Ultra High Energy Cosmic Rays 2018

Report of Contributions

https://indico.in2p3.fr/e/17063

Contribution ID: **5** Type: **ORAL**

Galactic model of ultra-high energy cosmic rays.

The hypothesis of existence of the new stable heavy hadrons in the cosmic rays is proposed. It follows from the comprehensive study of extensive air showers in
the hybrid experiment HADRON which was carried out at the level 685 g/cm^2 of the Tien Shan mountains. The spectra of the high energy hadrons inside the cores of extensive air showers were obtained for the first time by means of the large X-ray emulsion chamber combined with showers installation. The scaling violation in the hadron spectra was detected for primary energies of cosmic rays 3•10^15-10^17 eV. The slope of the spectra decreases and then returns to the previous or slightly larger value. This is an unexpected result. In addition the interval of the scaling violation coincides with the region of the transformation of the spectrum of extensive air showers. It means that unusual scaling violation and cosmic ray spectrum reconstruction are caused by one reason. The discussion shows that the observed results contradict as the traditional model of growth of the part of heavy nuclei in these energies and changing of the characteristics of nuclear cascades. This effect can be associated with penetrating anomalous component of cosmic rays such as the hypothetical particles of strange quark matter-strangelets.
The result allows us to put forward a hypothesis that the CR consists of ordinary nuclei up to energies ~10^15 eV , and at high energies of quasi-nuclei (strangelets) with masses from ~10^3 to 10^7 GeV.

Primary author: SHAULOV, Sergey (P.N.Lebedev Physical Institute)

Presenter: SHAULOV, Sergey (P.N.Lebedev Physical Institute)

Session Classification: Sessions

Contribution ID: **6** Type: **ORAL**

Ultra-high energy cosmic rays from radio galaxies

Tuesday, October 9, 2018 3:20 PM (20 minutes)

The origin of ultra-high energy cosmic rays (UHECRs) is an open question, but radio galaxies offer one of the best candidate acceleration sites. Acceleration at the termination shocks of relativistic jets is problematic because relativistic shocks are poor accelerators to high energy. Using hydrodynamic simulations and general physical arguments, I will show that shocks with non- or mildly relativistic shock velocities can be formed as plasma flows from the termination shock into the radio lobe and that these shocks have suitable characteristics for acceleration to 10-100EeV. I will discuss a model in which giant-lobed radio galaxies such as Centaurus A and Fornax A act as slowly-leaking UHECR reservoirs, with the UHECRs being accelerated during a more powerful past episode. I will also show that Centaurus A, Fornax A and other radio galaxies may explain the observed hotspots in the Auger and TA data at ultra-high energies.

Primary authors: MATTHEWS, James (University of Oxford); Prof. BELL, Tony (University of Oxford); Prof. BLUNDELL, Katherine; Dr ARAUDO, Anabella (Astronomical Institute, Czech Academy of Sciences)

Presenter: MATTHEWS, James (University of Oxford)

Session Classification: Sessions

Contribution ID: **65** Type: **ORAL**

EPOS 3

Thursday, October 11, 2018 11:55 AM (20 minutes)

With the recent results of large hybrid air shower experiments, it is clear that the simulations of the hadronic interactions are not good enough to obtain a consistent description of the observations. Even the most recent models tuned after the first run of LHC show significant discrepancy with air shower data. Since then many more data have been collected at LHC and lower energies which are not necessarily well described by these models. So before claiming any new physics explanation, it is necessary to have a model which can actually describe accelerator data in a very detailed way. That is the goal of EPOS 3, to understand both soft and hard particle production not only in light systems like proton-proton interactions but in heavy ions too. The latest results of the model will be presented and in particular the correlations between various observables which are very important to understand the real physical processes.

Primary authors: PIEROG, Tanguy (KIT, IKP); WERNER, klaus (univ nantes)

Presenter: PIEROG, Tanguy (KIT, IKP)

Session Classification: Sessions

Contribution ID: **66** Type: **ORAL**

Ultra-High-Energy Cosmic Rays from Radio Galaxies

Tuesday, October 9, 2018 2:20 PM (20 minutes)

Radio galaxies are intensively discussed as the sources of cosmic rays observed above about 3 EeV, called ultra-high energy cosmic rays (UHECRs). The talk presents a first, systematic study that takes the individual characteristics of these sources into account, as well as the impact of the galactic magnetic field, as well as the extragalactic magnetic-field structures up to a distance of 120 Mpc.

It will be shown that the average contribution of radio galaxies taken over a very large volume cannot explain the observed features of UHECRs measured at Earth, but could provide an explanation of the CRs with energies of a few EeV. However, a very good agreement with the spectrum, composition, and arrival-direction distribution of UHECRs measured by the Pierre Auger Observatory (Auger) is obtained by the contribution from only a few ultra-luminous ones, in particular Cygnus A and Centaurus A. Cygnus A needs to provide a mostly light composition of nuclear species dominating up to about 60 EeV, whereas the nearest radio galaxy, Centaurus A, provides a heavy composition and starts to dominate above 60 EeV. Thus, this scenario most likely also predicts differences in UHECR spectrum and composition between the northern and southern hemispheres. In order to account for these differences we include the geometrical exposure effects of Auger and the Telescope Array Observatory, which even improves the aggreement to the their measurements.

Primary author: EICHMANN, Björn

Presenter: EICHMANN, Björn

Session Classification: Sessions

Contribution ID: **72** Type: **POSTER**

Ultra high energy cosmic rays simulations with CONEX code

Tuesday, October 9, 2018 10:33 AM (3 minutes)

Nowadays, ultra high energy cosmic rays (UHECR) are subject to intense research of great interest. The existence of such rays with an energy above 10^{20} eV is contradicted by the limit GZK due to photo-pion production, or by nuclei photo-disintegration, in the interaction of UHECR with the cosmic microwave background.
In this work, detailed simulations of extensive air showers have been carried out with the help of CONEX program in order to evaluate the shower maximum depth longitudinal profile, X_{max}. This parameter and its fluctuations are very sensitive to the primary particle mass.

Primary author: Dr TALAI, Mohamed Cherif (Badji Mokhtar University of Annaba, Department of Physics)

Co-author: LAKEL, Ghazala (Badji Mokhtar University of Annaba, Department of Physics)

Presenter: Dr TALAI, Mohamed Cherif (Badji Mokhtar University of Annaba, Department of Physics)

Session Classification: POSTER SESSION

Contribution ID: **73** Type: **ORAL**

The most updated results of the magnetic field structure of the Milky Way

Tuesday, October 9, 2018 3:00 PM (20 minutes)

Magnetic fields are an important agent for cosmic rays to transport. The observed all-sky Faraday rotation distribution implies that the magnetic fields in the Galactic halo have a toroidial structure, but the radius range and scale height as well as the strength of the toroidial fields are totally unknown. In the Galactic disk, the magnetic fields probably follow the spiral structure with a strength of a few microGauss and several large-scale reversals in the arm and interarm regions, as inferred from the rotation measure distribution of pulsars inside our Milky Way and from the rotation measure difference between distant pulsars and the radio sources behind the Galactic disk. See Han JL (2017, ARA&A 55, 111) and Han JL et al. (2018, ApJS 234, 11) for details.

Primary author: Prof. HAN, JinLin (National Astronomical Observatories, Chinese Academy of Sciences)

Presenter: Prof. HAN, JinLin (National Astronomical Observatories, Chinese Academy of Sciences)

Session Classification: Sessions

Contribution ID: **74** Type: **INVITED**

Particle Acceleration in Radio Galaxies

Tuesday, October 9, 2018 9:00 AM (30 minutes)

Ultra-high energy cosmic rays pose an extreme challenge to theories of particle acceleration. We discuss the reasons why diffusive acceleration by shocks is a leading contender. A crucial aspect of shock acceleration is that cosmic rays must be efficiently scattered by magnetic field. This requires magnetic field amplification on scales comparable with the cosmic ray Larmor radius, which in turn indicates that the shocks cannot be fully relativistic; nor can the shocks be too slow. The lower limit, arising from the Hillas condition, on the energy processed in the shock severely restricts the range of possible sources of UHECR. These conditions combine to make the lobes of radio galaxies a likely source of UHECR.

Primary authors: Prof. BELL, Tony (University of Oxford); Dr MATTHEWS, James (University of Oxford); Prof. BLUNDELL, Katherine (University of Oxford); Dr ARAUDO, Anabella (Astronomical Institute, Czech Academy of Sciences)

Presenter: Prof. BELL, Tony (University of Oxford)

Session Classification: Sessions

Contribution ID: **75** Type: **INVITED**

Transition from Galactic to Extragalactic Cosmic Rays

Tuesday, October 9, 2018 5:50 PM (30 minutes)

Additionally to the all-particle cosmic ray (CR) spectrum, data on the primary composition and anisotropy have become available from the knee region up to few $\times 10^{19}$ eV. These data point to an early Galactic-extragalactic transition and the presence of Peter's cycle, i.e. a rigidity-dependent maximal energy. Theoretical models have to explain therefore the ankle as a feature in the extragalactic CR spectrum. Moreover, the Galactic CR spectrum has to explain the knee, and has to extend to sufficiently high energies. I review the experimental data and their interpretation, as well as models aiming to reproduce them.

Primary author: KACHELRIESS, Michael (Department of Physics, NTNU)

Presenter: KACHELRIESS, Michael (Department of Physics, NTNU)

Session Classification: Sessions

Contribution ID: **77** Type: **ORAL**

KASCADE-Grande: Post-operation analyses and latest results

Tuesday, October 9, 2018 5:10 PM (20 minutes)

The KASCADE-Grande experiment has significantly contributed to the current knowledge about the energy spectrum and composition of cosmic rays for energies between the knee and the ankle. Meanwhile, post-LHC versions of the hadronic interaction models are available and used to interpret the entire data set of KASCADE-Grande. In addition, a new, combined analysis of both arrays, KASCADE and Grande, were developed increasing significantly the accuracy of the shower observables. Results of the new analyses of the KASCADE-Grande experiment will be discussed as well as limits on the high-energy gamma ray flux over a large energy range. In addition, further developments of the KASCADE Cosmic Ray Data Centre (KCDC) will be presented.

Primary authors: HAUNGS, Andreas (KIT); KASCADE-GRANDE COLLABORATION

Presenters: HAUNGS, Andreas (KIT); KASCADE-GRANDE COLLABORATION

Session Classification: Sessions

Contribution ID: **78** Type: **ORAL**

Minimal model of UHECR and IceCube neutrinos

Monday, October 8, 2018 4:45 PM (20 minutes)

In this talk I'll present minimal model, which explain UHECR spectrum and composition and at the same time explain IceCube astrophysical neutrino signal (M.Kachelriess et al, "Minimal model for extragalactic cosmic rays and neutrinos," Phys.Rev.D 96}, 083006 (2017) Also I'll discuss galactic-extragalactic transition in context of this model.

Primary author: Mr SEMIKOZ, Dmitri (APC, Paris)

Presenter: Mr SEMIKOZ, Dmitri (APC, Paris)

Session Classification: Sessions

Contribution ID: **79** Type: **INVITED**

Recent IceCube results - evidences of neutrino emission from the blazar TXS 0506+056 and searches for Glashow resonance

Wednesday, October 10, 2018 2:00 PM (30 minutes)

Finally a hundred years after the discovery of cosmic-rays, a blazar has been identified as a source (at ~3 sigma level) of high-energy neutrinos and cosmic-rays thanks to the real-time multimessenger observation lead by the cubic-kilometer IceCube neutrino observatory. In this talk, details of the spatial-timing correlation analysis of the ~290 TeV neutrino event with Fermi light curves will be presented.

The second part of the talk will be dedicated to the searches for the highest energy neutrinos of all flavours with IceCube. In particular, results on the Glashow resonance and implications for the neutrino diffuse spectrum will be shown for the first time. The early-muons originated from hadronic shower generated via Glashow resonance decay could be used to improve cascade direction resolution. Possible sources of the Glashow candidate will be introduced.

Primary author: LU, Lu (Chiba University)

Co-author: ICECUBE COLLABORATION

Presenter: LU, Lu (Chiba University)

Session Classification: Sessions

Contribution ID: **80** Type: **INVITED**

The Highest Energy Particles in Nature – the Past, the Present and the Future

Monday, October 8, 2018 2:05 PM (45 minutes)

The Highest Energy Particles in Nature – the Past, the Present and the Future
Alan Watson
University of Leeds

Since the earliest days cosmic-ray physicists have been studying the highest-energy particles in Nature. A basic understanding of the development of electromagnetic cascades led to the first targeted searches for air showers and, soon after the discovery of charged and neutral pions, the concept of using the muon content to find the mass of the primary particles was proposed. Progress in the field has relied on the conception and mastery of new techniques, including the development of Monte Carlo simulations, and by the levels of funding available. The challenge of measuring the direction of high-energy cosmic rays was solved through the development of scintillator arrays, while the ability to detect Cherenkov light and fluorescence radiation has aided model-free estimates of the primary energy. The radio technique, demonstrated in 1965 but abandoned 10 years later, is again showing promise. I will describe something of the history of the development of the experimental methods exposing the long lead-times between their conception and successful implementation.

However the challenge of determining the mass of the primary particles requires knowledge of hadronic physics at centre-of-mass energies well-beyond those reached at the LHC, while details of key pion interactions are seriously lacking. It may be that we need to exploit anisotropies and magnetic fields in some smart manner to solve this problem. I will comment on the present state of knowledge of the key parameters to set the stage for the Working Group reports that are an important feature of this meeting. I will also discuss briefly discuss prospects for future developments in space and on the ground.

Primary author: Prof. WATSON, Alan (University of Leeds)

Presenter: Prof. WATSON, Alan (University of Leeds)

Session Classification: Sessions

Contribution ID: **81** Type: **POSTER**

Studies for High Energy air shower identification using RF measurements with the ASTRONEU array

Wednesday, October 10, 2018 10:51 AM (4 minutes)

The Hellenic Open University (HOU) Cosmic Ray Telescope (ASTRONEU) comprises 9 charged particle detectors and 3 RF antennas arranged in three autonomous stations operating at the University Campus of HOU in the city of Patra. In this work, we extend the analysis of very high energy showers that are detected by more than one station and in coincidence with the RF antennas of the Telescope. We present the angular distributions as well as the energy distribution of the selected showers in comparison to the Monte Carlo (MC) simulations expectations. Special attention is given to the transfer functions of the antennas which are strongly frequency and angular dependent. We find that the RF spectra (at frequencies 30-80 MHz) of the detected showers are exhibiting features of the antenna response predicted by detailed MC simulation suggesting thus, that a single antenna spectrum might give access to the Cosmic Ray arrival direction.

Primary authors: Mr NONIS, Stavros (Malkou); Dr BOURLIS, George; Prof. GKIALAS, Ioanis; Prof. LEISOS, Antonis; Dr MANTHOS, Ioanis; Prof. PAPAGEORGIOU, Kostas; Dr TSIRIGOTIS, Apostolis; Prof. TZAMARIAS , Spyros

Presenter: Mr NONIS, Stavros (Malkou)

Session Classification: POSTER SESSION

Contribution ID: **82** Type: **ORAL**

Probing the hadronic energy spectrum in proton air interactions through the fluctuations of the EAS muon content

Thursday, October 11, 2018 11:35 AM (20 minutes)

The average number of muons in air showers and its connection with the development of air showers has been studied extensively in the past. With the upcoming detector upgrades, UHECR observatories will be able to also probe higher moments of the muon distribution. Here we present a study of the physics of the fluctuations of the muon content. In addition to proving that the fluctuations must be dominated by the first interactions, we show that the fluctuations and entire shape of the distribution of the number of muons is determined by the energy spectrum of hadrons in the first interaction.

Primary authors: Dr CAZON, Lorenzo (LIP, Lisbon); CONCEIÇÃO, Ruben (LIP, Lisbon); RIEHN, felix (LIP, Lisbon)

Presenter: RIEHN, felix (LIP, Lisbon)

Session Classification: Sessions

Contribution ID: **83** Type: **POSTER**

Search and study of extensive air shower events with the TUS space experiment.

Tuesday, October 9, 2018 10:30 AM (3 minutes)

The TUS experiment is designed to investigate the ultra high energy cosmic rays (UHECR) at energy ~100 EeV from the space orbit by the UV radiation measurement of extensive air showers (EAS). It is the first orbital telescope aimed for such measurements and is taking data since April 28, 2016. TUS detector consists of a modular Fresnel mirror and a photo receiver matrix with a field of view ±4.5° and the number of PMT pixels 16x16. The DAQ electronics has a main mode of operation with 0.8 μs temporal resolution and a 200 μs duration of measured waveforms. Spatial resolution in the atmosphere is 5 km with a total field of view of about 80x80 km^2 . The TUS apparatus structure, methods of UHECR on-line selection and off-line data analysis are described. A few UHECR EAS candidates were found. Preliminary results of their investigation and comparison with the corresponding Monte-Carlo events are presented.

Primary authors: GRINYUK, Andrey (Joint Institute for Nuclear Research); DMITROTSA, A.; EREMEEV, V.; GARIPOV, G.; GREBENYUK, V.; KHRENOV, B.; KLIMOV, P.; LAVROVA, M.; PANASYUK, M.; SAPRYKIN, O.; SHARAKIN, S.; SHIROKOV, A.; TKACHENKO, A.; TKACHEV, L.; VOLVACH, A.; YASHIN, I.; ZOTOV, M.

Presenter: GRINYUK, Andrey (Joint Institute for Nuclear Research)

Session Classification: POSTER SESSION

Contribution ID: **84** Type: **INVITED**

The GRAND Project

Friday, October 12, 2018 11:30 AM (20 minutes)

The Giant Radio Array for Neutrino Detection (GRAND) aims at detecting ultra-high-energy extraterrestrial neutrinos via the extensive air showers induced by the decay of tau leptons created in the interaction of neutrinos under the Earth's surface. Consisting of an array of $\sim 200\,000$ radio antennas deployed over $\sim 200\,000\,\mathrm{km}^2$, GRAND plans to reach, for the first time, a sensitivity of $\sim 10^{-10}\,\mathrm{GeV\,cm^{-2}\,s^{-1}\,sr^{-1}}$ above 5×10^{17} eV and a sub-degree angular resolution, beyond the reach of other planned detectors. In this talk, we will show preliminary designs and simulation results, plans for the ongoing, staged approach to construction, and the rich research program made possible by the proposed sensitivity and angular resolution.

Primary authors: KOTERA, Kumiko (Institut d'Astrophysique de Paris); MARTINEAU, Olivier (IN2P3)

Presenter: MARTINEAU, Olivier (IN2P3)

Session Classification: Sessions

Contribution ID: **85** Type: **ORAL**

UHECR science with ground-based imaging atmospheric Cherenkov telescopes

Tuesday, October 9, 2018 3:40 PM (20 minutes)

Arrays of imaging atmospheric Cherenkov telescopes (IACTs), such as VERITAS and the future CTA observatory, are designed to detect particles of astrophysical origin. IACTs are nominally sensitive to gamma rays and cosmic rays at energies between tens of GeV and hundreds of TeV. As such, they can be used as both direct and indirect probes of particle acceleration to very high energies.

Recent measurements by VERITAS of the cosmic ray electron and iron spectra are discussed. Such observations probe the activity of nearby sources, and may shed light on acceleration mechanisms and on propagation effects. In addition, gamma rays can be used to study ultra high energy cosmic rays (UHECRs), by directly observing their sources. Gamma ray bursts (GRBs) have been proposed as possible UHECR accelerators. More specifically, low-luminosity GRBs are emerging as leading candidates. A new study on the detection prospects for such events with CTA is presented.

Primary author: Dr SADEH, Iftach (DESY-Zeuthen)

Presenter: Dr SADEH, Iftach (DESY-Zeuthen)

Session Classification: Sessions

Contribution ID: **86** Type: **ORAL**

Results from the first missions of the JEM-EUSO program

Thursday, October 11, 2018 3:20 PM (20 minutes)

The origin and nature of Ultra-High Energy Cosmic Rays (UHECRs) remain unsolved in contemporary astroparticle physics. To give an answer to these questions is rather challenging because of the extremely low flux of a few per km^2 per century at extreme energies such as E > 5 × 10^19eV. The objective of the JEM-EUSO program, Extreme Universe Space Observatory, is the realization of a space mission devoted to scientific research of cosmic rays of highest energies. Its super-wide-field telescope will look down from space onto the night sky to detect UV photons emitted from air showers generated by UHECRs in the atmosphere.
The JEM-EUSO program includes different missions using fluorescence detectors to make a proof-of-principle of the UHECR observation from space and to raise the technological level of the instrumentation to be employed in a space mission. EUSO-TA, installed at the Telescope Array site in Utah in 2013, is in operation. It has already detected 9 UHECRs in coincidence with Telescope Array fluorescence detector at Black Rock Mesa. EUSO-Balloon flew on board a stratospheric balloon in August 2014. It measured the UV intensity on forests, lakes and the city of Timmins as well as proved the observation of UHECR-like events by shooting laser tracks. EUSO-SPB was launched on board a super pressure balloon on April 25th and flew for 12 days. It proved the functionality of all the subsystems of the telescope on a long term; observed the UV emission on oceans and has a self-trigger system to observe UHECRs with energy E > 3x10^18 eV. TUS, the Russian mission on board the Lomonosov satellite in orbit since April 28th 2016, is now included in the JEM-EUSO program and has detected so far in the UHECR trigger-mode a few interesting signals. Mini-EUSO is in its final phase of integration in Italy, where several performance tests are being held. Mini-EUSO will be installed inside the International Space Station (ISS) in late 2018 or early 2019.
During this contribution I will summarise the main results obtained so far by such missions and put them in prospect of future space detectors such as K-EUSO and POEMMA.

Primary author: BERTAINA, Mario (University & INFN Torino)

Co-author: JEM-EUSO, Collaboration

Presenter: BERTAINA, Mario (University & INFN Torino)

Session Classification: Sessions

Contribution ID: **87** Type: **POSTER**

A Quality Control of High Speed Photon Detector

Tuesday, October 9, 2018 10:36 AM (3 minutes)

High speed photon detectors are one of the most important tools for observations of high energy cosmic rays. As technology of photon detectors and its read-out electronics improved rapidly, it became possible to observe cosmic rays with time resolution better than one nano-second. To utilize such devices effectively, calibration using a short-pulse light source is mandatory. We have developed a pulse laser of which width is 60 ps and peak intensity is adjustable up to 100 mW. This pulse laser is composed of a simple electric circuit and a laser diode. Details of this pulse laser and its application for quality controls of photon detectors are reported in this contribution.

Primary author: Mr INOME, Yusuke (Konan University, Icrr)

Co-authors: Prof. YAMAMOTO, Tokonatsu (Konan University, ICRR); Dr SAITO, Takayuki (ICRR); Mr SUNADA, Yuji (Saitama University); Mr CHOSHI, Yuki (Konan University); Mr TAMURA, Kenji (Konan University)

Presenters: Mr INOME, Yusuke (Konan University, Icrr); Prof. YAMAMOTO, Tokonatsu (Konan University, ICRR)

Session Classification: POSTER SESSION

Contribution ID: **88** Type: **ORAL**

Ultra-high energy neutrinos from neutron-star mergers

Tuesday, October 9, 2018 11:50 AM (20 minutes)

In the context of the recent multi-messenger observation of neutron-star merger GW170817, we examine whether such objects could be sources of ultra-high energy astroparticles. At first order, the energetics and the population number is promising to envisage the production of a copious amount of high-energy particles, during the first minutes to weeks from the merger. In addition, the strong radiative and baryonic environment in the kilonova ejecta can be an important background causing energy losses for cosmic-ray nuclei and producing associated high-energy neutrino emissions. We model the evolution of the photon density and the baryonic density in the kilonova ejecta and calculate numerically the signatures in terms of ultra-high energy neutrinos.

Primary authors: DECOENE, Valentin (Institut d'Astrophysique de Paris); FANG, Ke (University of Maryland); GUÉPIN, Claire (IAP); KOTERA, Kumiko (Institut d'Astrophysique de Paris)

Presenter: DECOENE, Valentin (Institut d'Astrophysique de Paris)

Session Classification: Sessions

Contribution ID: **89** Type: **ORAL**

Latest results on high-energy cosmic neutrino searches with the ANTARES neutrino telescope

Wednesday, October 10, 2018 2:30 PM (20 minutes)

The ANTARES detector is currently the largest undersea neutrino telescope. Located in the Mediterranean Sea at a depth of 2.5 km, 40 km off the Southern coast of France, it has been looking for cosmic neutrinos for more than 10 years. High-energy cosmic neutrino production is strongly linked with cosmic ray production. The latest results from IceCube represent a step forward towards the confirmation of a high energy cosmic ray source. The ANTARES location in the Northern Hemisphere is optimal for the observation of most of the Galactic Plane, including the Galactic Center. It has allowed to contribute independently on constraining the IceCube neutrino excess origin as well as, more recently, the flux from the source identified in the Blazar TXS 0506+056. The latest results of ANTARES on such analyses, including point-like and extended sources, diffuse fluxes, transient phenomena and multi-messenger studies, will be presented.

Primary author: SÁNCHEZ LOSA, Agustín (INFN - Sezione di Bari)

Presenter: SÁNCHEZ LOSA, Agustín (INFN - Sezione di Bari)

Session Classification: Sessions

Contribution ID: **90** Type: **INVITED**

High energy cosmic ray interactions and UHECR composition problem

Thursday, October 11, 2018 9:00 AM (30 minutes)

I'll discuss the differences between contemporary Monte Carlo generators of high energy hadronic interactions and their impact on the interpretation of experimental data on ultra-high energy cosmic rays (UHECRs). In particular, key directions for model improvements will be outlined. The prospect for a coherent interpretation of the data in terms of the primary composition will be investigated.

Primary author: Dr OSTAPCHENKO, Sergey (Frankfurt Institute for Advanced Studies (FIAS))

Presenter: Dr OSTAPCHENKO, Sergey (Frankfurt Institute for Advanced Studies (FIAS))

Session Classification: Sessions

Contribution ID: **91** Type: **ORAL**

Ultra-High-Energy Cosmic Rays and Neutrinos from Tidal Disruptions by Massive Black Holes

Tuesday, October 9, 2018 12:10 PM (20 minutes)

In addition to the emergence of time domain astronomy, the advent of multi-messenger astronomy opens up a new window on transient high-energy sources. Through the multi-messenger study of the most energetic objects in our universe, two fundamental questions can be addressed: what are the sources of ultra-high energy cosmic rays (UHECRs) and the sources of very-high energy neutrinos?

Jetted Tidal Disruption Events (TDEs) appear as interesting candidate sources of UHECRs, with their impressive energy reservoir and estimated occurrence rates. By modeling and simulating the propagation and interaction of UHECRs in various types of radiative backgrounds, we can evaluate the signatures of TDEs powering jets in UHECRs and neutrinos. We find that we can reproduce the latest UHECR spectrum and composition results of the Auger experiment for a range of reasonable parameters. The diffuse neutrino flux associated with this scenario is found to be subdominant, but nearby events could be detected by IceCube or next-generation detectors such as IceCube-Gen2.

Primary author: GUÉPIN, Claire (IAP)

Co-authors: KOTERA, Kumiko (Institut d'Astrophysique de Paris); BARAUSSE, Enrico (IAP/CNRS); FANG, Ke (University of Maryland); MURASE, Kohta (Penn State University)

Presenter: GUÉPIN, Claire (IAP)

Session Classification: Sessions

Contribution ID: **92** Type: **ORAL**

The space road to UHECR observations: challenges and expected rewards

Friday, October 12, 2018 11:50 AM (20 minutes)

Significant progress has been made in the last decade in the field of Ultra-High-Energy Cosmic Rays (UHECRs), thanks to the operation of large ground-based detectors and to the renewed theoretical interest that they triggered. While multi-messenger astronomy is rapidly developing worldwide, the sources of the charged messengers, namely the cosmic rays, are still to be determined, and the acceleration process to be understood. Even at the highest energies, the particle deflections by intervening magnetic fields appear to be too large to allow direct identification, at least with the current statistics. Concentrating on the highest energies has the advantage to reduce the number of sources, thanks to the so-called GZK effect, and thus potentially reduce source confusion. However, the very low flux of UHECRs in the GZK range requires huge detectors to be deployed. Alternatively, a single instrument could be used to significantly increase the current statistics if it could be operated from space, looking down to the nadir to detect the fluorescence light of UHECR-induced air showers over a huge volume of atmosphere. In addition, such a space mission would cover the whole celestial sphere and allow to draw the first complete map of UHECRs with essentially uniform coverage and systematics. Such a program has been undertaken by the JEM-EUSO Collaboration. In this talk, I will review the major steps taken along this road to space, including ground-based experiments and balloon flights. I will also present the future planned missions, on a super-pressure balloon as well as in/on the ISS. Finally, I will discuss the current efforts to extend the science case of such a mission to high-energy neutrino astronomy, complementing the ground-based neutrino detectors, and address the interesting issue of high-altitude UHECR shower, which only a space mission could observe.

Primary authors: PARIZOT, Etienne (APC - University Paris 7); JEM-EUSO, Collaboration

Presenter: PARIZOT, Etienne (APC - University Paris 7)

Session Classification: Sessions

Contribution ID: **93** Type: **POSTER**

Blazar flares as the origin of high-energy astrophysical neutrinos?

Tuesday, October 9, 2018 10:39 AM (3 minutes)

The IceCube Collaboration recently announced the detection of a high-energy astrophysical neutrino consistent with arriving from the direction of the blazar TXS 0506+056 during an energetic gamma-ray flare. In light of this finding, we consider the implications for neutrino emission from blazar flares in general. We discuss the likely total contribution of blazar flares to the diffuse neutrino intensity by considering an ensemble of observational constraints. Further, we consider the multi-messenger constraints from single-zone models, showing that neutrino flares must be accompanied by X-ray and gamma-ray emission. Finally, we suggest a two-zone model that can satisfy the X-ray constraints for the 2017 flare of TXS 0506+056, in which the neutrinos are produced via either photomeson or hadronuclear processes.

Primary authors: OIKONOMOU, Foteini (ESO); MURASE, Kohta (Penn State University); PETROPOULOU, Maria (Purdue University)

Presenter: OIKONOMOU, Foteini (ESO)

Session Classification: POSTER SESSION

Contribution ID: **94** Type: **POSTER**

UHECR 8 EeV dipole anisotropy hint of galactic pollution sources

The discover in AUGER of a dipole remarkable anisotropy it is statistically the most strong in the whole Ultra High Energy Cosmic Ray history. It implies a dipole anisotropy almost overlapping to the Argo-Hawc one at tens TeV energy. However
the tens TeV anisotropy it must be very local (galactic) one while the UHECR are supposed to be (as their name suggest) Cosmic ones.
We show that there are very convincing arguments that favor the presence in the anisotropy source of a nearby unique local UHECR source (few Mpc far) as NGC 253 star burst galaxy.
We also suggest that the few brightest galactic gamma sources as Vela, Crab and LMC might also be also the polluting galactic sources able to lead to such a bright anisotropy.

Primary author: FARGION, Daniele (Physics Departm Rome 1 INFN 1)

Presenter: FARGION, Daniele (Physics Departm Rome 1 INFN 1)

Session Classification: POSTER SESSION

Contribution ID: **95** Type: **ORAL**

A Close Correlation between TA Hotspot UHECR Events and Local Filaments of Galaxies and its Implication

Wednesday, October 10, 2018 5:35 PM (20 minutes)

The Telescope Array (TA) experiment identified a concentration of ultra-high-energy cosmic ray (UHECR) events on the sky, so-called hotspot. Besides the hotspot, the arrival directions of TA events show another characteristic feature, i.e., a deficit of events toward the Virgo cluster. As an effort to understand the sky distribution of TA events, we investigated the structures of galaxies around the hotspot region in the local universe. We here report a finding that there are filaments of galaxies, connected to the Virgo Cluster, and a correlation of statistical significance between the galaxy filaments and TA events. We then present an astrophysical model to explain the origin of the hotspot and the deficit of TA events.

Primary authors: Dr KIM, Jihyun (UNIST); Prof. RYU, Dongsu (UNIST); Prof. KANG, Hyesung (Pusan National University); Dr KIM, Suk (Korea Astronomy and Space Science Institute); Prof. REY, Soo-Chang (Chungnam National University)

Presenter: Dr KIM, Jihyun (UNIST)

Session Classification: Sessions

Contribution ID: **96** Type: **INVITED**

A next-generation ground array for the detection of ultrahigh-energy cosmic rays: the Fluorescence detector Array of Single-pixel Telescopes (FAST)

Friday, October 12, 2018 9:40 AM (20 minutes)

The origin and nature of ultrahigh-energy cosmic rays (UHECRs) is one of the most intriguing mys- teries in astroparticle physics. The two largest observatories currently in operation, the Telescope Array Experiment in central Utah, USA, and the Pierre Auger Observatory in western Argentina, have been steadily observing UHECRs in both hemispheres for over a decade. We highlight the latest results from both of these experiments, and address the requirements for a next-generation UHECR observatory. The Fluorescence detector Array of Single-pixel Telescopes (FAST) is a design concept for a next-generation UHECR observatory, addressing the requirements for a large-area, low-cost detector suitable for measuring the properties of the highest energy cosmic rays with an unprecedented aperture. We have developed a full-scale prototype consisting of four 200 mm photomultiplier-tubes at the focus of a segmented mirror of 1.6 m in diameter. In October 2016 and September 2017 we installed two such prototypes at the Black Rock Mesa site of the Telescope Array Experiment. Both telescopes have been steadily taking data since installation. We report on preliminary results of the full-scale FAST prototypes, including measurements of artificial light sources, distant ultra-violet lasers, and UHECRs. Futhermore, we discuss our plan to install an additional identical FAST prototype at the Pierre Auger Observatory. Possible benefits to the Telescope Array and the Pierre Auger Observatory include a comparison of the transparency of the atmosphere above both experiments, a study of the systematic uncertainty associated with their existing fluorescence detectors, and a cross-calibration of their energy and X_{max} scales.

Primary author: FUJII, Toshihiro (ICRR, University of Toyo)

Presenter: FUJII, Toshihiro (ICRR, University of Toyo)

Session Classification: Sessions

Contribution ID: **97** Type: **POSTER**

Simulation of the optical performance of the Fluorescence detector Array of Single-pixel Telescopes

Tuesday, October 9, 2018 4:00 PM (4 minutes)

The Fluorescence detector Array of Single-pixel Telescopes (FAST) is a proposed large-area, next-generation experiment for the detection of ultra-high energy cosmic rays via the atmospheric fluorescence technique. The telescope's large field-of-view (30°x30°) is imaged by four 200 mm photomultiplier-tubes at the focal plane of a segmented spherical mirror of 1.6 m diameter. Two prototypes are installed and taking data at the Black Rock Mesa site of the Telescope Array experiment in central Utah, USA. We present the process used for optimisation of the optical performance of this compact and low-cost telescope, which is based on a simulation of the telescope's optical point spread function.

Primary authors: MANDAT, Dusan (Institute of Physics of Academy of Science of The Czech Republic); FUJII, Toshihiro (ICRR, University of Toyo)

Presenters: MANDAT, Dusan (Institute of Physics of Academy of Science of The Czech Republic); FUJII, Toshihiro (ICRR, University of Toyo)

Session Classification: POSTER SESSION

Contribution ID: **98** Type: **INVITED**

Ultra High Energy Cosmic Ray Propagation and Source Signatures

Wednesday, October 10, 2018 9:00 AM (30 minutes)

Knowledge about the processes dictating UHECR losses during their propagation in extragalactic space allows the secondary species to be used to probe the source location. In this talk I will cover the state of our knowledge on these processes, and gives examples about properties of the sources that may be inferred from the observed secondary species at Earth. Some suggestion will also be provided as to how such multi-messenger studies may be taken further in the future.

Primary author: Prof. TAYLOR, Andrew

Presenter: Prof. TAYLOR, Andrew

Session Classification: Sessions

Contribution ID: **99** Type: **ORAL**

Results of the first orbital ultra-high-energy cosmic ray detector TUS in view of future space mission KLYPVE-EUSO

Thursday, October 11, 2018 3:00 PM (20 minutes)

The observation of ultra-high energy cosmic rays (UHECR) from Earth orbit relies on the detection of the UV fluorescence tracks of the extensive air shower (EAS). This technique is widely used by ground-based detectors. Analogous measurements from space will allow to achieve the largest instantaneous aperture for observation the whole sky with nearly homogeneous exposure. It is important for the efficient search for anisotropy, spectrum and composition of UHECR flux.
The first experience of UHECR measurements from space was obtained in the operation of the TUS (Tracking Ultraviolet Set-up) detector on board the Lomonosov satellite. It was launched on April 28, 2016. The TUS detector is a UV telescope with 2 m2 mirror and ±4.5° field of view. During two years of operation an important information on transient UV atmospheric emission which determine the conditions of measurements was obtained. The TUS trigger was optimized for EAS search but it has to operate in conditions of the atmosphere glow as of natural origin (aurora light, scattered moon light, thunderstorm) so of anthropogenic origin (city light). Search for EAS events in the TUS data and their analysis with an emphasis on a strong UHECR candidate registered on October 3, 2016 has been done. Conditions of the measurements were studied to exclude thunderstorm atmospheric events and anthropogenic sources. An arrival direction and energy of a primary particle have been estimated basing on results of simulations and new reconstruction algorithms.
KLYPVE-EUSO (K-EUSO) is the next step in the program for UHECR studies from space. It is a large fluorescence telescope has to be installed at the Mini-Research Module of the Russian Segment (RS) of the International Space Station (ISS). Recently the design studies were done by SINP MSU together with the JEM-EUSO collaboration based on the TUS experience and the collaboration expertise to enhance the instrument performance with improved detector of larger field of view. The optical design is based on the Schmidt telescope including the 4 m diameter carbon plastic mirror and the 2.5 m corrector lens, made of Poly Methyl Methacrylate (PMMA). This allows to increase the telescope field of view to 40 degrees The focal surface of K-EUSO is nearly identical to that of JEM-EUSO and consists of ~105 pixels with 1 mrad angular resolution. The launch of the experiment is scheduled to 2022 on the RS of the ISS for at least two years of operation.

Primary author: KLIMOV, P.

Presenter: KLIMOV, P.

Session Classification: Sessions

Contribution ID: **101** Type: **ORAL**

Supergalactic Structure of Multiplets with the Telescope Array Surface Detector

Tuesday, October 9, 2018 2:00 PM (20 minutes)

Evidence of supergalactic structure of multiplets has been found for ultra-high energy cosmic rays (UHECR) with energies above 10^{19} eV using 7 years of data from the Telescope Array (TA) surface detector. The tested hypothesis is that UHECR sources, and intervening magnetic fields, may be correlated with the supergalactic plane, as it is a fit to the average matter density within the GZK horizon. This structure is measured by the average behavior of the strength of intermediate-scale correlations between event energy and distance (multiplets). These multiplets are measured in wedge-like shapes on the spherical surface of the field-of-view to account for uniform and random magnetic fields. The evident structure found is consistent with toy-model simulations of a supergalactic magnetic sheet and the previously published Hot/Coldspot results of TA. The post-trial probability of this feature appearing by chance, on an isotropic sky, is found by Monte Carlo simulation to be ~4.5σ.

Primary author: LUNDQUIST, Jon Paul (University of Utah - Telescope Array)

Co-author: SOKOLSKY, Pierre (University of Utah)

Presenter: LUNDQUIST, Jon Paul (University of Utah - Telescope Array)

Session Classification: Sessions

Contribution ID: **102** Type: **ORAL**

Air showers, hadronic models, and muon production.

Thursday, October 11, 2018 2:20 PM (20 minutes)

We report on a study about the mechanisms of muon production during the development of extended air showers initiated by ultra-high-energy cosmic rays. In particular, we analyze and discuss on the observed discrepancies between experimental measurements and simulated data.

Primary author: SCIUTTO, Sergio (Departamento de Física - Universidad Nacional de La Plata - Argentina)

Presenter: SCIUTTO, Sergio (Departamento de Física - Universidad Nacional de La Plata - Argentina)

Session Classification: Sessions

Contribution ID: **103** Type: **ORAL**

Latest cosmic-ray results from IceCube and IceTop

Tuesday, October 9, 2018 4:30 PM (20 minutes)

The IceCube Neutrino Observatory at the geographic South Pole, with its surface array IceTop, detects three different components of extensive air showers: the total signal at the surface, low energy muons in the periphery of the showers, and high energy muons in the deep array of IceCube. These three components allow for a variety of cosmic ray measurements including the energy spectrum and composition of cosmic rays from the PeV to EeV, the anisotropy in the distribution of cosmic ray arrival directions, the muon density of cosmic ray air showers, and the PeV gamma ray flux. Furthermore, IceTop can be used as a veto for the neutrino measurements. The latest results from these IceTop analyses will be presented along with future plans.

Primary author: ANDEEN, Karen (Marquette University)

Co-author: Dr PLUM, Matthias (Marquette University)

Presenter: ANDEEN, Karen (Marquette University)

Session Classification: Sessions

Contribution ID: **104** Type: **ORAL**

The cosmogenic neutrino flux determines the fraction of protons in UHECRs

Wednesday, October 10, 2018 3:30 PM (20 minutes)

When UHECRs propagate through the universe, cosmogenic neutrinos are created via several interactions. In general, the expected flux of these cosmogenic neutrinos depends on multiple parameters describing the sources and propagation of UHECRs. However, using CRPropa, we show that a 'sweet spot' occurs at a neutrino energy of ~1 EeV. At that energy this flux only depends strongly on two parameters, the source evolution and the fraction of protons in UHECRs. These parameters are already constrained by current neutrino experiments, indicating that the sources of UHECRs cannot have a large proton fraction and a strong source evolution. Upcoming neutrino experiments will be able to constrain the fraction of protons in UHECRs even further, and for any realistic model for the evolution of UHECR sources.

Primary author: Dr VAN VLIET, Arjen (DESY Zeuthen)

Co-authors: Dr ALVES BATISTA, Rafael (Universidade de São Paulo); Dr HÖRANDEL, Jörg (Radboud University Nijmegen)

Presenter: Dr VAN VLIET, Arjen (DESY Zeuthen)

Session Classification: Sessions

Contribution ID: **105** Type: **INVITED**

POEMMA: Probe Of Multi-Messenger Astrophysics

Friday, October 12, 2018 12:10 PM (20 minutes)

Developed as a NASA Astrophysics Probe mission concept study, the Probe Of Multi-Messenger Astrophysics (POEMMA) science goals are to identify the sources of ultra-high energy cosmic rays (UHECRs) and to observe cosmic neutrinos above 10 PeV. POEMMA consists of two satellites flying in loose formation at 525 km altitudes. A novel focal plane design is optimized to observe the UV air fluorescence signal in a stereoscopic UHECR observation mode and the Cherenkov signals from air showers from UHECRs and neutrino-induced tau leptons in an Earth-limb viewing mode. POEMMA is designed to achieve full-sky coverage and significantly higher sensitivity to the highest energy cosmic messengers compared to what have been achieved so far by ground-based experiments. POEMMA will measure the spectrum, composition, and full sky distribution of the UHECRs above 10 EeV to identify the most energetic cosmic accelerators in the universe and study the acceleration mechanism(s). POEMMA will also have high sensitivity to cosmogenic neutrinos by observing the upward-moving air showers induced from tau neutrino interactions in the Earth. POEMMA will also be able to re-orient to a Target-of-Opportunity (ToO) neutrino mode to view transient astrophysical sources. In this talk, the science goals, instrument design, launch and mission profile, and simulated UHECR and neutrino measurement capabilities for POEMMA will be presented.

Primary author: Dr KRIZMANIC, John (CRESST/NASA//GSFC/UMBC)

Presenter: Dr KRIZMANIC, John (CRESST/NASA//GSFC/UMBC)

Session Classification: Sessions

Contribution ID: **106** Type: **POSTER**

A comparative study of the ”muon excess” in extensive air showers

The excess of muons in observed extensive air showers with respect to Monte-Carlo simulations shows up itself in the data of various experiments and under different conditions. We present a comparative quantitative analysis of the muon content of showers observed at various energies, zenith angles, core distances etc. by several experiments.

Primary authors: KARPIKOV, Ivan (INR RAS); Prof. KALMYKOV, Nikolai (SINP MSU); Prof. RUBTSOV, Gregory (INR RAS); Prof. TROITSKY, Sergei (INR RAS); ZHEZHER, Yana (INR RAS)

Presenter: KARPIKOV, Ivan (INR RAS)

Session Classification: POSTER SESSION

Contribution ID: **107** Type: **ORAL**

Cosmogenic neutrinos from a combined fit of the Auger spectrum and composition

Tuesday, October 9, 2018 2:40 PM (20 minutes)

We present a combined fit of the Auger spectrum and composition based on a newly developed code for the extragalactic propagation of cosmic ray nuclei (PriNCe). This very efficient numerical solver of the transport equations allows for scans over large ranges of unknown UHECR source parameters.

Here, we present a study of a generalized source population with three parameters (rigidity-dependent maximal energy, spectral index and redshift evolution). By scanning over the redshift source evolution we derive a robust estimate of the allowed range of the cosmogenic neutrino flux.

We also test the robustness under alternative assumptions for the source model. Specifically the impact of using different air-shower models.

Primary authors: HEINZE, Jonas; Dr BONCIOLI, Denise; Dr FEDYNITCH, Anatoli; Dr WINTER, Walter

Presenter: HEINZE, Jonas

Session Classification: Sessions

Contribution ID: **108** Type: **INVITED**

Detection of ultra-high energy cosmic ray air showers by Cosmic Ray Air Fluorescence Fresnel-lens Telescope for next generation

Friday, October 12, 2018 10:00 AM (20 minutes)

In the future, ultra-high energy cosmic ray (UHECR) observatory will be expanded due to the small flux. Then, cost reduction is useful strategy to realize a huge scale observatory. For this purpose, we are developing a simple structure cosmic ray detector named as Cosmic Ray Air Fluorescence Fresnel-lens Telescope (CRAFFT). We deployed CRAFFT detectors at the Telescope Array site and performed the test observation. We have successfully observed UHECR air showers. We will report the status and the result of the test observation.

Primary authors: Dr TAMEDA, Yuichiro (Osaka Electro-Communication University); Mr YAMAMOTO, Mashu (Shinshu University)

Co-authors: TOMIDA, Takayuki (Shinshu University); Dr IKEDA, Daisuke (Earthquake Research Institute,The University of Tokyo); Dr YAMAZAKI, Katsuya (Kanagawa University); Mr IWAKURA, Hirokazu (Shinshu University); Mr NAKAMURA, Yuya (Shinshu University); Prof. SAITO, Yasunori (Shinshu University); Mr KAINO, Yuki (Osaka Electro-Communication University); Ms OGOSHI, Yurina (Osaka Electro-Communication University)

Presenter: Dr TAMEDA, Yuichiro (Osaka Electro-Communication University)

Session Classification: Sessions

Contribution ID: **109** Type: **ORAL**

Leading cluster approach to simulations of hadron collisions with GHOST generator

Thursday, October 11, 2018 3:40 PM (20 minutes)

We present the current version of generator GHOST which can be used in the simulation of Non Diffractive (ND),Non Single Diffractive (NSD), single diffractive (SD) and double diffractive (DD) events at cosmic ray energies.
The generator is based on four-gaussian parameterization of pseudorapidity distribution which is related to the leading cluster approach in distribution of secondary particles. Rapidity and pseudo-rapidity, the charged multiplicity distribution (as well as total multiplicity including neutral secondaries) is derived using the negative binomial distribution as used previously in ISR and LHC. The transverse momenta pt are taken from the power law distribution inserted in CORSIKA code. Recently we updated the model using lately measured pseudorapidity distributions of neutrons , ⊠'s and photons by the group of LHCf.
Rapidity and pseudo-rapidity distributions, the average multiplicity and average central densities at √s= 0.2, 1, 7, 8, 13 TeV we obtained and we have provided guide lines for extrapolations above 14 TeV. We observed a possible convergence of the negative binomial distribution in the energy range 8-13 TeV in agreement with by the theoretical limit at ~√s = 40 TeV expected for the SSC …25 years ago.

Primary authors: CAPDEVIELLE, Jean-Noel (APC et IRFU CEA-Saclay); J,SZABELSKI,; B. SZABELSKA; Z.PLEBANIAK

Presenter: CAPDEVIELLE, Jean-Noel (APC et IRFU CEA-Saclay)

Session Classification: Sessions

Contribution ID: **111** Type: **INVITED**

Measurements of UHECR Mass Composition by Telescope Array

Tuesday, October 9, 2018 9:50 AM (20 minutes)

Telescope Array (TA) has recently published results of nearly nine years of $X_{\max}$ observations providing it's highest statistics measurement of UHECR mass composition to date for energies exceeding $10^{18.2}$ eV. This analysis measured agreement of observed data with results expected for four different single elements. Instead of relying only on the first and second moments of $X_{\max}$ distributions, we have employed a morphological test of agreement between data and Monte Carlo to allow for systematic uncertainties in data and in current UHECR hadronic models. Results of this latest analysis and implications of UHECR composition observed by TA will be presented. TA can utilize different analysis methods to understand composition as both a crosscheck on results and as a tool to understand systematics affecting $X_{\max}$ measurements. The different analysis efforts underway at TA to understand composition will also be discussed.

Primary author: HANLON, William (University of Utah)

Presenter: HANLON, William (University of Utah)

Session Classification: Sessions

Contribution ID: **112** Type: **POSTER**

anisotropy by UHECR at 60 EeV ruled by lightest nuclei mainly originated from CenA, M82, NGC 253 near AGN.

The very recent anisotropy at highest UHECR energies is smootly clustering in several wide spots (or hot spots) : Cen A, M82, NGC 253 are at a few Mpc distance and are possible the main sources of these anisotropies in AUGER and TA data.
Because the Virgo absence and the UHECR airshower slat depth most of UHECR are lightest nuclei. Other additional growing clustering may be related to well known Z-Burst model where the relic neutrinos are the sterile ones at 1,6 eV. Future signature in those clustering area of a nucleon composition may test this exciting and extreme astro-particle model.

Primary author: FARGION, Daniele (Physics Departm Rome 1 INFN 1)

Presenter: FARGION, Daniele (Physics Departm Rome 1 INFN 1)

Session Classification: POSTER SESSION

Contribution ID: **113** Type: **POSTER**

New Constraints on the Random Magnetic Field of the Galaxy

Tuesday, October 9, 2018 4:10 PM (4 minutes)

The knowledge of the magnitude and coherence length of the random component of the Galactic Magnetic Field (GMF) is of fundamental importance for establishing the rigidity threshold above which astronomy with charged particles is possible.

Here we present a new study of the random component of the GMF using synchrotron intensity as measured by Planck, WMAP and Haslam et al and combine it for the first time with the observed fluctuations of the rotation measures of extragalactic radio sources. This combined information allows us to constrain both, the strength and coherence length of random magnetic field in the Galaxy.

Primary author: UNGER, Michael (KIT)

Co-author: FARRAR, Glennys

Presenter: UNGER, Michael (KIT)

Session Classification: POSTER SESSION

Contribution ID: **114** Type: **INVITED**

High-energy emissions from neutron star mergers

Tuesday, October 9, 2018 11:20 AM (30 minutes)

ast year, LIGO-VIRGO collaborations reported detection of the first neutron star merger event, GW170817, which accompanied with observations of electromagnetic counterparts from radio to gamma rays. High-energy gamma rays and neutrinos were not observed. However, the mergers of neutron stars are expected to produce these high-energy particles. Relativistic jets are expected to be launched when the neutron stars merge, which can be a source of high-energy neutrinos. Also, the central remnant object after the merger event, either a black hole or a neutron star, can produce high-energy photons weeks to months after the merger. In addition, the neutron star mergers produce massive and fast ejecta, which can be a source of Galactic high-energy cosmic rays, analogous to supernova remnants. In this talk, I will discuss these high-energy processes and prospects for multi-messenger detections related to the neutron star mergers .

Primary author: KIMURA, Shigeo (Pennsylvania State University)

Presenter: KIMURA, Shigeo (Pennsylvania State University)

Session Classification: Sessions

Contribution ID: **115** Type: **INVITED**

Telescope Array search for ultra-high energy photons and neutrinos

Tuesday, October 9, 2018 11:00 AM (20 minutes)

We report the ultra-high energy (> 1EeV) photon flux limits based on the analysis of the 9 years data from the Telescope Array Surface detector. The multivariate classifier is built upon 16 reconstructed parameters of the extensive air shower. These parameters are related to the curvature and the width of the shower front, the steepness of the lateral distribution function and the timing parameters of the waveforms sensitive to the shower muon content. A total number of 2 photon candidates found in the search which is fully compatible with the expected background. The diffuse flux limits as long as the point source flux limits for all directions in the Northern hemisphere are presented. We report the limits on ultra-high energy down-going neutrino search.

Primary authors: RUBTSOV, Grigory (Institute for Nuclear Research of the Russian Academy of Sciences); TELESCOPE ARRAY COLLABORATION

Presenter: RUBTSOV, Grigory (Institute for Nuclear Research of the Russian Academy of Sciences)

Session Classification: Sessions

Contribution ID: **130** Type: **POSTER**

Development of the calibration device using UAV mounted UV-LED light source for the fluorescence detector

Tuesday, October 9, 2018 10:55 AM (2 minutes)

We are developing a standard light source with UV-LED of calibration device for fluorescence detector (FD). This device is called Opt-copter. The standard light source is mounted on the UAV, and it can stay at an arbitrary position within the FOD of the FD. The GPS for surveying is highly accurate (~10 cm) and measures the position of the light source synchronously with the light emission. This allows us to better understand the geometric optics properties of FD.

Primary authors: Dr TOMIDA, Takayuki (Shinshu University); Mr INADOMI, Taichi (Shinshu university)

Co-authors: Mr SEKI, Terutsugu (Shinshu University); TAMEDA, Yuichiro (Osaka Electro-Communication University); Mr SANO, Kengo (Shinshu University); Mr OKU, Yuya (Osaka Electro-Communication University); Prof. SAITO, Yasunori (Shinshu university)

Presenters: Dr TOMIDA, Takayuki (Shinshu University); FOR TA COLLABORATION

Session Classification: POSTER SESSION

Contribution ID: **131** Type: **POSTER**

Atmospheric transparency measurement on Telescope Array site by the central laser facility

Tuesday, October 9, 2018 4:16 PM (4 minutes)

The TA experiment has three FD stations these containing 38 FDs.
In addition, 16 FD was newly added by TAx4 and TALE.
In order to reconstruct FD observation data to air shower information, it is necessary to calibrate the influence of aerosol attenuation. CLF measures atmospheric transparency of TA site.

Primary authors: Mr UEHAMA, Takafumi (Shinshu University); Dr TOMIDA, Takayuki (Shinshu University)

Co-authors: Dr UDO, Shigeharu (Kanagawa University); Prof. SAITOH, Yasunori (Shinshu University)

Presenters: Dr TOMIDA, Takayuki (Shinshu University); FOR THE TELESCOPE ARRAY COLLABORATION

Session Classification: POSTER SESSION

Contribution ID: **132** Type: **POSTER**

Cloud monitoring at Telescope Array site by Visible Fisheye CCD.

Wednesday, October 10, 2018 10:30 AM (3 minutes)

The Telescope Array (TA) is an international experiment studying ultra-high energy cosmic rays. TA uses fluorescence detection technology to observe cosmic rays, and in order to estimate the flux of cosmic rays with the observation of the fluorescence detector (FD), it is necessary to estimate the condition of FD observation area correctly.
Because the cloud has a great influence on the Field Of View (FOV) of the FD, it is necessary to measure the cloud amount and formation on the FOV.
We realize the cloud monitor in the night sky with ccd camera.
In this report, we will introduce the result of CCD cloud monitor.

Primary authors: Dr TOMIDA, Takayuki (Shinshu University); Mr NAKAMURA, Ryo (Shinshu University)

Co-authors: Dr YAMAZAKI, Katsuya (Kanagawa University); Prof. SAITOH, Yasunori (Shinshu University)

Presenters: Dr TOMIDA, Takayuki (Shinshu University); FOR THE TELESCOPE ARRAY COLLABORATION

Session Classification: POSTER SESSION

Contribution ID: **133** Type: **ORAL**

Recent results from the LHCf experiment

Thursday, October 11, 2018 12:15 PM (20 minutes)

The LHCf experiment aims for measurements of the forward neutral particles at an LHC interaction point to test hadronic interaction models which are widely used in cosmic-ray air-shower simulations. The LHCf had an operation with proton-proton collisions at the center of mass collision energy of 13 TeV in 2015. The LHCf detectors were composed of sampling and imaging calorimeters and they were installed at both sides of the ATLAS interaction point. We have measured the energy spectra of very forward photons and neutrons and these results will be reviewed in the presentation.
We also performed a joint analysis with the ATLAS experiment to measure the contribution of diffractive interactions on the forward photon production. In additions to operations at LHC, we had an operation at BNL-RHIC with proton-proton at 510 GeV collision energy to evaluate the energy scaling of forward particle production. These activities will be introduced in the presentation also.

Primary author: MENJO, Hiroaki (ISEE, Nagoya University, Japan)

Co-author: LHCF COLLABORATION

Presenter: MENJO, Hiroaki (ISEE, Nagoya University, Japan)

Session Classification: Sessions

Contribution ID: **134** Type: **ORAL**

NICHE: Air-Cherenkov light observation at the TA site

Monday, October 8, 2018 5:05 PM (20 minutes)

An array of non-imaging Cherenkov light collectors has recently been installed at the Telescope Array Middle Drum site, in the field-of-view of the TALE FD telescopes. This allows for imaging/non-imaging Cherenkov hybrid observations of air showers in the energy range just above 1 PeV. The performance of the array and the first analyses using hybrid measurements will be presented.

Primary authors: Prof. BERGMAN, Douglas (University of Utah); Prof. TSUNESADA, Yoshiki (Osaka City University); KRIZMANIC, John (CRESST/NASA//GSFC/UMBC); Mr OMURA, Yugo (Osaka City University)

Presenter: Prof. BERGMAN, Douglas (University of Utah)

Session Classification: Sessions

Contribution ID: **135** Type: **ORAL**

The Cosmic-Ray Energy Spectrum between 2 PeV and 2 EeV Observed with the TALE detector in monocular mode

Tuesday, October 9, 2018 4:50 PM (20 minutes)

We present a measurement of the cosmic ray energy spectrum by the Telescope Array Low-Energy Extension (TALE) air fluorescence detector (FD). The TALE FD is also sensitive to the Cherenkov light produced by shower particles. Low energy cosmic rays, in the PeV energy range, are detectable by TALE as "Cherenkov Events". Using these events, we measure the energy spectrum from a low energy of ~2 PeV to an energy greater than 100 PeV. Above 100 PeV TALE uses the air fluorescence technique to reach energies of a few EeV. In this talk, we will describe the detector, explain the technique, and present results from a measurement of the spectrum using ~1080 hours of observation. The observed spectrum shows a clear steepening near 10^{17.1} eV, along with an ankle-like structure at 10^{16.2} eV. These features present important constraints on galactic cosmic rays origin and propagation models. The feature at 10^{17.1} eV may also mark the end of the galactic cosmic rays flux and the start of the transition to extra-galactic sources.

Primary authors: ABUZAYYAD, Tareq; JUI, Charles

Presenter: JUI, Charles

Session Classification: Sessions

Contribution ID: **136** Type: **INVITED**

Status and prospects of the TAx4 experiment

Friday, October 12, 2018 9:00 AM (20 minutes)

The TAx4 experiment is a project to observe highest energy cosmic rays by expanding the detection area of the TA experiment with newly constructed surface detectors (SDs) and fluorescence detectors (FDs). The construction of both SDs and FDs is ongoing. New SDs are arranged in a square grid with 2.08 km spacing at the north east and south east of the TA SD array. Field of view of new FDs overlaps the detection area of new SDs to observe SD FD hybrid events. New SDs are planning to be deployed early next year. The first light with new FDs was already observed on February 2018. The prospects of the detectors will be shown in this talk. Especially the hotspot and energy spectrum anisotropy are expected to be understood in more detail from the implications obtained by the TA experiment. The expectation of the physics will be also shown in this talk.

Primary author: Dr KIDO, Eiji (Institute for Cosmic Ray Research, University of Tokyo)

Presenter: Dr KIDO, Eiji (Institute for Cosmic Ray Research, University of Tokyo)

Session Classification: Sessions

Contribution ID: **137** Type: **INVITED**

Hadronic interaction studied by TA

Thursday, October 11, 2018 9:50 AM (20 minutes)

Telescope Array (TA) is measuring ultra-high energy cosmic rays in the Northern hemisphere since 2008. Using hybrid detectors namely surface detector array (SD) and fluorescence telescopes (FD), TA can measure the lateral and longitudinal developments of extensive air showers, respectively, in detail. Recent analysis of SD data reveals the excess of muons at large distance from the shower core with respect to the MC predictions. Deep penetrating showers observed by FD were used to determine the p-air inelastic cross section. These measurements are useful to study the hadronic interaction beyond the energy of current accelerator reach. In this talk, we will review the TA results relevant to study the high-energy hadronic interaction.

Primary author: SAKO, Takashi (ICRR, University of Tokyo)

Presenter: SAKO, Takashi (ICRR, University of Tokyo)

Session Classification: Sessions

Contribution ID: **138** Type: **INVITED**

TA Anisotropy Summary

Wednesday, October 10, 2018 4:20 PM (25 minutes)

The Telescope Array (TA) is the largest ultra-high-energy cosmic-ray (UHECR) detector in the northern hemisphere, which consists of 507 surface detector (SD) covering a total 700 km^2 and three fluorescence detector stations. In this presentation, we will summarize recent results on the search for directional anisotropy of UHECRs using the latest data set collected by the TA SD array.

Primary author: KAWATA, Kazumasa (ICRR, University of Tokyo)

Presenter: KAWATA, Kazumasa (ICRR, University of Tokyo)

Session Classification: Sessions

Contribution ID: **139** Type: **POSTER**

CRPropa 3.2: Improved and extended open-source astroparticle propagation framework from TeV to ZeV energies

Wednesday, October 10, 2018 10:33 AM (3 minutes)

Experimental observations of Galactic and extragalactic cosmic rays, neutrinos and gamma rays in the last decade challenge the theoretical description of both the sources and the transport of these particles. The latest version of the publicly available simulation framework CRPropa 3.2 is a Monte-Carlo based software package capable of providing consistent solutions of the cosmic-ray origin problem. It is not only able to describe the propagation of Galactic and extragalactic cosmic rays in a ballistic single-particle approach, but can also solve a cosmic-ray transport equation, describe the production and propagation of neutrinos and electromagnetic cascades, and simulate the cosmic-ray acceleration inside their sources. This combined approach will allow for a consistent description of cosmic rays, neutrinos and photons from the highest energies down to the TeV range, including electromagnetic cascades down to the GeV range. This contribution will summarize the latest extensions and improvements of the code, e.g. solving the transport equation, revamped electromagnetic cascades, source targeting, cosmic-ray acceleration and many technical enhancements. The new opportunities coming with these developments will be explained including simple user examples.

Primary author: Dr VAN VLIET, Arjen (DESY Zeuthen)

Co-authors: Dr ALVES BATISTA, Rafael (Universidade de São Paulo); Prof. BECKER TJUS, Julia (Ruhr-Universität Bochum); Mr DUNDOVIC, Andrej (University of Hamburg); Prof. ERDMANN, Martin (RWTH Aachen University); Mr HEITER, Christopher (Max Planck Institute for Radio Astronomy); Prof. KAMPERT, Karl-Heinz (Bergische Universität Wuppertal); Dr KUEMPEL, Daniel (RWTH Aachen University); Mr MERTEN, Lukas (Ruhr-Universität Bochum); Mr MÜLLER, Gero (RWTH Aachen University); Prof. SIGL, Günter (University of Hamburg); Dr WALZ, David (RWTH Aachen University); Dr WINCHEN, Tobias (Vrije Universiteit Brussel); Mr WIRTZ, Marcus (RWTH Aachen University)

Presenter: Dr VAN VLIET, Arjen (DESY Zeuthen)

Session Classification: POSTER SESSION

Contribution ID: **140** Type: **POSTER**

Origins of Extragalactic Cosmic Ray Nuclei by Contracting Alignment Patterns induced in the Galactic Magnetic Field

Wednesday, October 10, 2018 10:36 AM (3 minutes)

We present a novel approach to search for origins of ultra-high energy cosmic rays. In a simultaneous fit to all observed cosmic rays we use the galactic magnetic field as a mass spectrometer and adapt the nuclear charges such that their extragalactic arrival directions are concentrated in as few directions as possible. During the fit the nuclear charges are constraint by the individual energy and shower depth measurements. Using different simulated examples we show that, with the measurements on Earth, reconstruction of extragalactic source directions is possible. In particular, we show in an astrophysical scenario that source directions can be reconstructed even within a substantial isotropic background.

Primary authors: Mr WIRTZ, Marcus (RWTH Aachen University); Prof. ERDMANN, Martin (RWTH Aachen University); Mr GEIGER, Lukas (RWTH Aachen University); Mr SCHMIDT, David (RWTH Aachen University); Mr URBAN, Martin (RWTH Aachen University)

Presenter: Mr WIRTZ, Marcus (RWTH Aachen University)

Session Classification: POSTER SESSION

Contribution ID: **142** Type: **POSTER**

The detection of UHECRs with the EUSO-TA telescope

Wednesday, October 10, 2018 10:39 AM (3 minutes)

EUSO-TA is a cosmic ray detector developed by the JEM-EUSO Collaboration (Joint Experiment Missions for Extreme Universe Space Observatory), observing during nighttime the fluorescence light emitted through the path of extensive air showers in the atmosphere. It is installed at the Telescope Array site in Utah, USA, in front of the fluorescence detector station in Black Rock Mesa, as ground-based pathfinder experiment for a future space-based mission.
EUSO-TA has an optical system with two Fresnel lenses and a focal surface with 6×6 multi-anode photomultiplier tubes with 64 channels each, for a total of 2304 channels. The overall field of view is $10.6° \times 10.6°$. This detector technology allows the detection of cosmic ray events with high spatial resolution, having each channel a field of view of about $0.2° \times 0.2°$ and a temporal resolution of $2.5\,\mu$s.
The observation of the first ultra high energy cosmic rays, supported by dedicated simulation studies, revealed the cosmic ray detection capability of EUSO-TA. Simulations were also used to test the trigger algorithm which will make the detector autonomous rather than working in coincidence with the Telescope Array fluorescence detectors. The foreseen upgrade of EUSO-TA will improve the efficiency of the detector and will increase the statistics of detected events.
In this work I will report on the recent results about the detection capability of EUSO-TA and its limits, passing through the variation of signals depending on the energy and geometry of the extensive air showers.

Primary authors: BISCONTI, Francesca (INFN Sezione di Torino); JEM-EUSO COLLABORATION

Presenters: BISCONTI, Francesca (INFN Sezione di Torino); BERTAINA, Mario (Univ. of Torino, Italy); SHINOZAKI, Kenji (University of Torino, Italy)

Session Classification: POSTER SESSION

Contribution ID: **143** Type: **ORAL**

Data-driven model of the cosmic-ray flux and mass composition over all energies

Monday, October 8, 2018 5:25 PM (20 minutes)

We present a parametrisation of the cosmic-ray flux and its mass composition over an energy range from 1 GeV to 10^{11} GeV, which can be used for theoretical calculations. The parametrisation provides a summary of the experimental state-of-the-art for individual elements from proton to nickel. We seamlessly combine measurements of the flux of individual elements from high-precision satellites and balloon experiments with indirect measurements of mass groups from the leading air shower experiments. We propagate both statistical and systematic uncertainties with correlations, and obtain a large flux covariance matrix as a result which can be further propagated. Variations in the energy scales of individual experiments are taken into account with nuisance parameters. We obtain a unified energy scale and adjustment factors for the energy scales of the participating experiments. Our fit has a reduced chi2 value of 1, showing that the data sets are in good agreement, if systematic uncertainties are taken into account.

Primary authors: DEMBINSKI, Hans (Max Planck Institute for Nuclear Physics, Heidelberg); Dr FEDYNITCH, Anatoli; GAISSER, Thomas (University of Delaware)

Presenter: DEMBINSKI, Hans (Max Planck Institute for Nuclear Physics, Heidelberg)

Session Classification: Sessions

Contribution ID: **144** Type: **POSTER**

Investigating an angular correlation between nearby starburst galaxies and ultrahigh-energy cosmic rays with the Telescope Array experiment

Tuesday, October 9, 2018 4:20 PM (5 minutes)

The arrival directions of cosmic rays detected by the Pierre Auger Observatory (Auger) with energies above 39 EeV were recently reported to correlate with the positions of 23 nearby starburst galaxies (SBGs): in their best-fit model, 9.7% of the cosmic-ray flux originates from these objects and undergoes angular diffusion on a 12.9° scale. On the other hand, some of the SBGs on their list, including the brightest one (M82), are at northern declinations outside the Auger field of view. Data from detectors in the northern hemisphere would be needed to look for cosmic-ray excesses near these objects. In this work, we preliminarily tested the Auger best-fit model against data collected by the Telescope Array (TA) in a 9-year period, without trying to re-optimize the model parameters for our dataset in order not to introduce statistical penalties. The resulting test statistic (double log-likelihood ratio) was -0.54, corresponding to 1.2σ significance among isotropically generated random datasets, and to -1.3σ significance among ones generated assuming the Auger best-fit model. In other words, our data is still insufficient to conclusively rule out either hypothesis. The ongoing fourfold expansion of TA will collect northern hemisphere data with much more statistics, improving our ability to discriminate between different flux models.

Primary authors: DI MATTEO, Armando (ULB, Brussels, Belgium); FUJII, Toshihiro (ICRR, University of Toyo); KAWATA, Kazumasa (ICRR, University of Tokyo)

Co-author: FOR THE TELESCOPE ARRAY COLLABORATION

Presenter: DI MATTEO, Armando (ULB, Brussels, Belgium)

Session Classification: POSTER SESSION

Contribution ID: **145** Type: **INVITED**

The extragalactic gamma-ray background above 100 MeV

Wednesday, October 10, 2018 10:00 AM (30 minutes)

I will review our knowledge about the properties and the origin of the extragalactic gamma-ray background above 100 MeV. Since the universe is transparent to MeV and GeV gamma rays up to very high redshifts, the extragalactic gamma-ray background contains the imprint of all gamma-ray emission from the beginning of star formation until the present day. Its properties have important implications in the context of multi-messenger astronomy and put constraints on beyond-the-standard-model physics.

Primary author: ACKERMANN, Markus (DESY)

Presenter: ACKERMANN, Markus (DESY)

Session Classification: Sessions

Contribution ID: **149** Type: **INVITED**

TA Spectrum

Monday, October 8, 2018 2:50 PM (25 minutes)

Telescope Array (TA) is measuring cosmic rays of energies from PeV to 100 EeV and higher in the Northern hemisphere. TA has two parts: main TA and the TA low energy extension (TALE). Main TA is a hybrid detector that consists of 507 plastic scintillation counters on a 1200m - spaced square grid that are overlooked by three fluorescence detector stations. TALE is also a hybrid detector and it consists of additional fluorescence telescopes arranged to view higher elevations and an infill array of 100 plastic scintillation counters. In this work, we present a combined spectrum, over 5 orders of magnitude in energy, measured by the TA and TALE and compare this results with other experiments.

Primary author: IVANOV, Dmitri (University of Utah)

Presenter: IVANOV, Dmitri (University of Utah)

Session Classification: Sessions

Contribution ID: **150** Type: **POSTER**

TA SD Spectrum

Wednesday, October 10, 2018 10:42 AM (3 minutes)

Telescope Array (TA) is a large cosmic ray detector in the Northern hemisphere that measures cosmic rays of energies from PeV to 100 EeV and higher. Main TA consists of a surface detector (SD) of 507 plastic scintillation counters of 1200 m separation on a square grid that is overlooked by three fluorescence detector stations. We present the cosmic ray energy spectrum measured by the TA SD above 10^18.2 eV and discuss the TA SD measurement and reconstruction techniques that are based on a detailed Monte Carlo simulation of the detector. We will also demonstrate that two different analysis approaches, the constant intensity cuts method and the Monte-Carlo based energy estimation procedure produce the same answer in the energy domain where the TA SD acceptance is constant with energy.

Primary author: IVANOV, Dmitri (University of Utah)

Presenter: IVANOV, Dmitri (University of Utah)

Session Classification: POSTER SESSION

Contribution ID: **151** Type: **INVITED**

Depth of maximum of air-shower profiles: testing the compatibility of measurements performed at the Pierre Auger Observatory and the Telescope Array experiment

Tuesday, October 9, 2018 10:10 AM (20 minutes)

At the Pierre Auger Observatory and the Telescope Array (TA) experiment the measurements of depths of maximum of air-shower profiles, $X_{\rm max}$, are performed using direct observations of the longitudinal development of showers with the help of the fluorescence telescopes. Though the same detection technique is used by both experiments, the straightforward comparison of the characteristics of the measured $X_{\rm max}$ distributions is not possible due to the different approaches to the analysis of the recorded events. In this work, the Auger-TA Composition Working Group presents a technique to compare the $X_{\rm max}$ measurements from the Auger Observatory and TA. Using this technique the compatibility of the measured $X_{\rm max}$ distributions and of their first two moments is tested for energies $E > 10^{18.2}$ eV. The results of the tests show that the characteristics of the $X_{\rm max}$ distributions recorded by the Auger Observatory and TA are compatible within the systematic and statistical uncertainties.

Primary authors: BELLIDO, Jose; BELZ, John; DE SOUZA, Vitor; HANLON, William; IKEDA, Daisuke; SOKOLSKY, Pierre; TSUNESADA, Yoshiki; UNGER, Michael; YUSHKOV, Alexey (Institute of Physics AS CR, Prague)

Presenter: YUSHKOV, Alexey (Institute of Physics AS CR, Prague)

Session Classification: Sessions

Contribution ID: **152** Type: **POSTER**

TALE surface detector array and TALE hybrid system

Wednesday, October 10, 2018 3:50 PM (3 minutes)

The Telescope Array Low-energy Extension (TALE) experiment is a hybrid air shower detector for observation of air showers produced by very high energy cosmic rays above 10^16.5 eV.TALE is located at the north part of the Telescope Array (TA) experiment site in the western desert of Utah, USA. TALE has a surface detector (SD) array made up of 103 scintillation counters, including 40 with 400 m spacing, 36 with 600 m spacing and 27 with 1.2 km spacing, and a Fluorescence Detector (FD) station consisting of ten FD telescopes located at the Telescope Array Middle Drum FD station, which is made up of 14 telescopes. TALE-FD has been operational since 2013. The deployment and construction of the 103 SDs was completed in 2018, and to date about 80% of the array is in operation with a full triggering and DAQ system. Moreover, the hybrid triggering system will be implemented in September 2018. Here we report an overview of the experiment, its capabilities and the technical details of the TALE SD array and the hybrid operations.

Primary authors: Prof. OGIO, Shoichi (Osaka City University); Mr FUJIWARA, Ryota; Mr ODA, Hiroyuki; NONAKA, Toshiyuki (University of Tokyo)

Presenter: Prof. OGIO, Shoichi (Osaka City University)

Session Classification: POSTER SESSION

Contribution ID: **153** Type: **INVITED**

Multi-messenger Astrophysics at Ultra-High Energy with the Pierre Auger Observatory

Wednesday, October 10, 2018 12:00 PM (20 minutes)

The study of correlations between observations of fundamentally different nature from extreme cosmic sources promises extraordinary physical insights into the Universe. With the Pierre Auger Observatory we can significantly contribute to multi-messenger astrophysics by searching for ultra-high energy particles, particularly neutrinos and photons which, being electrically neutral, point back to their origin. Using Pierre Auger Observatory data, stringent limits at EeV energies have been established on the photon and neutrino fluxes from a large fraction of the sky, probing the production mechanisms of ultra-high energy cosmic rays. The good angular resolution and the neutrino identification capabilities of the Observatory at EeV energies allow the follow-up of events detected in gravitational waves, such as the binary mergers observed with the Advanced LIGO/Virgo detectors, or from other energetic sources of particles.

Primary author: JAIME, Alvarez-Muniz (Dept. Particle Physics, Univ. Santiago de Compostela)

Presenter: JAIME, Alvarez-Muniz (Dept. Particle Physics, Univ. Santiago de Compostela)

Session Classification: Sessions

Contribution ID: **154** Type: **INVITED**

Measurement of energy spectrum of ultra-high energy cosmic rays with the Pierre Auger Observatory

Monday, October 8, 2018 3:15 PM (25 minutes)

The energy spectrum of high-energy cosmic rays measured using the Pierre Auger Observatory is presented. The measurements extend over three orders of magnitude in energy from 3 x 10^17 eV up to the very end of the spectrum and they benefit of the almost calorimetric estimation of the shower energies performed with the fluorescence telescopes. The huge amount of data collected with the surface detector allowed us to measure the spectrum in different regions of the sky with high precision.
We will present the results of the measurements together with a detailed description of the systematic uncertainties.

Primary author: VERZI, Valerio (INFN Roma "Tor Vergata")

Presenter: VERZI, Valerio (INFN Roma "Tor Vergata")

Session Classification: Sessions

Contribution ID: **155** Type: **POSTER**

Search for Extreme Energy Cosmic Rays with the TUS telescope and comparison with ESAF

Wednesday, October 10, 2018 3:53 PM (3 minutes)

The Track Ultraviolet Setup (TUS) detector was launched on April 28, 2016 as a part of the scientific payload of the Lomonosov satellite. TUS is a path-finder mission for future space-based observation of Extreme Energy Cosmic Rays (EECRs, E > 5x10^19 eV) with experiments such as K-EUSO. TUS data offer the opportunity to develop strategies in the analysis and reconstruction of the events which will be essential for future space-based missions.
During its operation TUS has detected about 80 thousand events which have been subject to an offline analysis to select among them those that satisfy basic temporal and spatial criteria of EECRs. A few events passed this first screening. In order to perform a deeper analysis of such candidates, a dedicated version of ESAF (EUSO Simulation and Analysis Framework) code as well as a detailed modeling of TUS optics and detector have been developed.
This contribution will report on the results of such an analysis.

Primary authors: BERTAINA, Mario (Univ. of Torino, Italy); FENU, Francesco (University of Torino, Italy); KLIMOV, Pavel (Moscow State University, Russia); SALSI, Anthony (University of Torino Italy and University of Nice, France); SHINOZAKI, Kenji (University of Torino, Italy); ZOTOV, Mikhail (University of Moscow, Russia); TUS, Collaboration; JEM-EUSO, Collaboration

Presenter: BERTAINA, Mario (Univ. of Torino, Italy)

Session Classification: POSTER SESSION

Contribution ID: **156** Type: **INVITED**

Search for a correlation between the UHECRs measured by the Pierre Auger Observatory and the Telescope Array and the neutrino candidate events from IceCube and ANTARES

Wednesday, October 10, 2018 2:50 PM (20 minutes)

We present the results of three searches for correlations between UHECR events measured by the Pierre Auger Observatory and Telescope Array and high energy neutrino candidate events from IceCube and ANTARES. A cross-correlation analysis is performed, where the angular separation between the arrival directions of UHECRs and neutrinos is scanned. The same events are also exploited in a separate search by stacking the neutrino arrival directions: a maximum likelihood approach is used where a modelling of magnetic deflections of UHECRs is included and accounted for. Finally, a similar analysis is performed on stacked UHECR arrival directions and the IceCube and ANTARES samples of through-going muon-track events that were optimised for neutrino point source searches.

Primary author: Dr CACCIANIGA, Lorenzo (Università degli studi di Milano)

Presenter: Dr CACCIANIGA, Lorenzo (Università degli studi di Milano)

Session Classification: Sessions

Contribution ID: **157** Type: **POSTER**

Cloud distribution evaluated by the WRF model during the EUSO-SPB1 flight

Wednesday, October 10, 2018 3:56 PM (3 minutes)

EUSO-SPB1 was a balloon-borne mission of the JEM-EUSO (Joint Experiment Missions for Extreme Universe Space Observatory) Program aiming at the observation of UHECRs from space. The EUSO-SPB1 telescope was a fluorescence detector with a 1 m2 Fresnel refractive optics and a focal surface covered with 36 multi-anode photomultiplier tubes for a total of 2304 channels covering ~11 degrees FOV. Each channel performed the photon counting every 2.5 μs time frame, allowing for spatiotemporal imaging of the air shower events. Being provided with an active trigger algorithm, EUSO-SPB1 was the first balloon-borne experiment having a potential to detect air shower events initiated by cosmic rays in the range of several EeV. On 25 April 2017, EUSO-SPB1 was launched from Wanaka, New Zealand on the NASA's Super Pressure Balloon that flew at ~ 16 – 33 km flight altitude for ~292 hours. Before the flight was terminated due to an unexpected gas leakage, we retrieved the ~27 hours data acquired in the air shower detection mode. In the present work, we aim at evaluating the role of the clouds during the operation of EUSO-SPB1. We employ the WRF (Weather Research and Forecasting) model to numerically calculate the cloud distribution in the EUSO-SPB1 FOV. We discuss the keys result of the WRF model and the impact of the clouds on the air shower measurement and on the efficiency of the cosmic ray observation. We will also mention the relevant issues towards future ballon-borne and satellite-based UHECR observation missions.

Primary authors: SHINOZAKI, Kenji (University of Torino, Italy); JEM-EUSO COLLABORATION

Presenter: SHINOZAKI, Kenji (University of Torino, Italy)

Session Classification: POSTER SESSION

Contribution ID: **158** Type: **INVITED**

Covering the sphere at ultra-high energies: full-sky cosmic-ray maps beyond the ankle and the flux suppression

Wednesday, October 10, 2018 5:10 PM (25 minutes)

Despite deflections by Galactic and extragalactic magnetic fields, the distribution of the flux of ultra-high energy cosmic rays (UHECRs) over the celestial sphere remains a most promising observable for the identification of their sources. This distribution is remarkably close to being isotropic. Thanks to a large number of detected events over the past years, a large-scale anisotropy at energies above 8 EeV has been identified, and there are also indications from the Telescope Array and Pierre Auger Observatory Collaborations of deviations from isotropy at intermediate angular scales (~20°) at the highest energies. In this contribution, we map the flux of UHECRs over the full sky at energies beyond each of two major features in the UHECR spectrum - the ankle and the flux suppression -, and we derive limits for anisotropy on different angular scales in the two energy regimes. In particular, full-sky coverage enables constraints on low-order multipole moments without assumptions on the strength of higher-order multipoles. Following previous efforts from the two collaborations, we build full-sky maps accounting for the relative exposure of the arrays and differences in the energy normalizations. These results are obtained by cross-calibrating the UHECR fluxes reconstructed in the declination band around the celestial equator covered by both observatories. We present full-sky maps at energies above ~10 EeV and ~50 EeV, using the largest datasets shared across UHECR collaborations to date. We report on anisotropy searches exploiting full-sky coverage and discuss possible constraints on the distribution of UHECR sources.

Primary author: BITEAU, Jonathan (IPNO)

Presenter: BITEAU, Jonathan (IPNO)

Session Classification: Sessions

Contribution ID: **159** Type: **INVITED**

Estimates of the Cosmic-Ray Composition with the Pierre Auger Observatory

Tuesday, October 9, 2018 9:30 AM (20 minutes)

We present measurements from the Pierre Auger Observatory related to mass composition of ultra-high energy cosmic rays.

Using the fluorescence telescopes of the Observatory we determine the distribution of shower maxima (Xmax) from 10^17.2 to 10^19.6 eV and derive estimates of the mean and variance of the average logarithmic mass of cosmic rays. The fraction of p, He, N and Fe nuclei as a function of energy is derived by fitting the Xmax distribution with templates from air shower simulations using the most recent version of LHC-tuned hadronic interaction models.

Furthermore, we will discuss the analysis of the time structure of the signals from air showers recorded with the water-Cherenkov detectors to study the mass composition from 10^17.5 to 10^20 eV.

Primary author: UNGER, Michael (KIT)

Co-author: PIERRE AUGER COLLABORATION

Presenter: UNGER, Michael (KIT)

Session Classification: Sessions

Contribution ID: **160** Type: **INVITED**

Auger-TA energy spectrum working group report

Monday, October 8, 2018 3:40 PM (25 minutes)

The energy spectrum of ultra-high energy cosmic rays is the most emblematic observable for describing these particles. Beyond a few tens of EeV, the Pierre Auger Observatory and the Telescope Array, currently being exploited, provide the largest exposures ever accumulated in the Northern and the Southern hemispheres to measure independently a suppression of the intensity, in a complementary way in terms of the coverage of the sky. However, the comparison of the spectra shows differences that are not reducible to an overall uncertainty on the calibration of the energy scale used to reconstruct the extensive air showers. In line with the previous editions of the UHECR workshops, a working group common to both experiments examined these differences by focusing this time on quantification of these differences in the region of the sky commonly observed, where the spectra should be in agreement within uncertainties when directional-exposure effects are accounting for. These differences are compared with the systematic uncertainties of each experiment. We have also revisited the methods of determining cosmic ray energies and deriving the energy spectrum. We present the SD spectrum from energy calibration based on the constant intensity cut (CIC) method, SD spectrum from the Monte-Carlo based attenuation correction, and the hybrid spectrum, where the energies are determined from the longitudinal profile seen by the fluorescence detector.

Primary authors: ABUZAYYAD, Tareq; DELIGNY, Olivier; Dr IKEDA, Daisuke (Earthquake Research Institute,The University of Tokyo); IVANOV, Dmitri (University of Utah); LHENRY-YVON, Isabelle (IPN Orsay); MARIS, Ioana (Universitaet und Forschungszentrum Karlsruhe); Ms DANIELA, Mockler (Karlsruhe Institute of Technology, Institut für Kernphysik, Karlsruhe, Germany); NONAKA, Toshiyuki (University of Tokyo); Dr ROTH, Markus (Karlsruhe Institute of Technology, Institut für Kernphysik, Karlsruhe, Germany); Dr SALAMIDA, Francesco (Universit'a dell'Aquila, L'Aquila, Italy); Prof. THOMSON, Gordon (University of Utah); Prof. TSUNESADA, Yoshiki (Osaka City University); Dr VALINO, Ines (Universidad de Santiago de Compostela, Santiago de Compostela, Spain); VERZI, Valerio (INFN Roma "Tor Vergata")

Presenter: IVANOV, Dmitri (University of Utah)

Session Classification: Sessions

Contribution ID: **161** Type: **POSTER**

Determination of the invisible energy of extensive air showers from the data collected at Pierre Auger Observatory

Wednesday, October 10, 2018 4:00 PM (3 minutes)

In order to get the primary energy of cosmic rays from their extensive air showers using the fluorescence detection technique, the invisible energy should be added to the measured calorimetric energy. The invisible energy is the energy carried away by particles that do not deposit all their energy in the atmosphere.
It has traditionally been calculated using Monte Carlo simulations that are dependent on the assumed primary particle mass and on model predictions for neutrino and muon production.
In this work the invisible energy is obtained directly from events detected by the Pierre Auger Observatory. The method applied is based on the correlation of the measurements of the muon number at the ground with the invisible energy of the showers. By using it, the systematic uncertainties related to the unknown mass composition and to the high energy hadronic interaction models are significantly reduced, improving in this way the estimation of the energy scale of the Observatory.

Primary author: Dr MARIAZZI, Analisa (Universidad Nacional de La Plata and CONICET, La Plata, Argentina)

Presenter: Dr MARIAZZI, Analisa (Universidad Nacional de La Plata and CONICET, La Plata, Argentina)

Session Classification: POSTER SESSION

Contribution ID: **162** Type: **POSTER**

Potential of a scintillator and radio extension of the IceCube surface detector array

Wednesday, October 10, 2018 4:03 PM (3 minutes)

An upgrade of the present IceCube surface array (IceTop) with scintillation detectors and possibly radio antennas is foreseen. The enhanced array will calibrate the impact of snow accumulation on the reconstruction of cosmic-ray showers detected by IceTop as well as improve the veto capabilities of the surface array. In addition, such a hybrid surface array of radio antennas, scintillators and Cherenkov tanks will enable a number of complementary science cases for IceCube such as enhanced accuracy to mass composition of cosmic rays, search for PeV photons from the Galactic Center, or more thorough tests of the hadronic interaction models. Two prototype stations with 7 scintillation detectors each have been already deployed at the South Pole in January 2018 where these R&D studies provide a window of opportunity to additionally integrate radio antennas with minimal effort.

Primary authors: HAUNGS, Andreas (KIT); ICECUBE-GEN2 COLLABORATION

Presenter: HAUNGS, Andreas (KIT)

Session Classification: POSTER SESSION

Contribution ID: **163** Type: **POSTER**

A novel method for the absolute end-to-end calibration of the Auger fluorescence telescopes.

Thursday, October 11, 2018 10:40 AM (3 minutes)

The fluorescence detector technique is using the atmosphere as a calorimeter. Besides the precise monitoring of the parameters of the atmosphere a proper knowledge of the optical properties in the UV range of all optical components involved in the measurements of the fluorescence light is vital.

Until now, the end-to-end calibration was performed with a 4.5 m^2 large, uniformly lit light source attached to the aperture of the telescopes. To improve the maintainability we propose an alternative setup where a small and lightweight light source of known optical properties re-samples the measurement of the big light source piece by piece. This will be achieved by moving the light source based on an integrating sphere in two dimensions in front of the aperture. A prototype setup has been installed and we are currently in the phase of optimizing the parameters of the system and the procedures. The outcome which we are aiming for is to reduce the effort for the procedure without diminishing the quality of the measurement.

First measurements with this setup have been already performed and the measurements of the geometrical and optical properties of the light source are an ongoing activity. We will present our calibration scheme and the first, preliminary results.

Primary authors: MATHES, Hermann-Josef; FOR THE PIERRE AUGER COLLABORATION

Presenter: MATHES, Hermann-Josef

Session Classification: POSTER SESSION

Contribution ID: **164** Type: **ORAL**

Atmospheric Muons Measured with IceCube

Thursday, October 11, 2018 2:40 PM (20 minutes)

IceCube is a cubic-kilometer Cherenkov detector in the deep ice at the geographic South Pole. The dominant event yield is produced by penetrating atmospheric muons with energies above several 100 GeV. Due to its large detector volume, IceCube provides unique opportunities to study atmospheric muons with large statistics in great detail. Measurements of the energy spectrum and the lateral separation distribution of muons offer insights into hadronic interactions during the air shower development, for example, and can be used to test hadronic models. In addition, the surface detector IceTop provides information about the electromagnetic component of air showers. Together with muon measurements in the deep ice this can be used to derive the mass composition of cosmic rays.

We will present an overview of various measurements of atmospheric muons in IceCube, including the energy spectrum of muons between 10 TeV and 1 PeV. This is used to derive an estimate of the prompt contribution of muons, originating from the decay of heavy (mainly charmed) hadrons and unflavored mesons. We will also present measurements of the lateral separation distributions of TeV muons between 150 m and 450 m for several initial cosmic ray energies. In addition, studies on the seasonal variations of atmospheric muon fluxes in IceCube will be shown. Finally we will introduce new techniques to study the cosmic ray mass composition up to EeV energies. This hybrid approach uses muon measurements in the deep ice detector, together with information from the surface detector array.

Primary author: Dr SOLDIN, Dennis (University of Delaware)

Presenters: Dr SOLDIN, Dennis (University of Delaware); FOR THE ICE CUBE COLLABORATION

Session Classification: Sessions

Contribution ID: **165** Type: **INVITED**

Report on tests and measurements of hadronic interaction properties with air showers

Thursday, October 11, 2018 10:10 AM (25 minutes)

Unambiguously determining the mass composition of ultra-high energy cosmic rays is a key challenge at the frontier of cosmic ray research. The mass composition is inferred from air shower observables using air shower simulations, which rely on hadronic interaction models. Current hadronic interaction models lead to varying interpretations, therefore tests of hadronic interaction models with air shower measurements are important. Such tests may even reveal new physics phenomena. Tests have been done by various experiments and cover the cosmic ray energies from PeV to tens of EeV. In this talk, the Working Group on Hadronic interactions and Shower Physics presents a summary of tests and measurements related to hadronic interactions in air showers from the Pierre Auger Observatory, Telescope Array, IceCube, KASCADE-Grande, EAS MSU, SUGAR and NEVOD-DECOR. Results include measurements of the proton-air cross-section, the lateral density profile of muons in air showers as well as electrons and photons, TeV muons, and the muon production depth. Our goal is to develop a consistent picture out of the individual measurements, to gain a detailed understanding where current hadronic interaction models succeed or fail in describing air shower observables.

Primary author: DEMBINSKI, Hans (Max Planck Institute for Nuclear Physics, Heidelberg)

Presenter: DEMBINSKI, Hans (Max Planck Institute for Nuclear Physics, Heidelberg)

Session Classification: Sessions

Contribution ID: **166** Type: **POSTER**

Preliminary results of the AMIGA engineering array at the Pierre Auger Observatory

Thursday, October 11, 2018 10:43 AM (3 minutes)

The prototype array of the underground muon detector as part of the AMIGA enhancement was built and operated until November 2017. During this engineering phase, the array was composed of seven stations. The detector design as well as its performance for physics deliverables were validated and optimized. The most notable improvement was the selection of silicon photo-multipliers rather than photo-multiplier tubes as optical devices. It has been demonstrated that the detectors resemble the behavior of ideal poissonian counters. The counting efficiency for units of $10\ \mathrm{m}^2$ was established to be $> 98\%$ for SiPM, and 83% for PMT. The energy evolution of the muon densities measured with AMIGA shows a slope of $b = 0.90 \pm 0.04$, in accordance to the one expected for a constant composition. The full-sized underground muon detector array with 61 stations is foreseen to be completed by the end of 2019.

Primary author: TABOADA NUNEZ, Alvaro (IKP, KIT / ITeDA)

Presenter: TABOADA NUNEZ, Alvaro (IKP, KIT / ITeDA)

Session Classification: POSTER SESSION

Contribution ID: **167** Type: **POSTER**

Air Shower Structure measured with the Telescope Array Surface Detectors

Tuesday, October 9, 2018 4:25 PM (3 minutes)

Telescope Array constructed in Utah USA is a largest air shower observatory in the northern hemisphere aiming at clarifying the origin of UHECRs. In order for better understandings of the air shower phenomenon we report a study on the distribution of arriving signals measured with FADC of the TA Surface detector we use 10 years TA SD data to examine which include delay time to shower front plane and the thickness of the disk of particles. The analysis method consists in selecting data sample extending range from 7.08 to over 100 EeV with a minimal bias and systematics uncertainties to observe a correlation between thickness and the distance of shower axis to each SD which have dependance on signal distribution such as electromagnetic or muonic component, impact parameter, energy, and its effect such as zenith and azimuthal angle along the plane of an EAS.

Primary authors: Ms MAYTA PALACIOS, Rosa (Osaka City University); Prof. TSUNESADA, Yoshiki (Osaka City University); Prof. OGIO, Shoichi (Osaka City University)

Presenter: Ms MAYTA PALACIOS, Rosa (Osaka City University)

Session Classification: POSTER SESSION

Contribution ID: **168** Type: **POSTER**

Prospects of testing an UHECR single source class model with the K-EUSO orbital telescope

Thursday, October 11, 2018 10:35 AM (3 minutes)

KLYPVE-EUSO (K-EUSO) is a planned orbital detector of ultra-high energy cosmic rays (UHECRs), which is to be deployed on board the International Space Station. K-EUSO is expected to have an almost uniform exposure over the celestial sphere and register from 120 to 500 UHECRs at energies above ~57 EeV in a 2-year mission. We employ the CRPropa3 package to estimate prospects of testing the UHECR single source class model by Kachelriess, Kalashev, Ostapchenko and Semikoz (2017) with K-EUSO in terms of the large-scale anisotropy. According to the simulations, K-EUSO will be able to probe the model in case it records ~200 or more events and the from-source flux constitutes ~20% of the whole data set.

Primary authors: Dr KALASHEV, Oleg (Institute of Nuclear Physics, RAS); Prof. PSHIRKOV, Maxim (Institute of Nuclear Physics, RAS); ZOTOV, Mikhail (Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University)

Presenter: ZOTOV, Mikhail (Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University)

Session Classification: POSTER SESSION

Contribution ID: **170** Type: **POSTER**

Study of muons from ultrahigh energy cosmic ray air showers measured with the Telescope Array experiment

Wednesday, October 10, 2018 4:06 PM (3 minutes)

One of the uncertainties in ultrahigh energy cosmic ray (UHECR) observation derives from the hadronic interaction model used for air shower Monte-Carlo (MC) simulations. One may test the hadronic interaction models by comparing the measured number of muons observed at the ground from UHECR induced air showers with the MC prediction.
The Telescope Array (TA) is the largest experiment in the northern hemisphere observing UHECR in Utah, USA. It aims to reveal the origin of UHECRs by studying the energy spectrum, mass composition and anisotropy of cosmic rays by utilizing an array of surface detectors (SDs) and fluorescence detectors. We studied muon densities in the UHE extensive air showers by analyzing the signal of TA SD stations for highly inclined showers. On condition that the muons contribute about 65% of the total signal, the number of particles from air showers is typically 1.88 ± 0.08 (stat.) ± 0.42 (syst.) times larger than the MC prediction with the QGSJET II-03 model for protons. The same feature was also obtained for other hadronic models, such as QGSJET II-04. In this presentation, we report the method and the result of the study of muons from UHECR air showers with the TA data.

Primary author: Dr TAKEISHI, Ryuji (Sungkyunkwan University, South Korea)

Co-author: FOR THE TELESCOPE ARRAY COLLABORATION

Presenter: Dr TAKEISHI, Ryuji (Sungkyunkwan University, South Korea)

Session Classification: POSTER SESSION

Contribution ID: **171** Type: **INVITED**

In-ice radio arrays for the detection of ultra-high energy neutrinos

Friday, October 12, 2018 11:10 AM (20 minutes)

Radio techniques show the most promise for measuring and characterizing
the astrophysical neutrino flux above about 10^17 eV. Complementary strategies include observing a target volume from a distance and deploying sensors in the target volume itself. I will focus on the current status of experiments utilizing the latter strategy, in-ice radio arrays. I will give an overview of results from the past fifteen years of experience and the status of developing plans for the future. I will preview what we might expect from in-ice arrays in terms of astrophysics and particle physics results in the next ten years

Primary author: CONNOLLY, Amy (The Ohio State University)

Presenter: CONNOLLY, Amy (The Ohio State University)

Session Classification: Sessions

Contribution ID: **172** Type: **INVITED**

Measurements and tests of hadronic interactions at ultra-high energies with the Pierre Auger Observatory

Thursday, October 11, 2018 9:30 AM (20 minutes)

Extensive air showers are complex objects, resulting of billions of particle reactions initiated by single cosmic ray at ultra-high-energy. Their characteristics are sensitive both to the mass of the primary cosmic ray and to the details of hadronic interactions. Many of the interactions that determine the shower features occur in energy and kinematic regions beyond those tested by human-made accelerators.

We will report on the measurement of the proton-air cross section for particle production at a center-of-mass energy per nucleon of 39 TeV and 56 TeV. We will also show comparisons of post-LHC hadronic interaction models with shower data by studying the moments of the distribution of the depth of the electromagnetic maximum, the number and production depth of muons in air showers, and finally a parameter based on the rise-time of the surface detector signal, sensitive to the electromagnetic and muonic component of the shower. While there is good agreement found for observables based on the electromagnetic shower component, discrepancies are observed for muon-sensitive quantities.

Primary authors: Dr ROTH, Markus (Karlsruhe Institute of Technology, Institut für Kernphysik, Karlsruhe, Germany); Dr CAZON, Lorenzo (LIP, Lisbon)

Co-author: FOR THE PIERRE AUGER COLLABORATION

Presenters: Dr ROTH, Markus (Karlsruhe Institute of Technology, Institut für Kernphysik, Karlsruhe, Germany); Dr CAZON, Lorenzo (LIP, Lisbon)

Session Classification: Sessions

Contribution ID: **173** Type: **POSTER**

Average shape of longitudinal shower profiles measured at the Pierre Auger Observatory

Thursday, October 11, 2018 10:46 AM (3 minutes)

The average profiles of cosmic ray showers developing with traversed atmospheric depth are measured for the first time, with the Fluorescence Detectors at the Pierre Auger Observatory. The profile shapes are well reproduced by the Gaisser-Hillas parametrization, at the 1% level in a 500 g/cm2 interval around the shower maximum, for cosmic rays with log(E/eV) > 17.8. The results are quantified with two shape parameters, which are measured as a function of energy.

The average profiles carry information on the primary cosmic ray and its high energy hadronic interactions. The shape parameters predicted by the commonly used models are compatible with the measured ones within experimental uncertainties. These are dominated by systematic uncertainties which, at present, prevent a detailed composition analysis.

Primary author: ANDRINGA, Sofia (LIP)

Presenter: ANDRINGA, Sofia (LIP)

Session Classification: POSTER SESSION

Contribution ID: **176** Type: **POSTER**

The Auger@TA Project: Phase II Progress and Plans

Tuesday, October 9, 2018 10:58 AM (2 minutes)

The Auger@TA project is a combined effort involving members of both the Pierre Auger Observatory and the Telescope Array experiment (TA) to cross-calibrate detectors and compare results on air showers detected at one location. We have recently reported results from Phase I of the project, during which we collected and presented data from two Auger water-Cherenkov surface-detector stations deployed into the TA experiment near the Central Laser Facility. For Phase II we will deploy a micro-array of six single-PMT Auger surface detector stations co-located with TA scintillator surface-detector stations. The Auger micro-array will trigger and collect data independently from the TA allowing for a complete end-to-end comparison of detector data, calibration, and reconstructed event quantities on a shower-by-shower basis between the TA and Auger detector systems. We describe progress towards development of the micro-array for Phase II including the preparation of surface detector water tanks, station electronics, wireless communications, trigger and data acquisition. We also outline plans for deploying the Auger@TA micro-array into the Telescope Array experiment during early 2019 with preliminary estimates for coincident air-shower rates.

Primary author: COVAULT, Corbin (Case Western Reserve University)

Presenter: COVAULT, Corbin (Case Western Reserve University)

Session Classification: POSTER SESSION

Contribution ID: **177** Type: **INVITED**

Overview of the Auger@TA project and preliminary results from Phase I

Thursday, October 11, 2018 2:00 PM (20 minutes)

Auger@TA is a joint experimental program of the Telescope Array experiment (TA) and the Pierre Auger Observatory (Auger), the two leading ultra-high energy cosmic-ray experiments located respectively in the northern and southern hemispheres. The aim of the program is to achieve a cross-calibration of the Surface Detector (SD) from both experiments. The first phase of this joint effort is currently underway and consists of comparing the response of two Auger and TA SD stations co-located at the TA central laser facility for a set of high-energy showers reconstructed by TA. The Auger and TA SD stations are based on different detection media and respond differently to the electromagnetic and muonic components of the shower. Hence, the study ultimately relies on comparing the signals induced in the SD stations with simulations using the shower parameters obtained by TA. Preliminary results will be presented. Phase II of the program consists of the deployment of a micro-array of six one-PMT Auger stations collocated with TA SD stations within TA, which will take data independently. In this phase, both station-level and event-level comparisons, including reconstruction parameters, can be performed for a subset of showers landing within the micro-array. We anticipate a deployment of the Auger micro-array in the first half of 2019.

Primary author: SARAZIN, Fred (Colorado School of Mines)

Presenters: SARAZIN, Fred (Colorado School of Mines); AND THE PIERRE AUGER AND TELESCOPE ARRAY COLLABORATIONS

Session Classification: Sessions

Contribution ID: **178** Type: **INVITED**

Inductive Particle Acceleration

Wednesday, October 10, 2018 11:00 AM (30 minutes)

Presenter: KIRK, John

Session Classification: Sessions

Contribution ID: **181** Type: **INVITED**

Black hole jets in clusters of galaxies as sources of high-energy cosmic particles

Wednesday, October 10, 2018 11:30 AM (30 minutes)

It has been a mystery that with ten orders of magnitude difference in energy, high-energy neutrinos, ultrahigh-energy cosmic rays, and sub-TeV gamma rays all present comparable energy injection rate, hinting an unknown common origin. Here we show that black hole jets embedded in clusters of galaxies may work as sources of all three messengers. By numerically simulating the propagation of cosmic ray particles in the magnetized intracluster medium (ICM), we show that the highest-energy cosmic rays leave the source rectilinearly, the intermediate-energy cosmic rays are confined by their massive host and interact with the ICM gas to produce secondary neutrinos and gamma rays, and the lowest-energy cosmic rays are cooled due to the expansion of the radio lobes inflated by the jets. The energy output required to explain the measurements of all three messengers is consistent with observations and theoretical predictions of black hole jets in clusters.

Primary authors: FANG, Ke; MURASE, Kohta (Institute for Advanced Study)

Presenter: FANG, Ke

Session Classification: Sessions

Contribution ID: **186** Type: **INVITED**

LHC results

Thursday, October 11, 2018 11:05 AM (30 minutes)

Presenter: D'ENTERRIA, David (CERN)

Session Classification: Sessions

Contribution ID: **188** Type: **INVITED**

AugerPrime: the Pierre Auger Observatory upgrade.

Friday, October 12, 2018 9:20 AM (20 minutes)

The world largest exposure to ultra high energy cosmic rays accumulated by the Pierre Auger Observatory lead to major advances in our understanding of their properties, but the many unknowns about the nature and distribution of the sources, the primary composition and the underlying hadronic interactions prevent the emergence of a uniquely consistent picture.
The new perspectives opened by the current results call for an upgrade of the Observatory, which main aim is the collection of new information about the primary mass of the highest energy cosmic rays on a shower-by-shower basis.
The evaluation of the fraction of light primaries in the region of suppression of the flux will open the window to charged particle astronomy, allowing for composition-selected anisotropy searches. In addition, the properties of multiparticle production will be studied at energies not covered by man-made accelerators and new or unexpected changes of hadronic interactions will be searched for.
We present the AugerPrime upgrade, describing the new plastic scintillator detectors on top of the water-Cherenkov detectors of the surface array (SD), the new SD electronics and the extension of the dynamic range with an additional PMT installed in the water-Cherenkov detectors. We discuss the expected performances and the improved physics sensitivity of the upgraded detectors and present the first data collected with the already running Engineering Array.

Primary authors: CASTELLINA, Antonella (INFN & INAF-OATo); FOR THE PIERRE AUGER COLLABORATION

Presenter: CASTELLINA, Antonella (INFN & INAF-OATo)

Session Classification: Sessions

Contribution ID: **189** Type: **POSTER**

On the maximum energy of protons in the hotspots of AGN jets

Thursday, October 11, 2018 10:50 AM (3 minutes)

It has been suggested that relativistic shocks in extragalactic jets may accelerate the highest energy cosmic rays. The maximum energy to which particles can be accelerated via a diffusive mechanism depends on the magnetic turbulence near the shock but recent theoretical advances indicate that relativistic shocks are probably unable to accelerate particles to energies much larger than a PeV. The cut-off of the synchrotron spectrum in the hotspots of powerful radiogalaxies is typically observed between infrared and optical frequencies, indicating that the maximum energy of non-thermal electrons accelerated at the jet termination shock is about 1 TeV for a canonical magnetic field of 100 micro Gauss. Based on theoretical considerations and observational data we show that the maximum energy of electrons cannot be constrained by synchrotron losses as usually assumed, unless the jet density is unreasonable large and most of the jet kinetic energy goes to non-thermal electrons. The maximum energy is ultimately determined by the ability to scatter particles downstream of the shock, and this limit applies to both electrons and protons. Therefore, the maximum energy of protons is also about 1 TeV. We show that non-resonant hybrid (Bell) instabilities generated by the streaming of cosmic rays can grow fast enough to amplify the jet magnetic field up to 100 micro Gauss and accelerate particles up to the maximum energies observed in the hotspots of radiogalaxies.

Primary authors: ARAUDO, Anabella; BELL, Tony (University of Oxford); Prof. BLUNDELL, Katherine (University of Oxford); MATTHEWS, James (University of Oxford)

Presenter: ARAUDO, Anabella

Session Classification: POSTER SESSION

Contribution ID: **190** Type: **INVITED**

Galactic and Intergalactic magnetic fields

Wednesday, October 10, 2018 9:30 AM (30 minutes)

I will review the status of measurements and modelling of Galactic and intergalactic magnetic fields in the context of multi-messenger astrophysics and in particular of UHECR observations.

Primary author: Prof. NERONOV, Andrii (University of Geneva & APC, Paris)

Presenter: Prof. NERONOV, Andrii (University of Geneva & APC, Paris)

Session Classification: Sessions

Contribution ID: **191** Type: **POSTER**

The Hard QCD Study In Terms of the GZK Limit

We consider the pion production in collisions of ultra high energy protons with the MBR . The probability of such a process is calculated, and is found to be in the strong dependence on the quark-gluon vertex at high energies in the hard QCD limit. The relation of the obtained results to the experimental knee in the energy spectrum of ultra high energy protons allows us to get information about the quark-gluon vertex in the hard QCD.

Primary author: Prof. KOSHELKIN, Andrew (National Research Nuclear University)

Presenter: Prof. KOSHELKIN, Andrew (National Research Nuclear University)

Session Classification: POSTER SESSION

Contribution ID: **192** Type: **INVITED**

Precision measurements of cosmic rays up to the highest energies with a large radio array at the Pierre Auger Observatory

Friday, October 12, 2018 10:20 AM (20 minutes)

High-energy cosmic rays impinging on the atmosphere of the Earth induce cascades of secondary particles, the extensive air showers. Many particles in the showers are electrons and positrons. Due to interactions with the magnetic field of the Earth they emit radiation with frequencies of several tens of MHz. In the last years huge progress has been achieved in this field through strong activities of various groups. The radio technique is now routinely applied to measure the properties of cosmic rays, such as their arrival direction, their energy, and their particle type/mass.
Horizontal air showers have a large footprint of the radio emission on the ground and they can be detected with sparse arrays with kilometer-scale spacing. With the Auger Engineering Radio Array (AERA) horizontal air showers are measured. Recent results will be presented. These measurements clearly demonstrate the feasibility to measure horizontal air showers with the radio technique. Ideas will be outlined to install radio antennas on all surface detector stations of the Pierre Auger Observatory in order to measure the properties of cosmic rays (in particular their particle type/mass) up to energies exceeding 10^20 eV.

Primary authors: Dr HÖRANDEL, Jörg (Radboud University Nijmegen); FOR THE PIERRE AUGER COLLABORATION

Presenter: Dr HÖRANDEL, Jörg (Radboud University Nijmegen)

Session Classification: Sessions

Contribution ID: **193** Type: **POSTER**

Multi-wavelength observation of cosmic-ray air-showers with CODALEMA/EXTASIS

Tuesday, October 9, 2018 10:50 AM (4 minutes)

Over the years, significant efforts have been devoted to the understanding of the radio emission of extensive air shower (EAS) in the range [20-80] MHz but, despite some studies led until the nineties, the [1-10] MHz band has remained unused for nearly 30 years. At that time it has been measured by some pioneering experiments but also suggested by theoretical calculations that EAS could produce a strong electric field in this band, and that there is possibly a large increase in the amplitude of the radio pulse with lower frequencies. The EXTASIS experiment, located within the radio astronomy observatory of Nançay and supported by the CODALEMA instrument, aims to reinvestigate the [1-10] MHz band, and to study the so-called "Sudden Death" contribution, the expected radiation electric field created by the particles that are stopped upon arrival to the ground. Currently, EXTASIS has confirmed some results obtained by the pioneering experiments, and tends to bring explanations to the other ones, for instance the role of the underlying atmospheric electric field.

Moreover, CODALEMA has demonstrated that in the most commonly used frequency band ([20-80] MHz) the electric field profile of EAS can be well sampled, and contains all the information needed for the reconstruction of EAS: an automatic comparison between the SELFAS3 simulations and data has been developed, allowing us to reconstruct in (quasi-)real time the latter ones.

Primary author: ESCUDIE, Antony (Subatech, IMT Atlantique, Nantes, France)

Presenter: ESCUDIE, Antony (Subatech, IMT Atlantique, Nantes, France)

Session Classification: POSTER SESSION

Contribution ID: **194** Type: **POSTER**

The Atmospheric Electricity Studies at the Pierre Auger Observatory

Wednesday, October 10, 2018 10:45 AM (3 minutes)

The Fluorescence Detector (FD) at the Pierre Auger Observatory has triggered on numerous elves since the first observation in 2005, and it has potential for simultaneous Terrestrial Gamma ray Flashes (TGF) detection. In addition, the Surface Detector (SD) observed peculiar events with radially expanding footprints, which are correlated with lightning strikes reconstructed by the World Wide Lightning Location Network (WWLLN).

Emissions of Light from Very low frequency perturbations due to Electromagnetic pulse Sources (elves) expand radially up to 300 km (in ~1 ms) at the base of the ionosphere. With the 100 ns time resolution of the FD, Auger provides the community with a detailed structure of the emission region, necessary for the study of various lighting discharges (ie: compact intra-cloud discharges and energetic in-cloud pulses) possibly associated with the current hot topic in atmospheric electricity physics, TGF's. In 2014, we improved the elves trigger for the Auger FD to allow the acquisition of photon traces up to 300 us and better our reconstruction of the lightning bolt position. In addition, the 30 degree field of view of individual FD telescopes is wide enough to capture lightning-related phenomena happening just above thunderstorms (~20 km altitude) and correlated elves at the base of the ionosphere (~90 km altitude).

Also in 2005, Auger found the first peculiar SD event with long-lasting traces (~10 us) compared to typical muon signals (~0.1 us). Since then, approximately 30 sporadic events were found to have similar, radially expanding footprints and time structures. The footprints vary from 2 to 8 km. Using the reconstruction of the events, we found that the observed timing is consistent with a spherical front expanding at the speed of light with an origin point very close to ground. In addition to the presence of triggered SD stations with high-frequency noise caused by lighting RF signals, many events are in coincidence with WWLLN. More recent focus has been on potential trigger improvements for the detection of future events.

Primary author: MERENDA, Kevin-Druis

Presenter: MERENDA, Kevin-Druis

Session Classification: POSTER SESSION

Contribution ID: **195** Type: **INVITED**

Study of the arrival directions of ultra-high-energy cosmic rays detected at the Pierre Auger Observatory

Wednesday, October 10, 2018 4:45 PM (25 minutes)

The distribution of the arrival directions of ultra-high energy cosmic rays is, together with the spectrum and the mass composition, a harbinger of their nature and origin. As such, it has been the subject of intense studies at the Pierre Auger Observatory since its inception in 2004, with two main lines of analysis being pursued at different angular scales and at different energies. One concerns the study of the large-scale anisotropy and of its evolution as a function of energy. The technique used is that of the harmonic analysis, performed over all the energy range accessible by the Observatory, from sub-EeV energies to the highest ones. The other line of analysis regards in turn only the arrival directions of the highest energies cosmic rays, namely those above a few tens of EeV: thanks to the high rigidities at play, it aims at the search for anisotropies on (relatively) low angular scales in association with catalogs of plausible astrophysical sources. The talk will review the outcome of such studies after almost 15 years of data taking. It will also illustrate the careful treatment of data as well as the methods used.

Primary authors: GHIA, Piera Luisa (IPNO); FOR THE AUGER COLLABORATION

Presenter: GHIA, Piera Luisa (IPNO)

Session Classification: Sessions

Contribution ID: **196** Type: **POSTER**

Ultra-high-energy cosmic rays from supermassive black holes

Thursday, October 11, 2018 10:55 AM (3 minutes)

Mechanism of acceleration of charged particles to ultra-high energies above EeV up to ZeV still remains unsolved. Recent multimessenger observations strongly established the source of ultra-high-energy cosmic rays (UHECRs) being extragalactic supermassive black hole (SMBH). I will show that UHECRs can be produced within a neutron beta-decay in a dynamical environment of SMBHs located at the centers of galaxies. For this, I will present the super-efficient mechanism for the energy extraction from SMBHs. Magnetic fields which are usually present in the vicinity of black holes play a role of catalyzing element that increases the efficiency of the energy extraction. From the other hand synchrotron loses and back-reaction of individual charged particles put constraints on the mass of SMBH, magnetic fields and propagation distances of UHECRs.

Primary author: TURSUNOV, Arman

Presenter: TURSUNOV, Arman

Session Classification: POSTER SESSION

Contribution ID: **198** Type: **ORAL**

Primary Energy Spectrum by the Data of EAS Cherenkov Light Arrays Tunka-133 and TAIGA-HiSCORE

Tuesday, October 9, 2018 5:30 PM (20 minutes)

Tunka-133 collected data since 2009. The data of 7 winter seasons (2009-2014 and 2015-2017) are processed and analyzed till now. The new TAIGA-HiSCORE array, designed for gamma astronomy tasks mostly, can be used for reconstruction of the all primary particle energy spectrum too. These two arrays provide the very wide range of primary energy measurements 2.10^14 – 2.10^18 eV with the same method of Cerenkov light registration. The new joint data on the primary energy spectrum in this wide energy range are presented

Primary authors: PROSIN, Vasily; AND THE TUNKA COLLABORATION

Presenter: PROSIN, Vasily

Session Classification: Sessions

Contribution ID: **199** Type: **INVITED**

Overview and results from the first four flights of ANITA

Wednesday, October 10, 2018 3:10 PM (20 minutes)

ANITA was designed as a discovery experiment for ultra-high energy (UHE) neutrinos using the radio Askaryan detection technique, launching from McMurdo Station in Antarctica under NASA's long duration balloon program and observing 1.5 million square kilometers of ice at once from an altitude of 40 km. Over ANITA's four flights we set the best constraints on UHE neutrino fluxes above 10^19 eV, unexpectedly observed radio emission from UHE cosmic ray air showers, making improvements to the instrument and lowering thresholds on each flight. I will give an overview of ANITA's remarkable history and plans for the future.

Primary authors: CONNOLLY, Amy (The Ohio State University); FOR THE ANITA COLLABORATION

Presenter: CONNOLLY, Amy (The Ohio State University)

Session Classification: Sessions

Contribution ID: **200** Type: **POSTER**

AugerPrime implementation in the Offline simulation and reconstruction framework

Wednesday, October 10, 2018 10:48 AM (3 minutes)

The Pierre Auger Observatory is currently upgrading its surface detector array by placing a 3.84 square meter scintillator on top of each of the existing 1660 water-Cherenkov detectors. The differing responses of the two detectors allow for the disentanglement of the muonic and electromagnetic components of extensive air showers, which ultimately facilitates reconstruction of the mass composition of ultra-high-energy cosmic rays on an event-by-event basis. Simulations of the scintillator surface detector enable both an assessment of proposed reconstruction algorithms and the interpretation of real shower measurements. The design and implementation of these simulations within a Geant4-based module inside Auger's software framework (Offline) are presented in addition to the tuning of these simulations to detector response measurements performed using a centimeter precision muon telescope. Augmentations of the Offline framework in order to accommodate the large-scale detector upgrade are also presented.

Primary author: SCHMIDT, David (Karlsruhe Institute of Technology)

Presenter: SCHMIDT, David (Karlsruhe Institute of Technology)

Session Classification: POSTER SESSION

Contribution ID: **201** Type: **POSTER**

Radio detection of cosmic rays with the Auger Engineering Radio Array

Thursday, October 11, 2018 11:00 AM (2 minutes)

The Auger Engineering Radio Array (AERA) complements the Pierre Auger Observatory with 150 radio-antenna stations measuring in the
frequency range from 30 to 80 MHz. With an instrumented area of 17 km^2, the array constitutes the largest cosmic-ray radio detector
built to date, allowing us to do multi-hybrid measurements of cosmic rays in the energy range of ~10^17 eV up to several 10^18 eV.
We give an overview of AERA results and discuss the significance of radio detection for the validation of the energy scale of
cosmic-ray detectors as well as for mass-composition measurements.

Primary authors: HUEGE, Tim (Karlsruhe Institute of Technology); FOR THE PIERRE AUGER COLLABORATION

Presenter: HUEGE, Tim (Karlsruhe Institute of Technology)

Session Classification: POSTER SESSION

Contribution ID: **202** Type: **POSTER**

ATMOSPHERIC AEROSOL EFFECT ON FD DATA ANALYSIS AT THE PIERRE AUGER OBSERVATORY

Thursday, October 11, 2018 11:02 AM (1 minute)

The atmospheric aerosol monitoring system of the Pierre Auger Observatory, initiated in 2004, continues to operate smoothly. Two laser facilities (Central Laser Facility, CLF and eXtreme Laser Facility, XLF) each fire sets of 50 laser shots four times per hour during Fluorescence Detector (FD) shifts.
The FD measures these UV laser tracks. Analysis of these tracks yields hourly measurements of the aerosol attenuation loads, expressed as Vertical Aerosol
Optical Depth (VAOD) profiles. These VAOD profiles, which may be highly variable, are used to correct the observed longitudinal UV light profiles of the Extensive Air Shower tracks detected by the FD. Two analysis techniques are used to obtain the VAOD profiles. The techniques been proven to be fully compatible. Measurement uncertainty of the VAOD profiles contribute to the measurement uncertainty of the reconstructed energy and depth at the maximum development of a shower (Xmax) of air shower events. To confirm the validity of the VAOD profiles applied to the FD event analysis, the flatness of the ratio
of reconstructed SD to FD energy as a function of the aerosol transmission to the depth of shower maximum has been verified to be at the level of 0.6%.

Primary author: VALORE, Laura (Universita' di Napoli Federico II)

Presenter: VALORE, Laura (Universita' di Napoli Federico II)

Session Classification: POSTER SESSION

Contribution ID: **203** Type: **not specified**

Welcome and Opening

Monday, October 8, 2018 2:00 PM (5 minutes)

Session Classification: Sessions

Contribution ID: **204** Type: **POSTER**

Direct measurement of the muon density in air showers with the Pierre Auger Observatory

Wednesday, October 10, 2018 4:09 PM (3 minutes)

As part of the upgrade of the Pierre Auger Observatory, the AMIGA (Auger Muons and Infill for the Ground Array) underground muon detector extension will allow for direct muon measurements for showers falling into the 750m SD vertical array. We optimized the AMIGA muon reconstruction procedure by introducing a geometrical correction for muons leaving a signal in multiple detector strips due to their inclined momentum, and deriving a new unbiased parametrization of the muon lateral distribution function. Furthermore, we defined a zenith-independent estimator ρ_{35} of the muon density by parametrizing the attenuation of the muonic signal due to the atmosphere and soil layer above the buried detectors and quantified the relevant systematic uncertainties for AMIGA. The analysis of one year of calibrated data recorded with the prototype array of AMIGA confirms the results of previous studies indicating a significant disagreement between the muon content in simulations and data.

Primary author: Mrs MUELLER, Sarah (KIT)

Presenter: Mrs MUELLER, Sarah (KIT)

Session Classification: POSTER SESSION

Contribution ID: **205** Type: **not specified**

Closing and Concluding Remarks

Friday, October 12, 2018 12:30 PM (5 minutes)

Presenter: ENGEL, Ralph (Karlsruhe Institute of Technology)

Session Classification: Sessions

Contribution ID: **206** Type: **POSTER**

CORSIKA upgrade, plans and status

Thursday, October 11, 2018 11:03 AM (1 minute)

Primary author: ULRICH, Ralf (KIT)

Presenter: ULRICH, Ralf (KIT)

Session Classification: POSTER SESSION

Contribution ID: **207** Type: **ORAL**

Introduction

Friday, October 12, 2018 2:00 PM (5 minutes)

Primary authors: ENGEL, Ralph (Karlsruhe Institute of Technology); OGIO, Shoichi (Osaka City University)

Presenters: ENGEL, Ralph (Karlsruhe Institute of Technology); OGIO, Shoichi (Osaka City University)

Session Classification: Mini Worshop on Future of UHECR

Contribution ID: **208** Type: **not specified**

Status and open problems in ultrahigh-energy cosmic ray and neutrino physics

Friday, October 12, 2018 2:05 PM (35 minutes)

Primary author: LIPARI, Paolo

Presenter: LIPARI, Paolo

Session Classification: Mini Worshop on Future of UHECR

Contribution ID: **209** Type: **not specified**

Origin of UHECR anisotropies and what we can learn from them

Friday, October 12, 2018 2:40 PM (10 minutes)

Presenter: Prof. SIGL, Günter (University of Hamburg)

Session Classification: Mini Worshop on Future of UHECR

Contribution ID: **210** Type: **not specified**

Mixed composition and the chances of finding UHECR sources

Friday, October 12, 2018 2:50 PM (10 minutes)

Primary author: UNGER, Michael (KIT)

Presenter: UNGER, Michael (KIT)

Session Classification: Mini Worshop on Future of UHECR

Contribution ID: **211** Type: **not specified**

Discussion time

Friday, October 12, 2018 3:30 PM (30 minutes)

Session Classification: Mini Worshop on Future of UHECR

Contribution ID: **212** Type: **ORAL**

A ”snake array” of fluorescence detectors (10 min)

Friday, October 12, 2018 4:30 PM (10 minutes)

Primary author: SOKOLSKY, Pierre (University of Utah)

Presenter: SOKOLSKY, Pierre (University of Utah)

Session Classification: Mini Worshop on Future of UHECR

Contribution ID: **213** Type: **not specified**

SKA with muon counters as super-cosmic-ray detector in the transition energy region

Friday, October 12, 2018 4:40 PM (10 minutes)

Primary author: HUEGE, Tim (Karlsruhe Institute of Technology)

Presenter: HUEGE, Tim (Karlsruhe Institute of Technology)

Session Classification: Mini Worshop on Future of UHECR

Contribution ID: **214** Type: **ORAL**

Lower energy TALE, down to 10^14 eV

Friday, October 12, 2018 4:50 PM (10 minutes)

Primary author: JUI, Charles

Presenter: JUI, Charles

Session Classification: Mini Worshop on Future of UHECR

Contribution ID: **215** Type: **not specified**

On the importance of analyzing very-high and ultra-high energy data together, towards a new working group for UHECR symposia

Friday, October 12, 2018 5:00 PM (10 minutes)

Primary author: HAUNGS, Andreas (KIT)

Presenter: HAUNGS, Andreas (KIT)

Session Classification: Mini Worshop on Future of UHECR

Contribution ID: **216** Type: **not specified**

Discussion

Friday, October 12, 2018 5:10 PM (20 minutes)

Session Classification: Mini Worshop on Future of UHECR

Contribution ID: **217** Type: **ORAL**

Towards a Global Cosmic Ray Observatory (GCOS) - requirements for a future observatory

Friday, October 12, 2018 3:00 PM (10 minutes)

Primary author: ENGEL, Ralph (Karlsruhe Institute of Technology)

Presenters: ENGEL, Ralph (Karlsruhe Institute of Technology); HAUNGS, Andreas (KIT); Dr ROTH, Markus (Karlsruhe Institute of Technology, Institut für Kernphysik, Karlsruhe, Germany)

Session Classification: Mini Worshop on Future of UHECR

Contribution ID: **218** Type: **not specified**

A giant air shower detector

Friday, October 12, 2018 3:10 PM (10 minutes)

Primary author: Dr HÖRANDEL, Jörg (Radboud University Nijmegen)

Presenter: Dr HÖRANDEL, Jörg (Radboud University Nijmegen)

Session Classification: Mini Worshop on Future of UHECR

Contribution ID: **219** Type: **ORAL**

Plans for GRAND 200k

Friday, October 12, 2018 4:20 PM (10 minutes)

Primary author: KOTERA, Kumiko (Institut d'Astrophysique de Paris)

Presenter: KOTERA, Kumiko (Institut d'Astrophysique de Paris)

Session Classification: Mini Worshop on Future of UHECR

Contribution ID: **220** Type: **not specified**

Layered surface detector (10 min)

Friday, October 12, 2018 3:20 PM (10 minutes)

Presenter: MARIS, Ioana (Universitaet und Forschungszentrum Karlsruhe)

Session Classification: Mini Worshop on Future of UHECR