

## Highlights from the 18th International Symposium on Heavy Ion Inertial Fusion

The Heavy Ion Fusion (HIF) Symposium was held on the campus of the Technical University in Darmstadt, Germany from August 28 through September 3, 2010. There were approximately 95 registered participants (see picture) from 8 countries -- a modest increase from the last meeting of the series held in 2008 in Japan. This included 41 participants from the host country, Germany, 19 U.S. participants, 15 Russians, 11 Japanese, 4 Chinese, 2 French, 2 British, and 1 Pole. China was a relative newcomer with significant representation at the meeting and reports increasing spending on HIF activities at Lanzhou. More information on registered attendees and presentations made can be found at: [http://www-aix.gsi.de/conferences/HIF2010/registration\\_list\\_HIF2010.php](http://www-aix.gsi.de/conferences/HIF2010/registration_list_HIF2010.php).



Participants of the 18<sup>th</sup> International Symposium on Heavy Ion Inertial Fusion.

We present below a summary of highlights of the meeting from the authors' perspectives. Descriptions of talks not covered or overlooked can be found at the symposium web site at:

<http://www.gsi.de/forschung/pp/dates/HIF2010.html>.

Prominent accelerator-related topics covered at the symposium included reports on the Neutralized Drift Compression Experiment II (NDCX-II) under construction at Lawrence Berkeley National Laboratory and the Facility for Antiprotons and Ion Research (FAIR) project at GSI, Germany. The NDCX-II attracted attention

for being able to achieve significant target parameters with a modest cost facility by creatively exploiting properties of Bragg peak stopping, and rapid pulse compression of a space-charge dominated beam. In addition to an overall project overview (Kwan), issues involving Li source technology (Roy) including surface heating with lasers (Ni), pulse compression schedules (Sharp), and error issues and extensive machine performance verifications with WARP simulations (Grote) were covered. Other HIFS VNL affiliated presentations relevant to NDCX-II and HIF included: ion source experiments (Grisham), optimized focusing schemes using electrostatic Einzel lens (Lund), diagnostics (Lidia), improvements in longitudinal g-factor models (Davidson), bunch compression (Lau), plasma neutralization technology (Gilson), neutralized beam transport stability (Startsev), and neutralized drift compression (Kaganovich). In the FAIR project, a long time HIF community colleague Boris Sharkov has left ITEP in Moscow and is now Scientific Director of the FAIR project which will have a significant Russian financial component. The project is now funded with physical construction soon commencing and it appears unlikely that the project could be under further jeopardy of being cancelled. Reports (Sharkov, Spiller) indicate that ion lifetime in the rings could be a remaining issue for the facility to reach design intensity goals. FAIR related presentations also included: longitudinal bunch compression physics (Boine-Frankenheim), non-intercepting beam diagnostics (Becker), and radiation damage thresholds (Mustafin). The symposium was moved for one day from the Technical University in Darmstadt to GSI to allow the GSI community to attend/participate in accelerator related topics. Numerous other accelerator related topics were presented at the meeting ranging from HIF to basic accelerator physics and technology including: ion source technology (Adachi), scaled beam compression experiments using electron beams (Horioka), bunch compression for HIF (Kikuchi), and the status of the ITEP TWAC facility (Golubev). Highlights included Chinese presentations (Yang, Zhao) reporting early steps in a

significant HIF/WDM program at Lanzhou, and a small industrial group (Helsley, Burke; Fusion Power Corporation) delivered very enthusiastic report on their efforts to interest commercial venture capital investors for a very large scale (~35 GW electric, \$50 billion-class) HIF based power plant which would be based as much as possible on proven accelerator technology and designed for minimal uncertainty rather than reduced cost.

In addition to accelerator topics, presentations were given at the symposium covering Warm Dense Matter (WDM), High Energy Density Physics (HEDP), ion stopping in matter, and HIF targets. Kawata discussed an indirect/direct drive hybrid target capsule design that used an Aluminum shell to stop the ions and a carbon foam to isotropize the radiation and that achieved high coupling efficiency. The HEDP physics program at FAIR was described by Tahir, that included investigations focusing on uniform target heating for EOS measurements (HIHEX); low-entropy compression of samples such as hydrogen or water for EOS studies relevant to planetary science (LAPLAS); shocked-induced instability studies; and experiments using a ramped pressure pulse to create extreme conditions without shocks. Proton radiography at FAIR was described Turtikov. Target diagnostics and target experiments on NDCX-II were discussed by Barnard, Bieniosek and Ni, that included multiple wavelength pyrometry experiments for EOS studies and ion-coupling experiments that used an ion pulse with varying ion energy. There were several talks on EOS (Lomonosov), transport properties, and atomic processes in materials including plasmas, solids, aerogels and porous metals. Target diagnostics using the K-alpha line was presented both theoretically (Kawamura) and experimentally (Rzadkiewicz). Laser-produced ion beams were also a topic at the symposium, and experiments that used the ion pulse for warm dense matter studies (such as the experimental investigation of the high pressure liquid phase of Carbon) were described (Roth). Presentations on polarized targets for IFE (Didelez) and fast ignition using very high energy particles (Deutsch) were also given.

A subset of the International Advisory Committee convened during the meeting and determined that the next (19th) meeting in the series should be held in 2012 on the US West Coast, and hosted by the US Heavy Ion Fusion Science Virtual National Laboratory, which will determine the site and specifics of the meeting.

--Steven Lund, John Barnard and Frank Bieniosek

## HIF 2010

18<sup>th</sup> International Symposium on Heavy Ion Inertial Fusion

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