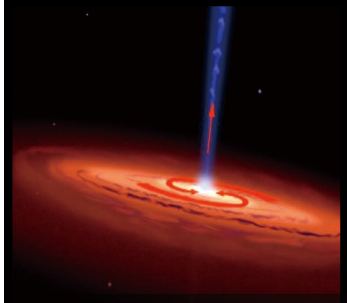
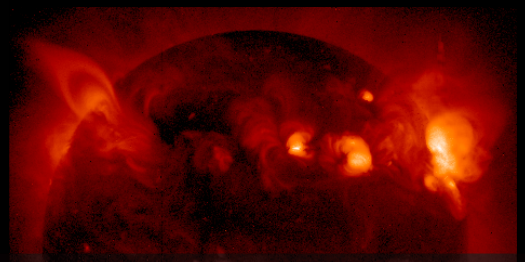
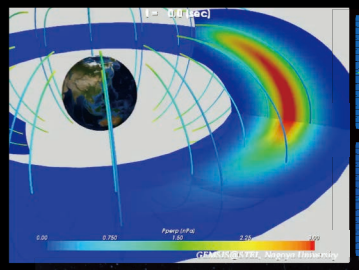
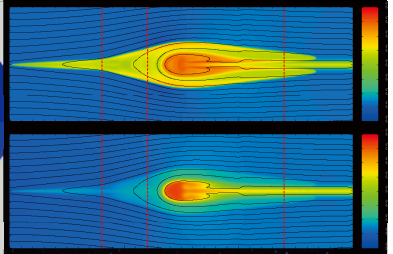
AGU 2019 Fall Meeting (12/12/2019)

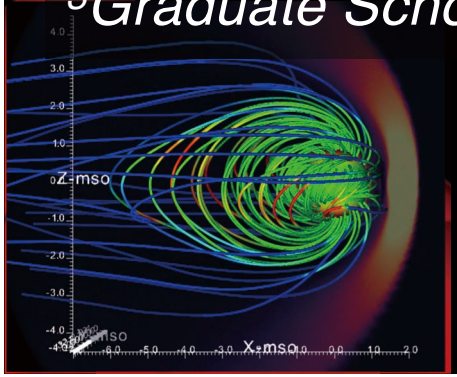
Introduction of the space physics and helio-physics education at the University of Tokyo

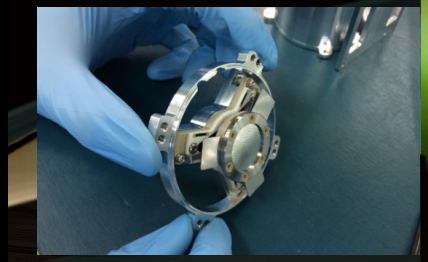


K. Seki[1], M. Hoshino[1], S. Kasahara[1], T. Yokoyama[1], T. Amano[1], K. Keika[1], M. Fujimoto[2], Y. Saito[2], T. Shimizu[2], I. Shinohara[2], H. Hasegawa[2], A. Yamazaki[2], I. Yoshikawa[3], T. Imamura[3], and K. Yoshioka[3]

[1]Department of Earth and Planetary Science, Graduate School of Science, University of Tokyo.
[2]Institute for Space and Astronautical Sciences, JAXA.
[3]Graduate School of Frontier Science, University of Tokyo.





Space physics and heliophysics education at the University of Tokyo

UTOPS in the University of Tokyo

Graduate School of Science

Department of Earth and Planetary Science

- **Space Plasma Theory**
- **Solar Phyisics**
- **Solar-Planetary System Science**
- **Heliophysics with homemade instruments**
- **Comparative planetology**
- **Planetary Material Science**

Department of Astronomy

Graduate School of Frontier Sciences

- **Practical Education**

ISAS/JAXA

- **Education with space missions**

Inter-institutional affiliated faculty

Graduate School of Engineering

- **CubeSat Development**

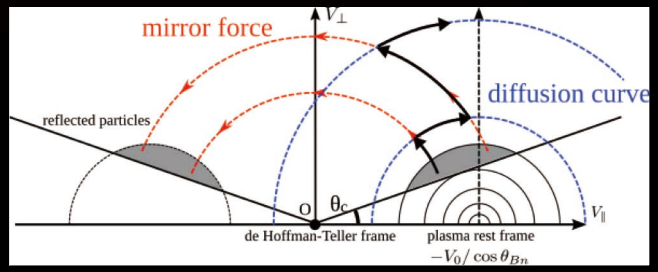
AGU 2019 Fall Meeting (12/12/2019)

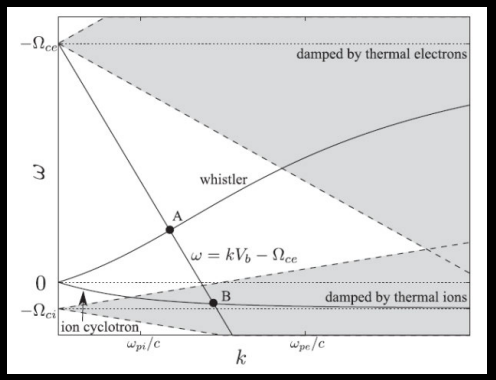
Space Plasma Theory

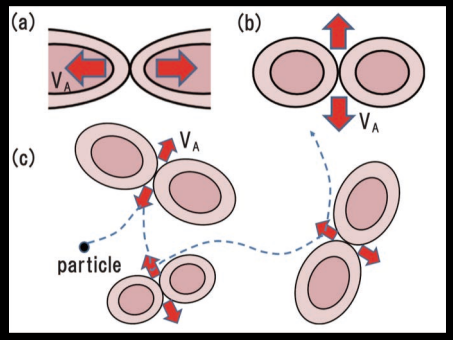
Contact: Hoshino and Amano

Understanding elementary physical processes and application to astrophysics.

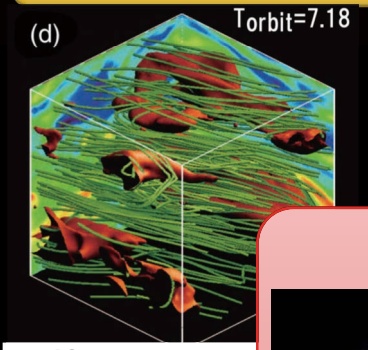
Theory

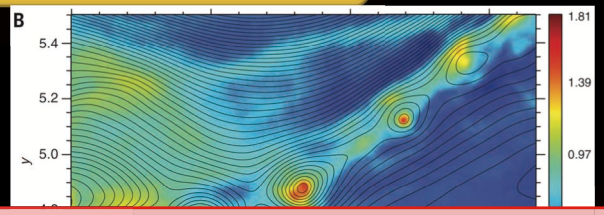


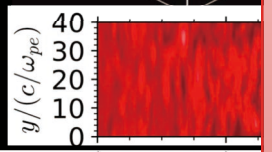


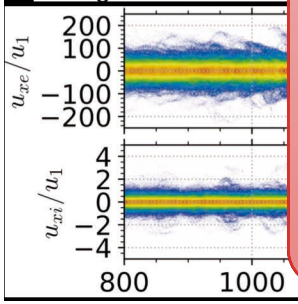


Numerical Simulations

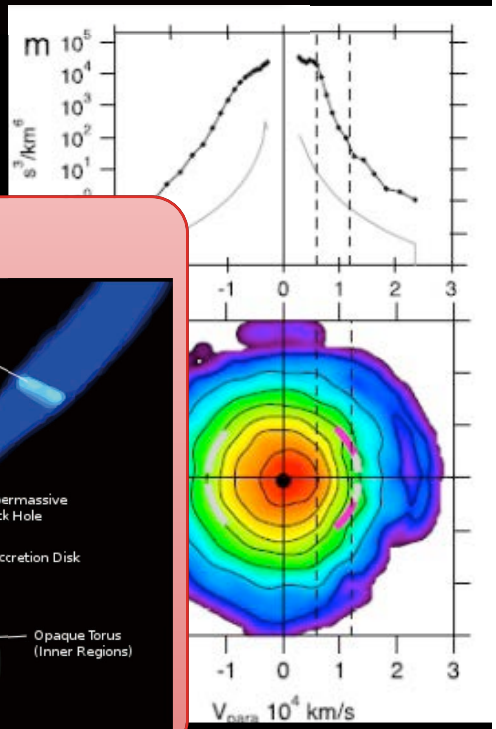




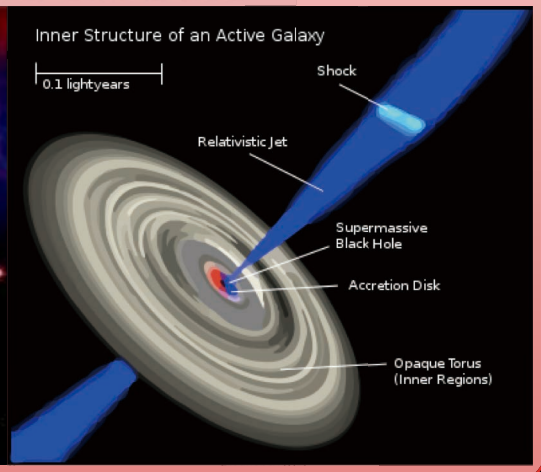




Spacecraft Data Analysis



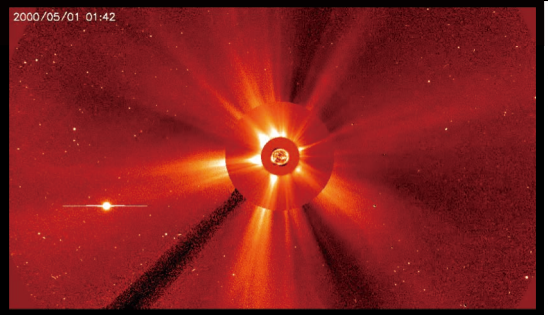
Astrophysical Applications

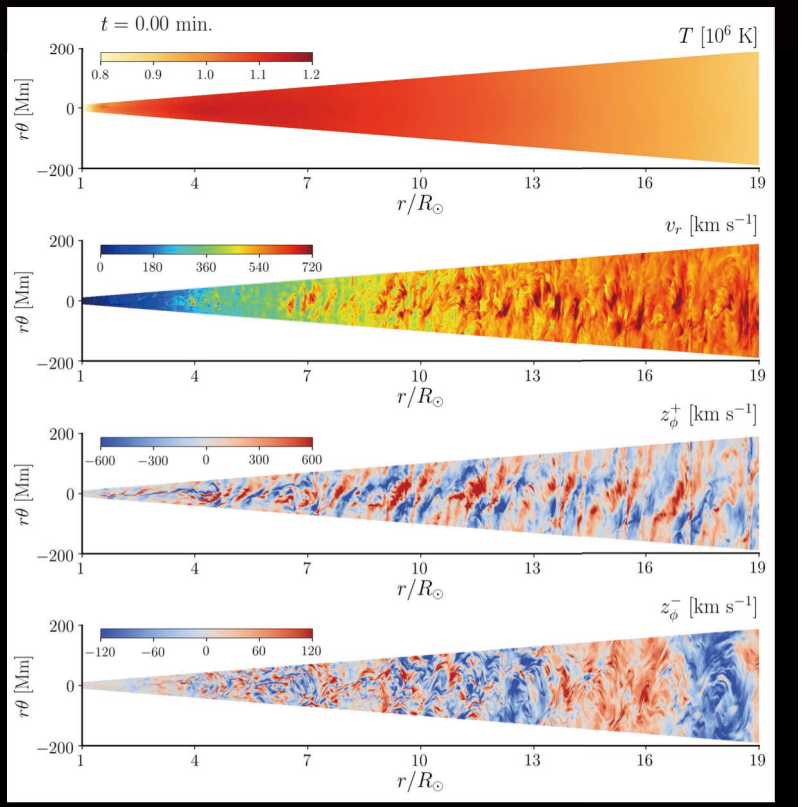


Solar Physics

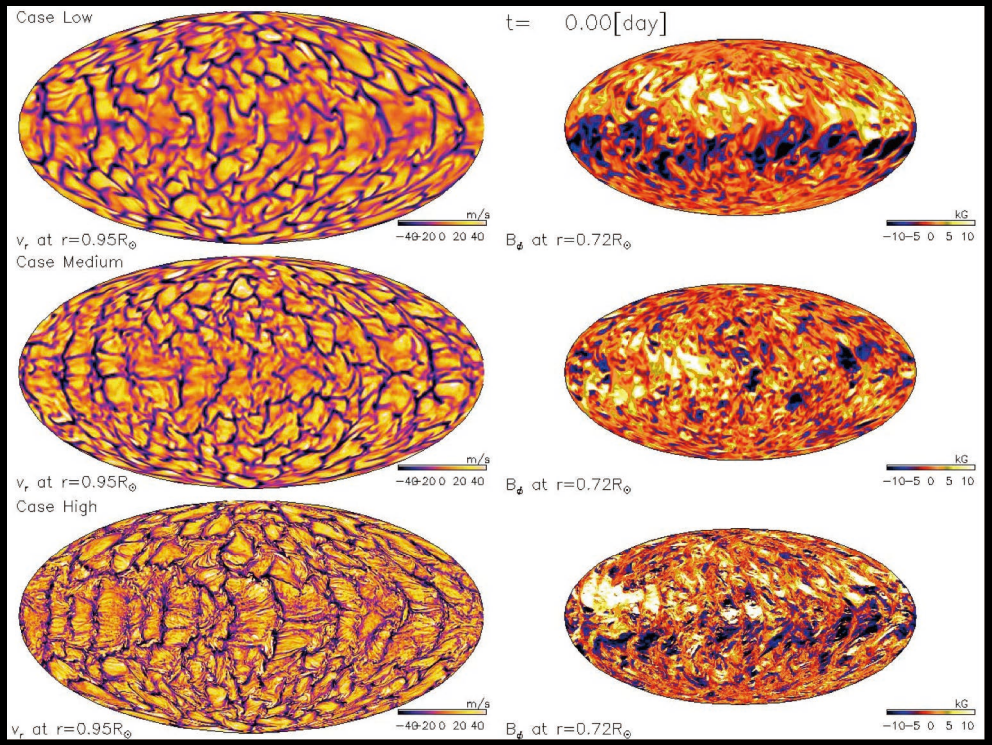
Contact: Yokoyama

Solar plasma dynamics is studied by high-performance computations. Non-linear interactions between the global-scale magneto-flow and small-scale turbulence are the key physics in the phenomena.

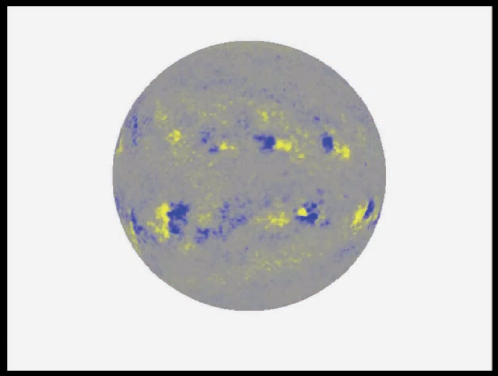




Solar wind (Shoda+ 2019)



Solar interior magnetoconvection (Hotta+ 2016)



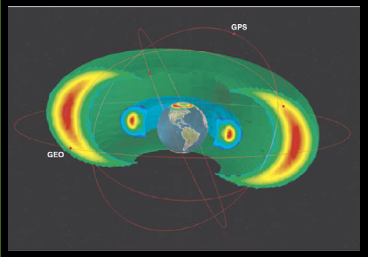
Solar-Planetary System Science

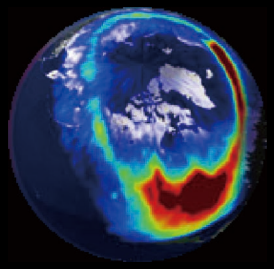
Contact: Seki

Space weather related researches

Plasma processes to cause the dynamic change of geospace environment:

aurora, radiation belts, current system, outflows, atmospheric heating





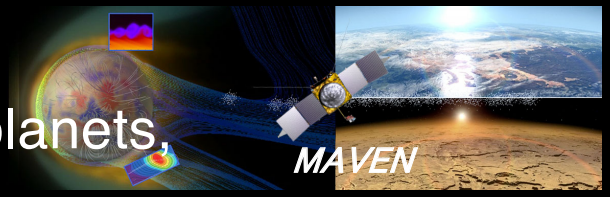
Comparative study of solar-planetary environments

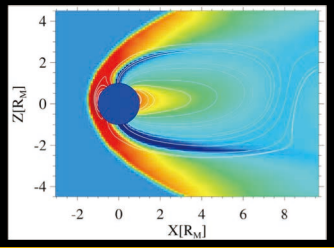
Universality and variety of solar-planetary environment:

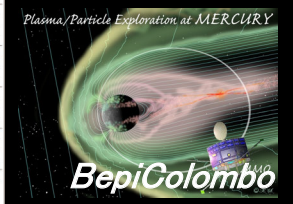
intrinsic magnetic fields,

aurora of unmagnetized planets,

effects of atmosphere, atmospheric escape and habitability, …



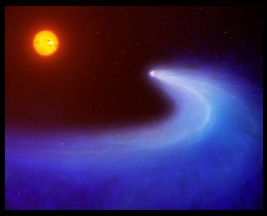


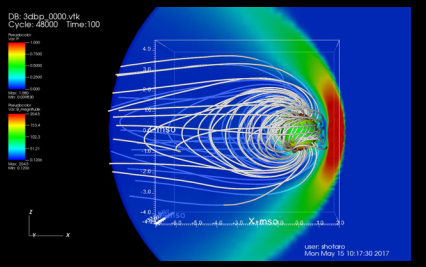


Space climate researches

Relation between solar (stellar) evolution and planetary climate:

Effects of XUV and solar wind evolution on planetary climate, Application to exoplanets, …

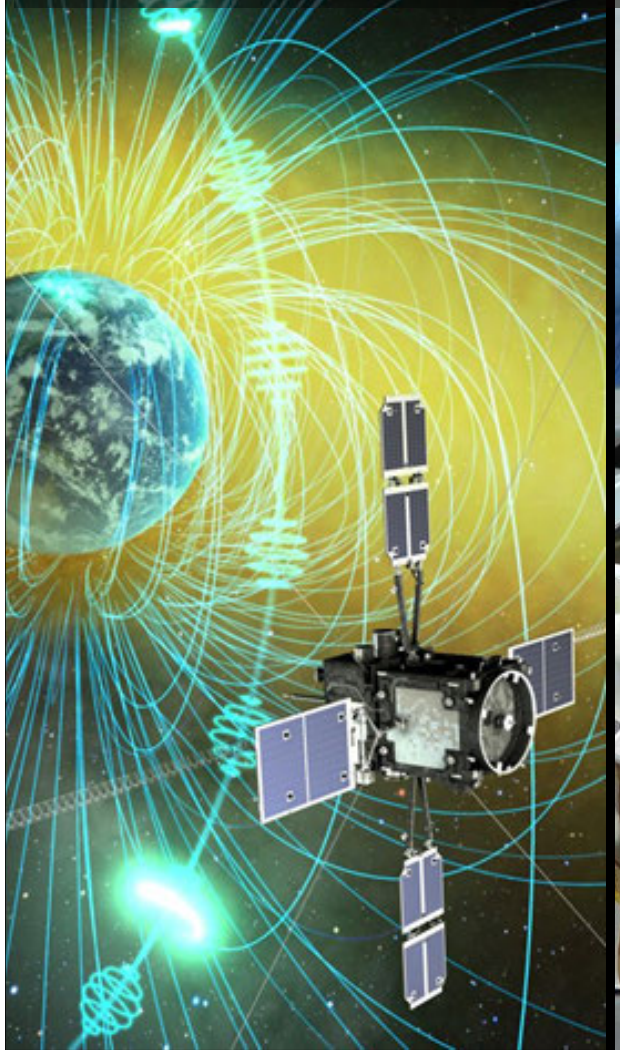


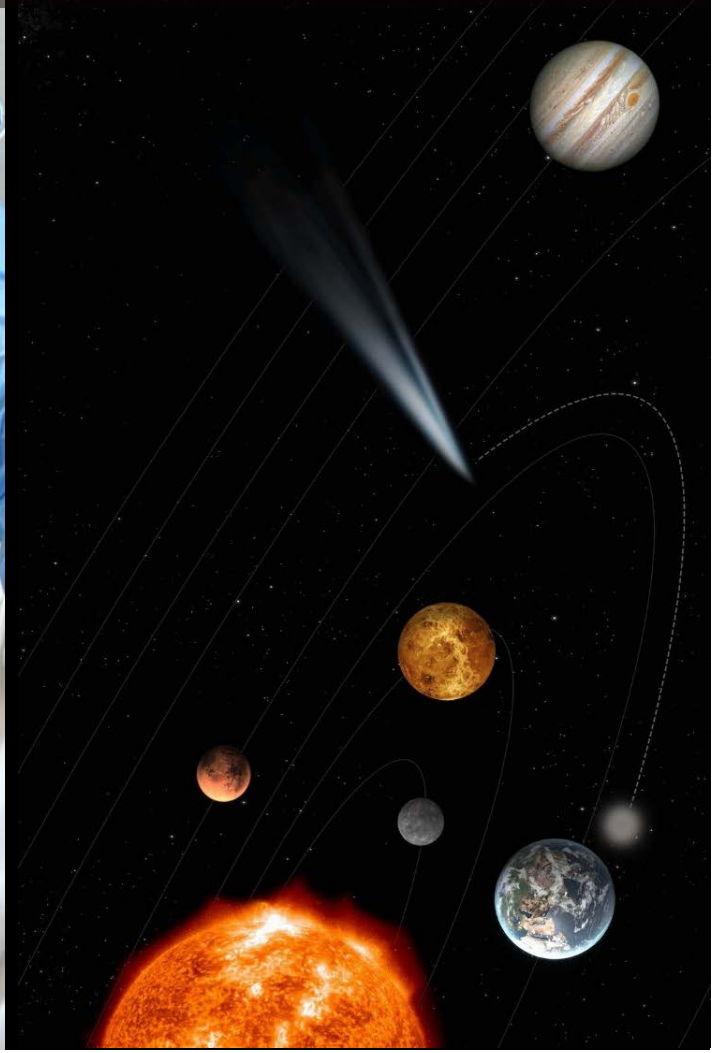


Heliophysics with homemade instruments

Contact: Kasahara

Students lead design, fabrication, and tests of particle instruments (mass spectrometers, electron sensors, etc) onboard spacecraft.
Relevant mission: ***ERG*** (Arase), Comet Interceptor, Mars orbiter, etc





AGU 2019 Fall Meeting (12/12/2019)

Practical Education

Contact: Yoshikawa and Imamura

Hands-on education based on close cooperation between Science and Engineering.

GRADUATE SCHOOL OF FRONTIER SCIENCES
THE UNIVERSITY OF TOKYO

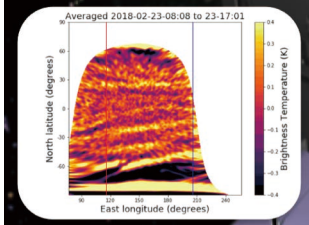
DESP
DEEP SPACE EDUCATION PROGRAM

Key technologies for spacecraft development

- Ion Thruster (Xenon ion & Water ion)
- Science instruments
- Hypersonic Aerodynamics for Atmospheric Entry
- Entry Probe using Deployable Membrane Aeroshell
- Operation for small satellites
- Calibration & Verification of satellites

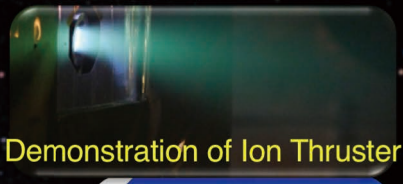
Science

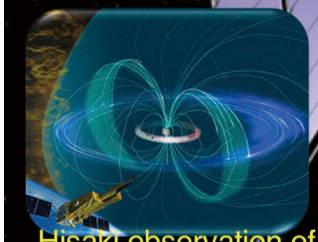
- Analysis of planetary atmosphere images (Akatsuki)
- **S**tudy for magnetosphere of outer planets (Hisaki)

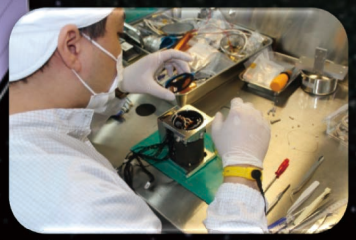


Venus IR image (Akatsuki)

Hodoyoshi-3 (Small satellite)


Demonstration of Ion Thruster

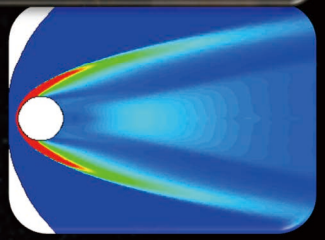

Hisaki observation of the IPT


Development of EUV camera on EQUULEUS

Integration of Hodoyoshi-3 (Small satellite)

Operation of small satellites

Entry Probe Aeroshell

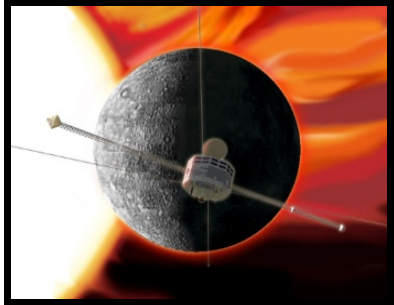

Simulation of Hypersonic

Education with Space missions

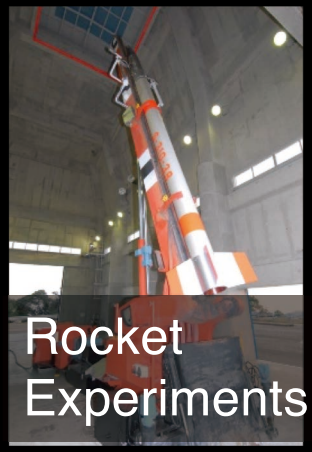
Contact: Saito and Shimizu

Cooperated graduate course at ISAS/JAXA enables students to promote researches and have unique experience in various phases of the satellite and rocket experiments.

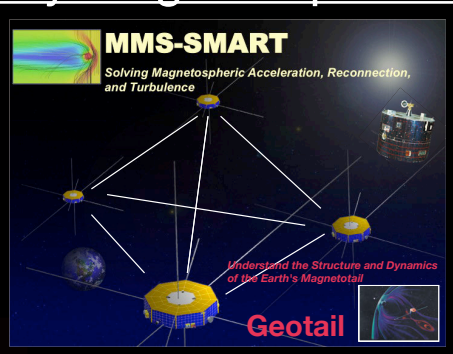
Solar-terrestrial Physics, Planetary magnetospheres



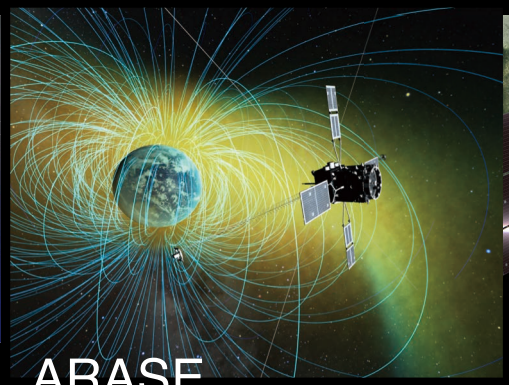
BepiColombo/Mio



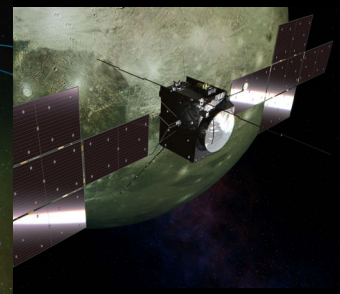
Rocket Experiments



Geotail-MMS



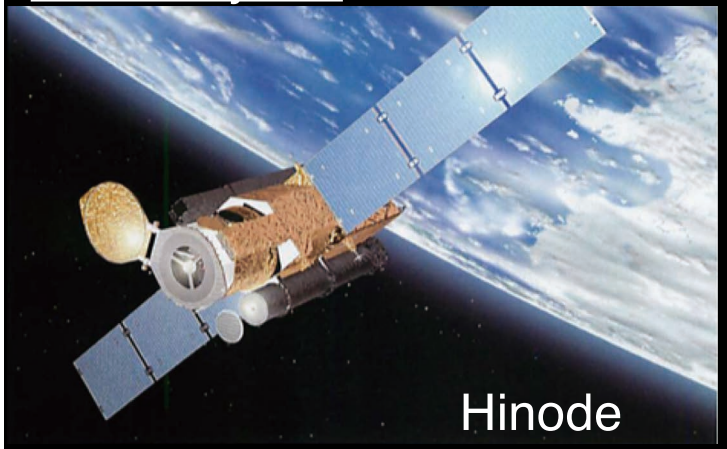
ARASE



JUICE

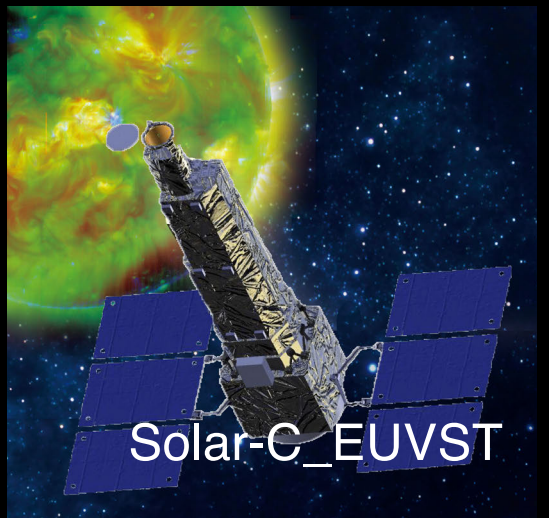
Data analysis Mission operations Instrumentations Future mission planning

Solar Physics



Hinode

Sunrise-3



Solar-C_EUVST

Efforts of inter-disciplinary education

UTOPS

Joint Organization with Astronomy Department and Engineering School

(UTokyo Organization for Planetary Space Science)

- We develop ultra-small spacecraft and miniaturized scientific instruments, aiming at quick and well-focused planetary explorations, with students
- Relevant divisions:
  - ✓Solid planetary observations
  - ✓Astronomical observations
  - ✓Theoretical research
  - ✓Engineering
- Relevant missions:
  - ✓EQUULEUS (6U-cubesat to moon on NASA's SLS)
  - ✓Comet Interceptor (ESA-lead mission)
  - ✓TAO (The University of Tokyo Atacama Observatory)

Summary of space physics & heliophysics education at the University of Tokyo

Department of Earth and Planetary Science in the Graduate School of Science of the University of Tokyo have provided a unique education curriculum both for undergraduate and graduate levels in the space physics and heliophysics in cooperation with ISAS/JAXA as well as with the Graduate School of Frontier Science. The remarkable characteristics of the education curriculum includes:

- close cooperation with astronomy department and engineering school through UTOPS,
- hands-on experience utilizing the cube satellite projects, and
- stimulation of inter-disciplinary minds through a wide range of courses including various research background with strong connection to astrophysics and planetary sciences and methodological (theory/modeling, experiments, and observations) aspects.

Students can major a wide variety of research fields in the graduate course such as the plasma astrophysics, solar-planetary system science, and space and planetary explorations. Joint weekly colloquium and student-lead seminars help students to acquire broad perspectives.

Known issues and future perspectives

- ✓ The number of foreign students are not large and if no foreign students are present, lectures are given in Japanese.

  ⇩

  International student exchange program such as middle- or long-term internship will help students to acquire international communication and collaboration skills and will strengthen our curriculum.

- ✓ SmallSat is useful platform to conduct hands-on education. However, the there is no regular SmallSat program dedicated to the education and the realization of CubeSat or SmallSat depends on funding situation.

  ⇩

  The importance of the regular platform of SmallSat (6U~50kg) dedicated to human resource cultivation are pointed out in many fields of space sciences and aerospace engineering.