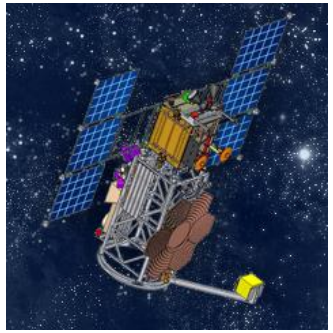
Relativistic dust grains: a new subject of research with orbital fluorescence detectors

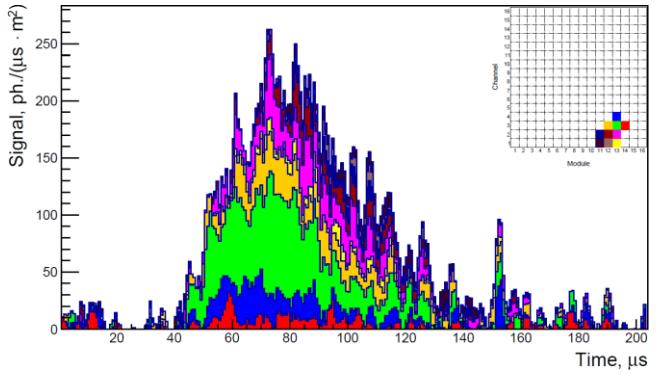
TUS is a first orbital fluorescent detector of ultra-high-energy cosmic rays



✓It was launched aboard the Lomonosov spacecraft on 04/28/2016. Time of operation until 12.2017 (with interruptions)

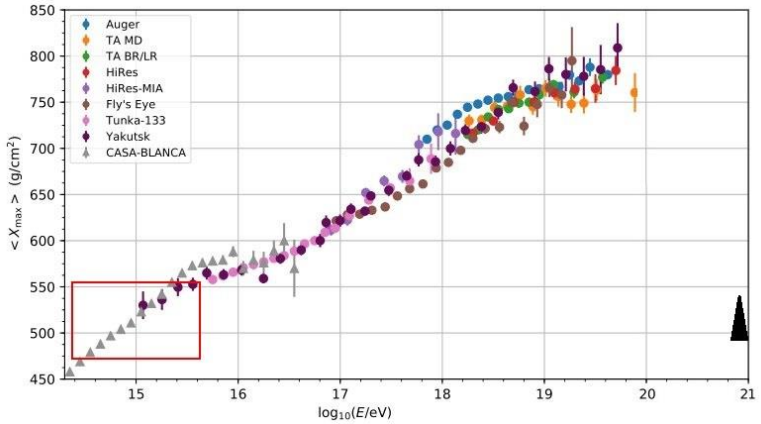
✓More than 200 thousand events registered

✓The total exposure ~ 1550 km^{2}sr yr.



✓ The TUS161003 event was registered on 3 October 2016.

✓ No potential sources of artificial UV light were identified on ground. The signal was registered in perfect observational conditions without any noticeable clouds.



Mean depth of maximum of EASs vs. energy of primary cosmic rays according to data of different experiments. The black triangle shows estimations for the TUS161003 event.

✓ The slant depth of the shower maximum was estimated from the light curve as ≤ 480-550 g/cm^2, which geometrically corresponds to altitudes ~7.5 – 8.5 km above the ground.

✓ If we consider the atmosphere to be a target for a cluster of nucleons (a dust grain) containing $N_n = 10^6$ nucleons in atomic and molecular states, with the primary energy of $E_0 \sim 10^{21}$ eV and energy per nucleon $Nn = E_0/N_n = 10^{15}$ eV. Applying the superposition model to this impact process, one should expect as a final observable picture the sum of N_n EASs with the total energy approximately equal to E_0.

✓ The Mini-EUSO telescope that currently operates at the International Space Station and the future EUSO-SPB2, K-EUSO, and the POEMMA missions can extend the capabilities of TUS and the ground-based detectors and shed new light on this hypothesis.