



Space Weather Payloads onboard of BDS-3 Satellites

14th Meeting of the International Committee on
Global Navigation Satellite Systems

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2019-12-10



| CONTENT |

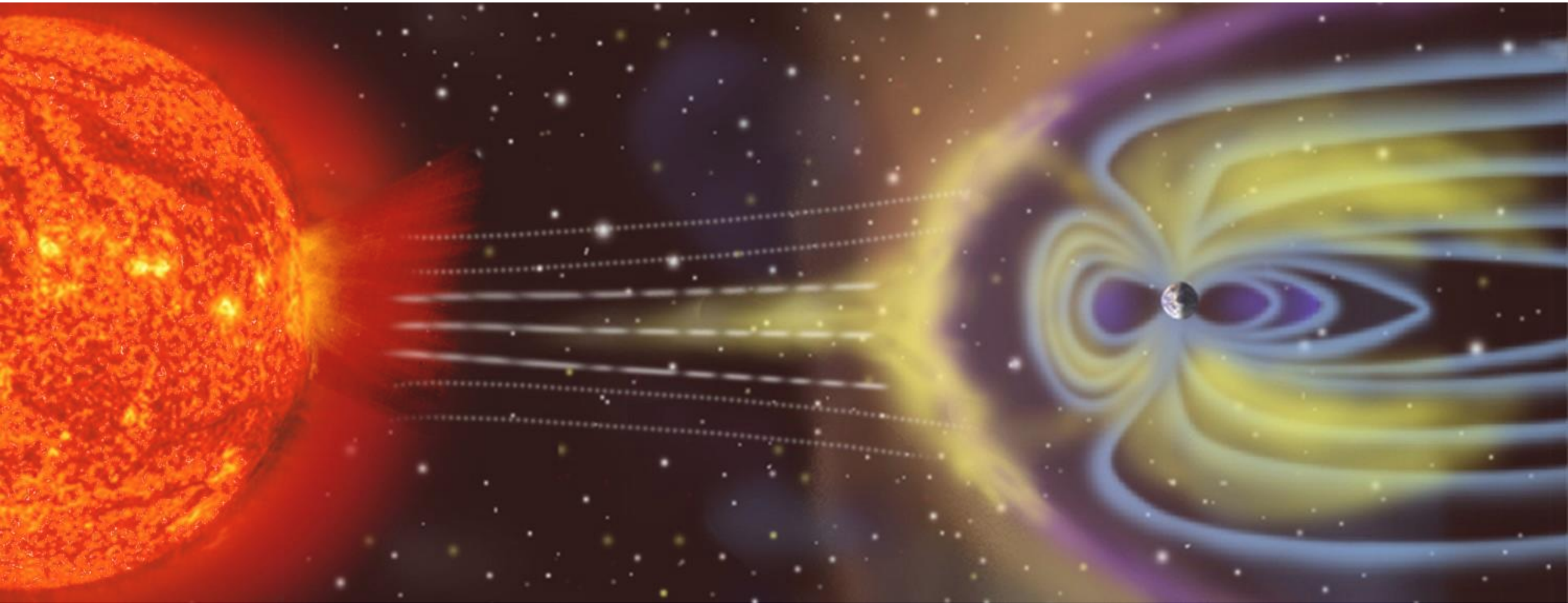
- 01 Space Weather and Human Activities**
- 02 Space Weather Payloads onboard of BDS-3 Satellites**
- 03 Recommendation about Sharing Space Weather Data**

01

Space Weather and Human Activities

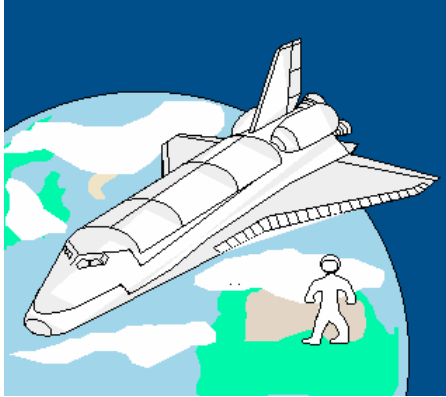
Space Weather

Space environment disruptions near Earth, caused by solar activities.

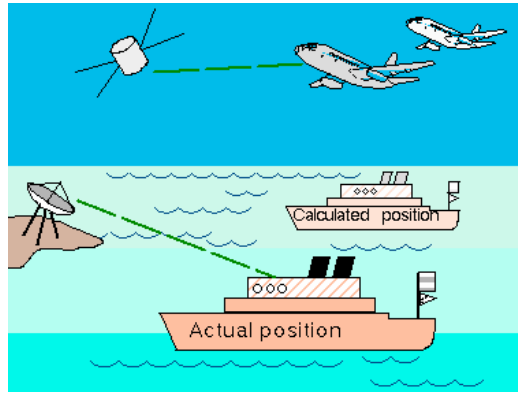


Possible Consequences of Space Weather Events

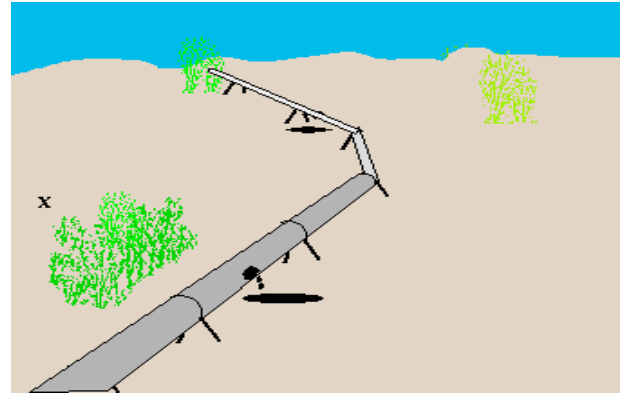
Astronauts' safety



Navigation System



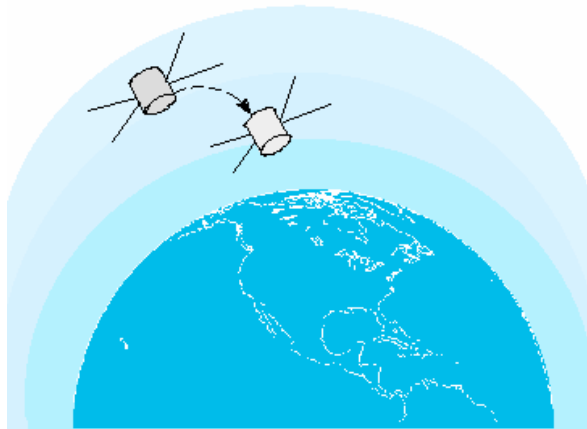
Oil Pipelines



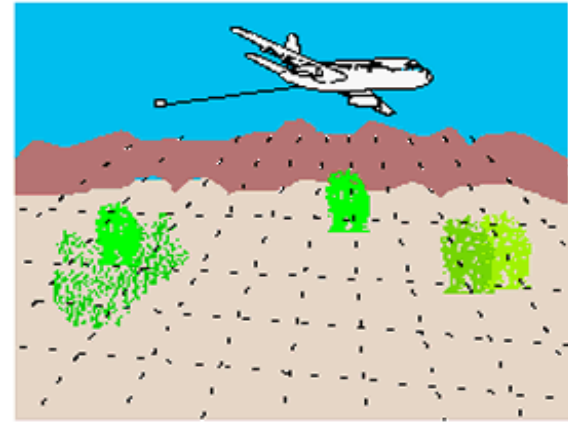
Power Network



Satellites



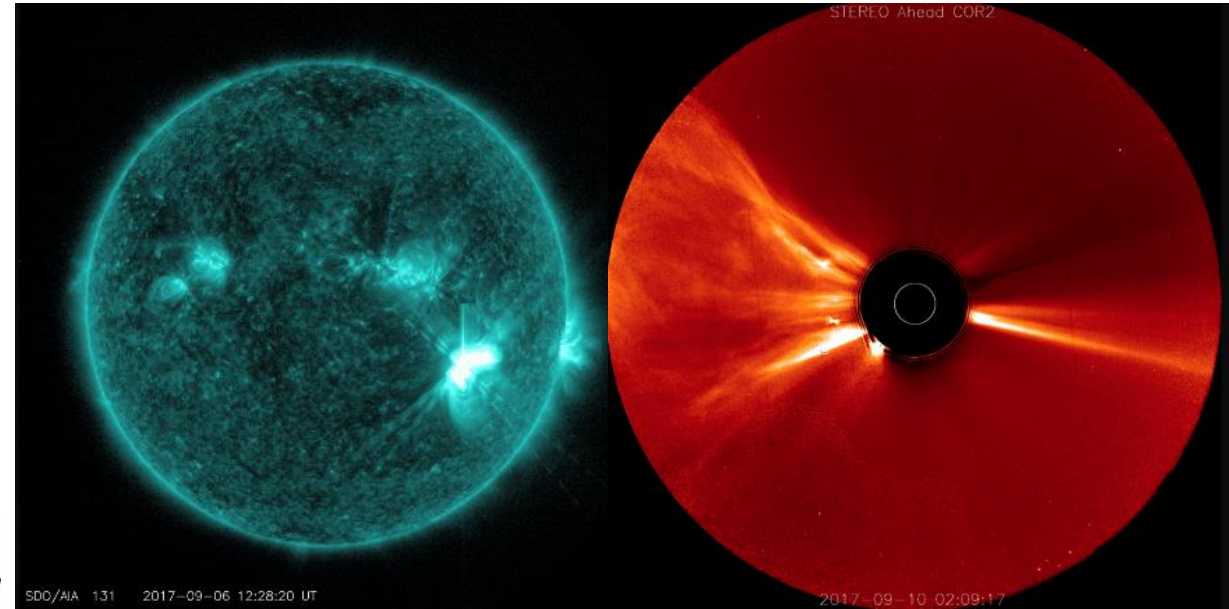
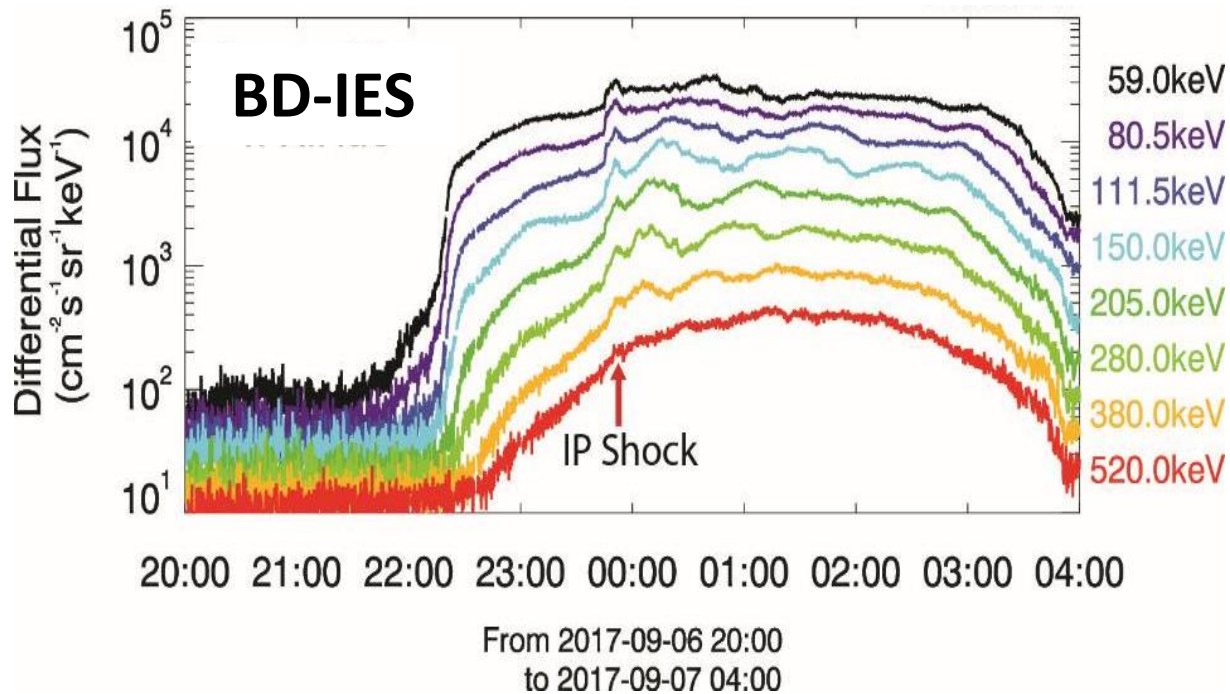
Mapping



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.

02

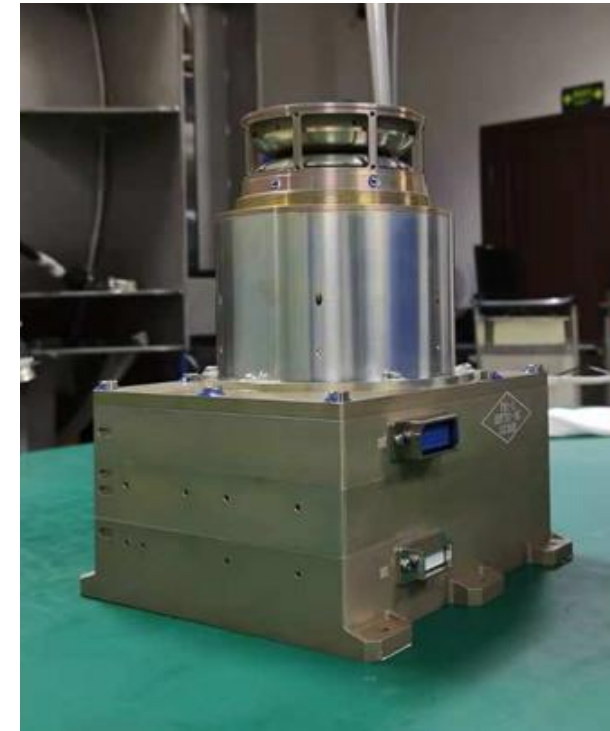
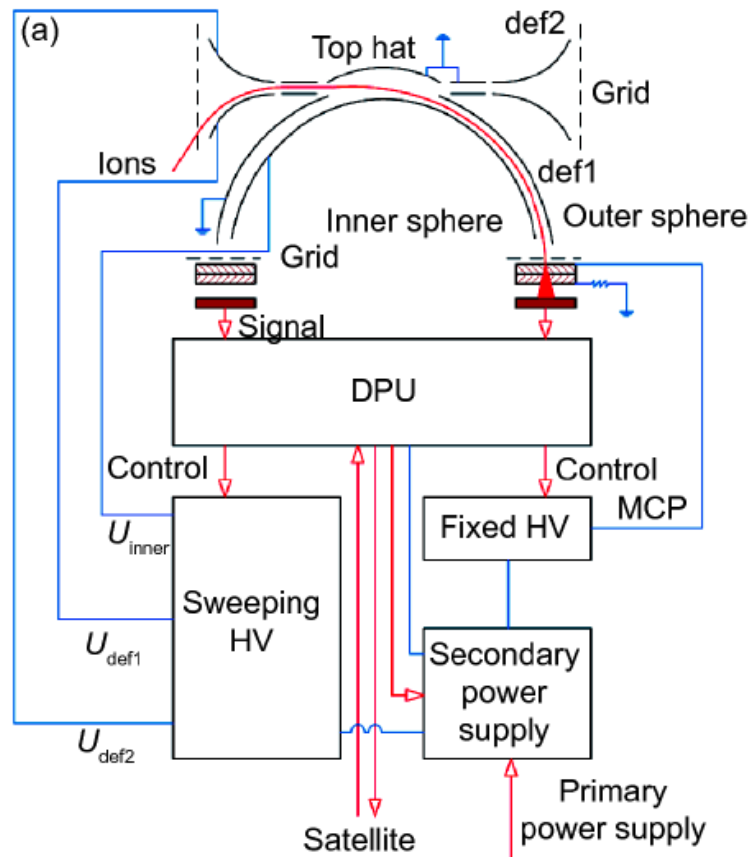
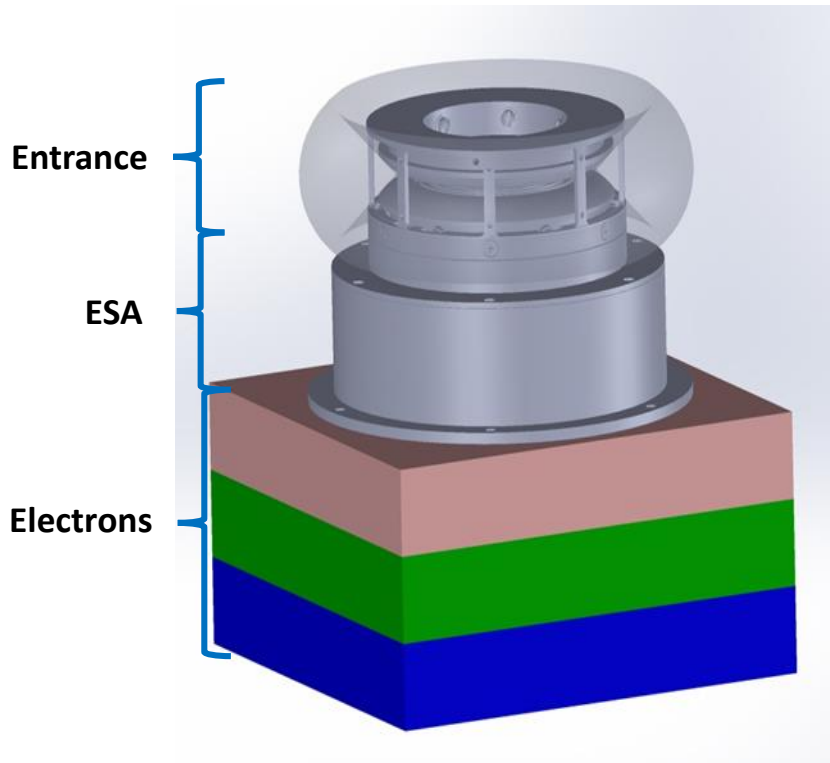
Space Weather Payloads onboard of BDS-3 Satellites

Space Weather Payloads Package

Space Plasma and Satellite Surface Charging Monitor
 —onboard of MEO-13 and MEO-14 launched in 2018

Payload	Characteristic Parameter	Function
Low Energy Electron/Ion Spectrometer	Energy: 0.1~15 keV FOV: 2π Resolution: $< 15\% \pm 2\%$	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: $0 \sim 10^7$ rad	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.

Low Energy Ion Spectrometer



Designed by University of Science and Technology of China

Application of the Payloads Observations

- Applied in studying the space environment of the navigation satellite.
- Applied in analyzing the abnormalities of the navigation satellite.
- Applied in modeling the radiation environment in MEO orbit.

03

Recommendation about Sharing Space Weather Data



Recommendation: Share GNSS Space Weather Data

I. At present, space weather payloads have been on board most of the GNSS satellites.

- **Space weather data is essential to the safety and stability of the GNSS system.**
- **Considering the difference orbits of GNSS satellites, these space weather data sets are unique.**
- **If space weather data sets obtained by GNSS satellites can be shared, the space weather model performance and forecast/nowcast accuracy will be improved.**

Recommendation: Share GNSS Space Weather Data

II. We propose that the space weather data obtained by the payloads onboard GNSS satellites should be shared:

- **Information about the space environment payloads onboard GNSS satellites should be introduced in ICG;**
- **Free and unrestricted sharing of space weather data;**
- **Exchange of the space weather models and forecast or nowcast outputs should be encouraged.**

Data Release: BD-IES(IGSO)

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)

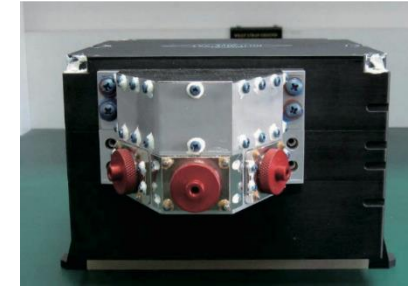


Table 1 Characteristic parameters of BD-IES sensor head

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	$\pm 15^\circ \times 180^\circ$	
Angular coverage (range/intervals)	180°/9	
Geometric factor (cm ² -sr)	$\sim 2.0 \times 10^{-3}$ *(for each direction)	

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



Conclusions

- **Space weather has great influence to human activities, including the operating GNSS systems;**
- **BD-3 satellites are carrying multiple payloads for space weather ;**
- **China is willing to share the space weather data from BDS with other GNSS systems;**
- **We propose to establish a communicating group to discuss the possible solution for data sharing.**

Thanks for your attention and support for BDS!

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