Sculpting electronic quantum trajectories with light

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The carrier wave of light can drive electrons through solids on time scales faster than a cycle of light. This ‘lightwave electronics’ concept opens a fascinating coherent quantum world full of promise for future quantum technologies. We will discuss prominent examples of lightwave-driven dynamics in solid-state quantum materials, ranging from Bloch oscillations via topologically non-trivial electron trajectories to optical band-structure engineering and attoclocking of Bloch electrons. We also take slow-motion movies of single molecules and atomic defects and observe the quantum flow of electrons with the first all-optical subcycle microscope reaching atomic resolution. Our results offer a radically new way of watching and controlling elementary dynamics in nature or steer chemical reactions, on their intrinsic spatio-temporal scales.