Technische Universität Braunschweig

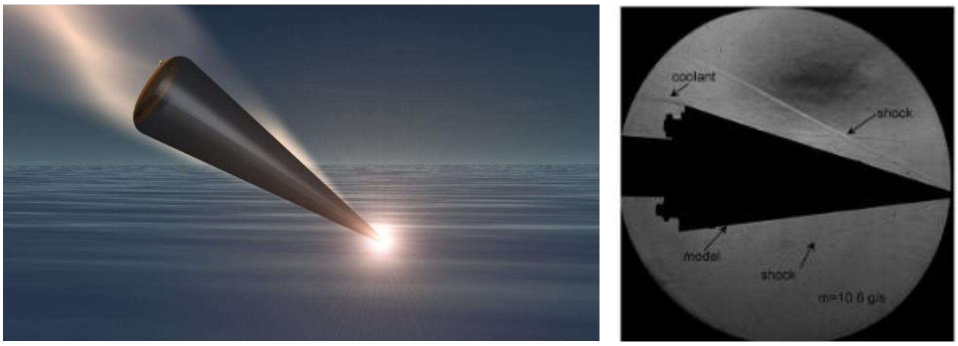
Institut für Strömungsmechanik

Call for candidates for a Master's Thesis or Studentarbeit in:

Nanoparticle Injection: An Alternative Active Cooling Technique for Hypersonic Flows

During re-entry, space shuttles encounter a scorching amount of heat, thereby necessitating a high amount of heat shielding. In order to reduce the heat shield's mass, active or passive cooling systems must be employed, which can result in the efficient utilization of resources and effective achievement of the desired goals. For example, investigations into helium-based sonic injection [1], air-based supersonic injection [2], and liquid injection [3] at varying mass flow rates and pressure ratios can result in significant temperature reductions. Metallic particles can provide further advantages than liquids and gases, as they exhibit extremely large heat capacities and can absorb heat through melting and evaporating.

Towards exploring the possibility of solid nanoparticle injection as a cooling strategy at hypersonic speed, the ISM initially plans to investigate the proposition numerically through commercial software. This is an exciting topic that the ISM eagerly wishes to pursue, and intends on performing experiments using the Hypersonic Ludwieg tube. This work will allow researchers at the ISM to create an informed experimental design to better understand the effect of nanoparticle air interaction on heat load alleviation. The student who takes on this project would work on numerically simulating the cross-flow injection of an air-nanoparticle suspension on a scaled Apollo capsule model at varying Reynolds numbers, which will facilitate the experiments at ISM in the years to come.



(Left) A conical re-entry vehicle under extreme heat during reentry. (Right) A schlieren experiment assessing the efficacy of injected coolant to alleviate heat loads [3].