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The Science of Dynamic Compression at the Mesoscale and the Matter-Radiation Interactions in Extremes (MaRIE) Project CRIS W. BARNES, JOHN L. SARRAO, MICHAEL F. STEVENS, Los Alamos National Laboratory — A scientific transition is underway from traditional observation and validation of materials properties to a new paradigm where scientists and engineers design and create materials with tailored properties for specified functionality. Of particular interest are the regimes of materials' response to thermomechanical extremes including materials deforming under imposed strain rates above the quasi-static range (i.e. $> 10^{-3}$ s^{-1}), material subjected to imposed shocks, but also material response to static, high-pressures. There is a need for the study of materials at the "mesoscale," the scale at which sub-granular physical processes and inter-granular organization couple to determine microstructure, crucially impacting constitutive response at the engineering macroscale. For these reasons Los Alamos is proposing the MaRIE facility as a National User Facility to meet this need. In particular, three key science challenges will be identified: Link material microstructure to macroscopic behavior under dynamic deformation conditions; Make the transition from observation and validation to prediction and control of dynamic processes; and Develop the next generation of diagnostics, dynamic drivers, and predictive models to enable the necessary, transformative research.

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