**TuePE21**

# Analysis of the Beam Halo in Negative ion Sources by Using 3D3V PIC Code

Kenji Miyamoto[1], Shu Nishioka[2], Ippei Goto[2], Akiyoshi Hatayama[2], Masaya Hanada[3], and Atsushi Kojima[3]

[1] *Naruto University of Education, 748 Nakashima, Takashima, Naruto-cho, Naruto-shi, Tokushima 772-8502, Japan*

[2] *Faculty of Science and Technology, Keio University, 3-14-1 Hiyoshi, Kohoku-ku, Yokohama 223-8522, Japan*

[3] *Japan Atomic Energy Agency, 801-1 Mukouyama, Naka 319-0913, Japan*

*Corresponding Author: Kenji Miyamoto, e-mail address: kmiyamot@naruto-u.ac.jp*

Negative ion based neutral beam injection system is one of the promising candidates for plasma heating and current drive of magnetic fusion reactors. The negative ion source which can produce negative ion beams with high power and long pulse is the key component for this system. One of the key issues for the design and development of such negative ion sources is to clarify negative ion trajectories. Especially, to understand the physical mechanism of the beam halo formation in the negative ion sources is inevitable for the suppression of the heat loads in the accelerator.

In this study, the negative ion trajectories from the plasma meniscus to the accelerator are investigated to clarify the halo formation and analyze the beam halo in the accelerator quantitatively. The negative ion trajectories from the plasma meniscus to the extractor are calculated by using the 3D PIC code in which the plasma meniscus is calculated self-consistently without any assumptions. On the other hand, the negative ion trajectories in the accelerator are calculated by using the commercial software (Omnitrak, Advanced Science Laboratory, Inc.) with the boundary condition that the potential at the location of 20 mm away from the exit of the extractor is given to be 52.4 kV.

The physical mechanism of the halo formation reported in ref. [1] with the 2D PIC code is verified: The beam halo consists of the negative ions extracted from the periphery of the meniscus, while the beam core consists of the negative ions extracted from the center of the meniscus. The curvature of the meniscus becomes larger near the periphery. Therefore, the difference of negative ion extraction location results in a geometrical aberration, and then the beam halo.

**References**

[1] K. Miyamoto, S. Okuda, A. Hatayama, M. Hanada, and A. Kojima, Appl. Phys. Lett., 102, 023512-1 (2013).