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Conceptual design of a 900-TW pulsed-power accelerator driven by impedance-matched Marx generators

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We have developed a conceptual design of a next-generation pulsed-power accelerator that is optimized for high-energy-density-physics experiments. The design is based on an architecture that is founded on two concepts: single-stage electrical-pulse compression and impedance matching [Phys. Rev. Accel. Beams **10**, 030401 (2007); **18**, 110401 (2015)]. The prime power source of the machine consists of 210 impedance-matched Marx generators (IMGs). Each IMG comprises 40 stages connected electrically in series; each stage is driven by 20 bricks connected electrically in parallel. Each brick consists of two 100-kV 80-nF capacitors connected in series with a 200-kV gas switch. Six water-insulated radial-transmission-line impedance transformers transport the power generated by the IMGs to a six-level vacuum-insulator stack. The stack serves as the accelerator’s water-vacuum interface. The stack is connected to six conical outer magnetically insulated vacuum transmission lines (MITLs), which are joined in parallel at a 10-cm radius by a triple-post-hole vacuum convolute. The convolute sums the electrical currents at the outputs of the six outer MITLs, and delivers the combined current to a single short inner MITL. The inner MITL transmits the combined current to the accelerator’s physics load. The accelerator is 72 m in diameter, stores 134 MJ of electrical energy, and generates 900 TW of peak electrical power at the output of the IMG system. The accelerator delivers 66 MA and 8.7 MJ in 113 ns to a magnetized-liner inertial-fusion (MagLIF) target [Phys. Plasmas **17**, 056303 (2010); **23**, 022702 (2016)]. The principal goal of the machine is to achieve high-yield thermonuclear fusion; i.e., a fusion yield that exceeds the energy initially stored by the accelerator’s capacitors.

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