GC2024-STP081

UV-microbursts of atmospheric emission in auroral zone

Pavel A. Klimov[1], Vera D. Nikolaeva[1], Konstantin D. Shchelkanov[1], Roman E. Saraev[1], Ksenia F. Sigaeva[1], Alexander A. Belov[1], Alexei S. Murashov[1], Boris V. Kozelov[2], Alexei V. Roldugin[2], Sergei A. Sharakin[1]

[1] M.V.Lomonosov Moscow State University, Skobeltsyn Institute of Nuclear Physics , Russia
[2] Polar Geophysical Institute of the Kola Scientific Center of the Russian Academy of Sciences

pavel.klimov@gmail.com

The Pulsating Aurora Imaging System (PAIPS) is being deployed at the Kola peninsula (Klimov et al., 2022) and is aimed to conduct stereo measurements of pulsating aurora (PsA) with high temporal resolution (1 ms). Photometers are lens telescopes using multi-anode PMTs as a photosensors operating in a single photon-counting mode, which provides extremely high sensitivity of the detectors.

In this work we present the results of the search and analysis of the fastest emissions measured in a form of UV-microbursts. These events were found in data of the imaging photometer at the Verkhnetulomsky observatory during 2021–2023. UV-microbursts are observed at various geomagnetic activity conditions from quite (average K_P index is 1+) to moderate (K_P = 4+) during the substorm recovery phase.

UV-microbursts are measured in various observational conditions: clouds, transparent clouds and clear sky. The temporal structure of UV-microbursts does not depend on cloud presence. Spatial structure of the events may vary from event to event: from a uniform diffuse glow to individual local spots in the FOV of the photometer. Microbursts are measured in series with a duration from 10 s to ~1 hour. Each pulse has a complicated structure with a single time sample (41 ms) high intensity peak and a subsequent prolonged afterglow. Time interval between pulses is not constant and varies in a range between 100 ms and 5 s. The typical amplitude is around 10^4–10^5 photon/cm^2 sr s.

Some UV-microbursts were measured simultaneously with pulsating aurora and represent a series of short (less than 0.5 s) pulses of emission with an angular size of bright spot ~0.2 rad. Simultaneous measurements of high-energy electron fluxes by Meteor-M2 and NOAA-19 satellites were analysed.

The probable source of UV-microbursts are relativistic electron microbursts (REMs), which are observed in satellite experiments (SAMPEX, for example) at the same geomagnetic latitudes and have similar temporal characteristics. Satellite electron detectors as well as balloon-born X-ray measurements demonstrate that REM appear as clusters or series of sharp peaks. The same is observed in the PAIPS photometer. This demonstrates that fundamental questions of magnetospheric physics, such as mechanisms of formation and losses of radiation belts, especially in a subsecond temporal scale, can be addressed by using the optical measurements by sensitive photometers with high temporal resolution.

This research was funded by Russian Science Foundation grant number 22-62-00010 (https://rscf.ru/project/22-62-00010/).