Contribution ID: **46** Type: **Poster**

Model Improvement for Isotope Effects in a Negative Ion Source Using KEIO-MARC and Rate Equation Model

Monday, 8 September 2025 16:30 (1h 30m)

In the Research and Development Negative Ion Source (RNIS) at the National Institute for Fusion Science (NIFS), it has been reported that the electron density increases by approximately three times when changing the operation gas from hydrogen to deuterium [1].

In the previous studies, analyses were carried out using a three-dimensional kinetic electron transport code KEIO-MARC and a rate equation code 0D model to understand the hydrogen isotope effects [2]. The simulation showed that the electron density in the deuterium case was 1.61 times larger than in the hydrogen case, due to differences in vibrationally excited states of molecules and the sheath potential. However, the simulation results did not fully explain the discrepancy of electron density observed in the hydrogen and deuterium experiments.

In this study, to analyze the isotope effects in more detail, the numerical model has been improved in the following points: (1) the recombination process of protons is introduced into KEIO-MARC to solve the behavior of low energy electrons more precisely in the simulation. As the loss of low energy electrons is enhanced by the recombination process, the electron temperature is expected to increase. (2) The confinement time estimated in the KEIO-MARC is substituted into the 0D model to ensure consistency in the electron transport loss between the two codes. In addition, the 0D model is more closely coupled with KEIO-MARC for improved self-consistency.

In the presentation, impacts of these model improvements on results will be discussed in detail. In addition, the influence of arc current on hydrogen isotope effects will also be discussed. It is expected that increasing the arc current enhances the dissociation of molecules, resulting in a suppression of isotope effects in molecular processes.

[1]H. Nakano, et al., J. J. Appl. Phys. 59, SHHC09 (2020).
[2] K. Iwanaka, et al., 20th International Conference on Ion Source, Victoria Canada, 2023.

Primary author: SOEJIMA, Hayato (Keio-University)

Co-authors: SHIBATA, Takanori (KEK); NAKANO, Haruhisa (National Institute for Fusion Science, National Institutes of Natural Sciences); HAYASHI, Katsuya (Keio University); MIYAMOTO, Kenji (Naruto University of Education); Prof. HOSHINO, Kazuo (Keio University)

Presenter: SOEJIMA, Hayato (Keio-University)

Session Classification: Poster Session

Track Classification: Negative ion sources and sources for fusion facilities