Japanese URSI Commission H (Waves in Plasmas)
Activity Report
April 2017 - September 2017

[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 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 is at ESA/ESTEC (European Space Research and Technology Centre, Netherlands) from April 2015. 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).

3. Arase (ERG)

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

The 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 20, 2016 to explore in the heart of the Earth's radiation. The the Plasma Wave Experiment (PWE, PI: Y. Kasahara [Kanazawa Univ.]) was developed to measure DC electric field and plasma waves in the inner magnetosphere. It consists of two sets of orthogonal electric field sensor (WPT; wire-probe antennas), three-axis magnetic sensor

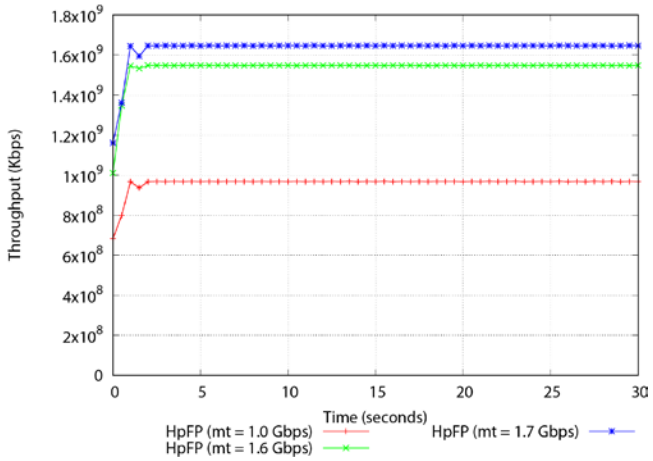
(MSC; magnetic search coils), and receivers named EFD (electric field detector), WFC/OFA (waveform capture and onboard frequency analyzer), and HFA (high frequency analyzer). Using these sensors and receivers, the PWE covers wide frequency range from DC to 10 MHz for electric field and from a few Hz to 100 kHz for magnetic field. The Software-Wave Particle Interaction Analyzer (SWPIA) (PI: H. Kojima, [Kyoto. Univ.]) is equipped onboard the ERG to realize direct measurements of interactions between energetic electrons and whistler-mode chorus in the Earth's inner magnetosphere.

The Arase has started nominal scientific operation in March 2017. Varieties of wave phenomena such as chorus, EMIC, 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. During these conjunction periods, we intensively conducted the PWE burst mode operations, by which waveforms were continuously captured.

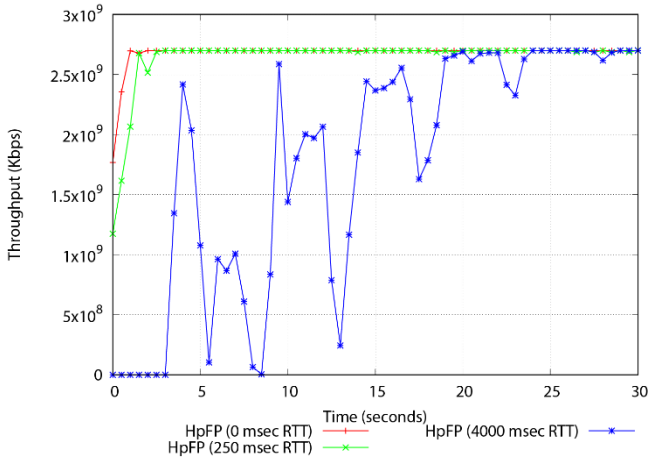
4. High-Speed Data Transfer Protocol for Geostationary Orbit Satellites HpFP protocol

http://hpfp.nict.go.jp/

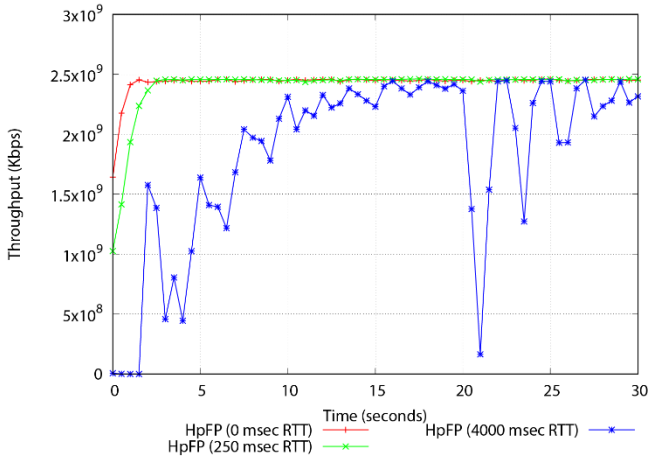
In communication systems using geostationary orbit satellites, throughput of transmission control protocol (TCP) is limited due to the impact of latency on network and packet loss caused by signal attenuation in severe weather conditions like heavy rain. It is high time to develop network techniques and applications in broadband communications over the gigabit satellite and the high throughput satellite (HTS). In this paper, we introduce a high-speed data transfer protocol, named highperformance and flexible protocol (HpFP), to achieve high throughput over a geostationary satellite link even in severe weather conditions. The HpFP is firstly evaluated on a laboratory experiment simulating a geostationary orbit satellite link. It is clarified that the HpFP shows high throughputs even when the packet loss ratio (PLR) is 0.01%. We next carry out a field experiment using the Wideband InterNetworking engineering test and Demonstration Satellite (WINDS). The performance of the HpFP over single, dual, and multiple connections are evaluated. The result shows that the aggregate throughput of dual connections of HpFP almost reaches to the maximum bandwidth, and the time to the maximum bandwidth is within 3 sec which is over 20 times faster than that by the TCP. For multiple connections, the HpFP shares the bandwidth equally among all 50 connections.



(a) Throughput of single connection (target throughputs are 1.0 Gbps, 1.6 Gbps, and 1.7 Gbps)



(b) Aggregate throughput of dual connections (target throughputs are 1.4 Gbps for each and latency on the return path is 0 msec, 250 msec, and 4000 msec)



(c) Aggregate throughput of multiple connections (target throughput is 54 Mbps and latencies on the return path are 0 msec, 250 msec, and 4000 msec)

Figure: WINDS satellite experiments of the HpFP

5. Iceland - Syowa conjugate observation

A new VLF instrument has been installed at Husafell observatory in Iceland in September, 2016. Unique conjugate observations of auroral phenomena including the measurements of ULF and VLF waves have been carried out between Iceland and Syowa Station, Antarctica since 1983 by the National Institute of Polar Research in Japan in collaboration with University of Iceland.

6. PWING Project

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

PWING stands for "study of dynamical variation of Particles and Waves in the INner magnetosphere using Ground-based network observations". It is indispensable for quantitative

understanding of the dynamical variation of the particles and electromagnetic field to grasp the dynamical variation field eccentrically located at a particular longitude on a global scale. The objectives of this study are to grasp 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. Based on international collaboration, this project establishes eight ground-based stations separately positioned in the longitude direction along a latitude line, and observes how the particles rotating round the earth in the space around the earth fall into the earth atmosphere and interact with waves, making it possible to monitor the global conditions of the particles and waves 24 hours a day.

7. 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.

8. 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/. Geotail is presently under review for extending its operation for 3 more years in JAXA.

[2] Recent Meetings

1. European Geosciences Union (EGU) General Assembly 2017, Vienna, Austria, 23-28 April, 2017.
   http://www.egu2017.eu/
2. Japan Geoscience Union - American Geophysical Union Joint Meeting 2017, Chiba, Japan, 20-25 May, 2017.
   http://www.jpgu.org/meeting_e2017/
3. BepiColombo Hermean Environment Working Group Meeting & BepiColombo Science Working Team Meeting, Toulouse, France, 29 May – 1 June, 2017.
   http://www.bcoswt17.com/
4. Magnetospheres of the Outer Planets, Uppsala, Sweden, 12-16 June, 2017.
   http://www.irfu.se/mop2017/
5. PSTEP Summer School, Rikubetsu, Hokkaido, Japan, 30 July 30 - 4 August, 2017.
   http://www.pstep.jp/information/20170208.html
6. Asia Oceania Geosciences Society (AOGS) 14th Annual Meeting, Singapore, 6-11 August, 2017.
   http://www.asiaoceania.org/aogs2017/
7. 2017 Joint IAPSO-IAMAS-IAGA Assembly, Cape Town, South Africa , 27 August - 1 September, 2017.
   http://www.iapso-iamas-iaga2017.com

8. The 3rd ERG Mission Science Workshop, National Cheng Kung University, Tainan, Taiwan, 5-8, September, 2017.
   http://events.asiaa.sinica.edu.tw/workshop/20170905/
9. JUICE RPWI team meeting, London, UK, 6-8 September, 2017.
10. SELENE Symposium, Tokyo, Japan, 13-14 September, 2017.
    http://planetb.sci.isas.ac.jp/selenesymp2017/selenesymp2017.html
11. The 3rd COSPAR Symposium: Small satellites for space research, Jeju, Korea, 18-22 September, 2017.

    http://www.cospar2017.org/

[3] Future Meetings

1. The 12th European Planetary Science Congress (EPSC), Riga, Latvia, September 17-22, 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. **Symposium on Waves in Space Plasma (Symposium in Sustainable Humanosphere)**, Kanazawa, 29-30 October, 2017.
   The symposium will be held in cooperation with Japanese URSI-H commission and subcommittee on plasma wave in SGEPSS (Society of Geomagnetism and Earth, Planetary and Space Sciences).
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. Symposium on Planetary Science 2019, Sendai, Japan, 27 February – 1 March, 2017.
   http://pparc.gp.tohoku.ac.jp/workshop.html
10. 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/
11. European Geosciences Union (EGU) General Assembly 2018, Vienna, Austria, 8-13 April, 2018.
    http://www.egu2018.eu/
12. Japan Geoscience Union Meeting 2018, Chiba, Japan, 20-24 May, 2018.
    http://www.jpgu.org/meeting_e2018/