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Advantages of the Single Pass RF Driver for Pellet Implosion and Ignition

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The discovery of the heavy ion driver in 1975 was that the technology of high-energy particle accelerators already had the tools to design ICF drivers that meet all the requirements for fusion power production. The hitch was that heavy ion drivers would excel at driving fusion power plants, but they would not lend themselves to cheap demonstrations with sub-scale pellet experiments. This implied a new paradigm for power production with ICF: 1. The performance of new configurations of mainstream accelerators is predictable. 2. To reduce the level of risk to that needed by investors, the driver parameters need to be set above the threshold of confidence for prediction of pellet performance. Using conservative parameters, the essence of the second part of the paradigm, is the focus of the Single Pass RF Driver.

Using 20MJ for Compression, SPRFD emphasizes achievable compression by using more energy than Basko to compress to the same density, 100g/cc.

Reducing the spot on target ≥10x (by not using storage rings), SPRFD provides the 50μm focal spot needed for fast ignition of 100g/cc fuel with ρR = 0.5g/cc.

By using isotopes for the Fast Ignition pulse whose range is ~1/7 that of the isotopes used to drive Compression, SPRFD reduces the Fast Ignition energy needed by Basko ~7x.

The shorter-range component of the beam pulse also drives implosion of the end caps of the cylindrical target. For this, the duration of the shorter-range component of SPRFD's beam is much longer than the time scale of fast ignition (~10 nsec vs. 0.1 nsec).

Only the final part of the shorter-range pulse needs the peak power required for fast ignition. This peak power is ~7x less than that used by Basko's cylindrical target.

The 50μm spot also is available for compression, because neither pulse uses storage rings. SPRFD spirals the beam spot, like Basko, to follow the implosion, and the 50μm concentrates the heating closer to the interface between the absorber and pusher layers.

The penultimate part of the shorter-range pulse burns a path through blow-off. This helps the final part of the pulse to get through the blow-off and get into and ignite the fuel that has the density needed to initiate propagating burn.

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