



## **Chung Liang Tang**

May 14, 1934 – May 31, 2022

On May 31, 2022, Professor Chung Liang Tang, passed away at the age of 88. He was a member of the faculty of Electrical and Computer Engineering faculty for 44 years, and a recognized leader in lasers and quantum electronics.

Chung was originally from China and told a fascinating story of how his family was first driven from their home by an invading Japanese army in WW2, then again driven to escape to Taiwan when Mao-Tse Tung consolidated power in China, and finally how he arrived in San Francisco in 1950 on a boat with \$100 in his pocket at age 17. He put himself through college by working any job he could find, such as cleaning trashcans at the university kitchens. This was before the days of internships.

Chung earned his B.S. from the University of Washington, M.S. from California Institute of Technology, and Ph.D. from Harvard University in 1960. At Harvard he won a fellowship for post-doctoral studies at the Technical University in Aachen, Germany.

Chung joined the electrical engineering faculty as an Associate

Professor in 1964 after being recruited by Henry Booker and George Wolga to get Cornell into the forefront of laser research, which was then in its nascent stages. At the time Chung was a principle research scientist at Raytheon.

Chung began his long and distinguished career here, and his scholarly contributions were remarkable for their quality, quantity, and breadth. Throughout his research career, he made important fundamental contributions to the theory of quantum electronics and landmark practical inventions as well. His work is still widely recognized by the international quantum electronics community. His drive for excellence clearly permeated all of his work. The quality of this work and the stature in which he was held by his peers provides clear evidence of his capabilities. Among his contributions are:

- He was the first to prove and establish the validity of the laser rate equations used to analyze dynamic behavior and stability of lasers.
- He presented the first quantum mechanical density matrix theory of the higher order of coherent Raman effect. He followed this by formulating one of the basic theories of the stimulated Brillouin effect and did some of the key experiments on this effect.
- He is responsible for measuring of the line strengths of a vast number of transitions, and the lifetimes of many excited states of rare gas ions. These are now often accepted standards in the field.
- He was the first to predict, name and observe the optical mutation effect.
- He presented the first quantum mechanical theory of the spontaneous parametric scattering process.
- He was the first to show explicitly the importance of charge transfer as the physical origin of the optical nonlinearity in III-V and II-VI compounds.
- He developed of the only high-speed electro-optical method for tuning dye and semiconductor lasers over wide spectral ranges.

- He led the development of femtosecond laser pulses. This invention shortened by two orders of magnitude the shortest time measurement capability and opens new areas to investigation, such as defining the ultimate limitations in high-speed integrated circuit devices.

His biggest impact, commercially, was the development of the femtosecond optical parametric amplifier. Versions of this laser are sold today by many companies around the world. Chung had explored optical parametric amplification for many years, developing sources that could convert the fixed output wavelength of a lasers into a tunable source. These devices were adopted by many fields, including pipeline companies that were searching for natural gas leaks in pipes using remote sensing.

Placing the nonlinear crystal inside the cavity of a femtosecond laser created a source producing femtosecond laser pulses at a dozen wavelengths simultaneously, something that researchers had only dreamed of. This remarkable device has been widely commercialized and used by chemists and scientists around the world to do pulse-probe measurements of chemical reactions. Several Nobel prizes have been based on work that used this device as their tool. The field of tunable femtosecond pulses has been transformed by this development, completely due to Chung's remarkable insight.

Chung was awarded the Spencer T. Olin Professor of Engineering in 1985. He was elected Fellow of the National Academy of Engineering in 1986, Fellow of the Optical Society of America in 1986, Fellow of the Institute of Electrical and Electronic Engineers in 1977, and Fellow of the American Physical Society in 1975. He was an honorary Professor the Academia Sinica of the Republic of China. During his tenure at Cornell he advised and graduated over 30 Ph.D. students, many of whom today have prominent positions throughout the world.

Chung was recognized with numerous awards from the Optical Society of America, including the Charles Town Award for

advances in quantum electronics in 1966. He served on many international conferences as chair or co-chair and was a member of numerous advisory committees involved with lasers and international workshops. His advice and input were sought and valued.

Chung's greatest source of pride and joy was his family. Chung was always affable, good humored, and self-effacing, which was amusing knowing how huge an impact he had on his field. Almost no conversation went by without some discussion of his wife Louise, or his children, Elizabeth, Gregory, and Julia. (On a personal note, the wisdom he shared with me was rarely about lasers and quantum electronics, but usually about life and family. He considered himself a lucky man to have the family he had, and often reminded me that family was the one thing that could not be replaced.) And finally, no memorial of Chung would be complete without mentioning his passion for tennis. He loved batting a tennis ball around, with another player, or even with a backstop by himself.

Chung was a true pillar of scholarship. His work had a huge impact on the research reputation of Cornell and of the School of Electrical and Computer Engineering. He enjoyed his life, and always felt lucky to have started his career at the same time as the discovery of the laser. The laser was a brand-new open book, and Chung played a major role in the subsequent discovery of many of the amazing phenomena that make lasers work.

*Written by Clifford Pollock*