Space Weather Impact on Spacecraft and Upcoming of the 25th Solar Maximum

Bin Wang

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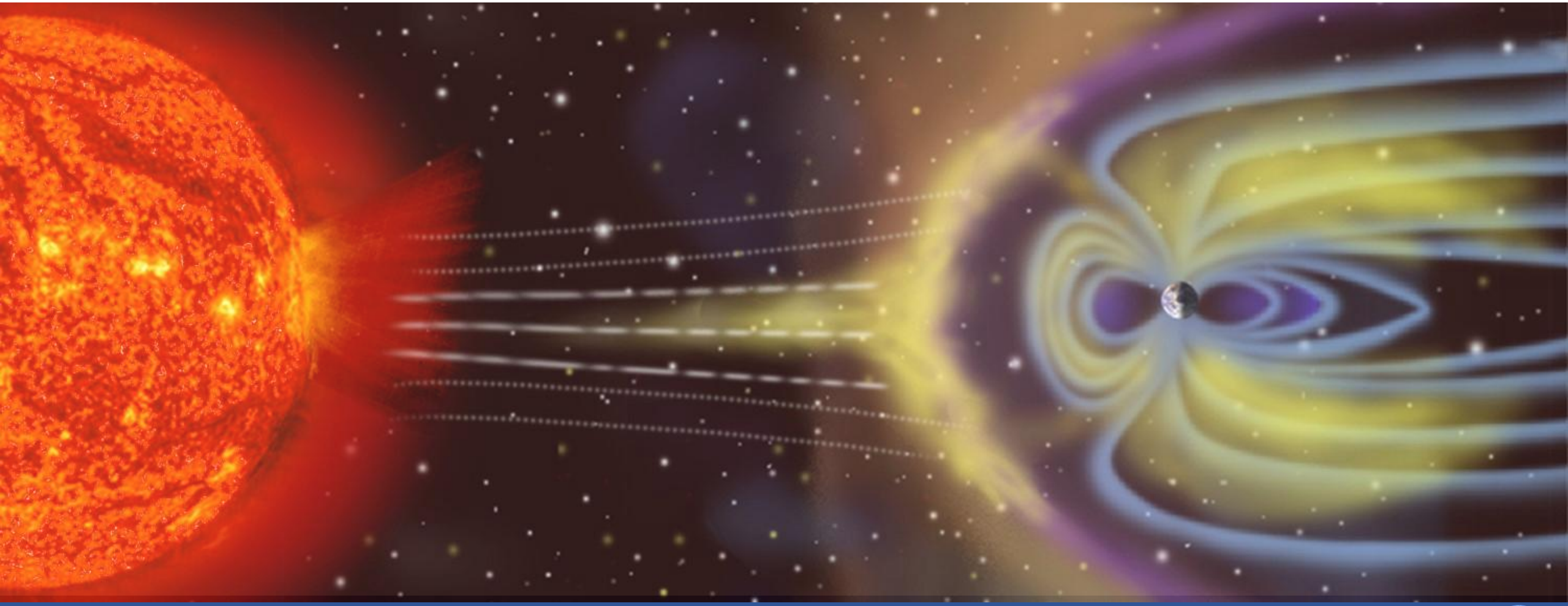
Space Weather Impact

01 Space Weather Impact

Essentials

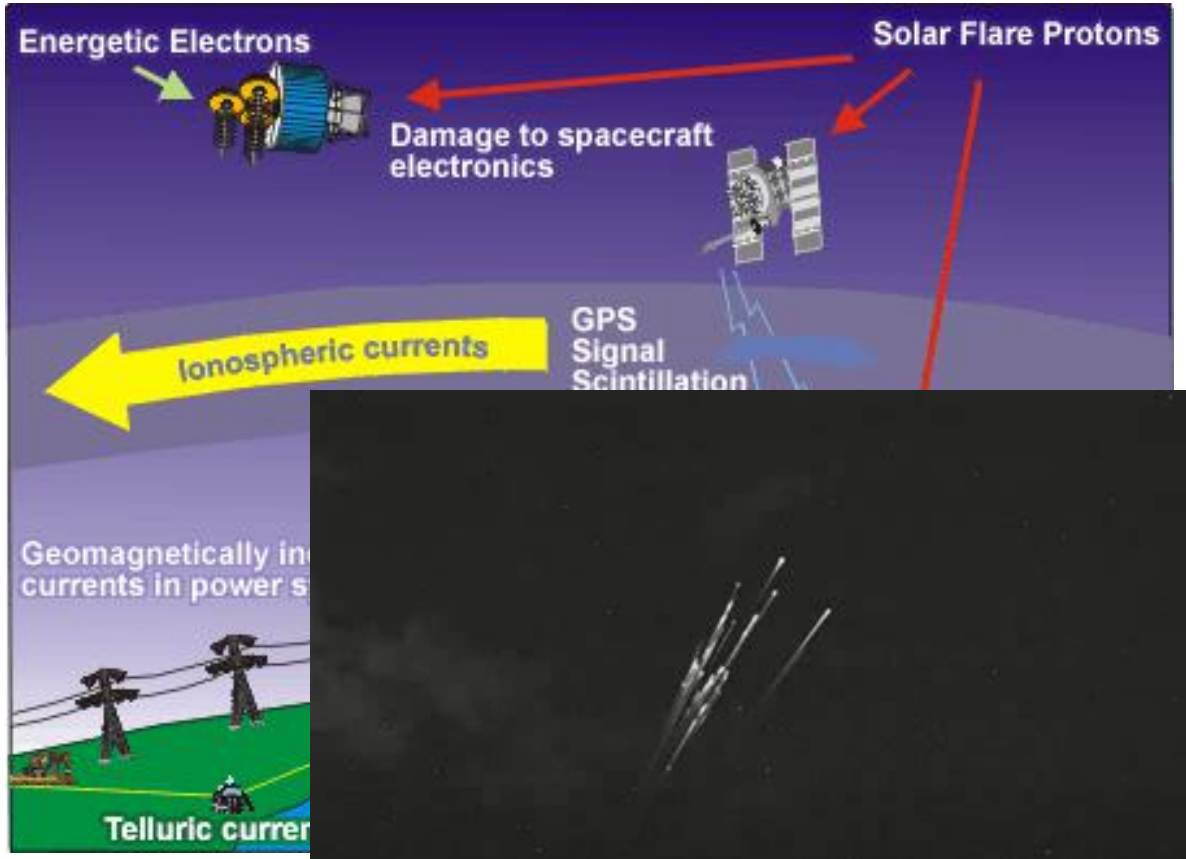


01 Space Weather Impact

Essentials

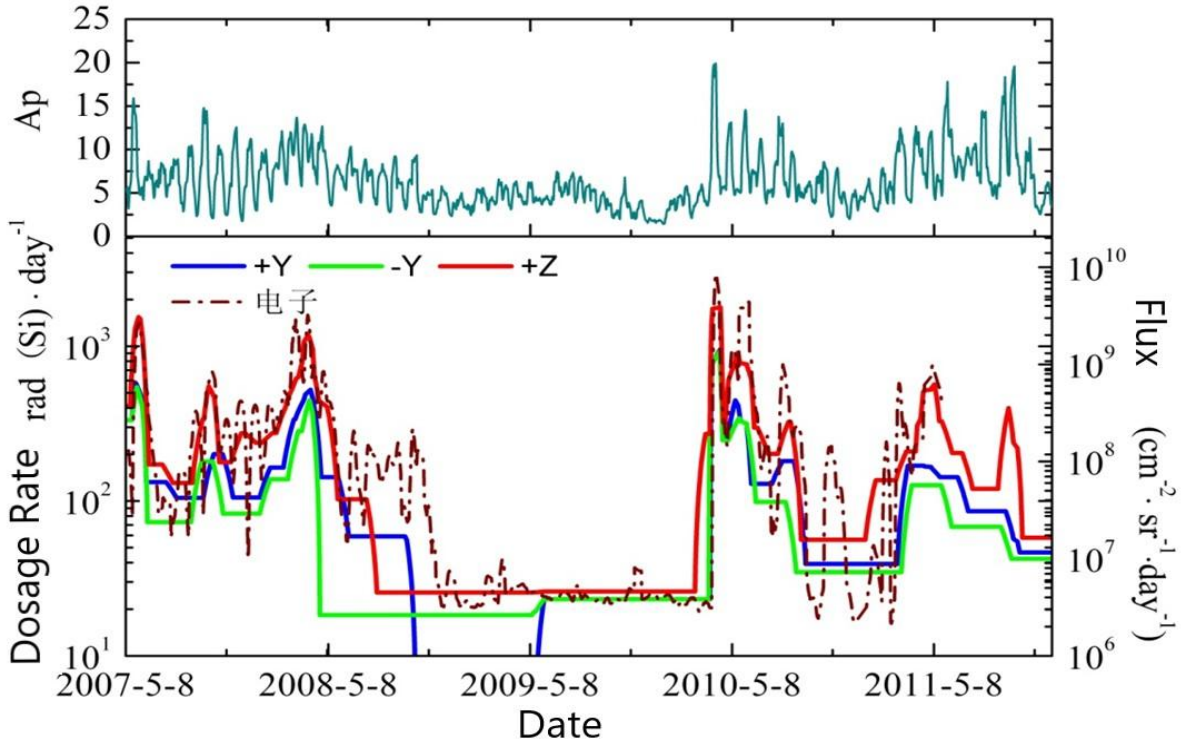
Usually，space weather events will impact spacecraft via disturbing the environment, and cause several effects like

- **Surface Charging**
- **Internal Charging**
- **Single Event Upsets**
- **Total Dose**
- **Atmospheric Drag**



01 Space Weather Impact

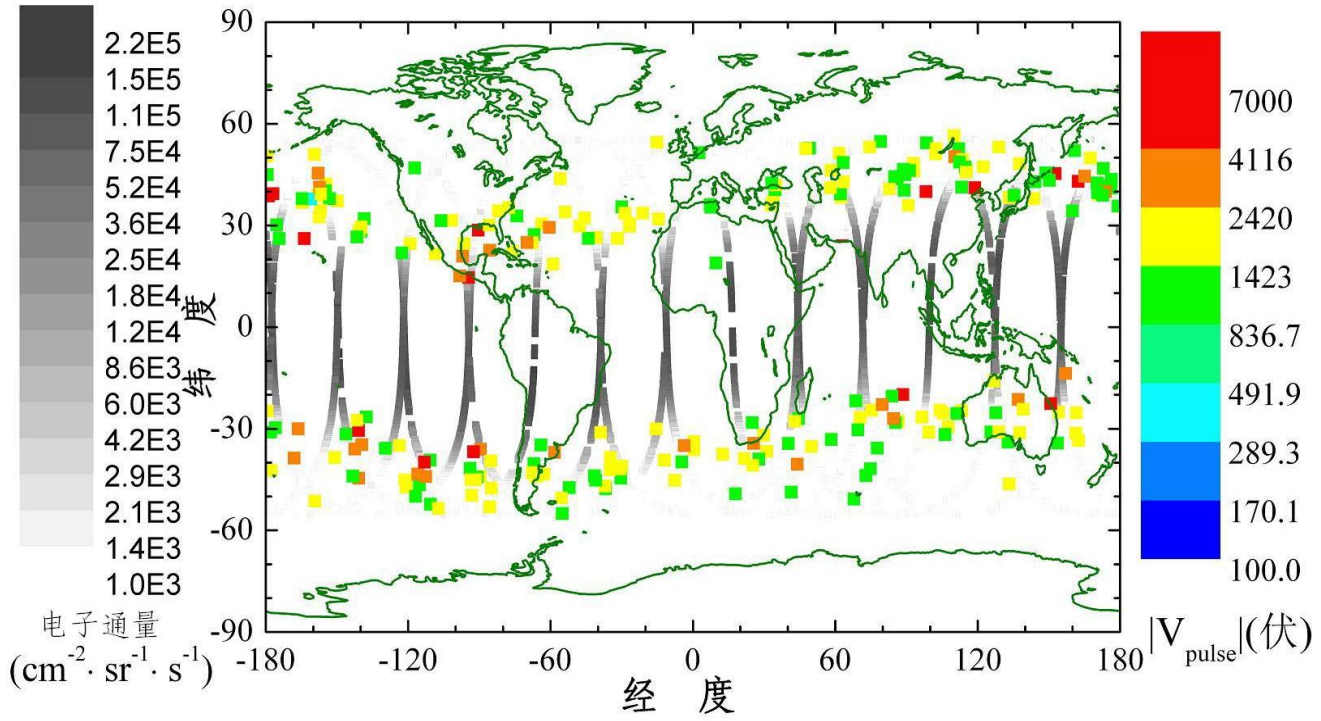
Observation of radiation dosage in MEO



It can be seen that the radiation dosage is highly relative with the high energy electron flux, and modulated by the geomagnetic activities.

01 Space Weather Impact

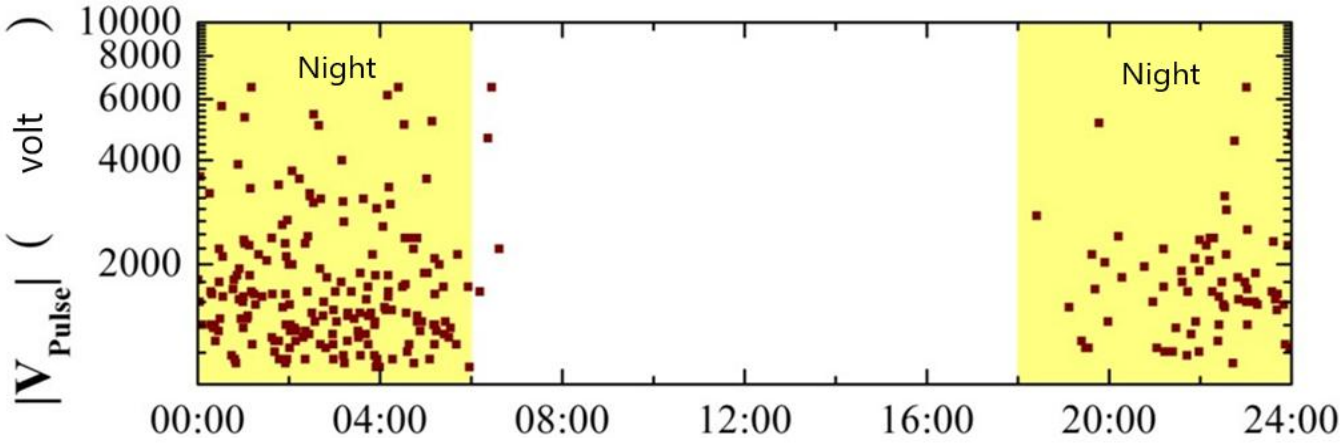
Observations of surface potential in MEO

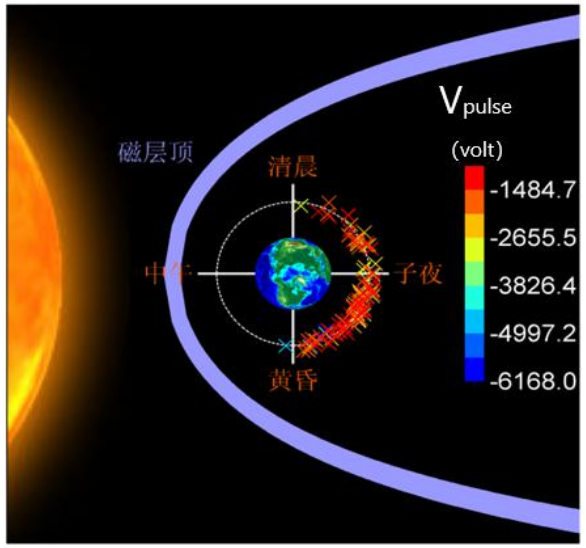


Pulse charge-discharge had been observed many times, which can charge the satellite surface to be thousands of volts in minutes.

01 Space Weather Impact

Observations of surface potential in MEO





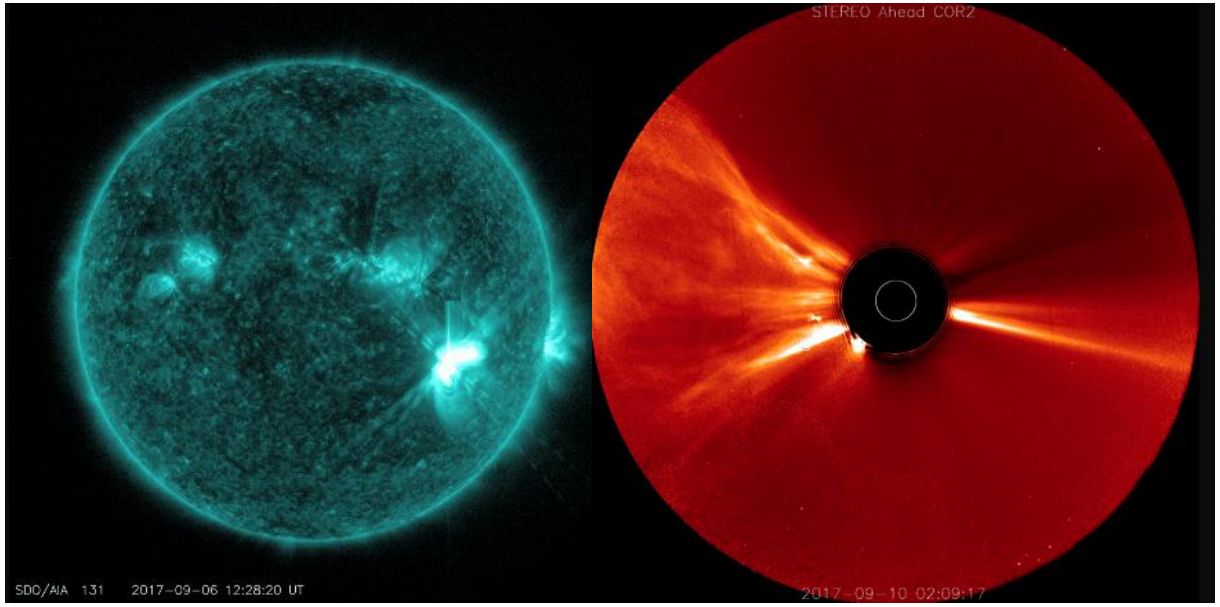
Most of the charge observations happened when the satellite locate at the night side of the magnetosphere, which indicates the charge phenomenon may be relative with the magnetotail plasma injection events.

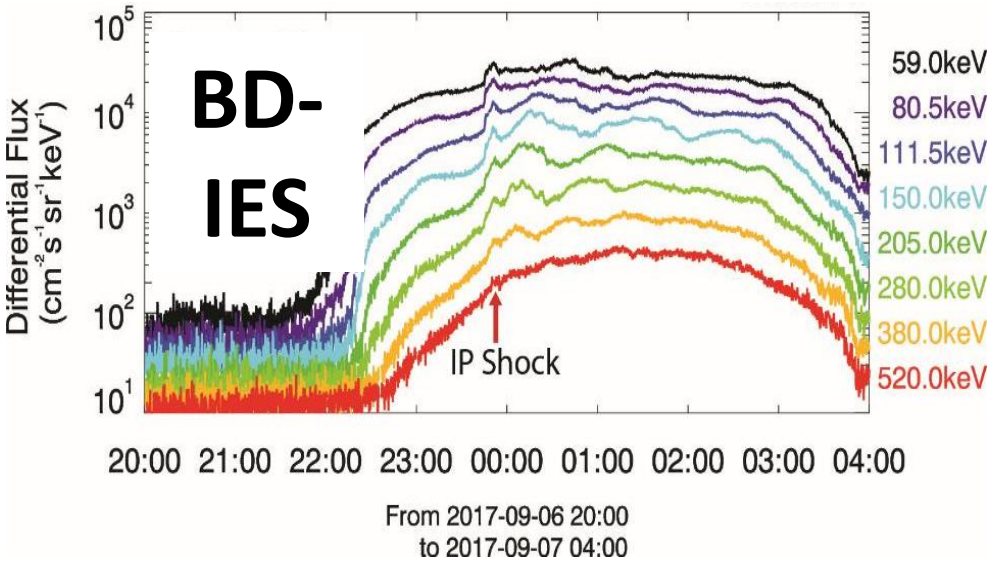
01 Space Weather Impact

Research and Forecast

Methods:

- **Observations analysis**
- **Simulations**
- **Model predictions**





Diversified data, such as different parameters, different orbits or different times, would help to understanding the whole physical picture about the space weather events.

Space Weather Payloads onboard BDS

02 Payloads Packages on BDS

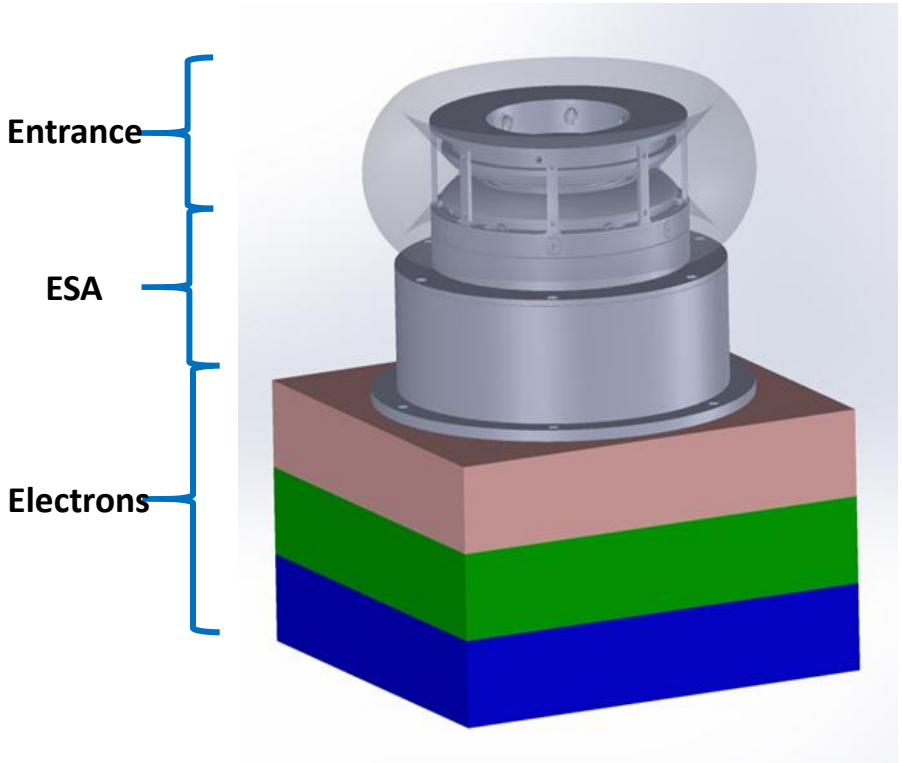
Space Plasma and Satellite Surface Charging Monitor

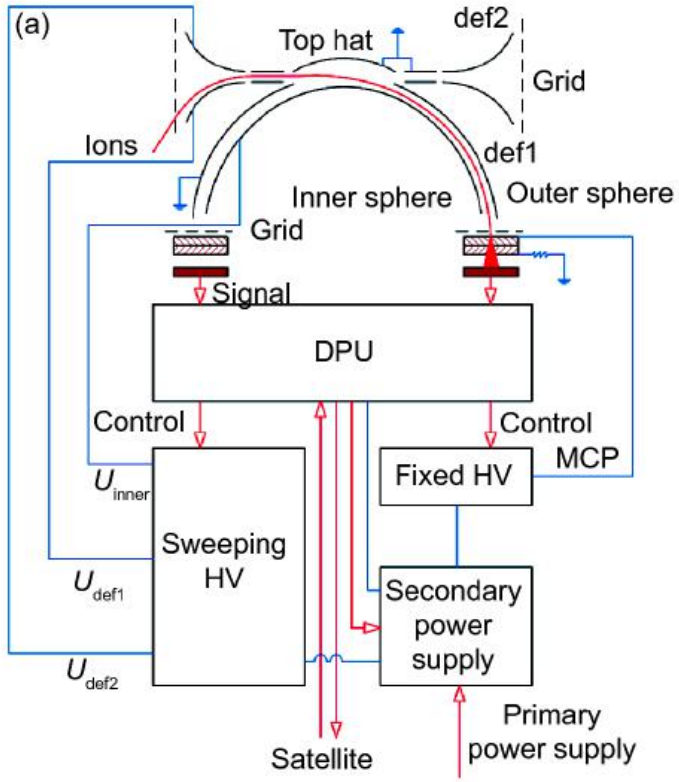
Payload	Characteristic Parameter	Function
Low Energy Electron/Ion Spectrometer	Energy: 0.1~15 keV FOV: 2π Resolution: <15%±2%	Detect parameters of in-situ electrons and ions, such as energy, flux, density and velocity.
Magnetometer	Range: -65000 nT ~ +65000 nT Noise: 10 nT	Measure the environmental magnetic field around the satellites.
Radiation dosimeter	Radiation dosage: 0~10^7rad	Measure total radiation dose to evaluate the lifetime of satellite.
Surface potential detector	Surface potential : 0.1 ~10 kV	Monitor the satellite' s surface potential.

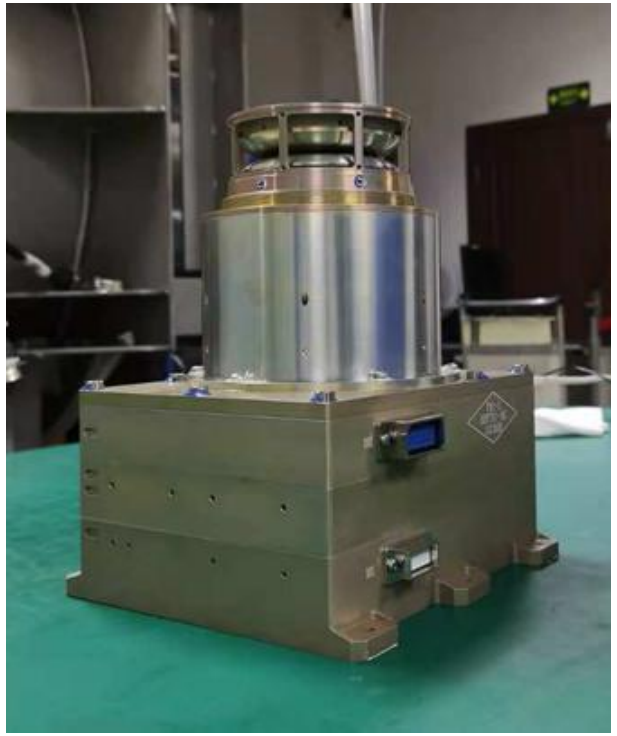
02 Data of Space Weather Payloads

Data accumulating

Low Energy Ion Spectrometer







02 Payloads Packages on BDS

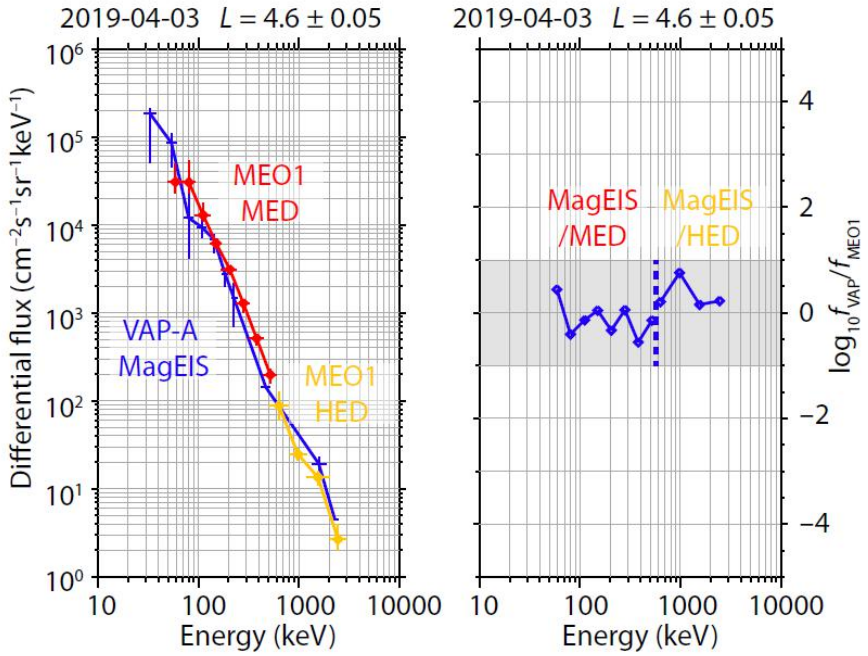
Energetic Electron Detection Packages

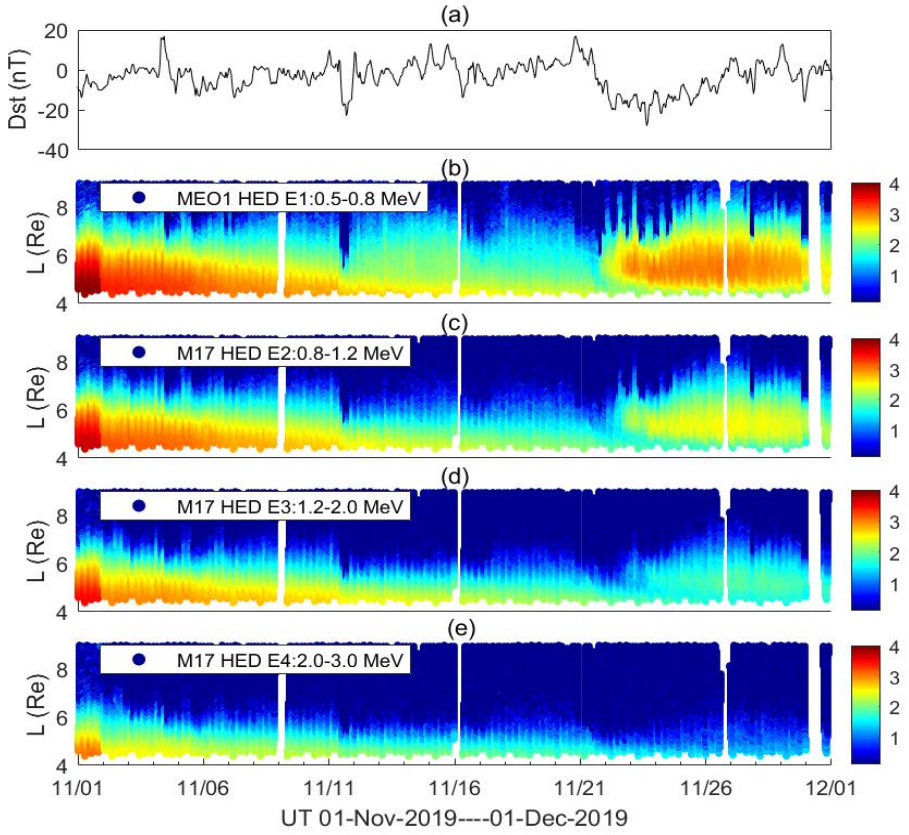
Payload	Characteristic Parameter	Function
Medium-energy Electron Spectrometer (MES)	Energy: 50~600keV FOV: 30°×180° Geometric factor: < ~2.0×10^{-3}	Measure the energy spectra and flux changes of medium electrons in the outer radiation belt.
High-energy Electron Detector (HED)	Energy: 0.5~3.0MeV FOV: 30° cone-angle Geometric factor: < ~1.0×10^{-2}	Measure the energy spectra and flux changes of high electrons in the outer radiation belt.
Deep Dielectric Charging Monitor (DDCM)	Charging Voltage: -2.5 kV to 0 V Charging Current: 0.01-50 pA	Measure the deep dielectric charging current and voltage.

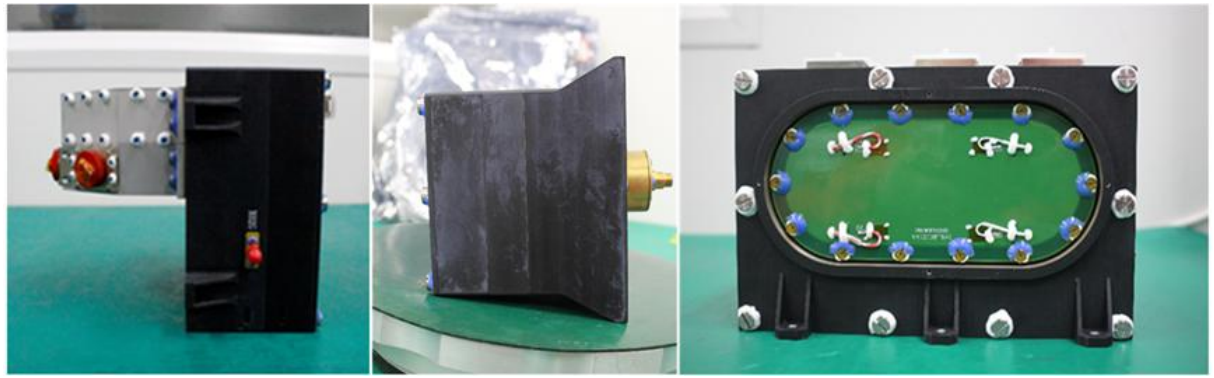
02 Data of Space Weather Payloads

Data accumulating

Energetic Electron Detection Packages (EEDP)







02 Data of Space Weather Payloads

Data of BD-IES has been released

关于发布北斗导航卫星空间环境载荷数据的公告

来源：北斗网　　发布时间：2019-12-09

为促进北斗系统搭载的空间环境载荷相关合作与交流，现将批准的北斗导航卫星空间环境载荷数据予以发布（内容附后），供研究交流。

文件中所有参数由载荷制造方提供，参数的具体定义、描述和文件格式说明可参考数据说明文档。首批载荷数据为“成像电子谱仪”观测数据，观测数据为卫星轨道50至600千电子伏的电子通量。后续北斗卫星搭载的一系列载荷将持续开展空间环境探测试验，并适时发布数据。

特此公告。

http://www.beidou.gov.cn/yw/gfgg/201912/t20191209_19614.html?from=timeline

中国卫星导航系统管理办公室

二〇一九年十二月九日

附件：

1、“成像电子谱仪”数据说明文档

2、“成像电子谱仪”数据说明文档（英文版）

3、北斗导航卫星空间环境载荷数据文件

500 MB data file
2015.10-2018.12

Image Electron Spectrometer (IES)

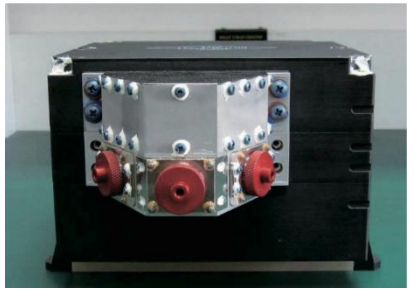


Table 1 Characteristic parameters of BD-IES sensor head

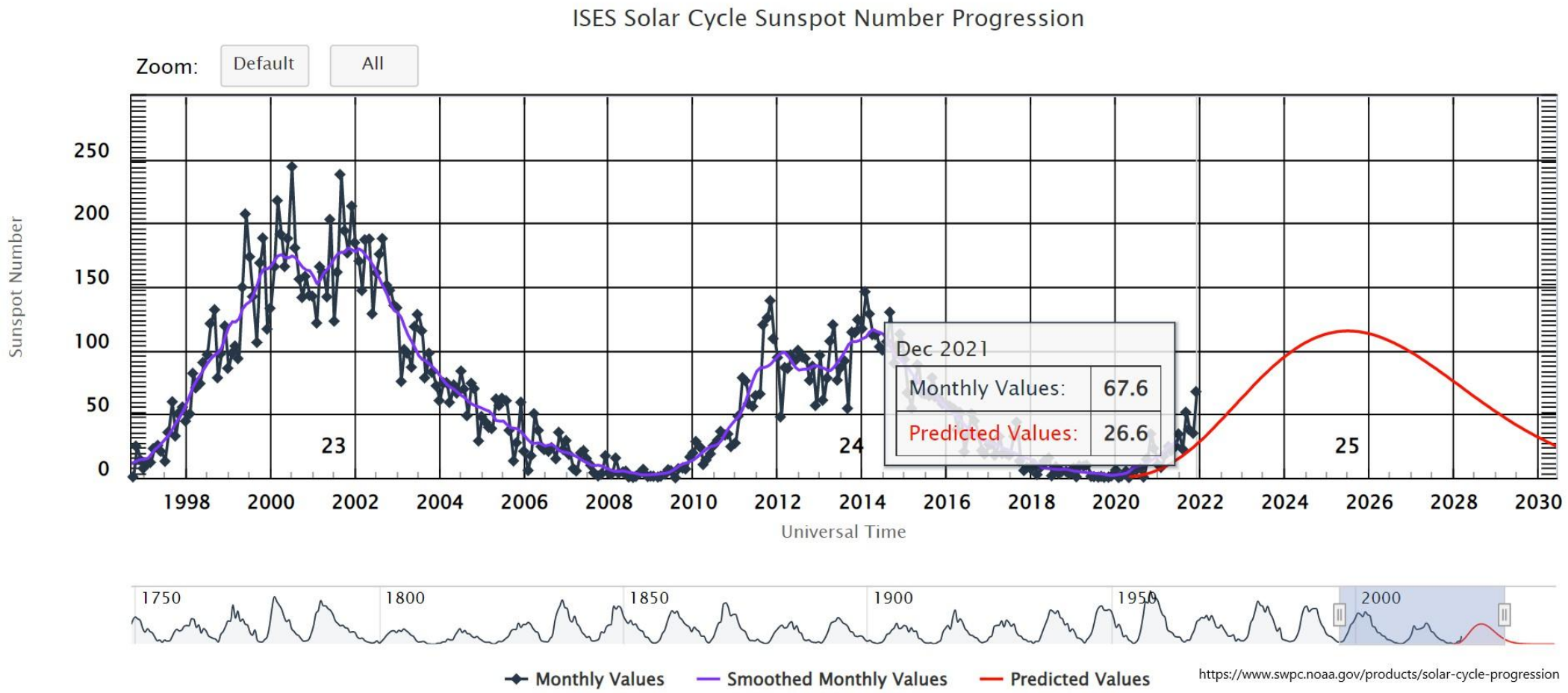
Parameters:	Energy range (50-600 keV)	
Electron channel:	E1	50-68
	E2	68-93
	E3	93-130
	E4	130-170
	E5	170-240
	E6	240-320
	E7	320-440
	E8	440-600
Field-of-view	±15° × 180°	
Angular coverage (range/intervals)	180°/9	
Geometric factor ($cm^2 \cdot sr$)	~2.0×10^{-3} *(for each direction)	

*the geometric factor is the average value of nine directions.

Upcoming of the 25th Solar Maximum

03 Space Weather threaten to Spacecraft

The Challenge



03 Space Weather threaten to Spacecraft

The Challenge

- **The upcoming of the 25th solar cycle certainly is challenge for the Spacecraft. The stability of Spacecraft will be verified in severe space weather events.**

- **More cooperation and action are called to cope with the ever-increasing solar activity in next several years, such as the release of observation data in public, specialized team to promote the international cooperation in space weather research, and so on.**

THE END