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Measuring charge and weakly-ionized plasma densities over 12 orders of magnitude[1] DANIEL WOODBURY, ROBERT SCHWARTZ, ELA ROCKAFELLOW, HOWARD MILCHBERG, University of Maryland, College Park — Electron avalanche ionization driven by picosecond mid-IR lasers is a sensitive measure of the presence of individual charges in air and other gases, driving an exponential electron growth from a single electron seed analogous to the detection of single photons in a photomultiplier tube. A mid-IR drive wavelength reduces multiphoton ionization observed with shorter wavelength drivers, a process which generates excess charges and masks the signal from pre-existing, low charge densities. Imaging the location of plasma breakdowns—which for a picosecond pump are spatially limited around the original seed electron—permits the determination of extremely low charge densities in air. For higher electron and weakly-ionized plasma densities, the avalanche plasma generated from each seed overlap, but seed density can still be determined by measuring the temporal evolution of the breakdown. We present measurements of laser produced charge and plasma densities over 12 orders of magnitude (from 10^4 to $10^{16}\,\mathrm{cm}^{-3}$) measured using mid-IR driven avalanche breakdown.

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