Department of Electrical and Computer Engineering

Study on the plasma physics of magnetized fusion plasma

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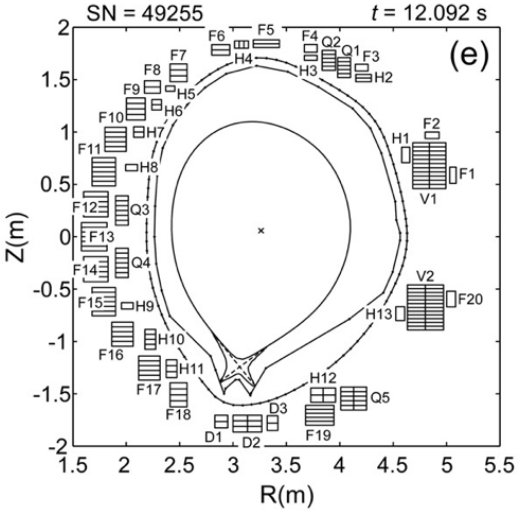
Research Outline

Data analysis and Simulation of plasma current decay during the disruption in tokamak fusion devices

Nuclear fusion process is expected for new energy sources. Many methods of making nuclear fusion process are exists, especially, the magnetic confinement fusion reactor is advanced. Disruption phenomena in a tokamak device, which is one of magnetic confinement fusion reactor, is one of the most critical issues for the ITER and DEMO reactors. Because disruption releases all thermal and magnetic energy in a brief period, it leads to the generation of heat loads on plasma-facing components (PFCs) and the inducing of large electromagnetic forces in the vacuum vessel and in-vessel components. If these forces are large, they can cause serious damage to these components. For the ITER(Internation Themonuclear Experimental Reactor) and DEMO reactors, it is necessary to avoid or mitigate disruption because the generation of disruption could lead to damage in the device.

Electromagnetic forces in vacuum vessel and in-vessel components are generated by the mutual interaction between the magnetic field and eddy and halo currents. In our laboratory, to predict the eddy and halo currents in the ITER and DEMO reactors, we analyze the experimental data in large tokamak devices, such as JT-60U(QST) and other tokamak devices, and simulate the disruption phenomena to make a physical model.



Development of method of 2D fluctuation measurement in plasma

In our laboratory, we are developing a compact and high-particle-flux thermal-lithium-beam source for two-dimensional measurement of plasma fluctuation. The study of the edge plasma in a magnetized confinement plasma is important because the edge plasma condition influences the formation of transport barrier, the edgelocalized modes (ELMs), etc. In addition, the edge plasma plays the role of a buffer layer in transferring a thermal energy from the main plasma to the divertor region. However, the physical mechanism of the edge plasma during disruption and ELMs has not thus far been understood.

Particle-beam probe diagnostics have been established to measure the plasma parameters of the edge plasma with high time and spatial resolutions. In such diagnostics, accelerated atoms from a thermal heater or particle gun are injected into the plasma, and the plasma parameters are measured by a photon emission by electrically excited particles. The lithium beam probe method has been used for electron density measurements of the edge plasma. In our laboratory, we are developing the 2D electron density measurement with high time resolution using a sheet-shaped thermal lithium beam source and fast camera.