**RESEARCHING OF HARD RADIATION PARAMETERS IN THE LIGHTNING ATMOSPHERIC DISCHARGE BY A TUNABLE MULTI-CHANNEL SCINTILLATION DETECTING ASSEMBLY**

1,2Rodionov A., 1Oginov A., 1Shpakov K., 1Baidin I.

*1Lebedev Physical Institute of RAS, Moscow, RF,* [*postmaster@lebedev.ru*](mailto:postmaster@lebedev.ru) *2Moscow Institute of Physics and Technology (State University), Moscow, RF,* [*info@mipt.ru*](mailto:info@mipt.ru)

The conducted researches of lightning discharges by means of spacecrafts, sounding balloons and also laboratory and field experiments, show that lightning discharges are accompanied by hard radiation: gamma radiation with an energy of 11-34 MeV; neutron radiation with an energy of 0.5-3 MeV [1].

Studies of the atmospheric discharge at the ERG installation (LPI RAS) [2-3] have shown the need for the development of scintillation diagnostics. It is required to study low-background registration of short impulses of x-ray and gamma radiation with photon energies from tens of keV to a several MeV. It is important to provide the best time and amplitude resolution on the available types of photomultipliers and available hardware components.

The paper presents the features of created "fast" scintillation detectors of radiation, based on the native PMT (the time resolution is ~5 ns), in assembly with use of various types of organic and inorganic scintillators. The special high-voltage power supply circuit, using the Zener voltage clamp circuit at the last stages of PMT amplification, was developed for providing demanded characteristics. Power dividers were optimized by techniques [4] to eliminate the instability of the PMT caused by a high time averaged load, and the linearity violation in pulse response. When designing buildings detectors are given special attention shielding from strong electromagnetic interference occurring at the time of discharge, for which the elements of the design were made of permalloy alloy 79HM.

The results of experimental studies of the anisotropy of short pulses of soft and hard X-ray, gamma and neutron radiation arising during the course of atmospheric discharge installation ERG (LPNU OYAFA LPI).

Statistical data collected during a consecutive series of experiments suggest the presence of radiation, their anisotropic character, and show the relationship of the observed phenomena with characteristics of current and voltage prepulse phase of atmospheric discharge.

This work was supported by Russian Foundation for Basic Research (RFBR grant 17-08-01690, 18-38-00230).

References

1. J. R. Dwyer et al., Observation of a gamma‐ray flash at ground level in association with a cloud‐to‐ground lightning return stroke, Journal of Geophysical Research: Space Physics, 2012, Vol. 117, No. A10.
2. A.V. Agafonov, A.V. Bagulya, O.D. Dalkarov, M.A. Negodaev, A.V. Oginov, A.S. Rusetskiy, V.A. Ryabov, and K.V. Shpakov, Observation of neutron bursts produced by laboratory high-voltage atmospheric discharge, Physical review letters, 2013, Vol. 111, No. 11, pp. 115003.
3. A.V. Agafonov, V. A. Bogachenkov, A. P. Chubenko, A. V. Oginov, A. A. Rodionov, A. S. Rusetskiy, V. A. Ryabov, A. L. Shepetov, K. V. Shpakov Observation of hard radiations in a laboratory atmospheric high-voltage discharge, J. Phys. D: Appl. Phys. 50 (2017) 165202 (9pp).
4. S.G. Basiladze, V.I. Ivanov, Preprint, 13-9172, Dubna, 1975.