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Pulsed Power Engines of Discovery for High Energy Density Science[1]

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Sessler and Wilson refer to particle accelerators as Engines of Discovery[2]. Classical accelerators have advanced our fundamental understanding of the universe and uncovered the deep underlying structure of matter. Pulsed power accelerators compress energy in space and time to create unique, transient states of high energy density matter. High energy density matter is found throughout the universe, wherever high pressure or compressed material or hot plasmas exist in stars, near neutron stars, in impact events or planetary collisions, in nuclear fusion plasmas, and in national security environments. The 80 TW Z accelerator is the largest such pulsed power accelerator in the world today, and is employed as an engine of discovery for fusion science, astrophysics and planetary science, atomic physics, and dynamic materials science. Areas of study encompass both fundamental science as well as national security science and applications. The Z accelerator stores up to 20 MJ in its capacitor banks and delivers currents of 15-30 MA in pulses of order 100-1000 ns. These currents are coupled to a variety of platforms that harness the currents and associated magnetic fields to produce microliters to milliliters of material in unprecedented and unique states. Energy is compressed by more than a factor of 10^9 in space and 10^9 in time to produce these microscopic volumes, providing environments that were previously unavailable for laboratory study. This talk will review recent progress on Z in magneto-inertial fusion and in x-ray driven science, and discuss future prospects.

[11]Sandia National Laboratories is a multi-mission laboratory managed and operated by National Technology Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energys National Nuclear Security Administration under contract DE-NA0003525; [2]Engines of Discovery A Century of Particle Accelerators, A. Sessler, E. Wilson