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When the LCLS X-ray Free Electron Laser was first turned on in 2009 it increased the peak X-ray brightness available to researchers by nine orders of magnitude. This step change in capabilities has led to advancement across the biological and physical sciences, opening up regimes previously inaccessible to experimental research.
The LCLS houses 7 instruments, one of which is Matter in Extreme Conditions, or MEC. MEC allows for the combination of ultrashort (sub 50 fs), coherent, hard X-rays with matter which has been excited via optical laser drivers; both long pulse (ns), high energy lasers, and a short pulse (ps), high intensity. The states accessed typically enter the High Energy Density regime (i.e. energies above 10^11 J/m^3, or equivalently, 1Mbar in pressure).
In this talk I will discuss just some of the work carried out at MEC, focussing on the diagnosis and understanding of structural solid-solid phase transitions in shock compressed matter. Specifically, I will discuss the development of complementary x-ray diffraction and phase contrast imaging diagnostics which together allow for complementary probing of real and reciprocal space information, allowing for better understanding of the often complex dynamical behaviour within these spatially inhomogeneous systems.