

ADVANCES IN THE SCIENCE AND TECHNOLOGY FOR LASER FUSION ENERGY*

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Fusion energy with lasers, direct drive targets and solid wall chambers can lead to a conceptually simple and an attractive energy source. We discuss recent advances in developing the principal components, including: the lasers, final optics, target fabrication, target injection, target engagement, and the chambers and associated materials [1]. A companion paper [2] presents the target physics and path to develop Laser Fusion Energy.

We are developing two types of lasers: the krypton-fluoride (KrF) e-beam pumped laser at NRL, and the diode pumped solid state laser (DPSSL) at LLNL. The Electra KrF laser has produced 400-700 Joules of laser light at both 1 Hz and 5 Hz, and has run continuously at 1 Hz for up to 10,000 shots. The Mercury DPSSL laser has produced 50 Joules per pulse at up to 5 Hz, for runs exceeding 10,000 shots. One candidate for the final optic is a grazing incidence aluminum mirror. In small scale experiments this optic has operated for more than 100,000 shots at fluences up to 18 J/cm² in 20 nsec pulses (We need 4 J/cm² in 4 nsec). The targets are foam shells filled with solid DT. We have made shells of the right dimensions and within a factor of two of the required non concentricity, and have demonstrated that the foam underlay leads to a very smooth solid DT layer. We have developed a light gas gun that repetitively accelerates surrogate targets to 400 m/sec. However current chamber concepts may allow a slower injection velocity and hence a simpler injector.

While a wide range of parameters are possible, we have focused our studies to one configuration to ensure we have a coherent picture for a power plant. We chose a target yield of 350 MJ (gain of 140) and a repetition rate 5 Hz. The chamber has a tungsten armored ferritic steel first wall and is 10.25 m radius. Experiments and supporting modeling suggest this FW should have the required long term resistance against the target emissions. We are evaluating various blankets including self cooled Li, dual coolant lithium lead, and a solid breeder [3]. The work described here, plus the work in target physics, will provide the scientific and technical foundation for the next phase in the development of laser fusion energy [2].

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[1] For a list of collaborators, see: J.D. Sethian, et al, Nuc Fusion, **43**, 1693-1709 (2003).

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