

2019



11 years of TGE observations on Aragats

THUNDERSTORMS & ELEMENTARY PARTICLE ACCELERATION

SYMPOSIUM PROGRAMME



October 14-17, 2019

NOR AMBERD

International Conference Centre
of the Yerevan Physics Institute,
Byurakan, Aragatsotn District,

ARMENIA



**THUNDERSTORMS & ELEMENTARY PARTICLE
ACCELERATION**

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GENERAL INFORMATION:

TIME FRAME: October 14-17, 2019

LOCATION: Nor Amberd International Conference Centre
of the Yerevan Physics Institute,

Byurakan, Aragatsotn District, Armenia.

SYMPOSIUM WEBSITE:

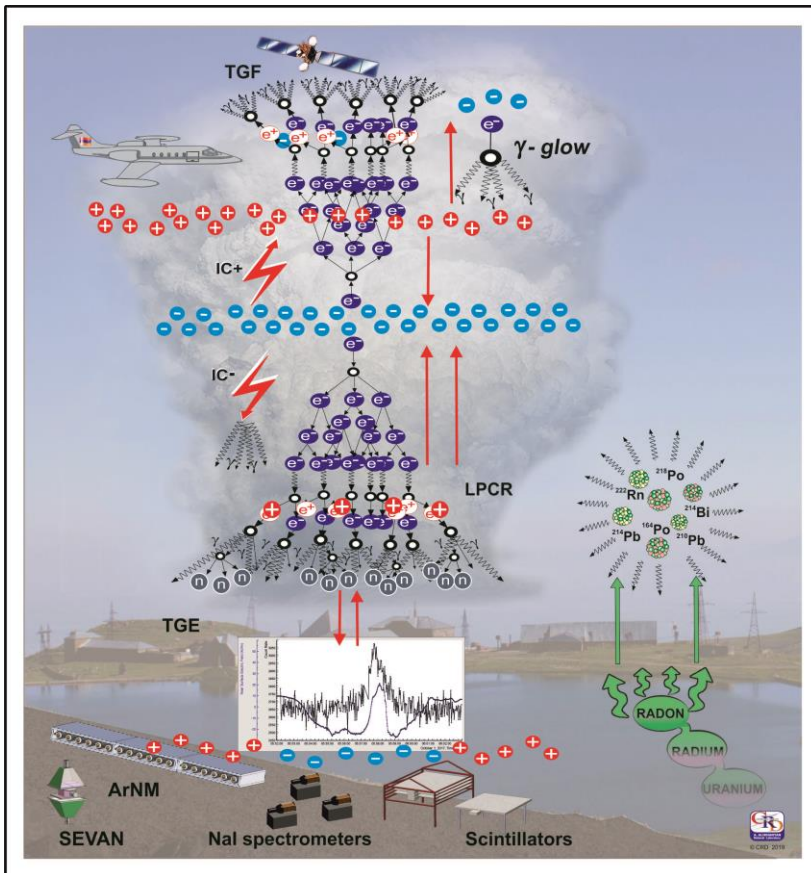
http://crd.yerphi.am/TEPA_2019

ORGANIZERS:

Cosmic Ray Division
of Yerevan Physics Institute, Armenia

Skobeltsyn Institute of Nuclear Physics
of Moscow State University, Russia





INTERNATIONAL ADVISORY COMMITTEE:

- Ashot Chilingarian**, Yerevan Physics Institute, Armenia, chair
- Lev Dorman**, Israel Cosmic Ray Center and Emilio Segre' Observatory, Israel
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- Gerald Fishman**, NASA-Marshall Space Flight Center, Huntsville, AL, USA
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- Johannes Knapp**, DESY Zeuthen, Germany
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- Yasushi Muraki**, STE laboratory, Nagoya University, Japan
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- Vladimir Rakov**, University of Florida, USA
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- Harufumi Tsuchiya**, Cosmic Radiation Laboratory, Riken, Japan
- Lev Zeleny**, Space Research Institute, Russian Academy of Sciences, Russian Federation
- Bagrat Mailyan**, Florida Institute of Technology, Melbourne, FL, USA.

BACKGROUND:

The high-energy atmospheric physics (HEAP) has been enriched recently by important observations of particle fluxes on Earth's surface, in troposphere and in space. HEAP presently includes 3 main types of measurements: Terrestrial Gamma Ray Flashes (TGFs) - brief burst of gamma radiation (sometimes also electrons and positrons) registered by orbiting gamma ray observatories in the space, Thunderstorm ground enhancements (TGEs) - prolonged electron and gamma ray fluxes (also neutrons) registered on the earth's surface, and gamma glows - gamma ray bursts observed in the thunderclouds by facilities on balloons and aircraft.

The central engine initiating the 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, Russian, Armenian, Chinese, and Slovakian groups prove 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. Precisely recovered particle energy spectra gives new clues for testing models of electron acceleration in atmosphere, as well as, for scrutinizing the structure of the electric field in thunderclouds. 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 past 11 years can be widely used for the validation of models aimed to explain TGF phenomena.

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 the 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 the scientists to meet, discuss, invent new ideas and make new bridges for collaborative works.

STRUCTURE OF THE SYMPOSIUM:

We anticipate the following sessions:

1. Multivariate observations of particles fluxes from the Earth's surface, in atmosphere and from space (TGEs, gamma glows and TGFs);
2. Registration of atmospheric electric fields and discharges by radars, lidars, fast and slow field sensors;
3. Models of atmosphere electrification and electron acceleration;
4. 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.

PROGRAMME OF TEPA-2019

Sunday, 13 October

Meeting of participants at the Zvartnots airport, transportation to the Nor Amberd, Registration at Nor Amberd International Conference Center

Monday, 14 October

9:00 – 11:00 *Registration*

11:00 – 11:20 *Opening Ceremony*

Session 1: Multivariate observations of particles and fields

Chairperson – Johannes Knapp

**11:20 – 12:00 *Ashot Chilingarian, Yerevan Physics Institute, Armenia,*
Natural Gamma radiation measured during thunderstorms**

- 12:00 – 12:45 **Coffee break**
- 12:45 – 13:25 *Bagrat Mailyan, The University of Alabama, Huntsville, USA,*
**Analysis of Individual Terrestrial Gamma-Ray Flashes with
Lightning Leader Models and Fermi Gamma-Ray Burst
Monitor Data**
- 14:00 – 15:00 **Lunch**
- 15:00 **Session 1: Chairperson - Bagrat Mailyan**
- 15:30 – 16:00 *Vitaly Bogomolov, Moscow State University, Skobel'tsyn
Institute of Nuclear Physics:* **Atmospheric Gamma-Ray Time
Profiles Measured During Thunderstorms in Moscow
Region and at Aragats Station.**
- 16:00 – 16:30 *Balabek Sargsyan, Yerevan Physics Institute,* **Origin of the
low-energy gamma ray flux of the long-lasting
thunderstorm ground enhancements (TGEs)**
- 16:30 – 17:00 *Roberta Colalillo, INFN and Università degli Studi di Napoli, Italy,*
TGE at UHECR energies
- 17:00 – 17:30 *Gagik Hovsepyan, Yerevan Physics Institute,* **On the angular
distribution of the low-energy components of TGE recorded
at mountain heights.**
- 17:30 – 18:00 **Coffee break**
- 18:30 – 19:00 *Alek Elbekian, Beirut University, Livan,* **Correlation of the
electric field and Rn progenies intensity**
- 19:00 – 19:30 *Davit Aslanyan, Yerevan Physics Institute, Armenia,*
**Thunderstorm Ground Enhancement (TGE) events
observed on Aragats in 2018-2019 years**
- 20:00 **Special Event: Icebreaker, Nor Amberd Conference Center
Restaurant**

Tuesday, 15 October

09:00

Breakfast

Session 2. Registration of atmospheric electric fields and discharges

Chairperson - Roberta Colalillo

10:00 - 10:30

Suren Soghomonyan, Yerevan Physics Institute, Armenia;
Termination of thunderstorm-related bursts of energetic radiation and particles by inverted intracloud and hybrid lightning discharges

10:30 – 11:00

Ekaterina Svechnikova, Institute of Applied Physics of RAS, Nizhny Novgorod, RF,
Seasonal variations of meteorological characteristics of clouds producing enhancements of energetic particle flux

11:00 - 11:30

Hripsime Mkrтчyan, Yerevan Physics Institute, Armenia;
Electric Field Polarity Asymmetry in the Occurrence of Thunderstorm Ground Enhancements during the End of Storm Oscillation (EOSO)

11:30 - 12:00

Coffee break

12:00 – 12:30

Hripsime Mkrтчyan, Yerevan Physics Institute, Armenia;
Radar diagnosis of the thundercloud electron accelerator

12:30 – 13:00

Arsen Galumyan, Yerevan Physics Institute, Armenia;
Features of Electric Field Measurements during Thunderstorms Using Polarization LIDAR System.

13:00 – 13:30

Jana Minářová, Institute of Atmospheric Physics, Czech Academy of Sciences, Czech Republic,
Explicit simulation of lightning within COSMO Numerical Weather Prediction model: dependence on background ion generation rate by cosmic rays

13:30 – 14:00

Jakub Šlegl, Nuclear Physics Institute CAS, Czech Republic,
Role of actual atmospheric variables in the model of cosmic ray induced ionization

14:00 – 15:00

Lunch

Session 3: Models of atmosphere electrification and electron acceleration; Chairperson – Ekaterina Svechnikova	
16:00 – 16:30	Artem Syssoev, <i>Institute of Applied Physics of RAS, Nizhny Novgorod, RF</i> , Numerical modeling of stepping process in negative lightning leaders
16:30 – 17:00	Egor Stadnichuk, <i>MIPT/INR RAS</i> , Completely random reactor model for the RREA initiation
17:00 – 17:30	Timur Khamitov, <i>MIPT, Moscow, RF</i> , Simulation of RREA and an VHF signal generated by decelerating electrons
17:30 – 18:00	Coffe breake
18:00 – 19:00	Evening Lecture: Anatoly Petrukhin, National Research University, MEPhI, Moscow, Russia , Muon puzzle in ultra-high energy cosmic rays and possible ways of its solution
20:00	Supper
Wednesday, 16 October	
09:00	Breakfast
Session 3 . Models of atmosphere electrification and electron acceleration; - Chairperson – Leonid Sorokin	
10:00 - 10:30	Mary Zazyan, <i>Yerevan Physics Institute, Armenia</i> ; Effect of near-earth thunderstorms electric field on the electron-positron annihilation peak at Aragats research station
10:30 – 11:00	Grigori Karapetyan, <i>Yerevan Physics Institute, Armenia</i> ; Chaotic electric field of charged hydrometeors in thundercloud as a driving force for atmospheric high energy phenomena Physics Institute,
11:00 - 11:30	Eduard Mnatsakanyan, <i>Yerevan Physics Institute, Armenia</i> ; Estimation of volumetric activity Radon at Aragats outdoors and indoors (SKL) using the intensity of the Bi²¹⁴ line (609 keV)

11:30 - 12:00	<i>Suren Hovhakimyan, Ministry of Emergence situations of Armenia, The possibility of using data`s of lightning detectors for short-term earthquakes predictions.</i>
12:30 – 13:30	Lunch
13:30 – 18:00	Excursion to Aragats Cosmic Ray Station; Introduction to Aragats Space Environmental Center particle monitors; Visit of medieval footrest Amberd
20:00	Conference dinner
<i>Thursday, 17 October</i>	
09:00	Breakfast
Session 4. Instrumentation	
Chairperson - Anatoly Petruchin	
10:00 - 10:20	<i>Rinat Fakhruddinov, NRC "Kurchatov institute" – IHEP, Moscow, RF, The Tomograph Based on Drift Tubes for Atmospheric Muons Registration</i>
10:20 – 10:40	<i>Natalia Barbashina, National Research Nuclear University, MEPhI, Moscow, RF, Muonography of the Earth's atmosphere and near-terrestrial space</i>
10:40 - 11:00	<i>Leonid Sorokin, Peoples' Friendship University of Russia, Moscow, RF, Experience of operation Blitzortung lightning detector array in Armenia</i>
11:00 - 11:20	<i>Aleksandra Kachur, National Research Nuclear University, MEPhI, Moscow, RF, Thundercloud imaging by means of muon hodoscope URAGAN and Doppler weather radar DMRL-C</i>
11:20 - 11:40	Closing Ceremony
12:00- 13:00	Lunch
13:00 - 18:00	Excursion to Echmiadzin (cathedral church) and Yerevan (ancient manuscript museum)
20:00	Supper
<i>Thursday, 18 October</i>	
Transport participants to Zvartnots airport	

List of Participants

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