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Light-field driven electron dynamics in graphene CHRISTIAN HEIDE, TOBIAS BOOLAKEE, HEIKO B. WEBER, PETER HOMMELHOFF, Department of Physics, Friedrich Alexander University ErlangenNuremberg (FAU) — Graphene is a unique material for lightfield-controlled electron dynamics inside of a (semi-) metal. Its Dirac cone dispersion relation represents a two-level system to study intricately coupled intraband motion and interband (Landau-Zener) transitions driven by the optical field of phase-controlled few-cycle laser pulses [1, 2, 3, 4]. Based on the coupled nature of the intraband and interband processes, we observe repeated coherent Landau-Zener transitions between valence and conduction band separated by around half an optical period of $\sim$1.3 fs, fully supported by numerical simulations. Because of the extremely fast dynamics, fully coherent Landau-Zener-Stckelberg (LZS) interferometry manifests itself in ultrafast current injection, with a record-fast turn-on timescale of 1 fs for a current in a metal. Moreover, we could show complex electron trajectory control by tailoring the polarization state of the driving laser pulses. This way, we can manipulate LZS interference [3].

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