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Hydrodynamic Tunneling of 440 GeV SPS protons in Solid Material: Production of Warm Dense Matter at CERN HiRadMat Facility
NAEEM AHMAD TAHIR, GSI Darmstadt, JUAN BLANCO SANCHO, RUEDIGER SCHMIDT, CERN, ALAXANDER SHUTOV, IPCP Chernogolovka, FLORIAN BURKART, DANIEL WOLLMANN, CERN, ANTONIO ROBERTO PIRIZ, University of Castilla-La Mancha — Numerical simulations have shown that the range of 7 TeV LHC protons in solid matter will be significantly increased due to hydrodynamic tunneling [1-3]. For example, in solid copper and solid carbon, these protons and the shower can penetrate up to 35 m and 25 m, respectively. However, their corresponding static range in the two materials is 1 m and 3 m, respectively. This will have important implications on machine protection design.In order to validate these simulation results, experiments have been performed at the CERN HiRadMat facility using the 440 GeV SPS proton beam irradiating solid copper cylindrical target [4]. The phenomenon of hydrodynamic tunneling has been experimentally confirmed and good agreement has been found between the simulations and the experimental results. A very interesting outcome of this work is that the HiRadMat facility can be used to generate High Energy Density matter including Warm Dense Matter and strongly coupled plasmas in the laboratory.

References: [1] N.A. Tahir et al., J. Appl. Phys. 97 (2005) 083532. [2] N.A. Tahir et al., Phys. Rev. E 79 (2009) 046410. [3] N.A. Tahir etal., Phys. Rev. Special Topics Accel. Beams 15 (2012) 051003. [4] J. Blanco Sancho et al., Proceedings of IPAC 2013 Conf., Shanghai, China, 2013.

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