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Stark control of electrons along nanojunctions

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In a recent experiment, Schiffrin et al. [Nature 493, 70 (2013)] demonstrated how a strong (I~10^13-10^14 W/cm^2) non-resonant 4 fs laser pulse can be used to induce currents along gold-silica-gold nanojunctions. Phenomenologically, these currents arise due to the nonlinear interaction of the junction with a laser pulse that has a low temporal symmetry. By varying the carrier envelope phase it is possible to vary the degree of time asymmetry of the incident radiation, and thus the direction and magnitude of the photoinduced current. The experiment marks a new frontier in the experimental laser control of electronic dynamics and is the fastest existing method for the generation of currents. However, since the photo-generated current depends on a highly non-equilibrium state of matter that has never been observed before, the microscopic origin of this rather spectacular effect is unclear and the subject of recent controversy. In this talk, I will discuss the feasibility of different possible mechanisms that have been proposed, and discuss simulations of the laser-induced transport along gold-silica-gold nanojunctions that clarify the microscopic origin of the effect.

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