

Terapascal laser-compression and X-ray diffraction experiments to understand material behavior deep inside planets

Federica Coppari
Lawrence Livermore National Laboratory, Livermore, CA

Using lasers to generate extreme compression states enables the study of material properties and equations of state at unprecedented pressures and temperatures. Combined with ultra-fast x-ray diagnostics these techniques allow us to probe *in-situ* the transformation happening when matter is subjected to extreme conditions, providing key insights into material behavior inside planetary mantles and cores. The Omega Laser at the Laboratory for Laser Energetics (Rochester, NY) is a high-power laser facility where such experiments are now possible.

In this talk, I will present the results of x-ray diffraction experiments on laser-compressed magnesium oxide and iron oxide, important components of the mantle of the Earth and of terrestrial extrasolar planets. Our data show that both materials transform to the B2-CsCl structure above 600 GPa (MgO) and 250 GPa (FeO), respectively [1,2], which may impact the interior structure and rheology of large exoplanets.

[1] Coppari *et al*, Nature Geoscience 6, 926 (2013)

[2] Coppari *et al*, Nature Geoscience 14, 121 (2021)

This work was performed under the auspices of the US Department of Energy by Lawrence Livermore National Laboratory under Contract No. DE-AC52-07NA27344

Bio: Dr. Coppari received a B.Sc. and M.Sc. in Physics from University of Camerino (Italy) and a Ph.D. in Materials Science from the University Pierre et Marie Curie, Paris (France). In 2011 she joined Lawrence Livermore National Laboratory where she has been working on investigating material behavior at extreme conditions by laser-driven compression, with focus on phase transitions and equations of state determination. Her research interests and expertise span from high pressure/temperature condensed matter and disordered systems to high energy density and planetary science.