Clockwise from top: Charles & Frances Townes at the Amazing Light Symposium in 2005; Townes early in his career; discussing physics with Reinhard Genzel; 'The Bench' where he sat as his thoughts on how the laser could work became clear; his 99th birthday on the UC Berkeley campus; at work in mid-career. Collage by Sarah Wittmer, physics department.

Nobel laureate and laser inventor Charles Townes dies at 99

By Robert Sanders, Media Relations | January 27, 2015

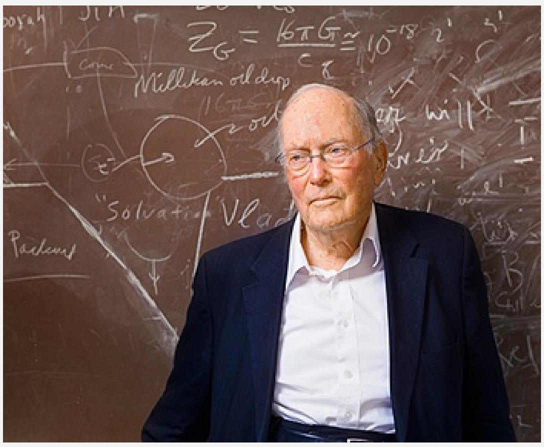
BERKELEY — Charles Hard Townes, a professor emeritus of physics at the University of California, Berkeley, who shared the 1964 Nobel Prize in Physics for invention of the laser and subsequently pioneered the use of lasers in astronomy, died early Tuesday, Jan. 27. He was 99 and in failing health, and died on his way to the hospital.

"Charles Townes embodies the best of Berkeley; he's a great teacher, great researcher and great public servant," said UC Berkeley Chancellor Nicholas Dirks on the occasion of a campuswide celebration of Townes' 99th birthday last July 28. "As we celebrate this 99-year milestone and a career spanning nearly 80 years, we can only be impressed by the range of his intellectual curiosity, his persistence and his pioneering spirit."

Until last year, Townes visited the campus daily, working either in his office in the physics department or at the Space Sciences Laboratory.

"Charlie was a cornerstone of the Space Sciences Laboratory for almost 50 years," said Stuart Bale, director of the lab and a UC Berkeley professor of physics. "He trained a great number of excellent students in experimental astrophysics and pioneered a program to develop interferometry at short wavelengths. He was a truly inspiring man and a nice guy. We'll miss him."

"Charlie Townes had an enormous impact on physics and society in general," said Steven Boggs, professor and chair of the UC Berkeley Department of Physics. "Our department and all of UC Berkeley benefited from his wisdom and vision for nearly half a century. His overwhelming dedication to science and personal commitment to remaining active in research was inspirational to all of us. Berkeley physics has lost a true icon and our deepest sympathies go out to his wife, Frances, and the entire Townes family."



Charles Townes in 2014 in his Birge Hall office. (Elena Zhukova photo)

"The passing away of Professor Charles Townes today marks the end of an era," said astrophysicist Reinhard Genzel, a professor of physics at UC Berkeley and director of the Max Planck Institute for Extraterrestrial Physics. "He was one of the most important experimental physicists of the last century. To those who knew him as colleagues or students, he was a role model, a wonderful mentor and a deeply admired person. His strength was his curiosity and his unshakable optimism, based on his deep Christian spirituality."

Townes, a longtime member of the First Congregational Church of Berkeley, often emphasized the importance of faith in his life, and was honored with the 2005 Templeton Prize for contributions to "affirming life's spiritual dimension."

Revelation

Townes was 35 in the spring of 1951 when, seated on a park bench among blooming azaleas in Washington, D.C., he

Share this story

Latest News

Campus poised to act on salary gaps for women, minority faculty

Nobel laureate and laser inventor Charles Townes dies at 99

Campanile turns 100, national parks, privacy in the spotlight

Long dry spell doomed Mexican city 1,000 years ago

Scientists take big step in making graphene a viable silicon substitute

Popular Stories

Nobel laureate and laser inventor Charles Townes dies at 99

Berkeley Global Campus the talk of the higher-ed world

Happy Birthday, Campanile!

Scientists set quantum speed limit

SkyDeck sends six to '30 Under 30'

Berkeley in the News

Early stage work shows graphene could be used as a semiconductor
New Electronics (UK) | January 27

Bending the Cost Curve
Inside Higher Education | January 27

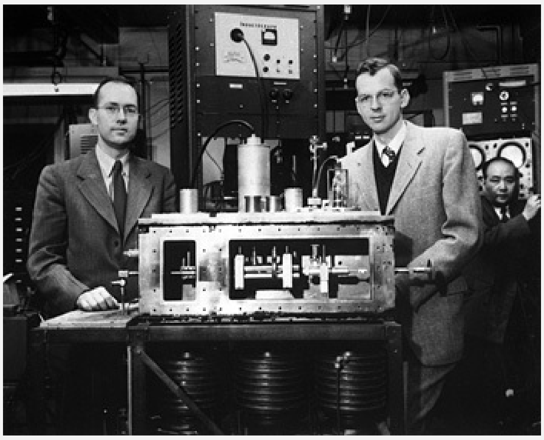
UC Berkeley's Campanile celebrates its 100th birthday
Berkeleyside | January 27

'Lentil Underground,' by Liz Carlisle
San Francisco Chronicle | January 27

Read the full daily digest »

was struck by the solution to a longstanding problem, how to create a pure beam of short-wavelength, high-frequency light.

That revelation – not much different from a religious revelation, Townes believed – eventually led to the first laser, a now ubiquitous device common in medicine, telecommunication, entertainment and science.



Charles H. Townes (left) and James P. Gordon shown with the second of two microwave amplifiers, or masers, that they built in 1955 with H. J. Zeiger (not shown). Townes shared the 1964 Nobel Prize in Physics for invention of the maser and the description of the laser, which was first built in 1960. (Courtesy the American Physical Society)

Then a professor at Columbia University and a consultant for Bell Telephone Laboratories, Townes had transitioned from working on radar during World War II to using shorter wavelengths of light to study the energy states of molecules, a field called spectroscopy. The problem bedeviling him was how to create an intense beam of microwave energy to use as a probe. Albert Einstein proposed in 1917 that the right wavelength of light can stimulate an excited atom to emit light of the same wavelength, essentially amplifying it, but Townes was stymied by how to corral a gas of excited atoms without them flying apart.

His revelatory solution allowed him to separate excited from non-excited molecules and store them in a resonant cavity, so that when a microwave traveled through the gas, the molecules were stimulated to emit microwaves in step with one another: a coherent burst. He and his students built such a device using ammonia gas in 1954 and dubbed it a maser, for microwave amplification by stimulated emission of radiation.

From maser to laser

Four years later, in 1958, he and his brother-in-law and future Nobelist Arthur Schawlow conceived the idea of doing the same thing with optical light, but using mirrors at the ends of a gas tube to amplify the light to get an "optical maser." Bell Labs patented the laser, while Townes retained the patent on the maser, which he turned over to a nonprofit. Townes' appointment as director of research for the U.S. government's Institute of Defense Analysis in 1959 slowed his efforts to build an optical device, opening the door for Theodore Maiman to demonstrate the first laser – light amplification by stimulated emission of radiation – in 1960.

Townes shared the 1964 Nobel Prize in Physics with two Russians, Aleksandr M. Prokhorov and Nicolai G. Basov, who independently came up with the idea for a maser.

To date, more than a dozen Nobel Prizes have been awarded for work done with lasers. Lasers are incorporated into consumer electronics and optical fibers, surveying equipment and printers, light shows and laser pointers. Lasers are used to cut metal, slice through tissue during surgery, trap atoms, and even initiate nuclear fusion.

Townes himself went on to use masers for radio astronomy, and lasers for infrared astronomy and interferometry, and promoted their use in areas as diverse as precision timekeeping – the atomic clock – and extraterrestrial communication. With the help of lasers, he and colleagues detected the first complex molecules in interstellar space and first measured the mass of the black hole in the center of our galaxy.

He also served on numerous government panels. From 1966 to 1970, at a time when many scientists questioned the value of a manned space program, Townes accepted an appointment as chairman of an ad hoc science advisory committee to NASA's manned space program, to secure support for the Apollo moon flights from the larger scientific community and ensure that they would yield maximum benefits in scientific research. In 1981 he chaired a panel reviewing President Ronald Reagan's planned deployment of MX missiles, and he actively advocated controls on nuclear weapons, including a test ban treaty to regulate underground weapons testing.

Southern born

Born July 28, 1915, in Greenville, S.C., Townes attended Furman University and graduated summa cum laude in 1935 at the age of 19 with a BS in physics and a BA in modern languages. He was a member of the swim team, the football band and the college paper. He completed an MA in physics at Duke University in 1936 and moved to Caltech, from which he obtained his Ph.D. in 1939. His thesis involved isotope separation and nuclear spins.

He immediately joined the technical staff at Bell Labs in New Jersey, where he stayed through the war designing radar bombing systems. He then began applying his expertise in microwaves to spectroscopy, which he foresaw as providing powerful new tools for probing the structure of atoms and molecules and for controlling light. Bell Labs eventually terminated the program, however, seeing little application for it.

Nevertheless, Townes continued this work after accepting a faculty position at Columbia University in 1948, where he built the maser with graduate student James Gordon and post-doctoral researcher Herbert Zeiger. In 1961, after a brief tenure at the Institute for Defense Analyses, he was appointed provost and professor at MIT. He continued his research on quantum electronics and moved into the new field of infrared astronomy. In 1967 he was named a UC Professor-at-large based on the UC Berkeley campus.

Newly arrived at UC Berkeley, Townes soon learned of plans by young professor William "Jack" Welch to build a short-wavelength radio telescope, and offered some of his startup funds to build a maser amplifier and microwave spectrometer so the telescope could be used to search for evidence of complex molecules, like ammonia, in space. Told by many, including the astronomy department chairman, that such molecules could not possibly survive in space, Welch and Townes persisted and in 1968 proved them wrong. They were the first to discover three-atom combinations – ammonia and water vapor – near the center of the Milky Way galaxy. Others soon discovered even more complex molecules, providing evidence for a host of chemical reactions taking place in young and dying stars and giving credence to the idea that molecules from space could have seeded Earth with the building blocks of life.

Charles Townes in his office at the Space Sciences Laboratory, which has named a postdoctoral fellowship after him.

Welch and Townes went on to discover the water maser in space.

First evidence for black hole at center of Milky Way

In a UC Berkeley lab staffed mostly by students, Townes moved on again to pioneer the field of infrared astronomy, essentially looking at sources of heat in outer space, and precision infrared spectroscopy. He developed a novel infrared detector incorporating a precision CO_2 laser, which made it easier to study this wavelength of light without contamination from hot sources all around us. His infrared studies of the center of the galaxy with Reinhard Genzel, now a professor of physics at UC Berkeley and director of the Max Planck Institute for Extraterrestrial Physics, revealed in 1985 swirling gas clouds that could only be orbiting a massive object, presumably a black hole. That discovery was later confirmed by Genzel and others.

Townes subsequently built an interferometer, again using lasers, that combined infrared light collected by three separate telescopes into high-resolution images normally obtainable only with a much larger telescope. This Infrared Spatial Interferometer Array, housed in movable trailers at the Mt. Wilson observatory outside Los Angeles, can measure the diameters of stars that appear only as points of light in most telescopes. He and his colleagues have conducted long-term studies of the dust disks around old stars and the changes in aged red giants such as Betelgeuse, and are preparing the telescopes to look for possible infrared laser signals from newly discovered planets circling nearby stars, in search of extraterrestrial civilizations.

Charles Townes and his wife, Frances. (Taran Singh photo)

As with the maser, "he pursued the infrared interferometer because he saw a new technique with great possibilities," said Ed Wishnow, who collaborated with Townes beginning in 2007. "He really had a great sense of what was possible and reasonable; he was farsighted, yet grounded at the same time."

Throughout his life, Townes maintained an interest in the intersection of science and religion. His seminal 1966 article, "The Convergence of Science and Religion," established him as a unique voice – among scientists, in particular – seeking commonality between the two disciplines.

"My own view is that, while science and religion may seem different, they have many similarities, and should interact and enlighten each other," Townes wrote in a statement upon accepting the 2005 Templeton Prize.

"Science tries to understand what our universe is like and how it works, including us humans," he wrote. "Religion is aimed at understanding the purpose and meaning of our universe, including our own lives. If the universe has a purpose or meaning, this must be reflected in its structure and functioning, and hence in science."

Townes was a member of the National Academy of Sciences, National Inventors Hall of Fame, South Carolina Hall of Fame and Engineering and Science Hall of Fame. He received honorary degrees from 25 colleges and universities and numerous honors, including the National Medal of Science, National Academy of Sciences' Comstock Prize and the John J. Carty Medal, Rumford Premium of the American Academy of Arts and Sciences, Stuart Ballentine Medal of the Franklin Institute (twice), the C.E.K. Mees Medal of the Optical Society of America, the Medal of Honor of the Institute of Electrical and Electronics Engineers, Plyler Prize of the American Physical Society, NASA's Distinguished Public Service Medal, Thomas Young Medal and Prize of the Institute of Physics and the Physical Society (England), Wilhelm Exner Award (Austria) and the 1979 Niels Bohr International Gold Medal.

He also was a member and former president of the American Physical Society, a member of the American Academy of Arts and Sciences and the National Academy of Engineering, and a foreign member of the Royal Society and the Russian Academy of Sciences.

Townes is survived by his wife, Frances Hildreth Townes, whom he married in 1941; daughters Holly Townes, Linda Rosenwein, Ellen Townes-Anderson and Carla Kessler; six grandchildren and two great grandchildren.

Categories: News, Obituaries, Science
Tags: astronomy and astrophysics, honors and awards, obituaries, people, physics