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Stability and Confinement Studies in the Gas Dynamic Trap

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Interest to magnetic mirrors went missing in the 1980's because of three key problems: magnets' complexity, micro-instabilities, and low temperature of plasma. However, researches on the Gas Dynamic Trap (GDT) device at the Budker Institute of Nuclear Physics demonstrates the possibility to overcome these difficulties. Confinement of plasma with high energy density have been performed on GDT device with simple circular coils. "Vortex confinement"have been implemented to suppress the radial losses induced by flute-like MHD instability inherent to axially symmetric devices. This technique allowed reaching local plasma beta close to 0.6. The auxiliary microwave heating on electron cyclotron resonance (ECR) frequencies raised the electron temperature up to 0.9 keV near the device axis. Alfven ion-cyclotron (AIC) instability have been observed, but not affected to the plasma power balance. The proposed report is dedicated to next three topics. The first is optimization of the "vortex confinement"in presence of ECR heating. Introducing the additional "vortex" layer inside the existing one allows extending high-temperature phase behind the atomic beams turn off time. The second is definition of critical parameters for the diverter. It was shown, that the critical wall position corresponds to expansion ratio of magnetic field $K_{crit} \sim 40$. This value is in a reasonable agreement with a simple theoretical model and remains constant in the range of electron temperature 25 - 700 eV. The neutral gas in the diverter does not affected the discharge until its density exceeded an order of magnitude the plasma density. The third is study of unstable modes. In addition to AIC, the new type of oscillations are observed at the range of tens of ion-cyclotron frequencies. It was preliminary identified as Drift-Cyclotron Loss-Cone instability.

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