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Attosecond Physics: Time-dependent electronic dynamics in atoms, molecules, and solids[1]

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With the advent of sub-femtosecond ultrashort XUV pulses and of phase-stabilized IR pulses with sub-cycle time resolution, novel pathways have been opened up for studying time-resolved electronic quantum dynamics on the attosecond scale. These experiments pose challenges for theory: How do short pulses interact with matter? Which novel information can be extracted from time-resolved spectroscopies that cannot be gained from precision experiments in the spectral domain? In this talk, these issues will be addressed with the help of a few examples. Attosecond streaking allows a direct look at electronic correlations and rearrangement processes. Photoemissions from solid surfaces reveal an attosecond time delay between conduction electrons and core electrons and provide time-resolved information on electron transport, plasmon excitation, and dissipation. Attosecond pulses allow not only to probe but also to control and manipulate electronic dynamics which we will illustrate for two-electron emission from atoms and molecular break-up.

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