

IN MEMORIAM

Linn F. Mollenauer

1937–2021

Linn Frederick Mollenauer, whose work on optical solitons transformed the fields of nonlinear optics, ultrashort pulse generation and optical communications, died on 28 July 2021 at the age of 84.

Linn's demonstration in 1980 that solitons can propagate in optical fibers without dispersing electrified the optics community. He led a team at Bell Laboratories, NJ, USA, that carried out experimental, theoretical and computational work that firmly established the nonlinear Schrödinger equation as the basic "zeroth-order" equation that describes light propagation in optical fibers.

For the remainder of his career at Bell Labs, from 1980 to 2003, he pursued his vision of turning solitons into bits in an optical-fiber communications system. While this vision was not realized in practice, his work greatly enhanced our understanding of how optical phenomena like polarization mode dispersion and the Raman effect interact with nonlinear transmission. He also explored the potential of dispersion management, wavelength-division multiplexing, Raman amplification and erbium-doped fiber amplification.

In the course of this work, Linn developed or contributed to technical advances that are still widely used in industrial and academic labs to test new ideas for long-haul optical-fiber communication systems. In particular, he made significant contributions to recirculating-loop technology, which enables a long-haul system thousands of kilometers long to be experimentally mimicked with a much smaller length of optical fiber.

Linn worked with many collaborators inside Bell Labs, as well as external collaborators, including the author. He was a superb and gracious mentor—generous with his time when explaining the intricacies of his own work. His laboratory was notoriously sparse; he kept on hand only the equipment needed to do his work.

And he was a wizard in the lab. His initial work on solitons was enabled by his work during the 1970s on color-center lasers, which were notoriously difficult to make and manage. Famously competitive, he was sometimes slow to recognize the contributions of his senior colleagues at Bell Labs. When a 1991 front-page article appeared in the *Wall Street Journal* lauding his work, he exulted in his triumph over Arno Penzias, a Nobel Prize winner and then vice president of research at Bell Labs, who had suggested that he step back from his work on solitons.

The impact of Linn's work extended far beyond optical communications. Solitons are now ubiquitous in optics. In particular, Linn recognized that they are a useful paradigm



Linn F. Mollenauer (left) and Curtis Menyuk in 1989, during a visit to the General Physics Institute in Moscow, Russia.

Courtesy of C. Menyuk

for understanding pulses in mode-locked lasers. Solitons play a central role in the generation of frequency combs, and the development of technology to "lock" these combs has revolutionized time and frequency metrology. Locking the frequency comb consists of stabilizing the laser solitons in the presence of noise-induced timing and phase jitter—both effects that Linn explored in the 1980s with his theoretical collaborator James Gordon.

Solitons now play a central role in the study of frequency combs that are generated in micro-resonators as well as other resonators. Soliton molecules, soliton crystals, dark solitons, breathers and a host of other special waveforms predicted by the nonlinear Schrödinger equation and its extensions are the subject of research by numerous experimental and theoretical groups worldwide.

After his retirement, Linn pursued his interest in the environment. He installed solar panels on his home, and proudly informed the author that he was able to return power to the electrical grid. Almost as soon as they were available, he bought an electric car and described its advantages in detail to the author.

Linn and his wife Marjorie, who pre-deceased him in December 2020, enjoyed travel and could often be seen together in far-off locales to which Linn had gone for a meeting. Linn was devoted to his family and often spoke proudly of the accomplishment of his sons, David and James. He was no respecter of hierarchies and institutions. He had the ability—rare in the scientific research community—to look past a person's rank and institution. The author benefited from that, as did others.

Curtis Menyuk

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If you would like to make a memorial donation to the Optica Foundation in Linn F. Mollenauer's honor, please visit optica.org/foundation.