Dynamic Compression: From Meteorites to Exoplanets

Thomas Duffy*[1]

[1]Princeton University – Department of Geosciences, United States

Abstract

Dynamic compression studies have applications to problems in Earth and planetary science ranging from understanding the effects of impacts and explosions to the synthesis of new high-pressure phases of the deep Earth. In this talk I will describe two major new advances in this area. Laser-based dynamic compression provides opportunities to study the structures and properties of geological materials to ultrahigh pressure conditions reaching 1 terapascal and beyond. By controlling the shape and duration of the incident laser pulse, either shock or ramp (shockless) loading can be produced. By combining these techniques with pulsed x-ray diffraction, we have explored a variety of materials including iron silicide, magnesium oxide, and carbon to ultrahigh pressures relevant to exoplanet interior conditions. A second major new development is the Dynamic Compression Sector at the Advanced Photon Source which provides the capability to couple gas-gun shock-wave experiments with brilliant synchrotron X-rays. Here I will show results on the lattice-level structural response of quartz and fused silica under shock loading that provide a new understanding of the behavior of silicate minerals under dynamic compression.

*Speaker