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The Role of Hot Electron Divergence in Determining the Efficacy of Fast Fusion

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Fast Ignition (FI) is the name given to an ignition scheme in inertial confinement fusion (ICF): After a D-T cryogenic fuel pellet has been compressed to a high density (~300 g/cm^3) using long pulse compression lasers (either direct or indirect drive), the fuel is "ignited" by a high energy short pulse laser. The attraction of FI over conventional "hot spot" ignition is that the ignition mechanism is separated from the compression phase, with a predicted reduction in the precision of target preparation, and a higher neutron energy yield for a given laser compression energy. After nearly 10 years of concentrated experimental and modeling effort, it appears that the efficacy of FI is coming down to determining one overriding physical result—*the spatial divergence of the hot electron flux from the super intense laser-plasma interaction of the short-pulse laser used to ignite the compressed fuel.* If the divergence is found to be too large, then virtually all the anticipated advantages of FI over optimal hot spot ignition will be lost. If a large native divergence cannot be controlled by creative use of the shape and constituency of guiding cones, there is no need to pursue FI as an ignition scenario for ICF. As the science now stands, the research community is unable to answer the question of hot electron divergence with sufficient confidence to rule FI in or out.

In this presentation we discuss our work on hot electron divergence in the overall context of the research community's efforts. Specifically we will present new results on very large scale simulations as well as detailed experimental efforts; we will use these results, and the published results of others, to give the audience a clear picture of the realistic potential for the global implementation of Fast Ignition in the next 5 years.