

## William Bridges: A Rare Combination Of Talents

by Amnon Yariv

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illiam (Bill) Bridges, Carl F Braun Professor of Engineering, turned emeritus in July 2002,

thereby closing one chapter in a varied and productive life and career, and opening another. I ran into Bill in my second (his first) year at Berkeley in 1952. We have stayed friends and close professional colleagues to this date, so when asked to give an overview of his career, I jumped at the opportunity.

Bill was born in Inglewood, California on Thanksgiving Day, 1934. Bill lost his father at an early age. The vacuum left was filled by a grandfather and great uncle who introduced Bill to tinkering, building things—including amateur radios. Early on, he acquired that hands-on, “I can build anything” approach that would serve him so well as a scientist/engineer and as a teacher.

I still remember my first impression of Bill. I came from a background where to be good in math meant being theoretical and no good with your hands. Here was a kid who handled the tough Berkeley engineering courses with

ease, but who also could fix cars and radios. In addition, he was genuinely nice and gentle-mannered and unaware of the rare combination of his talents.

Bill graduated in 1956 with a BS in Electrical Engineering. He was among the top five in the Berkeley class of 5,000 and also the top engineering student. Now married, he chose to stay on for graduate school in Berkeley and pursue a thesis in microwave tubes (a technology still used in microwave amplifiers in communication satellites). Bill would finish his doctoral research under Professor Ned Birdsall doing pioneering work on instabilities in electron beams in a vacuum. These instabilities—spontaneous voltage and current oscillations—were thought to be the cause of much of the performance degrading noise in vacuum-tube amplifiers and oscillators. Their original work has been just rediscovered and used recently in Los Alamos and Russia for extreme high-power high-gain oscillators—one man’s instability is another man’s gain.

Bill received his PhD from Berkeley in 1962. After considering a whole slew of employment offers, Bill chose to join the Hughes Research Laboratory (HRL) in Malibu, California. HRL at the time was unique, and probably one of the most exciting research laboratories anywhere. Run essentially as a non-profit organization by Caltech, Berkeley, and Stanford PhDs, it provided a home to exceptional scientists who amazingly, by

today’s standards, were able to pursue fundamental ideas. The world’s first laser, the ruby laser, had been invented there by Theodore Maiman. Some early attempts at HRL to make He-Ne lasers (newly invented at Bell Labs) were unsuccessful and Bill was asked to help because of his background in tube and vacuum techniques. Before long, Bill found himself immersed in the new area of gas lasers, lasers in which the lasing medium is gas present in a mixture of some other gases and excited by an electric discharge.

Bill’s biggest claim to his very considerable fame occurred at this juncture. While trying systematically to understand the lasing of Hg, Bill tried mixtures of He-Hg, Ar-Hg, and other noble gases. In these experiments he observed a new and intense blue laser emission. After a process of substitution and elimination and very careful spectroscopy, which Bill learned on the fly, he was able to trace the lasing to the argon ion  $Ar^+$ . This would lead to the discovery of lasing in krypton and xenon as well, and to a new class of lasers, the noble gas lasers. It is difficult to work in any physics or chemistry laboratory in the world today without bumping into Bill’s “Argon Laser.” The invention of this laser was made possible by the unique blend of talents that Bill possesses: the insistence on understanding at the most basic level why something works, the hands-on ability to make things work, and the keen intellect to combine the two.

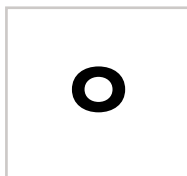
The following few years saw Bill become an internal “guru” at HRL; he was often asked to work on their most advanced and venturesome programs. These included gas-dynamic lasers, adaptive optics, and atomic-clock gas masers. But he was also being drawn more and more into management and away from the laboratory.

A Caltech Sherman Fairchild Scholarship during 1974–1975 provided relief from his management role. Bill spent most of the year teaching an optics lab that served to remind him how much he enjoyed teaching and interacting with students. It also convinced a group of us in Applied Physics and Electrical Engineering that Bill would make a splendid addition to the faculty. An offer was made and accepted and by 1977 Bill had joined Caltech.

One of his first projects was to set up and teach a demonstration class in optics, for which he built much of the equipment himself. His reputation as a teacher with a hands-on approach from his Fairchild Scholarship sojourn caused 70 students to register for the class—nearly a third of that year’s sophomore class. Bill’s hopes of secluding himself in the laboratory, however, did not quite materialize (which was partly his fault). He recognized very early that Caltech’s electrical engineering students could be better served. The lack of an official EE major in the curriculum with a set of required courses left students confused, and often resulted in students graduating without such basic EE courses as electromagnetic theory. Bill’s crusade to institute an EE major with well-prescribed requisite courses was highly successful, but it

also resulted in his becoming, a year after his arrival here, the executive officer for EE. Soon after his arrival, Bill’s inability to say no to worthwhile causes also landed him on the EE Search Committee, and subsequently on the Patent, Health, Freshman Admissions, and Undergraduate Academic Standards and Honors committees. He also became involved with the Society for Women Engineers as well as the Amateur Radio Club.

In a short span of three years Bill had become one of the most involved and effective faculty members, whose contributions extended well beyond his research program, as well as one of the most sought-after teachers.




On the research side, Bill switched gears at Caltech and started looking into extreme high-speed electrooptic modulators. These are optical waveguides “written” through selective doping through masks into electrooptic crystals such as  $\text{LiNbO}_3$ . When high-speed digital voltage pulses are applied to such waveguides they can switch light on and off. The work of Bill and his students helped turn this modulation scheme to the dominant method of launching bits into optical-fiber systems.

The involvement with  $\text{LiNbO}_3$  bore some unexpected, and to Bill, sweet fruit. Bill had been serving since 1986 on the board of a small company, Uniphase, which made small, mundane lasers. When the CEO started looking at new targets of opportunity, Bill encouraged the purchase of the  $\text{LiNbO}_3$  optical-modulator business of United Technologies. In a matter of a few

years, these modulators became one of the key devices in the quickly expanding technology of high-speed optical-fiber communication. In an amazing but separate story, Uniphase (now JDS Uniphase) became the world’s leading manufacturer of optical communication devices. Bill, who was paid “most in stock,” became “comfortable,” and was able with his wife, Linda to build their dream home in the woods near Nevada City in northern California.

Bill’s talents and achievements have, of course, been noted by the world at large. Besides garnering most of the major awards in the optics and laser fields, Bill is among a very small number of people who are elected members of both the National Academy of Science and the National Academy of Engineering. He also squeezed in a presidency of the Optical Society of America.

What is Bill going to do now? Once the house up north is finished, he plans on dividing his time between Pasadena and the woods, traveling more, and finally, getting back into the laboratory. I personally was relieved to hear that a good fraction of his time will still be spent at Caltech. The school cannot afford to lose his splendid counsel and input. 

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To learn more about Bill Bridges, visit <http://www.ee2.caltech.edu/People/Faculty/bridges.html>