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High Energy Density Physics in matter generated by Heavy Ion Beam (HEDgeHOB) at the FAIR Facility

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Knowledge of basic physical properties of matter under extreme conditions of high energy density, and in particular, of the so-called warm dense matter (WDM), such as equation-of-state, static and dynamic electrical conductivity and opacity is of fundamental importance for various branches of basic and applied physics. Intense beams of energetic heavy ions provide a unique capability for the WDM research compared to traditional drivers. Using intense ion beams, one can heat macroscopic volumes of matter fairly uniformly and generate this way high-density and high-entropy states. This new approach permits to explore fascinating areas of the phase diagram that are difficult to access by other means.

Various physics issues of the high-energy-density (HED) physics research with intense heavy ion that is to be carried out at FAIR is presented. In particular, a special attention is given to the emerging diagnostic technique - high energy proton microscopy (HEPM). The results of the recent experiments are presented along with new developments in target and ion-beam diagnostic instruments and methods that are essential for the future HEDgeHOB experiments at FAIR.

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