Web-based Platform for Data Analysis of Space Weather Observations

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Karlsruhe Institute of Technology

- Merger of Forschungszentrum Karlsruhe and Universität Karlsruhe
- Topics: RESEARCH – TEACHING – INNOVATION
- 25000 students
- 9,200 employees
- 360 professors
- 800 annual budget in Million Euros

Topics of the Collaboration with AANL 1997 – today (Artem Alikhanyan National Lab)

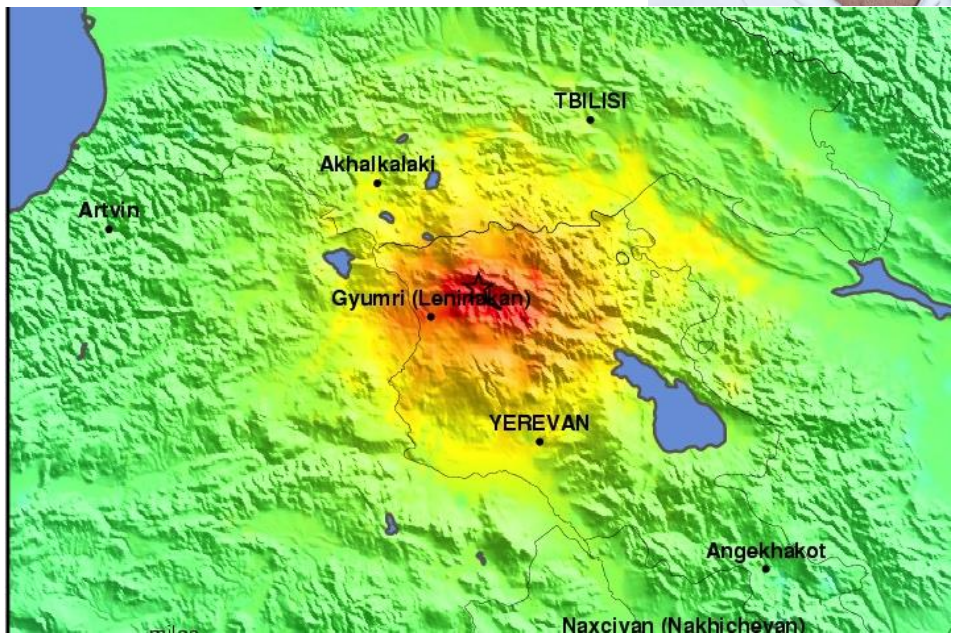
1. Analysis of cosmic ray air showers with neural networks
2. Space weather stations at Aragats:
   - Data acquisition and data analysis system and
   - setup of an international network
3. Lightning and cosmic rays, partly a chicken and egg problem ?

History of Armenian - German collaboration on cosmic ray physics

7.12.1988 Spitak earthquake
1985–1991 Decay of Sowjet-Union

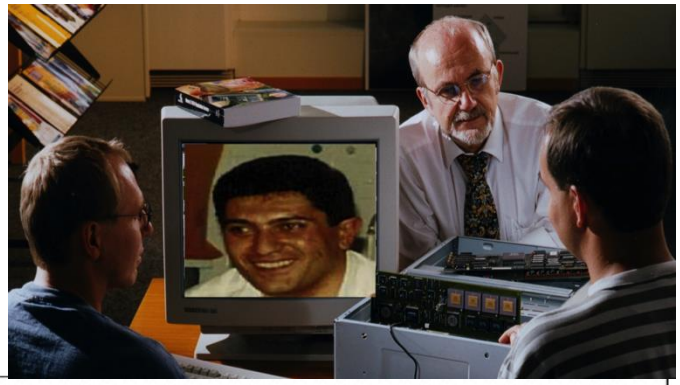
1993 Dr. Ashot Chilingarian
Head of Cosmic Ray Physics

Joint projects:
ISTC A116, “The Development and Implementation of Applied Neural Information Technologies”, 1997-1999.
ISTC A1058 “Development of a Prototype Detector System for Space Weather Monitoring and Forecasting World-Wide Network ”, 2004-2007.
NATO Grant N 975436, “Computer network for real-time data transfer using wireless connections”,1999-2001.
NATO Grant N 975954, “Construction of reliable data acquisition system for modern Astroparticle Physics experiments”, 1999-2001.

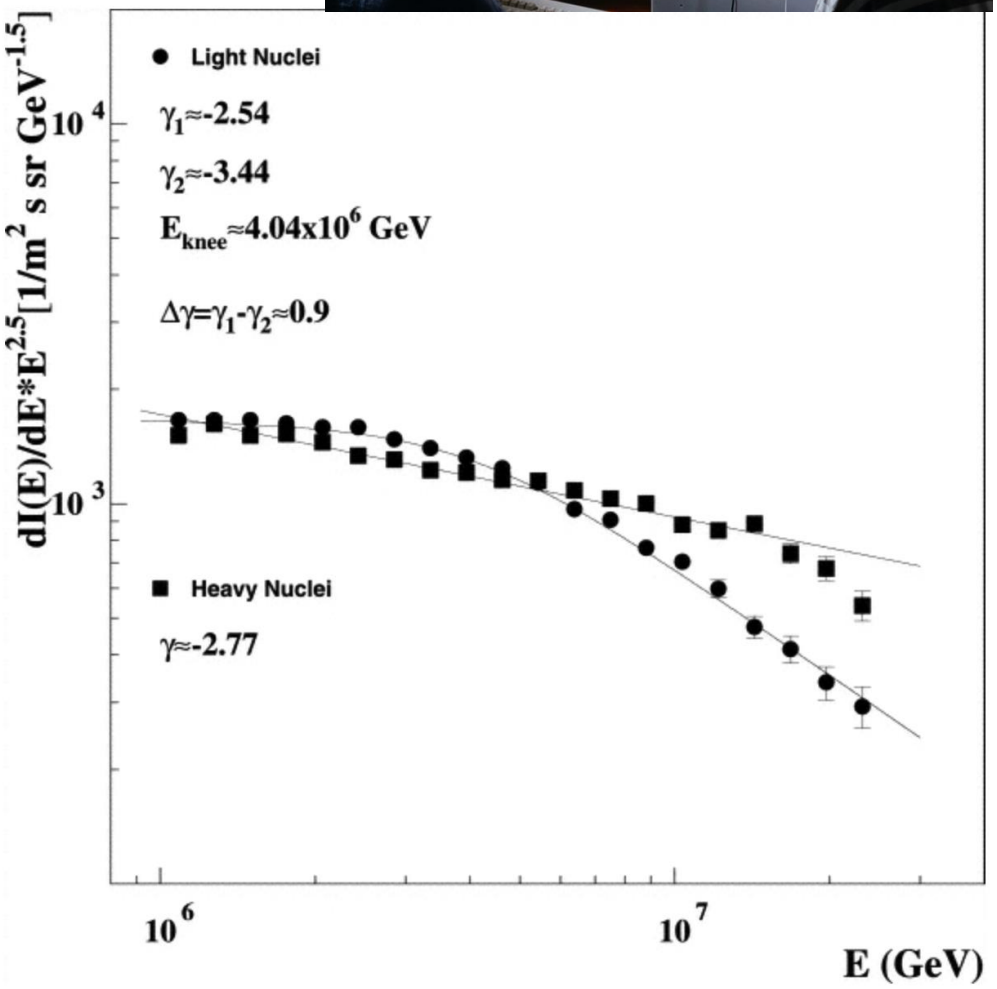


WTZ ARM, “Anwendung neuronaler Netze”, 1997-1999
WTZ ADEI, “Web-based Data Analysis Platform for Space Weather Observations” , 2014-2015

1. Neural Networks for the analysis of cosmic rays

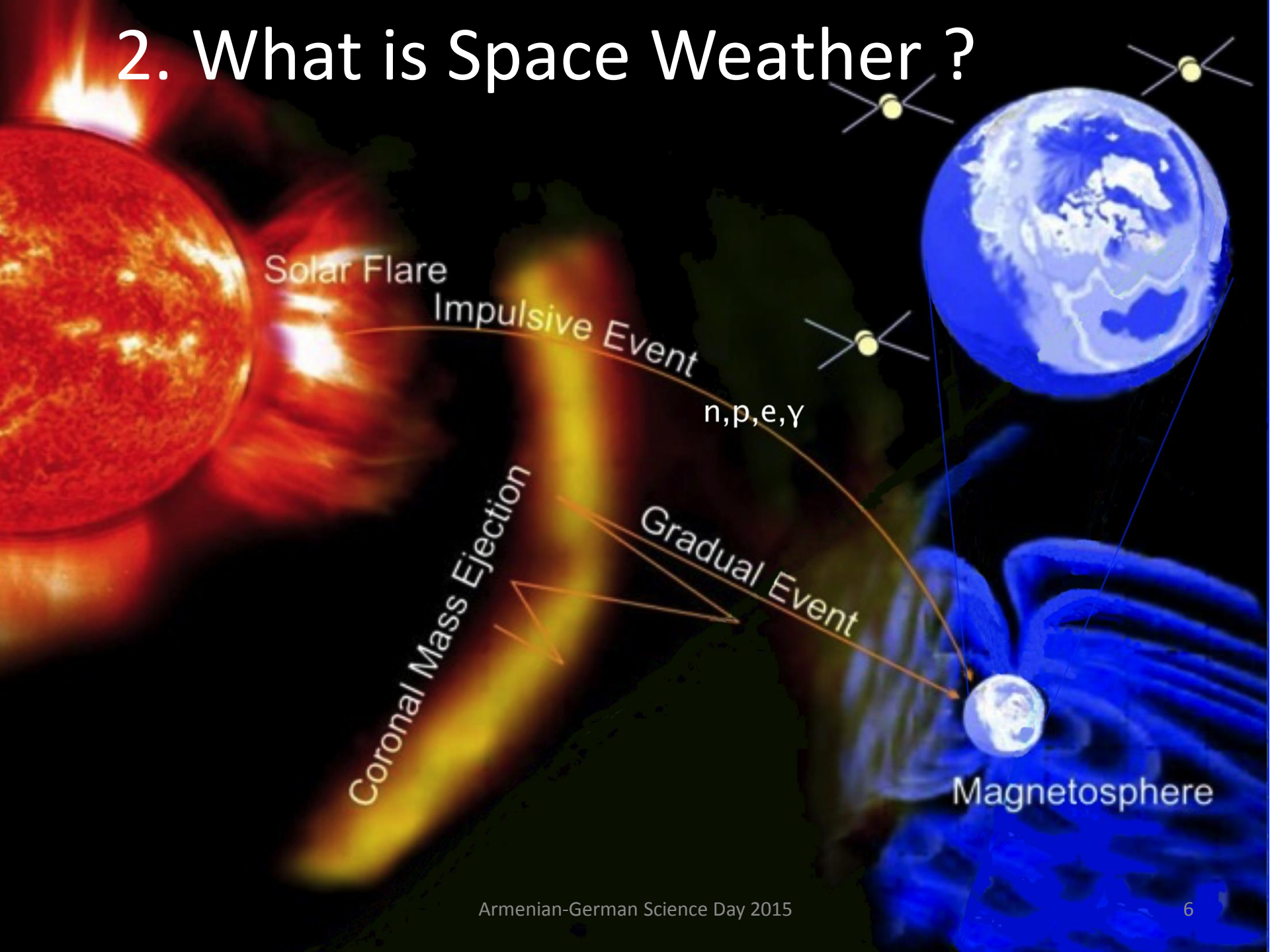


- Discovery of the mass-dependent position of the knee in cosmic ray spectra:
  - By use of neural networks
  - Experiment with MAKET-ANI detectors at Aragats

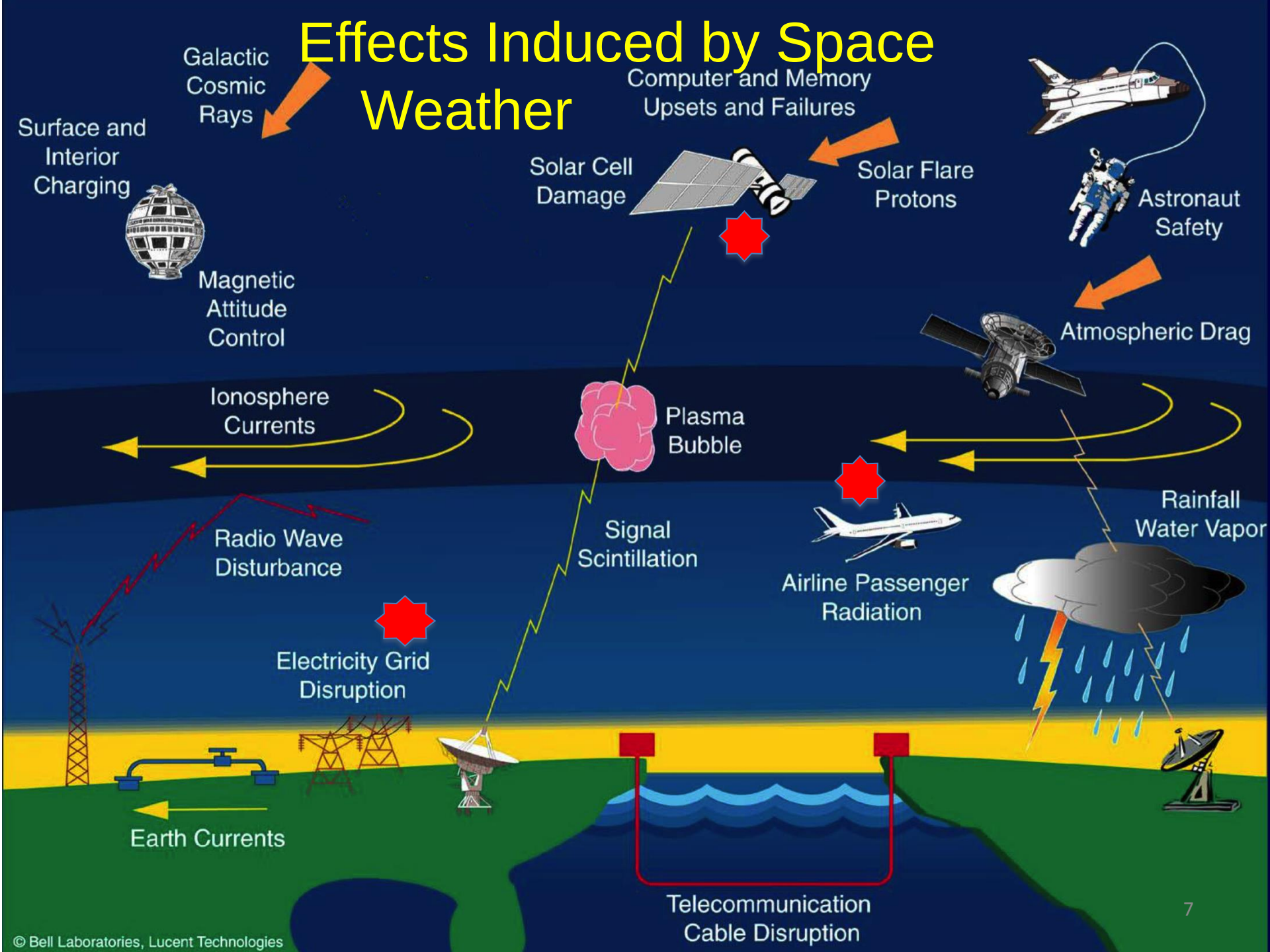


A. Chilingarian, G. Gharagyozyan, G. Hovsepyan, S. Ghazaryan, L. Melkumyan, and A. Vardanyan, Light and Heavy Cosmic-Ray Mass Group Energy Spectra as Measured by the MAKET-ANI Detector, The Astrophysical Journal Letters, Volume 603, Issue Number 1

2. What is Space Weather ?

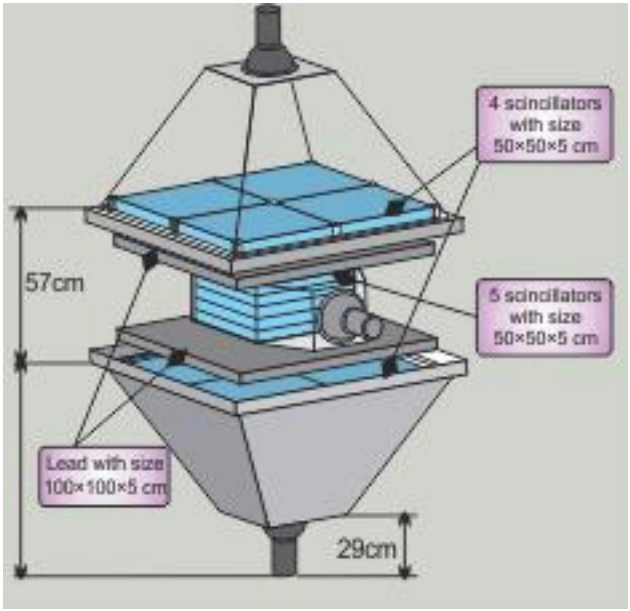


Effects Induced by Space Weather



Protection against Space Weather -> early warning

- First Neutrons (up to GeV) may get from a solar flair on a direct path to the earth in 7 min
- Main shock-wave of protons and electrons is delayed by 30 min (deflected by magnetic field of earth and lower energy)
- -> Network of solar n-detectors* around the earth for early warning Space Environmental Viewing and Analysis Network (**SEVAN**)

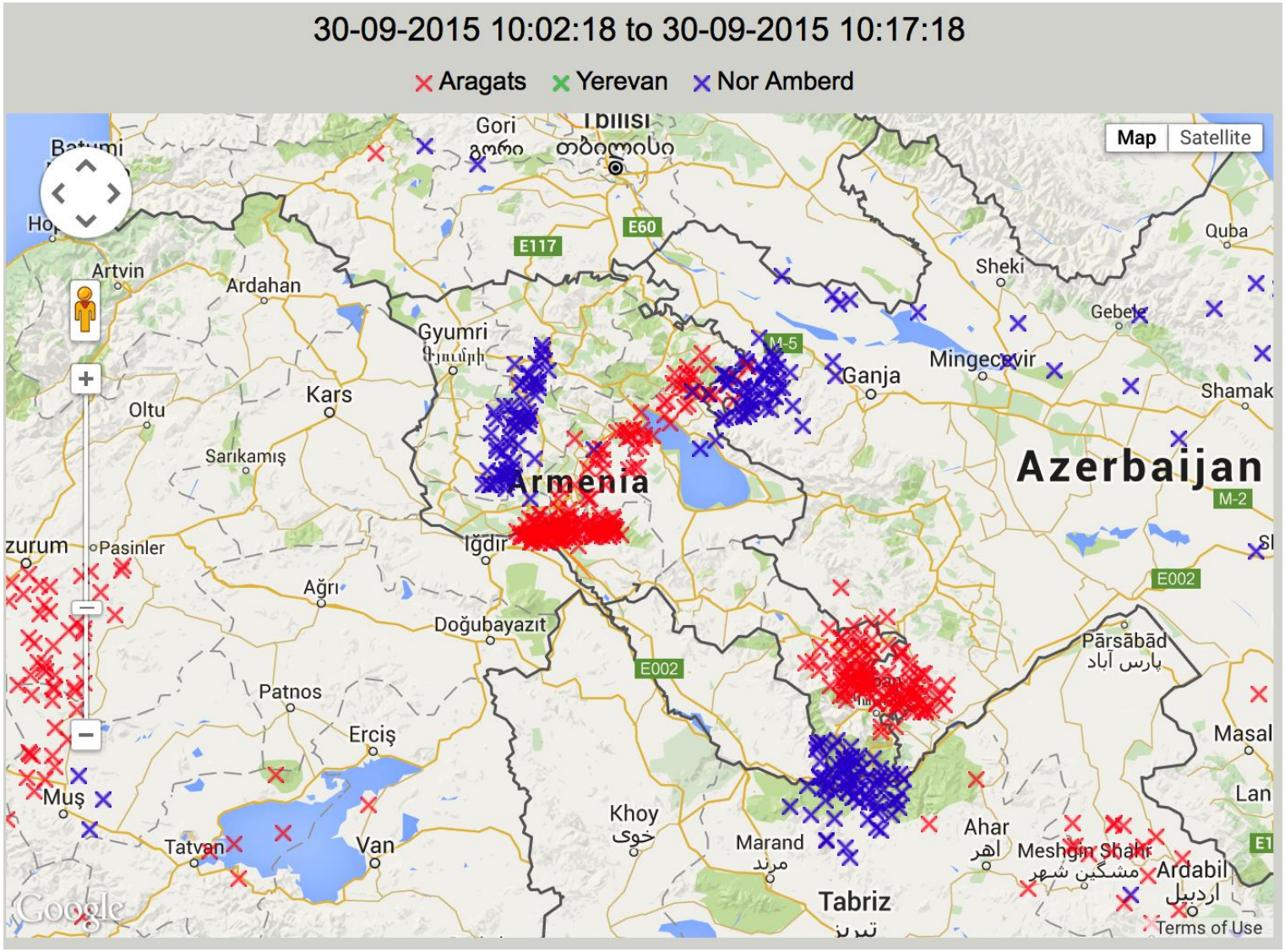


Data acquisition Networks

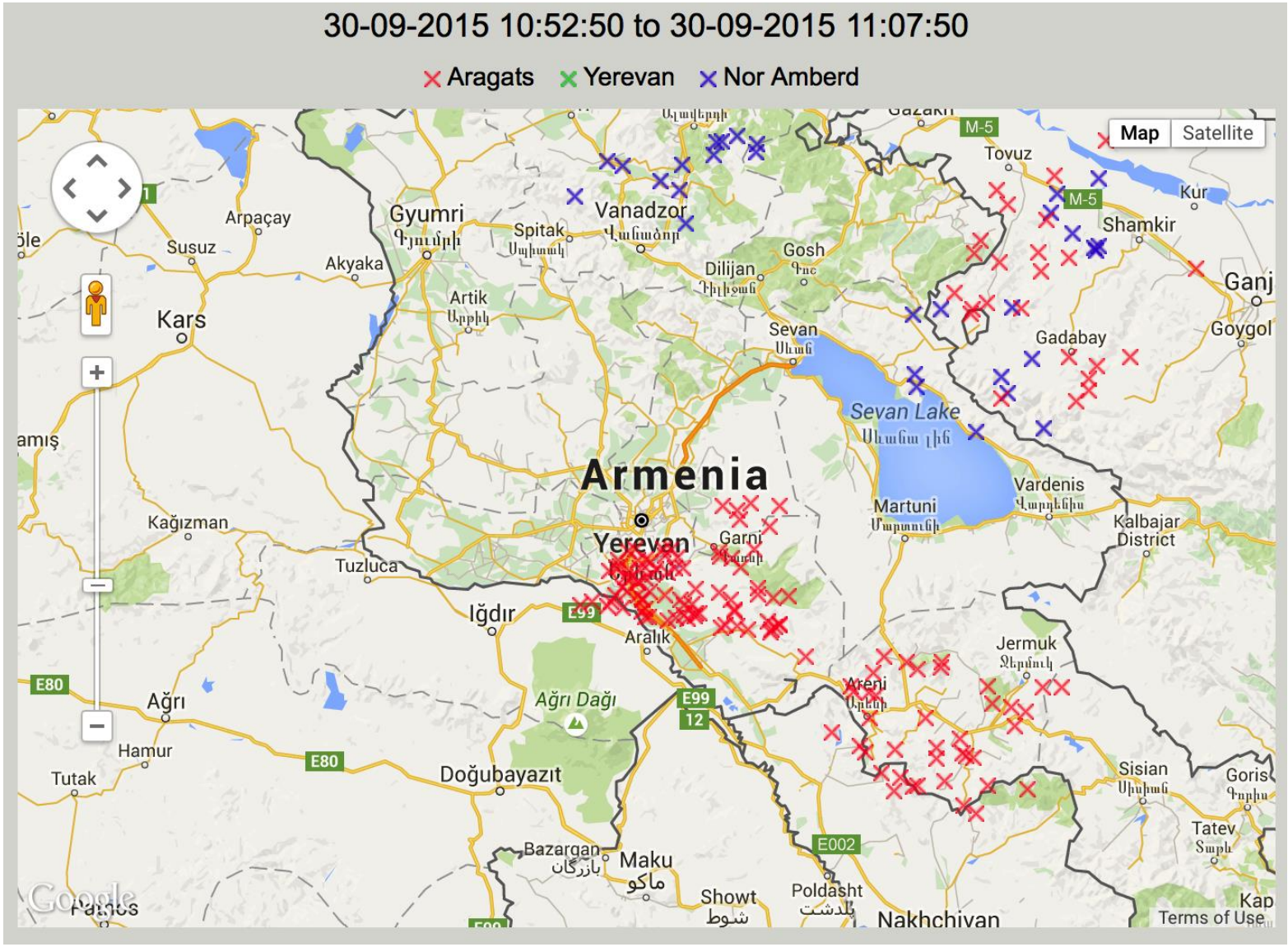
- SEVAN centered around Aragats Space Environmental Center (**ASEC**) further nodes in India, Bulgaria, Croatia and Slovakia. Equipped with
  - various particle detectors,
  - field meters for geomagnetic and electrical fields,
  - meteorological stations,
  - and lightning detectors.

- **S. Chilingaryan**, A.Chilingarian, V.Danielyan, W.Eppler, **Advanced data acquisition system for SEVAN**, *J. Phys.: Conf. Ser.,* Volume: 43, pp. 717-720
- K.Arakelyan, S.Abovyan, A.Avetisyan, A.Chilingarian, **S.Chilingaryan**, V.Danielyan, D.Pokhsraryan, **New electronics for the Aragats Space-Environmental Center (ASEC) Particle Detectors,** Proc. of Int. Symp. FORGES 2008, Nor Amberd, Armenia, Tigran Mets, 2009, pp. 105-115

Example of lightning detection:

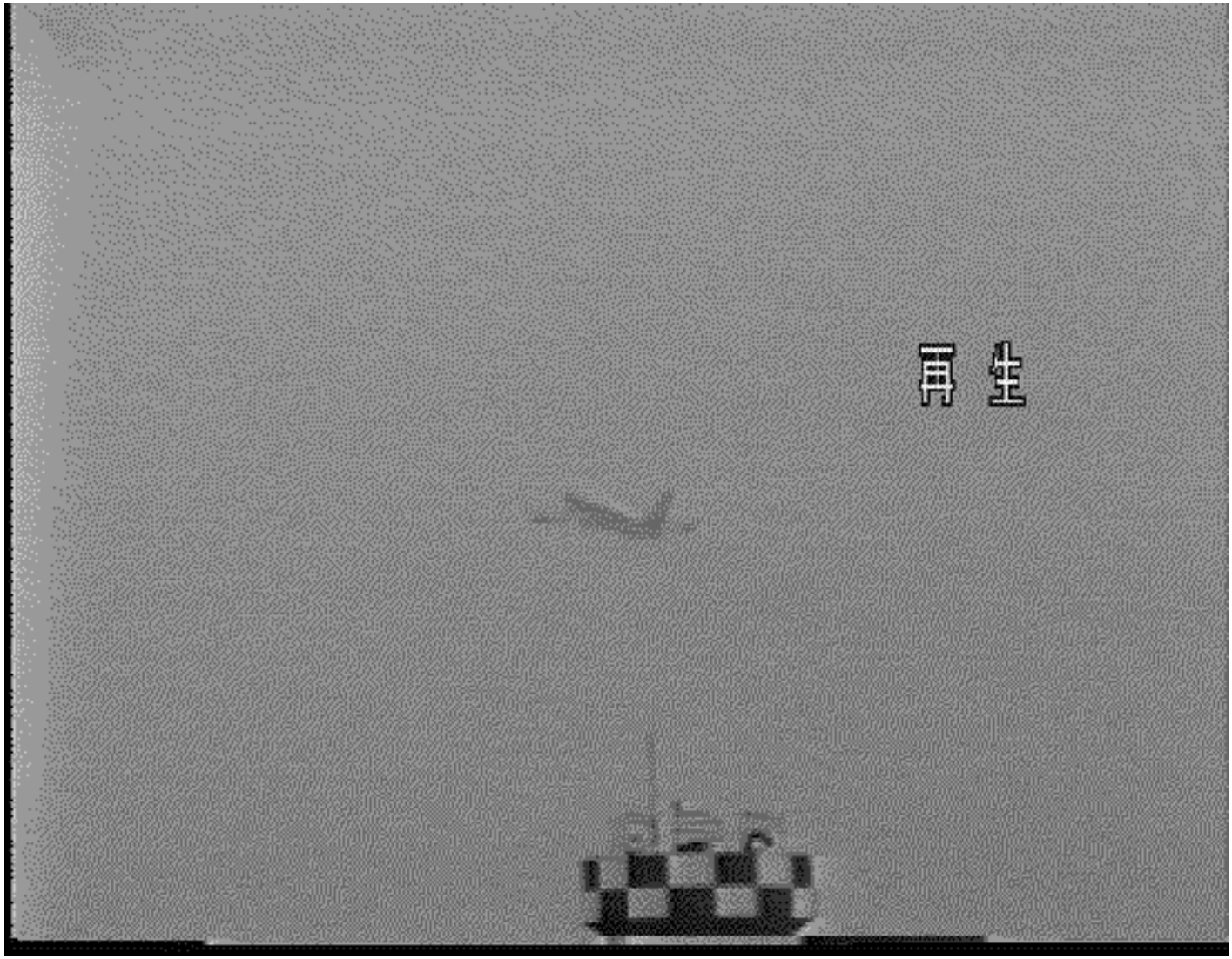


And half an hour later:

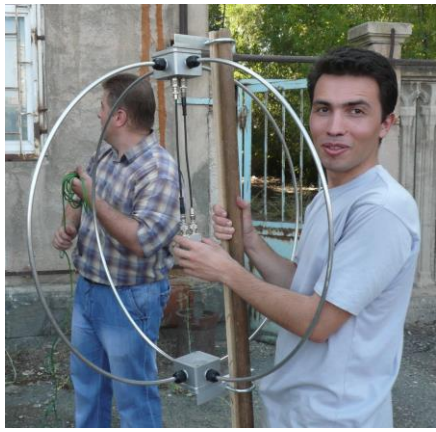


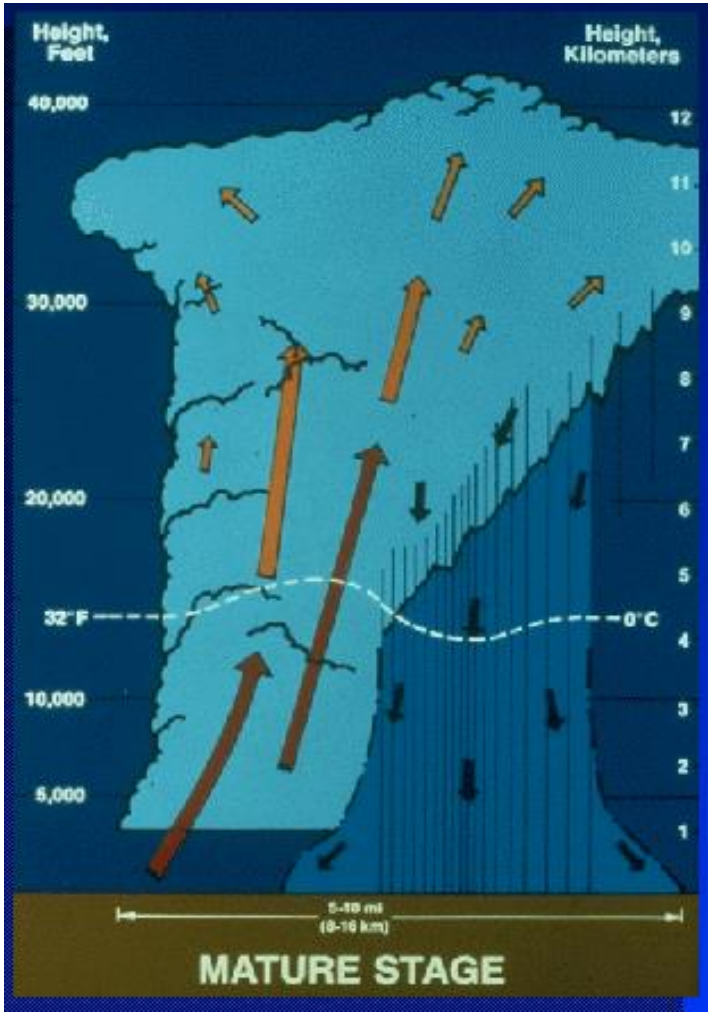
3. lightning and cosmic rays …

That happens not so often



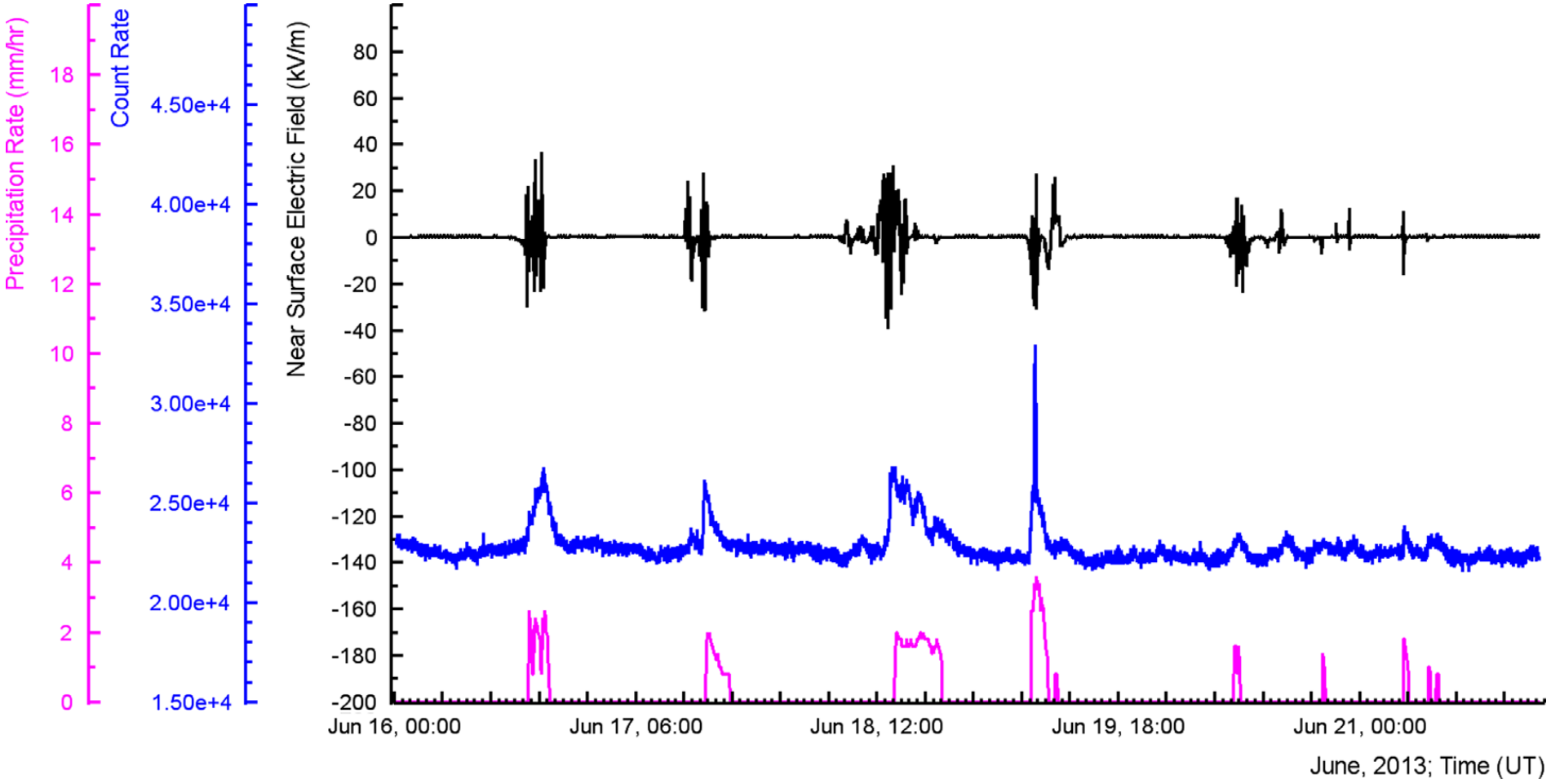
What creates a thundercloud?





- It depends on the rate at which the surrounding air gets colder with altitude.
- If the rate is large the updraft and charge-up is very fast.
- But that is only a small part of the story.
- cosmic ray starts lightning and/or high electric fields in the clouds induce particle fluxes and lightning …

Thunderstorm ground enhancements of cosmic rays and its kill by lightning



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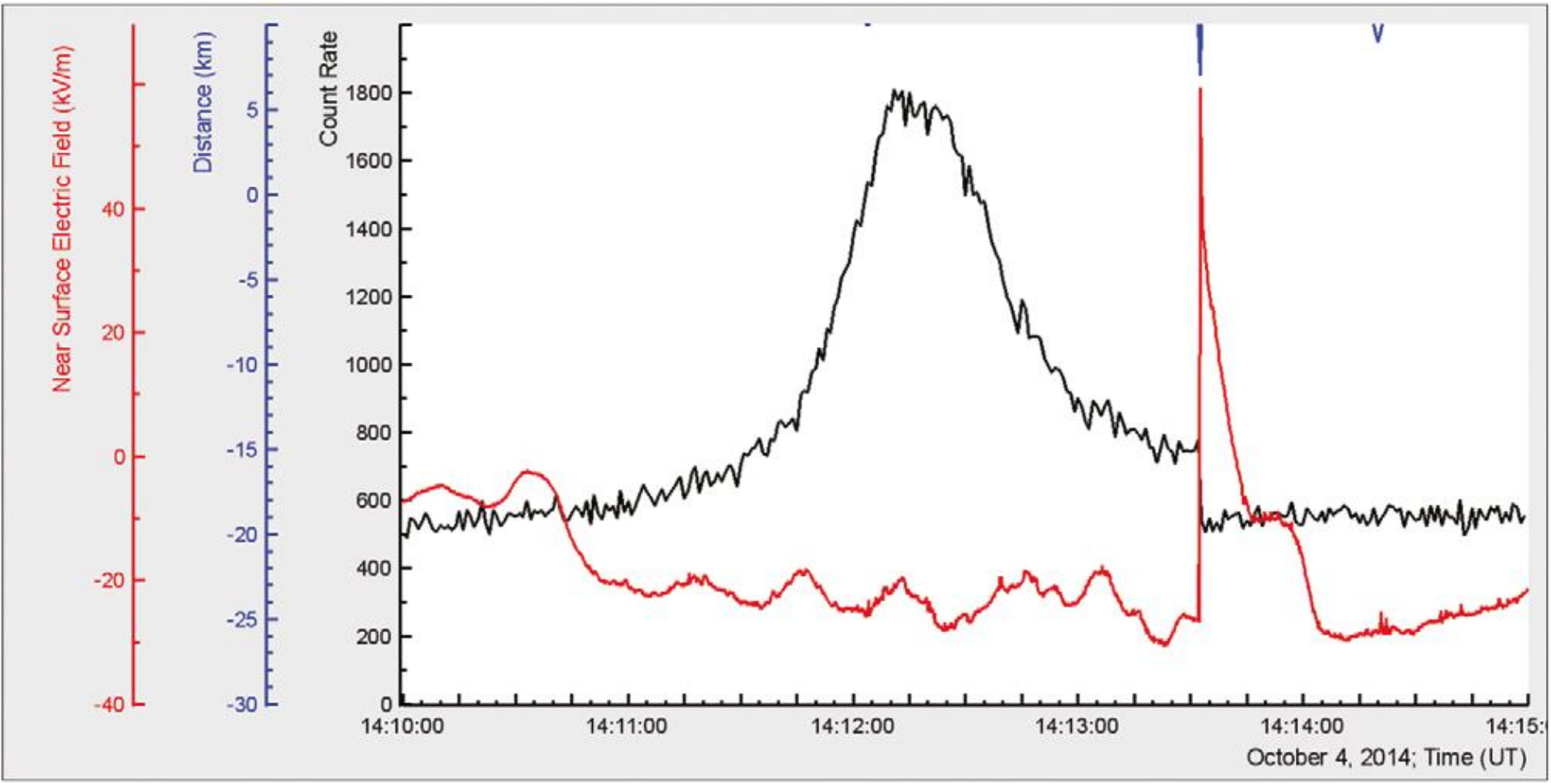


WEB-based Data Analysis Platform for Space Weather Observations

1. Upgrade of Aragats Space Environmental System (ASEC) with Advanced Data Extraction Infrastructure (ADEI)
2. Upgrade of ADEI to allow correlation studies and special analysis tasks -> to understand lightning

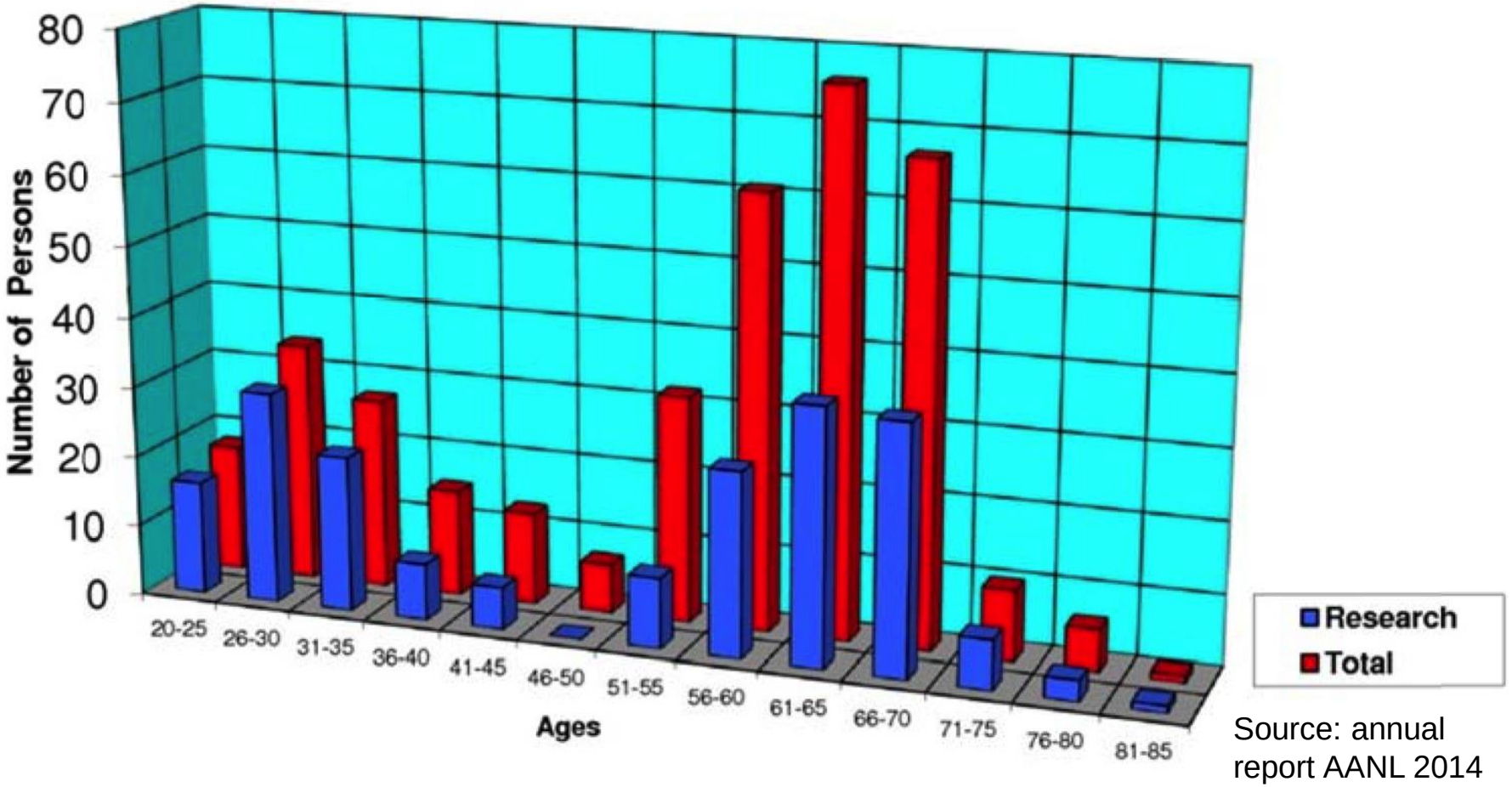
Successful work and exchange of Students!!!

Try it: http://www.crd.yerphi.am/ADEI

But I see also a problem for the future:

Age structure of AANL

- Dangerous age gap between 35 and 55
- also at University?

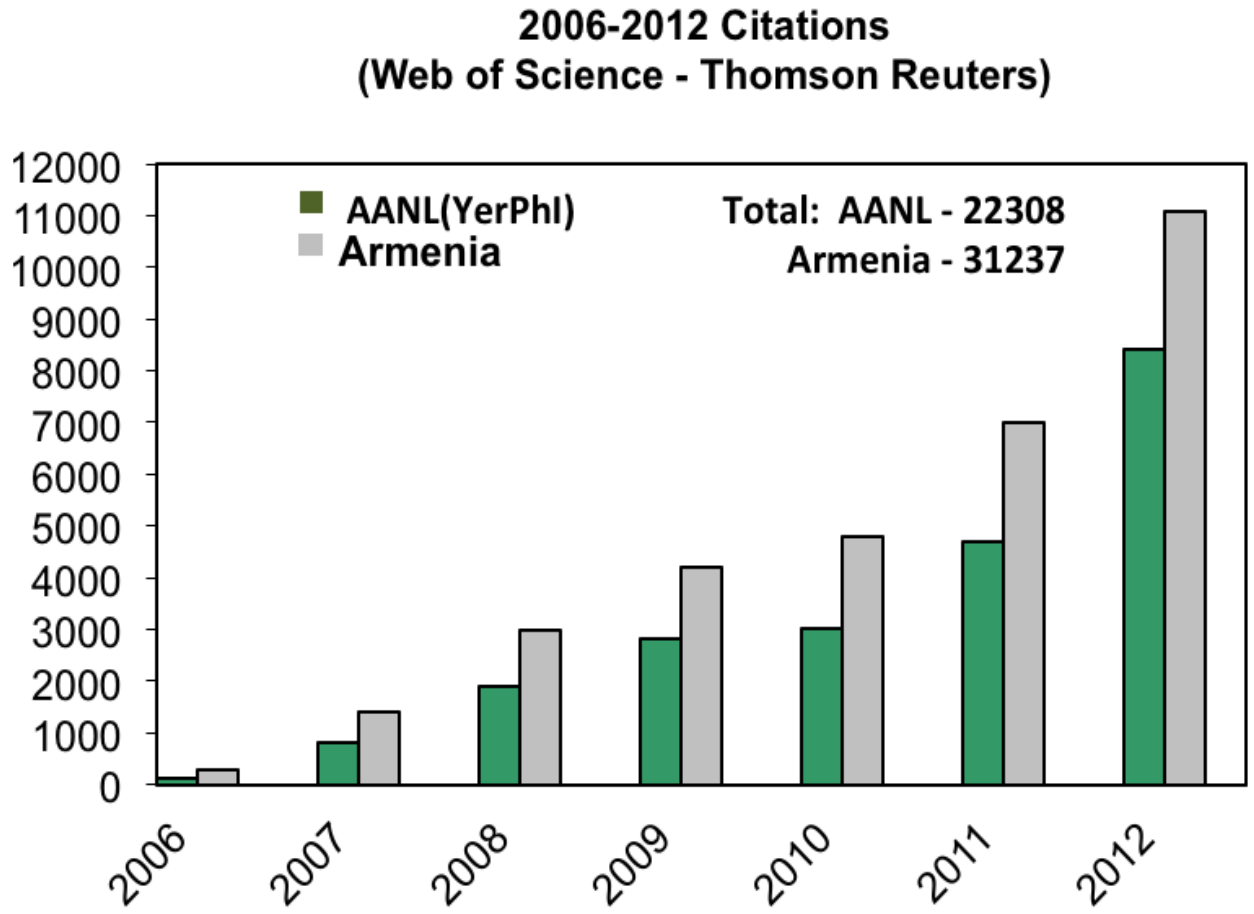


Source: annual report AANL 2014

Exists a simple & fast cure for the age problem?

- **No**
- But on long term unavoidable or …?!
  Some ideas:
  - Recognize the problem
  - Promotion of science in school and university
  - Scoring of the lecturer by the students
  - financial support of very good pupils and students
  - Excellence program for students
  - Excellence program to keep scientists
  - Money to “buy” some of the scientists back

But I found also something very positive: AANL has 71% of all citations of Armenia in science

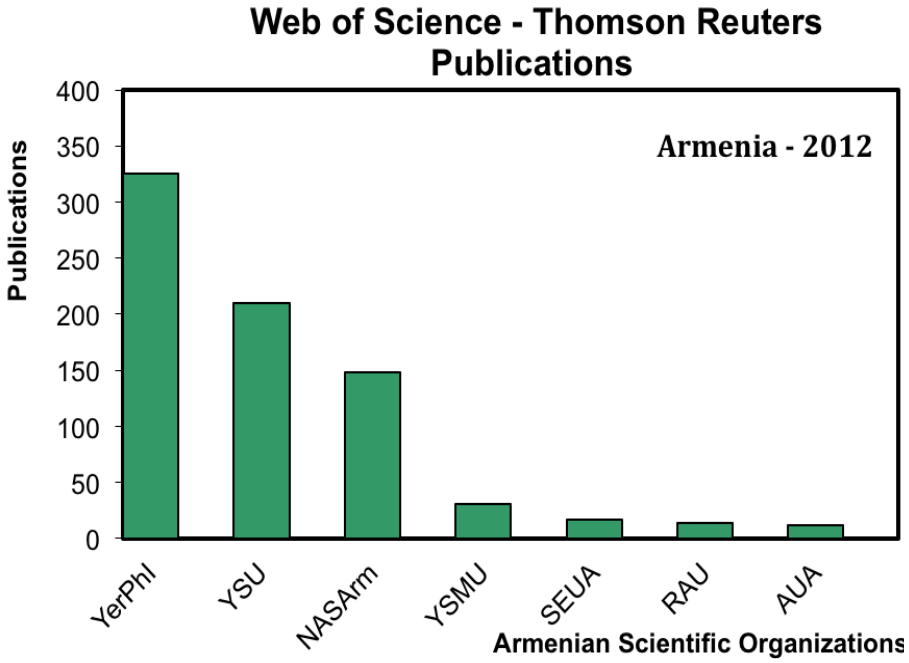


Annual report 2014 of AANL

AANL has the highest number of publications in Armenia

List of Armenian Scientific Organizations used in the review:

YerPhI – Yerevan Physics Institute = AANL
YSU – Yerevan State University
NASArm – National Academy of Sciences (NAS) of Armenia
Institute for Physical Research,
Institute of Radiophysics & Electronics,
Institute of Applied Problems of Physics,
Byurakan Astrophysical Observatory,
Institute of Molecular Biology,
Institute of Chemical Physics,
Institute of Biochemistry,
Institute of Fine Organic Chemistry
SEUA – State Engineering University of Armenia
YSMU - Yerevan State Medical University
RAU - Russian-Armenian (Slavonic) University
AUA - American University of Armenia



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