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Ultra-Fast Structural Studies of Shock-Induced Phase Transitions in Bismuth

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The study of structural phase transitions via dynamic compression has a long and illustrious history. But, due to the absence of suitably bright x-ray sources, it is only relatively recently that the structures of some of these high-pressure phases have been determined. Over the last 25 years, static compression studies have revealed the great structural complexity that exists in many high-pressure phases, and DFT calculations predict that such complexity will continue to pressures as yet unattainable experimentally. Are these same complex structures formed on shock timescales, and, if so, can we determine their structures with certainty via x-ray diffraction? The recent advent of x-ray free electron lasers (XFELs) now provides us with x-ray sources that are ideally suited to structural studies of shock-compressed matter on nanosecond timescales. In this talk I will describe results from recent experiments on the MEC beamline at the LCLS on diffraction studies of the phase transitions in bismuth, and look forward to what will be possible in the Euro-XFEL after its start-up in 2017.