

Can lasers allow us to see electrons?

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The wavelength of visible light is often assumed to impose fundamental limitations in optical microscopies and time-resolved spectroscopies of matter. In optical microscopies, it limits the spatial resolution to the nanometer scale while in time-resolved techniques it is often assumed to constrain the temporal resolution to the range of femtoseconds. In these lectures, we will discuss how recent developments in modern photonic science allow us to push both these essential frontiers.

We will study how the precision measurement and control of light fields allow us to break into the attosecond domain and to track the dynamics of electrons in real-time. We will also introduce ideas as to how the laser can enable the imaging of valence electrons in solids with picometer resolution. These capabilities bring us a few steps closer to the complete spatiotemporal visualization of the microcosm on the atomic level.