



Contribution ID: 129

Type: **Poster presentation**

Comparison of Photometry Measurement and Numerical Analysis for Plasma Density Oscillation with Doubled Value of RF Frequency in J-PARC RF Ion Source

Monday 16 October 2017 18:45 (15 minutes)

A direct comparison of Balmer line emission from J-PARC RF ion source (RFIS) plasma has been made between photometry measurement and 3D3V numerical analysis. The J-PARC RFIS has internal antenna coil for injection of a few 10 kW RF power with RF frequency of 2 MHz. Negative hydrogen ion (H^-) current of 45 mA is extracted with energy of 50 keV during the user operation in present. In the photometry measurement, line intensity has been observed by high time resolution photomultiplier through collimator lens of the source chamber. Time variation of RF current is also measured to observe the relation between time structures of RF current and line intensity (plasma density) oscillation. From the comparison, we confirmed two main physical behaviors of the RFIS plasma; (i) transition between E-mode to H-mode in a few micro seconds after RF power injection and (ii) oscillation of plasma density with doubled value of RF frequency (4 MHz). From the physical model in this study, the relation between source design and plasma/ H^- behaviors in the RFIS are also discussed.

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Session Classification: Poster Session 1

Track Classification: Fundamental processes