RECENT RESEARCH ACTIVITIES

Novel Space Environment Monitor, Instrument, and Space Mission Concepts

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Space Debris Observation, Trajrctory, and Mitigation

The space debris problem is tackled from observation (space situational awareness), trajectory evolution, and mitigation points of view. 1) A method to identify known space debris using MU (Middle and Upper) Radar of RISH, Kyoto Universiry, is investigated with some successful observation results. 2) An on-orbit space debris observing system is studied assuming an optical sensor onboard a satellite. 3) Space debris trajectory evolution is investigated focusing on objects smaller 10 cm. 4) Space debris mitigation (orbit control) using Lorentz force by positive charging effect is studied. The interaction between an electro-statically charged debris and the Earth's plasma environment is investigated. The orbit control method to decrease the altitude using Lorentz force is also studied.

Magneto-Plasma Sail and Electric Sail Space Propulsion System

A Magneto-Plasma Sail (MPS) is a unique propulsion system, which travels through interplanetary space by capturing the energy of the solar wind, which inflates a weak original magnetic field made by a High-Temperature Super-conducting (HTS) coil of several m in diameter with an assistance of a high-density plasma jet. We investigated the methods to maximize the thrust capability by increasing the thrust to mass ratio. The approaches we took are 1) optimizing the HTS coil design to increase the current and maximize its magnetic moment within the capacity of the space vehicle, and 2) developing a deployable HTS coil with a larger diameter to increase the coil area and magnetic moment in space. An Electric Sail (ES) is a space propulsion system by positively charging the extended wires attached to the spacecraft body, which captures the momentum of the solar wind. The thrust of the ES is evaluated and applied for deflecting near-Earth asteroids which has a possibility of approaching the Earth in the near future.

Miniaturization of plasma wave receiver system

To meet the recent requirements on the size, mass and power budgets in constellation missions or planetary missions, the miniaturization of plasma wave receiver is inevitable. The attempt to realize the extremely miniaturized plasma wave receiver have been made using analogue ASIC technology in the lab. The main activity in 2012 is the success in the development of the tiny waveform capture receiver, which is one of the typical types of plasma wave receivers. The size of the developed tiny waveform receiver is about one tenth of the conventional waveform receiver. Moreover, we also succeeded in implementing the preamplifier and the calibration system on the same analogue chip of the waveform receiver.

Quantitative evaluation of electrochemical properties of fine-bubbles in water based on the type of gas

Recently, fine bubble (FB) has found applications in various fields. We have reported the effectiveness of water containing FB water of approximately 100 nm diameter for removal of radioactive cesium from soil and gravel conglomerate and nonwoven cotton. In Fukushima, this method of radioactive contamination removal using FB water is currently under trial. We also investigated the freshness-keeping effect of water containing FB on cut flowers such as a gentian, a lisianthus, and a small chrysanthemum. Although there were statistical dispersions in experimental results, FB was effective in keeping the freshness in the experiments. We focused our attention on the electrochemical properties of pure water (such as pH and electrical conductance) containing FB; we evaluated their correlation with the concentration of FB and investigated their potential for use as parameters for the characterization of FB in water.