Identifying topological features of the snowflake configurations from the magnetic field data at a finite number of points

D.D. Ryutov, V.A. Soukhanovskii

Lawrence Livermore National Laboratory, Livermore CA 94550, USA

In the developing of the feedback control algorithms for advanced divertors an important step is a reconstruction of the field structure in the divertor area from a finite number of poloidal field (PF) measurements in this area. By comparing this structure with a desired one, the control system would develop appropriate adjustments to the PF coil currents. [In reality, there may not be any direct (say, magnetic probe) measurements in the divertor zone; instead, the field would be taken from a few spatial points from the real-time EFIT data; in the context of our study, those will be still called "measurements."] We focus our discussion on the snowflake divertor, where one wants to control position of the two nearby nulls. An interplay between these two nulls creates a large set of topologically-different configurations with multiple intersecting separatrices; this complicates the operation of the control system. A problem that we specifically address is an unambiguous identification of the "main" separatrix, the one that surrounds the core plasma. Our study is complementary to the earlier analyses of the snowflake controls of Refs. 1, 2. We use a complex representation of the poloidal field described in Ref. 3 and thereby reach a lot of algebraic simplifications. The aforementioned problem of the identification of the "main" separatrix is solved then by a simple set of prescriptions. We also suggest a few simple tests that allow one to verify standard divertor field models based on the assumptions of negligible divertor current. Work performed for U.S. DOE by LLNL under Contract DE-AC52-07NA27344; supported by the U.S. DOE OFES.

References

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