THUNDERSTORMS AND ELEMENTARY PARTICLE ACCELERATION

GENERAL INFORMATION:

TIME: October 17-20, 2022

LOCATION: Prague, Czech Republic

SYMPOSIUM WEBSITE:

http://www.crd.yerphi.am/TEPA_2022

ORGANIZERS:

Cosmic Ray Division of Yerevan Physics Institute, Armenia
Research Centre of Cosmic Rays and Radiation Events in Atmosphere (CRREAT), Nuclear Physics Institute of the CAS, Czechia

INTERNATIONAL ADVISORY COMMITTEE:

Ashot Chilingarian, Yerevan Physics Institute, Armenia (Chair)
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Tatsuo Torii, Japan Atomic Energy Agency, Tsuruga, Japan
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BACKGROUND:

The new emerging field of high-energy atmospheric physics (HEAP) has been enriched recently by important observations of particle fluxes on Earth's surface, in the troposphere, and in space. HEAP presently includes three main types of measurements: Terrestrial Gamma Ray Flashes (TGFs) – a brief bursts of gamma radiation (sometimes also electrons and positrons) registered by orbiting gamma ray space observatories, Thunderstorm ground enhancements (TGEs) – short and prolonged electron and gamma ray fluxes registered on the Earth's surface, and Gamma glows – gamma ray bursts observed in the thunderclouds by instrumentation on balloons and aircraft.

Recently some authors add inverse TGFs – a intense particle bursts of millisecond duration registered on the Earth's surface. The central engine initiating the TGEs and TGFs is believed to be the Relativistic Runaway Electron Avalanches (RREA), which accelerates seed electrons from an ambient population of cosmic rays (CR) in large-scale thundercloud electric fields. Observations of numerous TGEs by Japanese, Russian, Armenian, Czech, Chinese, Bulgarian and Slovakian groups prove that RREA is a robust mechanism for electron acceleration and multiplication. The origin of gamma glows can be also the modification of electron energy spectrum (MOS process) in the atmospheric electric field leading to additional gamma ray radiation. The hypothesis of the "lightning origin" of inverse TGFs is still under debate. TGE electron and gamma ray energy spectra give new clues for recovering the vertical profile of the atmospheric electric field and for testing models of electron acceleration in the atmosphere. Models using GEANT4 and CORSIKA codes confirm in-situ measurements of electron and gamma ray energy spectra at Aragats. Numerous observations of TGEs made on Aragats during the past 13 years can be widely used for the validation of models aimed to explain TGF phenomena. The CRREAT project is making good progress in developing instrumentation for the comprehensive measurements of the particle fluxes, lightning monitoring with fast cameras and various atmospheric parameters, including radar measurements of the hydrometeor evolution during storms. Many questions about thundercloud electrification and discharge mechanisms, lightning initiation, propagation and attachment processes, the global electrical circuit, and transient luminous events do not have yet a commonly accepted explanation. The estimated horizontal profile of the atmospheric electric field, that emerges during thunderstorms is still badly understood. The estimate of the size of the particle emitting region in the thundercloud, made a decade ago by Japanese and Armenian physicists (≈1 km radii) seen to be largely undervalued. Enigmatic light glows observed on Aragats during TGEs still await explanation. The new view of thunderclouds as media full of radiation can help to establish a comprehensive theory of cloud electrification and estimate the possible role of cloud radiation on climate change. The influence of the electrifying atmosphere on the fluxes of electrons and other charged particles can be important for experiments registering very-high-energy photons (Atmospheric Cherenkov telescopes) or electrons and hadrons (Surface arrays registering Extensive Air Showers). The TEPA meeting provides an opportunity for scientists to discuss the current ideas and exploit synergies between Atmospheric and Cosmic ray physics.

STRUCTURE OF THE SYMPOSIUM:

We anticipate the following sessions:

1. Multivariate observations of particles from the Earth's surface, in the atmosphere, and from space (TGEs, gamma glows, and TGFs);
2. Remote sensing and modeling of the atmospheric electric field;
3. Correlated measurements of the atmospheric discharges and particle fluxes, time-space structure of particle bursts;
4. Influence of the atmospheric electric field on measurements of experiments using the atmosphere as a target (Surface Arrays and Cherenkov Imaging Telescopes)
5. Instrumentation

We plan also discussions on the most intriguing problems of high-energy physics in the atmosphere and on possible directions for the advancement of collaborative studies.

Topics to be covered during oral and poster sessions:

- Energy spectra of electrons and gamma rays measured on the earth's surface, in the atmosphere and in the space; their relation to the strength of the electric field;
- Possible relations of the Solar activity and space weather to high-energy physics processes in the atmosphere;
- Registration of wide- and narrowband radio emissions produced by atmospheric discharges and particle fluxes;
- Lightning initiation and its relation to particle fluxes originated in thunderclouds;
- Radionuclide, neutron, and positron production during thunderstorms;
- SEVAN particle detector network as a tool for the TGE research;
- Methods of remote sensing of thundercloud charge structure and atmospheric electric fields;
- Lightning monitoring with fast cameras;
- Abrupt termination of the particle flux by the lightning flash;
- Precise electronics for the high-energy atmospheric research;
- Relations to the climate and space weather issues;
- Influence of the atmospheric electric fields on Extensive Air Shower (EAS) and Cherenkov light.
- The possibility of joint observations by space-borne and ground-based facilities.

ABSTRACT SUBMISSION:

Abstracts should be submitted electronically on the Symposium website. The deadline for abstract submission is on August 15th, 2022

REGISTRATION:

Registration for **TEPA 2022** should be done online via the Symposium website. We will provide participants with their own accounts on the Symposium website. These accounts will serve for the submission of abstracts, and papers for Symposium proceedings and for providing information about accompanying persons.

Registration fees:

- Regular Attendees [300 Euro]
- Undergraduate and Graduate Students [100 Eur]

The fee covers the cost, coffee breaks, as well as the Reception, the Banquet, and excursions.

Conference venue and accommodation options will be decided very soon.

CONFERENCE DEADLINES:

- 15 August 2022 Abstract submission deadline
- 15 September 2022 Contributed presentations selected and participants notified
- 5 October 2022 Symposium program on the Conference site

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