HILITE 2013

Report of Contributions

https://agenda.infn.it/e/hilite2013

Contribution ID: **0** Type: **not specified**

Welcome Address

Monday, September 30, 2013 9:00 AM (30 minutes)

Contribution ID: **1** Type: **not specified**

ELVES discovery, modeling, simulations

Monday, September 30, 2013 9:30 AM (45 minutes)

Lightning return strokes radiate an electromagnetic pulse (EMP) which interacts with the D-region ionosphere. The largest EMPs produce new ionization, heating, and optical emissions known as elves. Elves are among the most common transient luminous events, occurring at least six times more frequently than sprites. In this talk, a brief overview of elve research is presented. Additionally, we present a time-domain model of the lightning EMP and its interaction with the lower ionosphere. This model effectively simulates electron heating due to the lightning EMP and includes nonlinear effect such as ionization, attachment, detachment, and the optical emissions that give rise to elves.

Presenter: Dr BLAES, Patrick (Stanford Univ.)

Contribution ID: **2** Type: **not specified**

The physics of sprites: current studies in North America

Monday, September 30, 2013 10:15 AM (45 minutes)

Sprites are electrical discharges in the mesosphere/lower ionosphere caused by strong cloud-to-ground lightning flashes. They are highly structured with dominant filamentary structures known as streamers. They also exhibit highly dynamical properties. In this talk, we will present an overview of recent observational and modeling studies of sprites in North America. We will discuss the underlying physical mechanism of sprites, and focus on the progress made recently in order to understand different aspects of sprites.

Presenter: Prof. LIU, Ningyu (Florida Institute of Technology)

Contribution ID: **3** Type: **not specified**

Sprites-induced chemistry

Monday, September 30, 2013 11:30 AM (45 minutes)

Lightning and high energy processes are observed in the atmosphere above thunderstorms. These phenomena impact the Earth's atmosphere through ion-neutral chemistry reactions leading to additional chemical sources which are as yet not included in the present picture of atmospheric chemistry and climate. In this talk, we will revise results of sprite-chemistry models and observations, and discuss the relevance of sprite perturbations at regional and global scales.

Presenter: Dr ARNONE, Enrico (ISAC-CNR)

Contribution ID: **4** Type: **not specified**

Studies on ELVES with PIPER detectors

Monday, September 30, 2013 2:15 PM (45 minutes)

We present observations of elves using a ground-based, free-running photometer array called Photometric Imager of Precipitated Electron Radiation (PIPER). The PIPER photometer has a high (40μs) temporal resolution, making it ideal for studying fast TLEs such as elves. As a free-running instrument, it can record entire storms and there are no missed detections or sampling bias due to triggering. These photometers have observed thousands of elves during a number of summer campaigns in the American southwest. We present some relevant studies and statistics from these observational campaigns.

Presenter: Dr BLAES, Patrick (Stanford Univ.)

Contribution ID: **5** Type: **not specified**

Studies on ELVES at the AUGER Observatory

Monday, September 30, 2013 4:15 PM (45 minutes)

The Pierre Auger Observatory near Malargue (Argentina), is the largest facility (3000 km2) for the study of
Ultra High Energy Cosmic Rays (E>10^18 eV). The four sites of the Fluorescence Detector (FD), covering a field of view of 30x180 degrees) observe the night sky with 100 ns time resolution and a space resolution of about 1 degree. After the first serendipitous observation of an ELVES event, in May 2005, the Observatory has decided to develop strategies to improve the selection of these events.
Since March 2013, a special trigger has been implemented, to detect ELVES, whose topology (a rapidly evolving ring) is quite different from the one of cosmic ray events. This allows to record events with high efficiency and unprecedented accuracy. A large fraction of the events taken so far with this special trigger are simultaneously observed by two (stereo) o three (triplet) FD sites. This allows to further improve the determination of the
altitude of light emission, and to get more insight on the structures observed in the analog signals. Comparison with the WWLLN data will be discussed, together with prospects to further improve the ELVES triggering and buffering properties.

Presenter: Dr MUSSA, Roberto (INFN Torino)

Contribution ID: **6** Type: **not specified**

Sprites research in South America: the LATINELT network

Monday, September 30, 2013 3:00 PM (45 minutes)

South America's combination of intense thunderstorm activity and geomagnetic characteristics creates a unique natural laboratory for investigating a variety of atmospheric phenomena and their possible coupling. Its large latitudinal extent, from ~12o N to ~55o S, encompass equatorial, tropical and subtropical regions with meteorological conditions that makes South America the second most active thunderstorm and lightning, and consequently one of the most active Transient Luminous Events (TLEs) region of the globe. TLEs are optical emissions from transient plasma discharges excited in the upper atmosphere by the electromagnetic field of underlying lightning flashes from thunderstorms. Since 2002, five different campaigns have been performed in Brazil to make TLE observations, more than 700 events, mainly sprites, have been recorded over South American thunderstorms during Brazilian campaigns so far. During the first campaign, in 2002/2003, 18 sprites were recorded above Minas Gerais State in two different nights; 11 sprites from 3 different storms above Goias and Mato Grosso States was the total recorded on a single night of the second campaign, in 2005. The third campaign, in 2006, had the impressive record of more than 600 TLEs from two thunderstorms, over Argentina and Paraguay, in different nights. In 2007 we recorded 27 sprites from a single system above Uruguay, and in 2008, 13 TLEs were registered above one convective system over Rio Grande do Sul State. This paper will review the main results of these observations. It will also introduce the Transient Luminous Event and Thunderstorm High Energy Emission Collaborative Network in Latin America –LEONA. The network has two prototype observation camera system already installed in Brazil and will be developed to cover the whole South America.

Presenter: Dr DE SAO SABBAS TAVARES, Fernanda (INPE-National Institute for Space Research)

Contribution ID: **7** Type: **not specified**

Prospects for studies on ELVES and Sprites with JEM-EUSO

Monday, September 30, 2013 5:00 PM (45 minutes)

The Extreme Universe Space Observatory on board of the Japanese Experiment Module (JEM-EUSO) is a new type of observatory to be placed on the International Space Station after 2017 to observe Ultra High Energy Cosmic Rays (E>5x10^19 eV) from space. Among the exploratory objectives of the mission there is also the observation of the Transient Luminous Events (TLEs).
In this presentation the JEM-EUSO mission will be described, focusing on the main parameters of the instrument, and its capabilities to observe TLEs.

Presenter: Dr BERTAINA, Mario (INFN & University Torino)

Contribution ID: **8** Type: **not specified**

Terrestrial Gamma-ray Flashes studies with AGILE

Tuesday, October 1, 2013 2:05 PM (45 minutes)

The AGILE satellite detects more than 10 Terrestrial Gamma-ray Flashes (TGFs) per month in the latitude belt +/- 2.5 deg, providing the largest TGF surface density observed and the largest TGF statistics in the equatorial region to date. The current TGF sample comprises more than 400 events with maximum energy lower than 30 MeV detected by the Minicalorimeter (MCAL) instrument on-board AGILE. The characteristics of the AGILE events are analyzed and compared to the observational framework established by the two other currently active missions capable of detecting TGFs from space, RHESSI and Fermi. Longitude and local time distributions are compatible with previous observations, while duration distribution is biased towards longer values. The intensity distribution is compatible with previous observations, pointing towards a true fluence distribution at satellite altitude that can be described with a power law with index -2.4 and a rolloff at low fluence values. The TGFs cumulative spectrum supports a low production altitude, in agreement with previous measurements. AGILE also provides a unique dataset of TGFs with photon energies extending up to 100 MeV, which challenge current production models and possibly represent a distinct class of atmospheric phenomena. In addition to TGF physics, our group is actively studying TGF effects on atmospheric and ground environments.

Presenter: Dr MARISALDI, Martino (INAF - IASF Bologna)

Contribution ID: **9** Type: **not specified**

TGFs with FERMI Large Area Telescope (LAT)

Tuesday, October 1, 2013 2:50 PM (45 minutes)

The Fermi LAT regularly detects Terrestrial Gamma-ray Flashes (TGFs) during its nominal astrophysical sky-survey observing program. Because of the LAT's flexible trigger logic, TGF emissions at and above 10 MeV are detected with high sensitivity despite their having arrived from outside the instrument's field of view. A deep search of the first four years of LAT data reveals more than 300 TGFs with hard gamma-ray emission, of which many were independently detected by Fermi GBM. Here we present a summary of the spectral, temporal, diurnal, and geographic features of this sample of high-energy TGFs.

Presenter: Dr LATRONICO, Luca (INFN Torino)

Contribution ID: **10** Type: **not specified**

Photon modeling in TGFs and prospects of the ASIM mission

Tuesday, October 1, 2013 4:05 PM (45 minutes)

We present here the instruments of the ASIM mission to the ISS in 2015 to observe TGFs and associated TLEs, its current status of construction and testing. We will also talk about a new software package being developed at the University of Valencia to simulate the scattering physics of MeV electrons so that users interested in simulating theories of TGF origin will only have to specify the geometry of electric and magnetic fields, plus the geometries of energetic electron fluxes, in a script based system, to be able run the software and analyse its output.

Presenter: Dr CONNELL, Paul (Univ. Valencia - Image Processing Laboratory)

Contribution ID: **11** Type: **not specified**

Cosmic rays and gamma ray emissions during thunderstorms

Tuesday, October 1, 2013 9:00 AM (45 minutes)

During thunderstorm activities ground based particle detectors register enhancements in fluxes of secondary cosmic ray fluxes - Thunderstorm Ground Enhancements(TGE's). These events are particularly explained by Runaway Breakdown model of initiation of lightnings. The model gives a threshold, minimal value of atmospheric electric fields strengths, in case of which multiplication of secondary cosmic ray electron fluxes occures. The simulations of secondary cosmic ray propagation in atmospheric electric fields with strengths higher than critical value performed. The conditions of 2 biggest TGE's registered by Aragats Space Environmental Centre detectors are defined.

The simulations of secondary cosmic ray electrons propagation in weak electric fields (with the strengths smaller than the critical value, so called RB threshold) were performed to give an insight in the new physical process of gamma ray generation, not accompanied with electron multiplication in the RREA process. Comparing the results of simulations with the experimental data, we suggest, that the majority of small TGEs detected on Aragats during which ground based detectors register only gamma ray enhancements are of this type.

Presenter: Dr VANYAN, Levon (Yerevan Physics Institute)

Contribution ID: **12** Type: **not specified**

Studies on cosmic ray-lightning correlations in AUGER

Tuesday, October 1, 2013 9:45 AM (45 minutes)

The process that initiates lightning inside thunderclouds is not yet understood. Extended air shower from cosmic rays provide electrons and particles that in energetic runaway processes could trigger lightning. The Pierre Auger Observatory is the largest experiment measuring cosmic rays. The sensitivity to lightnings of the different detector types of the hybrid observatory as well as additional devices to detect lightnings are discussed in the context of a potential correlation measurement between cosmic rays and lightnings.

Presenter: Dr RAUTENBERG, Julian (Bergische Univ. Wuppertal)

Contribution ID: **13** Type: **not specified**

Studies on atmosphere-litosphere-magnetosphere interactions: the LIMADOU Project

Tuesday, October 1, 2013 12:00 PM (35 minutes)

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Presenter: Dr VITALE, Vincenzo (Univ. Roma Tor Vergata)

Contribution ID: **14** Type: **not specified**

Neutron emission in TGEs

Tuesday, October 1, 2013 11:20 AM (40 minutes)

We analyze the neutron fluxes correlated with thunderstorm activity recently measured at mountain altitudes by Aragats and other groups. We perform simulations of the photonuclear reactions of gamma rays born in the electron-gamma ray avalanches and calculate the expected count rates of the neutron detectors. Our analysis supports the Tibet and Aragats group's conclusions on the photonuclear nature of thunderstorm-correlated neutrons (directly in the neutron monitor and in the atmosphere). The photonuclear reactions of the gamma rays born in the electron-photon avalanches in the thunderstorm atmospheres interacting with the air atoms and with lead producer of a neutron monitor can provide neutron yield compatible with additional count of neutron monitors registered during thunderstorm ground enhancements.

Presenter: Dr VANYAN, Levon (Yerevan Physics Institute)

Contribution ID: **15** Type: **not specified**

The Colorado Atmospheric Monitoring Telescope as a detector for Elves?

Monday, September 30, 2013 5:45 PM (30 minutes)

The serendipitous observation of atmospheric Elves by the Pierre Auger Observatory has demonstrated that cosmic ray air fluorescence detectors can measure transient luminous events quite well. TLE measurements are also an important component of the science program that is planned for JEM-EUSO. In this talk I will discuss the possibility of using a simplified optical cosmic ray detector, called the Atmospheric Monintoring Telescope (AMT) to measure Elves and other TLEs. The AMT is a stand-alone remotely operated system developed for atmospheric R&D at the Pierre Auger R&D site in south east Colorado USA. (In this work it measured side scattered light from a vertical 355 nm YAG laser 40 km distant.) The AMT features a 3.5 m^2 mirror that focuses light from the night sky on to a camera of 256 PMTs. Although the field of view is only 15x12 degrees, it could be used to contributed wide separation stereo measurements to contribute to ongoing programs, for example at the Pierre Auger Observatory. The AMT measurement program could focused on atmospheric TLE's rather than cosmic rays. In this talk, which is intended to stimulate discussion, I will describe the AMT and some of the ways it could be used to measure TLEs.

Presenter: Prof. WIENCKE, Lawrence (Colorado School of Mines)

Contribution ID: **16** Type: **not specified**

Terrestrial Gamma rays in FERMI GBM

Tuesday, October 1, 2013 4:50 PM (45 minutes)

We present refined analyses of TGFs detected by the Gamma-ray Burst Monitor (GBM) instrument onboard Fermi. Of a sample of ~300 bright TGFs that triggered GBM, 19% are found to have multiple pulses. The individual pulses can be either be symmetric or asymmetric and are well fit with Gaussian or log-normal functions. A new data mode has been used to detect TGFs with GBM 10 times more frequently than previously. Using a sample of ~100 TGFs we obtain the fluence distribution in a model independent manner, correcting for detection efficiency, deadtime and pulse pileup. Detection effiency causes GBM not to detect some faint TGFs while deadtime and pulse pileup cause the intensities of TGFs to be underestimated. The corrected fluence distribution is well fit with a power-law of index −2.20 +/- 0.13.

Presenter: Dr FOLEY, Suzanne (Univ.College Dublin)

Contribution ID: **17** Type: **not specified**

Air showers measurements during thunderstorms in ARGO-YBJ

Tuesday, October 1, 2013 10:30 AM (20 minutes)

ARGO-YBJ is an air shower detector that operated from 2007 to 2013 at the
Cosmic Ray Laboratory of Yangbajing (Tibet, China) at 4300 m a.s.l.
devoted to Gamma Ray Astronomy and Cosmic Ray studies in the TeV energy range.
During thunderstorms ARGO-YBJ observed significant variations of the flux
of secondary particles of cosmic rays, strongly correlated with the local atmospheric electric field intensity.
During the occurrence of the most intense episodes, increases of the
triggered shower rate have also been observed. A study of the variation of the space-time features of showers during these events is in progress.

Presenter: Dr VERNETTO, Silvia (INAF Torino)