SIMULATION OF RADIATIVE EFFECTS IN PLASMA FLOWS

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In high enthalpy flows there can be significant heat transfer caused by radiation of the flow medium itself. Examples for such conditions are re-entry aerothermodynamics, flows in high enthalpy ground-test facilities or combustion processes. For ground testing, the analysis of this radiation is also a useful tool for flow field diagnostics. However, the computation of radiative heat transfer, as well as the correct interpretation of results of spectroscopic measurements, requires an accurate modeling of radiative transfer and of absorption and emission properties in the flowfield.

A computer code has been developed to calculate the radiative transfer in axi-symmetric domains of arbitrary shape An effective spectral integration procedure was developed to compute the total radiative heat flux from spectra obtained with line by line transfer computations.

To test the numerical model, the radiative heat flux was computed for argon plasmas for representative conditions of the VKI Minitorch, which is an inductively coupled plasma wind tunnel. The relative importance of radiative energy transport was assessed. Further numerical results of single line of sight computations were compared to spectroscopic measurements in the range of 7500 to 9500 Angstroms.

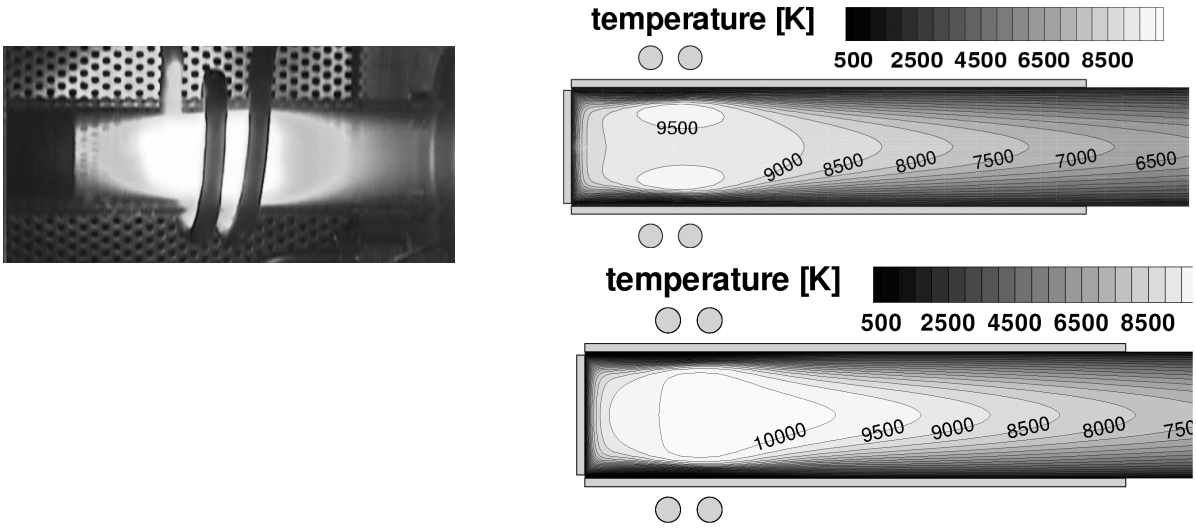

Figure 1: Plasma jet in the VKI Minitorch tunnel and temperature distribution obtained by numerical simulation with radiation coupling (top) and without (bottom)