Virtual National Laboratory for Heavy Ion Fusion Sciences

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HIFS News

11th US-Japan workshop on Heavy Ion Fusion

The HIFS VNL hosted the 11th US-Japan workshop on Heavy Ion Fusion (HIF) and High Energy Density Physics (HEDP) on December 18th and 19th, 2008. Researchers from three institutions in Japan (KEK, Tokyo Institute of Technology, and Utsunomiya University) gave talks and participated in discussions with colleagues from the VNL.

Figure 2. Participants at the US-Japan workshop on HIF and HEDP toured the NIF facility at LLNL on December 19, 2008.

The first day of the two-day workshop was at LBNL, with technical talks presented on fusion, accelerators, and warm dense matter (WDM). Also, a tour of the HIFS VNL Neutralized Drift Compression Experiment was given.

On the second day, the workshop moved to LLNL, where talks were given on the fusion energy program (by Ed Synakowski), the LIFE project (by Erik Storm), and technical topics that continued on the themes from the first day. Also, on the second day, the workshop participants were given a tour of NIF (see figure 1). The purpose of the workshop series is to foster collaborations between the US and Japanese researchers in the areas of HIF and HEDP.

Viewgraphs, agenda, and photos from the workshop may be downloaded from: http://hifweb.lbl.gov/public/USJapanWorkshop2008.

- John Barnard

Direct drive heavy-ion inertial fusion at high coupling efficiency

In a recent paper [1], Logan, Perkins and Barnard obtained from 1-D Lasnex simulations, up to 18% efficiency in the coupling in energy deposition between a driver ion beam and a fusion target. This is much closer to the theoretical maximum (20%-30%), in comparison to typical laser-driven direct drive coupling efficiency (~8%), or heavy-ion hohlraum coupling efficiencies (~2%-4%).

Assuming that successful capsule designs emerge, and that the NIF's ignition campaign is successful, the prospects for heavy-ion fusion development might look much different: Gain 100 at 200 kJ total drive energy! Further into the future, if optimized coupling efficiencies can reach 25% for larger mass targets, then it becomes possible to think of self-breed tritium without external blankets, and internally capturing the neutron energy into mostly plasma energy for direct conversion. In that event, prospects for fusion energy might be radically changed also.

In the paper, issues with coupling efficiency, beam illumination symmetry, and Rayleigh-Taylor instability are discussed for spherical heavy-ion-beam-driven targets with and without hohlraums. Efficient coupling of heavy-ion beams to compress direct-drive inertial fusion targets without hohlraums is found to require ion range increasing several-fold during the drive pulse.

One-dimensional implosion calculations using the LASNEX inertial confinement fusion target physics code shows the ion range increasing fourfold during the drive pulse to keep ion energy deposition following closely behind the imploding ablation front, resulting in high coupling efficiencies (shell kinetic energy over incident beam energy of 16% to 18%). Ways to increase beam ion range while mitigating Rayleigh-Taylor instabilities are discussed for future work.

- Grant Logan

[1] B G. Logan, L.J. Perkins, J. J. Barnard, "Direct drive heavy-ion-beam inertial fusion at high coupling efficiency", Physics of Plasmas **15**, 072701 (2008)

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