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Pulse-shape control of transient electronic characteristics of the filament wake channel in a dense gas[1] DMITRI ROMANOV, SUYASH BAJPAI, ROBERT LEVIS, Temple University — Ionization and excitation of a dense gas medium during the filamenting ultrashort laser pulse determines the evolution of the electronic degrees of freedom in the filament wake channel and sets up the transient transformations of linear and nonlinear optical characteristics of the channel. During the pulse, the strong-field ionization of constituent atoms/molecules competes with impact ionization and collisional excitation by energetic free electrons, which are driven by the oscillating laser field and gain considerable energy via inverse Bremsstrahlung process while scattering on neighboring neutral atoms. This complex interplay determines the transverse profiles of the densities of ions and excited atoms, as well as of the electron density and temperature at the end of the pulse. Using a kinetic model of these processes, we explore sensitivity of the composition of thus formed inhomogeneous and highly nonequilibrium plasma to the envelope shape of the driving laser pulse. By considering a family of pulses that differ from one another by the asymmetry of their envelope functions but are normalized by the same cumulative strong-field ionization output, we show that asymmetric pulse envelopes skewed toward the earlier time result in considerably higher ratio of excited atoms to ionized atoms. Medium-specific estimates are made for high-pressure argon gas; they agree well with the results of recent experiments.

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