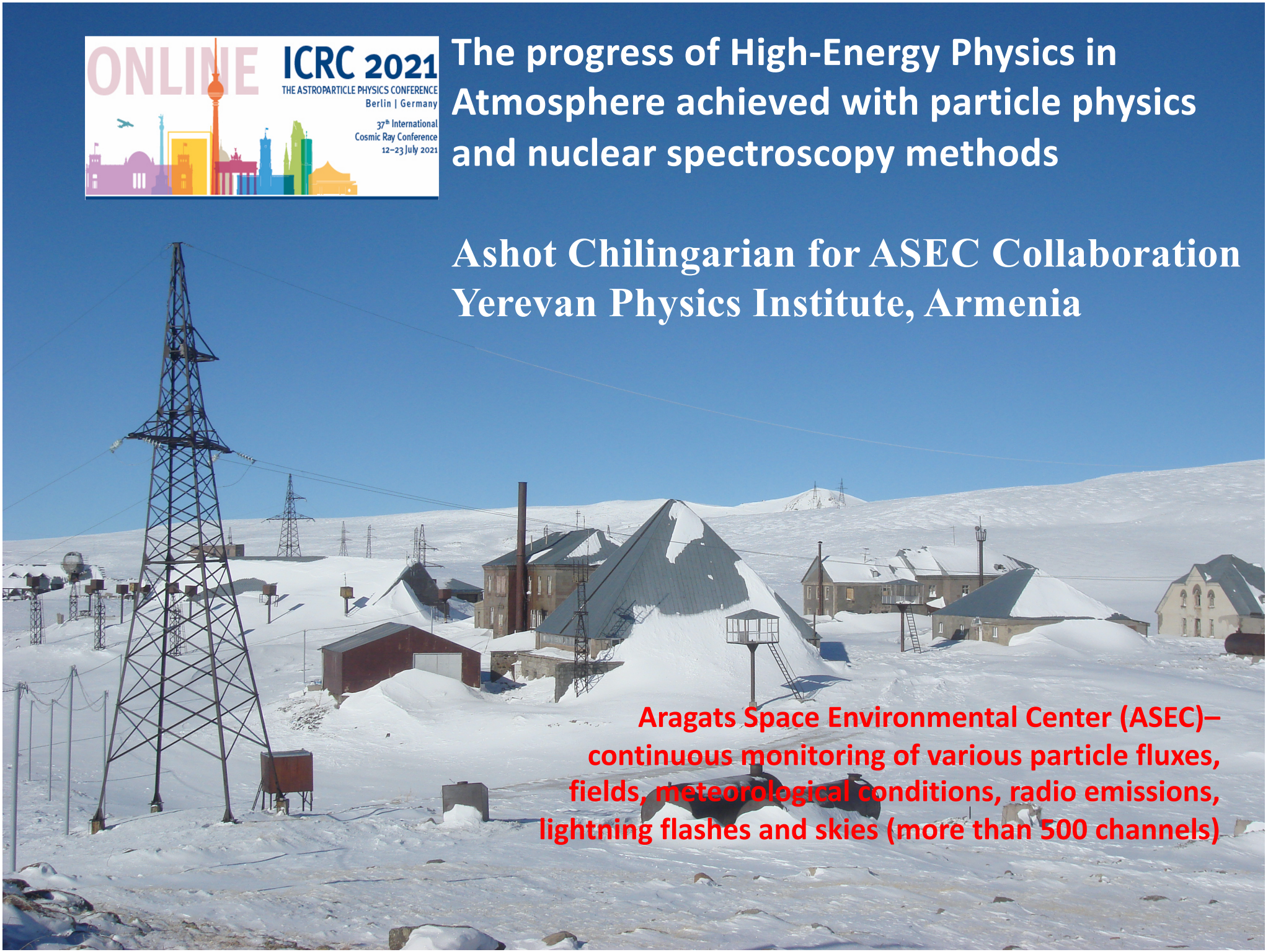
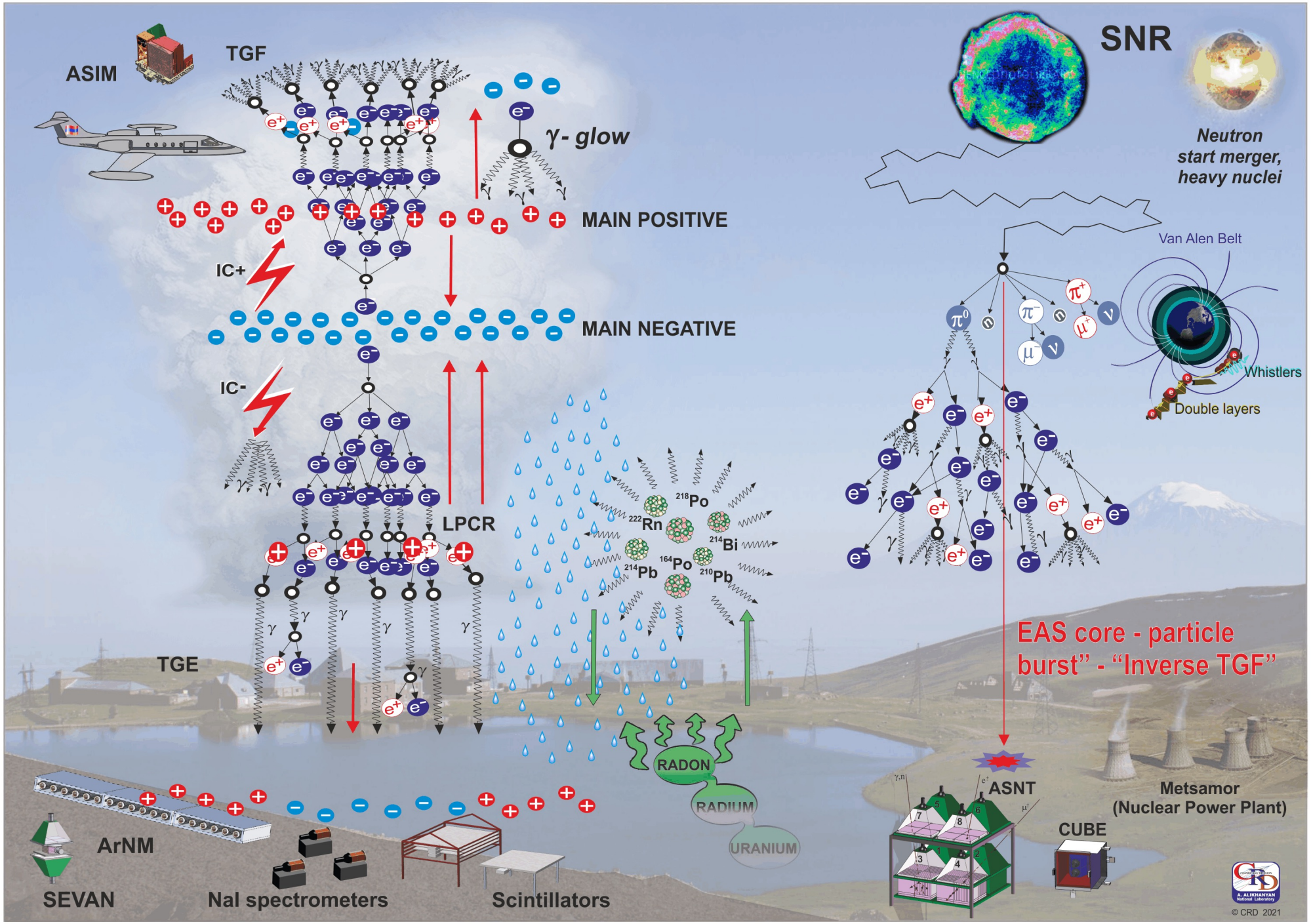


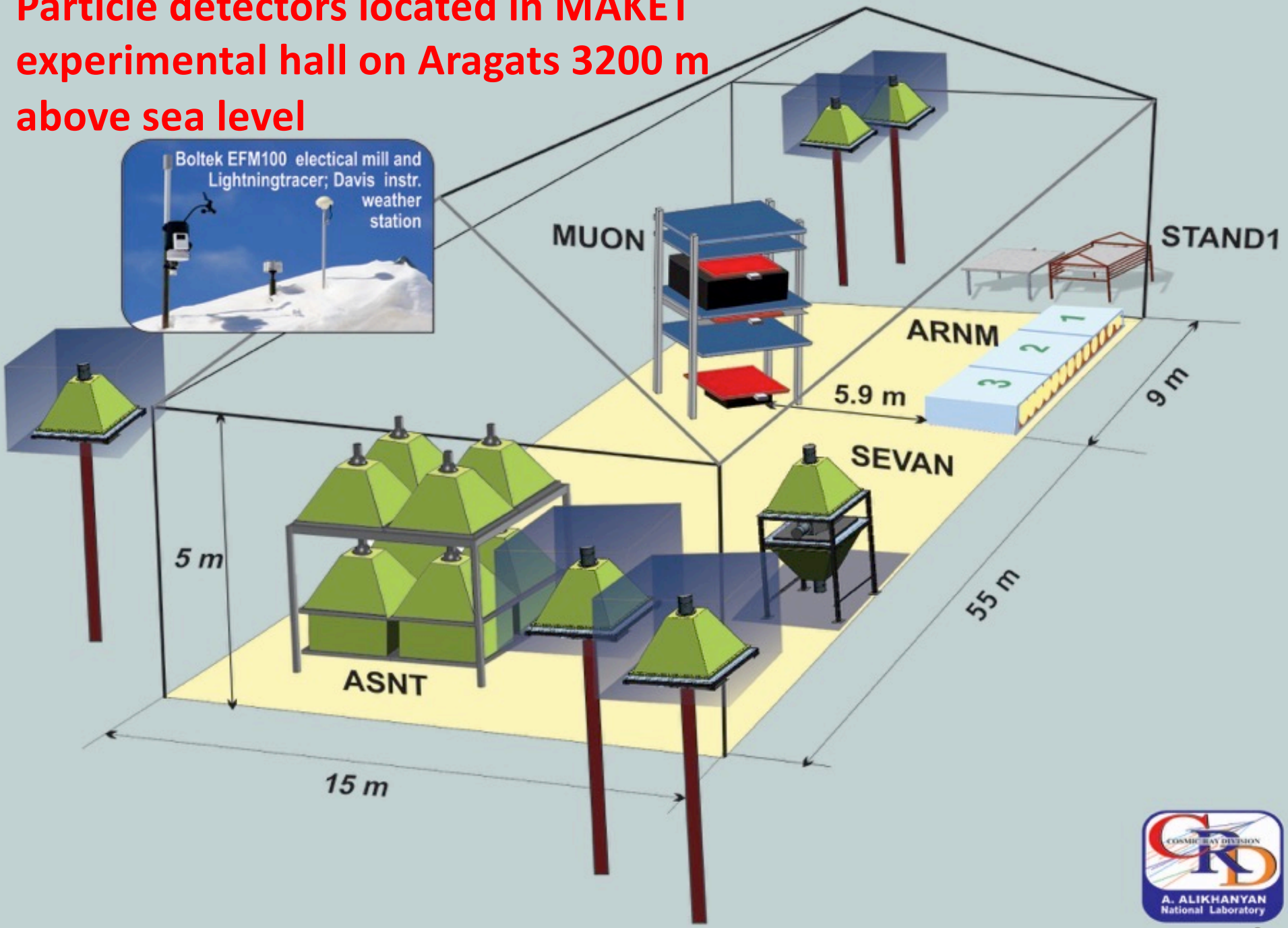
The progress of High-Energy Physics in Atmosphere achieved with particle physics and nuclear spectroscopy methods

Ashot Chilingarian for ASEC Collaboration
Yerevan Physics Institute, Armenia

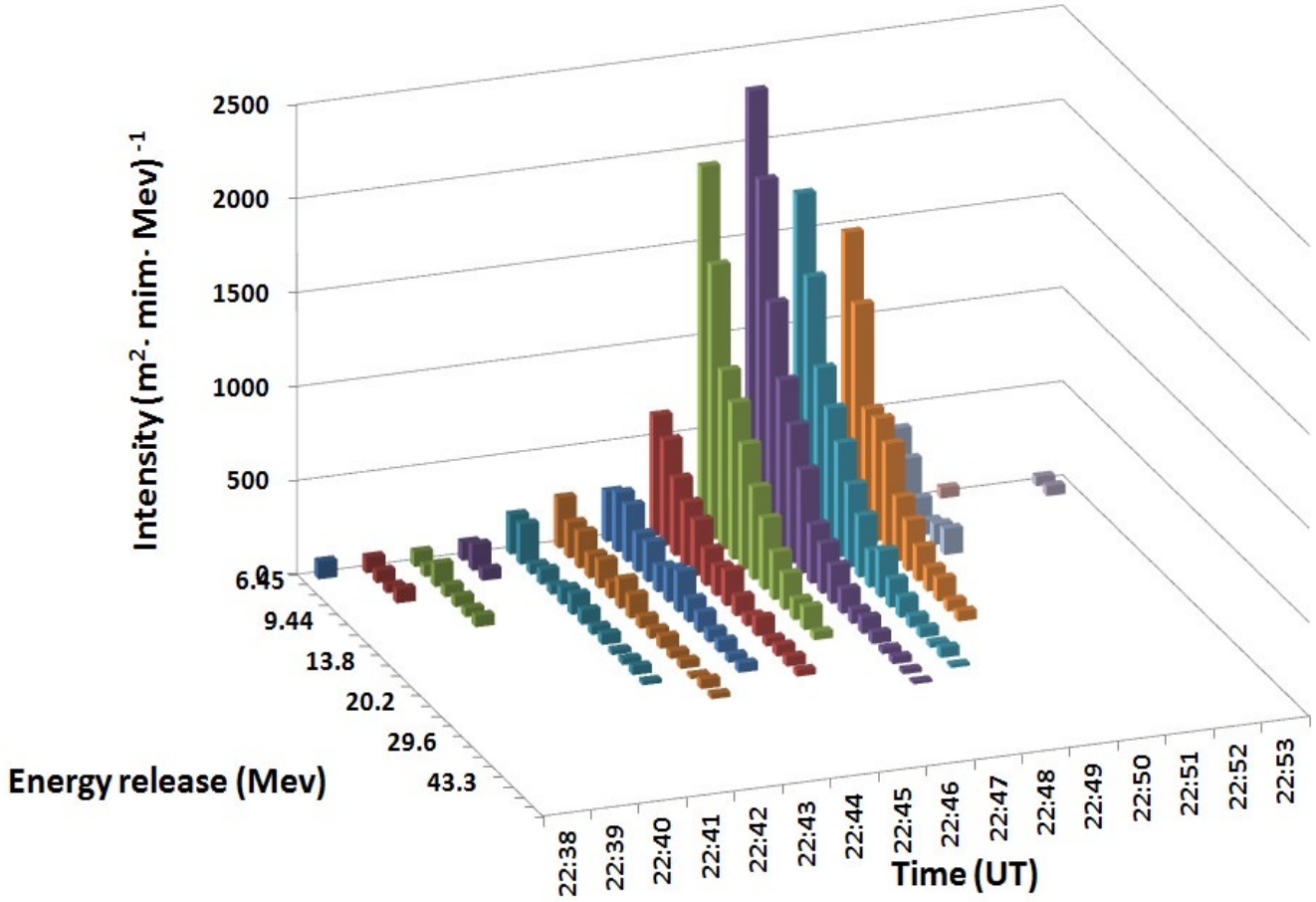
Aragats Space Environmental Center (ASEC)– continuous monitoring of various particle fluxes, fields, meteorological conditions, radio emissions, lightning flashes and skies (more than 500 channels)

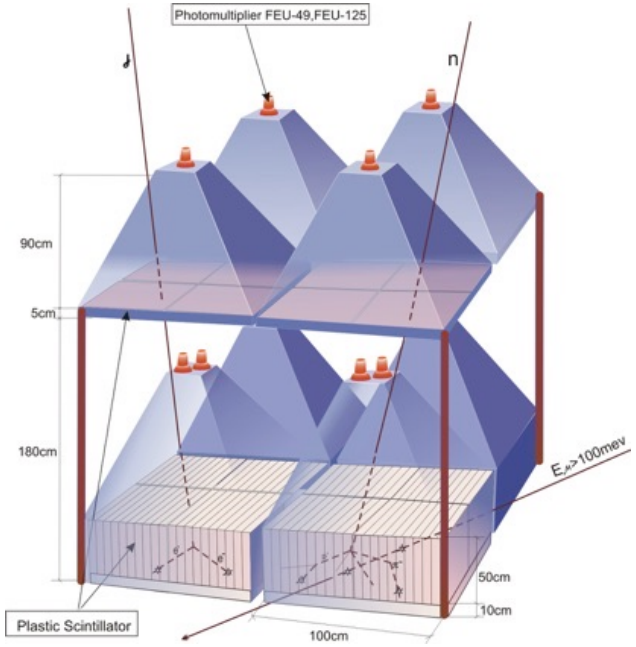

ASIM
TGF
γ- glow
MAIN POSITIVE
IC+
MAIN NEGATIVE
IC-
LPCR
TGE
^{218}Po
^{222}Rn
^{214}Bi
^{214}Pb
^{164}Po
^{210}Pb
RADON
RADIUM
URANIUM
ArNM
SEVAN
NaI spectrometers
Scintillators
SNR
Neutron start merger, heavy nuclei
Van Alen Belt
Whistlers
Double layers
EAS core - particle burst" - "Inverse TGF"
ASNT
CUBE
Metsamor (Nuclear Power Plant)
© CRD 2021

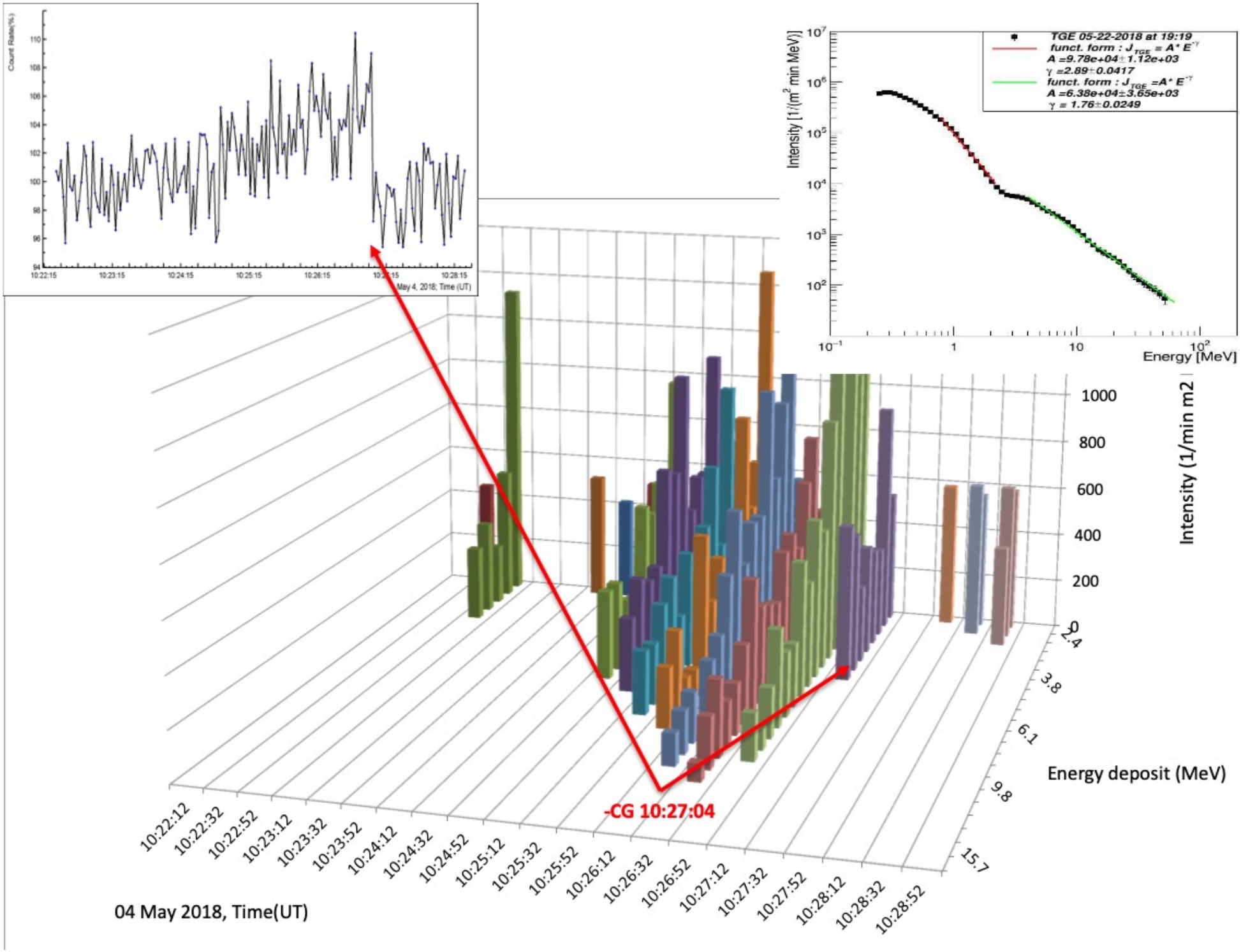
Particle detectors located in MAKET experimental hall on Aragats 3200 m above sea level



Energy release histogram of the TGE gamma rays obtained in 60 cm thick scintillators of the ASNT array; Largest ever TGE registered on 19 September 2009

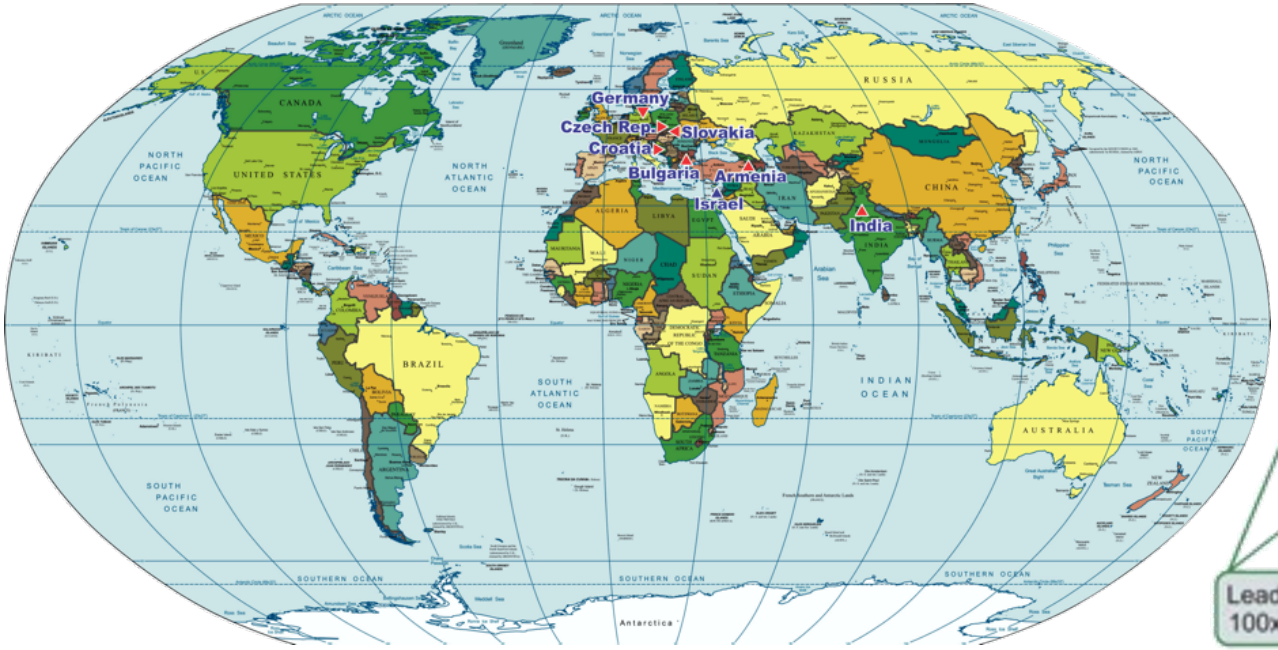


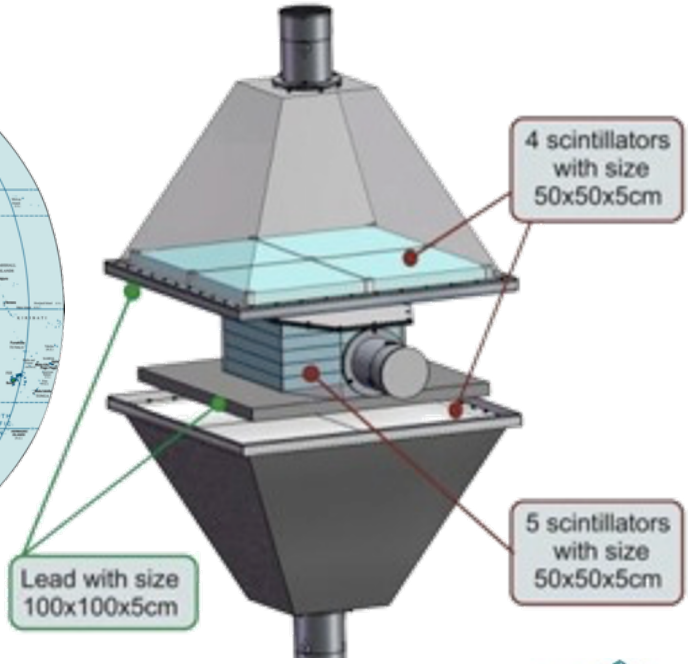



Count Rate(%)
May 4, 2018, Time (UT)
TGE 05-22-2018 at 19:19
funct. form : J_TGE = A* E^-γ
A =9.78e+04±1.12e+03
γ =2.89±0.0417
funct. form : J_TGE =A* E^-γ
A =6.38e+04±3.65e+03
γ = 1.76±0.0249
Intensity [1/(m² min MeV)]
Energy [MeV]
-CG 10:27:04
Intensity (1/min m2
Energy deposit (MeV)
04 May 2018, Time(UT)

Space Environmental Viewing and Analysis Network (SEVAN)

A network of middle to low latitude particle detectors called SEVAN (Space Environmental Viewing and Analysis Network) was accomplished in the framework of the International Heliophysical Year (IHY-2007), to improve fundamental research of the Solar accelerators and Space Weather conditions. The program of high-energy atmospheric physics with SEVAN network started in 2010.

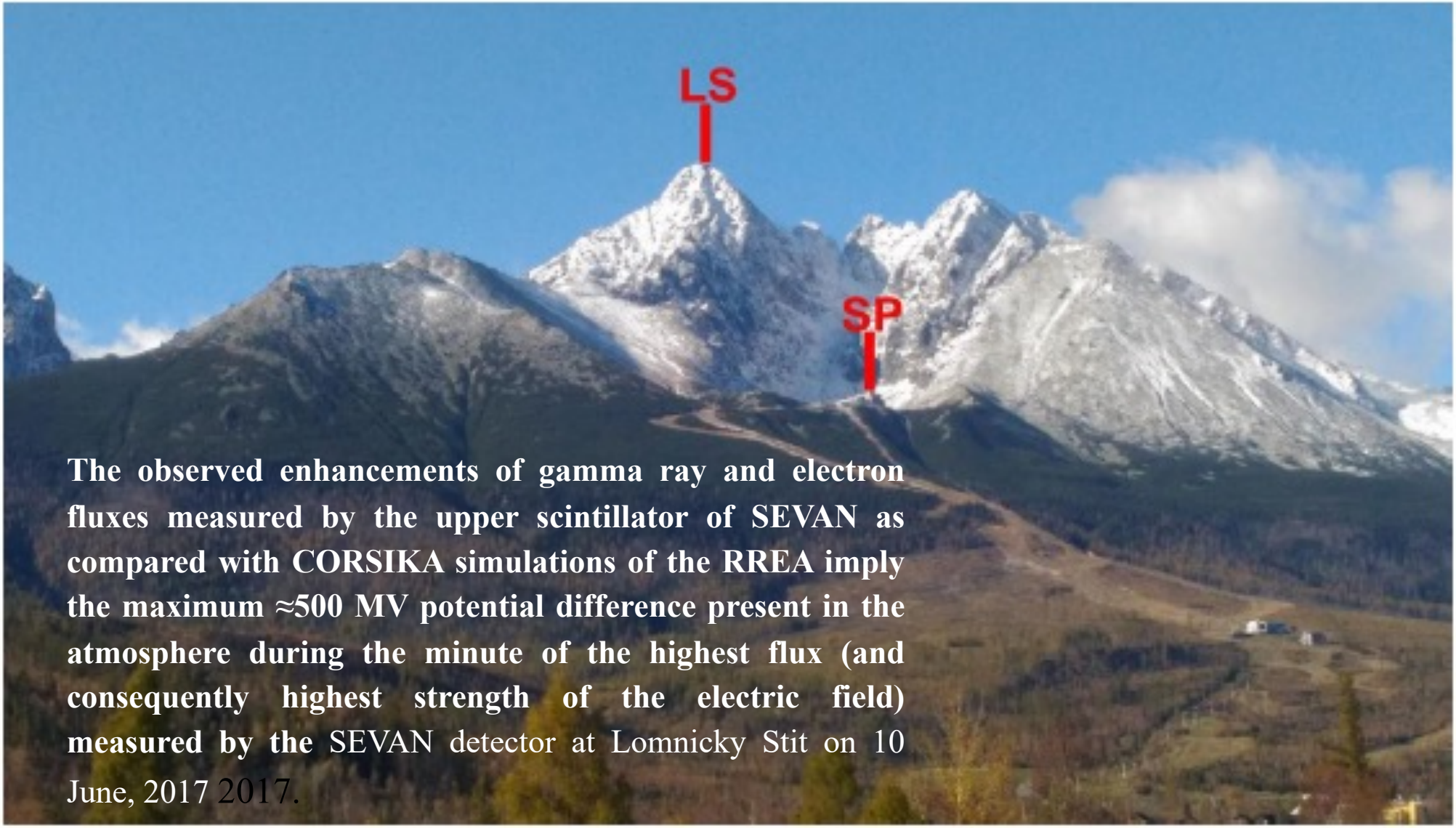




COSMIC RAY DIVISION
Alikhanyan Physics Institute,
Alikhanyan Brothers 2,
Yerevan 375036, Armenia

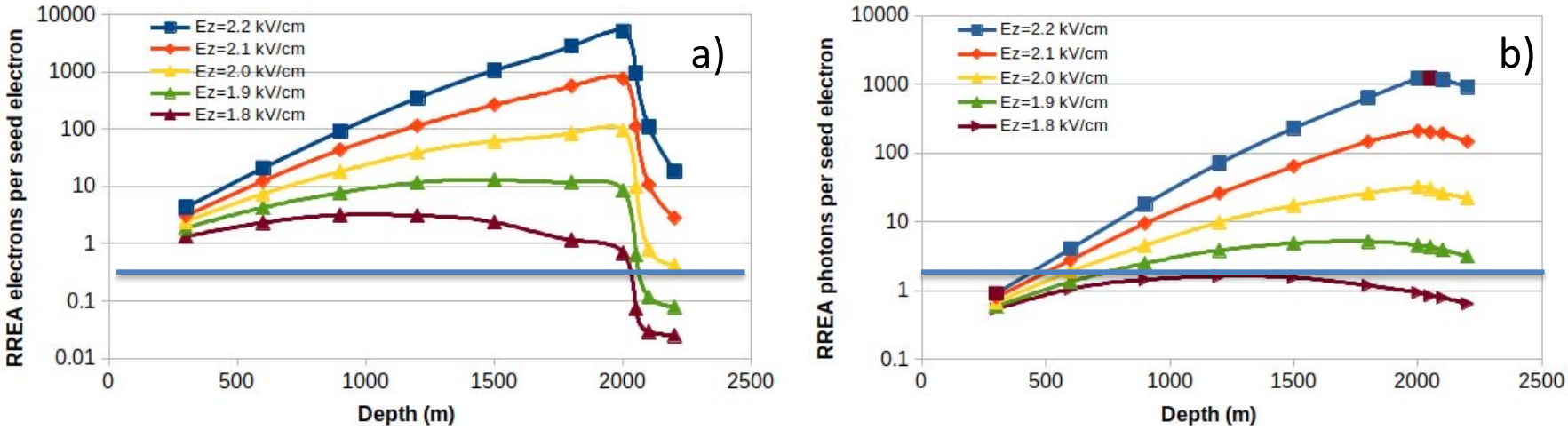
Installation of SEVAN module at entrance of DESY (Zeuthen)

Lomnický štít (LS) 49.1952 N 20.2131 E 2634 m



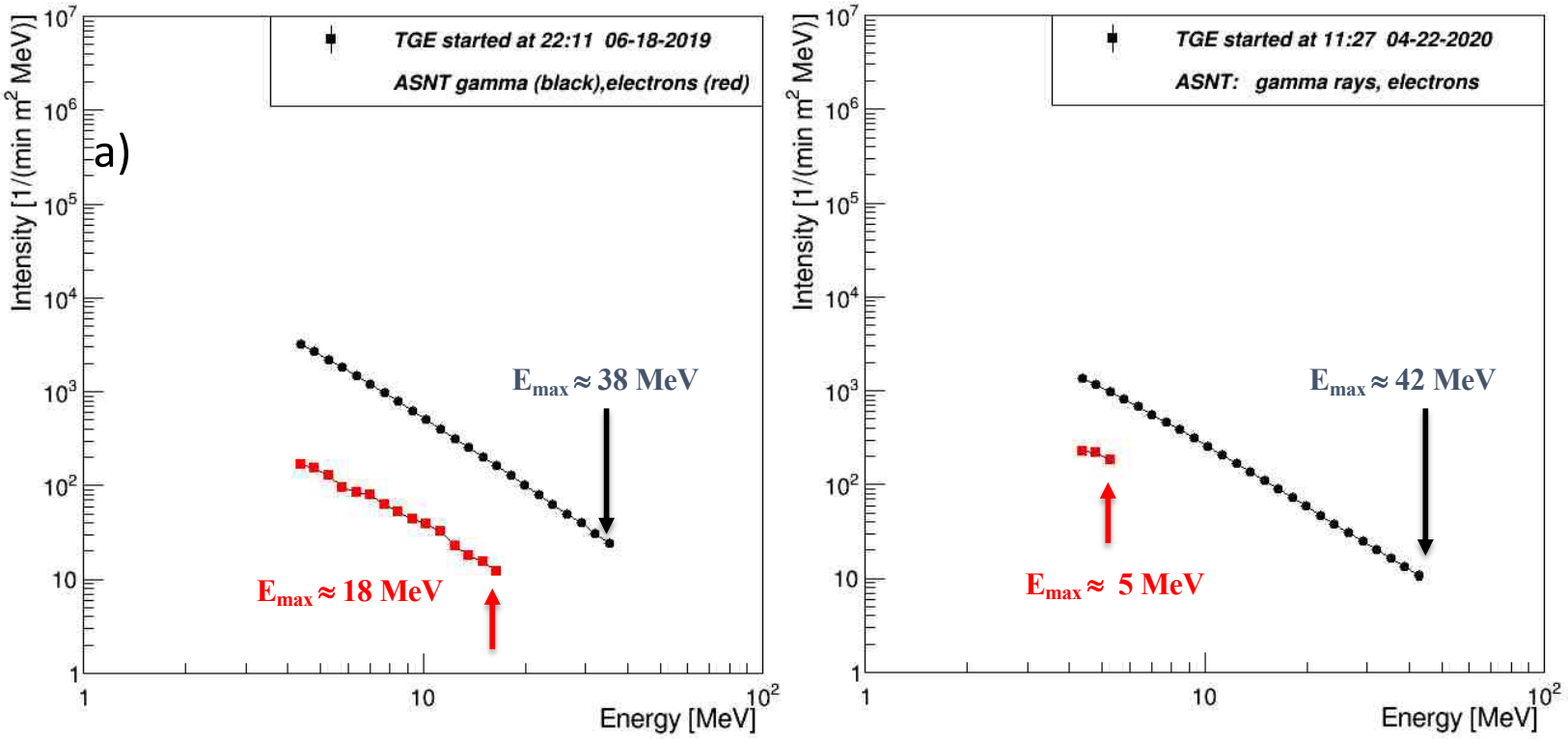
The observed enhancements of gamma ray and electron fluxes measured by the upper scintillator of SEVAN as compared with CORSIKA simulations of the RREA imply the maximum ≈500 MV potential difference present in the atmosphere during the minute of the highest flux (and consequently highest strength of the electric field) measured by the SEVAN detector at Lomnicky Stit on 10 June, 2017 2017.

Comparing measured TGE intensities with CORSIKA simulations



Avalanche started at 5400 m a.s.l. (0 depth), that is 2200 m above the Aragats station. The number of avalanche particles is calculated each 300 m. After exiting from the electric field propagation of avalanche particles is followed additionally 200 m before reaching the station. By blue line, we show the electron and gamma ray number per seed electron for the TGE that occurred on 14 June 2020.

The differential energy spectra of two TGE events of 2020 measured by ASNT spectrometer.



On 22 April the positive near-surface electric field lasting 4 minutes indicates the positive charge above, i.e., a mature LPCR that screened the negative charge of the MN layer. Thus, in contrast with the TGE that occurred on June 18, 2019, both MN-MIRR and MN-LPCR fields join to accelerate electrons in the direction of the earth's surface. Proceeding from the very low maximum energy of the electron energy spectrum (7 MeV compared with 40 MeV maximum energy of the gamma-ray flux) we conclude The electric field extends 100 m "deeper" than on 22 April, and electron flux attenuates much less than on 22 April.

Conclusion

High Energy Physics In Atmosphere (HEPA) get a mature state proving that cosmic rays are not only messengers that bring information on the largest accelerators in the Universe but also, by revealing the modulation effects that atmospheric electric fields pose on almost all species of secondary cosmic rays, on the cloud charged structure and overall on the climate change.