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# Impurity Behavior on Variable of Plasma Flow in Linear Divertor Simulator
# ダイバータ模擬装置によるプラズマ流速の変化に対する不純物粒子の挙動

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Impurity transport phenomena in detached plasma around were studied experimentally. We simulated the impurity backflow using linear divertor simulator, TPD-Sheet IV. The Plasma flow is controlled by ion cyclotron resonance in non-uniform magnetic field. The experiment was conducted using $H_2$ and Ar gas and a discharge current of 50 A. The plasma flow along the axis of the magnetic field was measured using a Mach probe. Intensities of Ar emissions in the detached plasma were measured by a spectrometer.

## 1. Introduction

The reduction of heat and particle loads at the divertor in a magnetically confined fusion device is crucial. It is necessary to reduce the divertor plate heat load to 10 MW/m$^2$. Plasma detachment is one method for reduction of heat and particle loads by using volume recombination processes. Plasma detachment at a divertor plays an essential role in the reduction of heat and particle loads in a magnetically confined fusion device[1]. Recent experiments on detached plasmas in the tokamak with a divertor configuration show that volumetric plasma recombination in the detached plasma plays an important role in the strong decrease in ion particle flux to the target plate[2]. A stationary detached plasma is particularly important for efficient divertor performance. The divertor plasma is cooled due to the radiation loss from the impurity and appears to recombine. In the case of impurity seeding, the backflow of impurities is predicted[3]. The detach plasma has a steep electron and ion temperature gradient so impurity ions are transported from the near-target region to the upstream region by the temperature gradient force[4]. It is important to understand the impurity transport phenomena around the divertor target for the impurity control.

In large fusion experiment devices (such as JT-60U, DIII-D, ASDEX), impurity transport in the divertor region has been investigated by measuring the impurity density and its flow velocity spectroscopically, and tudied by the code including many processes such as the friction between impurities and background particles and temperature gradients. However, it has not been clear how individual physical processes affect the impurity backflow.

By observing the intensity distributions of Ar line emissions, we simulated experimentally the impurity backflow using the linear plasma machine called TPD-Sheet IV.

## 2. Experimental setup

The experiments were performed in the linear divertor simulator TPD-SheetIV[5]. Figure 1 shows the device and the measuring system used. The plasma was divided into two regions, that of the sheet plasma source and that of the experiment. Hydrogen plasma was produced by a modified TPD DC discharge between a LaB6 hot cathode and a hollow anode. Eleven rectangular magnetic coils produced a uniform magnetic field of 0.8 kG in the experimental region. The sheet plasma was terminated by an electrically-floating, water-cooled target plate axially positioned at $z$ = 0.7 m away from the discharge anode. Plasma was generated with a hydrogen gas flow of 75 sccm, at a discharge current of between 30 and 100 A. The neutral pressure $P$ in the experimental region was adjusted to be between 0.05 and 3.0 Pa with a secondary gas feed. Seeding impurity(Ar) is injected by the gas feeder near the target. The Plasma flow is controlled by ion cyclotron resonance in non-uniform magnetic field.

Figure2 shows a block diagram of the RP power supply. The RF application circuit consists of an RF power supply, a matching circuit, and RF electrodes. The RF power supply consists of a function generator, a, RF amplifier, and a power meter. The maximum output of the RF power supply is approximately 500 W. The matching circuit consists of an LC circuit and a BAL-UN circuit, and transmits electric power without loss. The RF electrode is two parallel plate electrodes that are 200 mm long and 60 mm wide and face each other 38 mm apart. The plasma is sandwiched between the two parallel plate electrodes. The electron density and electron temperature are measured with a fast scanning Langmuir probe. The ion temperatures, $T_{i\perp}$ and $T_{i//}$, are measured with a fast scanning Faraday cup and a Faraday cup at the end target, respectively. Intensities of ArII emissions in the detached plasma are measured by a spectrometer. The spectral line of ArII is observed at near the target and around the anode.

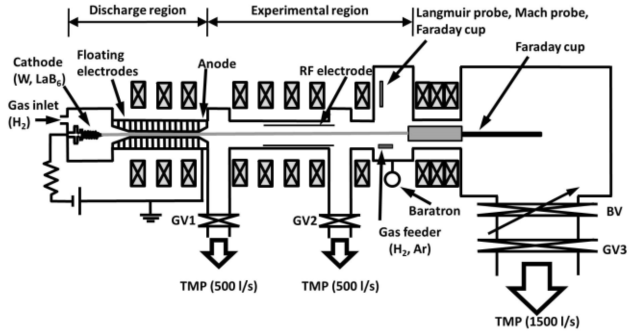

Figure1 Schematic diagram of the experimental setup, TPD-Sheet IV.

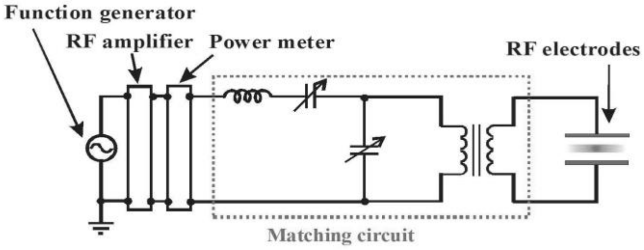

Figure2 Block diagram of the RF power supply.

## 3. Result

Figure 3 graphs the Mach number at a discharge current of 50 A. The Mach number increases with increasing RF power. The ion energy in the direction perpendicular to the magnetic field line ions are also accelerated along the axis of the magnetic field line due to the magnetic field gradient along the axis increases by with ion-cyclotron resonance.

Further details will be presented.

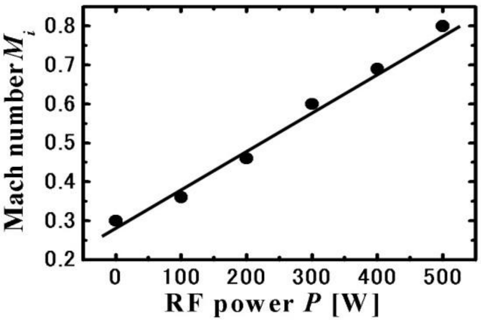

Figure3 Relation between Mach number and RF power at a neutral gas pressure of 0.1 Pa.

## Acknowledgments

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## References

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