Plenary Talk PV XI Fri 9:45 Paulussaal

Listening to, and learning from, ultrafast few-body quantum dynamics in intense laser fields — •Thomas Pfeifer — Max-Planck-Institut für Kernphysik

Interactions of electrons govern everything we touch and see around us. While manifesting on human timescales (> milliseconds (10^{-3} s)), the electronic timescale within atoms ticks in attoseconds (10^{-18} s). Their fast "heartbeat" makes these lightest charged fundamental particles respond quickly even to the electric fields of light, with their optical-cycle periods of femtoseconds (10^{-15} s). Coulomb forces bind electrons to nuclei in atoms, i.e. Angstrom-sized electron traps with internal quantum states observed by resonant driving with light, also giving objects their color. *But what happens when the light becomes so intense that electrons are pushed far outside their "comfort zone"?*

This question fascinates physicists since the invention of the laser. Its constant evolution now allows concentrating light in spacetime to (by far) exceed the Coulomb binding forces. Control over the coherent fields of light renders the steering of electrons in matter a reality—requiring "only" our understanding of *intense-light*–matter interaction on a fundamental level, involving the motion of at least two coupled electrons (the quantum few-body problem).

This talk will explain our ongoing quest of ultrafast quantum control of two or more bound electrons, show examples of what has been understood already, and shine light into the widely open future, where e.g. laser-programmed atoms may one day perform (quantum-)computational tasks at Terahertz (or faster) clock speeds.