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HU-ACE NEWS LETTER

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Activities of the Core

Mar. 3, 2025	The 17th Hiroshima University Biomass Premium Evening Seminar (co-organized by HU-ACE)
Mar. 17, 2025	The 101th HU-ACE Steering Committee Meeting
Mar. 21, 2025	The 10th Geo-seminar (organized by HU-ACE)
Mar. 24, 2025	The 30th Hiroshima University Biomass Project Center Symposium (co-organized by HU-ACE)

Biomass Symposium was held.

On March 24, 2025, we co-organized the Biomass Symposium “Workshop: Biofuels from the Basics” with HOSTY Biomass Gourp and Biomass Project Research Center in hybrid. The seminar featured lectures on three representative biofuels: wood pellets, biodiesel, and biogas in addition to a topical lecture on cultivation and utilization of microalgae through a joint research project between Hiroshima University and Mazda Motor Corporation. The lecture of microalgae was a notable one in terms of the future technology development. The purpose of this seminar was to provide clear explanation from the basics and share the latest information with those who are not specialists in biomass, those interested in biomass utilization, and those considering the introduction of biomass in their work. This seminar is held every March, so we look forward to your participation in the next year.

Related Events

Apr. 23, 2025: 16:20-17:50 The 120th Hiroshima University Biomass Evening Seminar (co-organized by HU-ACE)
Jun. 30, 2025-Jul. 1, 2025: The 9th International Symposium on Fuels and Energy (ISFE2025)

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Research consultation and joint research are welcome.

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Research Topics

Development of Edge Transport Analysis Methods for Multi-Ion Plasma

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Research fields :Nuclear Fusion

Keywords: Plasma, Magnetic confinement fusion, Edge transport

Abstract

Background

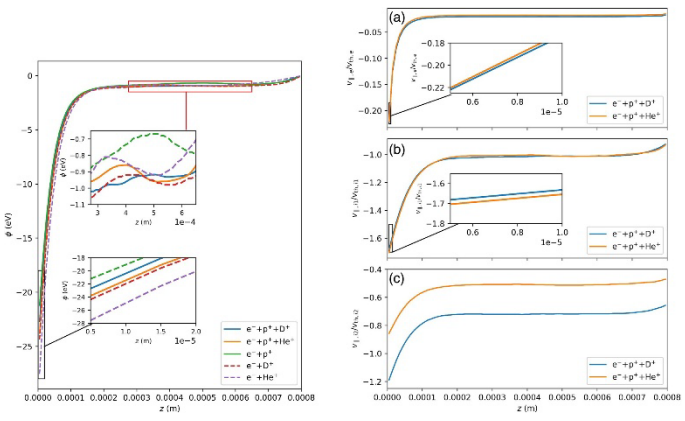
Magnetic confinement fusion utilizes the nuclear fusion reaction by creating high temperature and density conditions. However, in the future fusion power plant, the problem is how to control the high energy heat flux that is transported from the magnetic field. To control this, an additional magnetic field is created to divert the high energy heat flux, so-called the divertor. The plasma in the divertor is a multi-ion plasma that contains ions of deuterium and tritium, which are fuel particles, as well as ions of helium, which is a product of the nuclear fusion reaction. In addition, those ions are easily neutralized due to the lower temperature of the plasma compared to the center of the device. Most of the plasma studies in the divertor have focused on single ion plasmas, but few have investigated have been conducted on multi-ion plasmas, which is the actual situation. Therefore, we have developed a first-principles simulation code that can solve for multiple ion species in a self-consistent treatment.

Methods

Up to now, the analysis of plasma in a divertor has been based on a fluid model, which approximates the plasma flow as a single fluid flow. However, in a plasma containing hydrogen isotopes and helium, it is impossible to treat the plasma as a single fluid because the size and mass of each ion differ. Therefore, we have developed a new numerical simulation code based on the Particle-In-Cell (PIC) method, a hybrid method that solves plasmas using both particle and fluid properties. Although the PIC method has been used to analyze divertor plasmas, it has rarely been applied to treat multi-ion plasmas, which are the focus of this research.

Results

The figure shows the results of the analysis using the newly developed PIC method. A single-ion plasma consisting of only light hydrogen, deuterium, and helium, a mixed plasma of light hydrogen and deuterium, and a multi-ion plasma of light hydrogen and helium were analyzed. As a result, it was found that the ion velocities vary depending on the ion masses and that the electrostatic potentials in the plasmas differ, reflecting these velocity differences. Further analysis of these results is expected to clarify the behavior of plasmas in fusion reactors.



Ion velocities and static potential for divertor plasma obtained from PIC simulations.

References

Panupong Rintarak, Yasuhiro Suzuki, et al. Contribution to Plasma Physics **64**, e202300140 (2024).