

# Charles Hard Townes

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Charles Hard Townes	
	
Charles Townes in 1968	
<b>Born</b>	July 28, 1915 Greenville South Carolina
<b>Residence</b>	United States
<b>Nationality</b>	United States
<b>Fields</b>	Physics
<b>Institutions</b>	Bell Labs Institute for Defense Analyses Columbia MIT Berkeley
<b>Alma mater</b>	Furman University Duke Caltech
<b>Doctoral advisor</b>	William Smythe
<b>Doctoral students</b>	James P. Gordon Robert Boyd Ali Javan Raymond Y. Chiao
<b>Known for</b>	Inventing the maser
<b>Notable awards</b>	Nobel Prize in Physics (1964) Templeton Prize (2005)

**Charles Hard Townes** (born July 28, 1915) is an American Nobel Prize-winning physicist and educator. Townes is known for his work on the theory and application of the maser, on which he got the fundamental patent, and other work in quantum electronics connected with both maser and laser devices. He received the Nobel Prize in Physics in 1964.

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## Biography

Townes was born in Greenville, South Carolina, on July 28, 1915, the son of Henry Keith Townes, an attorney, and Ellen (Hard) Townes. He attended the Greenville public schools and then Furman University in Greenville, where he completed the requirements for the Bachelor of Science degree in Physics and the Bachelor of Arts degree in Modern Languages, graduating summa cum laude in 1935, at the age of 19. Physics had fascinated him since his first course in the subject during his sophomore year in college because of its "beautifully logical structure". He was also interested in natural history while at Furman, serving as curator of the museum, and working during the summers as collector for Furman's biology camp. In addition, he was busy with other activities, including the swimming team, the college newspaper and the football band.

Townes completed work for the Master of Arts degree in Physics at Duke University in 1936, and then entered graduate school at the California Institute of Technology, where he received the Ph.D. degree in 1939 with a thesis on isotope separation and nuclear spins.

A member of the technical staff of Bell Telephone Laboratories from 1933 to 1947, Townes worked extensively during World War II in designing radar bombing systems and has a number of patents in related technology. From this he turned his attention to applying the microwave technique of wartime radar research to spectroscopy, which he foresaw as providing a powerful new tool for the study of the structure of atoms and molecules and as a potential new basis for controlling electromagnetic waves.

At Columbia University, where he was appointed to the faculty in 1948, he continued research in microwave physics, particularly studying the interactions between microwaves and molecules, and using microwave spectra for the study of the structure of molecules, atoms, and nuclei. In 1951, Townes conceived the idea of the maser, and a few months later he and his associates began working on a device using ammonia gas as the active medium. In early 1954, the first amplification and generation of electromagnetic waves by stimulated emission were obtained. Townes and his students coined the word "maser" for this device, which is an acronym for microwave amplification by stimulated emission of radiation. In 1958, Townes and his brother-in-law, Dr. Arthur Leonard Schawlow, for some time a professor at Stanford University but now deceased, showed theoretically that masers could be made to operate in the optical and infrared region and proposed how this could be accomplished in particular systems. This work resulted in their joint paper on optical and infrared masers, or lasers (light amplification by stimulated emission of radiation). Other research has been in the fields of nonlinear optics, radio astronomy, and infrared astronomy. He and his assistants detected the first complex molecules in the interstellar medium and first measured the mass of the black hole in the center of our galaxy.

Having joined the faculty at Columbia University as Associate Professor of Physics in 1948, Townes was appointed Professor in 1950. He served as Executive Director of the Columbia Radiation Laboratory from 1950 to 1952 and was Chairman of the Physics Department from 1952 to 1955.

From 1959 to 1961, he was on leave of absence from Columbia University to serve as Vice President and Director of Research of the Institute for Defense Analyses in Washington, D.C., a nonprofit organization which advised the U.S. government and was operated by eleven universities.

In 1961, Townes was appointed Provost and Professor of Physics at the Massachusetts Institute of Technology (M.I.T). As Provost he shared with the President responsibility for general supervision of the educational and research programs of the Institute. In 1966, he became Institute Professor at M.I.T., and later in the same year resigned from the position of Provost in order to return to more intensive research, particularly in the fields of quantum electronics and astronomy. He was appointed University Professor at the University of California in 1967. In this position Townes is participating in teaching, research, and other activities on several campuses of the University, although he is located at the Berkeley campus.



Dr. Charles Hard Townes statue facing Falls Park on the Reedy River, Greenville, South Carolina

During 1955 and 1956, Townes was a Guggenheim Fellow and a Fulbright Lecturer, first at the University of Paris and then at the University of Tokyo. He was National Lecturer for Sigma Xi and also taught during summer sessions at the University of Michigan and at the Enrico Fermi International School of Physics in Italy, serving as Director for a session in 1963 on coherent light. In the fall of 1963, he was Scott Lecture at the University of Toronto. More recently (2002-2003) he has been the Karl Schwarzschild Lecturer in Germany and the Birla Lecturer and Schroedinger Lecturer in India.

In addition to the Nobel Prize, Townes has received the Templeton Prize, for contributions to the understanding of religion, and a number of other prizes as well as 27 honorary degrees from various universities.

Townes has served on a number of scientific committees advising governmental agencies and has been active in professional societies. This includes being a member, and vice chairman, of the Science Advisory Committee to the President of the U.S., Chairman of the Advisory Committee for the first human landing on the moon, and chairman of the Defense Department's Committee on the MX missile. He also served on the boards of General Motors and of the Perkins Elmer Corporations.

Townes and his wife (the former Frances H. Brown; they married in 1941) live in Berkeley, California. They have four daughters, Linda Rosenwein, Ellen Anderson, Carla Kessler, and Holly Townes.

## Research

Charlie Townes was the lead researcher in the construction of the Infrared Spatial Interferometer, the first astronomical interferometer to operate in the mid-infrared. He continues researching into astrophysics and astronomy at the University of California, Berkeley. With Arthur Leonard Schawlow, he wrote the book *Microwave Spectroscopy*, published in 1955.

During his time at Bell Labs Townes was asked to help with the development of a new radar system for aircraft in World War II. He never served in the military, but felt he was helping his country from within the lab. Townes and his team were successful in creating more accurate and precise radar systems, but none of them were ever mass produced by the military. Some of the new systems developed were used as prototypes in early B-52 bombers. After the war, Townes continued to work at Bell Labs, creating new radar by experimenting with different radio wavelengths. Moving from Bell Labs in 1948, to the physics department of Columbia University allowed Townes to return to experimental physics and away from the applications of physics. At Columbia, his research was still partially funded by the US Navy's desire for even smaller radar. At Bell Labs Townes helped develop a radar system with a 1.25 centimeter wavelength. After moving to Columbia, the military wanted radar systems with wavelengths only a few millimeters. The shortening of the wavelength led Townes and his colleagues to focus on microwave research. In 1951, the idea of the maser was proposed to Townes' superiors. After three years and many experiments, Townes and Jim Gordon created a working maser.

## Science and religion

A member of the United Church of Christ, Townes considers that "science and religion [are] quite parallel, much more similar than most people think and that in the long run, they must converge".<sup>[1]</sup> In 2005, he was awarded the Templeton Prize for "Progress Toward Research or Discoveries about Spiritual Realities."

## Awards

Townes has been widely recognized for his scientific work and leadership.

- 1956 - elected Full Member of the National Academy of Sciences.
- 1961 - awarded the David Sarnoff Electronics Award given by the Institute of Electrical and Electronics Engineers, and the Rumford Medal awarded by the American Academy of Arts and Sciences.
- 1962 - The John Carty Award given by the National Academy of Science.
- 1963 - Young Medal and Prize, for distinguished research in the field of optics presented by the Institute of physics.
- 1964 - The Nobel Prize in Physics with N. G. Basov and Aleksandr Prokhorov for contributions to fundamental work in quantum electronics leading to the development of the maser and laser.
- 1979 - He was awarded the Niels Bohr international medal awarded for contributions to the peaceful use of atomic energy.
- 1980 - Townes was inducted by his home state into the South Carolina Hall of Science and Technology, and has also been awarded a South Carolina Hall of Science and Technology Citation.
- 1982 - He received the National Medal of Science, presented by President Ronald Reagan.
- 1994 - elected Foreign Member of the Russian Academy of Sciences.
- 1996 - awarded the Frederic Ives Medal <sup>[2]</sup> by the OSA
- 1998 - awarded the Henry Norris Russell Lectureship by the American Astronomical Society.
- 2000 - awarded the Lomonosov Medal by the Russian Academy of Sciences.
- 2003 - awarded the Telluride Tech Festival Award of Technology in Telluride, Colorado.
- 2005 - awarded the Templeton Prize for "Progress Toward Research or Discoveries about Spiritual Realities."
  - He has also been awarded the LeConte Medallion.
- 2006 - Along with associate Raj Reddy, Townes was awarded the Vannevar Bush Award for Lifetime Contributions and Statesmanship to Science
- 2008 - On May 24 Townes received an Honorary Doctorate of Humane Letters from the University of Redlands.

## Representation

- Between 1966 and 1970 he was chairman of the NASA Science Advisory Committee for the Apollo lunar landing program.

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- F. Townes, *Misadventures of a Scientist's Wife*, Regent Press, 2007.

## See also

- List of science and religion scholars

## External links

- <http://www.hno.harvard.edu/gazette/2005/06.16/05-laser.html>
- Charles Hard Townes <sup>[3]</sup>
- Amazing Light: Visions of Discovery (Symposium in honor of Charles Townes) <sup>[4]</sup>
- Bright Idea: The First Lasers (history with interview clips) <sup>[5]</sup>
- Infrared Spatial Interferometer Array <sup>[6]</sup>
- Research page <sup>[7]</sup>
- Oral History interview transcript with Charles H. Townes 20 and 21 May 1987, American Institute of Physics, Niels Bohr Library and Archives <sup>[8]</sup>
- Dedication Program for the Charles H. Townes Center for Science, Furman University, November 1, 2008 <sup>[9]</sup>

## References

- [1] Harvard Gazette June 16, 2005 Laser's inventor predicts meeting of science, religion (<http://www.hno.harvard.edu/gazette/2005/06.16/05-laser.html>)
  - [2] <http://www.osa.org/aboutosa/awards/osaawards/awardsdesc/ivesquinn/>
  - [3] <http://nobelprize.org/physics/laureates/1964/townes-bio.html>
  - [4] <http://www.metanexus.net/fqx/townes>
  - [5] <http://www.aip.org/history/exhibits/laser>
  - [6] <http://isi.ssl.berkeley.edu/>
  - [7] <http://physics.berkeley.edu/research/faculty/Townes.html>
  - [8] <http://www.aip.org/history/ohilist/4918.html>
  - [9] [http://yearofthesciences.furman.edu/Townes\\_Center\\_Dedication\\_program.pdf](http://yearofthesciences.furman.edu/Townes_Center_Dedication_program.pdf)
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