



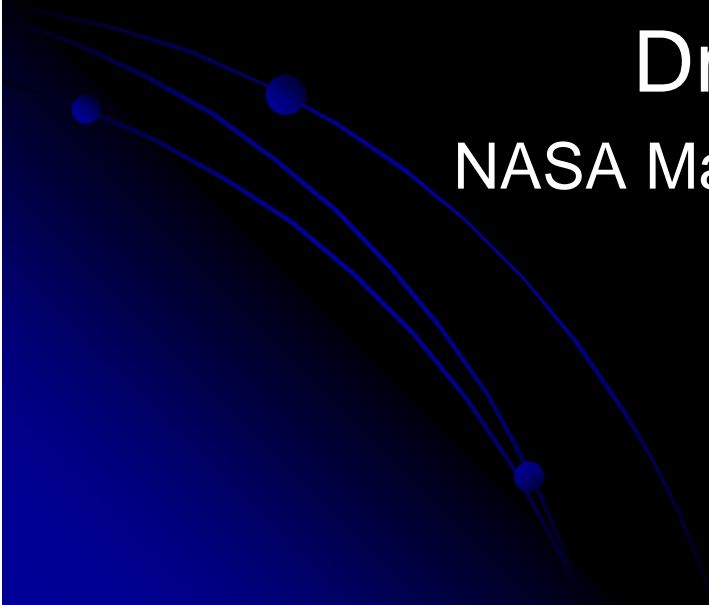
# Geospace Overview

## Space Weather Camp 2012

### Huntsville, Alabama

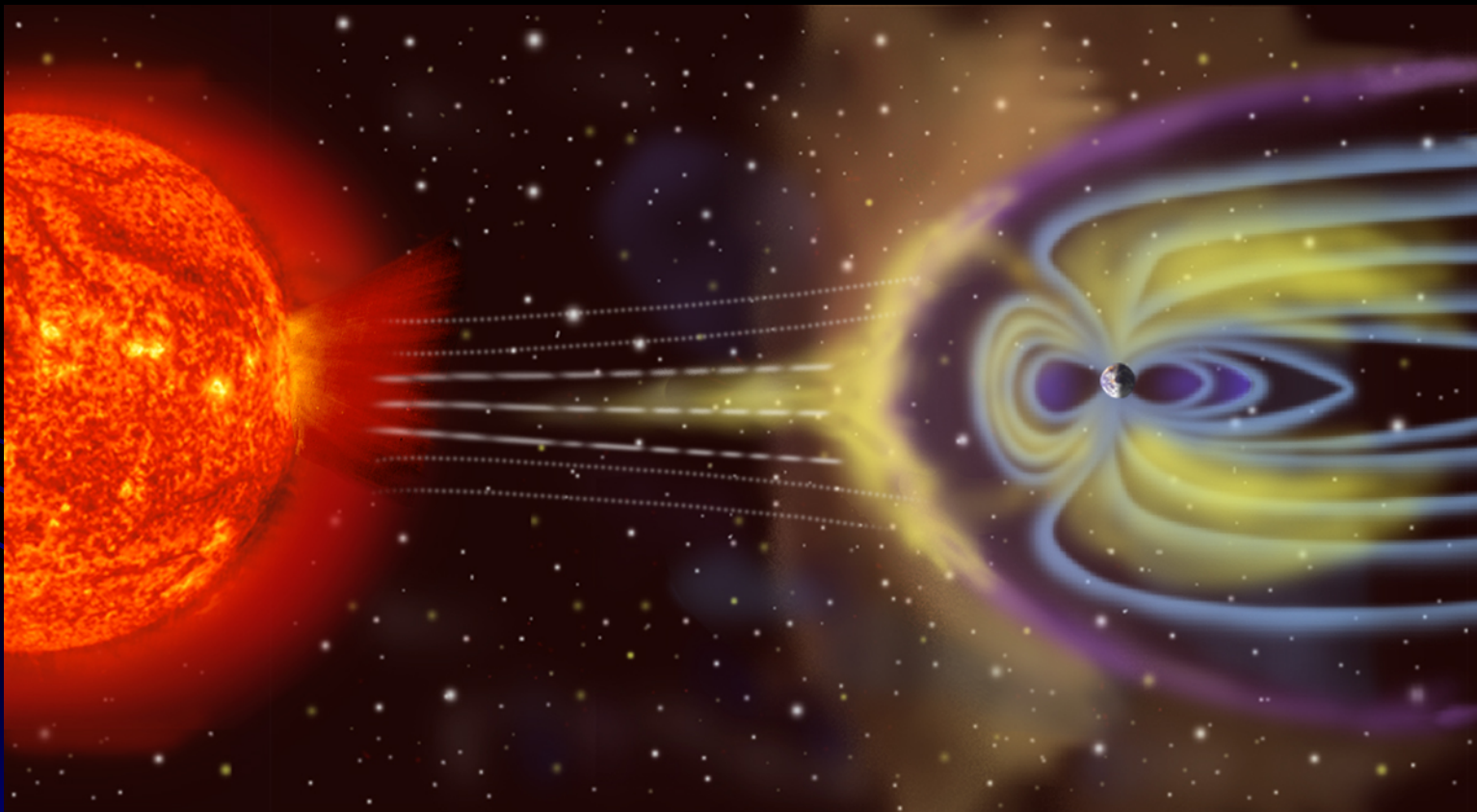
Dr. James Spann

NASA Marshall Space Flight Center





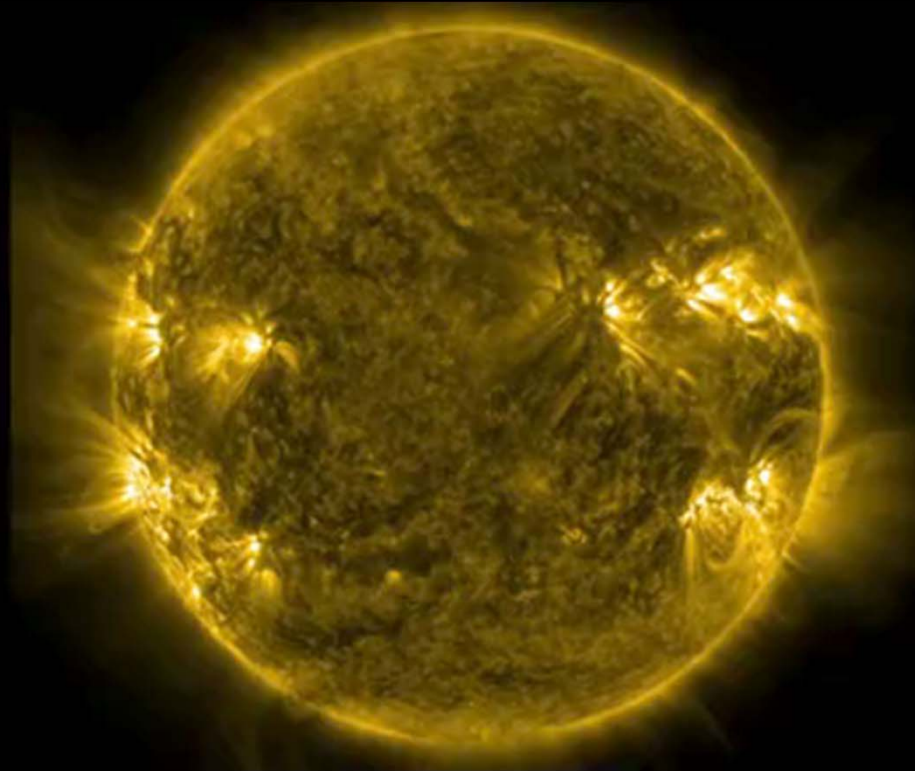
# Space Weather



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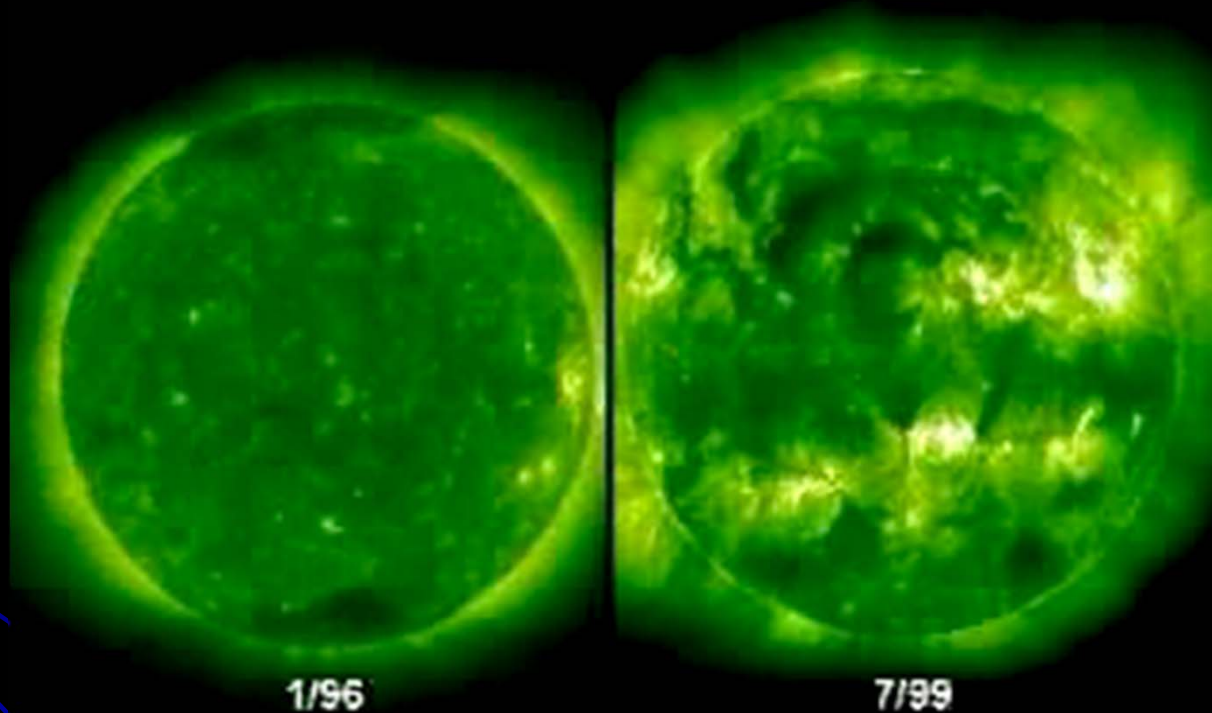
# the Sun



## **Sun Releases X-class Solar Flare**

This movie shows the July 6, 2012 X1.1 flare in the 171 Angstrom wavelength as captured by NASA's Solar Dynamics Observatory (SDO).

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## Solar minimum and maximum comparison

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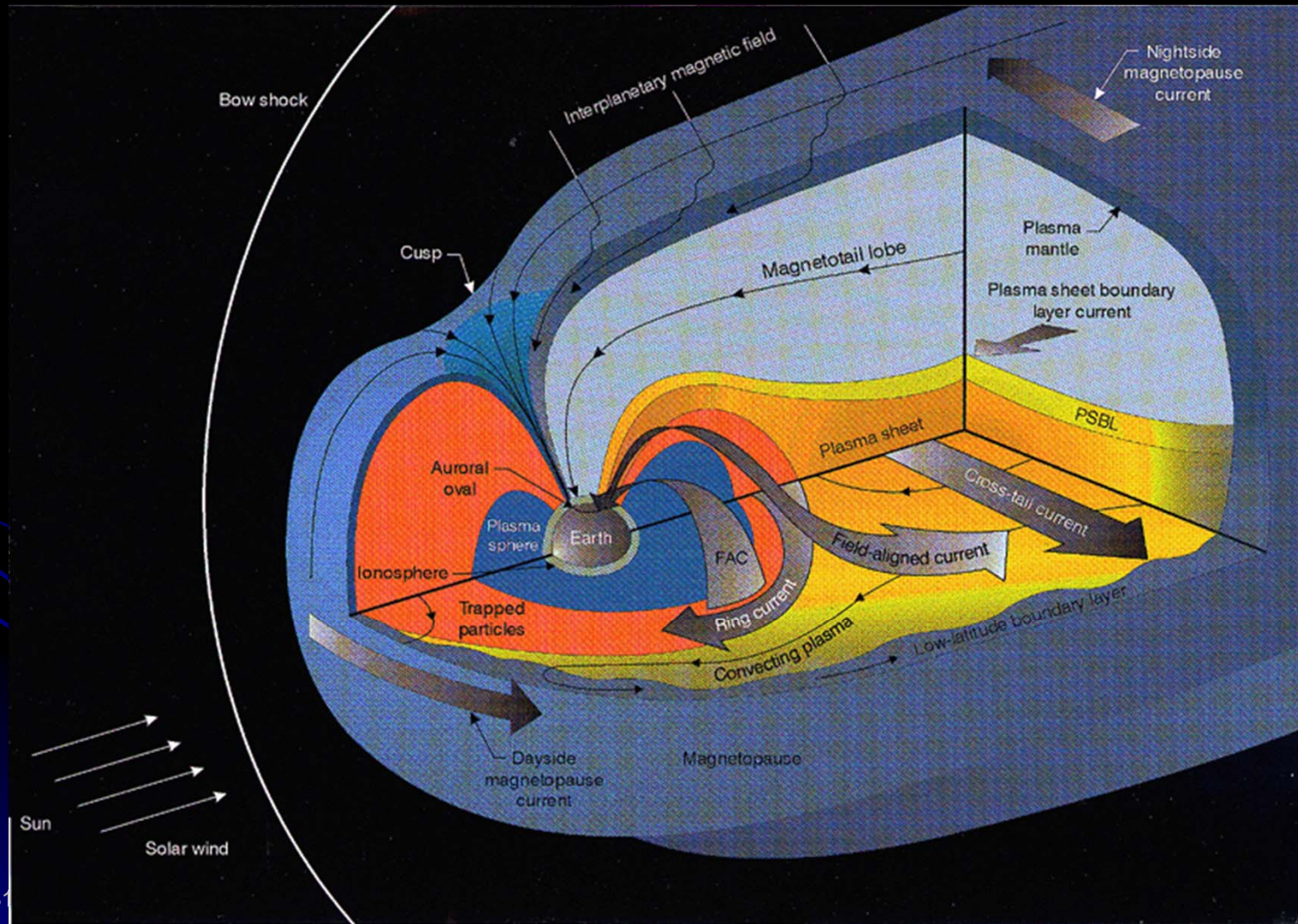
# Connection with Geospace



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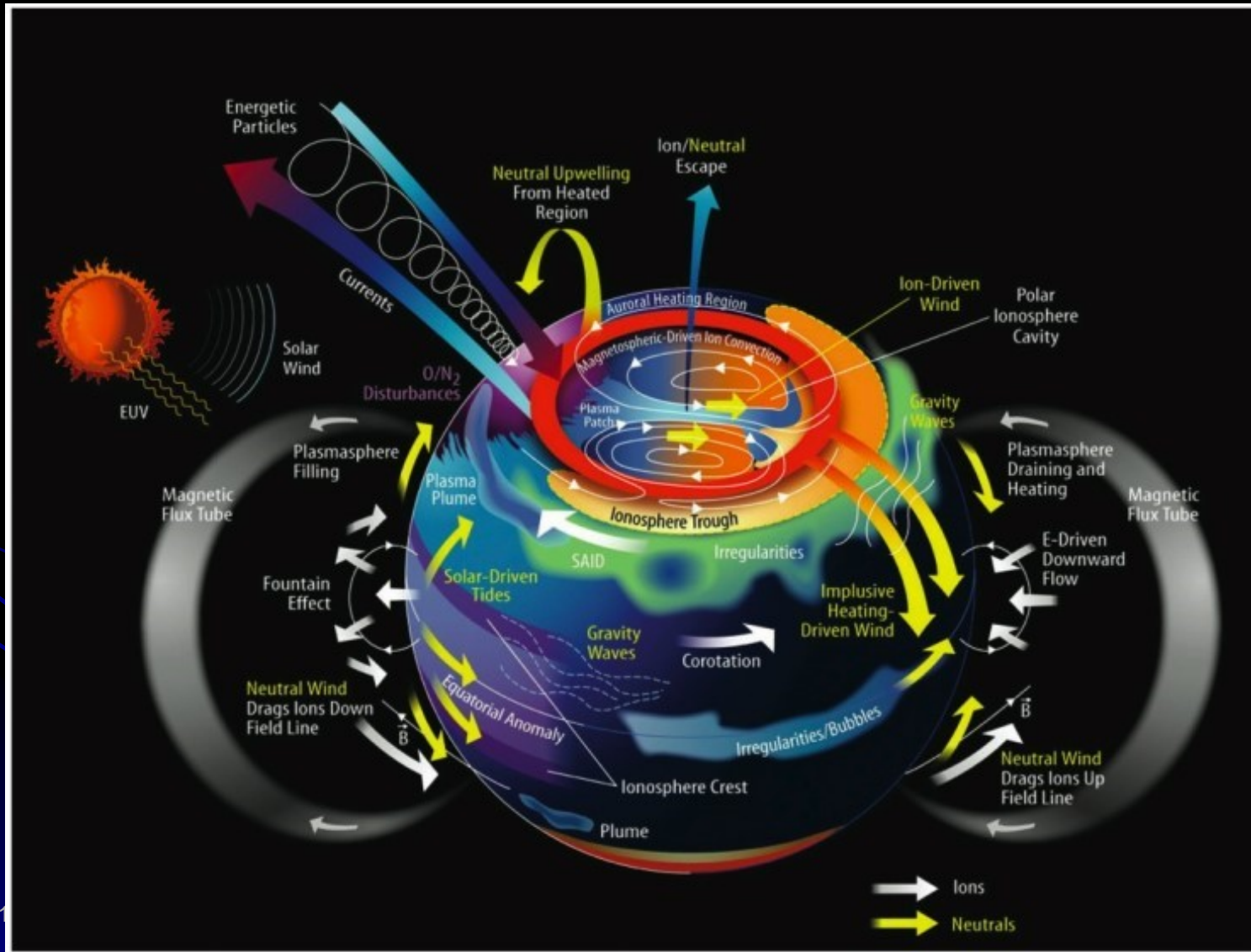
# Geospace



October 31



# Earth's boundary with space





# Aurora - the greatest light show on Earth



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# Aurora - the greatest light show on Earth



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# The aurora from ISS



## **Aurora From Orbit Sept. 17, 2011**

This gorgeous view of the aurora was taken from the International Space Station as it crossed over the southern Indian Ocean on September 17, 2011.

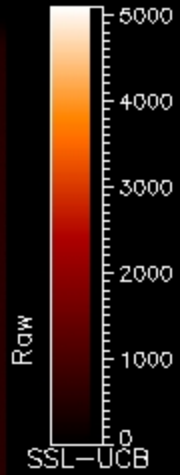
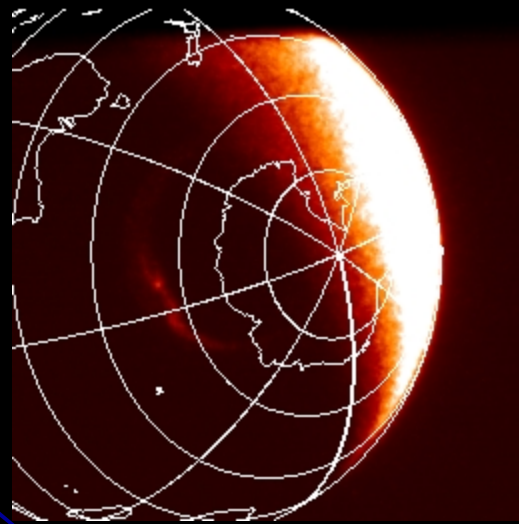
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The sped-up movie spans the time period from 12:22 to 12:45 PM ET.

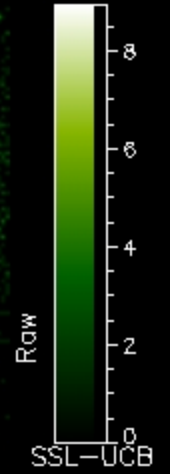
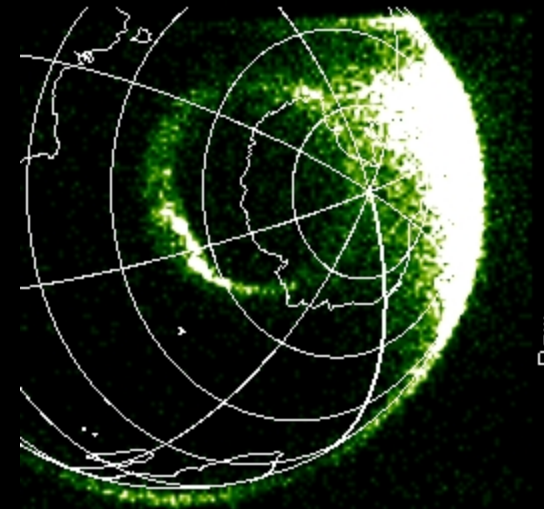


# The aurora

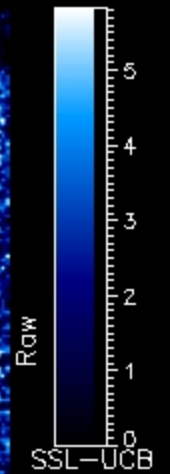
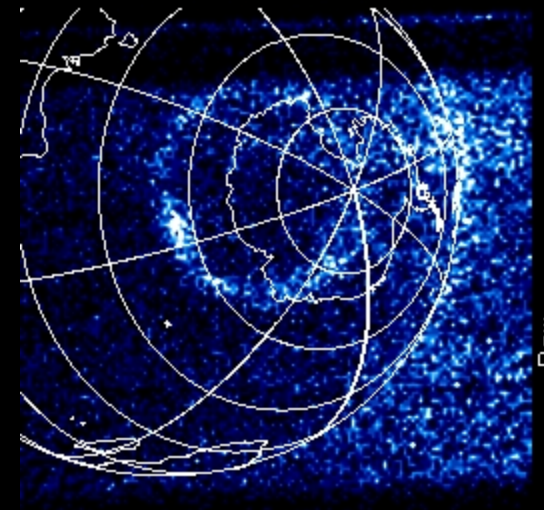
WIC 2004-03/07 19:08:41 UT



SI-13 2004-03/07 19:08:41 UT

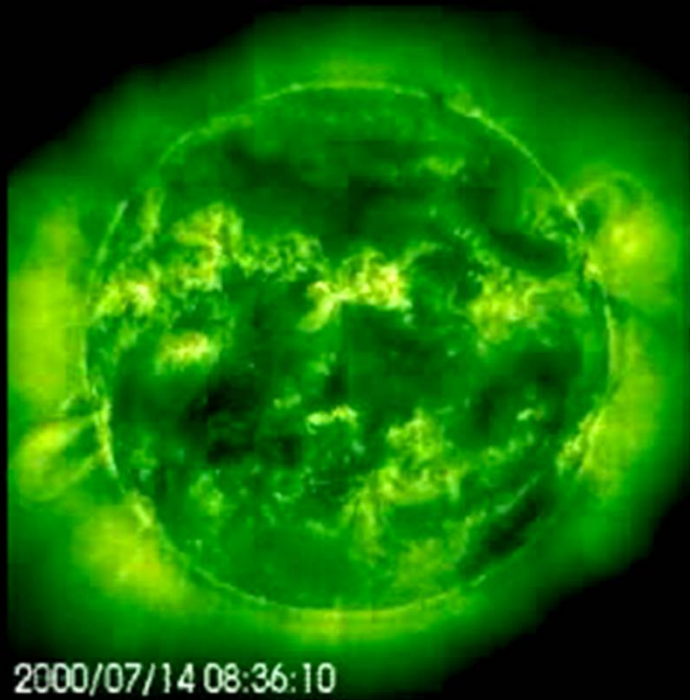


SI-12 2004-03/07 19:08:42 UT





# Bastille Day Event July 14, 2000 . . .



. . . a very active region on the Sun produces a flare - the brightest this solar cycle

2000/07/14 09:00:10



# within minutes, arrival of energetic proton storm affects s/c detectors

View of Earth from  
Polar VIS Earth  
Camera

VIS Earth Camera  
2000/196 10:00 UT

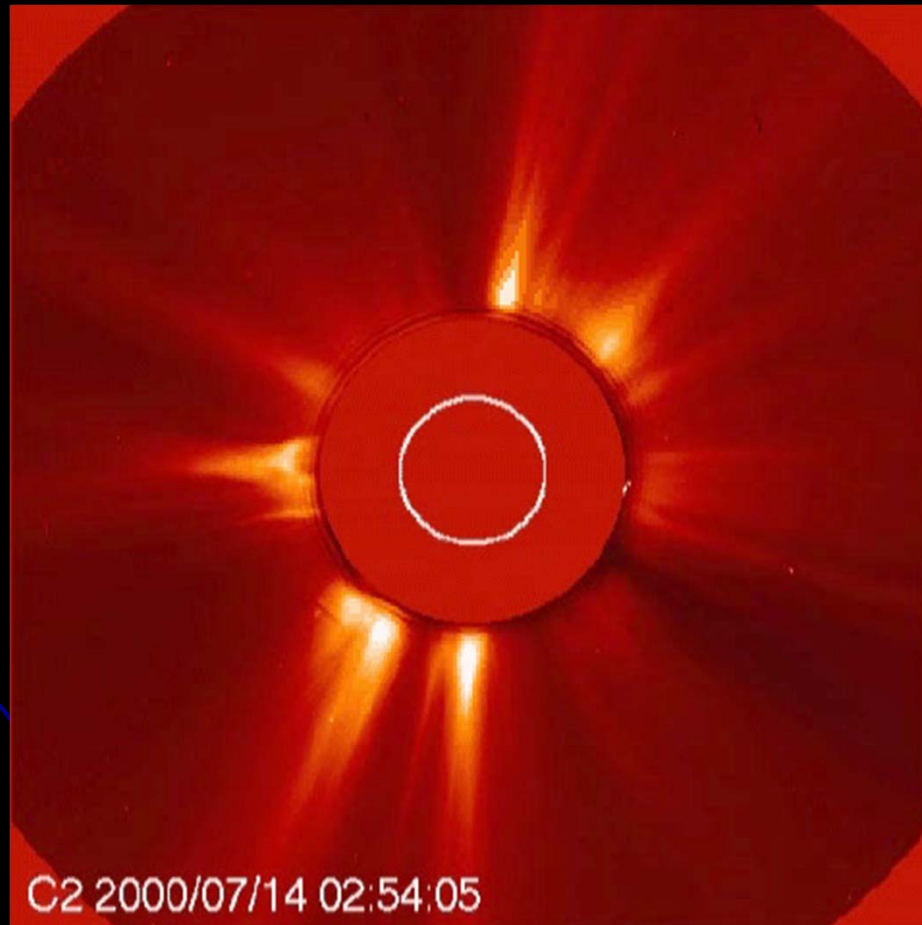


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. . . during the same hour, a  
CME is observed traveling  
toward Earth



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# . . . the next day, spacecraft contend with arrival of CME cloud

System	Name of System	Type of Impacts
Commercial Satellites	geo-synchronous*	Lost transponder - due to proton event
	geo-synchronous*	Orientation problems - due to magneto-pause crossing
	geo-synchronous*	Orientation problems - due to proton event
Operations Satellites	GOES 8, 10 and 11	"Salt and Pepper" effect on visible channel 1 and channel 2 of infrared sensor, 2MeV electron saturation due to proton event; infrared sensor problems effects fire detection users
Research Satellites	Japan's Orbiting X-ray Observatory (ASCA)	Went into "safe mode" and lost a lot of altitude drained back-up batteries and unable to regain control of craft (as of 7-22). Orientation probs. Unable to orient towards sun for recharge of batteries, from solar panels.
	SOHO	Permanent solar panel degradation equivalent to 1 year of normal degradation
	Wind Spacecraft QuickSCAT	~25% permanent loss of transmitter power s/c busses went down, lost 17 hours science data (earth science)
	NEAR	XGS instrument auto-shut down for 2 days
	ACE	plasma detectors lost output for days

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# ...and Earth's aurora responds



IMAGE-FUV-2000/07/15-14:00:39.UT





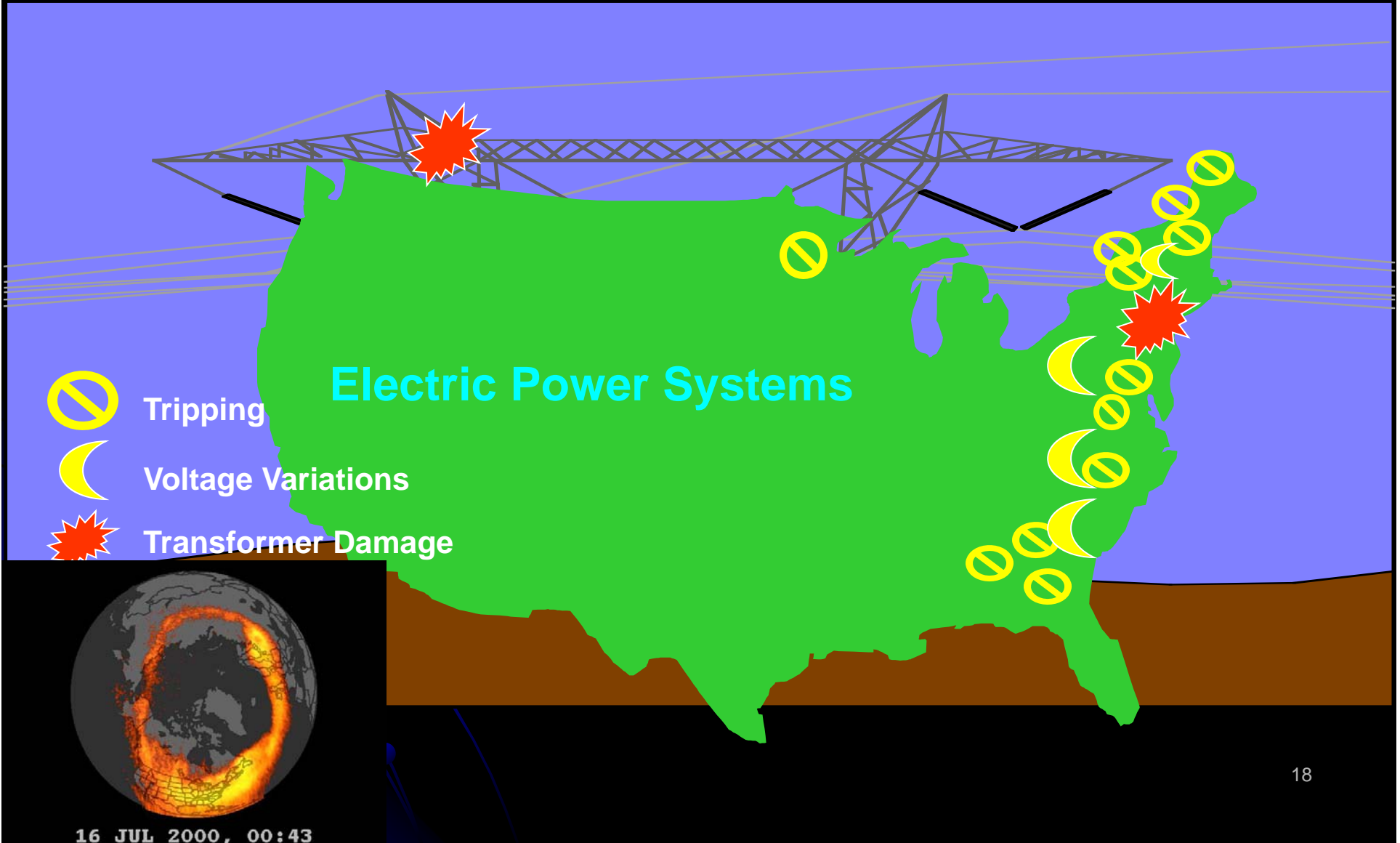
. . . on July 16th a large magnetic storm occurs . . .

- the aurora is reported as far south as:
- St Louis, MO
- Manassas, VA
- Bakersville, CA
- Bendigo, Victoria (Australia)



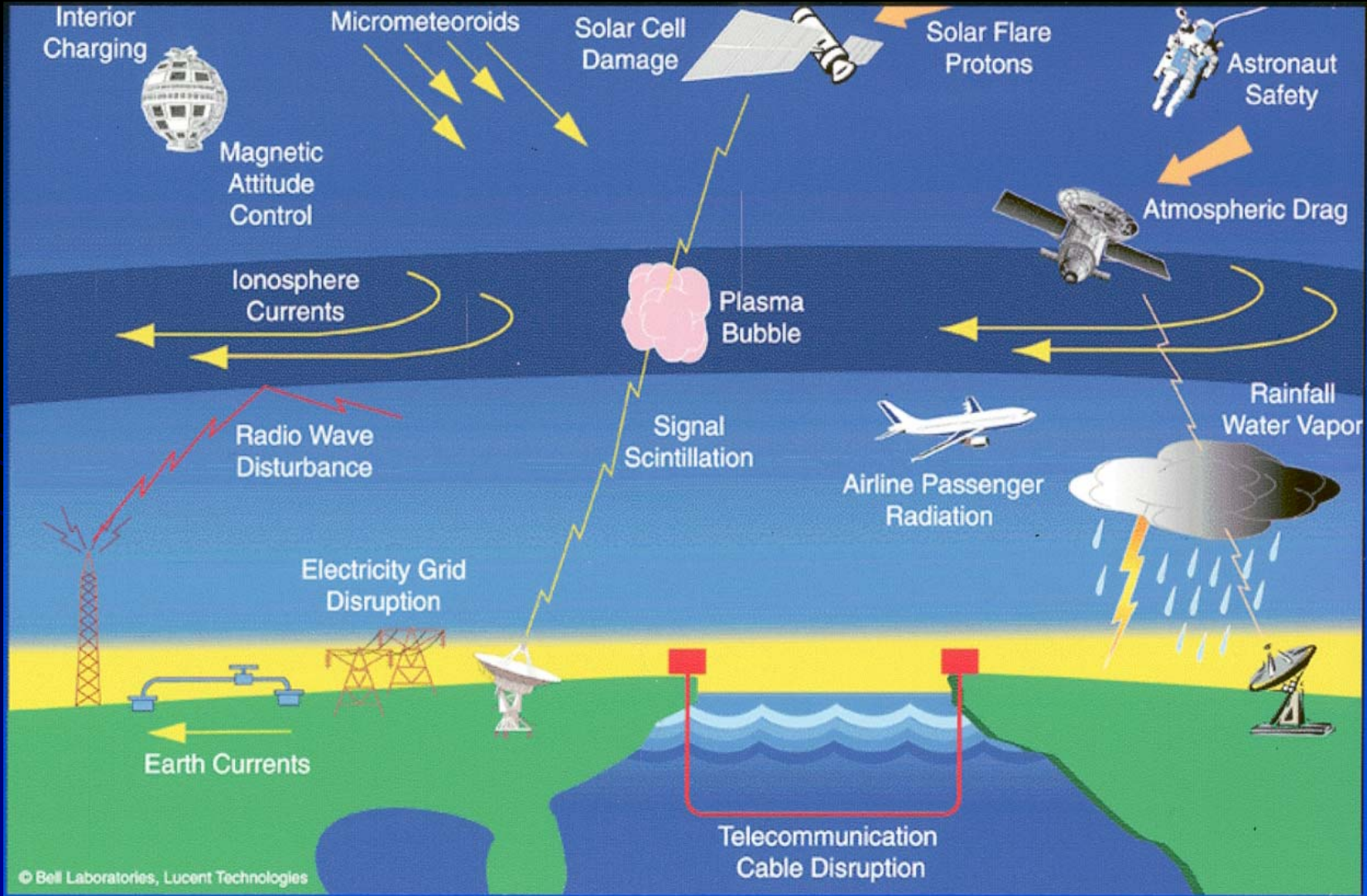


# ... and ground power systems experience impacts



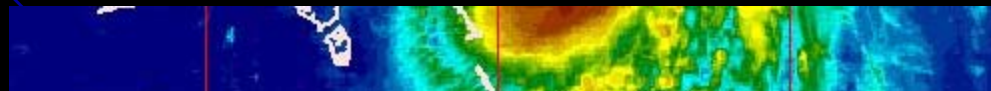
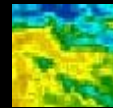
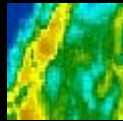


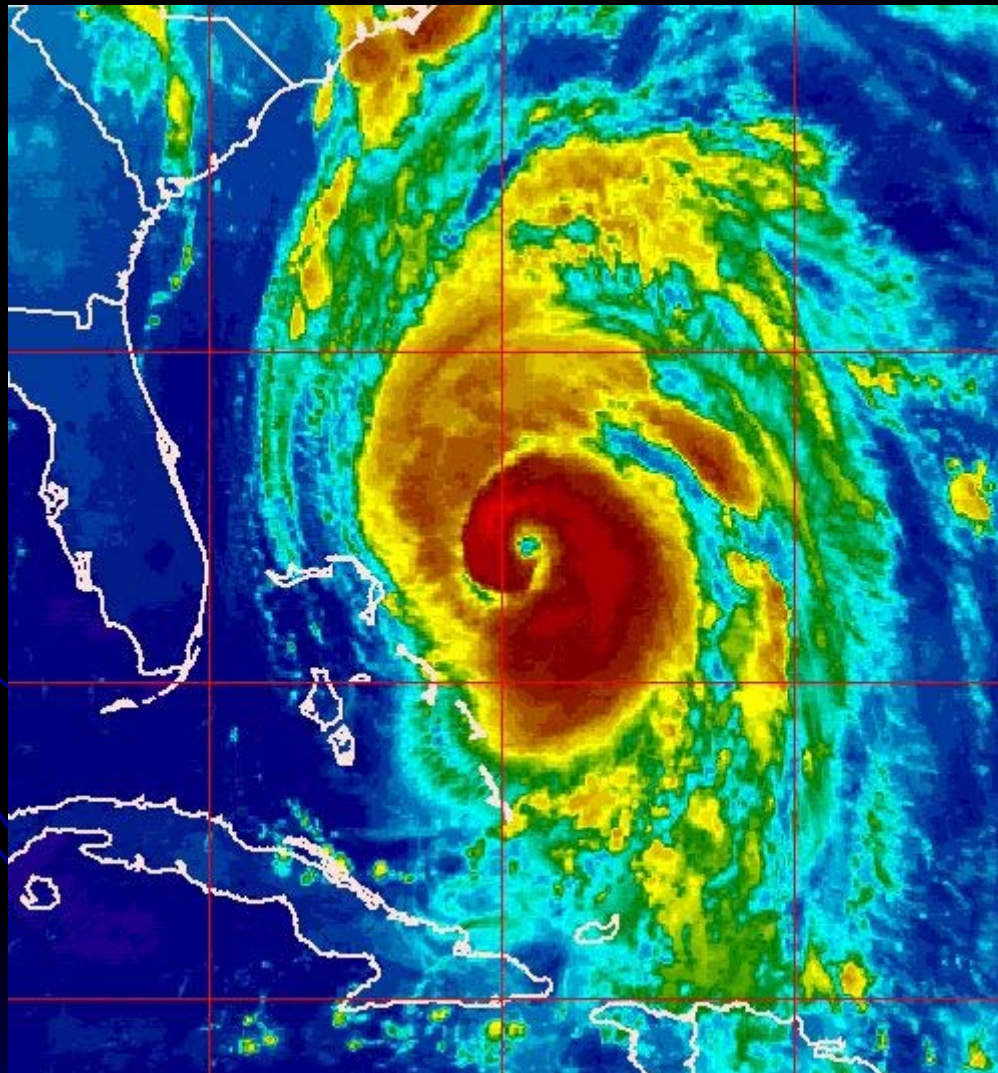
# Space Weather Effects





# What does it take to understand Space Weather impacts?





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The real voyage of discovery  
consists not in seeking new  
landscapes, but in having new eyes.

Marcel Proust



**IMAGE, seeing the invisible**<sub>22</sub>

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The real voyage of discovery  
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Marcel Proust



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IMAGE, seeing the invisible<sub>23</sub>



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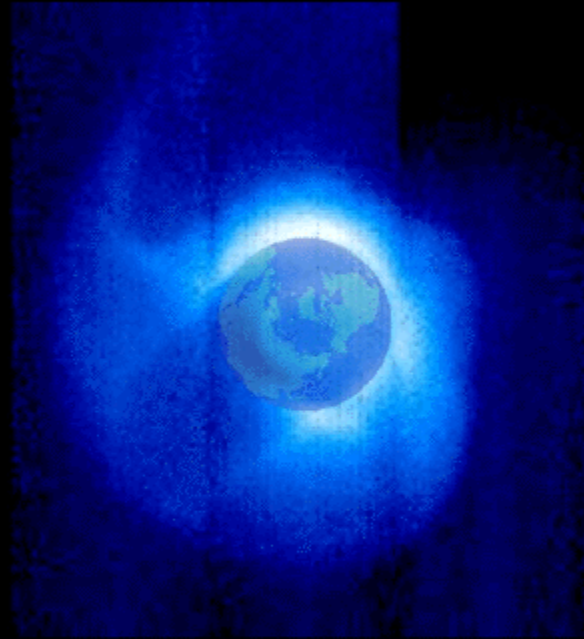
IMAGE, seeing the invisible<sub>24</sub>





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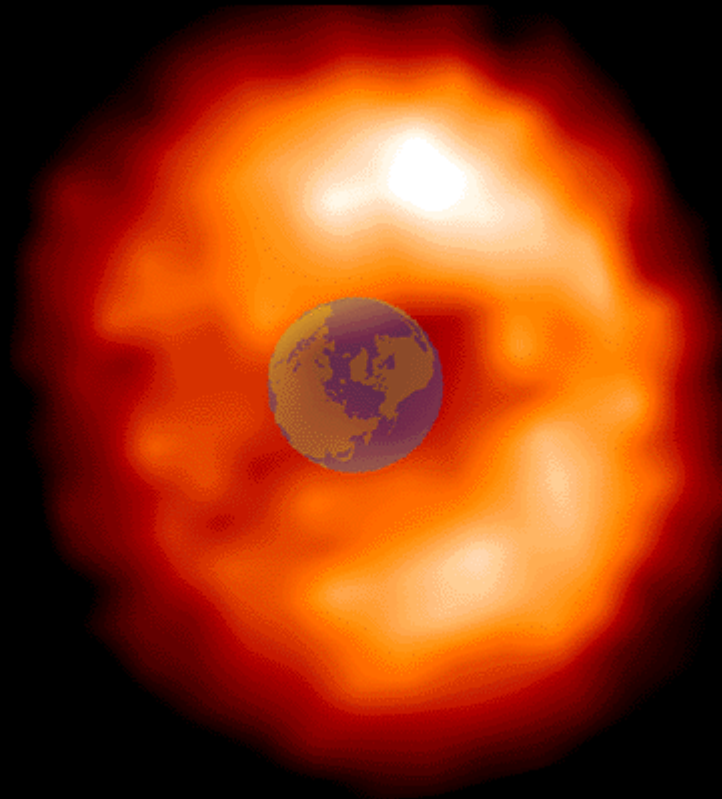
IMAGE, seeing the invisible

25



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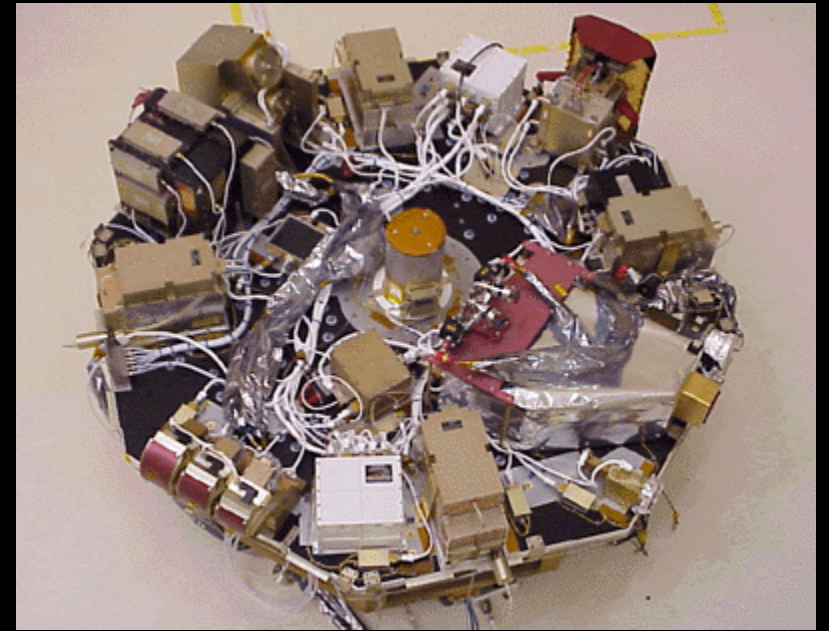
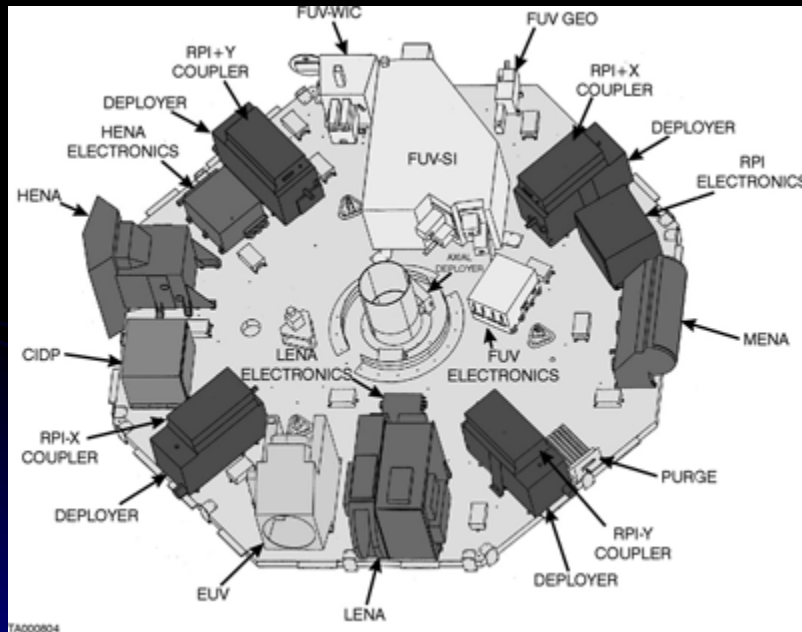
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IMAGE, seeing the invisible

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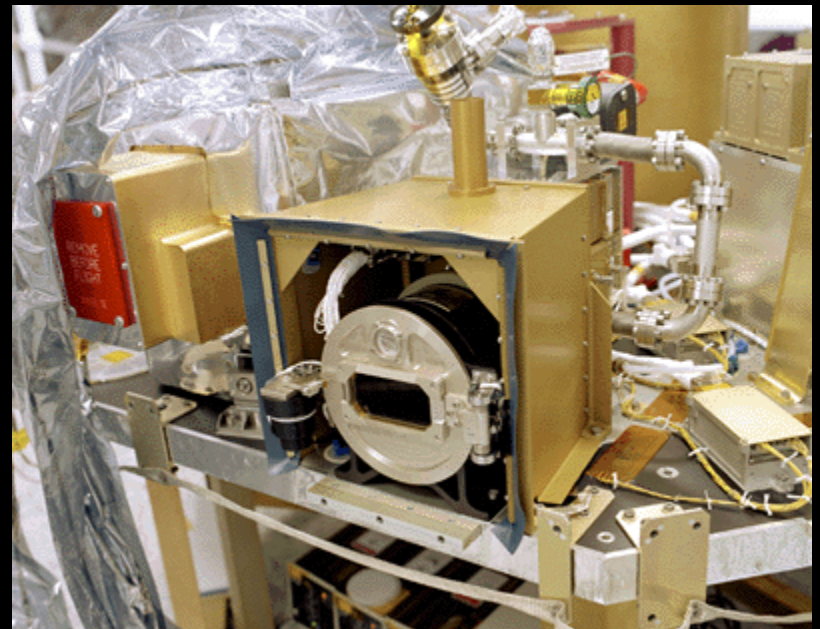
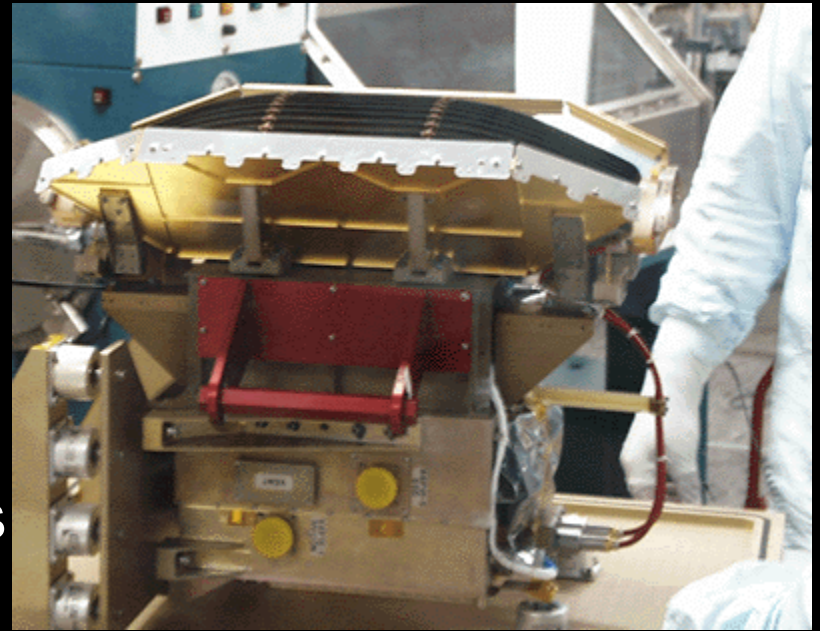


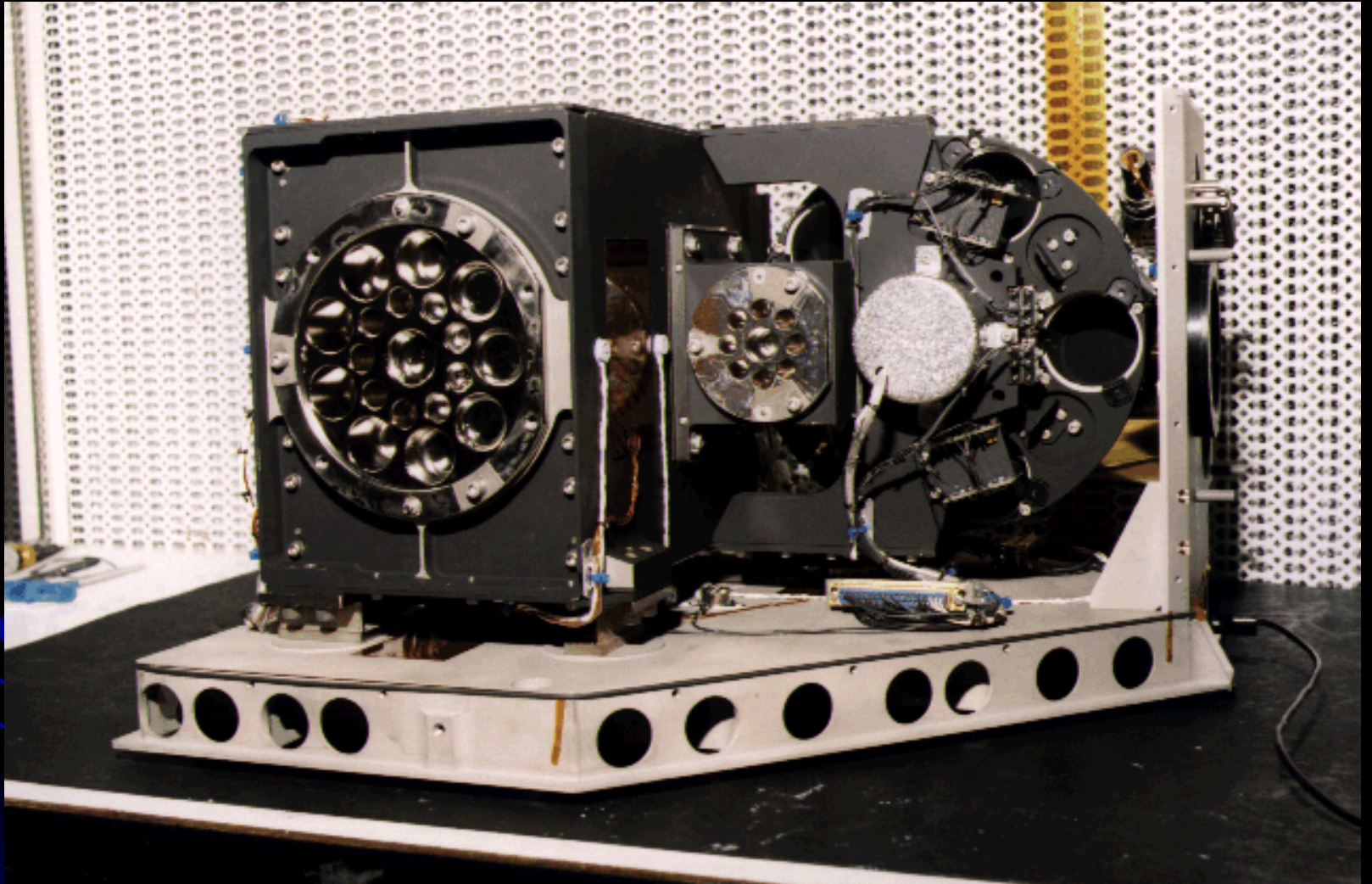
# What does it take to understand space?



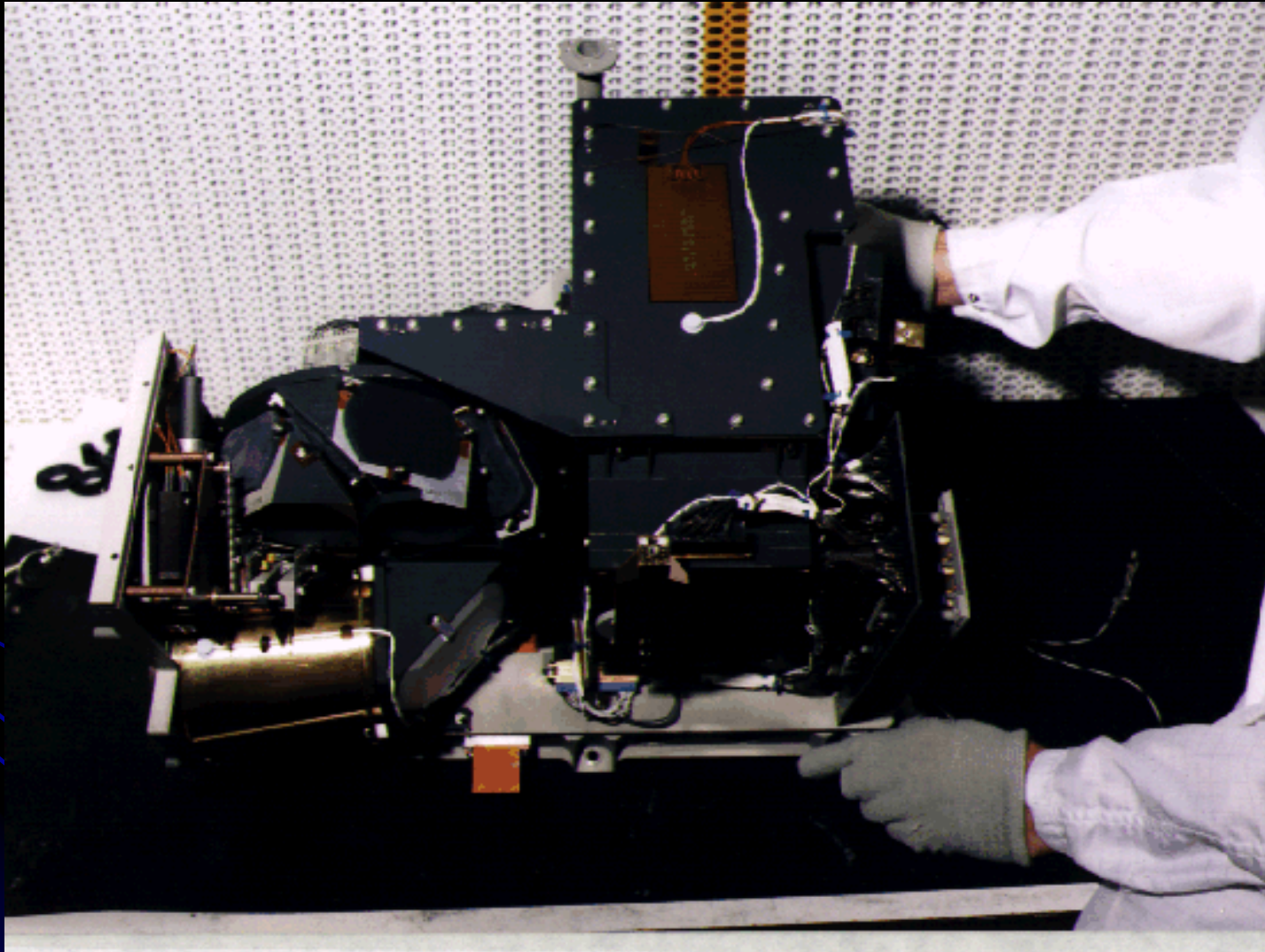


- design software - resources
  - mass, volume, thermal, mechanical, optical, circuits
- firmware/flight software
- cpu/memory/components
- radiation tolerant
- low power
- Reliability - it must work - there are no second chances

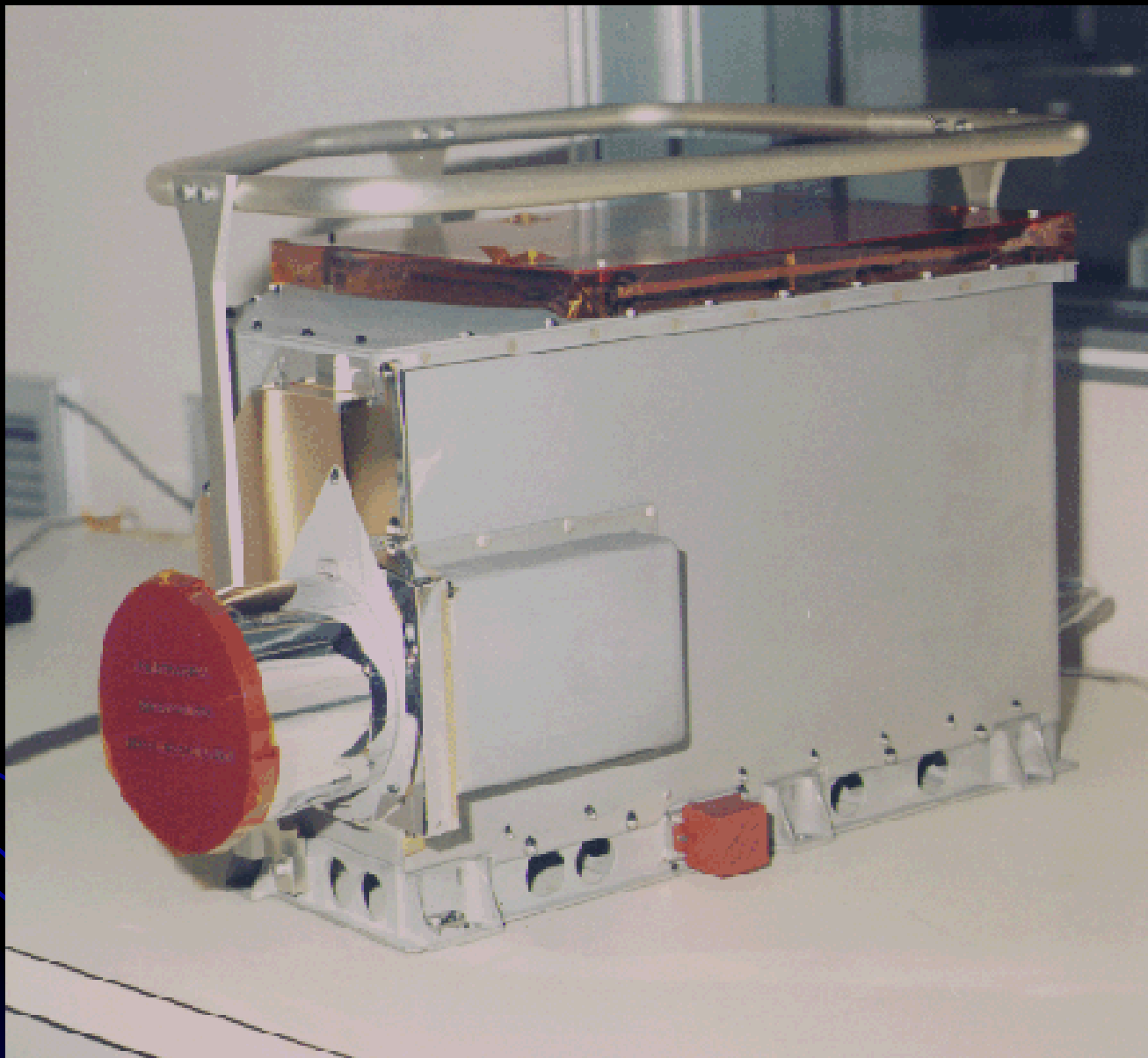




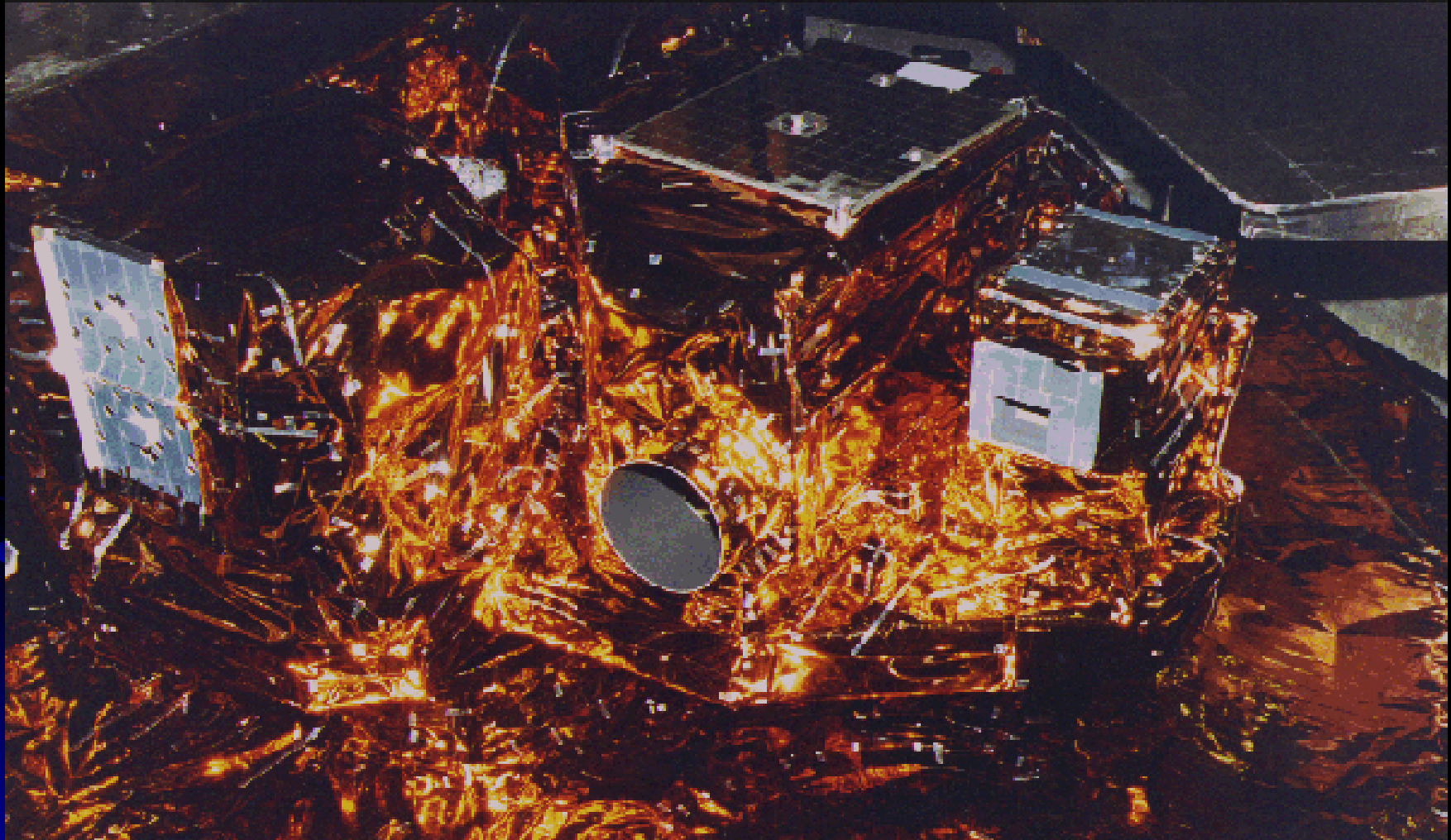
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# Theory and modeling

- must have physics for understanding
- must have useful output for application
- forward modeling - simulated instrument response
- integration of data into modeling
- coupling models - system view
- availability to community of users