Measurement of a tilting cylindrical probe in a RF magnetized plasma discharge

J. Ledig[1] , E. Faudot[1] , N. Lemoine[1], S. Heuraux[1], M. Usoltceva[2], J. Moritz[1]

[1] *Institut Jean Lamour, Nancy, France*

[2] *Max-Planck-Institut für Plasmaphysik, Garching, Germany*

I-V curve coming from Langmuir probe measurements is assumed to provide many physical plasma parameters as density, temperature, plasma potential, and floating potential. In the presence of magnetic field, probe understanding becomes more difficult because the magnetic field breaks down isotropy. Some works had already been done in this field for electron collection on a wall and parallel to magnetic field [1] and for a semi-infinite cylindrical probe aligned with magnetic field [2]. However, probe measurements in magnetized plasma is still a challenge especially in the case of a tilted probe with respect to the field (which occurs in Tokamaks). For the present work measurements were done in a linear plasma reactor, ALINE, a chamber of 1 m length and radius of 35 cm. The 1.2 Pa helium plasma was generated by an RF antenna at frequency 25 MHz. The injected power went from 30 W to 200 W. The 1 cm long cylindrical probe of radius 75 μm compensates RF fluctuations thanks to a compensation electrode and small chokes. Magnetic field was set between 0 and 100 mT and few tilting angles were used for Ψ from 0° (probe aligned with **B**) to 90° (probe perpendicular to **B**). Comparaisons of IV curves showed that increasing Ψ tend to increase electron saturations curents, but ion saturations currents remains approximatly the same. For low Ψ a current bump between exponential part of I-V characteristics and electron saturation current was noticed. A previous theory of electron collection for Ψ=0 on cylindrical probe for different values of magnetic field was used here using a simple projection to calculate plasma parameters in every tilting angle.

[1] J. Moritz *et al.*, Plasma sheath properties in a magnetic field parallel to the wall, Physics of Plasma 23, 062509 (2016)

[2] J.G. Laframboise *et al.,* Theory of a cylindrical probe in a collisionless magnetoplasma, Physics of Fluids 19, (1976)