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Design of a 5-MA 100-ns Z-pinch accelerator based on linear transformer driver

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we are planning to build an linear-transformer-driver (LTD) based accelerator for driving wire-array Z-pinch loads. The accelerator comprises six modules in parallel, each of which has eight series 0.8-MA LTD cavities in a voltage-adder configuration. Vacuum transmission lines are used from the interior of the adder to the central vacuum chamber where the load is placed. Thus the traditional stack-flashover problem is eliminated. The machine is 3.2 m tall and 12 m in outer diameter including supports.
A prototype cavity was built and tested for more than 6000 shots intermittently at a repetition rate of 0.1 Hz. A novel trigger, in which only one input trigger pulse is needed by utilizing an internal trigger brick, was developed and successfully verified in these shots.
A full circuit modeling was conducted for the accelerator. The simulation result shows that a current pulse rising to 5.2 MA in 91 ns (10%–90%) can be delivered to the wire-array load, which is 1.5 cm in height, 1.2 cm in initial radius, and 1 mg in mass. The maximum implosion velocity of the load is 32 cm/μs when compressed to 0.1 of the initial radius. The maximum kinetic energy is 78 kJ, which is 11.7% of the electric energy stored in the capacitors. This accelerator is supposed to enable a radiation energy efficiency of 20%–30%, providing a high efficient facility for research on the fast Z pinch and technologies for repetition-rate-operated accelerators.

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