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MEETINGS  

Observations of High-Energy Particles and Radiation From Thunderstorms  
Thunderstorms and Elementary Particle Acceleration; Nor Amberd, Armenia; 6–11 September 2010  

Reports of gamma rays and neutrons observed at ground level below thunderstorms have appeared in the scientific literature for the past several decades. There have been also been observations of intense flashes of gamma rays and electrons associated with thunderstorms by at least four different orbiting spacecraft since 1994. These have been termed non-stellar gamma ray flashes (TGF). The latest development in this area of research is a comprehensive set of groundlevel measurements of the spectra of high-energy gamma rays and electrons, together with neutrons, from a large array of cosmic ray detectors on Mount Aragats, in Armenia. The relationship of ground-level radiation to spaceborne TGFs is unknown, and the origin of both phenomena is still highly uncertain.

A meeting was held at the conference center of the Mount Aragats cosmic ray facility near Yerevan, Armenia. The purpose of the meeting was to discuss recent observations of these phenomena, the theory associated with them, related phenomena, and future directions in this now and rapidly expanding field. The conference was organized by the cosmic ray division of the Arminian National Laboratory (formerly known as the Yerevan Physics Institute), the Armenian State Committee, the Skobeltsyn Institute of Nuclear Physics of Moscow State University, and the Committee on Space Research (COSPAR). There were 40 attendees at the meeting, most from Armenia and Russia.

Most researchers in this field agree that the mechanism producing the high-energy radiation associated with thunderstorms is a process known as the relativistic runaway electron avalanche (RREA). In this process, electrons are accelerated and multiplied via avalanches to very high energies and high intensities. The relativistic electrons produce high-energy gamma rays via bremsstrahlung interactions with air (bremsstrahlung, from the German, "to brake") and strahlung, "radiation," i.e., "braking radiation" or "deceleration radiation," in electromagnetic radiation produced by the acceleration of a charged particle, such as an electron, when deflected by another charged particle. There are also thought to be positive feedback mechanisms involving positrons and Compton-produced electrons that further increase the radiation fluxes. The RREA process occurs within the strong electric fields and is observable with instruments on the ground near thunderstorms.

The conference presentations were available at http://ais.am.redland.org/Conferences/teja2010/Presentations. The meeting proceedings will be available in early 2011.

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Ancient Perspectives on Arctic Climate Change and Ice Sheet Dynamics  
APEX Fourth International Conference and Workshop: Arctic Paleoclimatic Proxies and Chronologies; Höfn, Iceland, 26–30 May 2010  

The Arctic is particularly sensitive to climate change. In a warming world, reductions in ice-covered areas on land and sea increase the amount of solar radiation absorbed at the Earth's surface. Thus, temperatures should increase more rapidly at high northern latitudes than elsewhere. Modern observations of temperature increases, reductions in the mass balances of the Greenland ice sheet and small glaciers, and loss of sea ice extent confirm climate scientists' expectations of enhanced Arctic response to climate change.

Although the flexoelectric mechanism responsible for Arctic climate change is well understood, the details must be provided by the paleoclimatological record. In particular, changes in Northern Hemisphere ice sheet sizes are an important part of Arctic paleoclimatology because the last deglaciation (~15,000 years ago to present) meltwater release from the ice sheets likely caused sea level to rise and ocean circulation to change, with subsequent effects on the atmosphere.

To help establish a more complete picture of changes in Arctic climate and ice sheet behaviour, the Arctic Paleoclimatology and its Extremes (APEX) program and the Midwinter routing and Ocean-Cryosphere-Atmosphere response (MOCA) project held a joint conference in Iceland. Afterward, the MOCA project participants held a separate 1-day meeting. A 2-day field excursion preceded the scientific program.

The theme of the joint meeting was Arctic paleoclimate proxies and chronologies. Highlights of the scientific program included a new proxy for palaeo-sea ice cover from sediment cores (T. Cronin, U.S. Geological Survey). This work shows that sea ice extent during the late glacial and early Holocene (14,500–5000 years ago) was much smaller than the observed extent in the past few hundred years. Several participants (L. Björnsson of the University of Tromsø, A. Killeen of Durham University, M. Jakobsson of Stockholm University) presented new bathymetry data from the seafloor. These data indicate the presence of fast flowing glacial ice in the western Barents Sea, offshore from Jakobshavn Isbrae in Greenland, and in Pine Island Bay in Antarctica. There were also several presentations on glacial chronology.

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