U054-026 **Room: Ocean B** **Time: May 15 13:45-14:00**

Introduction to plasma measurements/diagnostics and new technologies in the laboratory physics, astrophysics, and space physics

Shinichiro Kado[1]; Shunji Kitamoto[2]; # Masafumi Hirahara[3]

[1] High Temperature Plasma Ctr., Univ. Tokyo; [2] none; [3] Department of Physics, Rikkyo University

This tutorial talk presents the introductory knowledge and typical principles, methods, and new technologies of the plasma measurements in the research fields of three scientific societies, i.e., The Physical Society of Japan, Astronomical Society of Japan, and Society of Geomagnetism and Earth, Planetary, and Space Sciences.

The first introduction is on the laboratory experiments of the plasma in a magnetic fusion devices, such as tokamaks, helicals and mirrors, and laboratory plasma devices, such as ion sources, arc jets and traps. In these laboratory plasmas, the electron density is from less than 10 to the 15th to more than to the 20th, while the electron temperature is less than 1 eV to more than 10 keV. The electrons with these wide parameter ranges can coexist in fusion-relevant experimental devices. In these devices, active measurements making use of laser, beam or pellet injection can be applied. For the diagnostics which are to be applied to the fusion devices in the future, it is important to develop not only remote-control technologies but also measurement systems that can be used under the considerable neutron flux.

Second topic is given from the high-energy astrophysics research. The technology of the plasma diagnostics for the astrophysics has been developed in order to investigate the extremely high temperature celestial objects, origin and the properties of the extended hot gas in the universe, and to understand the physics of high energy phenomena. In particular, the Japanese 5th X-ray satellite, Suzaku, which was launched on July 10, 2005 by ISAS/JAXA, has three new type instruments. The micro-calorimeter is a non-dispersive X-ray spectrometer with a very fine energy resolution less than 10 eV covering the energy range from 0.5 keV to 10 keV. Although its capability had not been applied to the actual observation of the celestial bodies, its ability can reveal the fine structures of the atomic emission lines and make clear the various plasma properties such as the photo-ionized plasma. Suzaku can observe a very wide energy range with a high S/N ratio. The back-side-CCD and three front-side-CCDs have high quantum efficiencies form 0.3keV to 10keV with a good energy resolution. The well type phoswich scintillators and the silicon PIN detectors cover the hard X-ray region from 10keV to several hundreds of keV, which has an extremely low back ground. These instruments enable us to observe the emission lines from various light elements and cyclotron resonance feature by very strong magnetic field.

The in-situ observations of the space plasma are discussed as the last introductory talk. The space plasma distributing in the vicinity of Earth and planets in the solar system is the excellent target for studying characteristic processes in the non-collisional plasmas, e.g., acceleration, heating, and loss caused by shock, magnetic reconnection, and wave-particle interaction. Measurement techniques of the three-dimensional velocity distribution functions have been innovated for these three decades and actually applied to a number of spacecraft missions. While the detector components like CEM and MCP do not bring energy information of incident particles, their combination with an electrostatic analyzer realize the energy and angular analyses. Several types of mass spectrometers are often adopted behind the energy analyzer for identifying typical ion species in the space near the Earth and planets, which leads us to more comprehensive understanding of the space plasma universe. New types of SSD and APD are intensively researched and developed as well as their read-out electronics for the achievement of a wide energy range observation of the space plasmas from several eV up to several tens of MeV. The ASIC technology is also crucial for reducing the weight, size, and power of the plasma instruments.