Abstract Submitted
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The Challenge of Time-Dependent Control of Both Processing and Performance of Materials at the Mesoscale, and the MaRIE Project CRIS W. BARNES, Los Alamos National Laboratory — DOE and NNSA are recognizing a mission need for flexible and reduced-cost product-based solutions to materials through accelerated qualification, certification, and assessment. The science challenge lies between the nanoscale of materials and the integral device scale, at the middle or "mesoscale" where interfaces, defects, and microstructure determine the performance of the materials over the lifecycle of the intended use. Time-dependent control of the processing, structure and properties of materials at this scale lies at the heart of qualifying and certifying additive manufactured parts; experimental data of high fidelity and high resolution are necessary to discover the right physical mechanisms to model and to validate and calibrate those reduced-order models in codes on Exascale computers. The scientific requirements to do this are aided by a revolution in coherent imaging of non-periodic features that can be combined with scattering off periodic structures. This drives the need to require a coherent x-ray source, brilliant and high repetition rate, of sufficiently high energy to see into and through the mesoscale. The Matter-Radiation Interactions in Extremes (MaRIE) Project is a proposal to build such a very-high-energy X-ray Free Electron Laser.

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