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Sheath Formation in the Presence of Inhomogeneous and Oblique Magnetic Field

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The presence of a strong inhomogeneous magnetic field widely increases the intricacies associated with the formation of a plasma sheath. The inhomogeneous nature of the magnetic field has been employed to a host of problems, especially in magnetically confined devices, helicon discharges, and in dusty plasmas [1,2]. In this article, we highlight the role played by an inhomogeneous magnetic field towards sheath formation. The inhomogeneity of the magnetic field is found to restrict the motion of the ions towards the plasma wall, thereby leading to a higher deposition of space charges [3]. The ion neutral collision is subject to bring ample modification to sheath formation [4]. In this case, it assists the magnetic field in sheath formation. The inhomogeneity parallel to the wall reduces the ion mobility perpendicular to the field. As a consequence, the kinetic energy of the ions striking the wall surface is reduced. It further reduces the heat flux of the ions, and hence the erosion of the surface.

In addition, the role of an oblique magnetic field is discussed, where the thickness of the magnetized presheath is found to be dependent on the tilting angle [5-8]. A suitable criterion has been deduced, which governs the sheath formation in oblique magnetized scenario. There exists a critical regime of parameters where the magnetic field plays the dominant role towards sheath formation over the collision and ionization. The velocity sharing phenomenon has been found to have a wide impact on both the sheath formation and monotonic variation of the ion-density near the wall.

The difference between the uniform oblique magnetic field (UOM) and inhomogeneous magnetic field (IHM) is highlighted in this work [3]. Thus, a suitable configuration of the magnetic field may be used to control the drift of the ions towards the wall.

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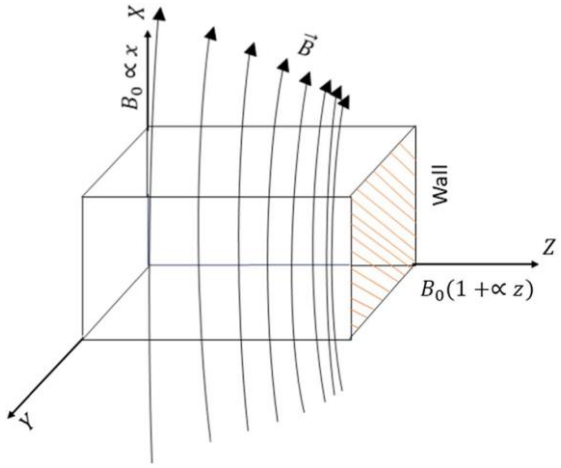

Figure 1. Schematic of the theoretical model for the inhomogeneous magnetic field.

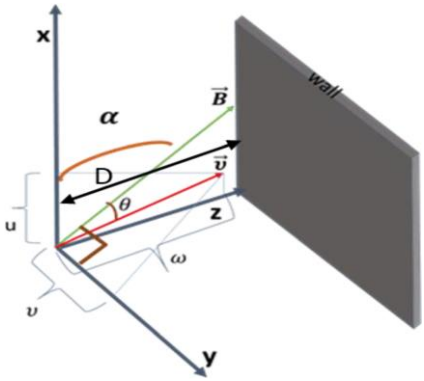

Figure 2. Schematic of the theoretical model for the oblique magnetic field.