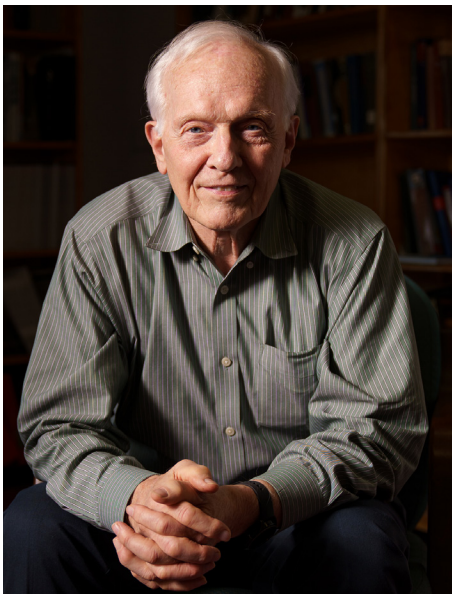
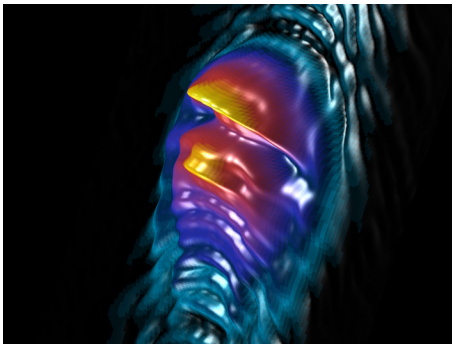
PURDUE PHYSICS AND ASTRONOMY HUBERT JAMES LECTURE SERIES

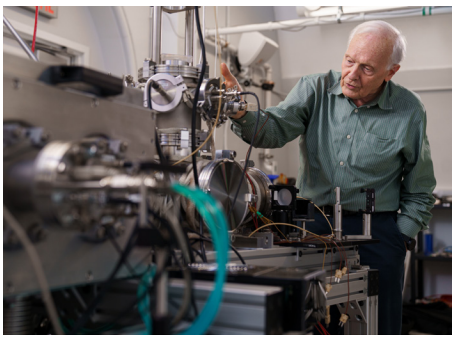
HOSTS

PAUL CORKUM: ATTOSECOND SCIENCE

THURSDAY, MARCH 28, 2024 | PHYS 112 | 3:30 P.M.







PAUL CORKUM: University of Ottawa & National Research Council Canada

Lasers are nearly 65 years old and during the past 65 years we have learned how to control light waves with exquisite precision. First, think of a light wave as a wave of force on a charged particle such as an electron, a bit like a water wave is a wave of force on a floating boat. With lasers we can make that force so short that it lasts only one period of the wave and points in any direction that we wish.

When an intense light wave is applied to electrons in an atom, we set up a "tug of war" between the laser and the ion that was previously holding the electron. We can always make the laser beam a bit stronger, so the laser always wins. Thus, with light we can detach an electron from an atom (molecule or solid) and from then on, the light wave dictates its subsequent motion. There is a chance that the electron will return to the ion and recombine, releasing its energy as a high-energy photon. This photon, and many similar photons, can form an attosecond soft-X-ray pulse – the shortest event that humans can control. The world record is 45x10-18 seconds or 45 attoseconds.

We can use the 45 attosecond light pulse to probe matter, but we can also use the recollision electron that led to the attosecond pulse, because we only see the underlying attosecond electron when we look at the electron through the pulse. In my opinion, the most dramatic measurement ever made with attosecond pulses is to take an image of a molecular orbital with the recollision electron.

You might think that an orbital is just a figment of imagination, and many chemists will agree. No electron, they will say, ever occupies an orbital. Rather, electrons exchange positions at any time, but the orbital we measure is the orbital from which the electron departed. This tends to be the HOMO orbital on which much of chemistry relies.

HOST: PROFESSOR DAVID KOLTICK

The Hubert M. James Lecture Series brings distinguished physicists to Purdue University to highlight fundamental aspects of physics for a broad university audience. The Department of Physics and Astronomy established the Hubert James Lecture in 1990 thanks to the generosity of the James family and in recognition of Prof. James's outstanding service to Purdue University from 1936 to 1974.

Hubert James Lecture Committee:

Chris Greene, David Nolte, Martin Kruczenski, Norbert Neumeister, Yong Chen, David Koltick

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