

Optimal Position of Ion Source for High Performance of IEC

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An inertial electrostatic confinement (IEC) fusion device is possibly used for the portable neutron sources. Recent paper reported that the neutrons of 1.8×10^8 n/s are produced by the use of the glow discharge under the conditions of about 0.5 Pa deuterium gas pressure and the applied voltage of 180kV¹⁾. In the most of IEC device, since gas pressure is too high, the accelerated ions lose their energy with the collisions with the neutral gas. The conditions of the high voltage and the low pressure are preferable because the energy which beam ions possess is used for the fusion reaction more efficiently. It, however, is difficult to keep the steady operation because the glow discharge at the low-pressure is not stable. One of the solutions is to equip ion sources such as a magnetron for supplying the ions near the anode.

We investigate the optimal position of ion sources to achieve a stable discharge even in the low pressure and stable discharge in the device by three-dimensional orbit following numerical code. This code includes atomic process, elastic collisions and the three dimensional electric field effects due to solid structures of the current feed-through and the cathode structures. We set D_2^+ ions at nearby inner side of the anode surface and trace the orbit of the ions until the ions are lost by the collisions with either the cathode or the feed-through or neutral gas.

The following results are obtained by the calculations.

1. The place where the ion source can realize the longest life of ion beam is 35 east longitudes and north latitude 11 degrees on the anode sphere (see Fig.1).
2. The optimal position equipping ion sources, in fact, depends on the operational gas pressure and the size of an ion source.
3. In order to expect that neutrons are generated effectively in low gas pressure by the beam-beam fusions, it is necessary to install two or more ion sources at the optimal positions on opposite sides.

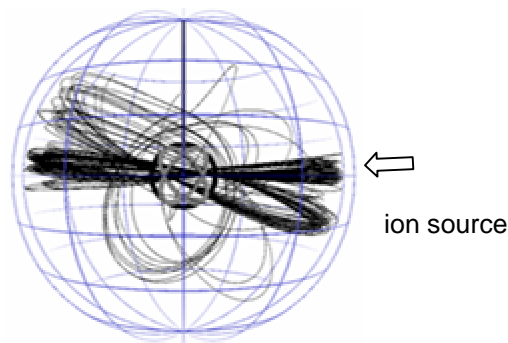


Fig.1 One example of ion beam orbit from the ion source

- 1) G. L. Kulcinski, et al. "6th US-Japan Workshop on Inertial Electrostatic Confinement Fusion" Tokyo Institute of Technology Yokohama, Japan Oct.20-21, 2003.