STUDIES OF HIGH-ENERGY-DENSITY STATES IN MATTER AT THE GSI DARMSTADT USING INTENSE BEAMS OF ENERGETIC HEAVY IONS

N.A. Tahir, GSI Darmstadt, Planckstrasse 1, 64291 Darmstadt, Germany
A. Shutov, I.V. Lomonosov, V.E. Fortov, IPCP, Chernogolovka, Russia
A.R. Piriz, M. Temporal, UCLM, 13071 Ciudad Real, Spain
C. Deutsch, LPGP, University of Paris-Sud, 91405 Orsy, France
N. Grandjouan, LULI, University Paris VI, Palaiseau, France
D.H.H. Hoffmann, S.Udrea, D. Varentsov, IKP, TU Darmstadt, Germany

The Gesellschaft für Schwerionenforschung (GSI) Darmstadt, is a unique laboratory worldwide that has a heavy ion synchrotron (SIS18) that delivers intense beams of energetic heavy ions. Currently this facility delivers a uranium beam that deposits about 0.7 kJ/g specific energy in solid matter. This facility is being upgraded and numerical simulations show that the the uranium beam generated at this upgraded facility will deposit about 50 kJ/g energy in solid targets [1]. GSI is also in the process of constructing a new bigger synchrotron ring, SIS100 that will deliver a much more intense uranium beam which will lead to a specific energy deposition of 200 kJ/g [2]. Availability of such high specific energy deposition will open up the possibility to study the equation-of-state (EOS) and transport properties of high-energy-density (HED) matter and access those parts of the phase diagram that are not accessible with other techniques.

An intense heavy ion beam can be used in two different schemes to achieve the above goals. One scheme involves isochoric heating of matter by the beam and subsequent isentropic expansion of the heated material [3]. In the second scheme one achieves a low-entropy compression of a sample material, like hydrogen that is imploded in a multi-layered cylindrical target [4,5]. In this paper we present novel designs for current and future EOS experiments using two-dimensional hydrodynamic simulations.

1 N. A. Tahir et al., Phys. Rev. E, **61** (2000) 1975.

2 N. A. Tahir et al., PR ST AB, **6** (2003) 020101.

3 D. H. H. Hoffmann et al., Phys. Plasmas , **9** (2002) 3651.

4 N. A. Tahir et al., Phys. Rev. E, **63** (2001) 016402.

5 A. R. Piriz et al., Phys. Rev. E, **66** (2002) 056403.