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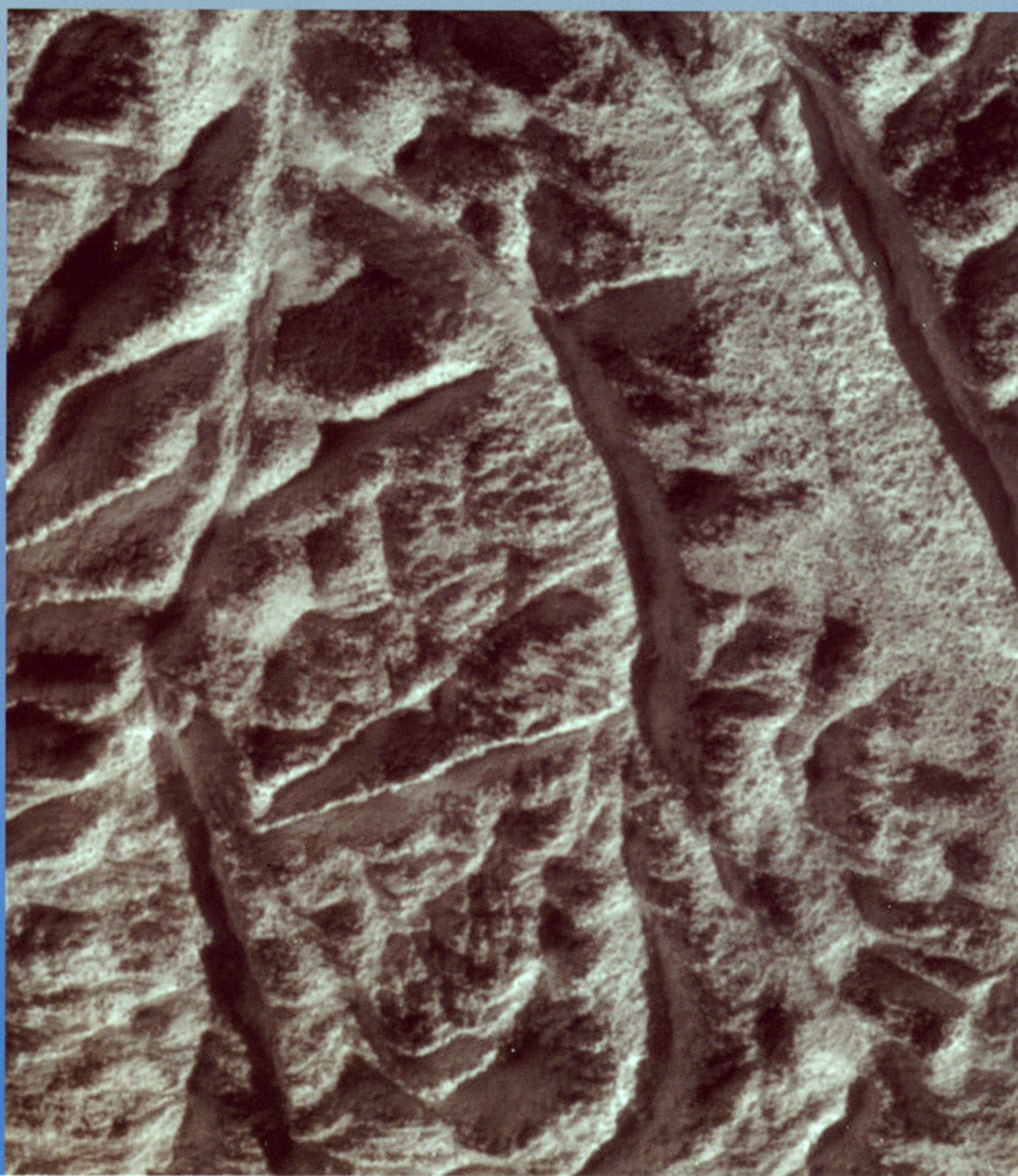

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accepted abstracts by 15 May 2011. Papers that are presented papers will be published in the conference proceedings by the IEEE. The papers in the proceedings with ISSN will be listed in the IEEE Xplore database indexed by INSPEC and ISI Thomson Reuters and will be submitted to SCOPUS for indexing.

For further information, see www.ukm.my/ispace or contact iconspace@ukm.my

Meeting Report

Thunderstorms and Elementary Particle Acceleration (TEPA-2010), Nor Amberd, Armenia, 6-11 September 2010

[Report by Ashot Chilingarian]

The TEPA 2010 conference was devoted to manifestations of the Relativistic Runway Electron Avalanche (RREA) process on the Earth's Surface, in the Atmosphere and in Space. It was organized by the Cosmic Ray Division (CRD) of the Armenia and Skobeltsyn Institute of Nuclear Physics of Moscow State University, Russian Federation, and sponsored by AANL, COSPAR and the Armenian State Science Committee. Forty scientists and students from the USA, UK, Germany, Mexico, Russia and Armenia attended and heard 37 original talks and lectures on the following subjects:

- Surface measurements of electrons, muons, neutrons and gamma rays from the relativistic runaway electron avalanche (RREA) processes, which exhibit themselves as thunderstorm ground enhancements (TGEs);
- Terrestrial gamma-ray flashes (TGFs) observed by orbiting gamma-ray observatories;
- Broadband electromagnetic signal detection from thunderstorms and extensive air showers (EAS);
- Transient luminous effects (TLE) in the upper atmosphere;
- Theory and simulation of the relativistic runaway electron avalanche process;
- Cosmic rays and space weather issues.

For the first time, the RREA phenomena were considered by all their manifestations obtained by various experimental techniques including:

- Electron, gamma-ray and neutron fluxes originated by the RREA process in thunderclouds and measured by various particle detectors operating at the cosmic-ray research stations on Mt Aragats (Armenia) and Baksan Valley (Russian Federation);
- Gamma-ray and electron-positron flashes observed with the orbiting *Fermi* gamma-ray burst monitor (NASA). Radio-emission from lightning detected by the LOPES experiment measuring radio signals of particle air showers and lightning (Germany) and LASS project at the Pierre Auger Observatory (Argentina);
- Ultraviolet (240-400 nm) and near-infrared (600-800 nm) radiation flashes observed onboard the *Tatiana-1* and *Tatiana-2* satellites (Moscow State University, Russian Federation).

Real-time monitoring of particle fluxes by space-borne and ground-based detectors both point to the same RREA origin of TGFs and TGEs. Two types of RREA events were detected on Mt Aragats: short (~1 μsec, inverse TGFs) and long (lasting hours, thunderstorm ground enhancements). Probably, the seed particles for the TGFs are produced during intercloud lightning, while the seed electrons for TGEs could be the ambient population of secondary MeV electrons from EAS. The proportion of short events was ~0.1% of the entire 8-minute enhancement detected on 19 September 2010.

Energy spectra of TGEs detected at Mt Aragats in 2009 and 2010 confirm the simulation study indicating that the electron energy spectrum is exponential and that of the gamma rays follows the power law. Both spectra for the largest event

on 19 September 2009 extend to energies as high as 45-50 MeV.

Huge fluxes of electrons, positrons, gamma rays and neutrons near the Earth's surface are undoubtedly newly discovered global physical phenomena that should be studied. Particle acceleration and multiplication, and broad-band electromagnetic emissions associated with thunderstorms trigger various dynamic processes in the atmosphere-ionosphere chain, causing global geo-effects. The events of huge energy (up to several gigajoules in an impulse) measured by the *Tatiana* satellites, demonstrate the importance of studying the atmosphere-ionosphere energy chain and draw attention to the upper atmosphere discharges, that possibly could be dangerous for high-altitudes flights. The precision muon detector developed by the National Nuclear University (MEPHI) in Moscow could be the first instrument to provide data both for space weather forecasting and meteorology. Simultaneous disturbances of the muon flux and of the geomagnetic field detected at Baksan in Russia point to particle-field interactions in the upper atmosphere. The amplification of the radio frequency electric field signals from EAS during a thunderstorm can lead to the modulation of the EAS size spectra and, consequently, to the possible estimation of the inter-cloud electric fields.

However, we have to remember that the Sun is the driving force of processes in the atmosphere, ionosphere and magnetosphere. Therefore, the full chain (solar-terrestrial system) includes the solar wind, the magnetosphere, the ionosphere and the atmosphere. The system is influenced by radiation from the Sun and the flux of solar and galactic cosmic rays. The radiation environment near the Earth and plasma-geo-magnetic field interactions constitute the space weather conditions. Space weather influences the terrestrial climate and presents natural hazards, while the mechanisms of space weather effects on the Earth are far from being explained and many aspects of solar activity itself are still unclear. These effects can be understood and quantitatively estimated only by studying the solar-terrestrial system in its entirety: identifying the solar agents affecting the Earth, understanding their occurrence and evolution, and comprehending the mechanisms of solar energy transfer from the Sun all the way to the Earth. This requires integration of all existing information now spread around in many different scientific areas: solar physics, solar wind, cosmic rays, interplanetary space, magnetosphere, ionosphere, and upper, middle and lower atmosphere.

The new effects explored and discussed during the TEPA 2010 conference included the inverse flux of the huge energy transferred from the upper atmosphere to the ionosphere and even to the magnetosphere, and should be considered as an integral component of the solar-terrestrial system. The investigation of the RREA process has vital importance for understanding global change, dynamics and evolution of the terrestrial climate and natural hazards.

The research goals could be achieved only with broad multidisciplinary cooperation, integrating observational, research and modelling capacities. Participants in the conference agreed to cooperate in installing various sensors measuring particle fluxes, transient luminous events, broadband radio emission and radiation, on the Earth's surface and onboard orbiting satellites.

A solar radio antenna being installed on Mt Aragats.

All the participants visited the high altitude Mt Aragats cosmic ray research station in Armenia and saw various particle detectors being used to investigate space weather and the RREA process. New field meters and lightning detectors installed on the slopes of Mt Aragats should lead

to better understanding of the RREA process, space weather, solar-terrestrial connections and their influence on the climate.

The TEPA participants included 10 PhD students. Lectures were given by Sir Arnold Wolfendale (UK) on climate change and the possible influence of cosmic rays on the origin of life, Professor Anatoly Petrukhin (Russian Nuclear Research University) on a new explanation for the shape of the high-energy cosmic ray energy spectra, and Professor Razmik Mirzoyan (MPI, Munich) on the history and future of Čerenkov gamma-ray astronomy. The lectures were followed by lively discussions, revealing the curiosity and the strong interest of the participants.

The conference presentations are now available on the CRD site: http://crd.yerphi.am/Conferences/tepa2010/Presentations, and the proceedings will be available in early 2011.

Publications

Submissions to *Space Research Today* – Reminder

Anyone may submit an article or news item to *SRT* and, in the spirit of a bulletin publication, we aim to be as flexible as possible in the submission procedures.

- Submission should be made in English, by e-mail to any member of the Editorial Team (see inside front cover for contact details)
- Submissions may be made in the following formats:
  - E-mail text (especially appropriate for short news or information items)
  - Word files with embedded images (in colour or greyscale)
  - Other formats can be considered; please contact the editorial team with your request
- Deadlines: 1 February for the April issue, 1 June for the August issue, and 1 October for the December issue.

The editors will always be pleased to receive the following types of inputs or submissions, among others:

- Research Highlight articles – generally substantial, current review articles that can be expected to be of interest to the general space community, extending to over five pages or so (*ca.* 1200-1500 words with figures and images – which may be in colour). These submissions should include a brief, one paragraph statement 'About the Author' and be accompanied by an image of the author.
- Research Notes – short research announcements, up to a three or four pages, with images as appropriate.
- News and Views, and 'In Brief' items – short announcements and news items (generally amounting to one page or less).
- In Memoriam submissions – Articles extending to a few pages, including an image, about a significant figure in the COSPAR community.
- Letters to the Editor – up to two pages on any subject relevant to COSPAR and space research in general.
- Meeting announcements, meeting reports and book reviews.

Articles are not refereed, but the decision to publish is the responsibility of the General Editor and his editorial team.

Letter to the Editor

The Stochastic Universe (Celebrating the 75th Birthday of Professor A.M. Mathai)

[By Hans J. Haubold (UN Office for Outer Space Affairs, Vienna)

In the 1970s, Professor A.M. Mathai (Director of the Centre for Mathematical Sciences India and Professor Emeritus of the Department of Mathematics and Statistics at McGill University, Canada) initiated a research programme on statistics and probability for physics with the