

5<sup>TH</sup> IAA CONFERENCE  
ON UNIVERSITY SATELLITE MISSIONS  
AND CUBESAT WORKSHOP

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Rome, Italy  
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"Getting closer to Mars"



# First results of UV radiation measurements made by AURA detector onboard VDNH-80 cubesat

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# Outline

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1. Introduction. UV radiation of the atmosphere.
2. UV detector AURA onboard “VDNH-80” satellite.
3. First results of measurements.
4. Future plans.
5. Conclusions.

# UV radiation of the atmosphere

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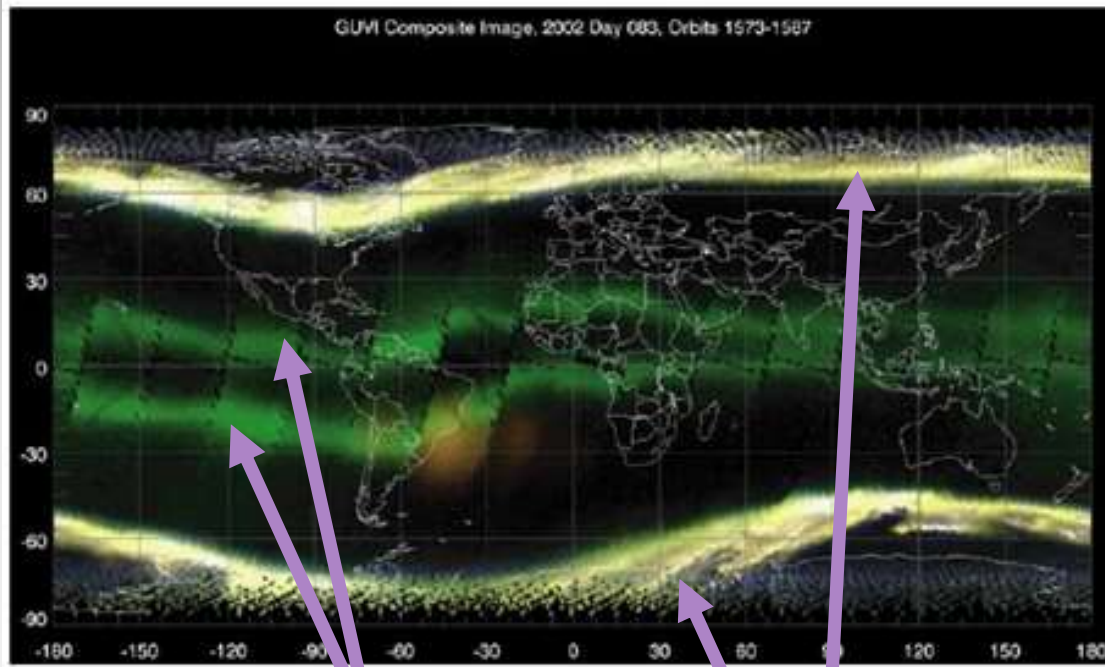
## Quasistationary

- ✓ Scattered moonlight and starlight
- ✓ Airglow
- ✓ Aurora light
- ✓ Equatorial arcs
- ✓ Anthropogenic lights

## Transient

- ✓ Lightning discharges
- ✓ Transient luminous events
- ✓ Fluorescence from charge particles penetration
- ✓ Far-from-thunderstorm flashes

GUVI Composite Image, 2002 Day 083, Orbits 1573-1587



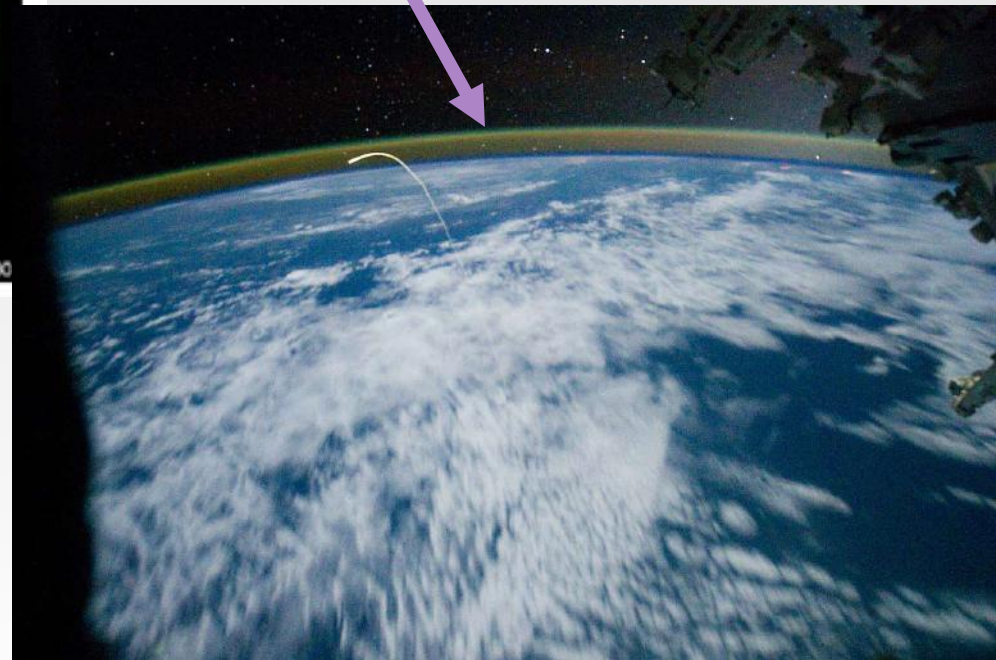
Equatorial arcs

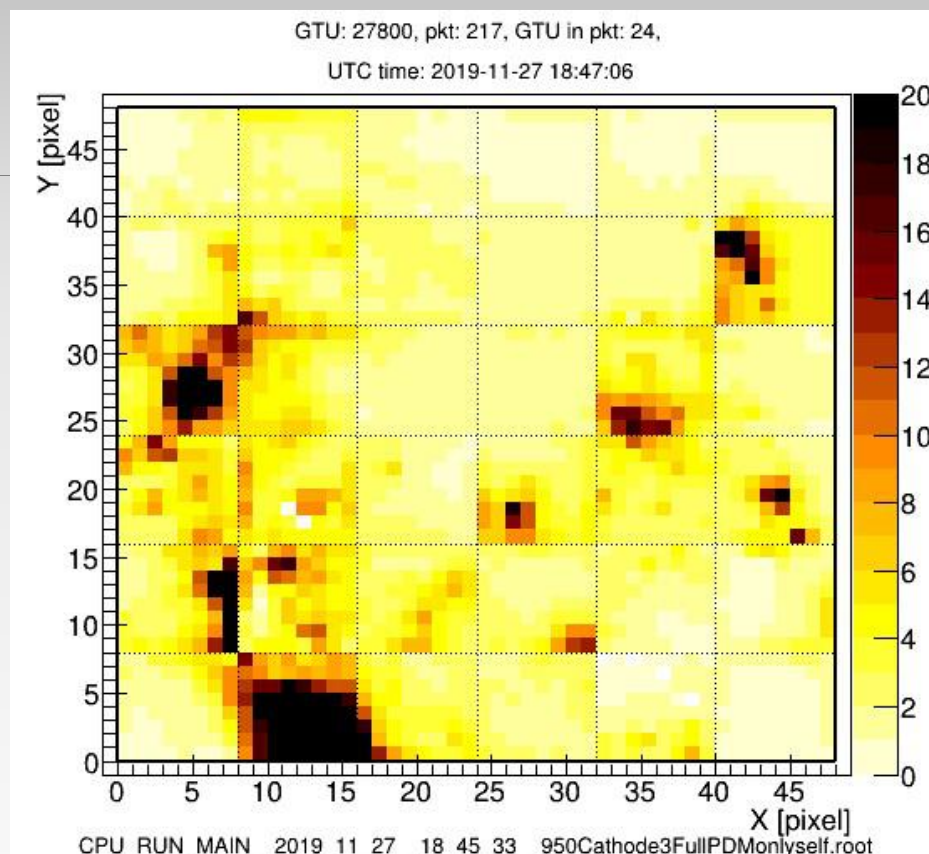
Aurora lights

## GUVI experiment data

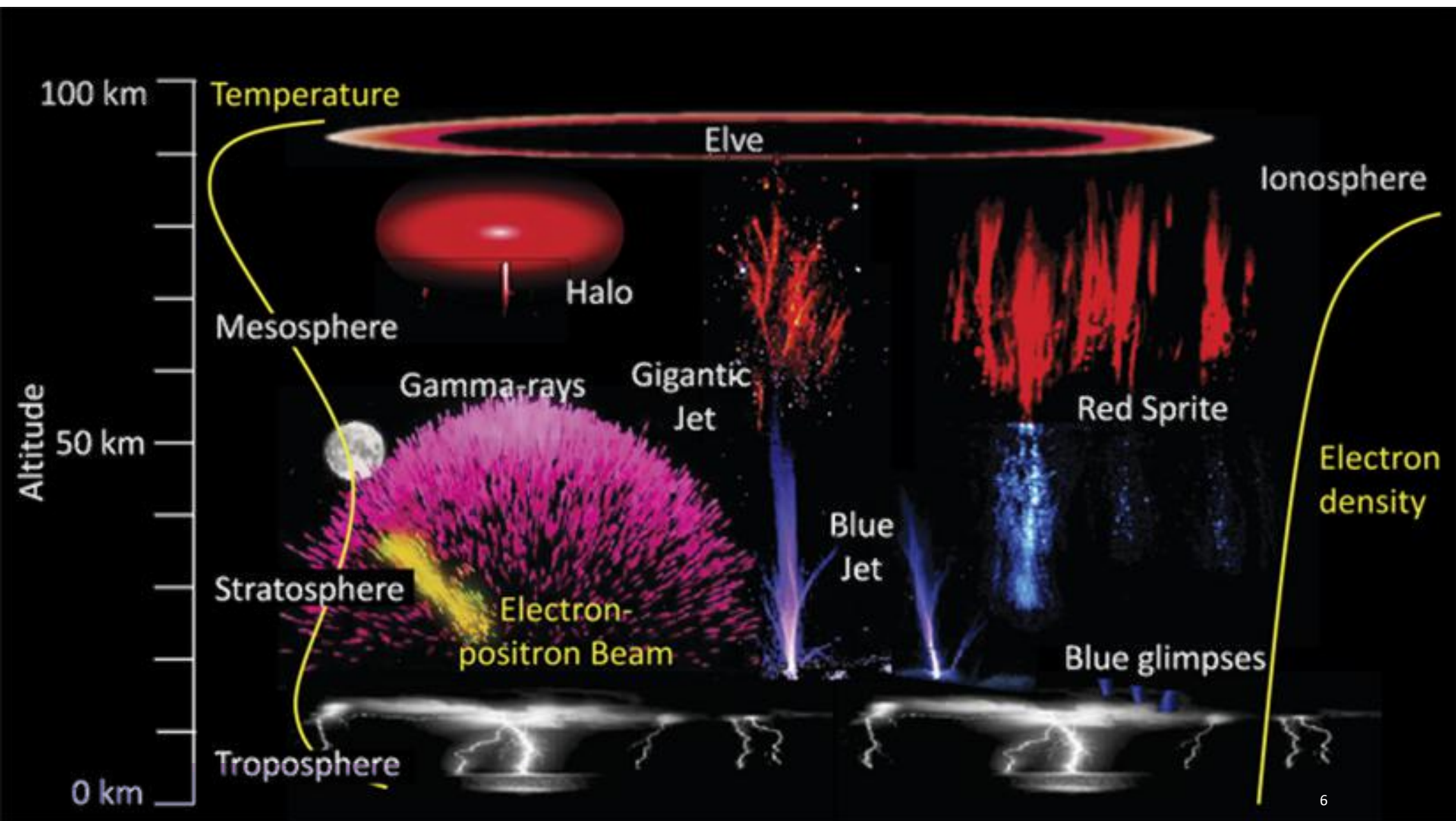
Airglow

From the ISS

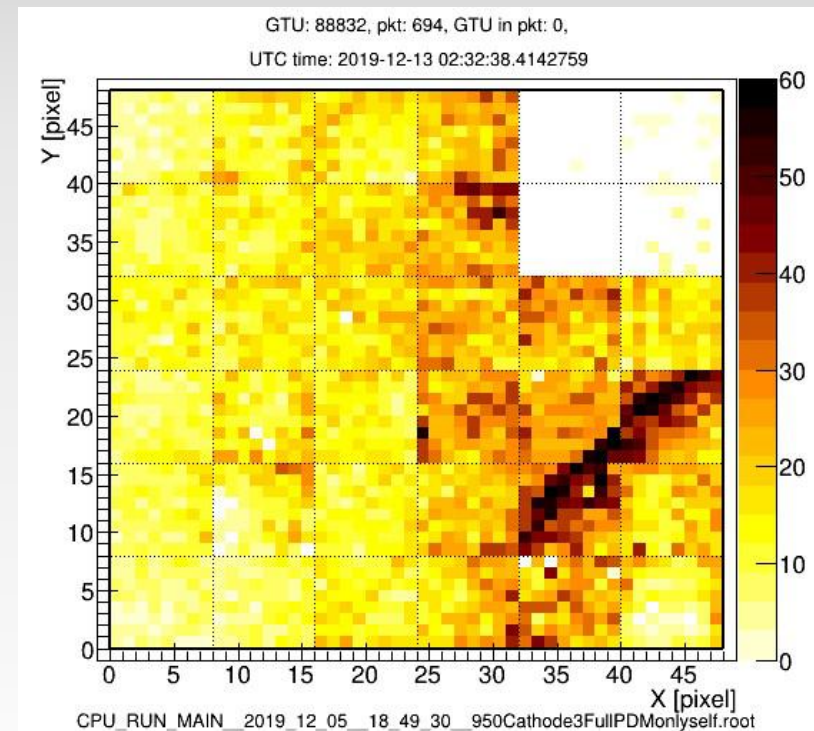
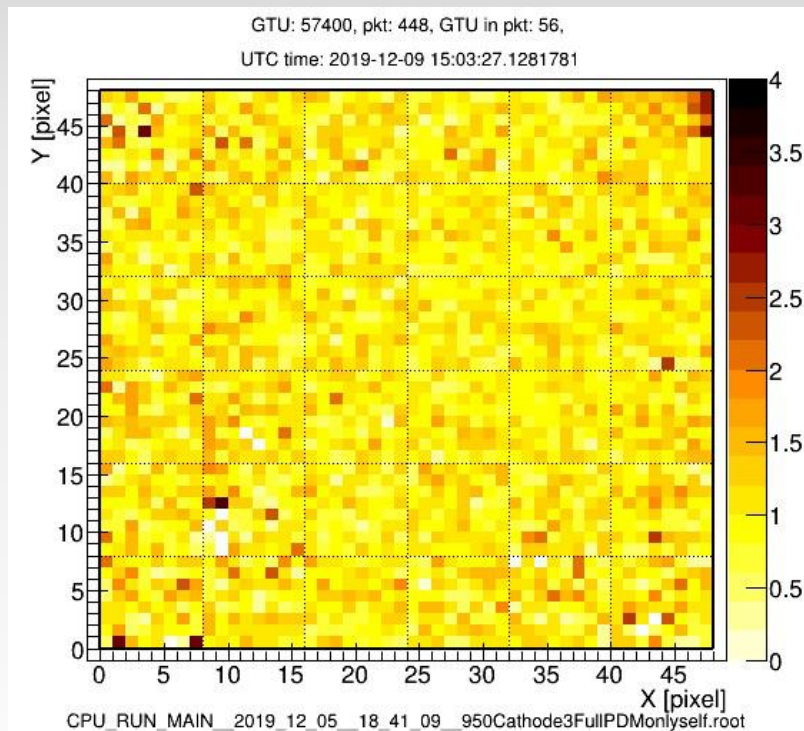


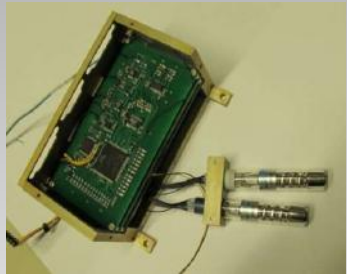




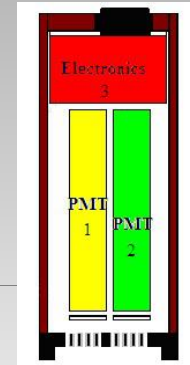


# ELVES examples measured by “UV atmosphere”

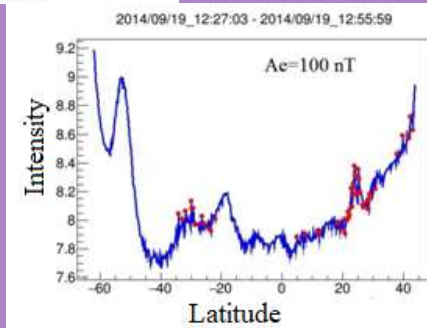
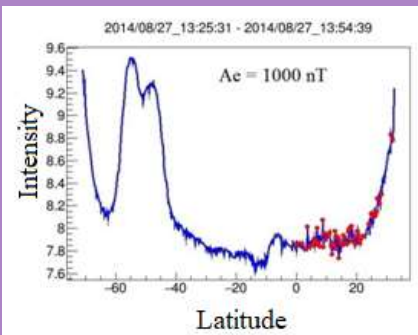




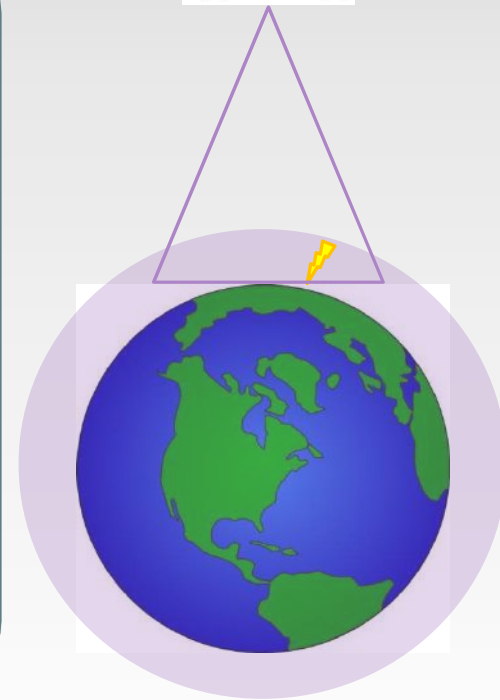
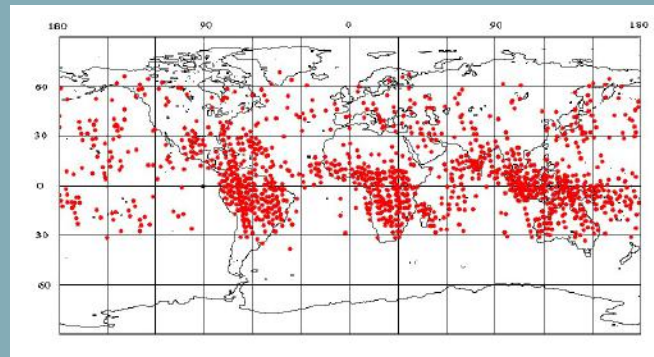
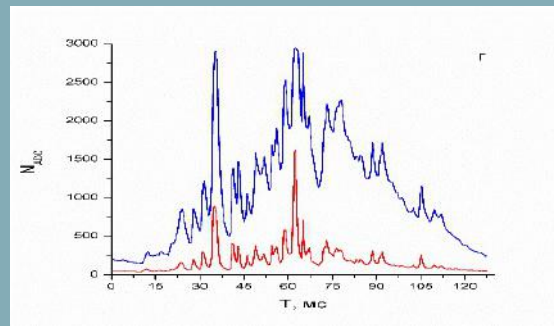
# UV detector onboard Tatiana and Vernov satellites



## Aurora lights and geomagnetic activity



## UV flashes





# VDNH-80 satellite



3U platform developer:

German Orbital Systems

Scientific payload developer:

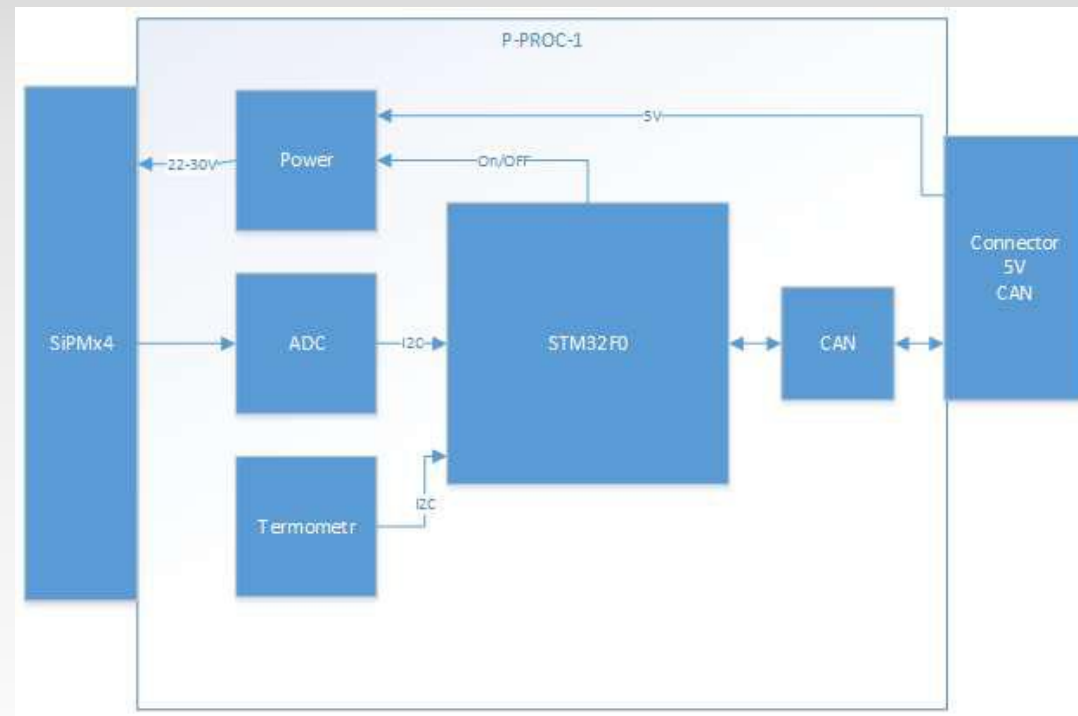
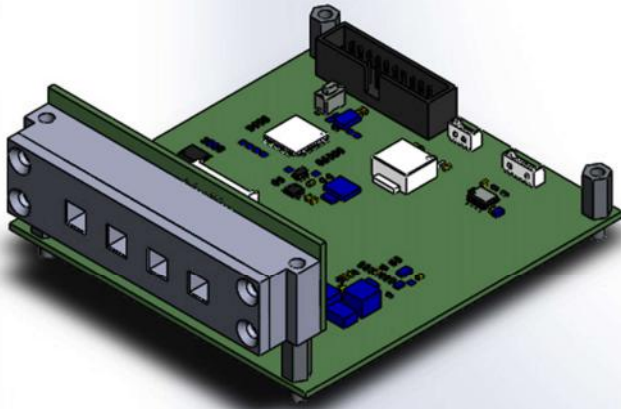
SINP MSU

Scientific payload includes: UV detector (AURA), Space radiation detector (DECOR)



July, 5<sup>th</sup> 2019. Cosmodrom Vostochny

# UV detector AURA (Atmospheric Ultraviolet RAdiation)

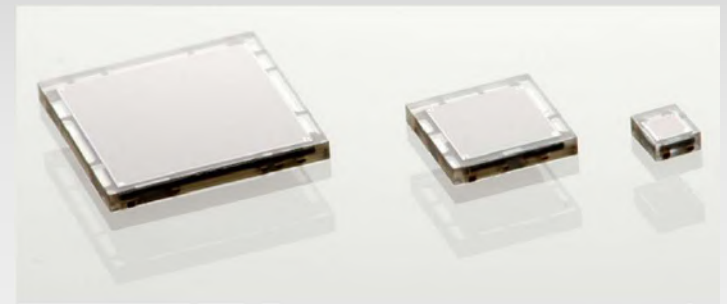


- Temporal resolution 1 s
- 3 UV filters (UFS1,UFS2,FS6) and one SiPM without filter
- FOV  $\pm 22.5^\circ$
- Gain Control System allows measurements in a wide range of intensities

# Silicon photomultipliers

- Compact light detector (thickness is about 1 mm);
- Need low voltage power supply (25-70 V); PMTs need 1 kV power supply;
- Very low weight;
- SiPMs have a wide sensitivity range from single photons to direct sunlight and quickly restore their nominal sensitivity when power is turned on or after excessive exposure
- High quantum efficiency (40 %)
- Temperature dependence of gain and dark current

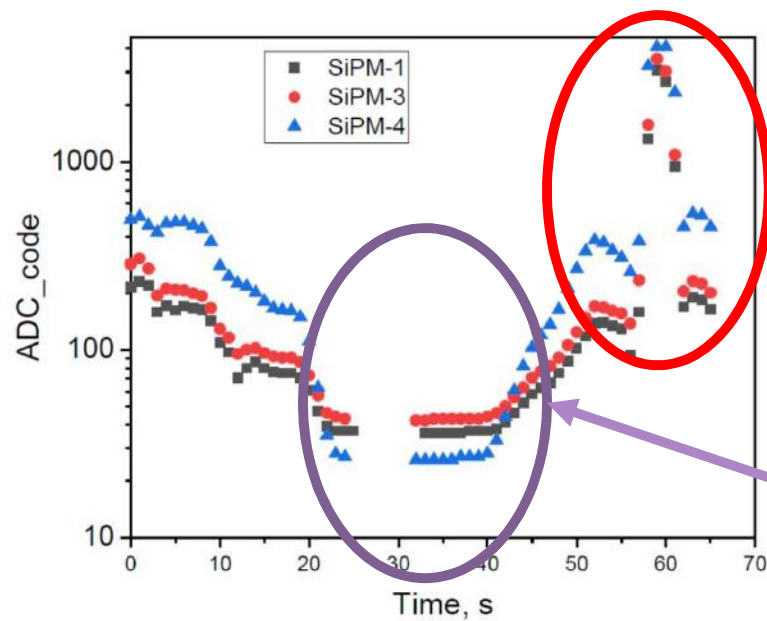
Optimal for usage on small satellites like CubeSats



VS



# Session 14.11.2019. Day side measurements

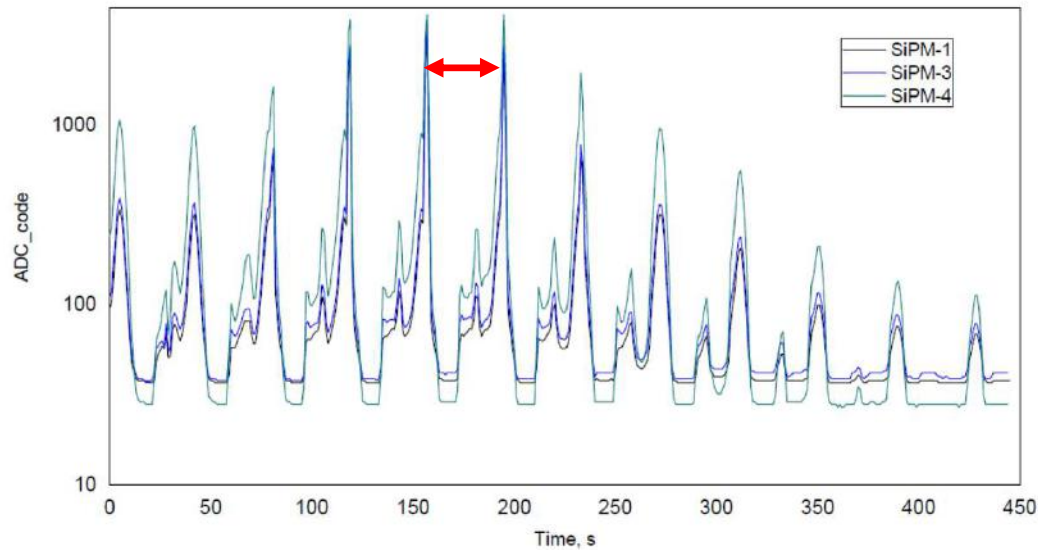


$W \sim 0.14 \text{ W/cm}^2$ .  
Direct Sun light measurements!

SiPM dark current. Corresponds to  
preflight measurements.

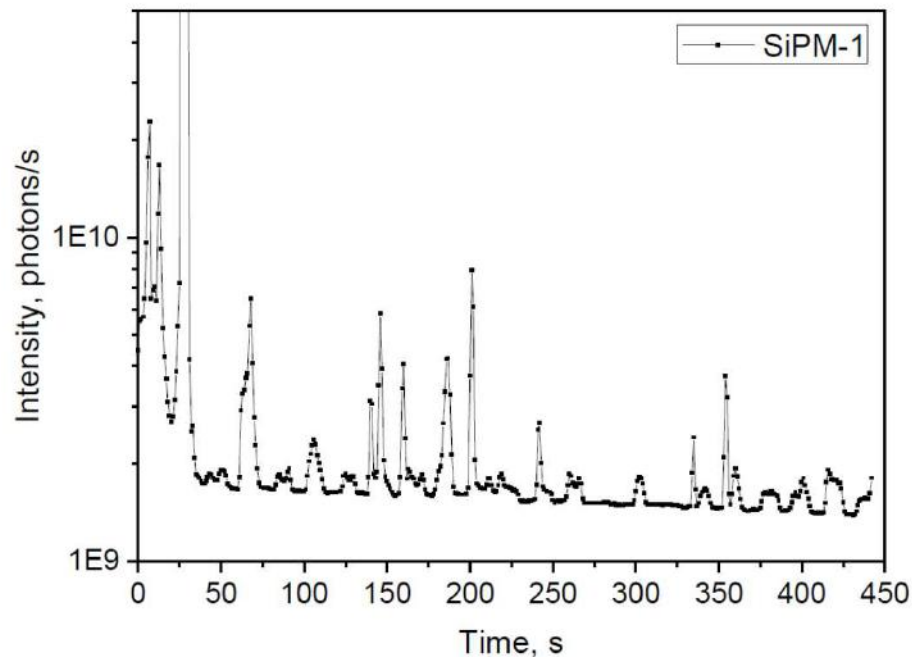


# Session 26.11.2019. Day side.



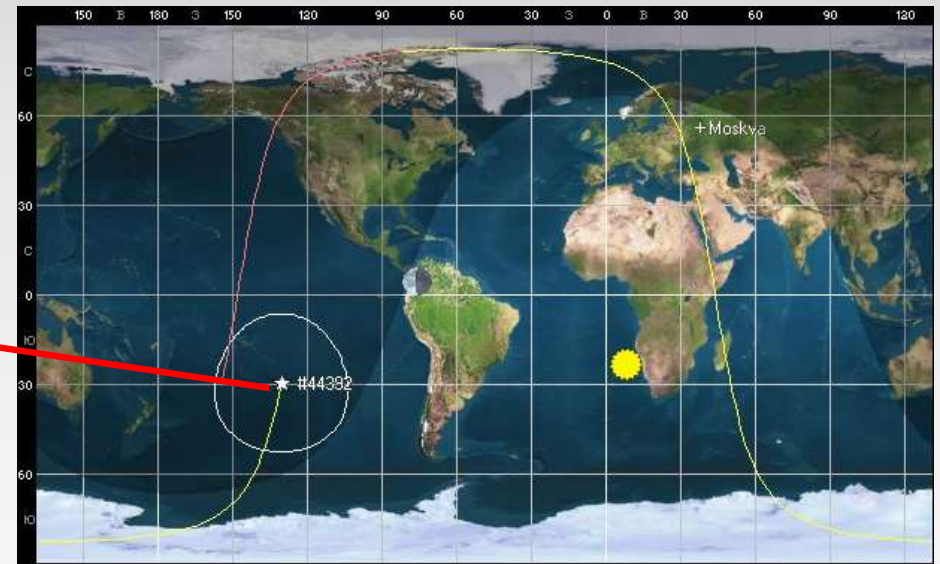
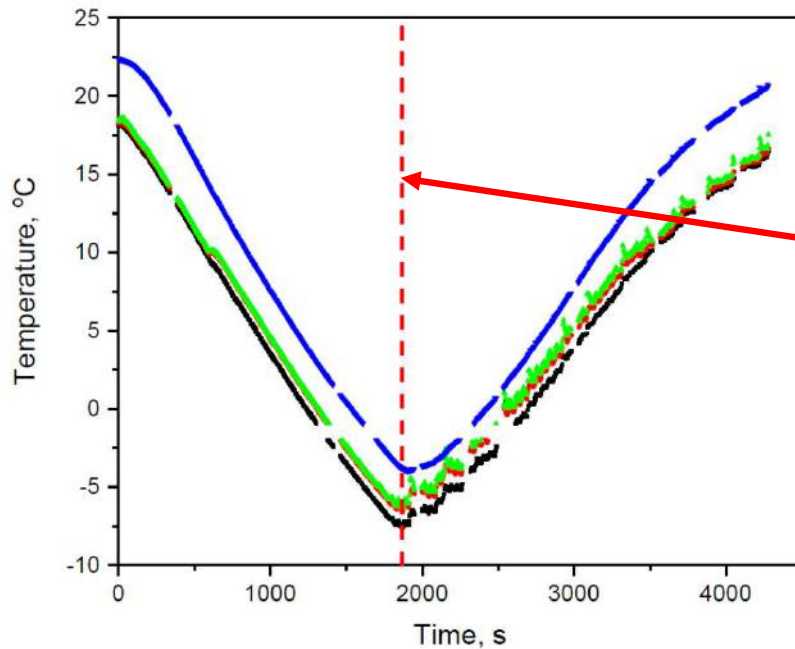
Satellite rotation period  
 $t \sim 40$  s

# Session 19.12.2020. Moonless night



- 1-30 s – day/night transition zone.
- 30-500 s –  $2 \times 10^9$  photons/second intensity value – corresponds to previous measurements on board Tatiana and Vernov satellites.
- 40 s rotation period is seen

# Session 19.12.2019. Temperature measurements



- Temperature range from  $-10^{\circ}\text{C}$  to  $+20^{\circ}\text{C}$ .
- Processor board warmer. "Comfortable" conditions for electronics.
- Influence SiPM gain and should be taken into account.

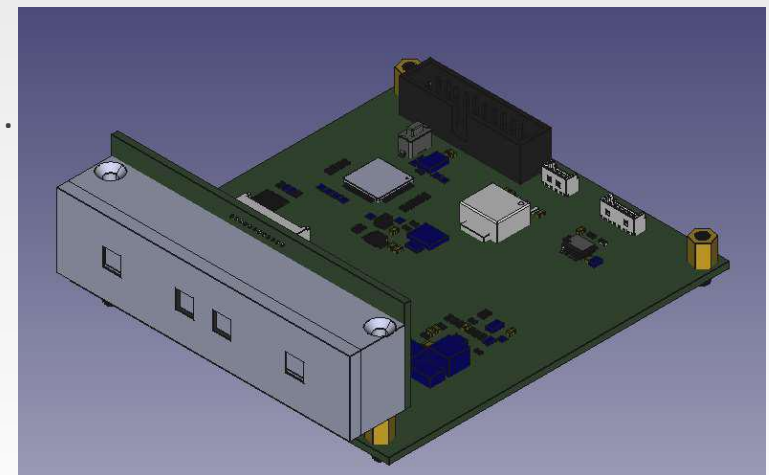
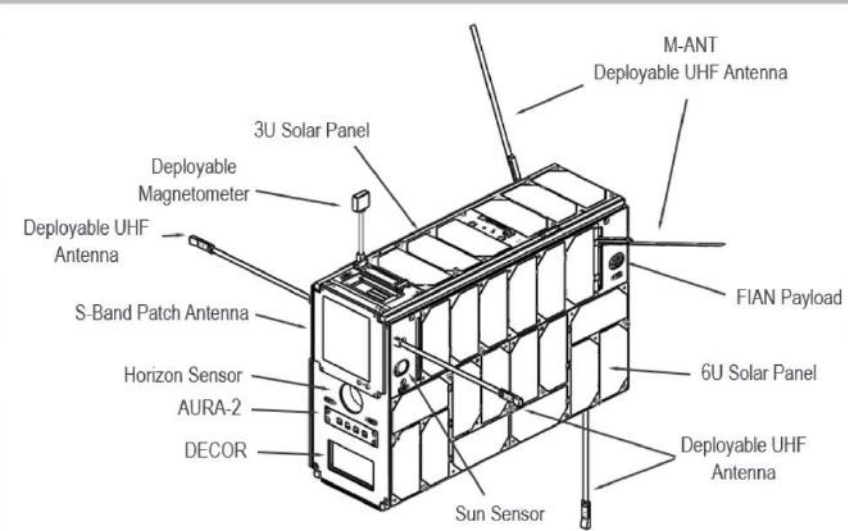
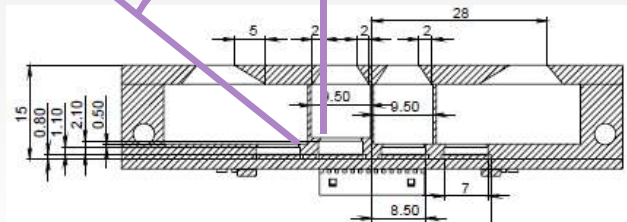
# Future plans

Photosensor (SiPM matrix 8x8)

AURA-2T

Lens

ector for the DECART MSU project – 6U  
UV and detectors.  
al res  
or FC  
or  
(Mbytes).  
on of the AURA-2T) is being developed.





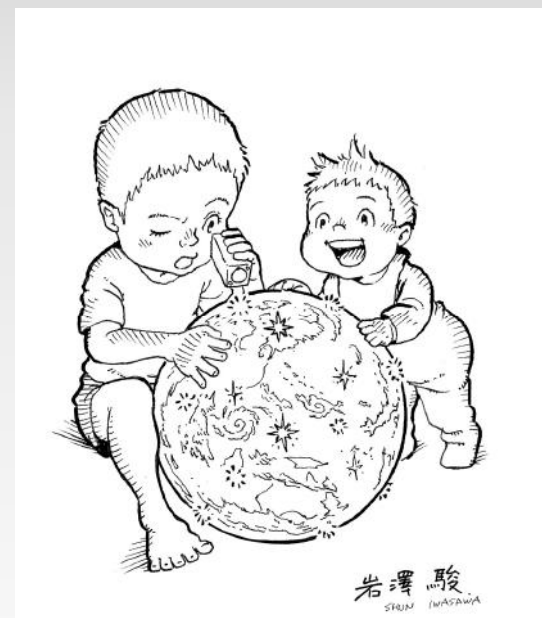
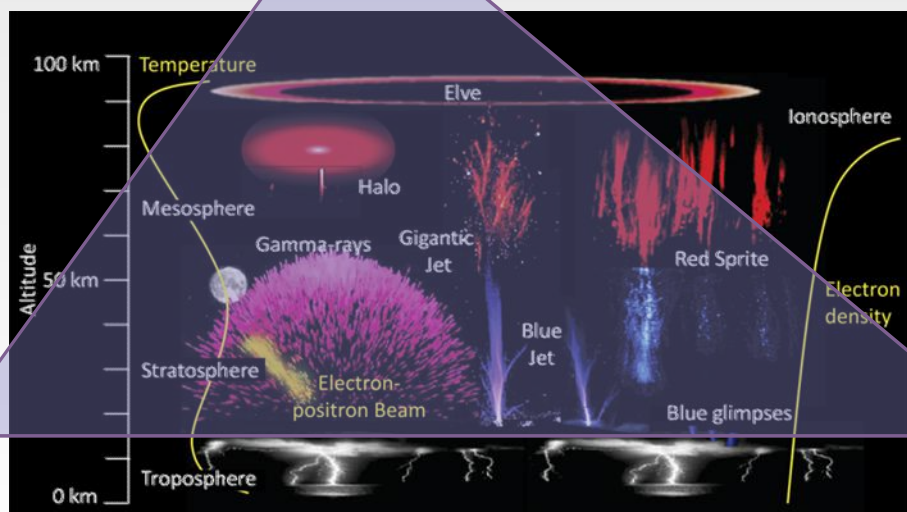
# Conclusions

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- Compact UV detector AURA based on SiPMs developed and tested.
- Successfully launched onboard “VDNH-80” satellite
- Daytime light and direct Sun light measurements conducted and confirm reliability of the detector
- Nighttime measurements of UV intensity conducted and operability of the detector in space conditions is proved. Obtained intensity values are consistent with previous measurements.
- Temperature regime of the detector is studied.
- Next generation of the detector, to be used in small satellites is being developed.

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# Grazie mille per l'attenzione



## Let's make science on satellites