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Title: Bi-directional ultrafast electric-field gating of interlayer charge transport in a cuprate superconductor
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Abstract: In cuprate superconductors, tunnelling between planes makes three-dimensional superconductive transport possible. However, the interlayer tunnelling amplitude is reduced when an order-parameter-phase gradient between planes is established. As such, interlayer superconductivity along the c-axis can be weakened if a strong electric field is applied along the c-axis. In this Letter, we use high-field single-cycle terahertz pulses to gate interlayer coupling in La(1.84)Sr(0.16)CuO(4). We induce ultrafast oscillations between superconducting and resistive states and switch the plasmon response on and off, without reducing the density of Cooper pairs. In-plane superconductivity remains unperturbed, revealing a non-equilibrium state in which the dimensionality of the superconductivity is time-dependent. The gating frequency is determined by the electric field strength. Non-dissipative, bi-directional gating of superconductivity is of interest for device applications in ultrafast nanoelectronics and represents an example of how nonlinear terahertz physics can benefit nanoplasmonics and active metamaterials.