Profile of Henry Kapteyn

Paul Gabrielsen, *Science Writer*

In 1989, Henry Kapteyn was completing his doctorate on short-wavelength lasers. "I remember looking out in the future," he says, "and thinking: When would all of this technology become useful as a laboratory laser used for discovery in science and technology? I thought it was going to take about 25 years." His estimate was not far off. Over the past quarter-century, Kapteyn, a professor of physics at the University of Colorado, Boulder, and member of the National Academy of Sciences, has continued to push the limits of lasers to the smallest fractions of time and into the X-ray region of the spectrum.

Role Models of Inquiry

Kapteyn was born in the suburbs of Chicago in 1963, the second of three children, to parents who emigrated from The Netherlands after World War II. His father, a machinist with an engineer's mindset, fueled Kapteyn's curiosity. "I remember him quizzing me on things when I was a kid, like 'why do you think this is this way?'" Kapteyn says. "That meshed with my mom, who was fiercely dedicated to making sure her kids got the best possible education." When he was four

years old, Kapteyn's mother enrolled him in a Saturday morning science course. He remembers climbing up on a stool while wearing laboratory goggles to ignite Bunsen burners.

Kapteyn's older brother was also interested in science, and asked their parents for an Altair 8800 kit, one of the first personal computers. Kapteyn and his brother, now a computer programmer, assembled and programmed the early machine. Kapteyn followed his brother to Harvey Mudd College in Claremont, California, where they both studied physics.

In a discussion with his undergraduate advisor, John Townsend, Kapteyn expressed an interest in studying a combination of fundamental and applied physics, something "exciting," but also useful. "I remember the conversation went around to scientists trying to make lasers at X-ray wavelengths," Kapteyn says. "That stuck in my head."

Kapteyn moved to Princeton University in 1982 for his graduate studies, but transferred to the University of California, Berkeley after earning his Master's degree in 1984. He had worked in the summers for the Cyclotron Corporation in Berkeley, performing design simulations for particle accelerators. The summer trips convinced him that he would be happier in California than on the East Coast. Berkeley felt like home. "I knew the place," he says.

Berkeley

In his first semester, Kapteyn met fellow doctoral student Margaret Murnane in a lasers class and then worked closely with her in the laboratory under physics professor Roger Falcone. "I found her very interesting and found out that she found me interesting," Kapteyn says. "Margaret likes to joke that we were the first two students of an assistant professor who needed to get tenure; therefore, we had no time to meet anyone else! But that wasn't the case—we hit it off immediately while we were both still finding our feet in the lab." The duo married in 1988, and Kapteyn received his doctorate the next year.

Kapteyn's dissertation work (1) made use of a 1970s-era laser-fusion test facility at Lawrence Livermore National Laboratory. Using this laser to create a plasma, he succeeded in generating laser pulses in the vacuum-ultraviolet region of the spectrum using

Henry Kapteyn with his wife Margaret Murnane at the south rim of the Grand Canyon in 2012. Image courtesy of Henry Kapteyn.

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being heated by a femtosecond laser pulse. In heat transfer, heat is represented by phonons, packets of vibrational energy. At the macroscale, the particle nature of heat can be ignored. At nanoscales, however, the physics of heat transfer become constrained by the length of the phonon path. Because of this quantum constraint, small structures cool more slowly than might otherwise be predicted (13). The study showed that closely packed ridges on a nanostructure cool more quickly than ridges spaced far apart, a result counter to observations on the macroscale. The article is an example of the scientific possibilities opened by new instrumentation. "We developed this new laser source, and its capabilities let us make an unexpected discovery," Kapteyn says.

Kapteyn and Murnane now sell ultrafast lasers and the equipment to construct a tabletop X-ray laser. Their company, KMLabs, was born during their Washington State days, when they started distributing kits to make it easier for people to build their solid-state femtosecond laser design. Industry investments, from Intel Capital and others, recognize the laser's potential to characterize nanoscale defects in microelectronics.

Having achieved his goal, Kapteyn is now focusing more on making this X-ray laser a broadly used tool for science and industry.

"I'm very far from retired," he says, "but I'm at a point where I'm just as happy, maybe even happier, to see other people make good use of this technology to do great science and to make a difference in society as a whole."

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