Estimation of the exposure of the TUS space-based cosmic ray observatory

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[*] Speaker

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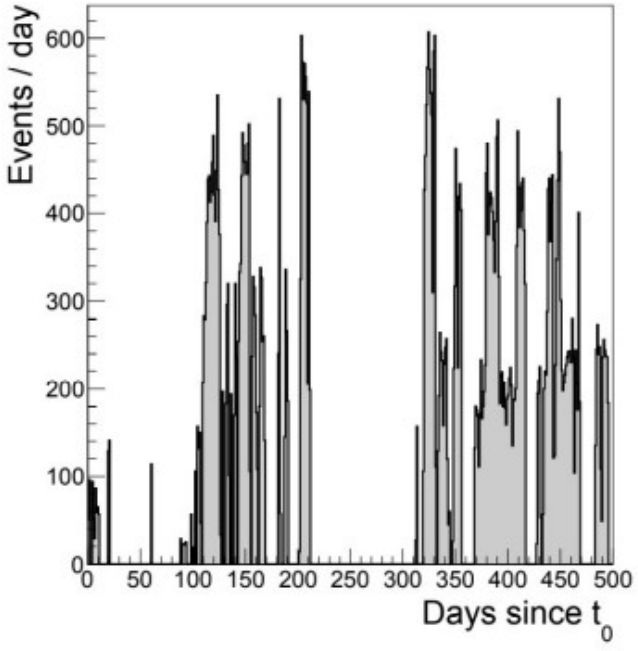
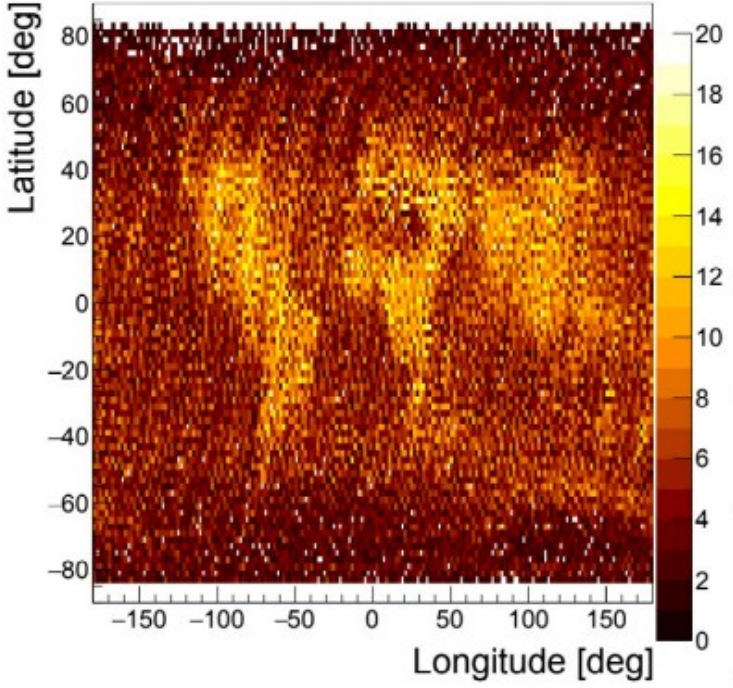
The TUS mission





- TUS: fluorescence detector placed on the Lomonosov satellite (test of the JEM-EUSO technique)
- Flight: 2016-2017
- 485 km altitude
- 95 min. sun-synchronous orbit
- 800 ns frame
- 80X80 km^2 field of view

Analysis based on ~78000 triggers in EAS mode collected from May 2016 to December 2017

The active time fraction

At the occurrence of a trigger ~52-60 s dead time

In quiet areas higher active time

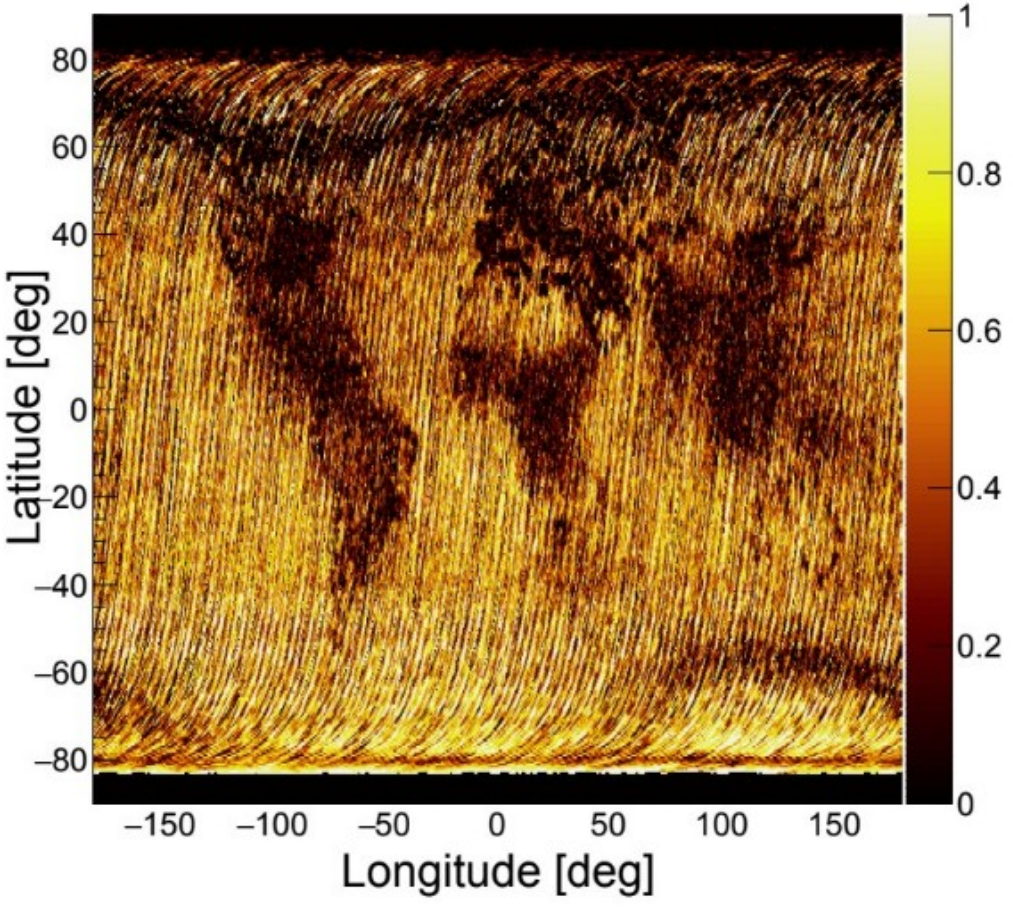
Over populated areas, Aurora ovals, stormy regions low active time

3118 acquisition orbits identified

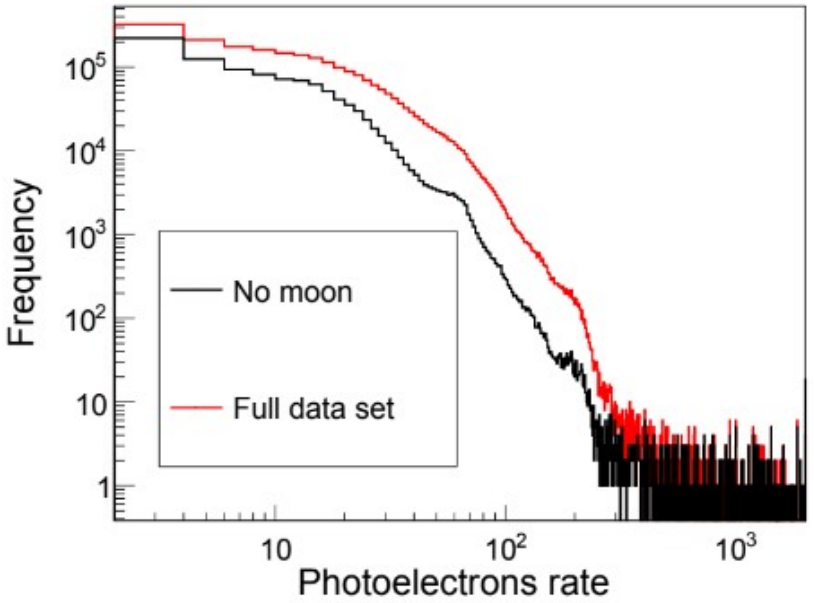
0-40 triggers per orbit

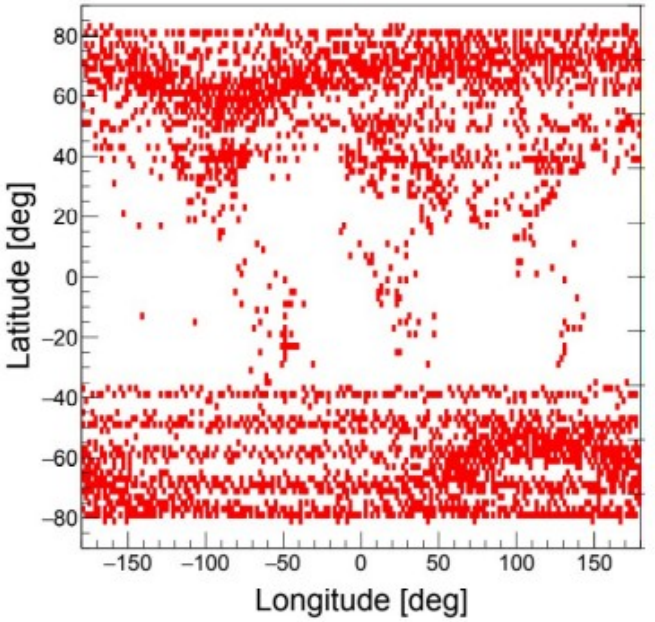
31 days of active time

Geometrical exposure: 1550 km² sr yr



The Earth emission rate calculation





Very variable rate

1-10^3 photoelectrons per frame

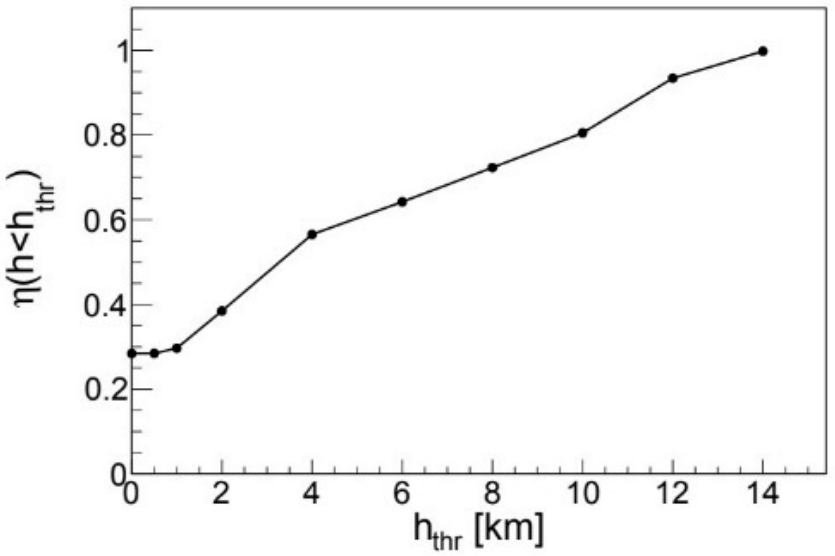
Higher luminosity:
- Aurora ovals
- Populated areas
- Near terminator

Dependence of exposure on Earth emission rate

Airglow rate [ph / frame]	5	18	30	50	100
$N_{Trigg.}$ / $N_{Trigg.,5}$	100%	60%	56%	18%	0%

Measured rates used in simulations

Impact of clouds on the exposure



Cloud top height estimated for each trigger

Trigger performance estimated with simulations for each cloud condition

After the inclusion of clouds the exposure is **57%** of what estimated in clear sky

Dependence of the exposure from cloud condition

	Clear sky	1 km	2 km	4 km	6 km	8 km	10 km	12 km	14 km
$\eta(h < h_{\rm thr})$	28%	29%	38%	56%	64%	72%	80%	93%	99.8%
$\epsilon_{\rm cloud}/\ \epsilon_{\rm CS}$	100%	100%	83%	53%	40%	16%	6%	6%	0%

Thanks a lot for your attention