



Geospace Research in Japan by the Geospace Explorer "Arase"

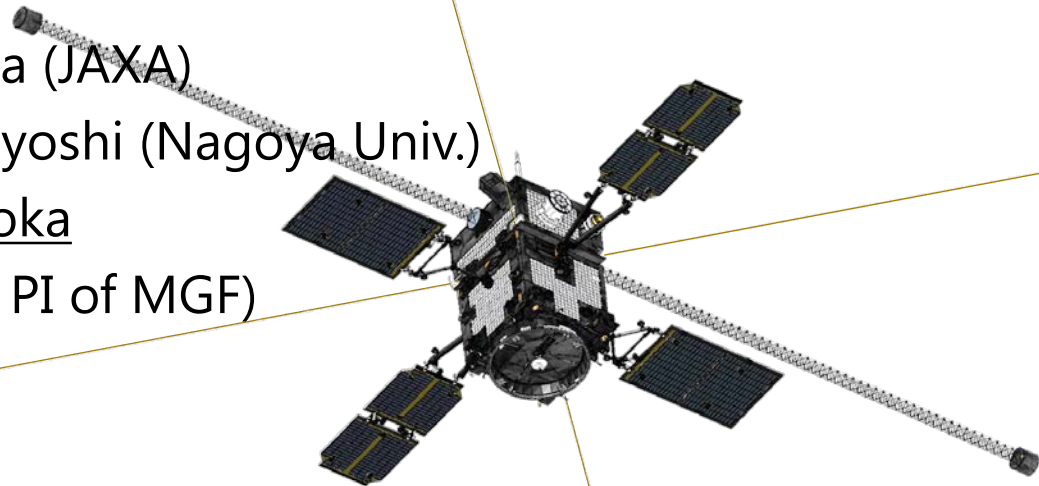
Arase Project Team

Project Manager : Iku Shinohara (JAXA)

Project Scientist : Yoshizumi Miyoshi (Nagoya Univ.)

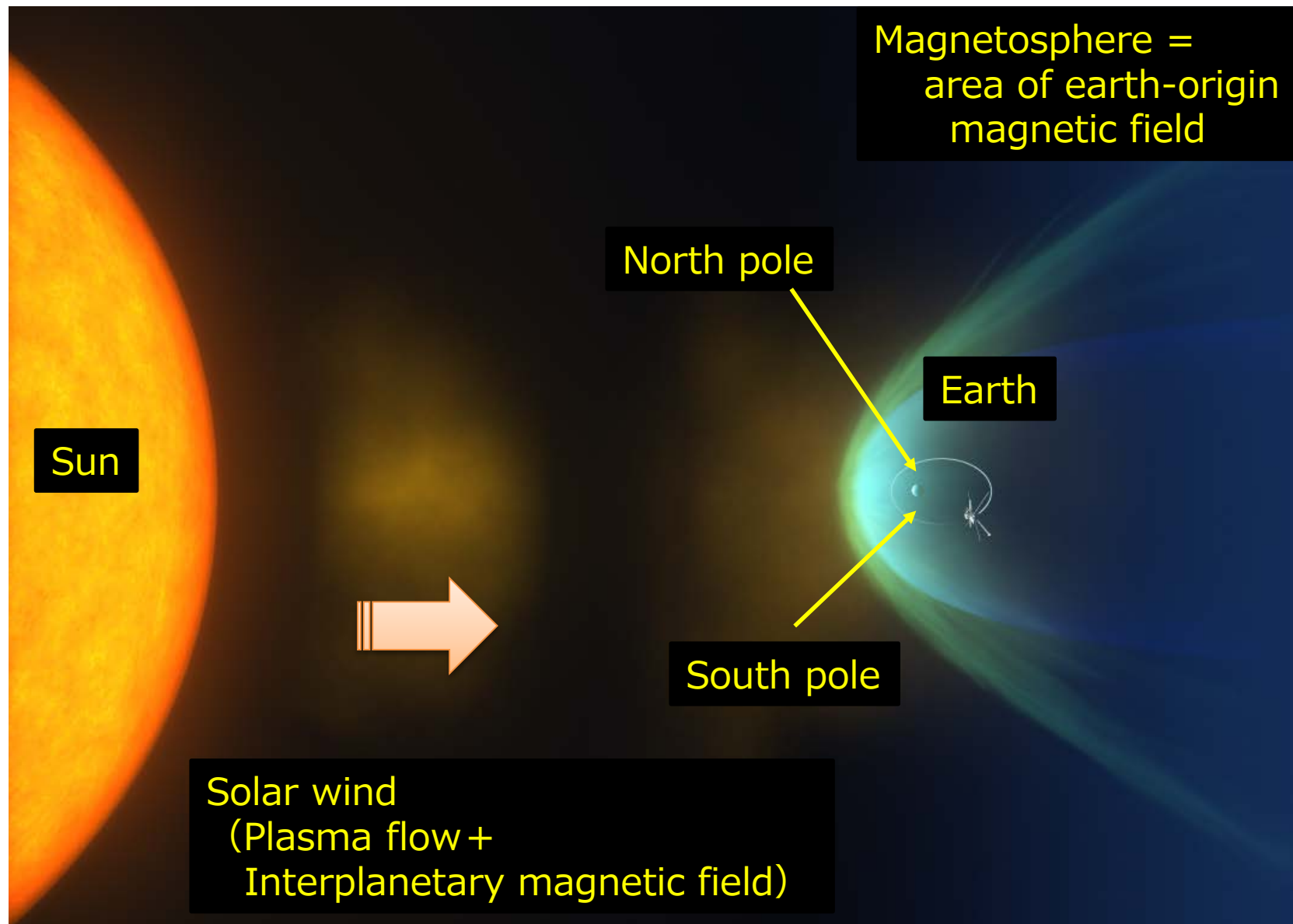
Today's speaker : Ayako Matsuoka

(JAXA, PI of MGF)



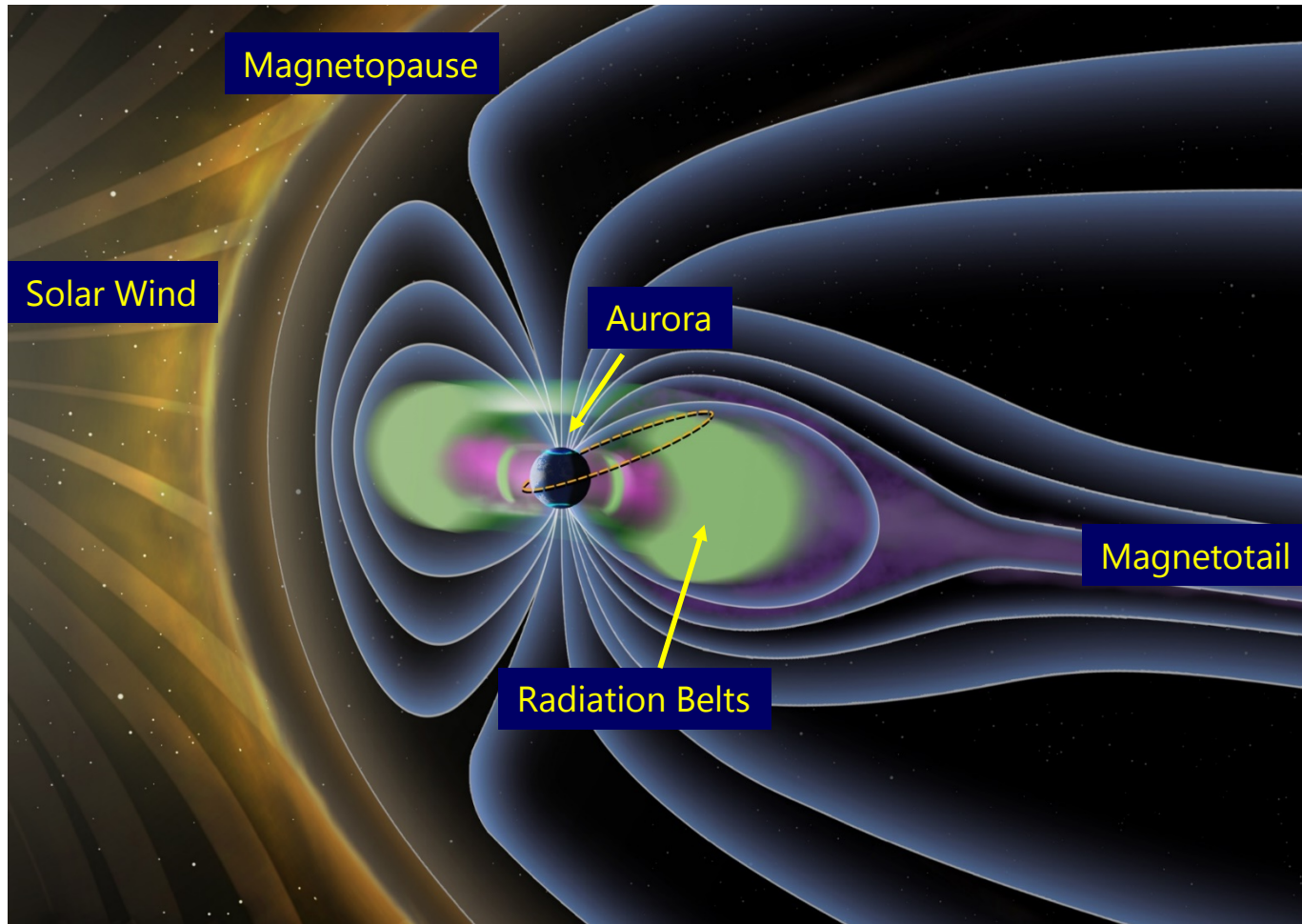


Geospace: Sun-Earth Connection





Magnetosphere



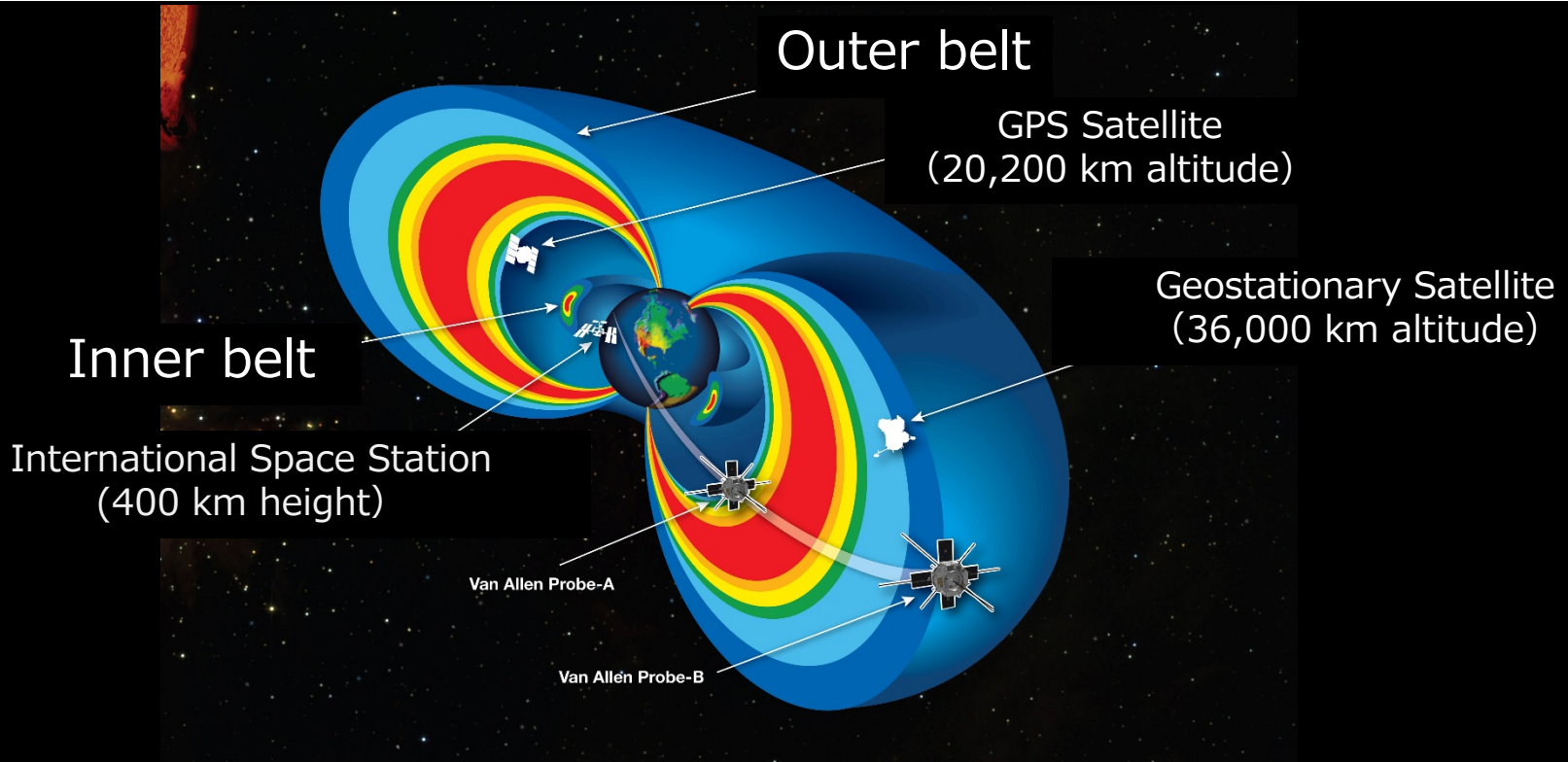
Typical energy of electrons in the space

- In the solar wind : about 100 electron volt
- In the earth ionosphere (auroral altitude) : about 1000 K
< 1 electron volt



Radiation belt

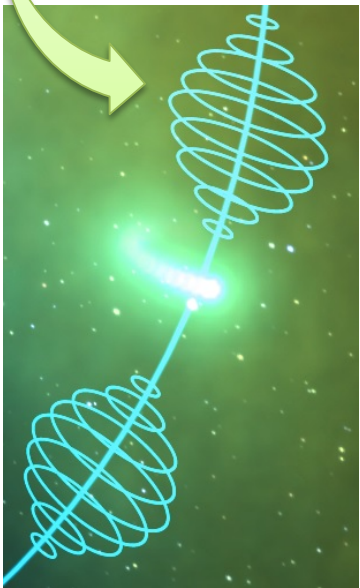
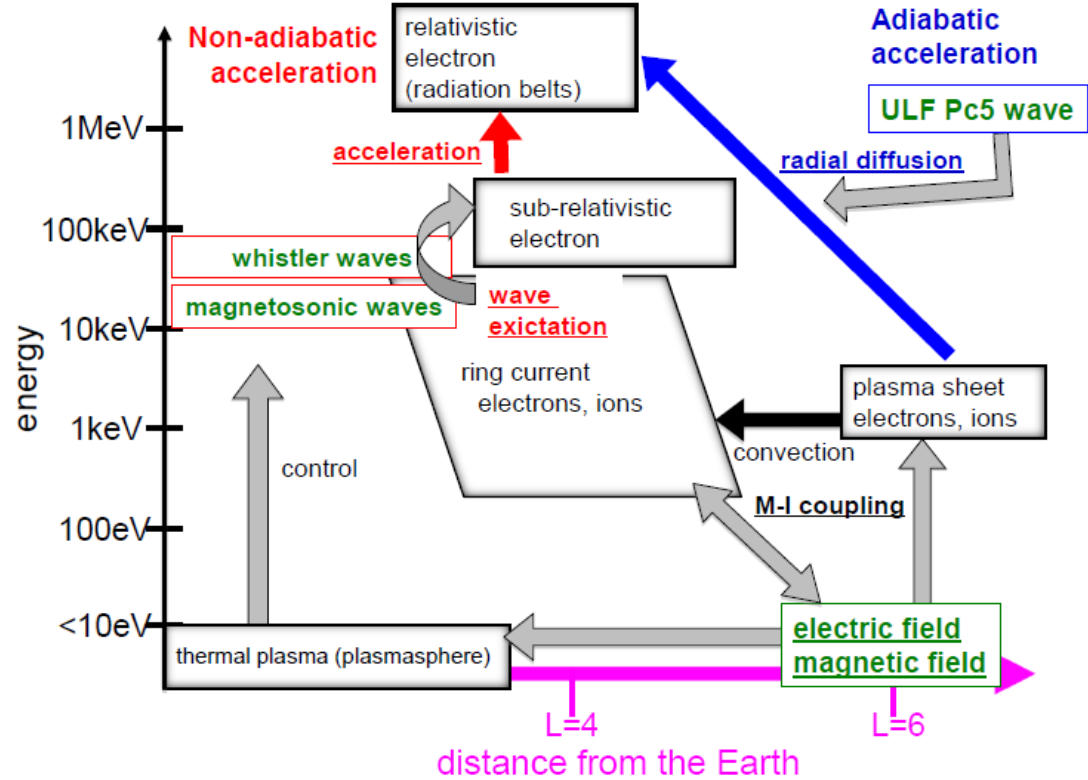
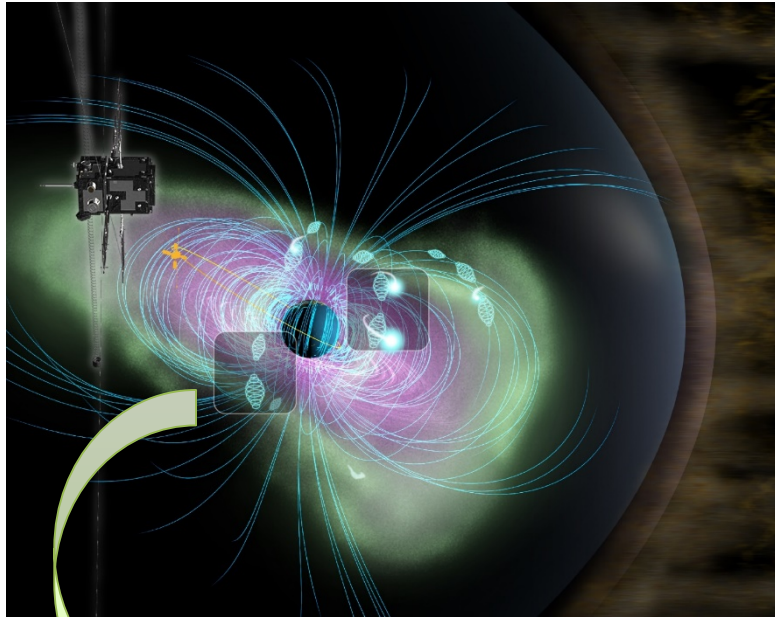
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- Area where the electron energy is highest in the geospace.
- Energy of electrons :
Several hundreds kiro- ~ several tens mega- electron volt
(several hundreds billion K)
- Electron speed is close to the light speed.
- Electron flux shows dynamic temporal variation.



Why so energetic ? Why sometimes decline ?



The interaction between electrons and plasma waves

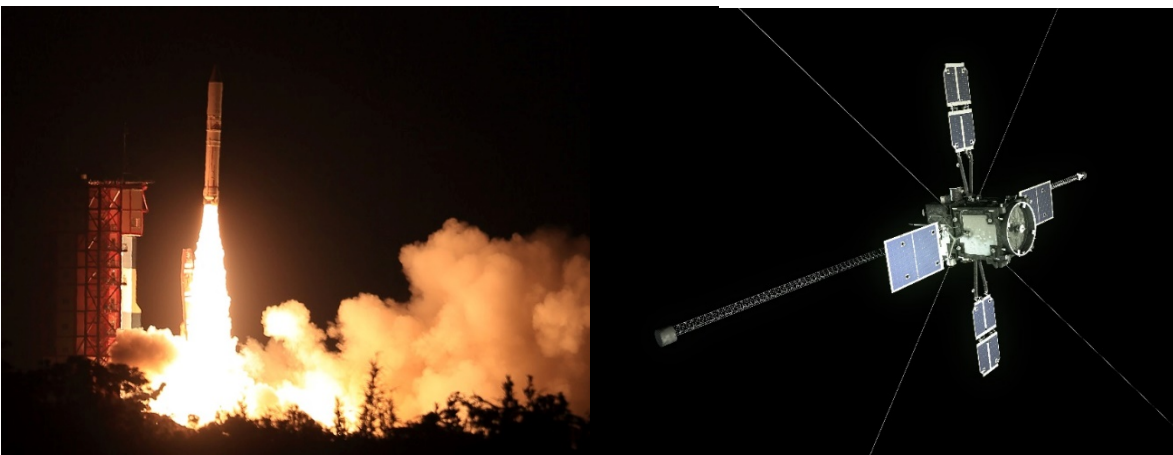
in the radiation belt is considered to be one of the key processes for electron energization and loss.

- Electrons gain energy from waves
- Electrons are scattered by waves and precipitated to the atmosphere



Arase (ERG) satellite

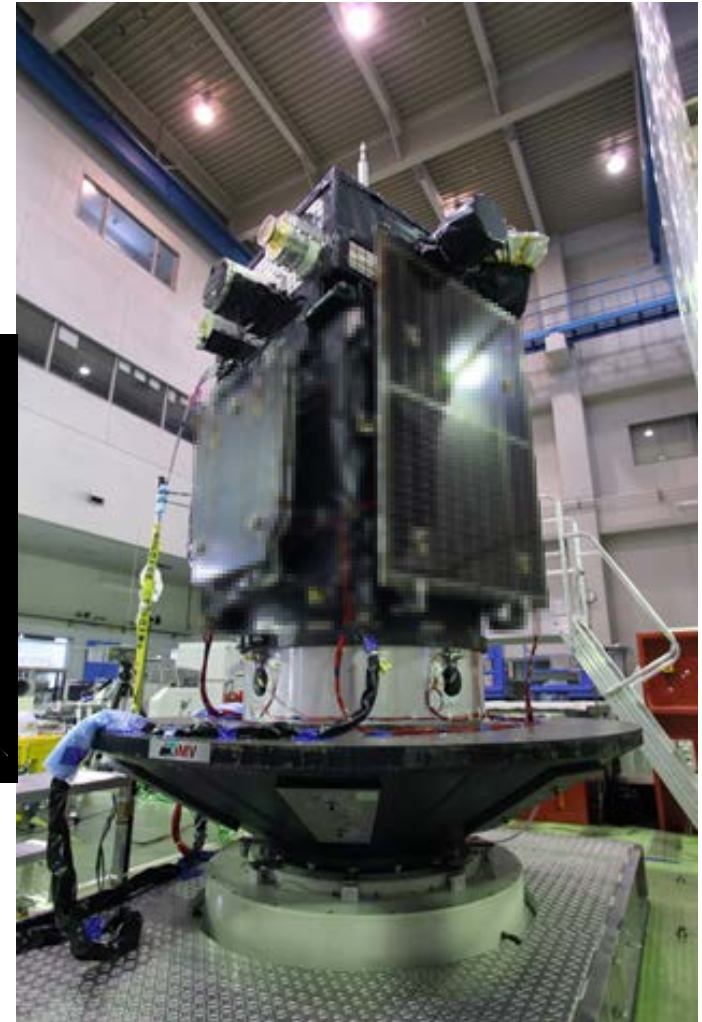
- ERG project was planned to study the **wave-particle interaction and electron energization/loss** in the radiation belt.
- ERG satellite was successfully launched on Dec. 20, 2016, and given the Japanese nickname "Arase"
- Regular science observation started on March 24 2017.



Launch at Uchinoura Space Center (USC) by Epsilon launcher

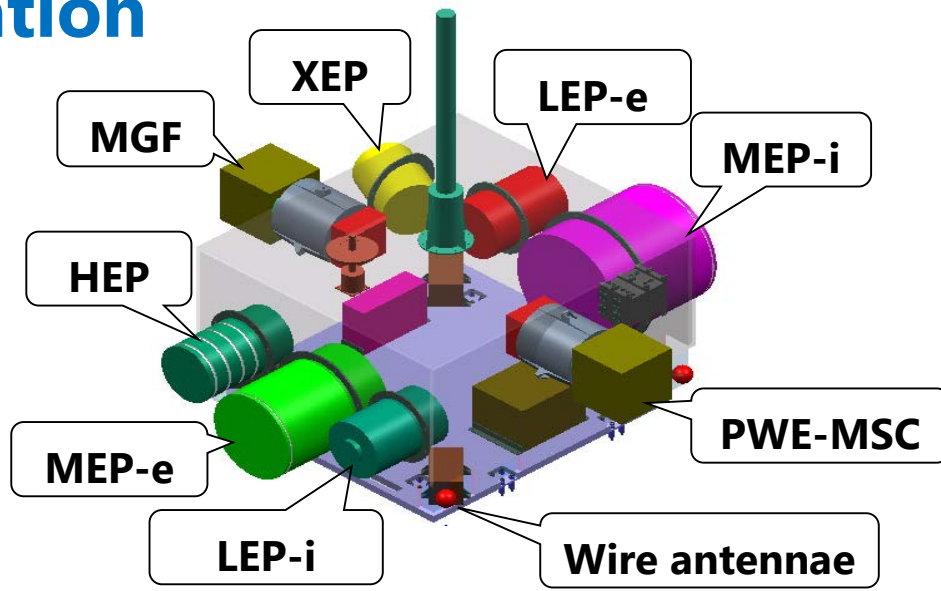
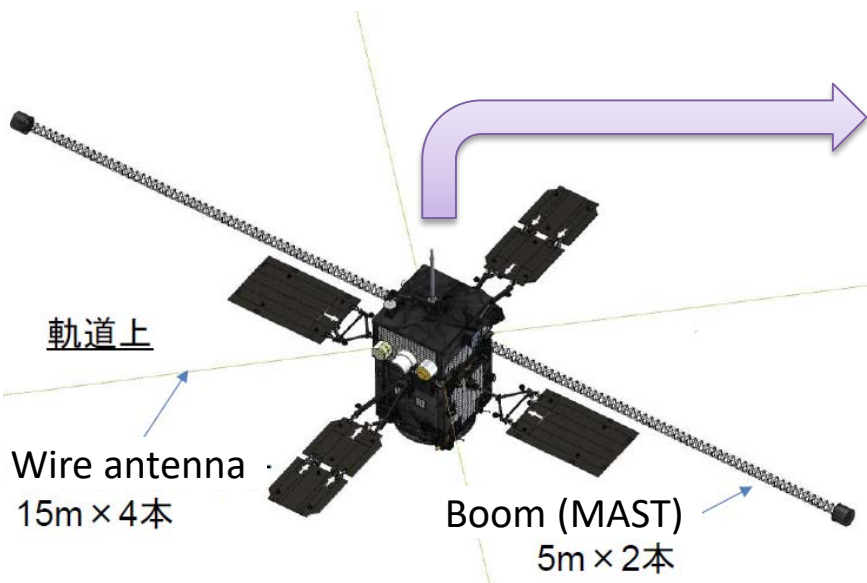
orbit

Apogee: ~ 32,000 km
Perigee: ~ 400 km
Inclination: 31 deg.

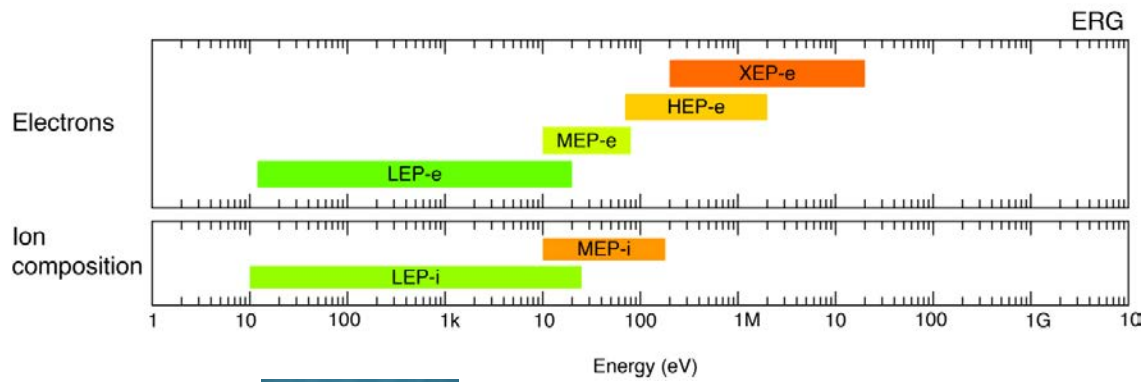




Arase (ERG) Observation



- ◆ Six sensors measure the plasma (electrons of 19 eV – 20 MeV and ions of 10 eV/q – 180 keV/q)
- ◆ Two booms and four wire antennae measure plasma waves (magnetic and electric fields)





Radiation Belt Observations for One Year

Arase/XEP

Solar wind speed

Vsw

low

450 keV

1650 keV

Electron Energy

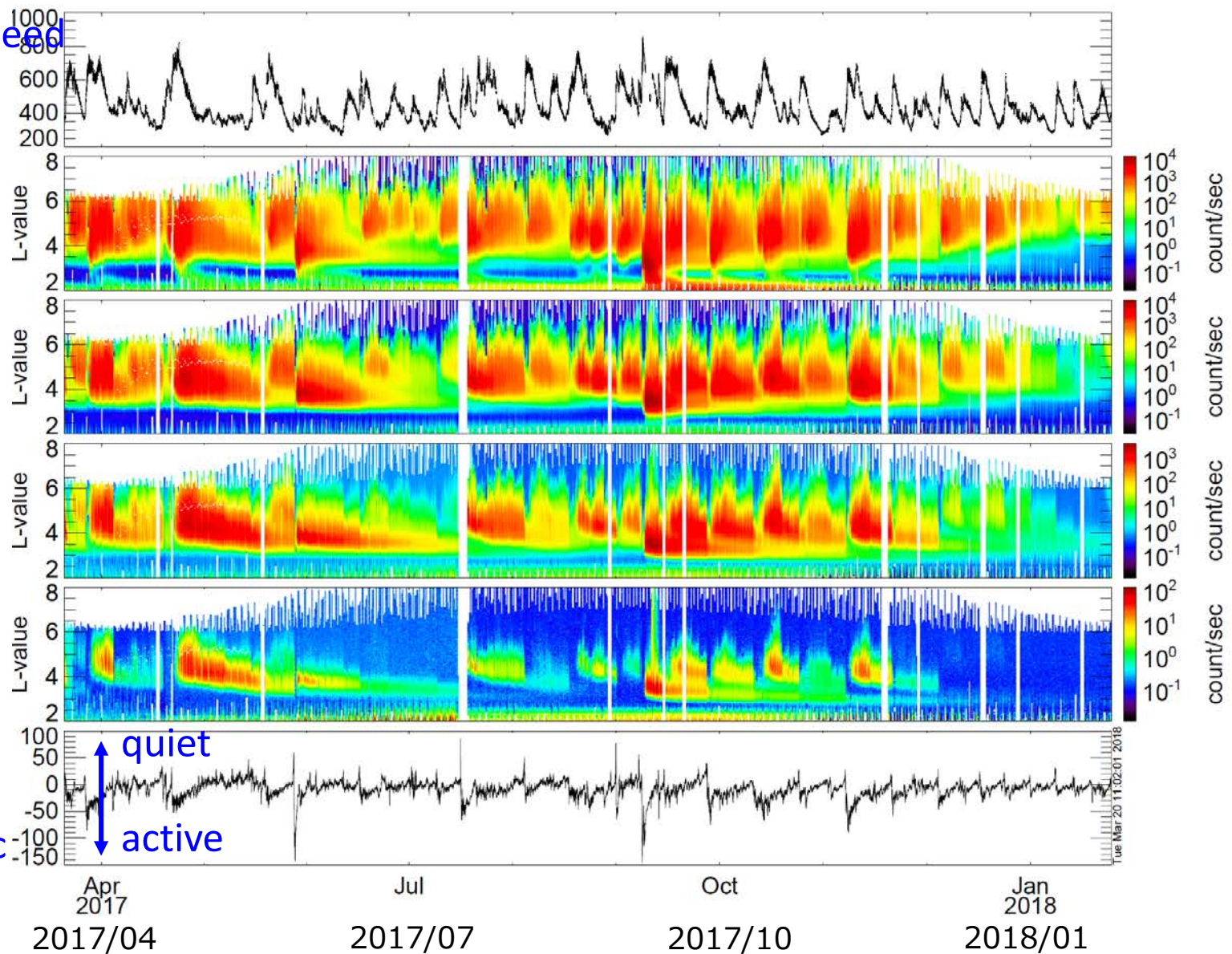
2500 keV

4850 keV

high

Dst

Geomagnetic Activity

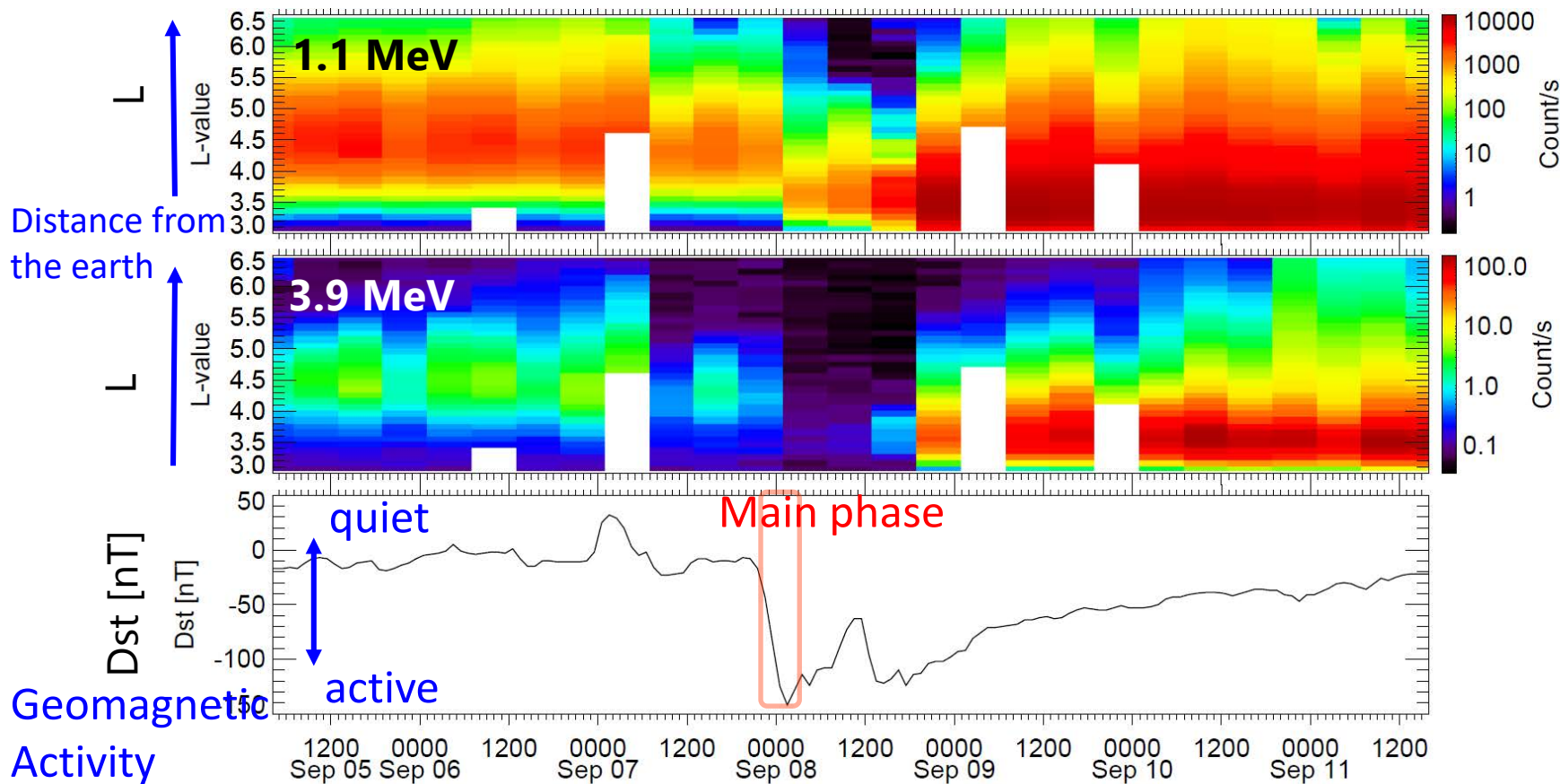


Apr 2017 2017/04 Jul 2017/07 Oct 2017/10 Jan 2018 2018/01 Tue Mar 20 11:02:01 2018



September 2017 storm

Arase/XEP



- loss of the outer-belt electrons during the main phase of the geomagnetic storm.

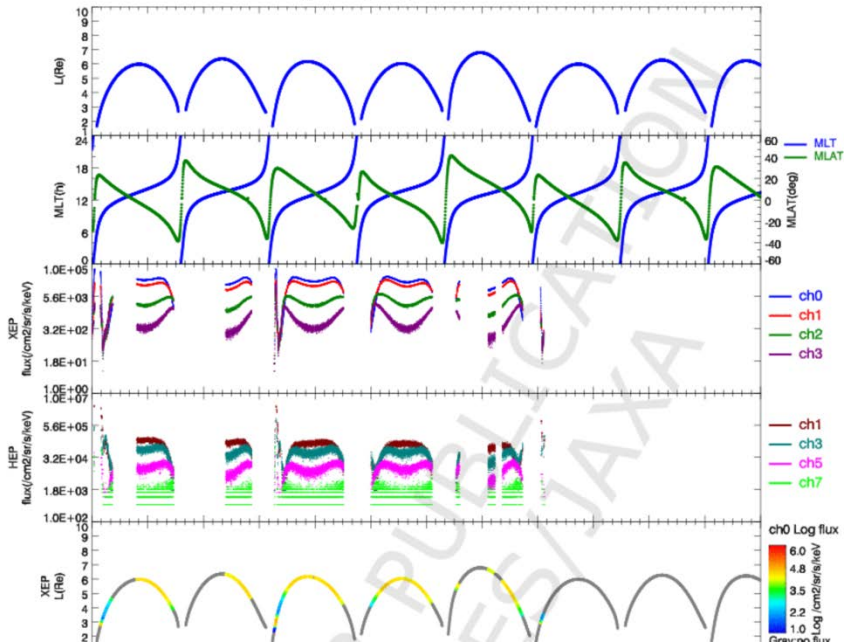


Real Time Space Weather Data

Arase is providing real-time data of radiation belt monitoring for nowcast as well as forecast of space weather.

JAXA/SEES

ARASE(ERG) 準リアルタイムグラフ表示機能
ARASE(ERG) Space Weather Data



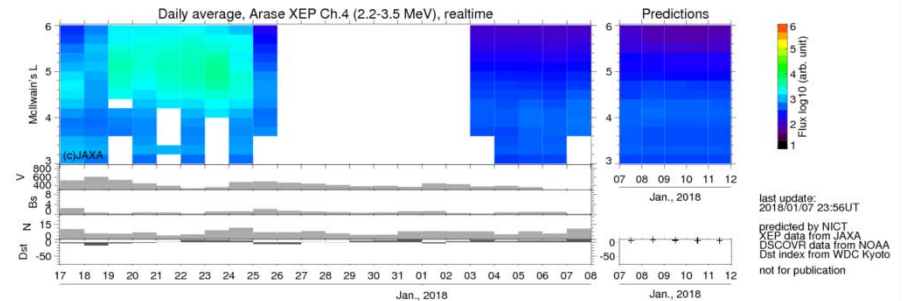
Space Radiation Model at NICT

Arase Space Weather data is used as input

Radiation Belts High-Energy Electrons

Prediction & ARASE satellite XEP space weather realtime data from JAXA

This page provides forecast of MeV electron flux variations in the outer radiation belt as a function of L values. Time resolution is 1 day (sample average along the Arase orbit). Predictions are calculated by multivariate autoregressive models and Kalman filter based on realtime observation data of Arase/XEP. Details of prediction methods are described in Sakaguchi et al., 2013, 2015. Update is every one hour. Plots can be used for quick look only. Realtime data of high-energy electrons observed by ARASE/XEP data is distributed from JAXA/SEES, realtime solar wind data observed by DSCOVR is provided from NOAA/SWPC, and realtime Dst index is provided by WDC for Geomagnetism, Kyoto.

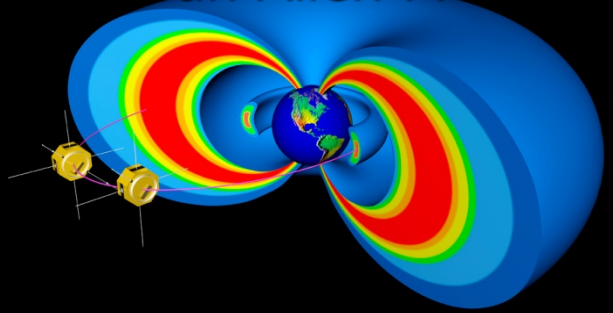


<http://seg-web.nict.go.jp/arase-spaceweather/forecast.html>

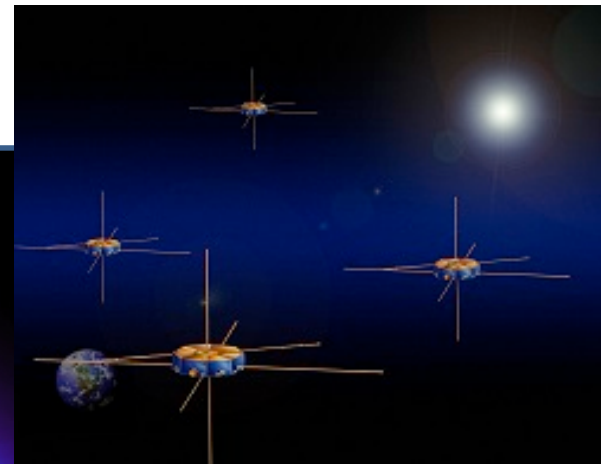


Collaborations

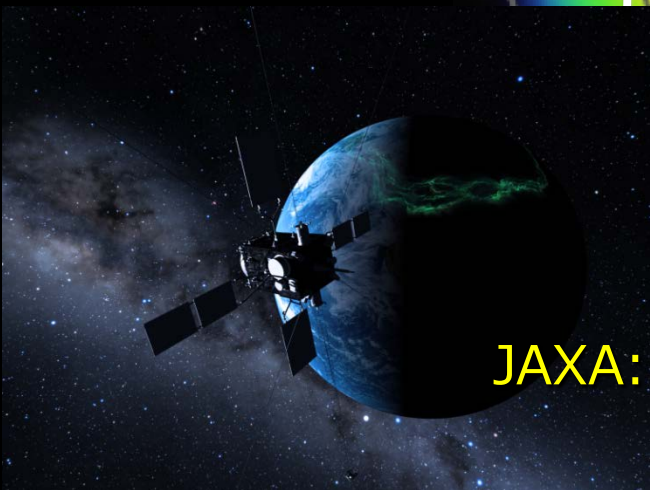
NASA:
Van Allen Probes



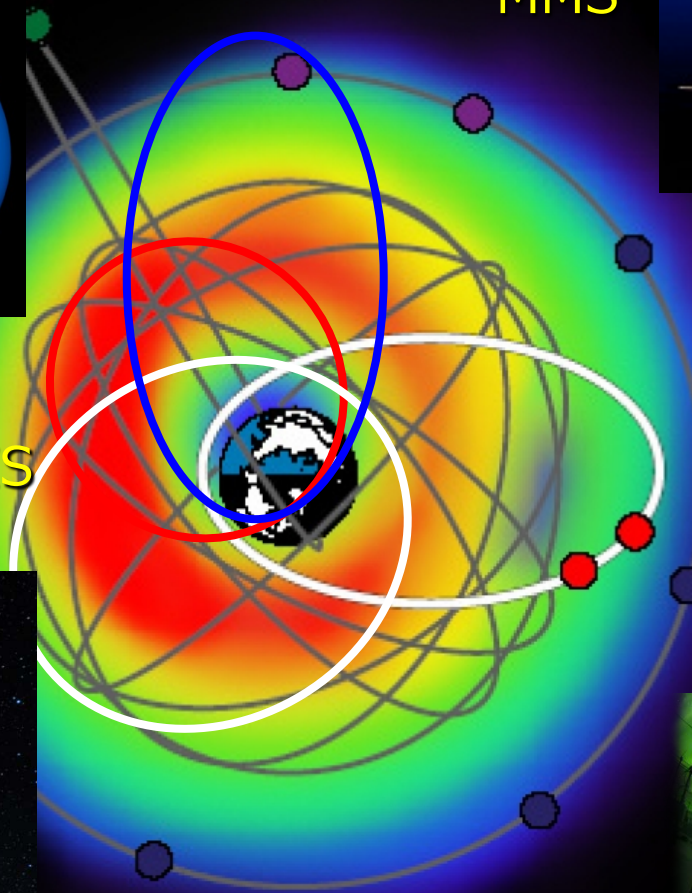
NASA:
MMS



NASA:
THEMIS



JAXA: *ERG*



Ground-based observatories
(EISCAT, Super DARN, etc.)



Summary

- "Arase" is observing inner magnetosphere and radiation belts, where acceleration and loss of energetic electrons occur through wave-particle interactions.
- Joint-observations with NASA Van Allen Probes have been executed at proper timings of good conjunctions. They help us to understand the spatial structure and temporal variations of the radiation belts.
- Joint operations with the world-wide ground-network observations has been carried out and will be planned. During these periods, we could successfully observed various types of magnetic storms.
- Soon we will start to open science data obtained by "Arase" in the early phase to the public.
- We hope the Arase's achievements will contribute to the space weather forecast.