International Conference, 17-20 October
Prague, Czech Republic

THUNDERSTORMS AND ELEMENTARY PARTICLE ACCELERATION

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*

STRUCTURE OF THE SYMPOSIUM:

We anticipate the following sessions:

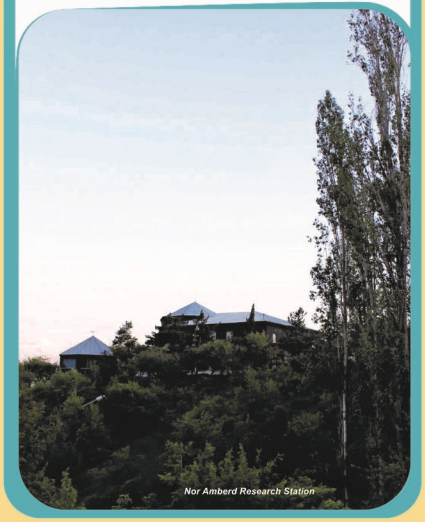
1. Multivariate observations of particles from the Earth's surface, in the atmosphere, and from space (TGEs, gamma glows, and TGFs);
2. Remote sensing and modeling of the atmospheric electric field;
3. Correlated measurements of the atmospheric discharges and particle fluxes, time-space structure of 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.

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 3 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 observatories in the space, 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 to this classification scheme some authors add inverse TGFs, a millisecond duration of intense particle bursts registered on the earth's surface. The central engine initiating the TGE 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 the large-scale thundercloud electric fields. Observation of numerous TGEs by Japanese, Russian, Armenian, Czech, Chinese, Bulgarian, and Slovakian groups proves that RREA is a robust and realistic mechanism for electron acceleration and multiplication. The origin of gamma glows can be also the MOS process, modification of electron energy spectrum 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 a new clue 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 support 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. CRREAT project is making good progress in establishing 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 (≈1km radii) seen to be largely undervalued. Enigmatic light glows observed on Aragats during TGEs still waiting for an 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) and hadrons (Surface arrays registering Extensive Air Showers). The TEPA meeting is a great opportunity for the scientists to establish synergy between Atmospheric and Cosmic ray physics, discuss new ideas, and make new bridges for collaborative works.

INTERNATIONAL ADVISORY COMMITTEE

- ***Ashot Chilingarian,*** *Yerevan Physics Institute, Armenia (Chair)*
- ***Ondrej Ploc,*** *CRREAT head, Nuclear Physics Institute of the CAS,*
- *Czechia (Co-chair)*
- ***Eric Benton,*** *Oklahoma University, USA*
- ***Lev Dorman,*** *Israel Cosmic Ray Center and Emilio Segré Observatory, Israel*
- ***Joseph Dwyer,*** *Department of Physics University of New Hampshire, USA*
- ***Gerald Fishman,*** *NASA-Marshall Space Flight Center, Huntsville, AL, USA*
- ***Hartmut Gemmeke,*** *Karlsruhe Institute of Technology, Germany*
- ***Johannes Knapp,*** *DESY Zeuthen, Germany*
- ***Jean Lilensten,*** *Institut de Planétologie et d'Astrophysique de Grenoble, France*
- ***Bagrat Mailyan,*** *Florida Institute of Technology, Melbourne, FL, USA.*
- ***Yasushi Muraki,*** *STE laboratory, Nagoya University, Japan*
- ***Vladimir Rakov,*** *University of Florida, USA*
- ***David Smith,*** *University of California, Santa Cruz*
- ***Marco Tavani,*** *INAF and University of Rome "Tor Vergata", Italy*
- ***Tatsuo Torii,*** *Japan Atomic Energy Agency, Tsuruga, Japan*
- ***Harufumi Tsuchiya,*** *Cosmic Radiation Laboratory, Riken, Japan.*



A. ALIKHANYAN National Laboratory

CRD COSMIC RAY DIVISION A. ALIKHANYAN National Laboratory

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

NUCLEAR PHYSICS INSTITUTE CAS
public research institution

SCA CRD