23rd Experimental Campaign, 2021

Weekly Report from LHD Experiment

January 12-14 (12th week)

In the twelfth week, we conducted experiments on plasma diagnostics by spectroscopy, plasma heating characteristics by waves, and turbulent transport characteristics in plasmas.

In the topic of spectroscopy, various experiments were conducted based on the light emitted from the plasma. It is known that there are electrons with extremely high energy due to selective heating by microwaves. We conducted experiments to confirm the existence of such high-energy electrons based on the characteristics of the light emitted by impurity ions in the plasma. Atoms and ions in plasmas emit light of a specific wavelength with an intensity determined by physical constants. It is theoretically predicted that the intensity of the emitted light may change in a magnetic field, so we conducted experiments to verify such theoretical predictions. Finally, we conducted an interdisciplinary experiment based on collaboration with the astronomical field. In order to confirm the occurrence of neutron star polymerization explosions called kilonova, a method of detecting the light emitted by the heavy elements produced in the process has been proposed. In this experiment, heavy elements that are expected to be produced by neutron star polymerization were introduced into the plasma, and the characteristics of the emitted light were investigated.

In the study of plasma heating characteristics by waves, we first conducted an experiment to investigate the role of plasma heating by electromagnetic waves in the ion cyclotron range of frequency (ICRF) on impurity emission in the plasma. We have obtained data for various impurities, as well as data for different heating conditions. We will analyze the impurity distribution and investigate how ICRF heating affects impurity transport in the plasma. In the millimeter-wave heating experiment for deuterium plasmas, we were able to maintain relatively high-density plasmas, and we plan to conduct similar experiments for light hydrogen plasmas to compare them and investigate isotope effects for energy confinement characteristics and turbulence behavior.

In the turbulent transport experiment, we investigated how turbulence responds to changes in the poloidal rotation in collaboration with Kyushu University. In this experiment, we succeeded in reversing the poloidal rotation using neutral beam injection. It was also found that when the direction of poloidal rotation was reversed, low frequency fluctuation appeared in the plasma. In a joint research with Southwest Jiaotong University in China, we conducted an experiment to visualize turbulence in the plasma edge using the gas puff imaging instrument that we have been jointly developing. As a result, it was found that in deuterium plasmas, larger flows are formed in the plasma edge than in light hydrogen plasmas. In addition to these experiments, we also conducted experiments on the transition of the energy confinement state of the plasma, the development of instability in the plasma core region, and the velocity distribution of fast ions.

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