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High Energy Density Physics Research at FAIR: The HEDgeHOB Collaboration

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High Energy Density Physics (HEDP) spans over wide areas of basic and applied physics including astrophysics, planetary sciences, geophysics, inertial fusion and many others. Over the past decade, extensive theoretical work [1-8] that included sophisticated 2D and 3D numerical simulations as well as analytic modeling, has shown that due to volumetric energy deposition in matter, an intense heavy ion beam is a very efficient and novel tool to study the HEDP. Construction of the Facility for Antiprotons and Ion Research (FAIR) will allow the scientists to access unexplored regions of the HEDM parameter space. So far, four different experimental schemes have been proposed as a result of the theoretical work to study various type of problems in HEDP. One scheme named HIHEX (Heavy Ion Heating and Expansion), is suitable to study the Equation of State (EOS) of HEDM while another scheme, named, LAPLAS (Laboratory Planetary Sciences) can be used to generate physical conditions that are expected to exist in the interiors of the Giant planets in our solar system as well as the exoplanets. The third scheme involves a shockless compression (ramp type compression) of a solid material which can be used to study the material properties (yield strength and shear modulus) under dynamic conditions. The fourth scheme proposes the study of the growth of the Richtmyer-Meshkov instabilty in linear as well as non-linear regime. Theoretical work continues to explore further experiment designs to study additional problems in HEDP.

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