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L-V Stellarator: Compact Torsatron for Physical Investigations

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In recent years significant experimental results have been obtained in stellarators, and in many cases a good understanding of their physical grounds has been reached. At the same time a number of questions call for detailed investigation. Among them, we could mention the necessity of experimental testing of the possibility to optimize a system in respect of neoclassical transport, the relation between neoclassical and turbulent transport, the study of mechanisms governing turbulent transport, the possibility of controlling the plasma column, etc. In this connection, it may be of interest to create a device destined for physical investigations and capable of realizing a variety of magnetic configurations. The description of such a device, proposed to be constructed in the General Physical Institute (Moscow), is presented in this report.

The proposed project is given the name L-V stellarator. The version developed by us permits making the magnetic configurations with elements of quasi-symmetry for trapped particles, configurations that have, on the average, the elliptical elongation of magnetic surfaces and ensure reduced amplitudes of Pfirsch—Schluter currents, magnetic configurations with a deep (up to 14%) magnetic well, to create conditions for suppression and onset of different instabilities. The stellarator is a compact torsatron with $l=2$ helical coils ($m=3$), 4 pairs of compensation coils, and a set of windings controlling helical ripples of the magnetic field. The basic geometric sizes of the stellarator are as follows: The major radius of the helical winding is $R = 112$ cm, the minor radius is $r_h = 44.8$ cm, the plasma size is $a_p = 28—35$ cm; the aspect ratio for the helical winding is $A_h = 2.5$, and that for the plasma is $A_p = 3.2—3.8$; the rotational transform at the plasma boundary is $\iota = 0.5—1$. The maximum magnetic field is $B_0 = 2$ T. It should be noted that the proposed system is unique in having a very low aspect ratio, which is of particular interest for fusion research. The dimensions and design of the vacuum chamber permit the siting of the divertor substructures and vacuum conditioning systems, and the port dimensions allow us to use any existing plasma heating methods. Supposedly, the ECR and ICR heating methods will be used at the first stage.