

§ 21. Development of Multi-antenna RF Ion Source II

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We have been developing the multi-antenna rf ion source [1-2]. As a filament free system, rf ion sources have several advantages, such as easy maintenance, long operation time, less contamination from the filament metals etc. In order to use the rf source for the practical NBI source for the fusion research, high beam current and large diameter beam are necessary to be developed. We examined the high rf performance of the multi-antenna ion source.

To increase the beam current of the rf ion source, the large rf power input into the antenna is necessary. For this purpose, mechanism of the rf voltage breakdown on the antenna needs to be solved. The multi-antenna system can reduce the antenna inductance and reduce the rf voltage on the antenna as a result. In addition, the reduction of the antenna voltage can reduce the plasma potential and fluctuations as well. The antenna elements are made of copper rods and placed in ceramic pipes to avoid taking the net electron current from the plasma, which raises the plasma potential. The antennas are installed in 35 cm x 35 cm x 18 cm rectangular bucket chamber (Fig. 1(a)) and are connected electrically outside the chamber to make 4-parallel antenna system (Fig. (b)). The maximum rf power of 9MHz is 25kW. The ion saturation current I_{ion} is measured by a Langmuir probe. In Fig.2, the rf power dependence on I_{ion} is shown. There seems to be two discharge modes above 10kW. The low density mode is capacitive coupled discharge and the high density mode seems to be the inductive one. In order to increase the rf power, the modification of the rf feed through of the antennas is now under the preparation.

References

- 1) Shoji, T, Sakawa, Y, Hamabe, M and Oka, Y., Ann. Rev, NIFS, (2001) 141
- 2) Shoji, T, Sakawa, Y, Hamabe, M and Oka, Y., Ann. Rev, NIFS, (2002) 140

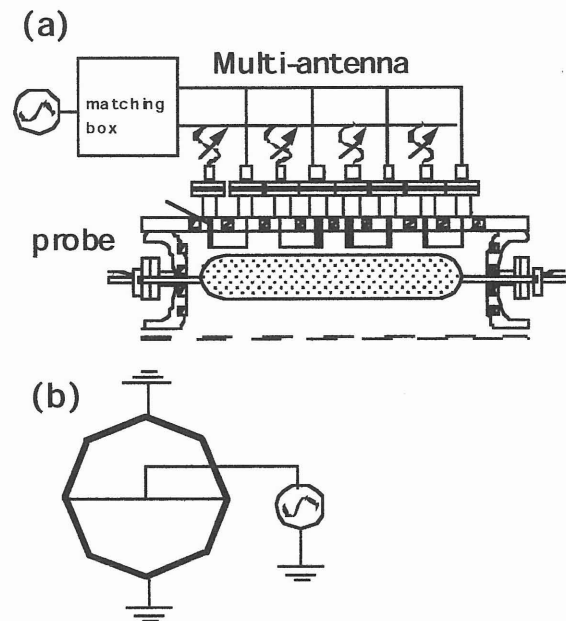


Fig. 1 (a) Multi-antenna rf ion source and segmented antennas, (b) 4-parallel antenna system.

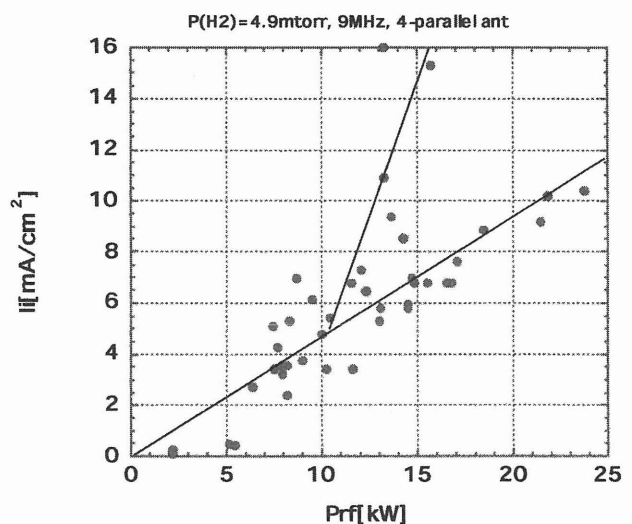


Fig. 2 Ion saturation current at the center of antenna loop as a function of rf input power.