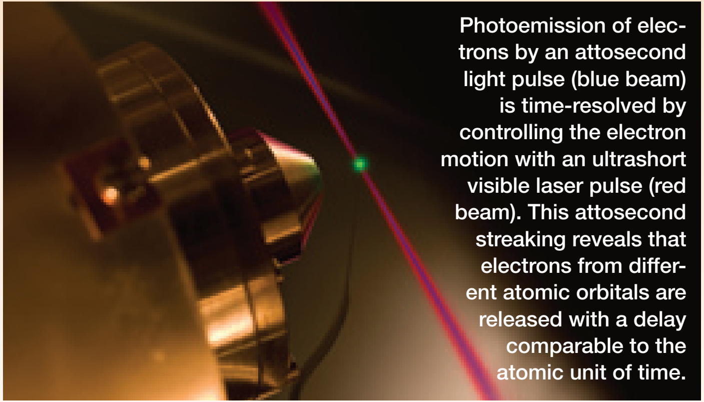
A Fleeting Look at the Details of Photoemission

Physicists have known about the photoelectric effect for well over a century, but some of the details have remained shrouded in mystery. For instance, after an atom has absorbed a single photon, how long does it take for it to emit an electron? And does that tiny lag time depend on which orbital expels the electron?

Thanks to cutting-edge ultrafast lasers, an international research team has measured this tiny time period in neon atoms (Science **328**, 1658). Along with their colleagues, Martin Schultze and Vladislav Yakovlev at the Max Planck Institute for Quantum Optics in Garching, Germany, found that an electron leaves the 2*p* subshell 21 ± 5 attoseconds (as) later than an electron kicked out of the 2*s* level. That's an astonishingly small differential, but the work still quantifies a process long assumed to be instantaneous.



Photoemission of electrons by an attosecond light pulse (blue beam) is time-resolved by controlling the electron motion with an ultrashort visible laser pulse (red beam). This attosecond streaking reveals that electrons from different atomic orbitals are released with a delay comparable to the atomic unit of time.

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The researchers chose neon because it is more complex than helium but simpler to model theoretically than the other noble gases, Yakovlev said. Neon also has a relatively high photoionization cross-section, which improved the signal-to-noise ratio of the experiments.

The neon gas was bombarded by sub-100-as pulses of extreme ultraviolet light