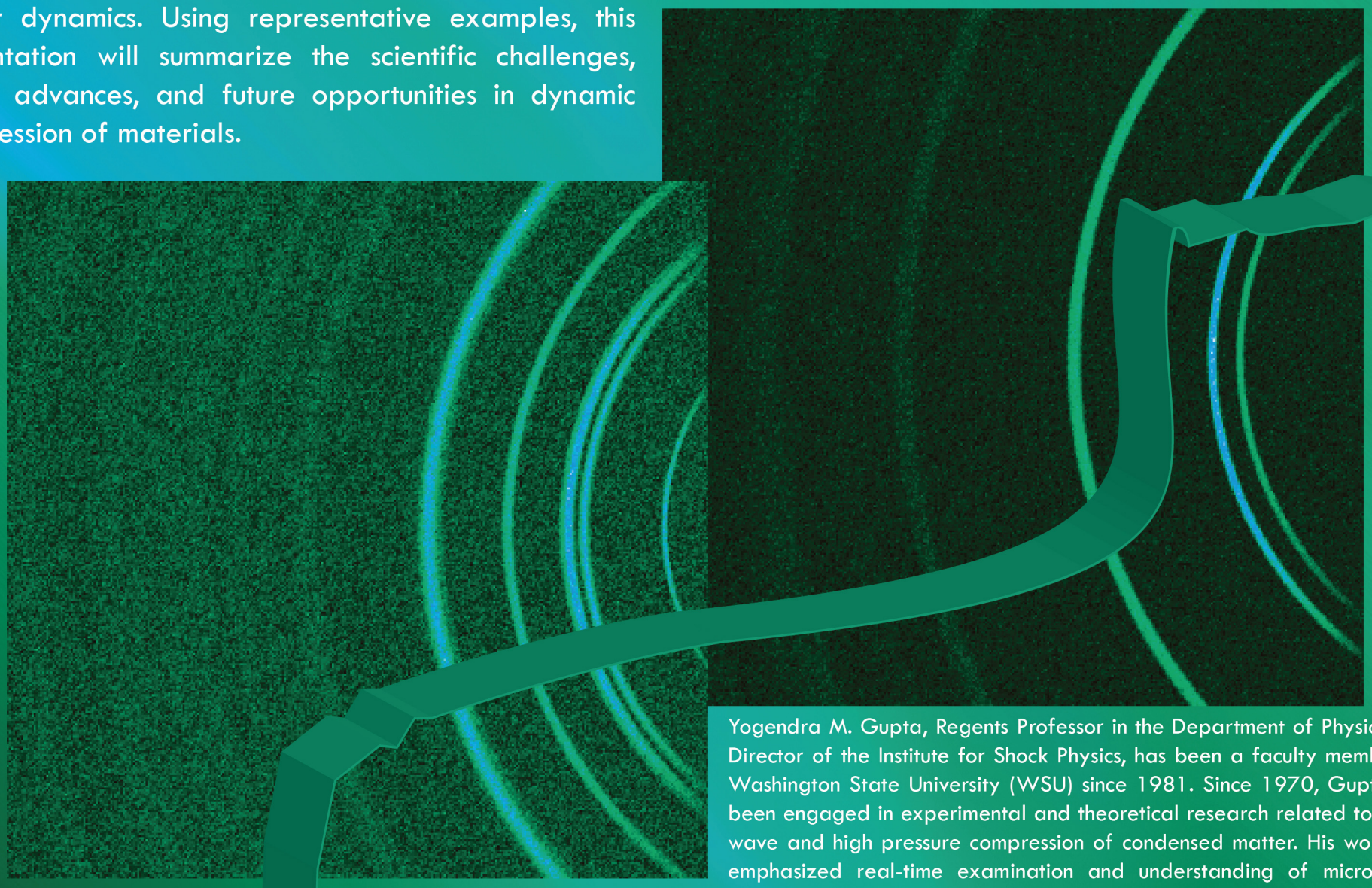
Yogendra M. Gupta

Argonne NATIONAL LABORATORY

Dynamic Compression of Condensed Matter: Recent Advances and Future Opportunities

Advances in dynamic compression capabilities (shock wave and shockless compression) can now routinely produce the most extreme thermo-mechanical states in bulk materials. These extreme states of matter are of interest to a broad range of scientific disciplines: condensed matter physics and chemistry, materials science, earth and planetary sciences, dense and non-ideal plasma physics, and astrophysics. Scientific efforts are underway to achieve fusion in inertially-confined experiments.

In addition to producing extreme states of matter, dynamic compression experiments provide a unique opportunity to examine and explore real time changes in material states to gain mechanistic insight into physical and chemical phenomena. Despite major experimental and computational achievements to date, scientific progress toward mechanistic understanding has been limited by the lack of time-resolved measurements at microscopic scales. Modern x-ray sources (APS, LCLS, etc.) are well suited for achieving the desired microscopic information in dynamic compression experiments. As such, linking x-ray capabilities to dynamic compression experiments is an exciting path forward to understand condensed matter dynamics. Using representative examples, this presentation will summarize the scientific challenges, recent advances, and future opportunities in dynamic compression of materials.



Yogendra M. Gupta, Regents Professor in the Department of Physics and Director of the Institute for Shock Physics, has been a faculty member at Washington State University (WSU) since 1981. Since 1970, Gupta has been engaged in experimental and theoretical research related to shock wave and high pressure compression of condensed matter. His work has emphasized real-time examination and understanding of microscopic processes using a variety of time-resolved measurements (optical spectroscopy, x-ray diffraction, and several continuum methods) and related analyses in a wide range of materials. Gupta and his collaborators have worked on a broad range of condensed matter phenomena: structural transformations, chemical reactions, and deformation and fracture. Currently, Professor Gupta is leading a major experimental effort to establish the Dynamic Compression Sector at the Advanced Photon Source (Argonne), a DOE/NNSA supported user facility. Professor Gupta is a Fellow of both the American Physical Society (1991) and the American Association for the Advancement of Science (2002), and has served on numerous committees related to U.S. national security, programs. In 2001, he received the American Physical Society's Shock Compression Science Award, the premier award in the field. In 2005, he was the recipient of Washington State University's highest faculty recognition, the Eminent Faculty Award.

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