



Observation of TGFs onboard “Vernov” satellite and TGEs in ground-based experiments

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“Vernov” satellite with RELEC experiment on-board was launched on 2014 July, 8 into a polar solar-synchronous orbit. The payload includes DRGE gamma-ray spectrometer providing measurements in 10-3000 keV energy range with four detectors directed to atmosphere. Total area of DRGE detectors is ~ 500 cm². The data were recorded both in monitoring and gamma by gamma modes with timing accuracy ~ 15 μ s. Several TGF candidates with 10-40 gammas in a burst with duration < 1 ms were detected. Analysis of data from other instruments on-board “Vernov” satellite shows the absence of significant electromagnetic pulses around correspondent time moments. Comparison with WLLN lightning network data base also indicates that there were no thunderstorms connected with most of detected TGF candidates. Possible connection of these flashes with electron precipitations is discussed.

Ground-based experiments, with similar gamma-spectrometers were conducted, to study the spectral, temporal and spatial characteristics of TGEs in 20-3000 keV energy range, as well, as to search the fast hard X-ray and gamma-ray flashes possibly appearing at the moment of lightning. The time of each gamma-quantum interaction was recorded with an ~ 15 μ s accuracy together with detailed spectral data. Measurements were done on the ground at Moscow region, and at mountain altitude in Armenia at Aragatz station. During the time interval covering spring, summer and autumn of 2015 a number of TGEs were detected. Measured low-energy gamma-ray spectra usually contain a set of lines that can be interpreted as radiation of Rn-222 daughter isotopes. The increase of Rn-222 radiation was detected during rainfalls with thunderstorm, as well, as during rainy weather without thunderstorms. Variations of Rn-222 radiation dominate at low energies (< 2.6 MeV) and must be taken into account in the experiments performed to measure low energy gamma-radiation from the electrons accelerated in thunderclouds. There were no significant flashes with duration of ~ 1 ms detected in coincidence with a nearby lightnings.