Laser-generated toroidal helium plasmas

Kooij, V.L.

Author: Kooij, V.L.
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Photographs of selected experimental set-ups

To give a more vivid impression of the research presented in this dissertation, we present photographs of selected experimental set-ups used for this research. References are given to the research in this dissertation to which these photos relate.

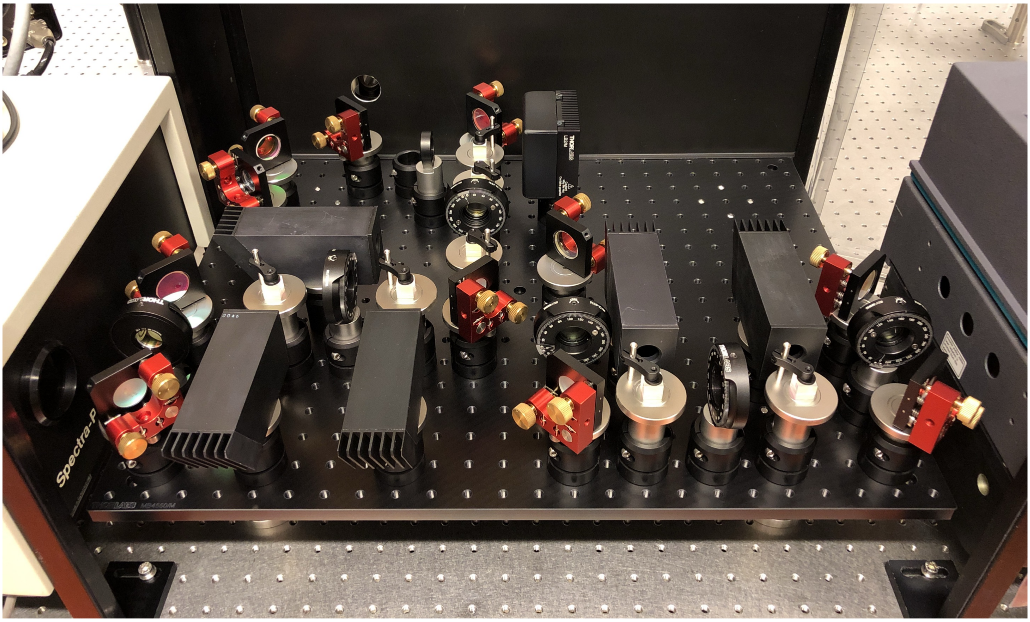

Photo 1: The pulsed high power optical set-up used to generated the transient toroidal helium plasmas studied in this work. On the left, the Quanta-Ray GCR-3 Q-switched Nd:YAG laser is visible, capable of generating high power 10 ns laser pulses with a wavelength of 1064 nm and with energies up to 275 mJ. On the right, the Continuum NY61-10 laser is visible, similarly capable of generating laser pulses with energies up to 300 mJ. At the top of the photo, a circular aperture is visible in the black aluminium plate, through which the high power laser pulses are guided on their way into the plasma reactor. The dimensions of the breadboard on which the optical set-up has been build is 600 x 450 mm in size. This photo is referenced on page 15 and in figure 2.2.

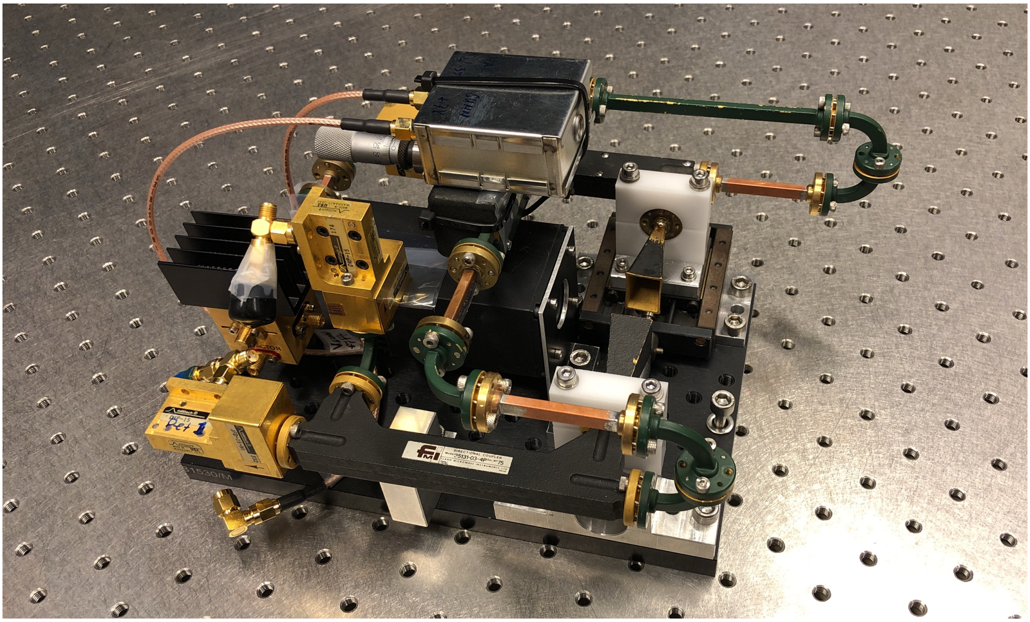

Photo 2: The sub-microsecond temporal resolution, microwave interferometric set-up, used to measure the complex transmission coefficient of 57 GHz microwave radiation traversing a transient toroidal helium plasma. The dimensions of the breadboard on which the interferometer has been build is approximately 230 x 150 mm in size. The copper pyramidal horn antennas, between which the toroidal plasma will be generated, are visible to the right of the breadboard. The central component of the interferometer is the black four-port 90° 3 dB directional coupler visible at the bottom of the breadboard. The microwave radiation is guided through rectangular TE10 mode wave-guide with dimensions of 3.76 x 1.88 mm. During measurements, the whole interferometric set-up will be mounted inside the plasma reactor. This photo is referenced on page 69 and in figure 4.2.

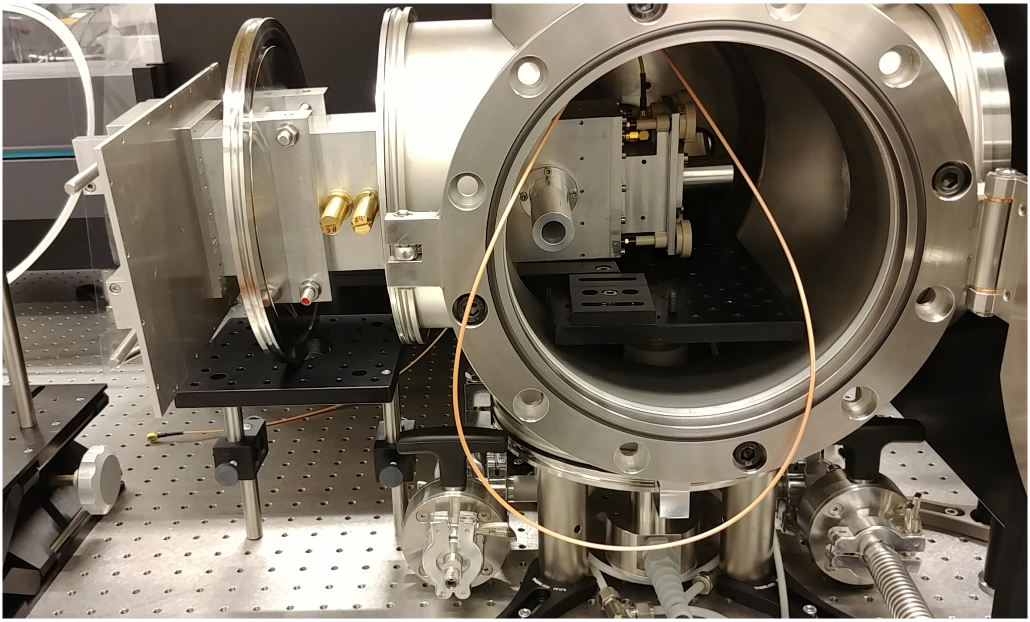

Photo 3: The tailor-made 2.465 GHz iris coupled TE101 mode $\lambda_g/2$ rectangular microwave cavity during integration into the plasma reactor. The microwave cavity will be positioned in such a way that the anti-node of the electric field of the TE101 mode coincides with the focal point of the lens creating the laser-induced breakdown plasmas from which the toroidal plasmas emerge. The brass stubs just visible to the left of the plasma reactor form the tailor-made three stub tuner. The aluminium beyond cut-off view ports used to let the laser pulses safely enter and exit the microwave cavity, and to image the toroidal plasma from the side, are visible on that part of the microwave cavity, that is already inside the plasma reactor. The microwave cavity goes straight through the left flange of the plasma reactor, and is vacuum sealed to ensure that experiments can be performed in a helium atmosphere. The guide wavelength for the rectangular wave-guide with internal dimensions of 90 x 40 mm is approximately 165 mm. This photo is referenced on page 88 and in figure 5.2.

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