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Editorial for the ICMRE 2018 special issue: Extreme variety and depth in Matter and Radiation at Extremes

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The world is now applying a number of new facilities, advanced computing, and scientific insights to explore a variety and depth of phenomena that do not occur naturally on Earth. High power and high intensity lasers, z-pinches, and ion beams allow for laboratory investigations of material and radiation at extreme conditions in detail. The variety and depth of phenomena is beyond what most of us imagined, and scientists are eagerly considering what more can be found. This special issue illustrates the broad variety of physical phenomena under investigation.

Two papers give insight into fast progress and new science within China on the adaptation of lasers for inertial fusion studies; optical Thomson scattering diagnostics[1] and laser-plasma interactions[2] are discussed in detail. China is substantially "in the game" seeking inertial confinement fusion in the laboratory.

Nine other papers from around Europe and the U.S. broaden the subjects covered. A featured paper provides unprecedented detail on hydrodynamics in convergent geometry (cylindrical),[3] a subject important to inertial fusion and other applications, and rich with variety. Additional papers include treat response of materials and plasma that control how inertial fusion targets respond to driving radiation[4–7]–again, with more variety than imagined. Two papers look to future applications of high intensity lasers for plasma optics and pair production.[8,9] New phenomena are coming. Papers on plasma facing components for future applications of inertial fusion[10] and the history of the relativistic magnetron[11] show connections to engineering challenges that arise in studies of materials and radiation at extremes. There will be more engineering challenges and opportunities coming.

This area of science has enormous potential for detailed insights into phenomena important to life (planets) and the nature of the universe (astrophysics and cosmology), as well as applications like inertial fusion on Earth. Universities are developing curricula to train new researchers in this high energy density science. Laboratories worldwide are applying and extending this science for basic interests and useful products. The science attracts new people and the development of new techniques and diagnostics.

The Matter and Radiation at Extremes (MRE) journal seeks to be a medium to enable rapid progress through open publication and can be effective and invaluable for scientists worldwide. The American Institute of Physics Publishing in New York is strongly supporting the journal and its editors. You, the scientists, can control whether or not MRE meets its goals. Submitting your papers, reviewing articles for publication, and citing the work reported in the journal will dictate success for the journal. High energy density science is important in national security applications, so caution by researchers in reporting results and in international interactions is appropriate and mandated by governments. However, the open science is flourishing and its publication needs your support.

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