Abstract Submitted
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Two RF measurement techniques with microsecond resolution of laser induced atmospheric-pressure helium plasmas FELIX SMITS, VINCENT KOOIJ, DAAN VAN SETERS, TIM KORTEKAAS, HARRY VISSER, HARMEN VAN DER MEER, MARTIN VAN EXTER, DIRK BOUWMEESTER[1], Leiden University — Plasmas are produced in atmospheric-pressure helium by a focused 300 mJ infrared laser pulse and evolve on microsecond time scales from a 3 mm elongated shape to a torus which grows to 10 mm diameter. The plasma is visible on a ICCD camera with exponentially decaying luminosity for up to 70 microseconds. The challenge is to measure its electron density at high time resolution over several decades. Two RF techniques are used to measure the complex permittivity. Complex permittivity measurements allow to determine both the electron density and the electron-neutrals collision frequency using the Drude model. At 57 GHz, the complex transmission coefficient of the plasma placed between a transmit and receive antenna is measured at microsecond time scale. Full wave transmission simulations with a dielectric torus are performed. The simulation results are matched to the plasma measurements by varying the complex permittivity. This yields the complex plasma permittivity as a function of time. Around 2.45 GHz, cavity perturbation measurements on the plasma in an iris coupled rectangular cavity are performed. Combining a series of single frequency reflection measurements allows to determine the complex plasma permittivity over a multidecade range at microsecond time resolution.

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