

MEETINGS

Exploring the Origin of High-Energy Particle Beams in the Atmosphere

***Thunderstorms and Elementary Particle Acceleration;
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High-energy processes in the magnetosphere and atmosphere such as thunderstorm ground enhancements (TGEs), terrestrial gamma ray flashes (TGFs), and transient luminous events (TLEs) and recently discovered relativistic electron acceleration in the Earth's outer radiation belt trigger various dynamic processes in the Earth's environments and have broad astrophysical relevance. Investigation of the accelerated structures in the geospace plasmas can shed light on particle acceleration to much higher energy in the similar structures of space plasmas in the most distant objects in the universe. The Earth's broad environment is a real laboratory for high-energy astrophysics.

To discuss these high-energy phenomena, a conference on thunderstorms and elementary particle acceleration was held at the Nor Amberd International Conference Center of the Yerevan Physics Institute (YerPhI) in Armenia. The Cosmic Ray Division of YerPhI and the Skobel'syn Institute of Nuclear Physics of Moscow State University organized the

workshop; YerPhI and the European Geophysical Union sponsored it. Thirty scientists and students from the United States, France, China, Israel, Russia, and Armenia attended.

Presentations focused on research on observations and models of the high-energy emissions in thunderclouds, emerging charged structures in thunderclouds and estimation of their size, radio frequency emissions from atmospheric electrical discharges, comparisons of different simulations of cascade developments in the atmospheric electric fields, observations of broadband electromagnetic emissions by the RELEC (Relativistic ELECTrons) and Chibis-M space missions, new methods of data analysis of registered TGFs, and new planned space missions.

Discussions covered questions such as the following: Are the TGEs and TGFs symmetric processes? Are the extensive cloud showers observed on a microsecond scale in TGEs an analog of the TGFs? Are there causal relations between particle fluxes and lightning?

The workshop participants agreed that it would be useful to compare the vast amount of experimental data on TGE energy spec-

tra with the TGF observations and models. Research on high-energy phenomena in thunderclouds is becoming more and more multidisciplinary and includes measurements of secondary cosmic rays, radio emissions from atmospheric discharges, optical monitoring of the thunderclouds and emissions from them, lightning detection and classification, and meteorological monitoring. The multivariate visualization and correlation analysis of all these measurements pose serious problems for searches in data archives when the data stream is pressing and new and interesting events are appearing almost every day.

One possible solution to assist researchers in physical analysis was presented at a symposium on an intellectual data exploration system developed in a collaboration between scientists at the Institute for Data Processing and Electronics of Karlsruhe Institute of Technology and the Cosmic Ray Division of YerPhI. The system has a user-friendly interface that interactively visualizes the multiple time series and selects relevant parameters for different research objectives. With this system, researchers can try to more fully utilize the new concept of "big data," and enormous numbers of relevant observations may culminate in new physics in an unprecedentedly fast and precise manner.

The presentation slides and discussion videos are available on the conference website, <http://crd.yerphi.am/Conferences/tepa2014/home>.

—ASHOT A. CHILINGARIAN, Cosmic Ray Division, Yerevan Physics Institute, Yerevan, Armenia; email: chili@aragats.am