Thunderstorms and Elementary Particle Acceleration (TEPA-2020)

GENERAL INFORMATION:

TIME: October 12-15, 2020

LOCATION: Nor Amberd International Conference Centre of the Yerevan Physics Institute, Byurakan, Aragatsotn Province, Armenia.

SYMPOSIUM WEBSITE:

http://www.crd.yerphi.am/TEPA_2020

ORGANIZERS:

Cosmic Ray Division of Yerevan Physics Institute, Armenia

Scobelcin Institute of Nuclear Physics, Moscow State University, Russian Federation

INTERNATIONAL ADVISORY COMMITTEE:

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BACKGROUND:

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Long-lasting streams of gamma rays, electrons, and neutrons called thunderstorm ground enhancements (TGEs) have been observed in association with thunderstorms. These observations demonstrate that levels of natural gamma radiation in the 10– to 50–MeV range can jump to 10 times their normal level over the course of several minutes, and levels of gamma rays with energies of hundreds of keV can be doubled for several hours. The emerging research field of high-energy atmospheric physics (HEAP) is now shedding light on what causes these particle showers. HEAP comprises studies of various physical processes that extend to altitudes of many kilometers in thunderclouds and many hundreds of kilometers in space. Since 2010 time, the Cosmic Ray Division (CRD) of Yerevan Physics Institute and Skobeltsyn Institute of Nuclear Physics of Moscow State University organized international conferences at which HEAP researchers discuss the most intriguing problems of high-energy physics in the atmosphere and explore possible directions for the advancement of collaborative studies.

The central engine initiating the high-energy part of TGE is believed to be the Relativistic Runaway Electron avalanches (RREA), that accelerates seed electrons from an ambient population of cosmic rays (CR) in the large-scale thundercloud electric fields. Observation of numerous TGEs by Japanese, Bulgarian, Russian, Armenian, Chinese, and Slovakian groups proves that RREA is a robust and realistic mechanism for electron acceleration and multiplication leaving no doubts about the correctness of the RREA model for the TGE initiation. However, RREA cannot explain hours of prolonged TGEs, continued even at fair-weather without any disturbances of the near-surface electric field. New comprehensive model of natural gamma radiation (NGR) helps clarify the mechanism of hours-long isotropic fluxes of low-energy gamma rays emitted by radon-222 progeny species. It has been known for many years that radon-222 progenies are the main source of low-energy gamma rays; however, the mechanism of abrupt enhancement of this radiation during thunderstorms was unknown. Experiments on Aragats, performed in 2019, proved that emanated radon progenies become airborne, immediately attach to dust and aerosol particles in the atmosphere, and are lifted by the near-surface electric field upward, providing isotropic radiation of low-energy gamma rays.

The relationship of lightning and elementary particle fluxes in the thunderclouds was established on microsecond timescales. The particle flux data, well synchronized with the information on atmospheric discharges give valuable information on the structure of the atmospheric fields in the upper and lower parts of the thunderclouds. 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 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 electrified atmosphere on the fluxes of electrons and other charged particles can be important for experiments registering very-high-energy photons (Systems of Imaging Cherenkov telescopes) and hadrons (Surface arrays registering Extensive Air Showers. The TEPA meeting is a great opportunity for scientists to meet, discuss, invent new ideas and make new bridges for collaborative work.

STRUCTURE OF THE SYMPOSIUM:

We anticipate the following sessions:

1. Models of atmosphere electrification and electron acceleration; estimation of the intracloud electric field by the modulation effects it poses on cosmic rays (muons and electrons).
2. Multivariate observations of particles and fields from the Earth's surface, in atmosphere and from space (TGEs, gamma glows and TGFs);
3. Registration of atmospheric discharges by lightning mapping arrays and interferometers;
4. Influence of the atmospheric electric field on measurements of experiments using 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 the 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 electron acceleration models;
- Registration of wide- and narrowband radio emissions produced by atmospheric discharges and particle fluxes;
- Lightning initiation and its relation to particle fluxes originated in thundercloud;
- Neutron and positron production during thunderstorms;
- SEVAN particle detector network as a tool for the TGE research and intracloud electric field estimation;
- Methods of remote sensing of thundercloud structure and atmospheric electric fields;
- Lightning monitoring with fast cameras;
- Millisecond length X- and gamma ray emissions from lightning;
- Abrupt termination of the particle flux by the lightning flash, identification of lightning types by machine learning methods;
- 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.
- The global electrical circuit.

ATTENDANCE LIMITATION:

Due to the size of the venue, the number of participants is limited to 40. Therefore, participation in the Symposium is by invitation only. Please, submit an abstract of presentation to apply.

ABSTRACT SUBMISSION:

Abstracts should be submitted electronically on the Symposium website. The deadline for abstract submission is 1 September 2020

REGISTRATION:

Registration to **TEPA 2020** should be done online via the Symposium website. We will provide participants with their own account on the Symposium website. These accounts will serve for the submission of abstracts, papers for Symposium proceedings and for providing information about accompanying persons.

Registration fees:

- Regular Attendees [300 Euro]
- Undergraduate and Graduate Students [150 Eur]

The fee covers the cost of transportation from and to airport, coffee breaks, as well as the Reception, the Banquet, and excursions.

Accommodation and full board costs:
60 euro per day for single occupation; 40 Euro per day for double occupation.

Payment of the registration fee will be accepted at the Symposium desk upon arrival.

CONFERENCE DEADLINES:

- 1 September 2020 Abstract submission deadline
- 15 September 2020 Contributed presentations selected and participants notified
- 5 October 2020 Symposium program in the Conference site

TRANSPORTATION AND LODGING:

The organizers will provide transportation from/to the Yerevan Airport "Zvartnots". Information on the arrival date, time and flight number should be sent to the Local Organizing Committee. During the Symposium, the participants will be accommodated at the hotels in Nor Amberd International Conference Center of Yerevan Physics Institute, located on the slopes of Mount Aragats, near the village of Byurakan, Aragatsotn District, Armenia. The Center has a rich tradition of hosting high-energy physics schools and is well equipped for international forums.

CORRESPONDENCE:

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