Experimental study on flow field of ion streamline detachment region in a diverging magnetic field

K. Terasaka, S. Yoshimura\textsuperscript{a}, M. Aramaki\textsuperscript{b}, and M. Y. Tanaka

\textit{IGSES, Kyushu University, Fukuoka 816-8580, Japan}
\textsuperscript{a}National Institute for Fusion Science, Gifu 509-5292, Japan
\textsuperscript{b}Department of Quantum Engineering, Nagoya University, Aichi 464-8603, Japan

terasaka@aees.kyushu-u.ac.jp

It has been widely recognized that plasma flow in a non-uniform magnetic field region is important to clarify astrophysical phenomena and to develop plasma propulsion systems. Many theoretical and experimental studies have been performed in a strong magnetic field region (magnetized region). In the magnetized region, plasma flows along the magnetic field line, and the structure formation of flow field in this region has been well understood. On the other hand, the flow structure formation in a weaker magnetic field region (detachment region), where ion streamline detachment from the magnetic field line takes place, has not been fully understood, so far. It is considered that the characteristics of flow and electromagnetic fields in the detachment region are different from those in the magnetized region because of the difference of motion between the detached ions and the magnetized electrons.

We have experimentally studied the plasma flow structure in a diverging magnetic field region using the HYPER-I device at the National Institute for Fusion Science. The ion flow velocity was measured with the directional Langmuir probes calibrated by using an LIF Doppler spectroscopy. The electrostatic potential, which determines the flow field in our plasma, was measured with an emissive probe and a Langmuir probe. We also measured the ion flow field in different magnetic field configuration. We observed an evidence of ion streamline detachment. It was also found that the plasma starts to rotate by an $E \times B$ drift in which the ion detachment takes place \cite{1}. The experimental results indicate that the characteristic of flow structure in the detachment region are clearly different from that in the magnetized region.