Atmospheric Entry Modeling for Asteroid Threat Assessment

Eric C. Stern, Ph.D.

Abstract: The NASA Planetary Defense Coordination Office (PDCO) is supporting a multidisciplinary effort to characterize the threat to Earth and its inhabitants by near-earth asteroids (NEAs). The Asteroid Threat Assessment Project (ATAP) has four primary research areas: asteroid characterization, entry modeling, hazard modeling, and risk assessment. This talk will provide an overview of on-going efforts in the area of entry modeling – which includes aerothermodynamics, radiation, ablation, and high-enthalpy ground testing – and the unique challenges associated with modeling large meteoroids entering Earth’s atmosphere at speeds in excess of 15 km/s. Two recent works, in particular will be highlighted. First, high-fidelity, fully-coupled CFD-radiation-ablation computations have been performed to derive a new model for aerodynamic heating during extreme atmospheric entry. Including the effects of shock layer radiative cooling, and radiation blockage from ablation products is shown to reduce the effective heat transfer coefficient by as much two orders of magnitude from the traditional meteor physics value. Second, the results of recent experiments to investigate the phenomenology of meteoroid ablation are presented. Continuous wave laser experiments performed on meteorite specimens have provided surface temperature and ablation rate measurements at radiative heating rates comparable to meteor flight. Experiments performed in the arc heated wind tunnel facility at NASA Ames show melt flow to be a dominant mechanism of ablation in meteoroids at moderate heating rates (~4kW/cm²). Analysis of emission spectra taken during the experiments suggest preferential vaporization of volatile elements occurring at the surface meteoritic melt. Finally, the effect of atmospheric entry models for asteroids on risk to populated areas will be discussed.

Bio: Eric Stern graduated from the University of Minnesota with his Ph.D. in Aerospace Engineering in 2015. Since joining NASA Ames as a Research Engineer, Eric has worked on and led several technology development efforts within the Entry, Descent, and Landing (EDL) discipline. He currently serves as Entry Modeling lead for the agency’s Planetary Defense Coordination Office.

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Place: CB 118
Time: 3:00 to 4:00p
Contact: Dr. Alexandre Martin 257-4462

Meet the speaker and have refreshments
Attendance open to all interested persons