Accelerators to make Electricity-- An Overview of Heavy-Ion-Driven Fusion*

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Making commercial electrical power using nuclear fusion, rather than fission, is a possible safe, environmentally friendly method of energy production, with plentiful fuel available. It was recognized in the late 1970's that heavy ion accelerators were a good candidate for providing the energy to heat and compress the heavy hydrogen fuel to the state necessary for fusion. Providing the large amount of power necessary (about 500 terrawatts every fifth of a second) necessitates a different kind of accelerator from classical accelerators used in high energy or nuclear physics. Multiple (~100) very intense beams of heavy ions must be accelerated to a few GeV simultaneously, then focused to a target a few millimeters in radius. The beam physics is very different from classical accelerator physics because beam particle density is ~1,000,000 times larger. Thus the physics is similar to a plasma, with all particles interacting with each other and the focusing system, while in classical accelerators the particle dynamics is mostly single-particle. The commercial energy motivation, the accelerator system to drive the fusion, and the physics involved in the beams will be discussed in this talk, along with some description of the experiments that are showing feasibility of this approach.

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