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High Energy Density Physics related to Inertial Fusion with Intense Ion- and laser Beams at GSI and FAIR in Darmstadt

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High Energy Density (HED) states in matter can be achieved by pulsed power deposition from intense laser or particle beams. GSI-Darmstadt presently provides the most intense heavy ion beam and a high power laser (PHELIX) for interaction experiments of laser plasma and ion beams. Approximately 200 scientists from 45 institutes and 16 countries worldwide are members of the HEDgeHOB [1] collaboration. They prepare novel experiments at FAIR (Facility for Antiproton and Ion Research) to study thermophysical, transport, and radiation properties of HED matter, generated by the impact of intense heavy ion- and laser beams on dense targets. Thus intense heavy ion beams open a new pathway to address the regime of Warm Dense Matter (WDM) with precision experiments. Warm dense matter is characterized by high density and relatively low temperature. This is a state that matter will pass through during the heating process of an inertial fusion target. Properties of matter in this regime are widely unknown. However the final state that will be reached during the heating process may well be determined by material properties of the dense strongly coupled plasma regime.

A novel diagnostic system (PRIOR) using high energy protons has been implemented at GSI and is currently undergoing first tests. Progress in high energy density physics is closely related to the potential to produce targets that are specifically designed for beam plasma experiments. Here considerable progress has been achieved in producing micrometer-thick cryogenic foil-like targets from pure hydrogen.

Intense ion beams also pose specific accelerator related problems, which we do address. These are related to the diagnostic of very intense ion beams and problems related to vacuum loss due to desorption processes. Moreover irradiation and activation of components does also influence material properties such as strain resistance, and electrical and thermal conductivity.

We will report on the current status of the FAIR and efforts of the HEDgeHOB collaboration to prepare for the experimental phase at FAIR in a few years.

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References

[1] HEDgeHOB Collaboration: http://hedgehob.physik.tu-darmstadt.de:

Primary author: Prof. HOFFMANN, Dieter H. H. (Technical University Darmstadt)

Presenter: Prof. HOFFMANN, Dieter H. H. (Technical University Darmstadt)