Japanese URSI Commission H (Waves in Plasmas)
Activity Report
October 2017 - June 2018

[1] Status of projects related with plasma wave observation

1. BepiColombo/MMO

http://global.jaxa.jp/projects/sat/bepi/
http://www.stp.isas.jaxa.jp/mercury/p_mmo.html

BepiColombo is a Mercury exploration project jointly planned by JAXA and the European Space Agency (ESA), planned for launch in Oct. 2018 and arrival at Mercury in 2025. It consists of two orbiters; the Mercury Planetary Orbiter (MPO) and the Mercury Magnetosphere Orbiter (MMO). JAXA is responsible for development of the MMO.

MMO was shipped from ESA/ESTEC (European Space Research and Technology Centre, Netherlands) to the launch site (Kourou) in April 2018 as a part of the huge cruise stack. For the plasma wave, Plasma Wave Investigation (PI: Y. Kasaba [Tohoku Univ.]) is aboard this spacecraft. PWI will first observe electric field, plasma waves, and radio waves around Mercury, which were not covered by past spacecraft.

The MMO and MPO were carried together by the Mercury Transport Module and the final test in launch configuration was performed in this summer. From October to December, we will perform final stand-alone test of the MMO such as rehearsals of the initial check-out after launch and extension sequence of the wire antennas and masts. PWI science team is now shifting to prepare the telemetry data pipelines and operation planning for the real science execution which will be realized in 2020s.

2. JUICE

http://sci.esa.int/juice/

JUICE (JUpiter ICy moons Explorer) is the L-class mission of ESA, planned for launch in 2022 and arrival at Jupiter in 2030s. It will spend at least three years making detailed observations of the Jovian system including Ganymede, Callisto and Europa, and finally be on the orbit around Ganymede. For the plasma wave, Radio and Plasma Wave Investigation (PI: J.-E. Wahlund [IRF Uppsala, Sweden]) is aboard this spacecraft and covers the information of the exospheres, surfaces, and conducting subsurface oceans of icy satellites and their interactions with surrounding Jovian magnetosphere. From Japan, High Frequency part (Preamp and Receiver) will be supplied (Co-PI: Y. Kasaba [Tohoku Univ.]), and provide the highly resolved information of Jovian radiation emitted from Jupiter and Ganymede by the first 3-axis E-field measurement. For the access to the conductive subsurface ocean, RPWI will first observe cold plasma and electric fields, in order to separate the global conductivity and current from the ionospheres. As a byproduct, reflected Jovian radio emission can be expected from the boundary of crust (ice) and subsurface ocean (conductive water). We already shipped Engineering Model to Europe, and now are manufacturing the Qualification model.

3. Arase (ERG)

http://ergsc.isee.nagoya-u.ac.jp/index.shtml.en
https://ergsc.isee.nagoya-u.ac.jp/mw/

The Arase (ERG; Exploration of energization and Radiation in Geospace) project is a mission to study acceleration and loss mechanisms of relativistic electrons around the Earth. The Arase (ERG) satellite was launched on December, 2016. The Plasma Wave Experiment (PWE, PI: Y. Kasahara [Kanazawa Univ.]) has measured DC electric field and plasma waves in the inner magnetosphere, with two sets of orthogonal electric field sensor (WPT; wire-probe antenna), tri-axial magnetic sensor (MSC; magnetic search coil), and receivers named EFD (electric field

detector), WFC/OFA (waveform capture and onboard frequency analyzer), and HFA (high frequency analyzer). The PWE covers wide frequency range from DC to 10 MHz for electric field and from a few Hz to 100 kHz for magnetic field. The Software-Wave Particle Interaction Analyzer (SWPIA) (PI: H. Kojima, [Kyoto. Univ.]) is equipped to realize direct measurements of interactions between energetic electrons and whistler-mode chorus in the Earth's inner magnetosphere. Moreover, the Arase/MGF observed various kinds of ULF waves in the inner magnetosphere.

Varieties of wave phenomena such as chorus, EMIC, ULF pulsations and lightning whistlers have been successfully observed by the PWE. We have also conducted cooperative observations with the ground-based stations, Van Allen Probes and the other satellites in the magnetosphere. We intensively conducted the PWE burst mode operations, by which waveforms were continuously captured.

4. PWING Project

http://www.isee.nagoya-u.ac.jp/dimr/PWING/en/

The PWING project investigates the process of dynamical variation of the particles and waves in the Earth's inner magnetosphere and clarify the mechanism of the dynamical variation quantitatively. This project establishes eight ground-based stations separately positioned in the longitudinal direction at subauroral latitudes, and observes how the particles rotating round the earth in the space around the earth fall into the earth atmosphere and interact with waves. Seven out of eight stations in Canada, Alaska, Russia, Finland, and Iceland are in full operation since March 2017. Conjugate measurements of particles and waves with the new ERG (Arase) satellite and the Van Allen Probes has been made extensively in 2017-2018.

5. Hisaki spacecraft

http://global.jaxa.jp/projects/sat/sprint_a/

Hisaki satellite with the EUV spectrometer (Extreme Ultraviolet Spectroscope for Exospheric Dynamics: EXCEED) is the UV/EUV space telescope dedicated to planetary sciences.

Hisaki has provided continuous observations of Jovian system in UV aurora total flux and EUV Io torus plasma distributions and plasma diagnostics, which connected the solar wind information and ground-based radio (Decameter [aurora] - VHF [radiation belt]) and IR (aurora and airglows) observations. From July 2016, NASA Juno orbiter started the observation around Jupiter. Hisaki's priority is on the support observation for this mission. The HISAKI mission period has extended until the end of Mar. 2020.

6. GEOTAIL

GEOTAIL spacecraft has been operated since 1992. The Plasma Wave Instrument (PWI) is continuously collecting the high resolution waveform data as well as the spectrum data. The color plots of the observed wave spectrum data have been opened in the PWI web site http://www.rish.kyoto-u.ac.jp/gtlpwi, and http://www.stp.isas.jaxa.jp/geotail. Furthermore, one can easily also make the color spectrum plots in flexible time scales in the NICT web page http://geotail.nict.go.jp/.

7. Development of Real-Time Monitoring System via Visual IoT

Visual Internet of Things (IoT) is a class of IoT that collects rich visual data. In general, the visual IoT device is equipped with a video transmission equipment such as a camera. The involved technologies are advanced video transmission techniques and information extraction from images by image recognition techniques. However, since the video data size is larger than the sensor data size, one of the issues of visual IoT is high-performance video transmission in networks in which the bandwidths are limited. In this paper, we design and develop a real-time monitoring system using visual IoT device. Our system is based on a novel protocol, named high-performance video

transmission (HpVT), for field monitoring via 4G LTE mobile networks. The performance of our system is evaluated in real fields to conclude that we can achieve full high-definition (full-HD) resolution video transmission with as high frame rate as 30 fps.

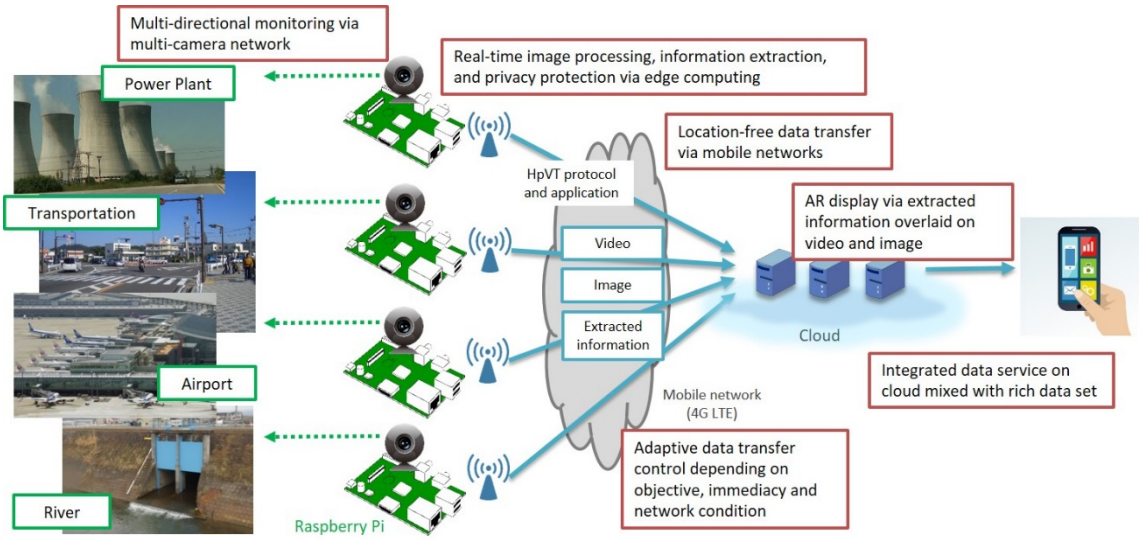

Figure 1 A schematic concept of Visual IoT

[2] Recent Meetings

1. The 12th European Planetary Science Congress (EPSC), Riga, Latvia, 17-22 September, 2017. http://www.epsc2017.eu
2. WDS Asia-Oceania Conference, Kyoto, Japan, 27-29 September, 2017. http://wdc2.kugi.kyotou.ac.jp/wds2017/
3. Arase-Van Allen Probes Joint meeting, Kyoto, Japan, 13-14 October, 2017.
4. SGEPSS Fall Meeting, Kyoto, Japan, 15-19 October, 2017. http://sgepss2017fall.jpn.org/
5. BepiColombo Hermean Environment Working Group Meeting & BepiColombo Science Working Team Meeting, Matera, Italy, 23-27 October, 2017. http://www.iaps.inaf.it/sz/bcswt-matera2017/index.html
6. **International Workshop on radio science and radio application technology (The 359th Symposium on Sustainable Humanosphere)**, Kanazawa, 29-30 October, 2017. The symposium was held in cooperation with Japanese URSI-H commission and subcommittee on plasma wave in SGEPSS (Society of Geomagnetism and Earth, Planetary and Space Sciences). http://www.rish.kyoto-u.ac.jp/events/symposium-0359_/
7. Plasma Conference 2017, Himeji, Japan, 20-24 November, 2017. http://www.jspf.or.jp/PLASMA2017/
8. American Geophysical Union Fall Meeting, New Orleans, 11-15 December, 2017. http://fallmeeting.agu.org/2017/
9. Outer heliosphere and interstellar pickup ions, Nagoya, Japan, 20-22 Feb. 2018. https://sites.google.com/site/heliosphericphysics/isee2017
10. Symposium on Planetary Science 2019, Sendai, Japan, 27 February - 1 March, 2017. http://pparc.gp.tohoku.ac.jp/workshop.html
11. American Geophysical Union Chapman Conference, Particle Dynamics in the Earth's Radiation Belts, Cascais, Portugal, 4-9 March, 2018. http://chapman.agu.org/particle-dynamics/
12. 17th Annual International Astrophysics Conference, Santa Fe, USA, 5-9 March, 2018. https://www.icnsmeetings.com/conference/17thannual/index.html

13. 8th VERSIM Workshop, Apatity, Murmansk region, Russia, 19-23 March 2018.
    http://www.iugg.org/IAGA/iaga_ursi/versim/meetings.html
14. European Geosciences Union (EGU) General Assembly 2018, Vienna, Austria, 8-13 April, 2018.
    http://www.egu2018.eu/
15. Mercury: Current and Future Science of the Innermost Planet, Columbia, Maryland, U.S.A., 1-3 May, 2018.
    https://www.hou.usra.edu/meetings/mercury2018/
16. Investigating the Magnetosphere through Magnetoseismology, Bern, Switzerland, 14-18 May, 2018.
    http://www.issibern.ch/teams/spherethroseismo/
17. Japan Geoscience Union Meeting 2018, Chiba, Japan, 20-24 May, 2018.
    http://www.jpgu.org/meeting_e2018/
18. Atlantic Radio Science Conference (AT-RASC), Gran Canaria, Spain, 28 May-1 June, 2018.
    http://atrasc.com/homepage.php
19. 15th Annual Meeting of Asia Oceania Geosciences Society, Honolulu, Hawaii, 3-8 June, 2018.
    http://www.asiaoceania.org/aogs2018/public.asp?page=home.htm

[3] Future Meetings

1. Magnetospheres of Outer Planets Conference, LASP, Colorado, USA, 9-13 July, 2018.
   http://lasp.colorado.edu/home/mop/mop2018/
   https://lists.colorado.edu/sympa/info/mop_conference
2. The 42nd COSPAR Scientific Assembly, Pasadena Convention Center, USA, 14-22 July, 2018.
   http://cospar2018.org/
3. JUICE-Clipper science workshop, Pasadena, USA, 22 July, 2018.
4. The 40th Progress In Electromagnetics Research Symposium (PIERS), Toyama, Japan, 1-4 August, 2018.
   http://piers.org/piers2018Toyama/
5. Workshop on plasma physics in laboratory, space and astrophysics (The 378th Symposium on Sustainable Humanosphere), Fukuoka, Japan, 20-21 Aug., 2018.
6. The 13th International School/Symposium for Space Simulations (ISSS-13), UCLA, September 6-14, 2018.
   https://conferences.pa.ucla.edu/ISSS13/
7. The 13th European Planetary Science Congress, TU Berlin, Germany, 16-21 September, 2018.
   https://www.epsc2018.eu/
8. JUICE Magnetosphere and Plasma Science Workshop #1, European Space Astronomy Centre (ESAC) Madrid, 26-28 September, 2018.
9. 2nd Asia-Pacific Conference on Plasma Physics (AAPPS-DPP2018), Kanazawa, Japan, 12-17 November, 2018.
   http://www.aappsdpp.org/DPP2018/
10. SGEPSS Fall Meeting, Nagoya, Japan, 24-28 November, 2018.
    http://sgepss.org/sgepss/
11. 16th Annual Meeting of Asia Oceania Geosciences Society, Singapore, 28 July-2 August, 2019.
    http://www.asiaoceania.org/society/index.asp

[4] Recently Published Papers

Hikishima, M., H. Kojima, Y. Katoh, Y. Kasahara, S. Kasahara, T. Mitani, N. Higashio, A. Matsuoka, Y. Miyoshi, K. Asamura, T. Takashima, S. Yokota, M. Kitahara, and S. Matsuda, Data processing in Software-type Wave–Particle Interaction Analyzer onboard the Arase satellite, Earth, Planets Space, 70:80, doi:10.1186/s40623-018-0856-y, 2018.

✓ The software-type wave–particle interaction analyzer (S-WPIA) is an instrument package

onboard the Arase satellite, which studies the magnetosphere. This paper describes the design of the S-WPIA and its calculations in detail, as implemented on board the Arase satellite.

Horky, M., Y. Omura, and O. Santolik, Particle simulation of electromagnetic emissions from electrostatic instability driven by an electron ring beam on the density gradient, Physics of Plasmas, 25, 042905, doi:10.1063/1.5025912, 2018.

- ✓ This paper presents the wave mode conversion between electrostatic and electromagnetic waves on the plasma density gradient.

Hsieh, Y.-K, and Y. Omura, Study of wave-particle interactions for whistler mode waves at oblique angles by utilizing the gyroaveraging method. Radio Science, 52, 1268-1281, doi:10.1002/2017RS006245, 2017.

- ✓ The validity of the gyroaveraging method for calculating oblique wave-particle interactions is confirmed. Multiple resonances of oblique whistler mode waves contribute to accelerations of relativistic electrons. The n = 0 Landau resonance causes significant acceleration by nonlinear wave trapping.

Imajo, S., A. Yoshikawa, T. Uozumi, Shin. Ohtani, A. Nakamizo, and P. J. Chi, Application of a global magnetospheric-ionospheric current model for dayside and terminator Pi2 pulsations, J. Geophys. Res. Space Physics, 122, 8589-8603, doi:10.1002/2017JA024246, 2017.

- ✓ We test the interpretation of ionospheric current oscillations for dayside and terminator Pi2s by numerically evaluating the magnetospheric-ionospheric current system. The calculated ground magnetic field reproduced previous observations and the global pattern of dayside Pi2 equivalent currents. The results indicate that the oscillation of the magnetospheric-ionospheric current system is a plausible explanation of Pi2s on the dayside and near the terminator.

Kakad, A., B. Kakad, and Y. Omura, Formation and interaction of multiple coherent phase space structures in plasma, Physics of Plasmas 24, 060704, doi:10.1063/1.4986109, 2017.

- ✓ The head-on collision of multiple counter-propagating coherent phase space structures associated with the ion acoustic solitary waves (IASWs) in plasmas composed of hot electrons and cold ions is studied here by using one-dimensional Particle-in-Cell simulation.

Kakad, B., A. Kakad, and Y. Omura, Particle trapping and ponderomotive processes during breaking of ion acoustic waves in plasmas, Physics of Plasmas 24, 102122, doi:10.1063/1.4986030, 2017.

- ✓ We performed one-dimensional particle-incell (PIC) simulations to examine the effects of kinetic processes on the behavior of these proxies at the breaking of IASWs in plasmas.

Kaneda, K., H. Misawa, K. Iwai, F. Tsuchiya, T. Obara, Y. Katoh, and S. Masuda, Polarization Characteristics of Zebra Pattern in Type IV Solar Radio Bursts, Astrophys. J., 842, 1, doi:10.3847/1538-4357/aa74c1, 2017.

- ✓ This paper reports coronal plasma structure near source regions and propagtion properties of Zebra-patterns (ZPs) in meter wave band type IV radio bursts based on statistical analysis of polarization characteristics of ZPs.
- ✓ The analysis for 21 ZP events showed that a degree of circular polarization (DCP) correlates with delay between two circularly polarized components, which suggests ZPs were multiply reflected at sharp plasma boundaries near their source regions by changing DCP.

Kaneda, K., H. Misawa, K. Iwai, S. Masuda, F. Tsuchiya, Y. Katoh, and T. Obara, Detection of Propagating Fast Sausage Waves through Detailed Analysis of a Zebra-pattern Fine Structure in a Solar Radio Burst, Astrophys. J. Lett., 855, 2, doi:10.3847/2041-8213/aab2a5, 2018.

- ✓ This paper reports the first detection of short-period propagating fast sausage mode waves in a solar coronal loop based on the analysis of a spectral fine structure for Zebra-patterns (ZPs) of a meter wave band type IV burst.

- ✓ The characteristic spectral features having quasi-periodic modulation and fast negative frequency drift in the ZPs indicate fast sausage mode waves propagating upward at phase speeds of 3000-8000 km/s.

Kasaba, Y., K. Ishisaka, Y. Kasahara, T. Imachi, S. Yagitani, H. Kojima, S. Matsuda, M. Shoji, S. Kurita, T. Hori, A. Shinbori, M. Teramoto, Y. Miyoshi, T. Nakagawa, N. Takahashi, Y. Nishimura, A. Matsuoka, A. Kumamoto, F. Tsuchiya, and R. Nomura, Wire Probe Antenna (WPT) and Electric Field Detector (EFD) of Plasma Wave Experiment (PWE) aboard the Arase satellite: Specifications and initial evaluation results, Earth Planets Space, 69:174, doi:10.1186/s40623-017-0760-x, 2017.

- ✓ Specifications and initial evaluation results of Wire Probe Antenna (WPT) and Electric Field Detector (EFD) onboard the Arase (ERG) spacecraft were summarized. The electric field waveform provides fundamental information about the plasma dynamics and accelerations, and the characteristics of MHD and ion waves. The spacecraft potential provides information on thermal electron plasma variations and structure.

Kasaba, Y., T. Kimura, D. Maruno, A. Morioka, B. Cecconi, L. Lamy, C. M. Jackman, C. Tao, H. Kita, H. Misawa, T. Tsuchiya, and A. Kumamoto, A flux comparison of northern and southern Saturn kilometric radio bursts during southern summer, Planetary Radio Emissions VIII, edited by G. Fischer, G. Mann, M. Panchenko, and P. Zarka, Austrian Academy of Sciences Press, Vienna, 205-215, 2017.

- ✓ The energy flux of the northern and southern Saturn kilometric radiation (SKR) bursts are statistically compared. In the main band (100-400 kHz), S-SKR bursts from summer-side hemisphere were 5-6 times stronger than the N--SKR bursts from winter-side. This is not far from the flux ratio in the non-burst status. In the low-frequency extension (10—50 kHz) of SKR bursts, this ratio is smaller, about 2-3 times.

Kasahara, S., Y. Miyoshi, S. Yokota, T. Mitani, Y. Kasahara, S. Matsuda, A. Kumamoto, A. Matsuoka, Y. Kazama, H.U. Frey, V. Anvelopoulos, S. Kurita, K. Keika, K. Seki, and I. Shinohara, Pulsating aurora from electron scattering by chorus waves, Nature, 554, 337-340, doi:10.1038/nature25505, 2018.

- ✓ This paper reports the Arase observations to indicate the direct evidence of the pitch angle scattering by whistler mode chorus waves. The satellite clearly showed the flux modulations inside the loss cone that are correlated with the lower-band chorus bursts. Both the flux modulations and the chorus bursts have a good correlation with the pulsating aurora.

Kasahara, Y., Y. Kasaba, H. Kojima, S. Yagitani, K. Ishisaka, A. Kumamoto, F. Tsuchiya, M. Ozaki, S. Matsuda, T. Imachi, Y. Miyoshi, M. Hikishima, Y. Katoh, M. Ota, M. Shoji, A. Matsuoka, and I. Shinohara, The Plasma Wave Experiment (PWE) on board the Arase (ERG) Satellite, Earth, Planets and Space, 70:86, doi:10.1186/s40623-018-0842-4, 2018.

- ✓ The Plasma Wave Experiment (PWE) is one of instruments on board the Arase satellite to measure plasma waves and DC electric field. The science targets and specifications of the PWE were introduced.
- ✓ The observation strategy and some initial results obtained by the PWE are also introduced.

Katoh, Y., H. Kojima, K. Asamura, Y. Kasaba, F. Tsuchiya, Y. Kasahara, T. Imachi, H. Misawa, A. Kumamoto, S. Yagitani, K. Ishisaka, T. Kimura, M. Hikishima, Y. Miyoshi, M. Shoji, M. Kitahara, O. Santolik, J. Bergman, W. Puccio, R. Gill, M. Wieser, W. Schmidt, S. Barabash, and J.-E. Wahlund, Software-type wave-particle interaction analyzer (S-WPIA) by RPWI for JUICE: Science objectives and implementation, Planetary Radio Emissions VIII, edited by G. Fischer, G. Mann, M. Panchenko, and P. Zarka, Austrian Academy of Sciences Press, Vienna, 495-504, 2017.

- ✓ This paper presents science objectives of Software-type Wave-Particle Interaction Analyzer, which will be realized as a software function of Low-Frequency receiver running on the DPU of

RPWI for the ESA JUICE mission.

- ✓ By providing the direct evidence of ion energization processes by plasma waves around Jovian satellites, S-WPIA increases the scientific output of JUICE while keeping its impact on the telemetry data size to a minimum.

Katoh, Y., H. Kojima, M. Hikishima, T. Takashima, K. Asamura, Y. Miyoshi, Y. Kasahara, S. Kasahara, T. Mitani, N. Higashio, A. Matsuoka, M. Ozaki, S. Yagitani, S. Yokota, S. Matsuda, M. Kitahara, and I. Shinohara, Software-type Wave-Particle Interaction Analyzer on board the Arase satellite, Earth Planets Space, 70:4, doi:10.1186/s40623-017-0771-7, 2018.

- ✓ This paper describes principles of the Wave–Particle Interaction Analyzer and the implementation of the Software-type WPIA on the Arase satellite.
- ✓ The dedicated system has been developed in the Arase satellite to realize the time resolution required for inter-instrument communication.

Katoh, Y., Y. Omura, Y. Miyake, H. Usui, and H. Nakashima, Dependence of generation of whistler-mode chorus emissions on the temperature anisotropy and density of energetic electrons in the Earth's inner magnetosphere, J. Geophys. Res. Space Physics, 123, 1165-1177, doi:10.1002/2017JA024801, 2018.

- ✓ By a series of self-consistent electron hybrid code simulations, this paper revealed the dependence of chorus generation process on the temperature anisotropy and density of energetic electrons in the Earth's inner magnetosphere.
- ✓ This paper clarified that the spectra of chorus are essentially different from those predicted by the linear theory and are determined fully by nonlinear processes of wave-particle interactions in the chorus generation region.

Kubota, Y., and Y. Omura, Nonlinear dynamics of radiation belt electrons interacting with chorus emissions localized in longitude. Journal of Geophysical Research: Space Physics, 123, doi:10.1029/2017JA025050, 2018.

- ✓ We have developed a new numerical Green’s function method for radiation belt modeling including MLT dependency of chorus emissions. Nonlinear interaction with chorus emissions localized in longitude causes rapid acceleration and precipitation of relativistic electrons. Rapid formation of radiation belt electron fluxes can be reproduced by the numerical Green’s function method.

Kubota, Y., Y. Omura, C. Kletzing, and G. Reeves, Generation process of large-amplitude upper-band chorus emissions observed by Van Allen Probes. Journal of Geophysical Research: Space Physics, 123, doi:10.1029/2017JA024782, 2018.

- ✓ Observations by Van Allen Probes show that the upper-band chorus emissions exist both inside and outside the plasmasphere. The densities and thermal velocities of electrons generating the chorus emissions are evaluated from HOPE particle data. Observed chorus amplitude and frequency ranges agree with the nonlinear wave growth theory.

Kumamoto, A., Y. Kasaba, F. Tsuchiya, H. Misawa, H. Kita, W. Puccio, J.-E. Wahlund, J. Bergman, B. Cecconi, Y. Goto, J. Kimura, and T. Kobayashi, Feasibility of the exploration of the subsurface structures of Jupiter's icy moons by interference of Jovian hectometric and decametric radiation, Planetary Radio Emissions VIII, edited by G. Fischer, G. Mann, M. Panchenko, and P. Zarka, Austrian Academy of Sciences Press, Vienna, 127-136, 2017.

- ✓ A new passive subsurface radar technique using interference patterns in the spectrum of the Jovian HOM/DAM has been proposed, and investigated for implementation on JUICE/ RPWI.
- ✓ Based on the calculation of the attenuation rate of the radio waves in the ice from 80 K to 250 K, the intensity of the subsurface echo was estimated. The waves are expected to reach just above the ice crust/liquid ocean boundary.

Kumamoto, A., F. Tsuchiya, Y. Kasahara, Y. Kasaba, H. Kojima, S. Yagitani, K. Ishisaka, T.

Imachi, M. Ozaki, S. Matsuda, M. Shoji, A. Matsuoka, Y. Katoh, Y. Miyoshi, and T. Obara, High Frequency Analyzer (HFA) of Plasma Wave Experiment (PWE) onboard the Arase spacecraft, Earth Planets Space, 70:82, doi:10.1186/s40623-018-0854-0, 2018.

- ✓ In the initial Arase PWE/HFA operations, UHR waves, AKR, whistler-mode chorus, ESCH waves, and NTC radiation were observed.
- ✓ For the purpose of derivation of electron number density, the semiautomatic UHR frequency identification by the computer and a human operator was applied to the HFA spectrograms.

Matsuda, S., Y. Kasahara, H. Kojima, Y. Kasaba, S. Yagitani, M. Ozaki, T. Imachi, K. Ishisaka, A. Kumamoto, F. Tsuchiya, M. Ota, S. Kurita, Y. Miyoshi, M. Hikishima, A Matsuoka, and I. Shinohara, Onboard Software of Plasma Wave Experiment aboard Arase: Instrument Management and Signal Processing of Waveform Capture/Onboard Frequency Analyzer, Earth, Planets and Space, 70:75, doi:10.1186/s40623-018-0838-0, 2018.

- ✓ We developed the onboard processing software for the Plasma Wave Experiment (PWE) on board the Arase satellite.
- ✓ The specifications of the onboard processing of the PWE especially for the WFC/OFA are introduced.

Miyoshi Y, I. Shinohara, T. Takashima, K. Asamura, N. Higashio, T. Mitani, S. Kasahara, S. Yokota, Y. Kazama, S-Y Wang, S. W. Y. Tam, P.T.P. Ho, Y. Kasahara, Y. Kasaba, S. Yagitani, A. Matsuoka, H. Kojima, H. Katoh, K. Shiokawa, and K. Seki, Geospace Exploration Project ERG, Earth Planets Space, 70:101, doi:10.1186/s40623-018-0862-0, 2018.

- ✓ This paper gives an overview of the ERG/Arase project, and several examples for the plasma waves in the inner magnetosphere observed by Arase are presented.

Miyoshi Y., T. Hori, M. Shoji, M. Teramoto, T. F. Chang, T. Segawa, N. Umemura, S. Matsuda, S. Kurita, K. Keika, Y. Miyashita, K. Seki, Y. Tanaka, N. Nishitani, S. Kasahara, S. Yokota, A. Matsuoka, Y. Kasahara, K. Asamura, T. Takashima, and I. Shinohara, The ERG Science Center, Earth Planets Space, 70:96, doi:10.1186/s40623-018-0867-8, 2018.

- ✓ This paper gives an introduction of the ERG Science Center as a hub of the ERG/Arase project. This center provides data files in a common format, data analysis software and plug-ins for data analysis.

Murata, K. T., P. Pavarangkoon, A. Higuchi, K. Toyoshima, K. Yamamoto, K. Muranaga, Y. Nagaya, Y. Izumikawa, E. Kimura, and T. Mizuhara, A web-based real-time and full-resolution data visualization for Himawari-8 satellite sensed images, Earth Sci. Inform., doi:10.1007/s12145-017-0316-4, 2017

- ✓ In this paper, we develop a web-based data visualization for Himawari-8 satellite sensed images in real time and with full resolution. This data visualization is supported by the ecosystems, which uses a tiled pyramid representation and parallel processing technique for terrain on an academic cloud system.

Nakagawa, T., M. N. Nishino, H. Tsunakawa, F. Takahashi, H. Shibuya, H. Shimizu, M. Matsushima, and Y. Saito, Electromagnetic ion cyclotron waves detected by Kaguya and Geotail in the Earth's magnetotail, J. Geophys. Res. Space Physics, 123, doi:10.1002/2017JA024505, 2018.

- ✓ Narrowband EMIC waves around 0.1 Hz were found on the lunar orbit in the Earth's magnetotail, irrespective of the presence of the Moon. They are thought to be generated through the cyclotron resonance with anisotropic ions in the plasma sheet boundary layer

Nakanotani, M., S. Matsukiyo, T. Hada, and C. X. Mazelle, Electromagnetic structure and electron acceleration in shock-shock interaction, The Astrophys. J., doi:10.3847/1538-4357/aa8363, 846, 113(7pp), 2017.

- ✓ Microstructure of colliding two shocks and the associated electron acceleration process are

investigated by using one-dimensional full particle-in-cell simulation.

Nakanotani, M., T. Hada, and S. Matsukiyo, Diffusive shock acceleration of cosmic rays from two stationary shocks, Earth Planets Space, doi: 10.1186/s40623-018-0799-3, 70, 33, 2018.

- ✓ Diffusive shock acceleration model is extended to the case that there are two stationary shocks are present by using test particle simulation and theoretical model.

Nosé, M., M. Uyeshima, J. Kawai, and H. Hase, Ionospheric Alfvén resonator observed at low-latitude ground station, Muroto, J. Geophys. Res., 122, doi:10.1002/2017JA024204, 2017.

- ✓ The ionospheric Alfvén resonator (IAR) observed at a low-latitude station, Muroto (24.40 deg geomagnetic latitude), is statistically studied. IAR occurs frequently during nighttime and from May to September with frequency separation between the harmonics of 0.2–0.275 Hz. A likely source for IAR at Muroto is the global thunderstorm activity.

Ohya, H., F. Tsuchiya, Y. Takishita, H. Shinagawa, K. Nozaki, and K. Shiokawa, Periodic Oscillations in the D-region Ionosphere after the 2011 Tohoku Earthquake using LF Standard Radio Waves, J. Geophys. Res., 123, doi: 10.0002/2018JA025289, 2018.

- ✓ This paper reports the first observation of earthquake-relatedperiodic oscillation in the D-region ionosphere through the LF standard radio waves. The observation was made just after the 2011 Tohoku Earthquake.

Otsuka, F., S. Matsukiyo, A. Kis, K. Nakanishi, and T. Hada, Effect of upstream ULF waves on the energetic ion diffusion at the earth's foreshock, Part 2: Theory and simulation, J. Geophys, Res., doi: 10.3847/1538-4357/aaa23f, 853, 117(11pp), 2017.

- ✓ Efficiency of spatial diffusion influenced by ULF waves generated by field aligned ion beam observed upstream of the earth's bow shock is studied theoretically and the result is compared with the observation by cluster satellites.

Ozaki, M., K. Shiokawa, Y. Miyoshi, R. Kataoka, M. Connors, T. Inoue, S. Yagitani, Y. Ebihara, C.-W. Jun, R. Nomura, K. Sakaguchi, Y. Otsuka, H. A. Uchida, I. Schofield, and D. W. Danskin, Discovery of 1 Hz range modulation of isolated proton aurora at subauroral latitudes. Geophys. Res. Lett., 45, 1209-1217, doi:10.1002/2017GL076486, 2018.

- ✓ This paper reports discovery of 1-Hz range modulation of isolated proton aurora at subauroral latitudes associated with the Pc1 waves observed on the ground, which are equivalent to the EMIC waves in the magnetosphere.
- ✓ The luminous modulation of isolated proton aurora was twice the frequency of the related Pc1 waves.

Ozaki, M., S. Yagitani, Y. Kasahara, H. Kojima, Y. Kasaba, A. Kumamoto, F. Tsuchiya, S. Matsuda, A. Matsuoka, T. Sasaki, and T. Yumoto, Magnetic Search Coil (MSC) of Plasma Wave Experiment (PWE) aboard the Arase (ERG) satellite, Earth Planets Space, 70:76, doi:10.1186/s40623-018-0837-1, 2018.

- ✓ This paper presents detailed performance values of the Magnetic Search Coil (MSC) that is part of the Plasma Wave Experiment on board the Arase (ERG) satellite.

Saito, S., Y. Nariyuki, and T. Umeda, Generation of Intermittent Ion Acoustic Waves in Whistler Turbulence, Phys. Plasmas 24, 072304; doi:10.1063/1.4990443, 2017.

- ✓ A two-dimensional, fully kinetic, electromagnetic, particle-in-cell simulation in a magnetized collisionless plasma demonstrates the generation of intermittent ion acoustic waves in finite-amplitude whistler-mode turbulence. It shows that ion/ion acoustic instability can be driven as a consequence of the nonlinear evolution of whistler-mode turbulence. The instability triggering the generation of ion acoustic waves occurs intermittently in several local regions in whistler turbulence.

Shiokawa, K., Y. Kato, Y. Hamaguchi, Y. Yamamoto, T. Adachi, M. Ozaki, S.-I. Oyama, M. Nosé, T. Nagatsuma, Y. Tanaka, Y. Otsuka, Y. Miyoshi, R. Kataoka, Y. Takagi, Y. Takeshita, A. Shinbori, S. Kurita, T. Hori, N. Nishitani, I. Shinohara, F. Tuchiya, Y. Obana, S. Suzuki, N. Takahashi, K. Seki, A. Kadokura, K. Hosokawa, Y. Ogawa, M. Connors, J. M. Ruohoniemi, M. Engebretson, E. Turunen, T. Ulich, J. Manninen, T. Raita, A. Kero, A. Oksanen, M. Back, K. Kauristie, J. Mattanen, D. Baishev, V. Kurkin, A. Oinats, A. Pashinin, R. Vasilyev, R. Rakhmatulin, W. Bristow, and M. Karjala, Ground-based instruments of the PWING project to investigate dynamics of the inner magnetosphere at subauroral latitudes as a part of the ERG-ground coordinated observation network, Earth Planets Space, 69:160, doi:10.1186/s40623-017-0745-9, 2017.

- ✓ This paper reports the detailed instrumentations of the PWING longitudinal network project to investigate dynamics of the innermagnetosphere at subauroral latitudes as a part of the ERG-ground coordinated observation network

Shoji, M., Y. Miyoshi, Y. Katoh, K. Keika, V. Angelopoulos, S. Kasahara, K. Asamura, S. Nakamura, and Y. Omura, Ion hole formation and nonlinear generation of Electromagnetic Ion Cyclotron waves: THEMIS observations, Geophys. Res. Lett., 44, 8730-8738, doi:10.1023/2017GL074254, 2017.

- ✓ Wave-particle interaction analysis method is applied to THEMIS data. Energy exchange between EMIC waves and protons is directly detected. Ion hole generated through nonlinear wave-particle interaction is found. The result clearly indicated that the rising tone of EMIC waves are caused by non-linear wave-particle interactions with ring current ions.

Shoji, M., and Y. Omura, Nonlinear generation mechanism of EMIC falling tone emissions. Journal of Geophysical Research: Space Physics, 122, 9924-9933, doi:10.1002/2017JA023883, 2017.

- ✓ EMIC falling tone emissions are reproduced by self-consistent simulation. Proton hill causing frequency drop is found in velocity space. Wave packet modulation by electrostatic structure generates the proton hill generation.

Suarjaya IMAD, Y. Kasahara, and Y. Goto, Statistical study on propagation characteristics of Omega signals (VLF) in magnetosphere detected by the Akebono satellite, Earth Planets Space, 69:100, doi:10.1186/s40623-017-0684-5, 2017.

- ✓ This paper shows a statistical analysis of 10.2 kHz signals transmitted from the Omega stations and detected by the Akebono satellite in the plasmasphere. The signal tended to propagate farther on the nightside than dayside and was more widely distributed in winter than summer. It was also demonstrated that more intense signals were detected further from the station when solar activity was at maximum.

Takahashi, N., Y. Kasaba, Y. Nishimura, A. Shinbori, T. Kikuchi, T. Hori, Y. Ebihara, and N. Nishitani, Propagation and evolution of electric fields associated with solar wind pressure pulses based on spacecraft and ground-based observations, J. Geophys. Res. 122, 8446-8461, doi:10.1002/2017JA0233990, 2017.

- ✓ We investigate spatial and temporal evolution of large-scale electric fields in the magnetosphere and ionosphere associated with sudden commencements (SCs) using multipoint equatorial magnetospheric (THEMIS, RBSP, and GOES) and ionospheric (C/NOFS) satellites with radars (SuperDARN). Tailward propagation of E-fields with the fast-mode wave speed is dominant in the equatorial magnetosphere. Poynting flux toward the ionosphere is launched from the equatorial plane. The propagation characteristics of electric fields in the equatorial plane depend on magnetic local time.

Tobita, M, and Y. Omura, Nonlinear dynamics of resonant electrons interacting with coherent Langmuir waves, Physics of Plasmas, 25, 032105, doi:10.1063/1.5018084, 2018.

- ✓ We perform test particle simulations of electrons in an electrostatic model with Langmuir waves

and a non-oscillatory electric field. The simulation results demonstrate deceleration/acceleration, thermalization, and trapping of particles through resonance with a single wave, two waves, and multiple waves.

Tsuchiya, F., H. Misawa, T. Obara, K. Iwai, K. Kaneda, S. Matsumoto, A. Kumamoto, Y. Katoh, M. Yagi, and B. Cecconi, Database of solar radio bursts observed by solar radio spectro-polarimeter AMATERAS, Planetary Radio Emissions VIII, edited by G. Fischer, G. Mann, M. Panchenko, and P. Zarka, Austrian Academy of Sciences Press, Vienna, 445-453, 2017.

✓ This paper introduces fine temporal and spectral resolution observations of solar radio burst by a radio spectro-polarimeter AMATERAS and a database of the AMATERAS observation.

Umeda, T., S. Saito, and Y. Nariyuki, Rapid decay of nonlinear whistler waves in two dimensions: Full particle simulation, Phys. Plasmas, 24, 054503, doi:10.1063/1.4982609, 2017.

✓ The decay of a nonlinear, short-wavelength, and monochromatic electromagnetic whistler wave is studied by a 2D full PIC simulation. There is a new instability for the rapid decay of the parent whistler wave in 2D, which is much faster than in the timescale of the parametric decay in 1D.

Watanabe, M., S. Fujita, T. Tanaka, Y. Kubota, H. Shinagawa, and K. T. Murata, A magnetohydrodynamic modeling of the interchange cycle for oblique northward interplanetary magnetic field, J. Geophys. Res. Space Physics, 123(1), 272–286, doi:10.1002/2017JA024468, 2018.

✓ We perform numerical modeling of the interchange cycle in the magnetosphere‐ionosphere convection system for oblique northward interplanetary magnetic field (IMF). The interchange cycle results from the coupling of IMF‐to‐lobe reconnection and lobe‐to‐closed reconnection.

Zushi, T., H. Kojima, and H. Yamakawa, One-chip analog circuits for a new type of plasma wave receiver on board space missions, Geosci. Instrum. Method. Data Syst. 6, doi:10.5194/gi-6-159-2017.

✓ This paper proposes a new type of FFT-based spectrum plasma wave receiver that overcomes the disadvantages of conventional receivers. To reduce the size of the receiver, its analog section was realized using application-specific integrated circuit (ASIC) technology, and an ASIC chip was successfully developed.