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Heavy Ion Targets

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During the last 38 years researchers have suggested and evaluated a large number of target designs for heavy ion inertial fusion. These target designs fall into a number of general categories including:

1. Direct ignition (or fast ignition) designs originally suggested by A. W. Maschke
2. Directly driven targets with dense, high-Z outer shells
3. Indirectly driven targets
4. Targets that lie somewhere on a continuum between categories 2 and 3
5. Directly driven targets with low-density ablators (without a dense outer shell)
6. Shock ignition targets

In general, the categories of targets that perform better in terms of higher target gain and/or reduced driver input energy impose more stringent requirements on accelerator design. For this reason, the optimization of a fusion power plant will involve the joint optimization of the target-accelerator system. Also, the categories of targets that perform better often rely on physics that has not been studied as thoroughly as the physics of some of the categories of targets that do not perform as well. For example, directly driven target designs usually have higher predicted gain and lower predicted driver energy requirements than indirectly driven targets. Unfortunately there is a paucity of theoretical and experimental data regarding fluid instabilities in the directly driven designs.

This paper will discuss the advantages and disadvantages of the various categories of targets, particularly with respect to accelerator considerations. The paper will also discuss some of the target physics issues that must be resolved to provide a more accurate assessment of the various target-accelerator options. The paper will conclude with a discussion of the connection between ion target physics uncertainties and recent results from the National Ignition Facility.

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