing her husband (me, also an AMO physicist) to remain gainfully employed. In 1997 Debbie turned her attention away from the "boring" study of bosons to the study of ultracold, quantum-degenerate Fermi gases because, as she would say, "fermions are real individualists!" That was a much harder experimental challenge: The evaporative cooling methods that produced Bose–Einstein condensates require frequent collisions for rethermalization, so they did not work for fermions, which nominally hardly collide at ultralow temperatures. Nevertheless, Debbie, along with graduate student Brian DeMarco, surmounted that difficulty and produced the first quantum Fermi gas within 18 months of inheriting an empty lab.

Debbie's achievements came full circle in a way when in 2003 she, graduate student Cindy Regal, and postdoc Markus Greiner coaxed ultracold fermions into Cooper-like pairs to form a Fermi superfluid. Their work answered important, long-standing questions about how the system evolves into a condensate of diatomic molecules as an interaction parameter is tuned. Ironically, although the techniques were different, Debbie's work was again focused on fermions (potassium-40 atoms) as opposed to the "heavy electrons," dressed by lattice interactions, in her graduate studies.

In 2008, in collaboration with Jun Ye, Debbie achieved another long-standing experimental goal of welding together pairs of ultracold atoms to form ultracold, ground-state polar molecules. With that revolutionary achievement came fundamental new observations of unusual chemical kinetics, since the reactants could be placed into single quantum states in all degrees of freedom—rotation, vibration, spin, and even the relative motion of the molecules. Reaction rates could be influenced by flipping a nuclear spin or applying modest electric fields.

In addition to being exceptionally smart and hardworking, Debbie possessed unparalleled common sense and an ability to focus on the important details. Her successes were frequently rewarded; the walls of her office groaned with the weight of plaques denoting the many awards she garnered. In her videotaped talks you can still see her brilliance shine through, in both the science and the remarkable skill with which she explained it; you can also see her famous dimples.

In the face of tremendous professional success, Debbie remained humble and good-natured. She would grant an interview to a high school student as readily as she would to a professional journalist. She mentored 16 PhD students and lots of postdocs, and she made time to talk to them frequently—about physics and about life in general. Hanging out during group cookouts or ski trips was an important part of life in the Jin group.

Debbie was aware of being a role model for women but did not dwell on it; instead, she preferred to let her achievements speak for themselves, while she worked where she could to help young women scientists. In one notable example, she spent a week in Paris as a recipient of the 2013 L'Oréal-UNESCO Award for Women in Science. Despite the exhausting schedule, Debbie reveled in the chance to interact with the young women from around the world who were receiving postdoctoral fellowships. She encouraged them to be fermions themselves and to pursue their individual talents and interests to the best of their ability.

Away from science, Debbie was a warm and dedicated mother. She also played violin and ukulele; enjoyed camping, skiing, and other outdoor activities; and was an effective utility player for the JILA softball team. She touched thousands of people in and out of science who will miss her terribly.

John Bohn
JILA
Boulder, Colorado

John Michael Julius Madey

The inventor of the free-electron laser (FEL), John Michael Julius Madey, died of lung cancer on 5 July 2016 in Honolulu, Hawaii. He left an indelible mark on the international accelerator community.

John was born in Elizabeth, New Jersey, on 28 February 1943. In 1946 he and his family moved to a new house in Clark, where John grew up. His father owned an auto repair shop and instructed him and his older brother Jules in basic machine-shop skills. When John was 11, he and Jules studied together for their ham radio licenses from the Federal Communications Commission and provided morale communications for US Navy crewmen and civilian scientists stationed in Antarctica and their loved ones back home.

John's increasing fascination with the vacuum tubes used in the transmitters led him to learn everything there was to know about vacuum-tube technology. He was an avid builder of his own ham equipment, and the skills he developed served him well in his physics career. Howard Schrader, the brother of John's next-door neighbor, owned one of the largest collections of vacuum tubes in the world. After hearing about the Madey brothers' enthusiasm for the technology, Schrader, who was Princeton University's official photographer, introduced them to John Wheeler and other faculty members.

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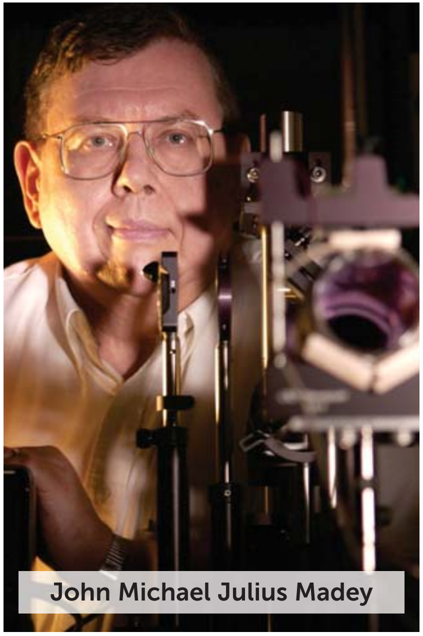

John Michael Julius Madey

In 1960 John went to Caltech, where he received a BS in physics in 1964 and an MS in quantum electronics in 1965. While there he became deeply interested in whether the transition rate for bremsstrahlung could be amplified through stimulated emission. That curiosity continued when he went to Stanford University, where he earned a PhD in 1970 under the supervision of William Fairbank and conceived his most important invention: the FEL. Its bunched electron beam would pass through a periodic magnetic structure to stimulate the emission of light. In 1976, while working at Stanford's High Energy Physics Laboratory, John and his team succeeded in demonstrating the FEL principle; they used a 24 MeV electron beam and a 5-meter-long wiggler magnet to amplify the beam from a carbon dioxide laser. By 1978 they had added mirrors to the system and increased the electron energy to 43 MeV, which allowed laser oscillations at a wavelength of 3.5 μm in the near-IR part of the optical spectrum. The power and efficiency were small—300 mW and 0.01%, respectively—but it was clear that the FEL scheme worked.

In contrast to early FELs that used mirrors or optical cavities, today's linac-based FELs, including SLAC's Linac Coherent Light Source and the European XFEL, operate at much shorter wavelengths. They have proved indispensable for research in physics, chemistry, and biology because their highly intense, coherent electromagnetic radiation is tunable over a broad range of frequencies.

In 1986 while still at Stanford, John became a professor of electrical engineering. Two years later he joined Duke University's physics department, and the following year he transported his FEL research laboratory there from Stanford and continued to direct it for almost 10 years. John moved to the department of physics and astronomy at the University of Hawaii at Manoa in 1998 and built an FEL facility from scratch using some parts obtained from Duke. The facility provided a unique opportunity for hands-on training of graduate students in FEL science and technologies. John was a great mentor; working side by side with students, he imparted his knowledge and expertise.

John held 13 patents on FEL-related technological inventions. A legal dispute over some of his patents led to a judgment in John's favor. On 3 October 2002, in *Madey v. Duke University*, the Federal Circuit Court of Appeals ruled that the university was infringing on two of John's patents because it was profiting from them beyond the experimental use "solely for amusement, to satisfy idle curiosity, or for strictly philosophical inquiry." The historic case, which ended a 170-year-old practice in which scientists freely used patented technologies when working on basic research that had no commercial application, has been discussed and written about by many legal scholars around the world.

Among the numerous awards and international recognitions that John received was the American Physical Society's 2012 Robert R. Wilson Prize for Achievement in the Physics of Particle Accelerators. At the 2015 Nobel Symposium on Free-Electron Laser Research in Sigtuna, Sweden, he served as the keynote speaker.

John will be remembered by his colleagues as the enthusiastic developer of the FEL and a prolific scientist of great drive and insight.

Pui Lam
University of Hawaii at Manoa
Honolulu
Vladimir Shiltsev
Fermi National Accelerator Laboratory
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