§78. Power Balance Estimation Using Water Temperature Increment of Plasma Facing Component and Steady State Operation

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In FY2014, a new water-cooling movable limiter was installed on the vacuum vessel in low field side to measure a heat load distribution oriented from energetic electrons accelerated with an intense microwave of 8.2GHz. Plucking it out of the plasma area, the distribution of the heat load clearly changed over. Estimation of energy distribution of direct-losing electrons may be able to be reconstructed.

1. Introduction

FY2013, plucking the movable limiter out of the plasma area at the mid-plane of QUEST, the distribution of the heat load clearly changed over from the movable limiter to fixed limiters located just on the vessel surface in low field side with keeping the constant sum of their deposited heat load. The observation clearly indicates the heat load is ascribed to direct-losing electrons produced by intense RF injection to drive plasma current [1].

FY2014, a new movable limiter was installed to investigate more details of the heat load distribution and relating energy spectrum of direct-losing electrons on QUEST. This is strongly relating to RF current drive efficiency such as an 8.2GHz microwave.

2. Experimental Apparatus

Another movable limiter (DML) was installed on the outer vacuum vessel on QUEST in addition to the existing movable limiter at the mid-plane (MML) as shown in Fig. 1, which is also useful for efficient heal removal to further extend plasma duration. The movable limiter (ML) is made of tungsten agglutinated on a cupper base, which is located at the lower side by 25.5cm from the mid-plane and is movable in the range of R=1.209-1.239m. As the result, we could obtain a more than 13 min discharge on the inboard null configuration. In this research, we investigated the distribution of the heat load due to direct-losing electrons.

3. Experimental Results

The position of the DML from a plasma in an inboard null configuration was changed shot by shot. The heat load to the DML is mainly delivered by energetic electrons, because it is coming even when the ML locates significantly far from the core plasma. Total amount of the heat load to the MLs measured with the calorimetric manner is almost constant as shown in Fig. 2 [1]. The transition of depositing heat load is coming from magnetic surface structure and orbital shift of direct-losing electrons. The orbital shift is strongly depending on energy of the electrons, therefore the data suits estimation of energy spectrum of the direct-losing electrons.

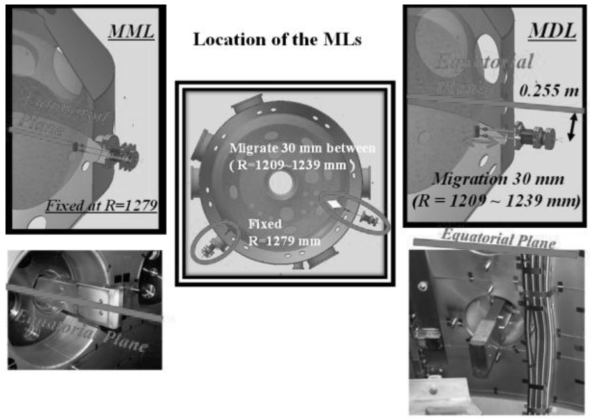

Fig. 1 Layout of the new movable limiter (MDL) and the existing movable limiter (MML). The center figure illustrates a top-cross-sectional view of the QUEST vessel and toroidal position of both MLs is clearly identified. Top-right and top-left show schematic pictures of MML and DML, respectively. Bottom-right and Bottom-left are the pictures of each ML.

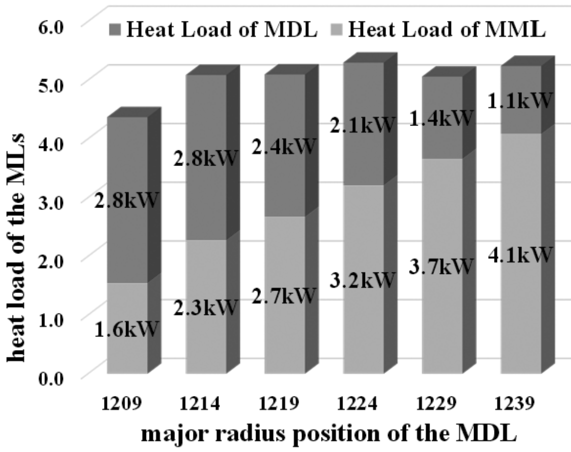

Fig. 2 Heat load distribution depending on the DML position is plotted, when the MML was located at R=1.279m Top and bottom sides of each square prism correspond to the heat load to DML and MML, respectively. Every data was monitored with calorimetric technique for cooling water.

Summary

Heat load measurement was done with a monitoring of temperature increment of cooling water for two movable limiters. Clear transition of heat load depositing on each movable limiter was observed and the data suits the purpose to estimate energy spectrum of direct-losing electrons.

[1] N.Hamada *et al.*, presented in ICPP as the poster MCF.P33. (2014).