Frontiers of Fundamental Physics 14

List of speakers in conference Astroparticle Physics

Updated on January 8, 2015

Imen **Al samarai** (IPNO) **July, 18, 16h05 – 16h30, Amphi "Charve", Astroparticle Physics**

Arrival direction distribution of cosmic rays from 100 PeV to the highest energies detected at the Pierre Auger Observatory

At the Pierre Auger Observatory, several searches for anisotropies in the distribution of arrival directions of cosmic rays detected above 100 PeV are undertaken. Although no significant deviation from isotropy is revealed at present, some measurements related to the angular distributions at large scales are suggestive of dipole patterns of small amplitudes over a wide energy range. Upper limits on the dipole and quadrupole moments derived from these analyses constrain scenarios in which cosmic rays could originate from stationary Galactic sources emitting in all directions up to the ankle energy. This is supported by the absence of any detectable point-like sources above 1 EeV that would be indicative of a neutron flux. At ultra-high energies, searches for correlations of cosmic rays with populations of nearby extragalactic objects are also presented.

Elena **Amato** (INAF) **July, 17, 16h00 – 16h30, Amphi "Charve", Astroparticle Physics**

Particle Acceleration and Radiation in Pulsar Wind Nebulae

Pulsar Wind Nebulae are the astrophysical sources that host the most relativistic shocks in Nature and the only Galactic sources in which we have direct evidence of PeV particles. These facts make them an ideal laboratory for High Energy Astrophysics and the ideal place where fundamental processes common to different classes of relativistic sources can be understood.

I will review the current status of our theoretical understanding of Pulsar Wind Nebulae. In recent years, axisymmetric models of pulsar winds with a latitude dependent energy flux have proved very successful at explaining the high energy morphology of PWNe. This success has prompted developments aimed at using multi-wavelength observations of these nebulae as a diagnostics of the hidden physics of the pulsar wind and of the mechanism(s) through which particles are accelerated at the highly relativistic shock that terminates the wind.

I will discuss these most recent developments in terms of the information that we infer from detailed comparison of simulated synchrotron and inverse Compton emission with current observations.

Eric **Baussan** (IPHC) **July, 16, 18h00 – 18h30, Amphi "Sciences Naturelles", Astroparticle Physics, High Energy Physics**

Future of neutrino based reactor experiments

The last angle of the PMNS mixing matrix has been measured by the neutrino reactor experiments. This important result opens the door to the precision era in the neutrino oscillation landscape. In this context, the next generation of reactor experiments at the kilo ton scale will significantly improve the measurements on the oscillation parameters and will give an answeron the mass hierarchy in the next decades. After a brief summary of the last results, these experiments will be presented with their technological challenges to reach the required sensitivity.

Anatael **Cabrera** (APC) **July, 16, 15h00 – 15h30, Amphi "Sciences Naturelles", Astroparticle Physics, High Energy Physics**

Neutrino Oscillations: Experimental Review

The Neutrino Oscillation phenomenon has been fully established manifestation of both the non-trivial mixing in the leptonic sector, characterised by the PMNS (3x3 matrix in the 3 neutrino type scenario) and the non-degenerate mass state spectrum of neutrinos. As a consequence, we know that mixing is part of the phenomenology of both quarks and leptons, including CP violation, although their mixing patterns have so far been measured to be very different and the possible physics behind remains unknown. Evidence for neutrino CP violation has not yet been observed, due to lack of experimental sensitivity. Also, thanks to the observation of neutrino oscillations, neutrinos are known to be massive. The absolute mass value is still unknown, being much lower than all other known fermions. In my talk, I will briefly review the experimental status of our knowledge as of the Neutrino 2014 (June 2014 at Boston, USA) conference. Improvements due to foreseen experiments will be also highlighted.

John **Carr** (CPPM) **July, 17, 17h00 – 17h20, Amphi "Charve", Astroparticle Physics**

The new Gamma Ray Telescope Observatory: CTA

The Cherenkov Telescope Array (CTA) will provide a new ground based gamma ray observatory with sensivity ten times better than existing gamma ray experiments. CTA will also have a much wider energy range and improved angular resolution.

The presentation will describe the telescope array which is reaching the final stages of design and prototyping. An vital first decision for CTA will be the choice of the sites and the status of this will be given together with the general schedule expected.

The science program will be presented with some focus on the plans for indirect searches for dark matter.

Paschal **Coyle** (CPPM) **July, 16, 17h00 – 17h30, Amphi "Sciences Naturelles", Astroparticle Physics, High Energy Physics**

Mediterranean Neutrino Telescopes

ANTARES is a deep sea neutrino telescope located in the deep sea 40km off the southern coast of France. The results of searches for cosmic neutrinos produced in astrophysical sources and from annhilation of dark matter in the Sun and Galactic centre are presented.

The European neutrino astronomy community has recently started the construction of KM3NeT, a several cubic kilometre neutrino telescope. The R&D for this new research infrastructure are described. Finally, the potential for a measurement of the neutrino mass hierarchy, with a densely instrumented detector configuration (ORCA) is discussed.

Frédéric **Daigne** (IAP) **July, 18, 14h30 – 15h05, Amphi "Charve", Astroparticle Physics**

Gamma-ray bursts

Gamma-ray bursts are the most powerful explosions in the Universe. They appear as brief bursts of gamma-rays followed by an afterglow at longer wavelengths. They involve a complex physics with a relativistic ejection by a new-born compact stellar mass source, and several phases of emission associated to internal dissipation in the ejecta and to the interaction of the ejecta with its environment. I will review the observations of these phenomena and discuss our current understanding of their physical origin.

Arache **Djannati-Atai** (APC) **July, 18, 15h05 – 15h40, Amphi "Charve", Astroparticle Physics**

The Very High Energy γ-ray Extragalactic Sky

After a decade of operation of third generation Imaging Atmospheric Cherenkov telescopes, not only the number and our knowledge of very high energy γ-ray ($>\sim$ 100 GeV) extragalactic sources have increased significantly, the use of their emission, either as probes of the intergalactic medium for cosmological applications, or as tools for exploring frontiers of fundamental physics, has revealed itself a very essential tool. I will review the field and discuss the latest results from major observatories.

Samia **Drappeau** (IRAP) **July, 17, 17h20 – 17h40, Amphi "Charve", Astroparticle Physics**

A new multiwavelength lepto-hadronic model of astrophysical jet emission

In the last few years, the rapid development of gamma-ray observations has open a new window on X-ray binaries (XRBs) sources, with at least one solid detection so far. Associated with these gamma-ray are neutrino emission. In this talk we introduce a new lepto-hadronic model that is based on successful work fitting the lower energy, broadband spectra of XRBs in the compact jet-dominated state. Protons (and electrons) are accelerated throughout the jet and cool via radiation and inelastic collisions, and we calculate spectral energy distributions (SEDs) including both hadronic and leptonic induced processes. We present new predictions for the gamma-ray fluxes in the GeV-TeV range. This model can also be scaled to describe the SEDs of low-luminosity active galactic nuclei such as our own Galactic Center black hole Sgr A*.

Benoit **Famaey** (UNISTRA) **July, 15, 14h30 – 15h03, Amphi "Charve", Astroparticle Physics**

Dark Matter in the Milky Way

We review most dynamical constraints on the shape of the gravitational field in the Milky Way, and on its corresponding dark matter halo. We review observational constraints in the central parts (core or cusped distribution), in the solar neighbourhood (local dark matter density) and in the outer parts (virial mass), and also point out various caveats, systematic effects and common misconceptions.

Jules **Gascon** (IPNL) **July, 15, 15h03 – 15h36, Amphi "Charve", Astroparticle Physics**

Review of Dark Matter Direct Searches

Direct Dark Matter Searches are experiments looking for the energetic recoils due to the scattering of Weakly Interacting Massive Particles (WIMPs) from our galactic halo on nuclei in a terrestrial target. The principles of these type of searches is described, and the status and results of the leading experiments in that field are presented, as well as their prospects in the coming years.

Andrea **Goldwurm** (APC) **July, 17, 15h30 – 16h00, Amphi "Charve", Astroparticle Physics**

High Energy Phenomena at the Center of our Galaxy

I will review the recent results on the high-energy phenomena occuring in the region of the Galactic Center by first describing the structure and the components of this fascinating area of the sky and then reporting the main discoveries that have been obtained in X-rays and gamma-rays. Several of these results indicate that the Galactic Center was the site of a powerful activity in the past, possibly driven by the central supermassive black hole, Sgr A*, that, today, appears very dim and quiet in contrast with the exuberant activity displayed by other galactic nuclei. I will try to put these results in contest with the general picture we have from the observations of the nuclei of external galaxies to see if this can lead to some new insights on the impact of the galactic supermassive black hole on its close environment and on the whole Galaxy.

Thomas **Lacroix** (IAP) **July, 15, 16h10 – 16h30, Amphi "Charve", Astroparticle Physics**

Fitting the Fermi-LAT GeV excess: on the importance of the propagation of electrons from dark matter

An excess of gamma rays at GeV energies has been detected in the Fermi-LAT data. This signal comes from a narrow region around the Galactic Center and has been interpreted as possible evidence for light (30 GeV) dark matter particles. Focussing on the prompt gamma-ray emission, previous work found that the best fit to the data corresponds to annihilations proceeding into b quarks, with a dark matter profile $r^{-1.2}$. In this talk, I will show that this is not the only possible annihilation set-up. More specifically, I will show how including the contributions to the gamma-ray spectrum from inverse Compton scattering and bremsstrahlung from electrons produced in dark matter annihilations, and undergoing diffusion through the Galactic magnetic field, drastically modifies the spectrum, in particular for leptonic final states.

Stefano **Magni** (LUPM) **July, 15, 17h00 – 17h20, Amphi "Charve", Astroparticle Physics**

Revisiting the escape speed impact on dark matter direct detection

The knowledge of the high velocity tail of the WIMP velocity distribution has strong impact on the way direct detection (DD) may constrain or discover light WIMPs in the GeV mass range. Recently, there has been important observational efforts to measure the so-called Galactic escape speed at the position of the Earth, like for instance the analysis released in late 2013 by the RAVE Collaboration. We revisit the estimate of the astrophysical uncertainties on DD limits and sensitivity from this perspective. We show that a treatment that consistently correlates all relevant parameters (local circular velocity, dark matter density, distance to the Galactic center, escape speed) leads to significantly reduced systematic errors in DD sensitivity. We go beyond the Maxwellian velocity approximation generally used to compute the DD limits by means of ergodic distribution functions, where the previously mentioned correlations are automatic and result from a minimal set of input parameters. Finally, we test our semi-analytical model against cosmological simulations and discuss its relevance. We show that it provides a consistent and simple way to derive meaningful astrophysical uncertainties.

Alexandre **Marcowith** (LUPM) **July, 17, 15h00 – 15h30, Amphi "Charve", Astroparticle Physics**

Cosmic Ray propagation in the interstellar medium

This review talk addresses the question of the Cosmic-Ray (CR) propagation in the interstellar medium (ISM). We will discuss some recent progresses made in the microphysical description of the CR interaction electromagnetic fluctuations in the ISM using both analytical and numerical approaches. We will discuss these models in the context of the CR phenomenological models.

Aurore **Mathieu** (CPPM) **July, 18, 17h00 – 17h20, Amphi "Charve", Astroparticle Physics**

Multi-Messenger analysis with the ANTARES High Energy Neutrino Telescope

ANTARES is currently the largest operating neutrino telescope in the Northern Hemisphere, mainly sensitive to TeV neutrinos. Its main goal is the detection of high energy neutrinos from astrophysical sources, which would provide important insights about the processes powering their engines and would help understand the origin of high energy cosmic rays.

To identify unambiguously such sources, ANTARES has developped several online and offline programs to reveal possible time and/or space correlations of neutrino candidates with other cosmic messengers : photons (mainly X-rays and GeV/TeV gamma-rays through the search from Gamma-ray bursts or GeV-flaring blazars, but also in the optical domain through alert and follow-up programs), cosmic rays and gravitational wave bursts detected by the Virgo/LIGO interferometers. Some of the most relevant results of these multi-messenger analyses will be presented in this contribution.

Pol **Mollitor** (LAM) **July, 15, 17h40 – 18h00, Amphi "Charve", Astroparticle Physics**

Cosmological N-body+hydro simulations of spiral galaxies and dark matter detection

We study three high resolution cosmological hydrodynamical simulations of Milky Way-sized halos including a comparison with the corresponding DM-only runs performed with the adaptive mesh refinement code RAMSES. We analyse the stellar and gas distribution and find one of our simulated galaxies with interesting Milky Way like features with regard to several observational tests. Thanks to consistently tuned star formation rate and supernovae feedback, we manage to obtain an extended disk and a flat rotation curve with the circular velocity and the dark matter density in the solar neighbourhood in agreement with observations. With a careful look at the derivation of the stellar-to-halo mass ratio, we also obtain competitive values for this criterion. Concerning the dark matter distribution, we explicitly show the interaction with the baryons and show how the dark matter is first contracted by star formation and then cored by feedback processes. In this consistent framework, we also study dark matter detection phenomenology which will be the subject of subsequent papers.

References

[1] Pol Mollitor, Emmanuel Nezri, Romain Teyssier, Baryonic and dark matter distribution in cosmological simulations of spiral galaxies. http://arxiv.org/abs/1405.4318

Chang-Mo **Ryu** (POSTECH) **July, 18, 17h20 – 17h40, Amphi "Charve", Astroparticle Physics**

Magnetic field generated by the Weibel instability

The origin of the magnetic field in the universe is of great interest. Biermann's battery and the Weibel instability have been considered as candidates for such mechanisms [1]. The Weibel instability is believed to play an important role in the Super Nova remnant (SNR) and in the inertial fusion plasma. In this paper, we discuss the evolution of current structures and magnetic fields of the nonlinear Weibel instability up to the saturation regime, based on PIC simulation results.

References

[1] D. Ryu, D. Schleicher, R. Treumann, C. Tsagas, and L. Widrow, *Magnetic fields in the large-scale structure of the universe*, Space Science Reviews, 158, 35 (2011).

David **Sanchez** (LAPP) **July, 18, 15h40 – 16h05, Amphi "Charve", Astroparticle Physics**

The extragalactic sky in the Fermi era

Since its launch by NASA in June 2008, the Fermi satellite has opened a new window on the gamma-ray sky. On-board Fermi, the Large Area Telescope (LAT) detect photons with an energy from 20 MeV to more than 300 GeV. After almost 6 years of monitoring of the sky, the LAT has increased our knowledge of the extragalactic sky with unexpected and sspectacular discoveries like the Cen A Lobes, a detailed measurement of the EBL and more. In this talk, the review of the most important results in the extragalactic sky of the last 6 years will be made as well as what can be expected for the future.

Vera Georgievna **Sinitsyna** (FIAN RAS) **July, 18, 17h40 – 18h00, Amphi "Charve", Astroparticle Physics**

Very high energy gamma-emission of Perseus Cluster

The cluster of galaxies in Perseus have long been considered as possible candidates for the sources of high and very high energy γ-ray emission generated by various mechanisms. We presented the results of fifteen-year-long observations of the central galaxy in the cluster NGC 1275 at energies 800 GeV-40 TeV discovered by the SHALON telescope in 1996 [1,2,3]. The data obtained at very high energies, namely the images of the galaxy and its surroundings, and the flux variability indicate that the TeV γ-ray emission is produced by a number of processes: a part of this emission is generated by relativistic jets in the nucleus of NGC 1275 itself. Whereas, the presence of an extended structure around NGC 1275 [3] is evidence of the interaction of cosmic rays and magnetic fields generated in the jets at the galactic center with the gas of the Perseus cluster.

References

[1] V.G. Sinitsyna, in Proc. of the Workshop, Towards a Major Atmospheric Cherenkov Detector V, Kruger Park, South Africa, Ed. by O. De Jager (Westprint, Potchefstroom, 1997), p. 136.
[2] V.G. Sinitsyna et al., Nucl. Phys. B Proc. Suppl. 196, 442 (2009).
[3] V.G. Sinitsyna and V. Yu. Sinitsyna, Astron. Lett. 40(2-3), 75 (2014); [ArXiv: astro-ph.HE1403.1740].

Vera Yurievna **Sinitsyna** (FIAN RAS) **July, 17, 18h00 – 18h20, Amphi "Charve", Astroparticle Physics**

Long-term studies of the Cygnus Region and its objects

Cygnus Region contains the number of powerful sources of radio and X-rays which are supposed as a potential TeV-emitting objects. The results of 17-year observations of the Cyg X-3 at energies 0.8 - 85 TeV, detected by the SHALON telescope in 1995 are presented [1,2,3]. A number of high activity period of Cyg X-3 were detected with SHALON during the all period of observation. The significant increases of flux are correlated with flaring activity at lower energy range of X-ray and/or at observations of Fermi LAT. Also, we present the results of long-term observations of the Cygnus region which are revealed the γ-ray emission from the one of nearby object - γCygni SNR [3], placed at 2° from Cyg X-3. The results of γCygni SNR observation by SHALON [3] are presented with spectral energy distribution, images and integral spectra at energies 0.8 - 50 TeV.

References

[1] V.G. Sinitsyna, Proc. of Towards a Major Cherenkov Detector-V ed. O.C. de Jager, (Wesprint-Potchefstrom, South Africa). 1997. v. 3. p. 273.
[2]V.G. Sinitsyna, Journal of the Physical Society of Japan, Supplement A. 78 (2009) p. 92.
[3] V. G. Sinitsyna and V. Yu. Sinitsyna, Bull. of the Lebedev Physics Institute, (New York: Allerton Press, Inc.), 40(5) (2013) p.2.

Li **Tao** (LAPP) **July, 15, 17h20 – 17h40, Amphi "Charve", Astroparticle Physics**

Measurement of leptons related quantities in AMS

The first results of the AMS experiment on board the International Space Station corresponding to the first two years of data taking will be presented. A measurement of the positron fraction in primary cosmic rays in the energy range from 0.5 GeV upwards, as well as the combined and individual electrons and positrons spectra will be expounded. The main features of these analysis will be explained and some perspectives on the future of these measurements will be given.

Thomas **Tavernier** (APC) **July, 17, 17h40 – 18h00, Amphi "Charve", Astroparticle Physics**

Bright Gamma-ray Pulsars in the Fermi Era : Results and prospects with ground-based telescopes

With more than 140 gamma-ray emitting pulsars detected, the Large Area Telescope (LAT) aboard the Fermi satellite has revolutionized the field of high-energy pulsar astronomy.

While the processes (e.g. curvature radiation, synchrotron, Inverse-Compton emission) thought to be responsible for the pulsed emission at high energies are well known, the details of the acceleration and radiation mechanisms at play are still widely debated through several models.

The analysis of the large data-set of events available from the brightest gamma-ray pulsars, six years after the launch of the Fermi satellite, reveals for these individuals a harder spectrum than previously measured (and expected) and hence increases the chance to detect them with ground-based Cherenkov Telescopes. The detection from ground at the highest energies brings in turn precious information allowing one to constrain severely existing models. The latest results will be presented, and prospects in the field will be discussed.

Yasunobu **Uchiyama** (Rikkyo Univ.) **July, 17, 14h30 – 15h00, Amphi "Charve", Astroparticle Physics**

High Energy and Very High Energy Gamma-rays from Galactic Particle Accelerators

We review recent observational results on the gamma-ray emission from galactic sources in which efficient particle acceleration can be seen. In particular, we highlight recent progress on our understanding of particle acceleration in supernova remnants, pulsar wind nebulae, and gamma-ray binaries, based on the results from the Fermi Gamma-ray Space Telescope and ground-based Cherenkov telescopes such as H.E.S.S.

Piero **Ullio** (SISSA) **July, 15, 15h36 – 16h09, Amphi "Charve", Astroparticle Physics**

Indirect dark matter detection: recent results and perspectives