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Plasma Confinement by Magnetic Field with Convex-Concave Field Lines

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It has been found that the plasma confinement by magnetic field of alternating-sign curvature - with convex-concave field lines results in a strong stabilizing action against convective (flute-interchange) perturbations [1]. For simple combinations of mirrors and cusps the calculations give a strongly, centrally peaked stable plasma pressure profiles instead of a shallow ones [1-2].
The pressure peaking arises at the minimum of the second adiabatic invariant J that takes place at the 'middle' of a tandem mirror–cusp transverse cross-section. The peaking arises for various plasma anisotropy –e.g. for the distribution function with 'empty loss cones'as well for opposite case –with a longitudinal velocity prevailing. The magnetic configurations with peaking include e.g. axially symmetric mirrors equipped with outer divertors and inner field reversing rings (cusps, internal rings, high-beta cells) and closed multimirror traps.
Such a methodic gives a promising tool for the magnetic confinement systems optimization. It can be applied in various fusion applications –like fusion-fission hybrid systems, as well as for intense plasma and particle sources –like multiply-charged ion sources.
The question is whether the required conditions for the experimental obtaining of the pressure peaking are limited by large enough alternating-sign magnetic field line curvature and low plasma-collisionality. This has been addressed to a compact magnetic confinement system with reverse-dipole configuration and ECR-discharge at low pressure [3].
This device has been modified by adding of external magnetic field to create the field lines of alternating-sign curvature. The electrostatic and magnetic probe techniques have been improved to investigate the plasma parameters spatial distribution and to find out whether the peaking can be experimentally observed in such a conditions.

[1] M.M. Tsventoukh 2014 Nucl. Fusion 54 022004 (7pp) http://stacks.iop.org/0029-5515/54/022004

[2] M.M. Tsventoukh 2011 Nucl. Fusion 51 112002 (6pp) http://stacks.iop.org/0029-5515/51/112002

[3] G.V. Krashevskaya et al 2012 Proc. VIII International Workshop MICROWAVE DISCHARGES: FUNDAMENTALS AND APPLICATIONS (MD-8) Russia, Zvenigorod, September 10-14, 2012. Edited by Yu.A. Lebedev. Moscow 2012, pp 101-104

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