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1P03 - Phase mixing and collisionless dissipation at the boundary sheath of magnetized low temperature plasmas

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High power impulse magnetron sputtering (HiPIMS) is an important example for the technical application of magnetized low temperature plasmas. The spontaneous emergence of self-organized structures (spokes) and the presence of anomalous transport - probably two sides of the same coin - play an important role in HiPIMS and related E×B discharges (e.g., Hall thrusters) [1]. These phenomena are not fully understood at present, although they seem to have a strong impact on the overall discharge behavior. Due to their symmetry breaking nature, in principle, a three dimensional kinetic simulation is required. Especially, for the HiPIMS regime ($n_\mathrm{e} \leq 10^{20}\,\mathrm{m}^{-3}$ and $p \approx 0.5\,\mathrm{Pa}$), conventional kinetic approaches like particle-in-cell (PIC) methods are too resource consuming to simulate relevant time scales. One possible alternative makes use of the fact, that the electron Larmor radius r_L of the thermal electrons is small compared to the typical length scale L of the system. This ansatz, however, breaks down at the plasma boundary sheath in front of the target. A hard wall model might be an effective boundary condition for the interaction of magnetized electrons with this interface [2,3]. In this work, we present numerical and analytical investigations to relate the incoming and the outgoing electron velocity distribution function (EVDF) for different inclination angles of the magnetic field. An interesting feature, which can be observed in the outgoing EVDF, are fractal type structures, which disappear due to phase mixing about a distance of a few Larmor radii away from the sheath edge.

1 Anders et al., Journal of Applied Physics 111, 053304 (2012)
2 Krüger et al., Plasma Sources Sci. Technol. 26, 115009 (2017)
3 Krüger et al., Plasma Sources Sci. Technol. 27, 025001 (2018)

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