High Energy Density Physics with intense Heavy Ion Beams

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It is expected that the future heavy ion facility, FAIR (Facility for Antiprotons and Ion Research) will provide compressed beam pulses with an intensity that exceed the current beam intensities by three orders of magnitude. This will open up the possibility to explore the thermophysical and transport properties of HED matter in a regime that is very difficult to access using the traditional methods of shock compression.

Currently the most intense heavy ion beam for experiments to induce high energy density states in macroscopic amounts of matter is available at GSI in Darmstadt. Recently a new record intensity was achieved with more than 10**10 Uranium Ions at charge state 73+ and an energy of 350 MeV/u. This allows studying thermophysical properties of high energy density states when matter passes the warm dense matter regime of the phase diagram at high density but relatively low temperature.

We have investigated hot liquid tantalum and tungsten and present measurements of the temperature as function of specific enthalpy. An ongoing project is the development of a non-contact measurement of the electrical conductivity of warm dense matter. The density evolution of warm dense matter will be investigated with a proton microscope, which is under construction at GSI. In this talk we will also summarize the progress on the development of cryogenic targets. Thus the talk will give an overview on recent results and developments of beam plasma, and beam matter interaction processes studied with heavy ion beams.