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Electronic matter wave rescattering at a nanoscale metal tip on attosecond time scales

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When femtosecond laser pulses are focused on nanometric metal tips, electrons are emitted. For few-cycle laser pulses, the liberated electronic matter wave can be driven back towards to parent tip when the laser field flips sign. At the tip's surface it can scatter elastically, gain more energy in the laser field, and travel towards the detector. We have observed this process, which is the basis of attosecond science and well known from atoms and molecules in the gas phase – for the first time from a solid-state, nanoscale metal tip. We show electronic matter wave interference in the time-energy domain, and first steps towards a new attosecond low-energy electron diffraction surface imaging technique.

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