TEPA-2016 Nor Amberd October 3-7




TEPA-2016 symposium is dedicated to the memory of

Harutyun Vaporciyan

(January 9, 1929- September 29, 2016)

Architect, husband, father, grandfather and devoted sponsor of CRD. Harutyun's support has been a critical force to establish CRD as a world-class scientific organization in Armenia during these difficult years.



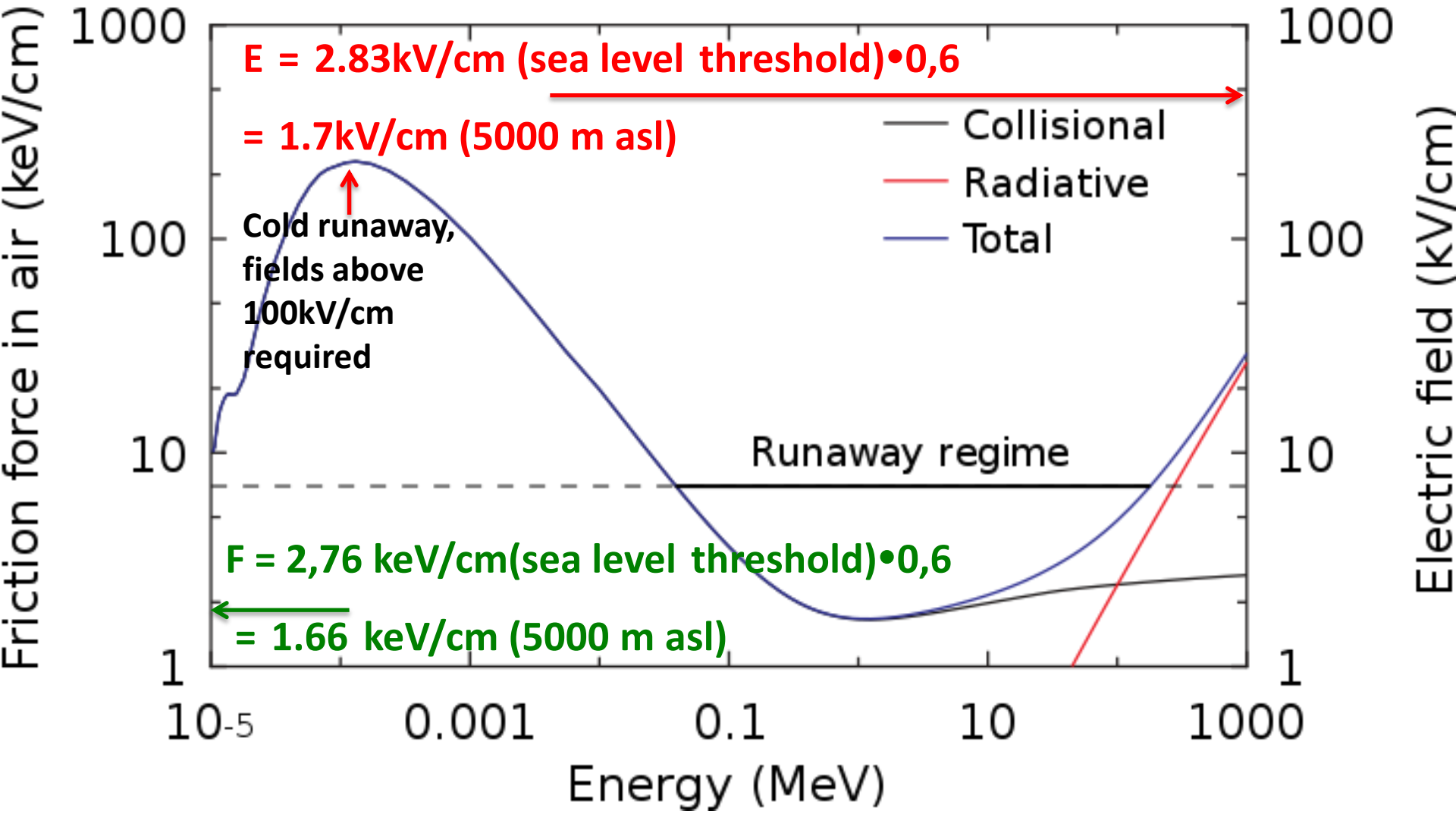

TEPA 2016 in numbers

- 30 participants from Russia, USA, Germany, Israel and Armenia present 20 plenary talks and 10 posters in 5 sessions:
  - Research of the Thunderstorm ground enhancements (TGEs) observed by particle detectors located on earth's surface;
  - Research of the Terrestrial gamma-ray flashes (TGFs) observed by the orbiting gamma-ray observatories;
  - Relation of Lightning to the TGE and TGF;
  - Monitoring of TLEs and thunderstorms from the orbit;
  - Cloud electrification and atmospheric discharges: measurements and applications.
- 2 discussion were hold:
  - Data bases in high-energy atmospheric physics description and cooperation;
  - Do lightning discharges produce relativistic particles?
- Visit to Aragats research station and installation of new detectors (collaboration YerPhI- SINP).

What are most intriguing problems of High-Energy Physics in Atmosphere (HEPA)?

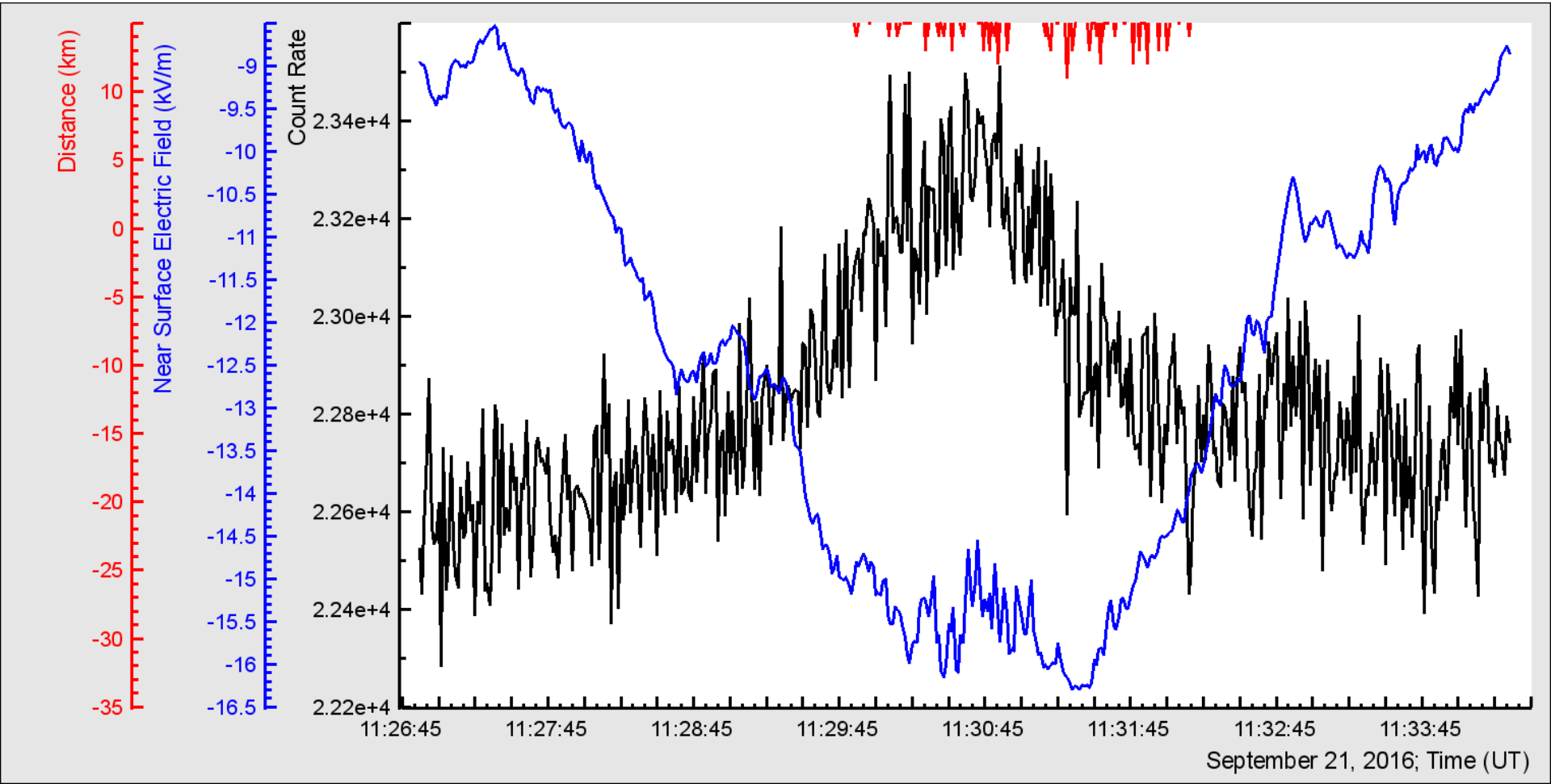
- **TGEs and TGFs: relation to RREA and classification;**
- **Do elementary particles born in lightning bolt(neutrons and gamma rays) or only in RREA process?**
- **Do we need additional mechanisms of seed particle generation (**Relativistic feedback discharge model (RFDM **) and Cold runaway?**
- **Confirmation of the *in situ* detection of the RB/RREA cascades – Extensive cloud showers, analog of EASs – Extensive cloud showers** (**particle fluxes on microsecond scale -MRB**);
- **What can we understand from observed TGEs about cloud electrification: tripole model, emerging Lower positively charged layer (LPCR);**
- **How to measure/estimate size of emitting region in the cloud;**
- **How the lightning switching off the RREA: time scales, distances…**
- **What atmospheric conditions switch on TGE (Development of the LPCR**, role of humidity and precipitation)**?**
- **How to explain energy spectra of the TGE extended until 100 MeV?**
- **Do RB/RREA "open" conductive channel to lightning?**
- **Neutron production by RREA, registration of neutrons on the Earth's surface;**
- **Do EASs facilitate lightning leader propagation (EAS-RB process)?**
- **Which lightnings cause maximal Electromagnetic inference (EMI)?**

Energy losses and energy gain: RB/RREA process

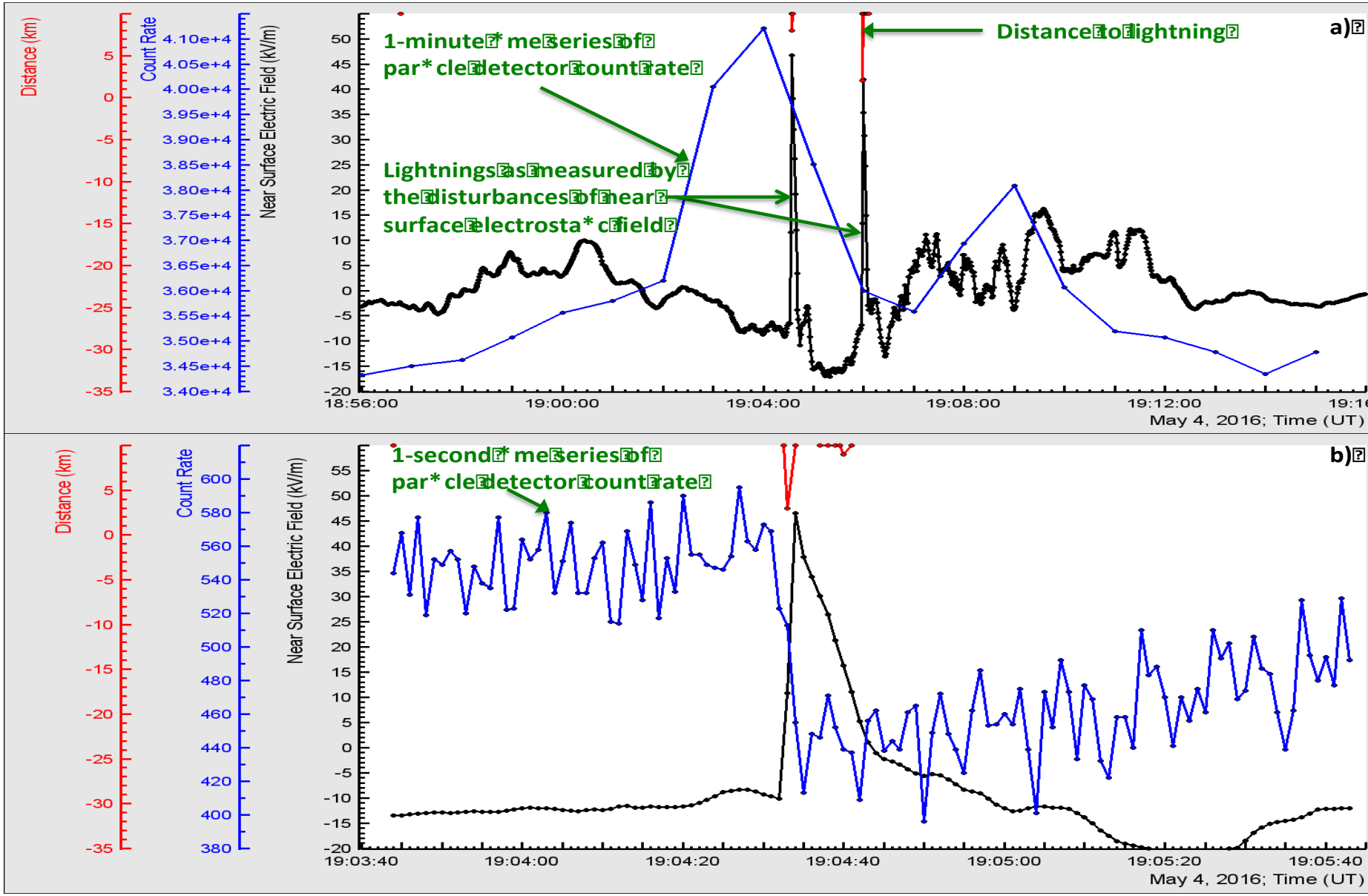


Gurevich et al., (1992), Symbalisty et al. (1998), Babich et al. (1998), Dwyer (2003), Chilingarian (2014)

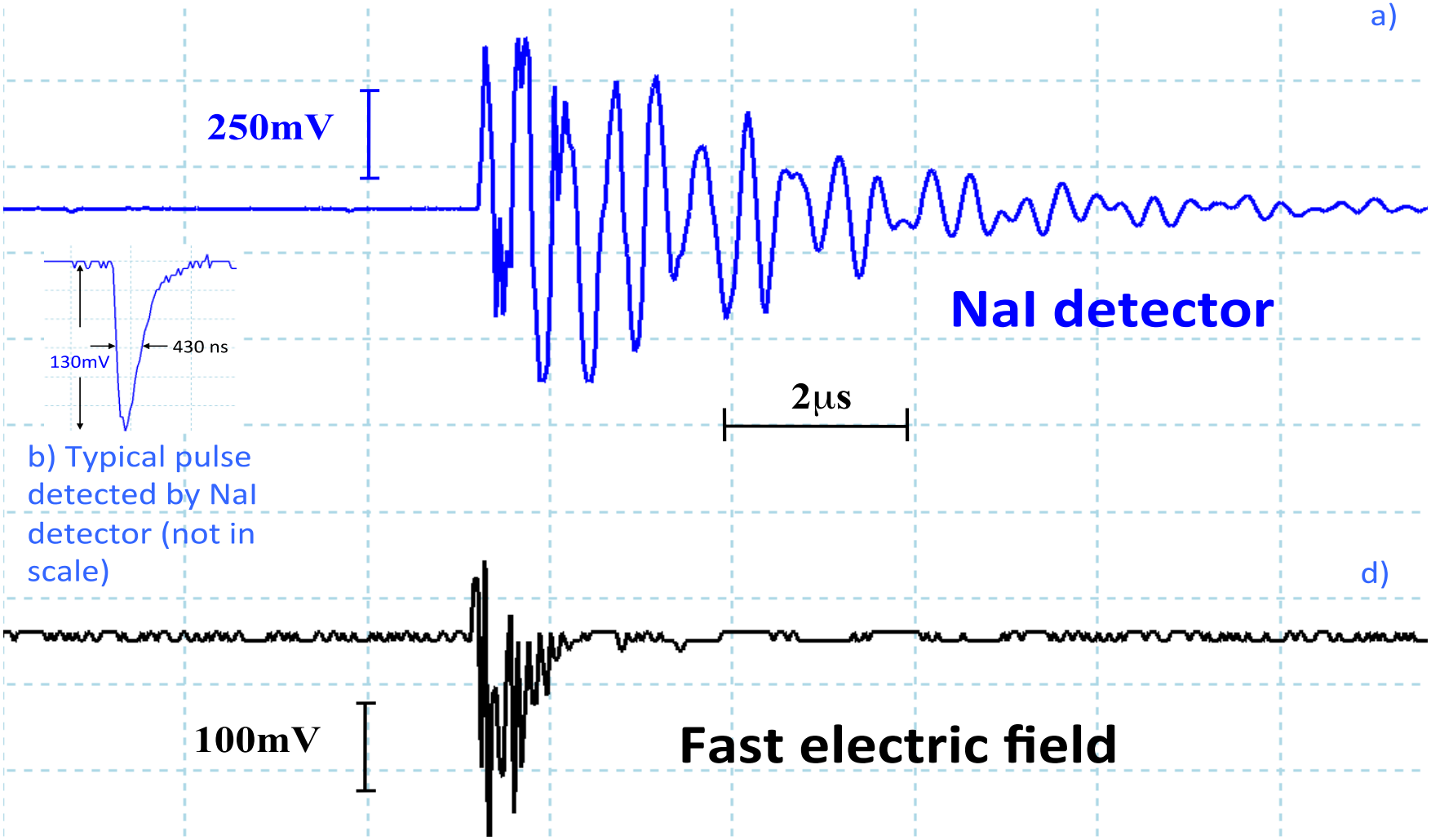
“Classical” shape of TGE and corresponding Electrostatic field disturbances; second scintillator of STAND1 detector network (located on roof of Gamma calorimeter); TGE lasting ~ 5 minreach maximum on minimal value of electrostatic field having small bumps emerging from this minimum (signaling on creation of LPCR).



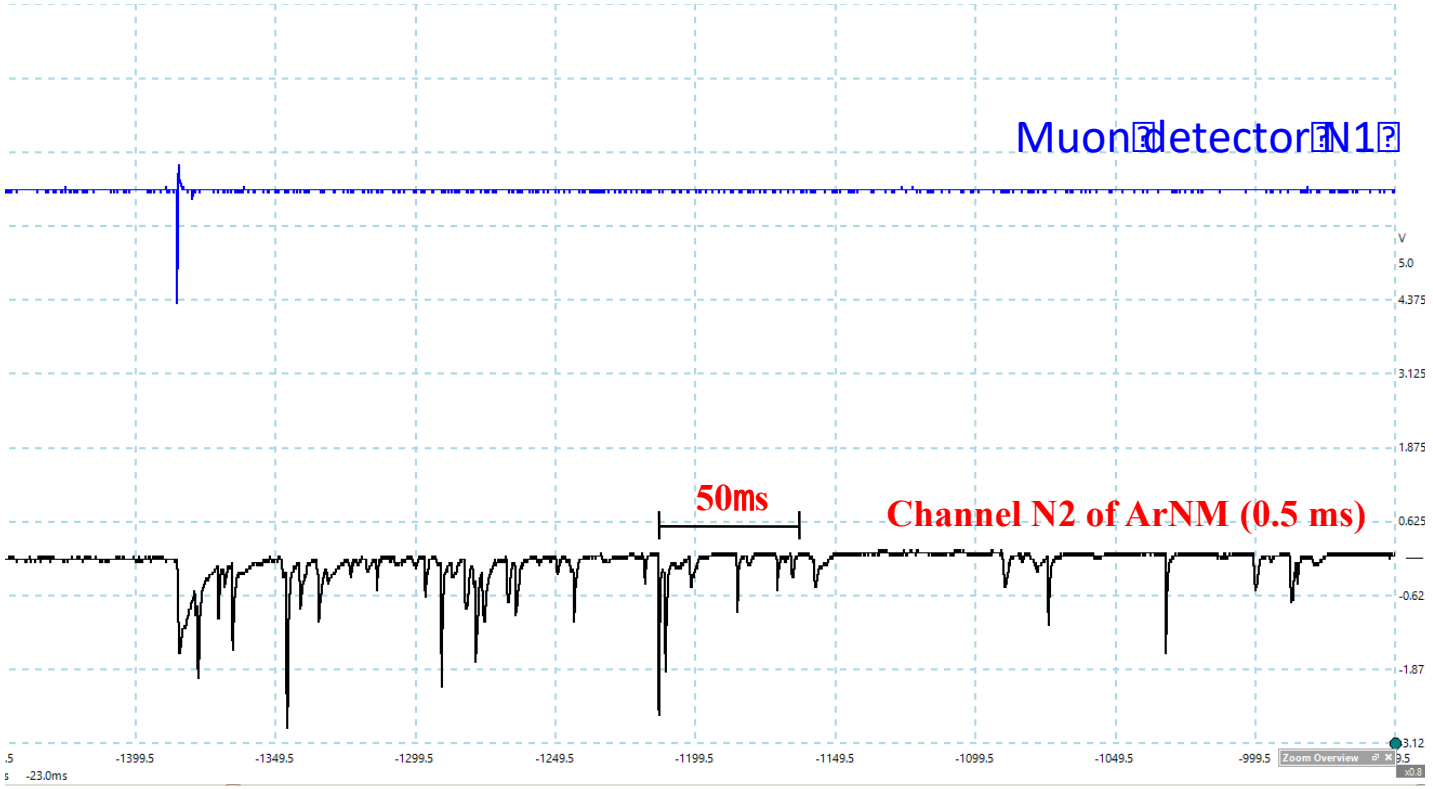
Lightnings and TGEs



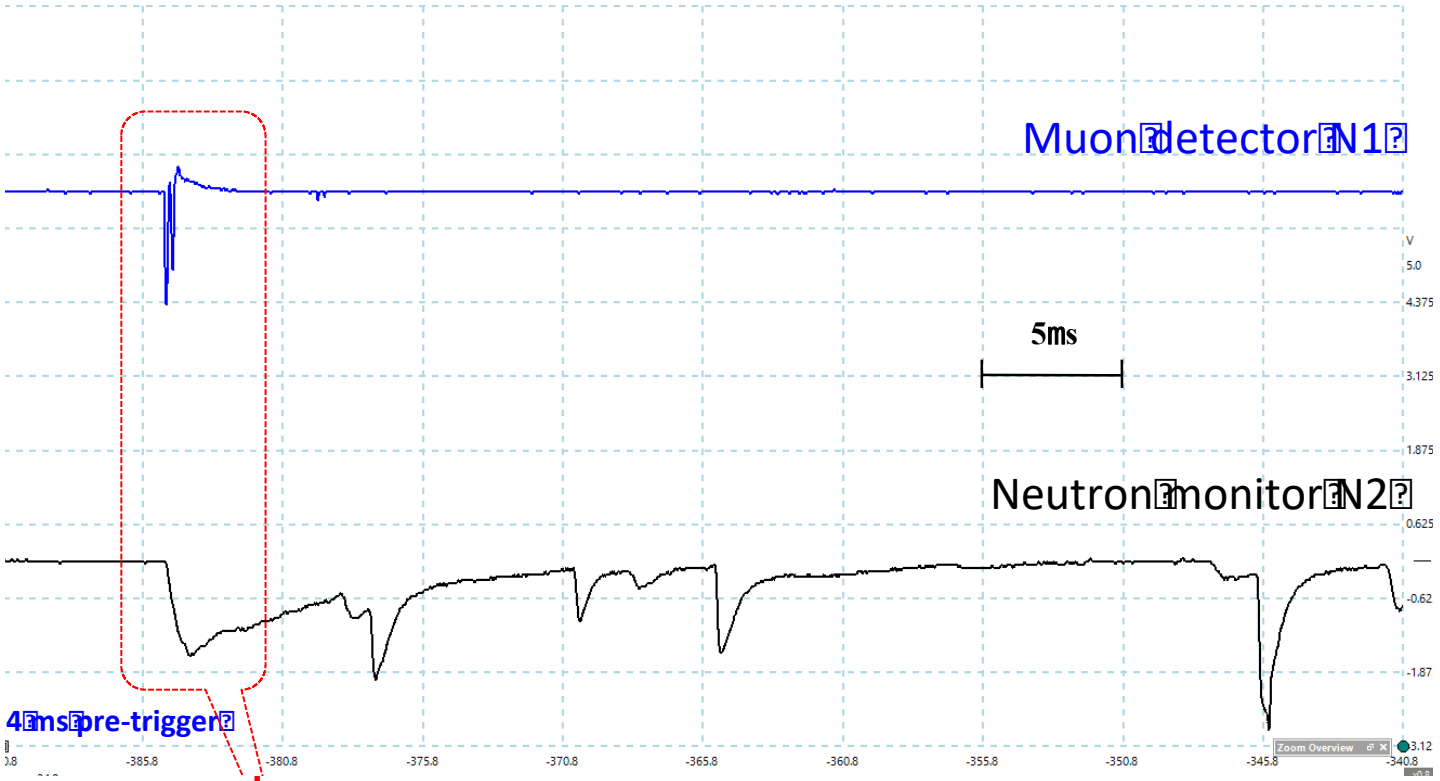
EMI and genuine particles response



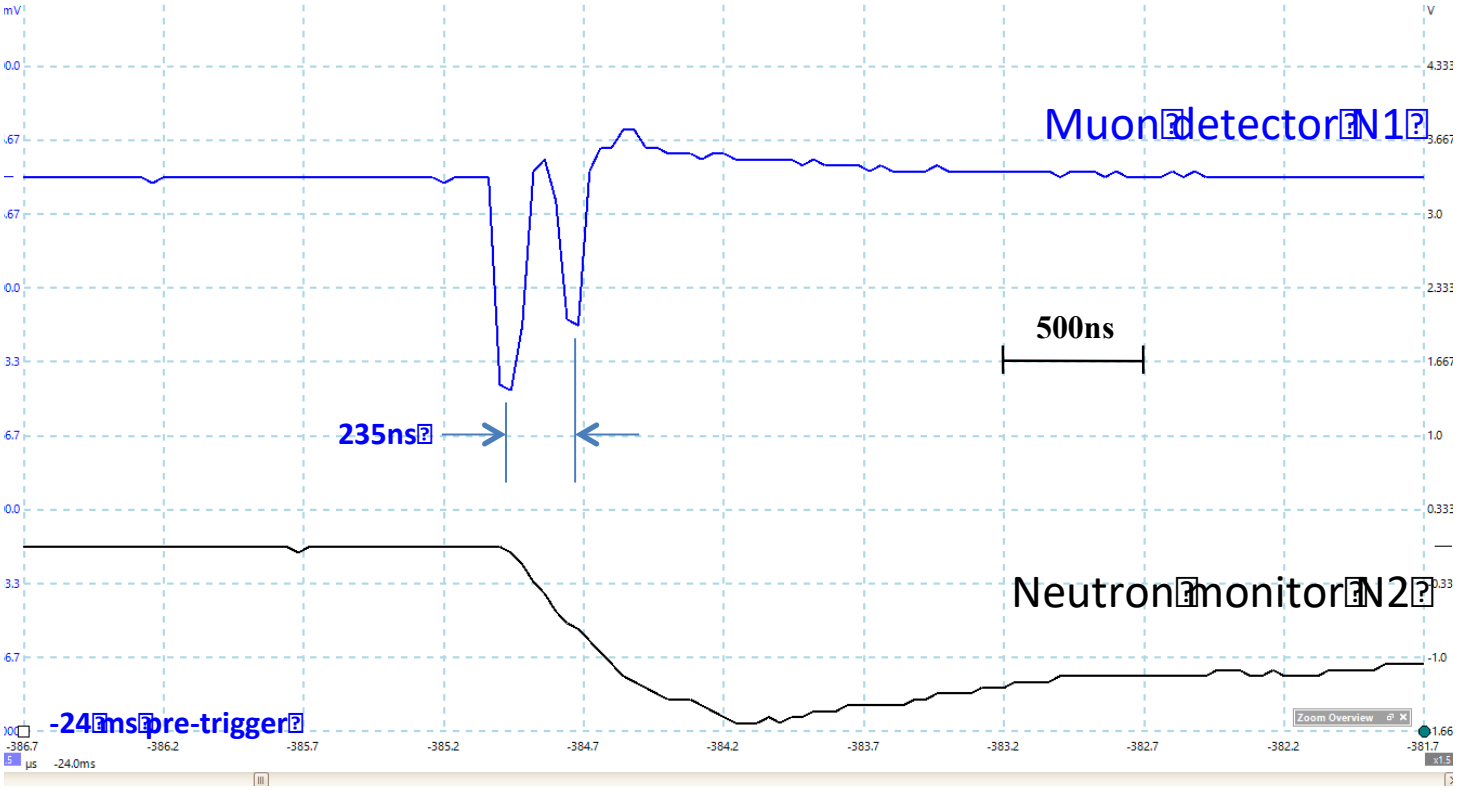
EAS hitting ArNM: multiple genuine particle pulses (no lightning, no EMI) within ~ 1ms; only 1 pulse in scintillator



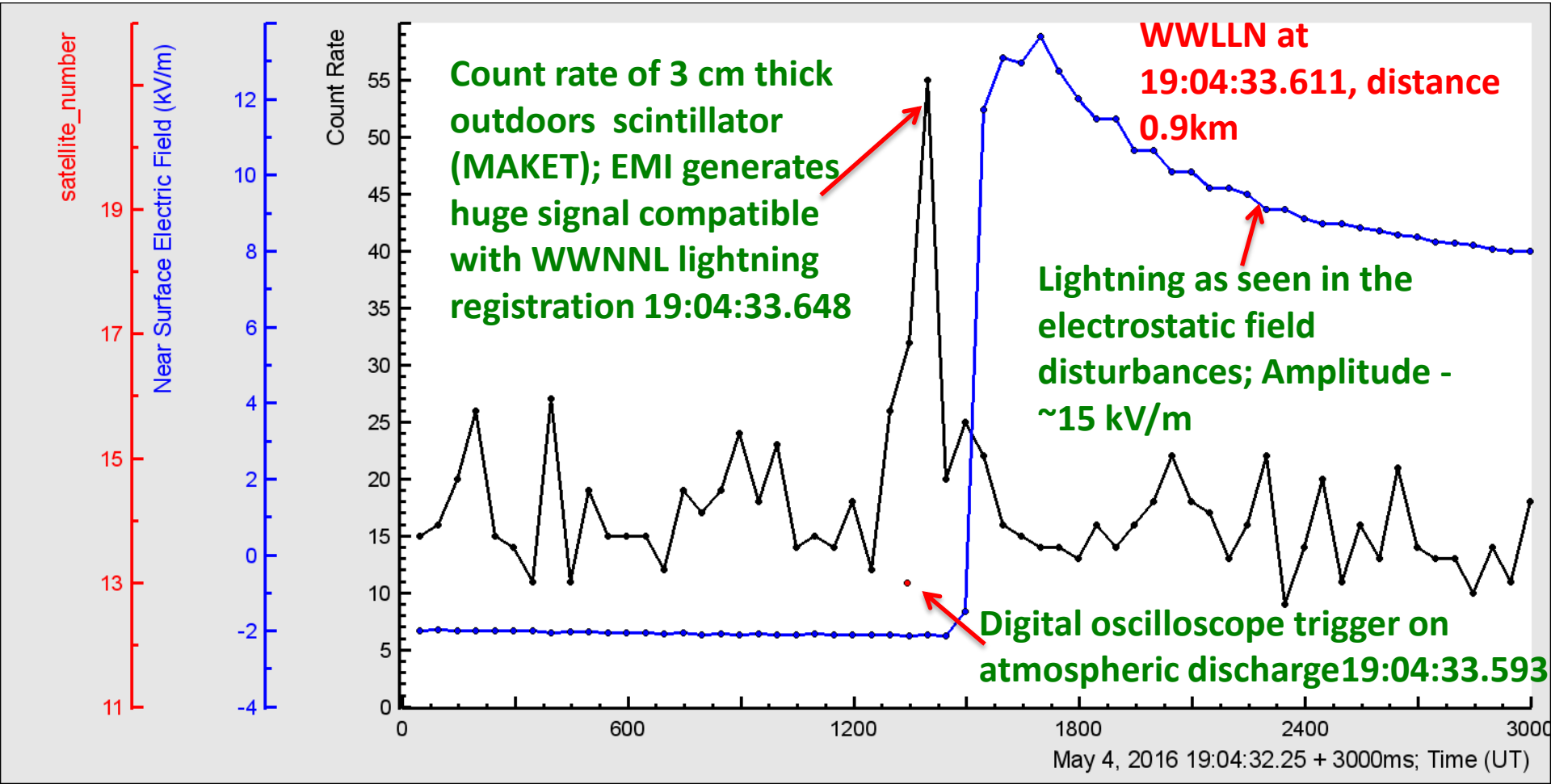
Pulses from particle detectors enumerated by high-frequency digital oscilloscope



On the nanosecond time scale we see that there were 2 pulses in scintillator and we see pileup in ArNM proportional counter due to several neutrons entering proportional tube



3 seconds of 50 ms time series including lightning occurrence



Lightnings and particle fluxes

- During numerous thunderstorm on Aragats there were no particles fluxes registered simultaneously with lightnings;
- Near 20 events were detected when lightning abruptly terminate particle flux from clouds;
- Investigations of pulses from particle detectors and atmospheric discharges prove that all pulses from detectors are electromagnetic interferences (EMI) because:

1. only some of particle detectors show pulses, for instanced in stacked detectors upper scintillators don't count any peaks and the third bottom detector demonstrate huge peak;
2. all peaks consists from bipolar pulses, pulses from genuine particles have unipolar shape;
3. large EASs hitting neutron monitor generate genuine multiple peaks without any relation to lightning.

- Only confirmed by fast electronics particle pulses can be accepted as genuine.
- **Observed on Aragats fluxes of electrons, gamma rays and neutrons can be explain with standard RREA + MOS theory with CR electron seeds. Lightnings do not generate high-energy particles!**

TGE and TGF

- TGE and TGF are not processes generated particles, terms are related to the observations and not to mechanism. It is particle registration phenomena on the Earth and in the space. In both cases only RREA/RB process generate particles; To call particle fluxes registered on the Earth's surface TGF is out of logic, they are TGEs!
- Duration of the particle flux is not essential it is only long or short superposition of very brief cascades from seed electron (ESC and MRB) in strong electric field inside thundercloud;
- We don't need RDFM (Feedback discharge model) for explaining TGE;
- We don't need "cold runaway" injected additional seed electrons for explaining TGE;

TEPA Establishing the topic of High-Energy Physics in Atmosphere (HEPA)

- There is big activity in several countries to establish surface particle detectors for research in TGE physics;
- RREA model with CR seeds and emerging transient LPCR rather well explain TGE measurements worldwide;
- Reported planned research of TLE and TGF from orbit should be coupled with surface measurements;
- Should be established links with meteorology, atmospheric electricity, ACT experiments, muonography.
- More convincing papers are needed on origin of TGE/TGF.
- Lightning mapping arrays will be very important addition to Aragats facilities;
- New fast electronics will reveal origin of TGEs and TGE-lightning relations;
- Broad collaboration with Space and Lightning physics experiments will significantly improve research and understanding in the new emerging HEPA field.


TEPA 2016 PeG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Electrification
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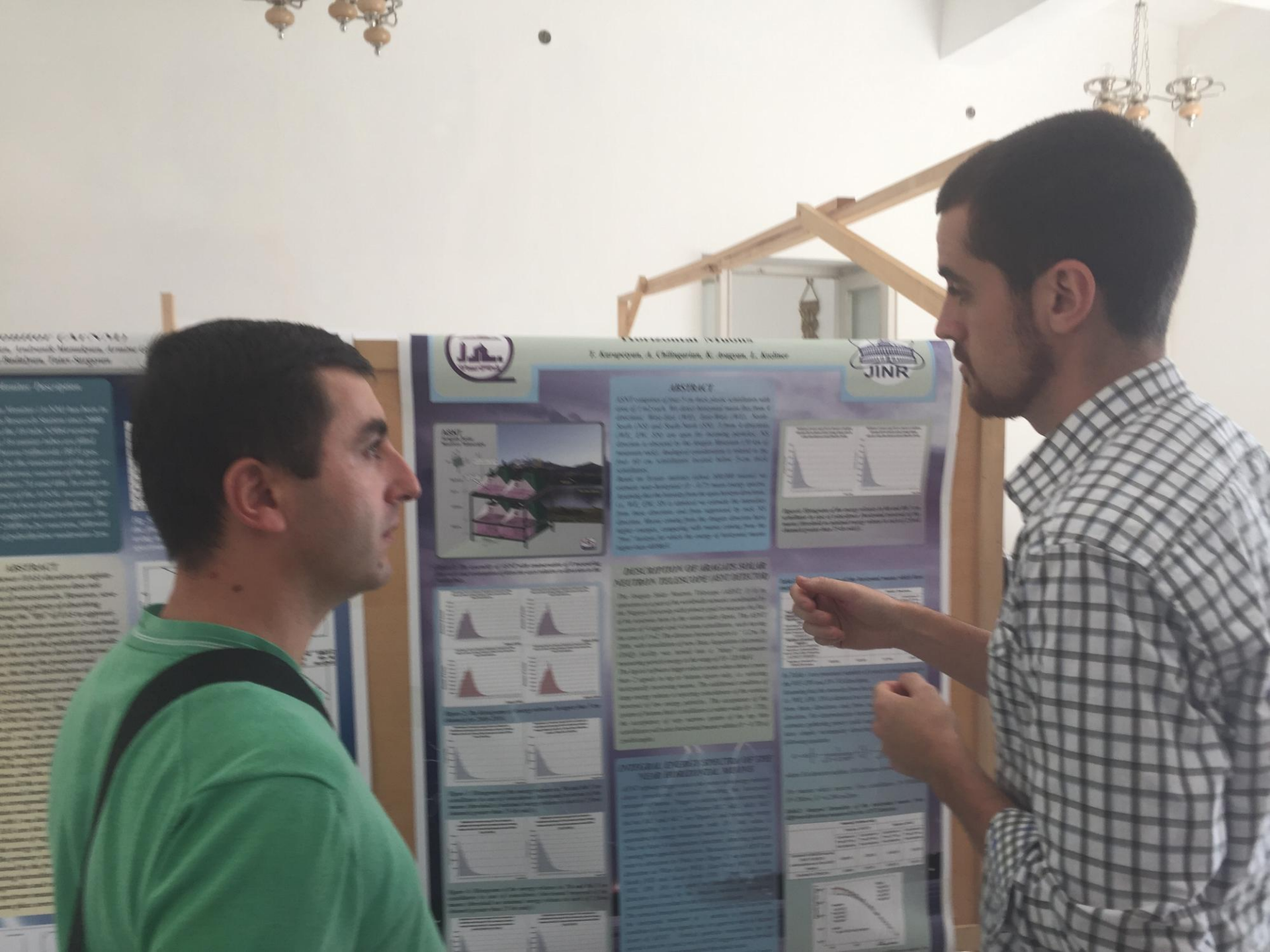
МОСКВА

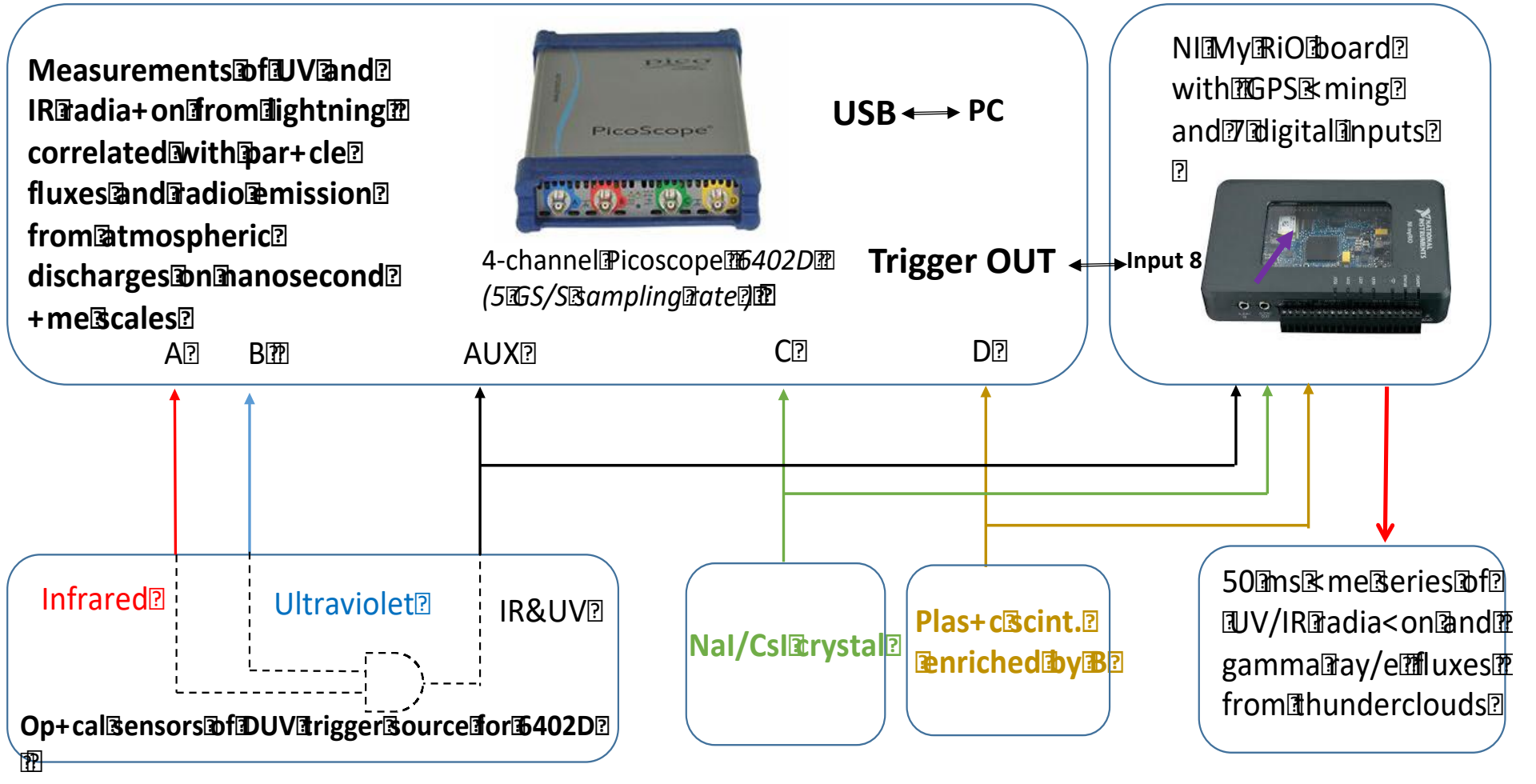

JINR
ABSTRACT

Excursion to Yerevan Opera house

Excursion to Garni and Geghard: Garny valley

Armenia national dances near pagane temple of first century

New fast DAQ for lightning and particle flux research. 4-channels PicoScope setup, connected to DUV (infrared and ultraviolet sensors) and 2 particle detectors. Coincidence of IR&UV signal is used as a trigger source for the picoscope. The same signal goes to myRIO board for precise time stamping.

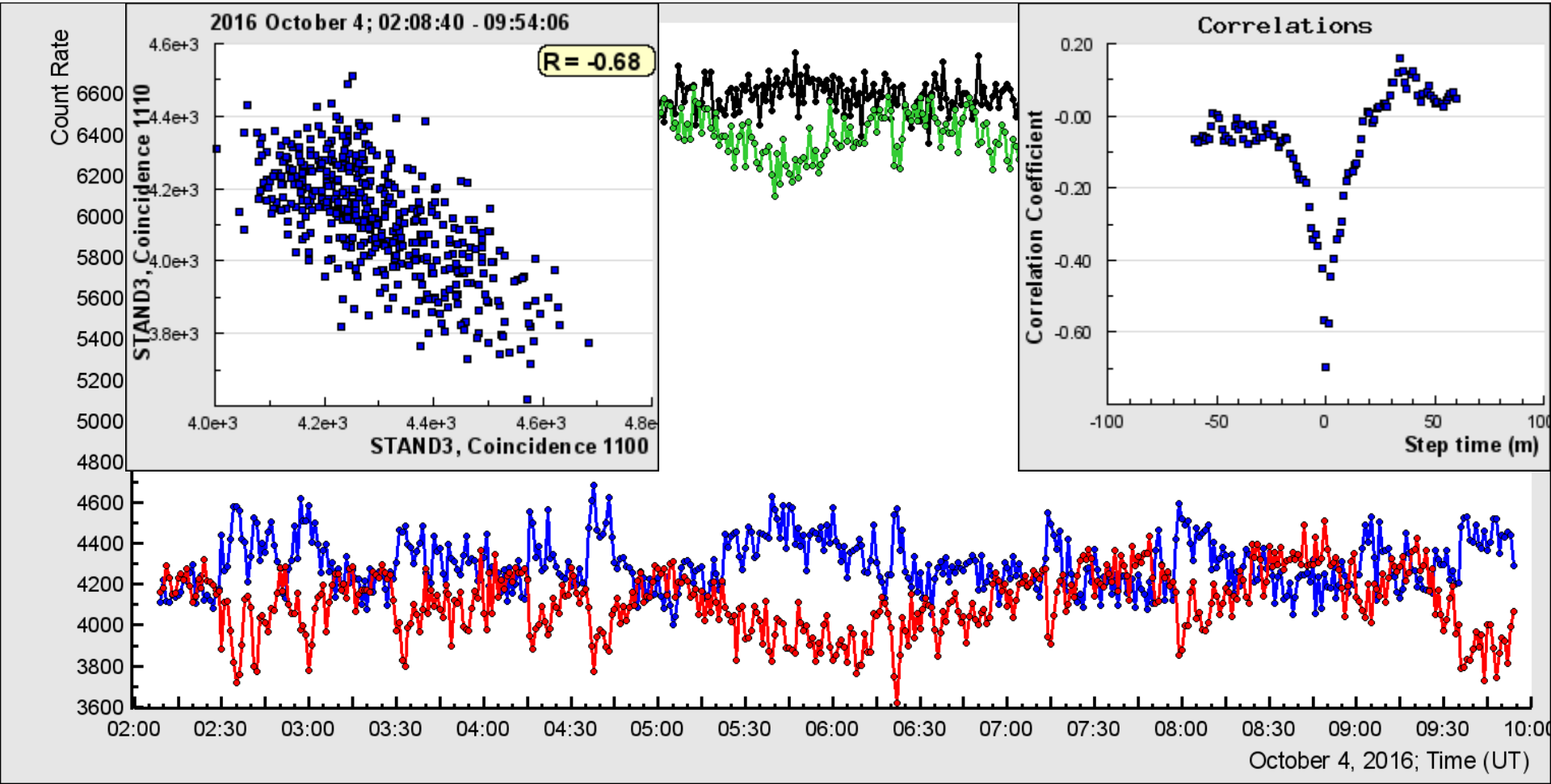



pico
PC Oscilloscope
DUVIK 24 134

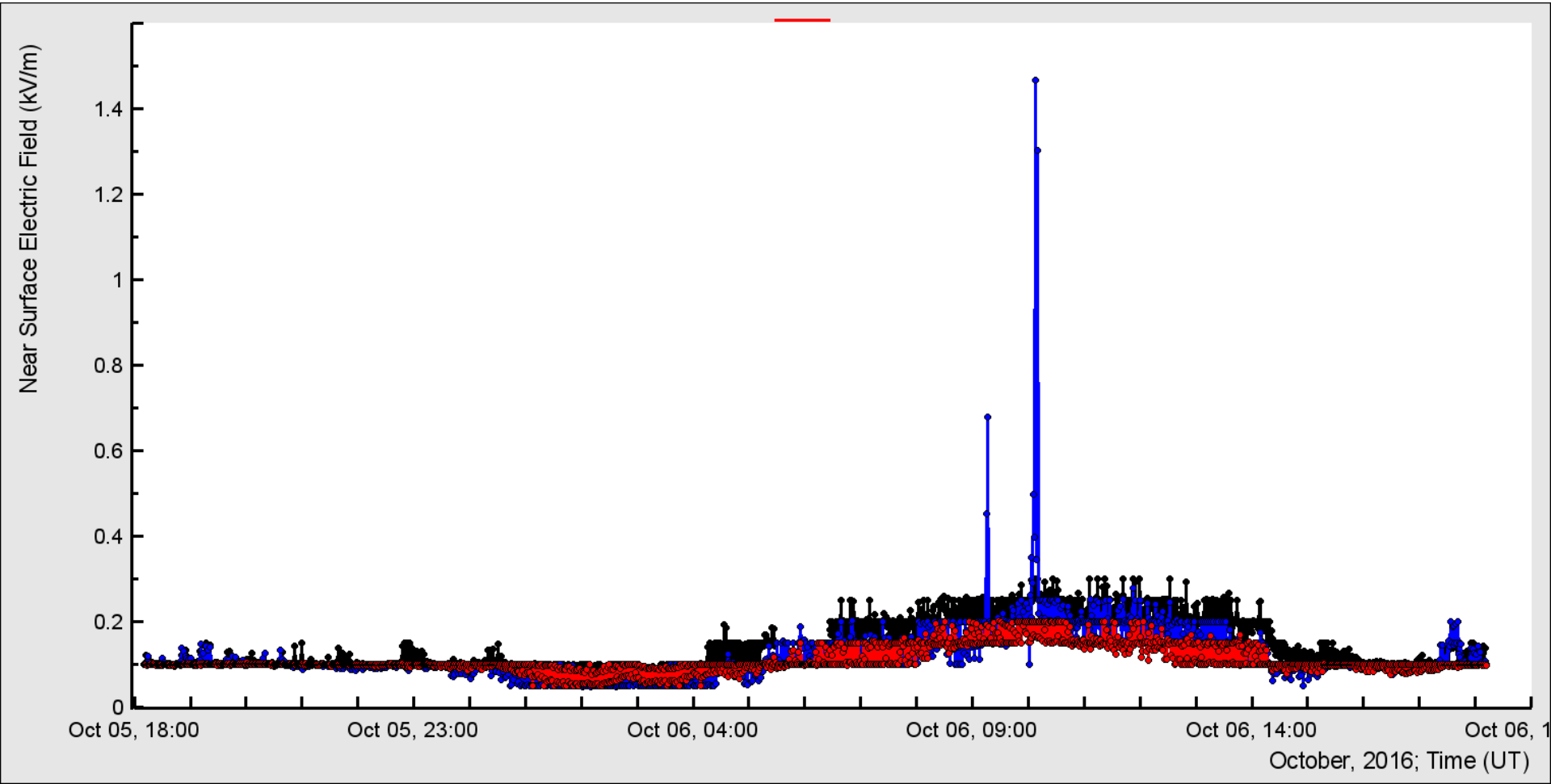

Aragats hotel, 8 October,
V.Bogomolov, G.Dgabaryan and
G.Garipov istalling new detectors


Aragats SKL building, 8 October,
E.Mnatsakanyan, V.Bogomolovand
G.Garipov measuring energy spectra
with modernized CsI spectrometer

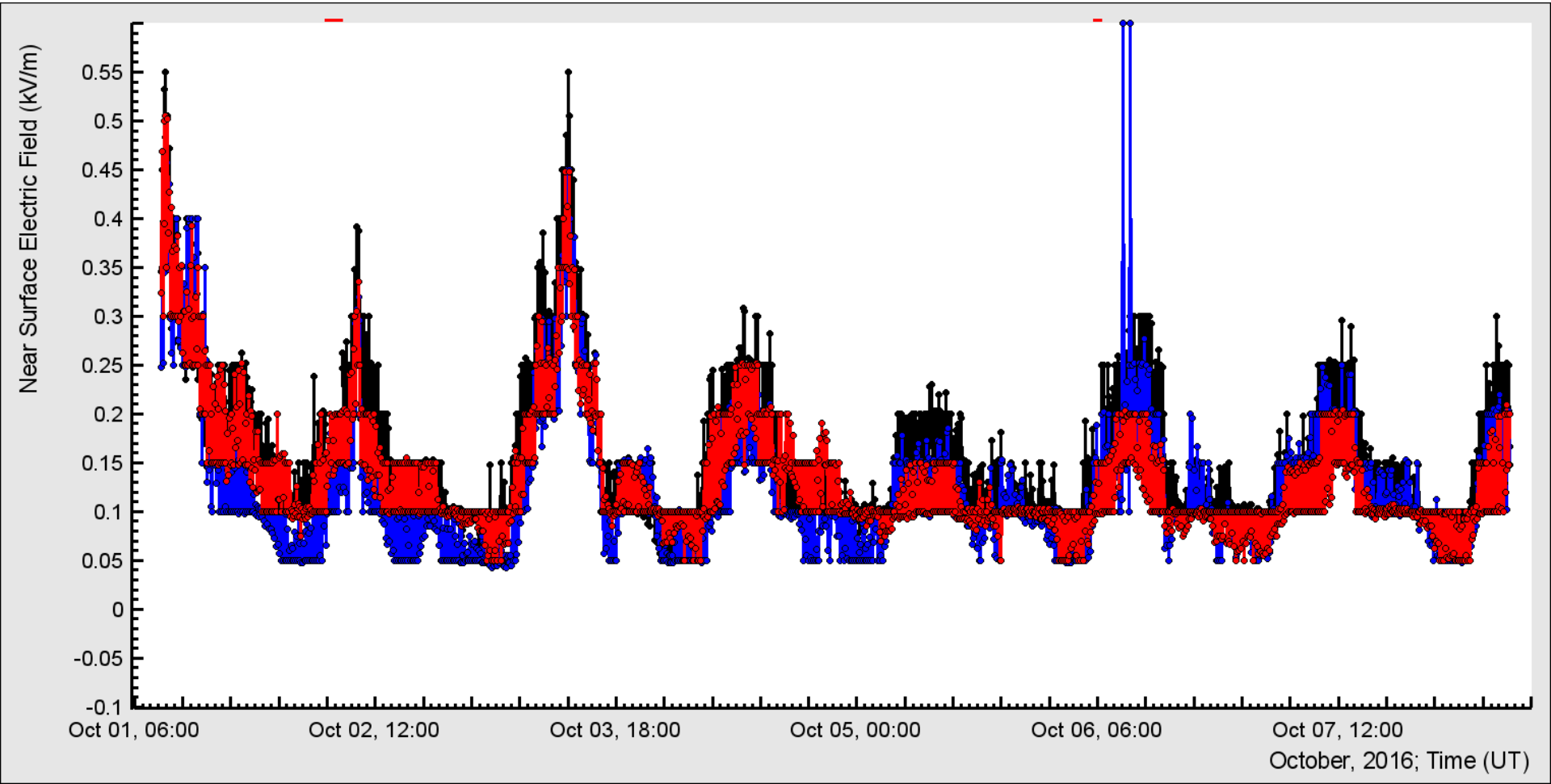
STAND 3cm: correlation analysis between 1100 and 1110 combinations;
these combination selects electrons/muons with different threshold energies.



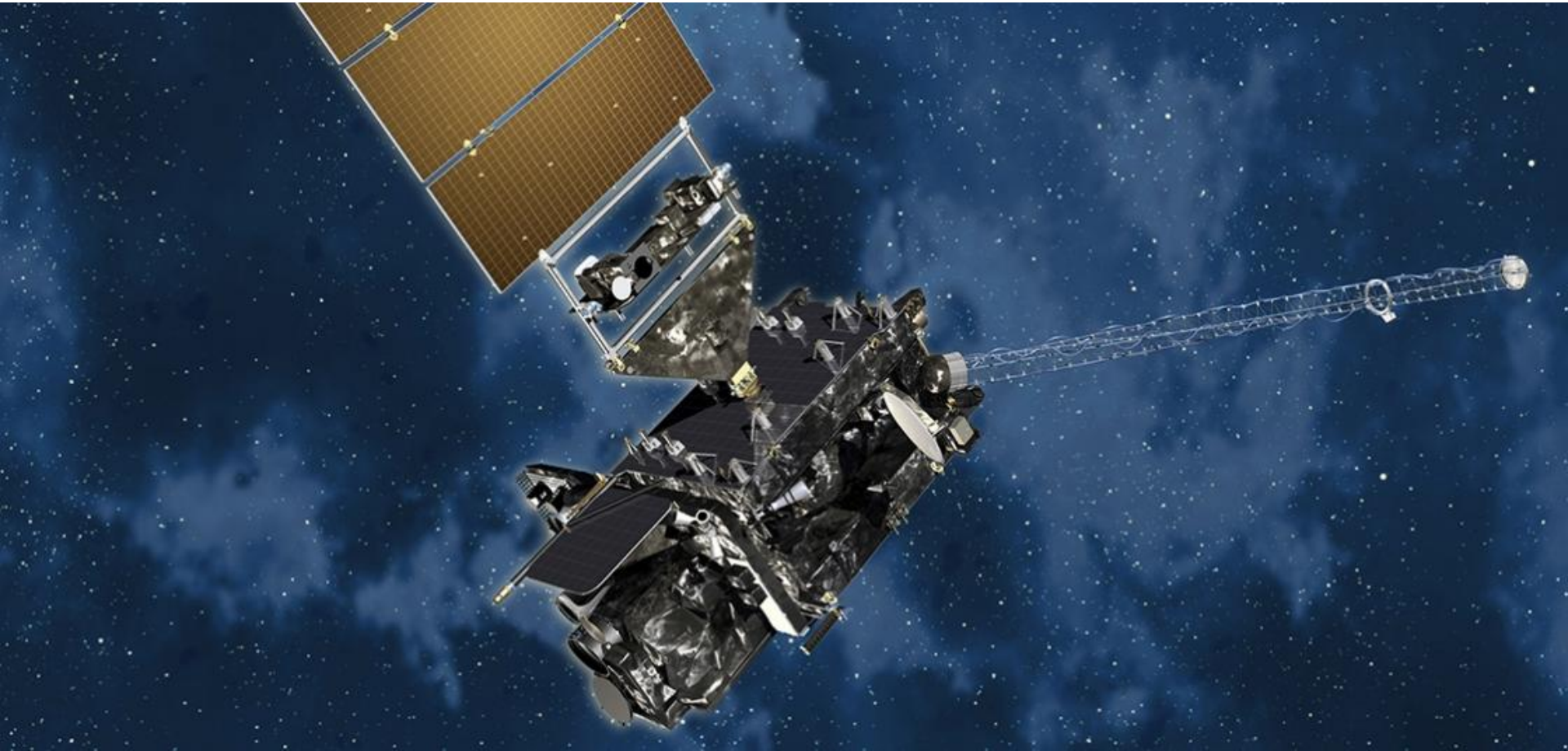
What is on the MAST?



MAKET, MAST, MONK; fair weather electrostatic field; no negative values; why periodicity?



First of NOAA's long-awaited, next-generation geostationary weather satellites launches into space, paving the way for faster, more accurate forecasts and warnings. The Geostationary Operational Environmental Satellite-R, known as GOES-R, is scheduled to launch Nov. 4 at approximately 5:40 p.m. EDT from Cape Canaveral, Florida, aboard an Atlas V 541 rocket.



GOES16- lightning imager (unfortunately only for Western Hemisphere)

- The new satellite can deliver vivid images of severe weather as often as every 30 seconds, scanning the Earth five times faster, with four times greater image resolution and using triple the number of spectral channels compared with today's other GOES spacecraft;
- GOES-R will fly in a geostationary orbit at the same rotational speed as the Earth, 22,300 miles above the equator;
- Once on orbit, the satellite will be known as GOES-16;
- Among GOES-R's six highly advanced instruments is the first operational lightning mapper in geostationary orbit, which will allow forecasters to track lightning over the entire hemisphere, almost instantaneously. This is important because intensification in lightning activity may indicate a storm is becoming increasingly severe;
- Currently weather forecasters can use lightning data provided by a surface-based network to help "nowcast" severe weather. This is a valuable tool; **however, it only has the capability of detecting cloud-to-ground flashes.** The GOES-R satellites will have the capability to detect both cloud-to-ground and inter-cloud lightning, through use of the Geostationary Lightning Mapper (GLM). This will help severe weather forecasters identify thunderstorms which are rapidly intensifying, and enable them to issue accurate and timely severe thunderstorm and tornado warnings.


GOES-R
NASA
GOES-R
NASA