DEVELOPMENT OF A METHOD FOR THE SIMULATION OF STAGNATION POINT HEAT TRANSFER WITH DUST COLLISION IN CO_2

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In response to the concerns of heat-shield erosion in upcoming Martian entry missions, a method of simultaneously simulating entry condition heat flux and atmospheric dust collision has been developed using the VKI minitorch plasma facility. The method of choice for simulating particle erosion is by the acceleration of a particle-gas mixture through a convergent-divergent nozzle into the center of the plasma discharge region. These particles pass into the plasma jet and impinge on a sample of heat shield material.

This jet was seen to radically alter the performance of the minitorch and the primary achievement of the project was the verification of the operability of this "new" facility. Steady operation of the facility was achieved under a relatively wide range of operating conditions in both air and CO_2 without particles in the carrier jet. CO_2 is the most relevant case as it is the main constituent of the Mars atmosphere (> 95%). The effects of the mass flow through the jet, the test chamber static pressure, and the anode power on the dynamic pressure and heat flux were examined closely. The measurement tools included a cooled Pitot probe with a 0.8 mm measurement orifice and a calorimeter heat-flux probe with an 8 mm sensing element. Finally, particles were included in the carrier gas with some degree of success. Tests indicated that the particle generator chosen is not well adapted to this setup and most likely needs redesigning. However, from the data obtained a notable increase (about 10%) in heat flux occurred as a result of the presence of particles but the trends previously observed remained unchanged.

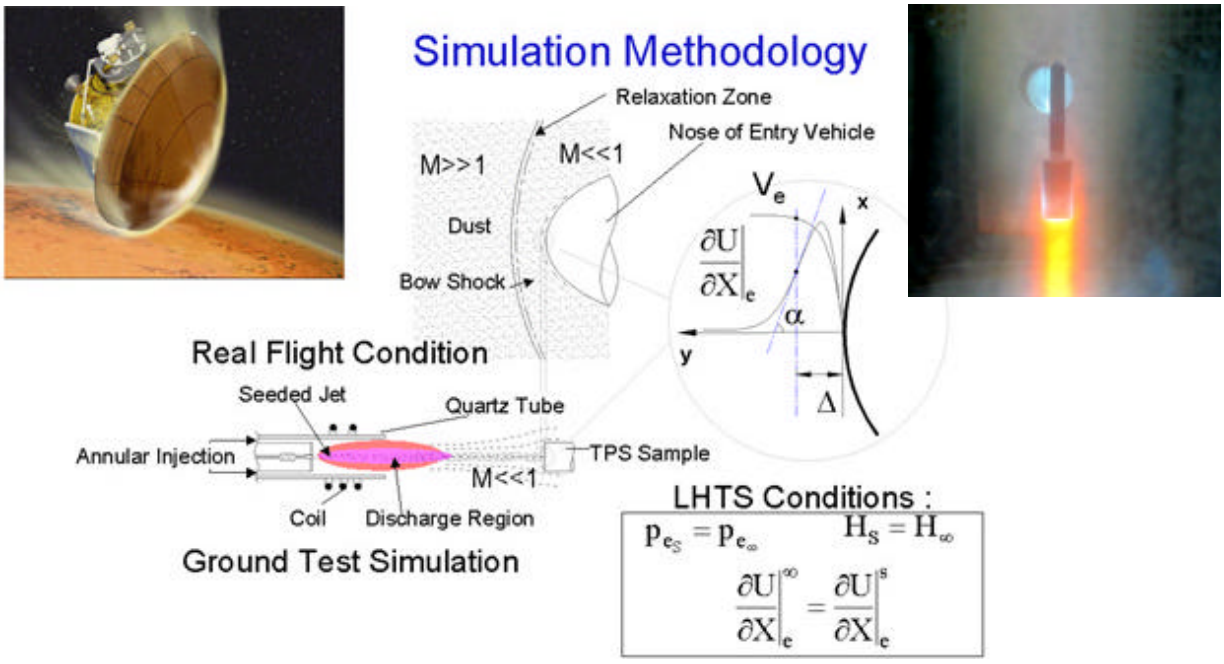

Figure 1: Methodology of ground test facility and photograph of particles impinging on heat flux probe (far right)