current STATE and PROSPECTS FOR experiments on linear traps for fusion Plasma

Beklemishev A.D., Bagryansky P.A., Burdakov A.V., Ivanov A.A.

Budker Institute of Nuclear Physics SB RAS, Novosibirsk, RF, [bekl@bk.ru](mailto:bekl@bk.ru)

Linear magnetic traps for fusion plasma are lagging behind on reached parameters as compared to the toroidal systems because of the difficulty of suppressing the longitudinal plasma losses along the open field lines. However, the relative simplicity of linear systems is a significant advantage in terms of possible applications of such reactors. The resurgence of attention and interest lately to experiments on linear traps is linked to two factors: the successful and rapid development of experimental devices of series C-2 (FRC-type) by the commercial company Three Alpha Energy in the United States, as well as to the achievement of electronic temperatures of approximately 1 keV in the gas-dynamic trap GDT in Novosibirsk.

In devices C-2 with the magnetic system of the magnetic-mirror geometry two initial FRC are injected from two sides simultaneously, so that their merging generates the target configuration for further heating and confinement using the neutral-beam injection. The stationary confinement of FRCs is demonstrated during the full 8ms time of NBI. Currently the Three Alpha operates the modification C-2W, the main objectives of which are to increase the electronic temperature using the new design of the diverter, to increase the plasma energy content by improving the power and the quality of injection, as well as to increase the duration of the FRC confinement using modification of the magnetic system and the conductive shell. The achieved record electron temperature in GDT is due to the use of an additional relatively weak near-axis ECR-heating. In this regime the electron-hot plasma was in only about a quarter of the cross section, so that the influence of this zone on confinement of fast ions was small. However, the mere fact of the electron heating is crucial to assess the prospects for the GDT type traps. First, it shows that the operation of the expander for electrostatic plasma thermal insulation in the electron channel is really effective, so that the hot plasma can be maintained on the open field lines just three meters from the endplates. Second, the transverse thermal conductivity is much lower than the Bohm estimates, while the achieved radial electron temperature gradient is about the same as in typical tokamaks.

Successful experiments on existing traps stimulated the emergence of new projects and construction of new facilities. The GDT-style traps will be built in two labs: in the United States, as a prototype of neutron source for transmutation of isotopes, and in Japan as a source of hot plasma to study the divertor physics. China has also built a new linear system that appears to be designed to work with the field-reversed configurations. In BINP, besides the GDT trap, operates the SMOLA device, which successfully demonstrated the helical confinement for suppression of longitudinal losses, while the new devices CAT and GOL-NB are being constructed in support of the project of the new- generation trap, GDMT.