

Editorial

During the report period of 2005 one of the major international events was the conference on Inertial Fusion Science and Applications (IFSA 2005) in Biarritz, France. The High Energy Density Physics community represented in this report had a good number of presentations and invited talks at this conference. Inertial fusion is widely regarded as laser fusion, however, this conference which is the most important in this field with approximately 600 participants, deals with all aspects of inertial fusion energy. It is therefore also devoted to ion beam drivers. In this respect it is an ideal platform to present the GSI research efforts to investigate the properties of intense heavy ion beams for inertial fusion energy. During this conference the basis for an agreement between the region Aquitaine and the state of Hessen was laid to collaborate on scientific issues of High Energy Density Physics and Inertial Fusion Energy with intense ion and laser beams. Later that year an agreement between the Institute Lasers & Plasmas (ILP) of the Université Bordeaux and GSI-Darmstadt was signed in the presence of the prime minister of the state of Hessen and the president of the region Aquitaine.

It is widely accepted that the principle advantage of heavy ion beams to generate high energy density states or warm dense matter is due to the fact that ions have the potential to heat a macroscopic volume homogeneously with low initial gradients in temperature and pressure. Moreover the initial conditions of energy deposition temporally and spatially are in principle well known. However, such intense beams as they are available already now at GSI and those that are expected from the FAIR accelerator are very difficult to diagnose. The accelerator department and our community are collaborating to develop non-destructive diagnostic methods for intense focussed ion beams. Since the hydrodynamic response of a target depends critically on the beam parameters it is not only necessary to measure these parameters with great precision, moreover it is also necessary to provide a properly tuned beam to match the complicated targets. In 2005 record beam parameters have been achieved. More than 4×10^9 Uranium ions ($q=73+$), arriving in a compressed bunch of 110 ns were focused to a spot of less than 300 micrometer in diameter. A new time resolving pyrometer measured a temperature of 12000K during direct ion heating of a tungsten target. The pressure was measured to be in the kilobar regime. Details of this experiment are described in the contribution "Progress on HEDP/WDM experiments at GSI" in section 1. This represents important progress for the high intensity beam program. Due to the high intensity available now another experiment which lay dormant for almost ten years was successful. This is the investigation of heavy-ion beam pumped lasers. The threshold for laser action of 10^9 ions in a compressed ion bunch was crossed and ion beam pumped, laser action in the short wavelength regime was observed. Now there is a pathway to shorter wavelength lasers pumped by intense heavy ion beams.

At the UNILAC Z6 area the investigation of projectile radiation during the slowing down process in matter made significant progress. The front cover of this report shows a heavy ion beam interacting with a target. The projectile radiation depends on the ionic state and varies with the projectile velocity. Comparing the situation with solid targets and gaseous targets a significant difference showed up emphasizing the importance of highly excited states which are present in a solid target, but not in a gas target.

The upgraded helix laser system showed stable operation in the experimental campaigns. Interferometric measurements provided a spatially resolved electron density measurement of the laser plasma for ion beam plasma experiments. A new diamond detector provided excellent beam signals even for low intensity ion beams. Both developments will lead to a new quality in stopping power measurements of ion beams in hot plasma. The laser experiments at GSI were supplemented by experiments to study the influence of non-gaussian laser beam profiles on proton acceleration at the Trident laser. Just recently also the first accelerated particle beams generated by the PHELIX laser were recorded in an experiment at the PHELIX laser bay. The progress of the PHELIX project is documented in this report in a special section.

There are some activities in collaboration with CERN. Since the LHC beam will be very intense, the potential of this beam to induce high energy density states was investigated. The result of this project was summarized in a Physical Review Letter and some more detailed publications which got the attention of Physics News Update, and APS News.

Astrophysical plasmas in the interior of the sun, as well as in the sun's halo are at the center of the projects connected to the CERN axion solar telescope. Also these results were mentioned in Physics News Update as well as in Nature and Science.

It is only natural that during the planning of such a large project like FAIR, details undergo dynamic changes. During the write up of the executive summary for the technical design report we assumed the Plasma Physics cave to be located not far from the current experimental area, the HHT cave. Therefore an extension of the PHELIX beamline was planned to transport the high power laser beam to the new experimental station. With the current location of the Plasma Physics cave this seems no longer to be feasible. The distance from the PHELIX laser building to the new target station is too large. We therefore suggested a new laser support building close to the experimental cave and to move the laser there, close to the target station.

Three experiments for the plasma physics community have been recommended by the scientific and technical issues (STI) advisory committee. These are HIHEX (Heavy Ion Heating and Expansion), LAPLAS (Laboratory Planetary Sciences), and WDM (Warm Dense Matter created by dynamical confinement).

Some details of these experimental schemes are described in the draft of the executive summary for the technical design report. The STI recommended further creating one collaboration to prepare the technical basis for these experiments. In June last year the HEDgeHOB (**H**igh **E**nergy **D**ensity generated by **H**eavy **i**On **B**eams) collaboration with 46 participating institutes, representing more than 180 scientists from 15 countries was founded at a meeting in the presidium of the Russian Academy of Sciences. This collaboration agreed to care for all three experiments providing the conditions that each experiment may maintain its individuality.

During this year we expect to have the PHELIX laser beam in the experimental area at Z6, which will allow starting with directly heated plasma targets of high temperature and to start hohlraum target experiments. Theoretical support for these experiments is supplied through an INTAS funded project with colleagues from Sarov, Russia. Therefore we are looking forward to an exciting period.

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