THE STATUS OF RESEARCH ON FAST IGNITION FOR INERTIAL FUSION ENERGY

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"Fast Ignition" is the concept of separating the compression and heating of fusion fuels to ignition conditions into two distinct steps, supported by two distinct driver systems. [1] The current mainline approach to inertial fusion energy is "central hot-spot ignition," wherein a powerful laser or particle beam is used to symmetrically compress a hollow spherical DT target to extreme density and in so doing compress the DT gas in the center, heating it to fusion conditions and providing the hot-spot spark needed to ignite the surrounding compressed DT fuel. Fast Ignition relies on a set of laser or particle beams to symmetrically compress a hollow spherical DT target, but with little gas in the center, resulting in much easier compression and no central hot spot. A separate, non-symmetric, very short pulse, very high intensity ($>10^{19}$ W/cm^2) laser beam is then used to ignite the compressed fuel. This approach offers potential for significant reduction in the total energy needed to achieve ignition and burn, and offers potential for higher total target gain. However, it also raises significant challenges to achieve the extreme laser intensity needed for ignition and to transport the ignition beam to the compressed target.

Recently significant progress has been made in understanding the processes for laser energy absorption and transport at extreme density. Experiments have been done at laser facilities around the world that appear to confirm our understanding of these processes. Integral experiments have been done in the US and Japan using symmetrical compression of targets followed by intense heating that indicate significant increases in the fusion neutron yield. Design studies have been done to assess the impact of fast ignition on the design, performance and challenges of an inertial fusion power plant.

We have recently served as the editors of a special issue of *Fusion Science and Technology* that will be published shortly, dedicated to the topic of fast ignition for inertia fusion energy that summarizes and reviews the latest theoretical, experimental and design information on this fascinating and potentially very powerful concept. Our paper will summarize the findings presented in this special issue.

Reference: [1] M. Tabak, J. Hammer, M. Glinsky et al., "Ignition and high gain with ultrapowerful lasers," Phys. Plasmas 1, 1626 (1994).