INVESTIGATION OF ELECTRON NUMBER DENSITY AND ELECTRON TEMPERATURE IN PLASMA FLOW

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In this project two plasma diagnostic methods are compared to determine the electron temperature and electron number density. These two parameters are important for the characterization of the plasma. The electron temperature indicates the thermal equilibrium in the plasma flow and the electron number density indicates the degree of ionization. These two parameters are interesting to measure for experiments with high enthalpy gases and for magneto-hydrodynamics applications. The measurement was conducted in an Induction Coupled Plasma (ICP) wind tunnel facility in the Von Karman Institute (VKI). The first diagnostic method is the electrostatic "Langmuir" probe measurement. Although this intrusive measurement technique was developed by I. Langmuir in the first half of 20th century, this traditional method still is a subject of active investigation. The second method is emission spectroscopy, a classical non-intrusive plasma diagnostic technique. The emission spectroscopy measurement was carried out at VKI in the Plasmatron facility.

A first step was to improve the present setup and check the reliability for measurement with an electrostatic probe. A second step was to perform simultaneously an electrostatic measurement together with an emission spectroscopy measurement for air in the Minitorch facility.

Both measurements were performed with mismatching results. The measurement with the electrostatic probe was affected by electromagnetic phenomena in the vicinity of the plasma and power supply and by thermal phenomena such as thermal properties of the ceramic and the ablation of the probe. The emission spectroscopy measurement was not possible to process due to the low enthalpy of the plasma in the Minitorch.

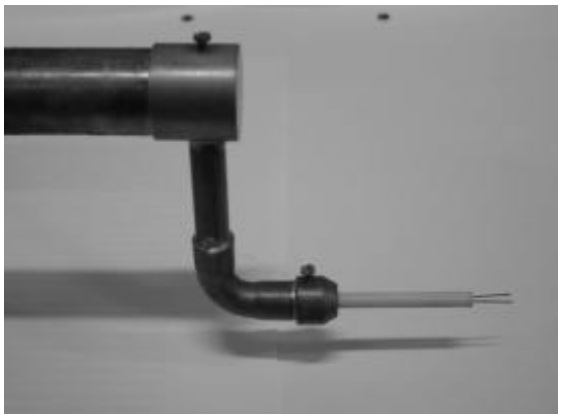

Figure 1: The double electrostatic probe

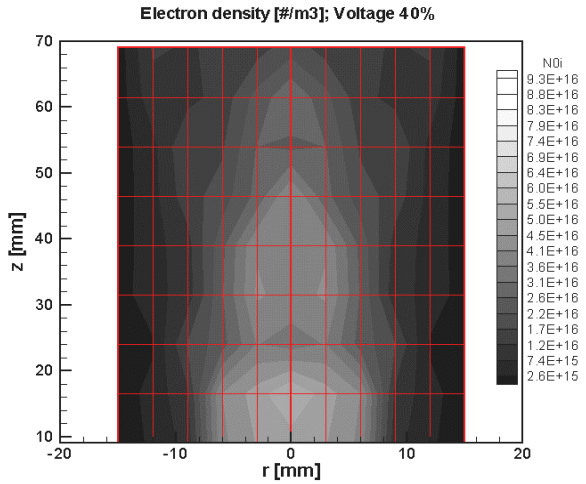

Figure 2: The electron number density space resolution of the plasma jet in the VKI Minitorch facility