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Probing matter at the extremes: new frontiers in high energy density physics[1]

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The ability to experimentally study scaled aspects of the explosion dynamics of core- collapse supernovae (massive stars that explode from the inside out) or the radiation kinetics of accreting neutron stars or black holes on high energy density (HED) facilities, such as high power lasers and magnetic pinch facilities, is an exciting scientific development over the last two decades. [2] Additional areas of research that become accessible on modern HED facilities are studies of fundamental properties of matter in conditions relevant to planetary and stellar interiors, protostellar jet dynamics, and with ultraintense short-pulse lasers, strong field effects, possibly relevant to gamma-ray burst dynamics. With the added tool of thermonuclear ignition on the National Ignition Facility, excited state ("multi-hit") nuclear physics studies, possibly relevant to nucleosynthesis, may also become possible. Techniques and methodologies for studying aspects of the physics of such extreme phenomena of the universe in submillimeter scale parcels of matter in the laboratory will be discussed. [2] "Experimental astrophysics with high power lasers and Z pinches," B.A. Remington, R.P. Drake, D.D. Ryutov, Rev. Mod. Phys. 78, 755 (2006).

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