

Ion acceleration mechanism in deuterium z-pinches

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Acceleration of high energy ions was observed in z-pinches as early as in the 1950s. Even though many theories have been suggested, the ion acceleration mechanism remains a source of controversy. Recently, the experiments on the GIT-12 generator demonstrated acceleration of hydrogen ions up to 30 MeV from a deuterium gas-puff z-pinch [1,2]. High deuteron energies enable us to obtain unique information about ions and to discuss various hypotheses of ion acceleration. The acceleration of 30 MeV deuterons can be explained by the fast increase of a z-pinch impedance with a sub-nanosecond e -folding time. The high impedance of $>10 \Omega$ and the generation of $>GV/m$ electric fields could result from a breakdown of quasi-neutrality and a gap formation after the ejection of plasmas from $m=0$ constrictions. Detailed knowledge of the ion acceleration mechanism is used with a neutron-producing catcher to increase neutron yields above 10^{13} at a current of 2.7 MA.

[1] D. Klir, P. Kubes, K. Rezac, J. Cikhardt, J. Kravarik, O. Sila, A.V. Shishlov, B.M. Kovalchuk, N.A. Ratakhin, V.A. Kokshenev, A.Yu. Labetsky, R.K. Cherdizov, F.I. Fursov, N.E. Kurmaev, G.N. Dudkin, B.A. Nechaev, V.N. Padalko, H. Orcikova, and K. Turek, *Physical Review Letters* **112**, 095001 (2014).

[2] D. Klir, A.V. Shishlov, V.A. Kokshenev, P. Kubes, A.Yu. Labetsky, K. Rezac, R.K. Cherdizov, J. Cikhardt, B.Cikhardtova, G.N. Dudkin, F.I. Fursov, A.A. Garapatsky, B.M. Kovalchuk, J. Krasa, J. Kravarik, N.E. Kurmaev, H. Orcikova, V.N. Padalko, N.A. Ratakhin, O. Sila, K. Turek, V.A. Varlachev, A. Velyhan, and R. Wagner, *Phys. Plasmas* **23**, 032702 (2016).