Japanese URSI Commission H (Waves in Plasmas)
Activity Report
July 2018 - March 2019

[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), launched in Oct., 2018 from Kourou (Aarrival at Mercury in 2025). It consists of two orbiters; the Mercury Planetary Orbiter (MPO) and the Mercury Magnetosphere Orbiter (MMO) whose nickname becomes 'MIO'. JAXA is responsible for the latter.
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 missions. The PWI science team is now shifting to develop the telemetry data pipelines and operation planning for the real science execution which will be realized in 2020s. The first step will be the Venus flyby in 2020.

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 2029. It will spend at least three years making detailed observations of the Jovian system including Ganymede, Calisto 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. 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). From Japan, High Frequency part (RWI-Preamp and HF-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. We already shipped Engineering Model, Structural and Thermal Model and Qualification Model to Europe. We will manufacture and ship the Flight Model (RWI-preamp) and Proto-Flight Model (HF-Receiver) in 2019.

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) was launched in Dec., 2016, and the prime mission started in March, 2017. The Plasma Wave Experiment (PWE, PI: Y. Kasahara [Kanazawa Univ.]) has measured DC electric field and plasma waves in the inner magnetosphere covering 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.
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. During the prime mission, all science instruments have operated in good health and the JAXA has approved the mission extension of Arase until end of March, 2022.

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 has operated eight ground-based stations separately positioned in the longitudinal direction at subauroral latitudes in Canada, Alaska, Russia, Finland, and Iceland, using induction magnetometers, riometers, VLF/ELF receivers, and all-sky airglow/aurora imagers and EMCCD cameras 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 2017-2019.

5. Ground-based observation of solar and planetary radio waves

http://pparc.gp.tohoku.ac.jp/data/iprt/index.html

http://ariel.gp.tohoku.ac.jp/jupiter/

Ground-based observation of solar and planetary radio waves is performed using IPRT (Iitate Planetary Radio Telescope) and HF antenna array developed by Tohoku University. IPRT has been operated at the Iitate observatory in Fukushima Japan since 2000. IPRT measures meter to decimeter natural radio waves at fixed frequencies of 325 and 785 MHz using LNA and also from 150 to 500 MHz using wide-band receiver. Primary purposes of the telescope are to investigate the dynamic behavior of Jupiter's synchrotron radiation and solar radio emissions in the low-frequency range. In addition to this, IPRT has capability to observe weak radio sources in the low frequency range such as pulsars. HF antenna array has been operated since 1974 for ground-based observation of Jovian decametric radiation (DAM; 15-40MHz). Wide-band spectrum monitor, and waveform receiver with single antenna, and long-baseline interferometer with 3 station's antenna (Kawatabi, Zao, and Yoneyama) are in operation. For observation of weaker non-Io Jovian DAM events, we started updating short-baseline interferometer, which was stopped due to aging of previous system.

6. 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.

7. 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/.

[2] Recent 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. American Geophysical Union Fall Meeting, Wahington D.C., U.S.A., 10-14 December, 2018.
    http://fallmeeting.agu.org/2018/
12. European Geosciences Union (EGU) General Assembly 2019, Vienna, Austria, 7-12 April, 2019.
    http://www.egu2019.eu/

[3] Future Meetings

1. Japan Geoscience Union Meeting 2019, Chiba, Japan, 26-30 May, 2019.
   http://www.jpgu.org/meeting_e2019/
2. 16th Annual Meeting of Asia Oceania Geosciences Society, Singapore, 28 July-2 August, 2019.
   http://www.asiaoceania.org/society/index.asp
3. Magnetospheres of Outer Planets (MOP) Conference 2019, Sendai, Japan, 3-7 June, 2019.
   http://lasp.colorado.edu/home/mop/resources/mop-conference/
4. SuperDARN workshop 2019, Fujiyoshida, Japan, 2-9 June, 2019.
   http://superdarn2019.nict.go.jp/
5. VarSITI completion symposium, Sofia, Bulgaria, 10-14, 2019.
   http://newserver.stil.bas.bg/VarSITI2019/
6. 32nd International Symposium on Space Technology and Science (ISTS), Fukui, Japan, 15-21 June, 2019.
   https://www.ists.or.jp/
7. The 27th IUGG General Assembly, Montréal, Québec, Canada, 8-18, July, 2019.
   http://iugg2019montreal.com/
8. Workshop on radio science and radio application technology (Symposium on Sustainable Humanosphere), Kanazawa, Japan, 24-25(TBC) September, 2019.
9. American Geophysical Union Fall Meeting, San Francisco, U.S.A., 9-13 December, 2019.

[4] Recently Published Papers

Angelopoulos, V., P. Cruce, A. Drozdov, E.W. Grimes, N. Hatzigeorgiu, D.A. King, D. Larson, J.W. Lewis, J.M. McTiernan, D.A. Roberts, C.L. Russell, T. Hori, Y. Kasahara, A. Kumamoto, A. Matsuoka, Y. Miyashita, Y. Miyoshi, I. Shinohara, M. Teramoto, J.B. Faden, A.J. Halford, M. McCarthy, R.M. Millan, J.G. Sample, D.M. Smith, L.A. Woodger, A. Masson, A.A. Narock, K. Asamura, T.F. Chang, C.-Y. Chiang, Y. Kazama, K. Keika, S. Matsuda, T. Segawa, K. Seki, M. Shoji, S.W.Y. Tam, N. Umemura, B.-J. Wang, S.-Y. Wang, R. Redmon, J.V. Rodriguez, H.J. Singer, J. Vandegriff, S. Abe, M. Nose, A. Shinbori, Y.-M. Tanaka, S. UeNo, L. Andersson, P. Dunn, C. Fowler, J.S. Halekas, T. Hara, Y. Harada, C.O. Lee, R. Lillis, D.L. Mitchell, M.R. Argall, K. Bromund, J.L. Burch, I.J. Cohen, M. Galloy, B. Giles, A.N. Jaynes, O. Le Contel, M. Oka, T.D. Phan, B.M. Walsh, J. Westlake, F.D. Wilder, S.D. Bale, R. Livi, M. Pulupa, P. Whittlesey, A. DeWolfe, B. Harter, E. Lucas, U. Auster, J.W. Bonnell, C.M. Cully, E. Donovan, R.E. Ergun, H.U. Frey, B. Jackel, A. Keiling, H. Korth, J.P. McFadden, Y. Nishimura, F. Plaschke, P. Robert, D.L. Turner, J.M. Weygand, R.M. Candey, R.C. Johnson, T. Kovalick, M.H. Liu, R.E. McGuire, A. Breneman, K. Kersten, and P. Schroeder, The Space Physics Environment Data Analysis System (SPEDAS), Space Science Review, 215(1), doi:10.1007/s11214-018-0576-4, 2019.

✓ The Space Physics Environment Data Analysis System (SPEDAS), a grass-roots software development platform (www.spedas.org), is now officially supported by NASA Heliophysics as part of its data environment infrastructure.

✓ We review the SPEDAS development history, goals, and current implementation, and explain its “modes of use” with examples geared for users and outline its technical implementation and requirements with software developers in mind.

Fukizawa, M., T. Sakanoi, Y. Miyoshi, K. Hosokawa, K. Shiokawa, Y. Katoh, Y. Kazama, A. Kumamoto, F. Tsuchiya, Y. Miyashita, Y. □M. Tanaka, Y. Kasahara, M. Ozaki, A. Matsuoka, S. Matsuda, M. Hikishima, S. Oyama, Y. Ogawa, S. Kurita, and R. Fujii, Electrostatic electron cyclotron harmonic waves as a candidate to cause pulsating auroras. Geophys. Res. Lett., 45, https://doi.org/10.1029/2018GL080145, 2018.

✓ The lower-band chorus and electrostatic electron cyclotron harmonic wave intensities had correlation with the pulsating auroral intensity.

✓ Taking advantage of high sampling rate of the imager, we estimated the energy of precipitating electrons.

✓ The energy of precipitating electrons was reasonable compared with the cyclotron resonance energy of each wave.

Hashimoto. K., Atsushi Kumamoto, Fuminori Tsuchiya, Yoshiya Kasahara, Ayako Matsuoka, Hectometric Line Spectra Detected by the Arase (ERG) Satellite, Geophys. Res. Lett., 45, https://doi.org/10.1029/2018GL080133, 2018.

✓ Hectometric line spectra (HLS) composed of line emissions from 525 to 1,700 kHz were frequently observed by Arase, suggesting a broadcasting wave is partially mode-converted to the Z mode at low-density with steep density gradient regions such as plasma bubbles.

✓ The Z-mode waves can be also mode-converted to the L-O mode and propagate widely in the lower density side of the density gradient surface.

Hirai, A., F. Tsuchiya, T. Obara, Y. Kasaba, Y. Katoh, H. Misawa, K. Shiokawa, Y. Miyoshi, S. Kurita, S. Matsuda, M. Connors, T. Nagatsuma, K. Sakaguchi, Y. Kasahara, A. Kumamoto, A. Matsuoka, M. Shoji, I. Shinohara, and J. M. Albert, Temporal and Spatial Correspondence of Pc1/EMIC Waves and Relativistic Electron Precipitations Observed with Ground□Based Multi□Instruments on 27 March 2017. Geophys. Res. Lett., 45, 24, 13,182-13,191. https://doi.org/10.1029/2018GL080126, 2018.

✓ Relativistic electron precipitation and electromagnetic ion cyclotron waves were observed during the main phase of a geomagnetic storm.

✓ Isolated proton auroras appeared on the radio propagation paths on which relativistic electron

precipitation was detected.
- ✓ We found a good correspondence between the time variations of relativistic electron precipitation and electromagnetic ion cyclotron waves

Kasaba, Y., T. Takashima, M. N. Nishino, and M. Fujimoto, Science operation concept of BepiColombo/MMO based on the MDP scheme, Proc. International Sympo. Planetary Science 2011, ed. S. Okano, Y. Kasaba, H. Misawa, pp.1-11. TERRAPUB, Tokyo, doi:10.5047/pisps.001, 2019.
- ✓ Science Payloads of BepiColombo MMO is operated through the MDP, and act as an integrated measurement system observing charged and energetic neutral particles, magnetic and electric fields, plasma waves, radio waves, dust, and exospheric constituents with a coordinated manner within our limited telemetry resource.

Kataoka, R., T. Nishiyama, Y. Tanaka, A. Kadokura, H. A. Uchida, Y. Ebihara, M. K. Ejiri, Y. Tomikawa, M. Tsutsumi, K. Sato, Y. Miyoshi, K. Shiokawa, S. Kurita, Y. Kasahara, M. Ozaki, K. Hosokawa, S. Matsuda, I. Shinohara, T. Takashima, T. Sato, T. Mitani, T. Hori, and N. Higashio, Transient ionization of the mesosphere during auroral breakup: Arase satellite and ground-based conjugate observations at Syowa Station, Earth, Planets and Space, 71(1), doi: 10.1186/s40623-019-0989-7, 2019.
- ✓ Transient mesospheric echo in the VHF range was detected at an altitude of 65–70 km during the auroral breakup that occurred from 2220 to 2226 UT on June 30, 2017.
- ✓ They demonstrated that the precipitation of energetic electrons of > 100 keV, rather than X-rays from the auroral electrons, played a dominant role in the transient and deep (65–70 km) mesospheric ionization during the observed auroral breakup.

Kazama, Y., H. Kojima, Y. Miyoshi, Y. Kasahara, H. Usui, B.-J. Wang, S.-Y. Wang, S. W. Y. Tam, T.-F. Chang, P. T. P. Ho, K. Asamura, A. Kumamoto, F. Tsuchiya, Y. Kasaba, S. Matsuda, M. Shoji, A. Matsuoka, M. Teramoto, T. Takashima, and I. Shinohara, Density Depletions AssociatedWith Enhancements of Electron Cyclotron Harmonic Emissions: An ERG Observation, Geophys. Res. Lett., 45, https://doi.org/10.1029/2018GL080117, 2018.
- ✓ The Arase observed an event near the magnetic equator where plasmapause had small-scale density depletions of cold electrons (<10eV) associated with enhancements of ECH waves.
- ✓ Enhancements of hot-electron fluxes (<1keV) perpendicular to the local magnetic field were probably due to perpendicular energization of cold electrons by the ECH waves.

Kawamura, S., K. Hosokawa, S. Kurita, S. Oyama, Y. Miyoshi, Y. Kasahara, M. Ozaki, S. Matsuda, A. Matsuoka, B. Kozelov, Y. Kawamura, and I. Shinohara, Tracking the region of high correlation between pulsating aurora and chorus: simultaneous observations with Arase satellite and ground‐based all‐sky imager in Russia, J. Geophys. Res. 124, doi: 10.1029/2019JA026496, 2019.
- ✓ An extended interval of PsA (~1 h) simultaneously observed by a newly launched magnetospheric satellite, Arase, and a ground‐based high‐speed all‐sky imager in Apatity, Kola Peninsula, Russia was investigated.
- ✓ The correspondence between PsA and chorus was verified, and the motion of the high-correlation region (correlation coefficient >0.5) was also successfully tracked in a continuous manner.

Kim, H., J. Hwang, J. Park, Y. Miyashita, K. Shiokawa, I. R. Mann, T, Raita, and J. Lee, Large scale ducting of Pc1 pulsations observed by Swarm satellites and multiple ground networks, Geophys. Res. Lett., 45, doi:10.1029/2018GL080693, 2018.
- ✓ This paper reports large scale ducting of Pc1 pulsations observed by the Swarm satellites and multiple ground networks including PWING induction magnetometers.

Kimura, T., Y. Hiraki, C. Tao, F. Tsuchiya, P. A. Delamere, K. Yoshioka, G. Murakami, A. Yamazaki, H. Kita, S. V. Badman, K. Fukazawa, I. Yoshikawa, and M. Fujimoto, Response of

Jupiter's Aurora to Plasma Mass Loading Rate Monitored by the Hisaki Satellite During Volcanic Eruptions at Io, J. Geophys. Res. 123, doi:10.1002/2017JA025029, 2018.

- ✓ Response of Jupiter’s aurora to mass loading from Io was investigated with a newly developed model and data from the Hisaki satellite.
- ✓ The estimated mass loading rate indicated increase and decay during volcanic eruptions at Io.
- ✓ During volcanic eruptions at Io, impulsive variation of aurora responded to the mass loading rate rather than the solar wind.

Kimura, T., A. Yamazaki, K. Yoshioka, G. Murakami, F. Tsuchiya, H. Kita, C. Tao, I. Yoshikawa, and C. Yamauchi, Development of ground pipeline system for high-level scientific data products of the Hisaki satellite mission and its application to planetary space weather, J. Space Weather Space Clim., 9, A8, doi:10.1051/swsc/2019005, 2019.

- ✓ This paper describes a data pipeline system developed for processing high-level scientific and ancillary data products from the Hisaki mission. Continuous monitoring with Hisaki will contribute considerably to our understanding of space weather relating to planets in our solar system.

Kita, H,. H. Misawa, A. Bhardwaj, F. Tsuchiya, G. Murakami, C. Tao, T. Kimura, K. Yoshioka, A. Yamazaki, Y. Kasaba, I. Yoshikawa, and M. Fujimoto, Short-term variation in the dawn-dusk asymmetry of the Jovian radiation belt obtained from GMRT and Hisaki EXCEED observations, Astrophys. J. Lett., 872:L24, doi:10.3847/2041-8213/ab0427, 2019.

- ✓ In order to reveal variations of days to weeks in the brightness distribution of Jovian Synchrotron Radiation (JSR), this paper reported analysis results of simultaneous radio and ultraviolet observations using the Giant Metrewave Radio Telescope (GMRT) and the Hisaki EXCEED. The statistical analysis indicates that JSR and IPT do not have a significant correlation.

Kis, A., S. Matsukiyo, F. Otsuka, T. Hada, I. Lemperger, I. Dandouras, V. Barta, and G. Facsko, Effect of upstream ULF waves on the energetic ion diffusion at the earth's foreshock, II: Observations, Astrophys. J., doi:10.3847/1538-4357/aad08c, 863, 136(9pp), 2018.

- ✓ Using Cluster data, the e-folding distance and the diffusion coefficient of the diffuse ions in the Earth’s foreshock is measured. It is shown that the e-folding distance and the diffusion coefficient become unusually small when the diffuse ions interact with high intensity waves generated by a strong field-aligned beam.

Koga, R., F. Tsuchiya, M. Kagitani, T. Sakanoi, M. Yoneda, K. Yoshikawa, T. Kimura, G. Murakami, A. Yamazaki, and I. Yoshikawa, The time variation of atomic oxygen emission around Io during a volcanic event observed with Hisaki/EXCEED, Icarus 200, 300-307, doi:10.1016/j.icarus.2017.07.024, 2018.

- ✓ The brightening of Io's extended nebula was observed in the spring of 2015.
- ✓ Atomic oxygen emission around Io also increased during the same period.
- ✓ There was a dawn-dusk asymmetry of atomic oxygen emission.

Koga, R., F. Tsuchiya, M. Kagitani, T. Sakanoi, M. Yoneda, K. Yoshioka, I. Yoshikawa, T. Kimura, G. Murakami, A. Yamazaki, H. T. Smith, and F. Bagenal, Spatial Distribution of Io's Neutral Oxygen Cloud Observed by Hisaki, J. Geophys. Res., 123, https://doi.org/10.1029/2018JA025328, 2018.

- ✓ Io's neutral oxygen cloud consists of a leading cloud inside the orbit and a longitudinally uniform region spreading out to 7.6 RJ.
- ✓ The estimated peak number density of oxygen atoms is 80 cm^3, which is spread 1.2 RJ in the north-south direction.
- ✓ The estimated source rate of oxygen ions is 410 kg/s, which is consistent with previous studies.

Kotov, D. V., P. G. Richards, V. Truhlík, O. V. Bogomaz, M. O. Shulha, N. Maruyama, M. Hairston, Y. Miyoshi, Y. Kasahara, A. Kumamoto, F. Tsuchiya, A. Matsuoka, I. Shinohara, M.

Hernández‐Pajares, I. F. Domnin, T. G. Zhivolup, L. Ya. Emelyanov, and Ya. M. Chepurnyy, Coincident Observations by the Kharkiv IS Radar and Ionosonde, DMSP and Arase (ERG) Satellites, and FLIP Model Simulations: Implications for the NRLMSISE-00 Hydrogen Density, Plasmasphere, and Ionosphere, Geophys. Res. Lett., 45, https://doi.org/10.1029/2018GL079206, 2018.

- ✓ This paper reports the results of ionosphere and plasmasphere observations with the Kharkiv incoherent scatter radar and ionosonde, Defense Meteorological Satellite Program, and Arase satellites and simulations with field line interhemispheric plasma model during the equinoxes and solstices of solar minimum 24.

Kuramitsu, Y., T. Moritaka, Y. Sakawa, T. Morita, T. Sano, M. Koenig, C. D. Gregory, N. Woolsey, K. Tomita, H. Takabe, Y. L. Liu, S. H. Chen, S. Matsukiyo, and M. Hoshino, Magnetic reconnection driven by electron dynamics, Nature Comm., 9, 5109, 2018.

- ✓ Experimental results on an electron scale magnetic reconnection driven by the electron dynamics in laser-produced plasmas are shown.

Kurita, S., Y. Miyoshi, S. Kasahara, S. Yokota, Y. Kasahara, S. Matsuda, A. Kumamoto, A. Matsuoka, and I. Shinohara, Deformation of electron pitch angle distributions caused by upper-band chorus observed by the Arase satellite, Geophys. Res. Lett., 45, https://doi.org/10.1029/2018GL079104, 2018.

- ✓ Deformation of electron pitch angle distributions associated with upper band chorus was reported.
- ✓ Tens of keV electrons were rapidly accelerated by upper-band chorus waves within 30 seconds, which suggests the deformation was a consequence of wave-particle interactions between electrons and upper-band chorus.

Kurita, S., Y. Miyoshi, K. Shiokawa, N. Higashio, T. Mitani, T. Takashima, A. Matsuoka, I. Shinohara, C. A. Kletzing , J. B. Blake, S. G. Claudepierre, M. Connors, S. Oyama, T. Nagatsuma, K. Sakaguchi, D. Baishev and Y. Otsuka, Rapid loss of relativistic electrons by EMIC waves in the outer radiation belt observed by Arase, Van Allen Probes, and the PWING ground stations, Geophys. Res. Lett., 45, doi:10.1029/2018GL080262, 2018.

- ✓ This paper reports rapid loss of relativistic electrons by EMIC waves in the outer radiation belt observed by Arase, Van Allen Probes, and the PWING ground stations during the geomagnetic storm on March 21, 2017 associated with an arrival of CIR in the solar wind.

Matsuda, S., Y. Kasahara, Y. Miyoshi, R. Nomura, M. Shoji, A. Matsuoka, Y. Kasaba, S. Kurita, M. Teramoto, K. Ishisaka, Spatial Distribution of Fine-Structured and Unstructured EMIC Waves Observed by the Arase Satellite, Geophys. Res. Lett., 45, https://doi.org/10.1029/2018GL080109, 2018.

- ✓ We surveyed 378 electromagnetic ion cyclotron (EMIC) wave events during the first year observation period of the Arase, and demonstrated that two types of EMIC waves (fine-structured and unstructured) have different spatial distribution.
- ✓ Fine-structured EMIC were mainly distributed in the off-equatorial region around the noon sector, which is a new finding due to the unique orbital condition of Arase.

Mitani, K., K. Seki, K. Keika, M. Gkioulidou, L. J. Lanzerotti, D. G. Mitchell, C. A. Kletzing, A. Yoshikawa, and Y. Obana, Statistical study of selective Oxygen increase in high-energy ring current ions during magnetic storms, J. Geophys. Res. - Space Physics., doi: 10.1029/2018JA026168, 2019.

- ✓ This is a statistical study of Selective Oxygen Increase (SOI) in high-energy ring current ions during magnetic storms using RBSPICE data from the Van Allen Probes mission. From the phase space densities of protons and oxygen ions they found 30 SOI events out of 90 magnetic storms. Observation results of Pc 4-5 ULF waves from ground-based magnetometers agreed with the scenario of the radial transport of oxygen ions due to a combination of drift and drift-bounce resonances with Pc 4-5 waves.

Nosé, M., A. Matsuoka, S. Kasahara, S. Yokota, M. Teramoto, K. Keika, K. Yamamoto, R. Nomura, A. Fujimoto, N. Higashio, H. Koshiishi, S. Imajo, S. Oimatsu, Y.□M. Tanaka, M. Shinohara, I. Shinohara, and Y. Miyoshi, Magnetic field dipolarization and its associated ion flux variations in the dawnside deep inner magnetosphere: Arase observations, Geophysical Research Letters, 45, doi:10.1029/2018GL078825, 2018.

- ✓ The Arase satellite observed clear dipolarization signatures at r~4.3–4.6 RE, GMLAT~16-18 deg, and MLT~5.5–5.7 hr around 15:00 UT on 27 March 2017 when Dst~−70 nT. Strong magnetic field fluctuations were embedded and their characteristic frequency was close to the local gyrofrequency of O+ ions.

Nosé, M., A. Matsuoka, A. Kumamoto, Y. Kasahara, J. Goldstein, M. Teramoto, F. Tsuchiya, S. Matsuda, M. Shoji, S. Imajo, S. Oimatsu, K. Yamamoto, Y. Obana, R. Nomura, A. Fujimoto, I. Shinohara, Y. Miyoshi, W. S. Kurth, C. A. Kletzing, C. W. Smith, and R. J. MacDowall, Longitudinal structure of oxygen torus in the inner magnetosphere: Simultaneous observations by Arase and Van Allen Probe A, Geophysical Research Letters, 45, doi:10.1029/2018GL080122, 2018.

- ✓ Simultaneous observations of the magnetic field and plasma waves made by the Arase and Van Allen Probe A satellites at different magnetic local time (MLT) enable us to deduce the longitudinal structure of an oxygen torus for the first time. For this event, the O+ density enhancement in the inner magnetosphere (i.e., oxygen torus) does not extend over all MLT but is skewed toward the dawn, being described more precisely as a crescent-shaped torus or a pinched torus.

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 periodic oscillations in the D-region ionosphere after the 2011 Tohoku Earthquake using LF standard radio waves passing over Japan.

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, I: Theory and simulation, Astrophys. J., doi: 10.3847/1538-4357/aaa23f, 853, 117(11pp), 2018.

- ✓ 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, K. Hosokawa, S. Oyama, S. Yagitani, Y. Kasahara, Y. Kasaba, S. Matsuda, R. Kataoka, Y. Ebihara, Y. Ogawa, Y. Otsuka, S. Kurita, R. C. Moore, Y.-M. Tanaka, M. Nosé, T. Nagatsuma, M. Connors, N. Nishitani, Y. Katoh, M. Hikishima, A. Kumamoto, F. Tsuchiya, A. Kadokura, T. Nishiyama, T. Inoue, K. Imamura, A. Matsuoka, and I. Shinohara, Microscopic observations of pulsating aurora associated with chorus element structures: Coordinated Arase satellite-PWING observations. Geophysical Research Letters, 45, 12,125– 12,134, https://doi.org/10.1029/2018GL079812, 2018.

- ✓ This paper reports microscopic observations of pulsating aurora associated with chorus element structures with a timescale less than 1 second using coordinated Arase satellite-PWING observations.

Ozaki, M., Y. Miyoshi, K. Shiokawa, K. Hosokawa, S. Oyama, R. Kataoka, Y. Ebihara, Y. Ogawa, Y. Kasahara, S. Yagitani, Y. Kasaba, A. Kumamoto, F. Tsuchiya, S. Matsuda, Y. Katoh, M. Hikishima, S. Kurita, Y. Otsuka, R. C. Moore, Y. Tanaka, M. Nosé, T. Nagatsuma, N. Nishitani, A. Kadokura, M. Connors, T. Inoue, A. Matsuoka, and I. Shinohara, Visualization of rapid electron precipitation via chorus element wave–particle interactions, Nature Communications, 10(257), 2019.

- ✓ This paper reports a visualization of chorus element wave–particle interactions in the Earth's magnetosphere by in-situ measurements of chorus waveforms with the Arase satellite and transient auroral flashes from electron precipitation events observed by a ground-based EMCCD camera of the PWING project..

Shinbori, A., Y. Otsuka, T. Tsugawa, M. Nishioka, A. Kumamoto, F. Tsuchiya, S. Matsuda, Y. Kasahara, A. Matsuoka, J. M. Ruohoniemi, S. G. Shepherd, and N. Nishitani, Temporal and spatial variations of storm time midlatitude ionospheric trough basedon global GNSS‐TEC and Arase satellite observations, Geophys. Res. Lett., 45, https://doi.org/10.1029/2018GL078723, 2018.

- ✓ Temporal and spatial variations of the mid-latitude ionospheric trough during a geomagnetic storm on 4 April 2017 have been investigated using Global Navigation Satellite System (GNSS) total electron content (TEC) data together with Arase observation.

Shoji, M., Yoshizumi Miyoshi, Yoshiharu Omura, Lynn M. Kistler, Yasumasa Kasaba, Shoya Matsuda, Yoshiya Kasahara, Ayako Matsuoka, Reiko Nomura, Keigo Ishisaka, Atsushi Kumamoto, Fuminori Tsuchiya, Satoshi Yagitani, Mariko Teramoto, Kazushi Asamura, Takeshi Takashima, Iku Shinohara, Instantaneous frequency analysis on nonlinear EMIC emissions: Arase observation, Geophys. Res. Lett., https://doi.org/10.1029/2018GL079765, 2018.

- ✓ EMIC waves with rising and falling frequencies were observed by the Arase.
- ✓ Instantaneous frequency of the rising tone EMIC wave was studied and the time variation of the instantaneous frequency shows a good agreement with the nonlinear theory for the frequency evolutions.

Takahashi, K., R. E. Denton, T. Motoba, A. Matsuoka, Y. Kasaba, Y. Kasahara, M. Teramoto, M. Shoji, N. Takahashi, Y. Miyoshi, M. Nosé, A. Kumamoto, F. Tsuchiya, R. J. Redmon, and J. V. Rodriguez, Impulsively excited nightside ultralow frequency waves simultaneously observed on and off the magnetic equator, Geophys. Res. Lett., 45, https://doi.org/10.1029/2018GL078731, 2018.

- ✓ A series of impulsively excited fundamental toroidal mode standing Alfvén waves in the midnight sector was observed by Arase outside the plasmasphere at magnetic latitudes 13–24°.
- ✓ The wave onsets are concurrent with Pi2 onsets detected by the Van Allen Probe B spacecraft at the magnetic equator in the duskside plasmasphere and by ground magnetometers at low latitudes.
- ✓ This multipoint observation indicates that different wave modes are excited from a common impulsive source located in the near‐Earth magnetotail.

Tao, C., T. Kimura, F. Tsuchiya, G. Murakami, K. Yoshioka, A. Yamazaki, S. V. Badman, H. Misawa, H. Kita, Y. Kasaba, I. Yoshikawa, and M. Fujimoto, Variation of Jupiter's aurora observed by Hisaki/EXCEED: 3. Volcanic control of Jupiter's aurora, Geophys. Res. Lett., 45, 71-79, doi:10.1002/2017GL075814, 2018.

- ✓ Responses of Jupiter's northern aurora spectra to Io volcanic activity were detected using Hisaki/EXCEED long-term monitoring.
- ✓ Decrease of color ratio, that is, auroral electron energy, suggests reduced electron acceleration for the more highly populated magnetosphere.
- ✓ Long-term observation provided the typical value and variances of auroral emission power and electron parameters.

Thomas, N., K. Shiokawa, and G. Vichare, Comprehensive study of low-latitude Pi2 pulsations using observations from multi-satellite Swarm mission and global network of ground observatories, J. Geophys. Res., 124, doi: 10.1029/2018JA026094, 2019.

- ✓ This paper reports comprehensive study of low-latitude Pi2 pulsations using observations from multi-satellite Swarm mission and global network of ground observatories.

Tsuchiya, F., A. Hirai, T. Obara, H. Misawa, S. Kurita, Y. Miyoshi, K. Shiokawa, M. Connors,

M. Ozaki, Y. Kasahara, A. Kumamoto, Y. Kasaba, A. Matsuoka, M. Shoji, and I. Shinohara, Energetic electron precipitation associated with pulsating aurora observed by VLF radio propagation during the recovery phase of a substorm on 27 March 2017. Geophysical Research Letters, 45. https://doi.org/10.1029/2018GL080222, 2018.

- ✓ Energetic electron precipitation was observed with subionospheric VLF propagation during a substorm on 27 March 2017.
- ✓ Similar time variations between the pulsating aurora and energetic electron precipitation were found.
- ✓ The short recovery time of the subionospheric perturbation indicates that pulsating aurora accompanied relativistic electron precipitation.

Tsuchiya, F., K. Yoshioka, T. Kimura, R. Koga, G. Murakami, A. Yamazaki, M. Kagitani, C. Tao, F. Suzuki, R. Hikida, I. Yoshikawa, Y. Kasaba, H. Kita, H. Misawa, and T. Sakanoi, Enhancement of the Jovian Magnetospheric Plasma Circulation Caused by the Change in Plasma Supply from the Satellite Io, J. Geophys. Res: Space Phys., 123, doi:10.1029/2018JA025316, 2018.

- ✓ Evolution of Io plasma torus radial distribution caused by volcanic eruptions in Io was observed in early 2015.
- ✓ Outward plasma transport from the Io plasma torus through 8 RJ from Jupiter enhanced for approximately 2 months.
- ✓ An inner magnetosphere plasma source is shown to affect large-scale mass/energy radial circulation in rotationally dominant magnetosphere.

Tsuchiya, F., H. Misawa, H. Kita, A. Morioka, and T. Kondo, Two-element radio interferometer for the observation of Jupiter's synchrotron radiation, Proc. International Sympo. Planetary Science 2011, ed. S. Okano, Y. Kasaba, H. Misawa, pp.47-58. TERRAPUB, Tokyo, doi:10.5047/pisps.047, 2019.

- ✓ This paper suggests that the two-element interferometer with the baseline length of about 3 km along the east-west direction is feasible to detect the difference of JSR emission distribution due to (1) fast radial transport and acceleration of energetic electrons in the equatorial region of the inner magnetosphere and (2) significant enhancement of energetic electrons outside the inner magnetosphere and their injection into the polar region.

Umeda, T., R. Yamazaki, Y. Ohira, N. Ishizaka, S. Kakuchi, Y. Kuramitsu, S. Matsukiyo, I. Miyata, T. Morita, Y. Sakawa, T. Sano, S. Sei, S. J. Tanaka, H. Toda, and S. Tomita, Full particle-in-cell simulation of the interaction between two plasmas for laboratory experiments on the generation of magnetized collisionless shocks with high-power lasers, Phys. Plasmas, 26, 032303, doi:10.1063/1.5079906, 2019.

- ✓ A preliminary numerical experiment is conducted for laboratory experiments on the generation of magnetized collisionless shocks with high-power lasers by using one-dimensional particle-in-cell simulation.

Zushi, T., H. Kojima, Y. Kasahara, and T. Hamano, Development of a miniaturized spectrum-type plasma wave receiver comprising an application-specific integrated circuit analog front end and a field-programmable gate array, Meas. Sci. Technol., 30, doi: 10.1088/1361-6501/ab0821, 2019.

- ✓ A miniaturized spectrum-type plasma wave receiver was developed comprising an application-specific integrated circuits (ASIC) and a field-programmable gate array (FPGA).
- ✓ The spectrum receiver was successfully implemented and showed sufficient performance for plasma wave observation.