Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Evolution of Imposed Vortices Over Concave Surfaces in Hypervelocity Flow WILLIAM FLAHERTY, JOANNA AUSTIN, University of Illinois — Steamwise oriented vortices in the boundary layer of a hypersonic flow have the potential to affect heat transfer and skin friction significantly. These effects can be exacerbated by the addition of extra strain rates associated with concave surface curvature. Vortices can either occur naturally (in the form of Goertler vortices), or be introduced by some form of mechanical distortion (such as a protuberance). In this work we experimentally investigate the effect of concave surface curvature on the propagation of imposed vortices. These experiments are carried out in the Hypervelocity Expansion Tube at the University of Illinois. This facility is capable of generating flows with high enthalpies (4-9MJ/kg) and Mach numbers (3-7). Using a novel, fast-response pressure sensitive paint we are able to observe the development of vortices which are induced using diamond-shaped vortex generators. Models with varying amount of surface curvature (encompassing Goertler numbers between 10-22) are used to investigate the dynamics of vortex propagation and interaction. Our results show that the vortices remain attached and of constant strength for 10-12cm (80 boundary layer thicknesses) along the curved surfaces, while on flat plates the vortices are no longer apparent within 6 cm downstream.

William Flaherty
University of Illinois

Date submitted: 03 Aug 2012 Electronic form version 1.4