Exploring the universe through the Discovery Science program on NIF

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New regimes of science are being experimentally studied at high energy density (HED) facilities around the world, spanning drive energies from microjoules to megajoules, and time scales from femtoseconds to microseconds. The ability to shock and ramp compress samples to very high pressures and densities allows new states of matter relevant to planetary and stellar interiors to be studied. Shock driven hydrodynamic instabilities evolving into turbulent flows relevant to the dynamics of exploding stars (such as supernovae), accreting compact objects (such as white dwarfs, neutron stars, and black holes), and planetary formation dynamics (relevant to the exoplanets) are being probed. The dynamics of magnetized plasmas relevant to astrophysics, both in collisional and collisionless systems, are starting to be studied. High temperature, high velocity interacting flows are being probed for evidence of astrophysical collisionless shock formation, the turbulent magnetic dynamo effect, magnetic reconnection, and particle acceleration. And new results from thermonuclear reactions in hot dense plasmas relevant to stellar and big bang nucleosynthesis are starting to emerge. A selection of examples providing a compelling vision for frontier science on NIF in the coming decade will be presented.

Bruce A. Remington is the Discovery Science Program Leader for the National Ignition Facility (NIF) at Lawrence Livermore National Laboratory (LLNL). He attended Michigan State University for graduate school, receiving a PhD in nuclear physics in 1986. He did a 2-yr postdoctoral appointment at LLNL in nuclear physics, then entered Laser Program, where he studied hydrodynamic instabilities, leading experiments on the Nova and Omega lasers in the US. He started research in high energy density (HED) materials science and HED laboratory astrophysics (HEDLA) in the mid-1990s, and in 1996, started the ongoing popular HEDLA bi-annual conference series. He has documented his work in over 400 publications in the technical literature, 15 articles in the popular press, and has a citation h-index of 52. He is a Fellow of the APS, recipient of the APS-DPP Excellence in Plasma Physics award; and recipient of the Edward Teller Medal for excellence in high energy density physics (HEDP). He is currently program leader for NIF Discovery Science, which is a program whereby external scientists and professors can propose, and carry out experiments on the NIF laser at LLNL for basic physics and applied science.