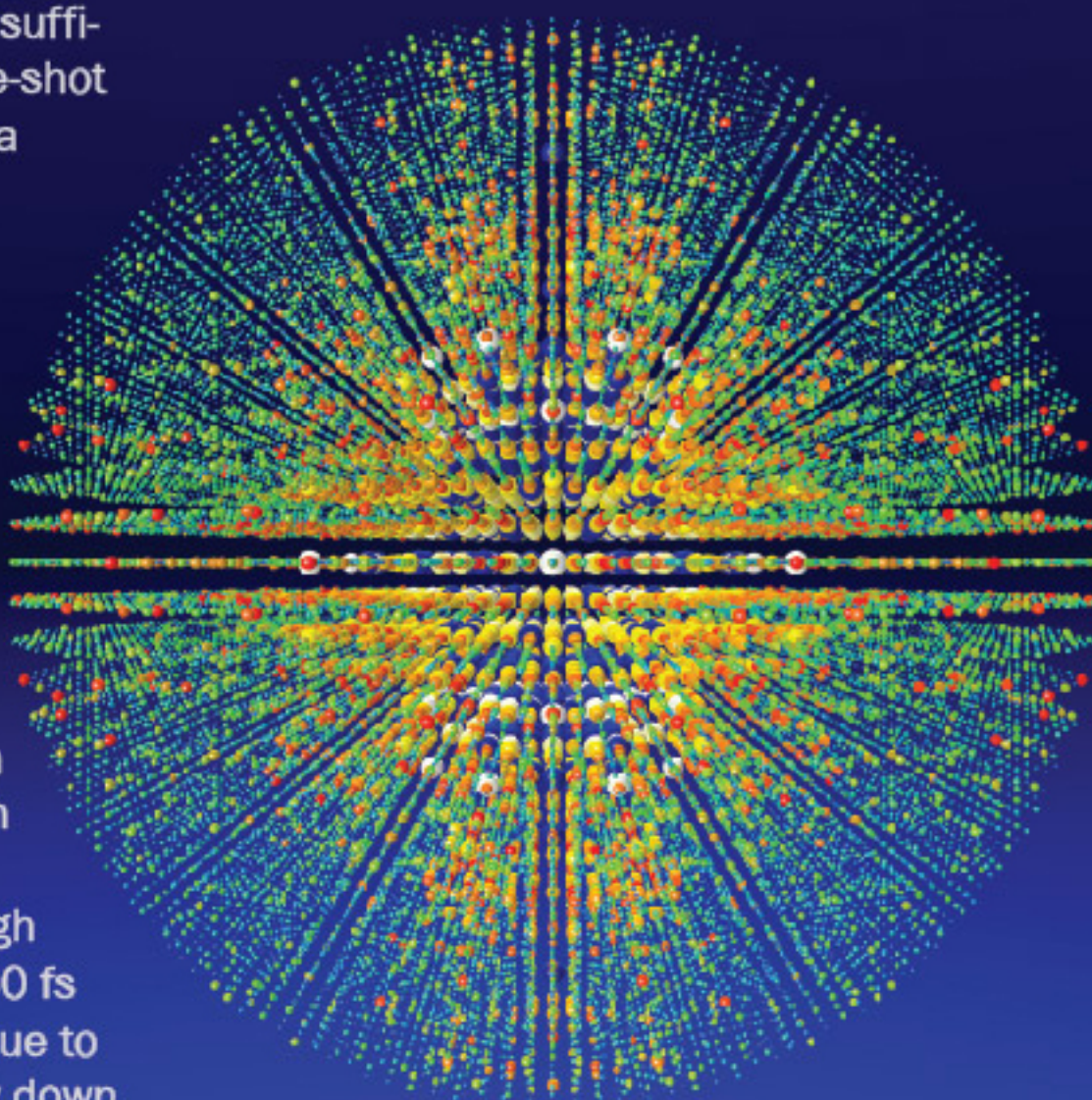


# Henry Chapman

## “Imaging Molecules and Viruses with X-ray Laser Pulses”

The ultrafast pulses from x-ray free-electron lasers (FELs) are of high enough intensity and of sufficiently short duration that individual single-shot diffraction patterns can be obtained from a sample before significant damage occurs at the atomic scale. This “diffraction before destruction” method has been applied to determine the molecular structures of proteins that cannot be grown into large enough crystals or are too radiation sensitive for conventional x-ray crystallography. Using the Linac Coherent Light Source, the world’s first hard x-ray FEL, millions of diffraction patterns were recorded from a flowing stream of protein nanocrystals of the photosystem I complex and other proteins. Measurements show that sample destruction at high resolution can be avoided with pulses of 30 fs or shorter. The aim is to push this technique to smaller and smaller samples — all the way down to the single molecule.



**Henry Chapman** is a founding director of the Center for Free-Electron Laser Science (CFEL) at DESY and the University of Hamburg. His research interests include x-ray optics, lithography, microscopy, and coherent imaging. He led pioneering experiments for high-resolution imaging of objects with intense x-ray free-electron laser (FEL) pulses, demonstrating the principle of “diffraction before destruction,” first at the FLASH FEL at DESY and then at the Linac Coherent Light Source at SLAC. He proposed that the details of the interaction of FEL pulses with biological materials could be best measured with nanocrystalline materials. These led to structure determination of proteins at radiation doses hundreds of times higher than tolerable with synchrotron sources. He was a senior scientist at Lawrence Livermore National Laboratory prior to his appointment in Hamburg. He was awarded the Bragg Medal by the Australian Institute of Physics for his Ph.D. work performed at the University of Melbourne, the Teller Fellowship, and the Bjørn Wiik Prize. He is a fellow of the Optical Society of America. He has authored over 100 papers and holds 13 patents.

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