High-energy proton microscopy for extreme state of matter research

Alexander GOLUBEV [1], Alexey KANTSYREV [1], Anton BOGDANOV [1], Vsevolod PANYUSHKIN [1], Aleksey SKOBLIAKOV [1], Dmitry KOLESNIKOV [1], Dmitry VARENTSOV[2], Viktor MINTSEV [3], Nikolay SHILKIN [3]and Alla ZUBAREVA [3]

1) Institute for Theoretical and Experimental Physics of name A.I. Alikhanova of the National research center "Kurchatov Institute", Moscow, Russia

E-mail: golubev@itep.ru

2) GSI Helmholtzzentrum fur Schwerionenforschung, Darmstadt, Germany

3) Institute of Problems of Chemical Physics RAS, Chernogolovka, Russia

The study of extreme state of matter generated by interaction of intense heavy ion beams or shock wave is one of the most challenging and interesting topics in modern physics. Measurement of density distribution, with high spatial and temporal resolution, is important task for fundamental understanding of dynamic material properties in extreme states. High-energy proton radiography with magnetic imaging lens between the object being studied and the detection system exceeds X-Ray diagnostic method in many ways, because it has more transmission ability and high spatial and density resolution [1]. The best spatial resolution was obtained by means of high-energy proton microscopy technique (pRad facility at LANL) [2]. Developed of the proton microscopy facility PUMA at ITEP was used for measurement of density distribution within static and dynamic objects by using of 800MeV proton beam [3]. Novel high-energy proton microscope called PRIOR (Proton Microscope for FAIR) will be the key diagnostic instrument for research program of HEDgeHOB (High Energy Density generation by Heavy iOn Beam) collaboration at FAIR (Facility for Antiproton and Ion Research, Darmstadt, Germany). PRIOR prototype was designed and commissioned on the synchrotron SIS-18 at GSI in 2014. The spatial resolution of 30 μm was achieved in the first experiments at PRIOR facility, with 3.6 GeV proton energy [4].

The new project of 247 MeV proton microscope is being developed in collaboration of ITEP, INR and IPCP's. Such setup is designed for investigation of density distribution for static objects and shock-wave processes in dynamic objects with areal density up to 5 g/cm2.

References

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