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Fundamental Study on Filter Effect of Confronting Divergent Magnetic Fields Applied to a Low-Pressure Inductively Coupled Plasma[1]

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Function of confronting divergent magnetic fields (CDMFs) applied to an inductively coupled plasma called the X-point plasma[2] was investigated. The plasma is driven by a planar spiral rf antenna on the top of a cylindrical chamber. The CDMFs are induced by two coaxial coils with dc currents of opposite directions, and have cusps on their separatrix plane and a magnetic null point at its center. Electron motion in H_2 at 1 Pa under the CDMFs was simulated using a Monte Carlo method. Electrons released form the chamber ceiling were captured in the upper region of the chamber by magnetic flux lines running between the ceiling and side wall. However, some of them diffused downward across the separatrix in two ways: passage through the weak magnetic field around the center, and displacement of electron gyrocenters from the upper region to the lower region due to scattering by gas molecules near the outer part of the separatrix. While the former was unselective about electron energy, the latter tended to occur for high-energy electrons with long gyroradii. This position-dependent selectivity in electron passage across the separatrix indicates applicability of the CDMFs as a magnetic filter or shutter.

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[2]T. Tsankov and U. Czarnetzki 2011 IEEE Trans. Plasma Sci. **39**, 2538.