Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Shock-wave surfing and the separation of meteoroid fragments in the atmosphere STUART LAURENCE, RALF DEITERDING — Studying the aerodynamic interactions between bodies travelling at highly supersonic speeds is necessary to our understanding of the separation of meteoroid fragments following atmospheric disruption. Here we show that a phenomenon referred to as "shock-wave surfing," in which a body moves in such a way as to follow the shock wave generated by another upstream body, can lead to the accumulation of a significantly higher relative lateral velocity between fragments than would otherwise be possible. The surfing phenomenon is investigated for the canonical cases of interactions between a sphere and a wedge, and between two spheres. Numerical simulations are performed and a simple theoretical model is developed to determine the forces acting on the surfing body. A phase-plane description is employed to elucidate features of the system dynamics in both cases. For the two sphere case, a strong influence of the body radius ratio on the separation process is found and a critical ratio is predicted for initially touching fragments that delineates entrainment of the smaller fragment within the larger fragment's shock from expulsion. It is also shown that a large fraction of the variation in the separation behaviour of meteoroid fragments deduced by previous authors from an analysis of terrestrial crater fields can be explained by a combination of surfing and a modest rotation rate of the parent body.

Stuart Laurence
German Aerospace Center (DLR)

Date submitted: 07 Aug 2010 Electronic form version 1.4