

# HONEST Workshops: Hot Topics in High Energy Astrophysics



## Report dei Contributi

ID contributo: 1

Tipo: **non specificato**

# Introduction to the motivations and topics of the workshop

*martedì 1 dicembre 2020 09:05 (15 minuti)*

**Relatore:** HINTON, Jim (MPIK)

**Classifica Sessioni:** Experimental part: Review of the latest results

ID contributo: 2

Tipo: **non specificato**

## **HAWC results on Geminga/PSR B0656**

*martedì 1 dicembre 2020 09:20 (30 minuti)*

**Relatore:** Dr. ZHOU, Hao (Tsung-Dao Lee Institute & School of Physics and Astronomy)

**Classifica Sessioni:** Experimental part: Review of the latest results

ID contributo: 3

Tipo: **non specificato**

## **H.E.S.S. results on extended emission surrounding middle-age pulsars**

*martedì 1 dicembre 2020 09:50 (30 minuti)*

**Relatore:** Dr. MITCHELL, Alison (ETH Zurich)

**Classifica Sessioni:** Experimental part: Review of the latest results

ID contributo: 4

Tipo: **non specificato**

## Fermi results on Geminga extended emission

*martedì 1 dicembre 2020 10:35 (30 minuti)*

**Relatore:** MANCONI, Silvia (Università degli Studi di Torino)

**Classifica Sessioni:** Experimental part: Review of the latest results

ID contributo: 5

Tipo: **non specificato**

## HAWC results on other TeV halos

*martedì 1 dicembre 2020 11:05 (30 minuti)*

**Relatore:** MALONE, Kelly (Los Alamos National Laboratory)

**Classifica Sessioni:** Experimental part: Review of the latest results

ID contributo: 6

Tipo: **non specificato**

## **LHAASO performance and first results on extended emission from known halos**

*martedì 1 dicembre 2020 11:35 (30 minuti)*

**Relatore:** Prof. SONGZHAN, Chen

**Classifica Sessioni:** Experimental part: Review of the latest results

ID contributo: 7

Tipo: **non specificato**

## **Pulsar wind nebula evolution**

*mercoledì 2 dicembre 2020 15:00 (20 minuti)*

**Relatore:** Dr. OLMI, Barbara

**Classifica Sessioni:** Theoretical Models: Halo classification and mechanisms



ID contributo: 8

Tipo: **non specificato**

## **TeV halos classification as extended sources surrounding pulsars**

*mercoledì 2 dicembre 2020 15:40 (20 minuti)*

**Relatore:** LINDEN, Tim (The Ohio State University)

**Classifica Sessioni:** Theoretical Models: Halo classification and mechanisms

ID contributo: 9

Tipo: **non specificato**

## **TeV halos classified by the dominant energetics in the region**

*mercoledì 2 dicembre 2020 16:00 (20 minuti)*

**Relatore:** GIACINTI, Gwenael (MPIK Heidelberg)

**Classifica Sessioni:** Theoretical Models: Halo classification and mechanisms

ID contributo: **10**

Tipo: **non specificato**

## **Origin of the Turbulence generated in TeV halos**

*mercoledì 2 dicembre 2020 15:20 (20 minuti)*

**Relatore:** EVOLI, Carmelo (Gran Sasso Science Institute)

**Classifica Sessioni:** Theoretical Models: Halo classification and mechanisms

ID contributo: 11

Tipo: **non specificato**

## **On the scales of extension of Pulsar Wind Nebulae**

*mercoledì 2 dicembre 2020 16:40 (20 minuti)*

**Relatore:** KHANGULYAN, Dmitry (Rikkyo University)

**Classifica Sessioni:** Theoretical Models: Halo classification and mechanisms

ID contributo: 12

Tipo: **non specificato**

## **Extended Inverse Compton gamma-ray emission beyond PWNe**

*mercoledì 2 dicembre 2020 17:00 (20 minuti)*

**Relatore:** Dr. LIU, Ruoyu (Nanjing University)

**Classifica Sessioni:** Theoretical Models: Halo classification and mechanisms

ID contributo: 13

Tipo: **non specificato**

## **Gamma-ray halos around SNRs and Massive Stellar Clusters - differentiation signatures from those around pulsars**

**Relatore:** CELLI, Silvia (GSGC)

**Classifica Sessioni:** Theoretical Models: Halo classification and mechanisms

ID contributo: 14

Tipo: **non specificato**

## Lessons from HAWC PWNe observations

*mercoledì 2 dicembre 2020 17:20 (20 minuti)*

**Relatore:** Prof. PROFUMO, Stefano

**Classifica Sessioni:** Theoretical Models: Halo classification and mechanisms

ID contributo: 15

Tipo: **non specificato**

## **VHE Cosmic Ray Electrons - observations and interpretation**

*giovedì 3 dicembre 2020 10:00 (30 minuti)*

**Relatore:** Dr. EGBERTS, Kathrin

**Classifica Sessioni:** Implications for Cosmic Rays and Future: Simulation of CR sea, CR leptons and prospects



ID contributo: 16

Tipo: **non specificato**

## **Review of different codes of Cosmic Ray Propagation in the Galaxy**

*giovedì 3 dicembre 2020 09:30 (30 minuti)*

**Relatore:** ORLANDO, Elena (Istituto Nazionale di Fisica Nucleare)

**Classifica Sessioni:** Implications for Cosmic Rays and Future: Simulation of CR sea, CR leptons and prospects

ID contributo: 17

Tipo: **non specificato**

## **MWL view of Halos (sub-GeV emission)**

*giovedì 3 dicembre 2020 09:00 (30 minuti)*

**Relatore:** DI MAURO, Mattia (TO)

**Classifica Sessioni:** Implications for Cosmic Rays and Future: Simulation of CR sea, CR leptons and prospects

ID contributo: **18**

Tipo: **non specificato**

## Prospects for CTA

*giovedì 3 dicembre 2020 11:30 (15 minuti)*

**Relatore:** DE ONA WILHELMI, Emma (DESY-Zeuthen)

**Classifica Sessioni:** Implications for Cosmic Rays and Future: Simulation of CR sea, CR leptons and prospects

ID contributo: **19**

Tipo: **non specificato**

## Prospects with SWGO

**Relatore:** LOPEZ COTO, Ruben (PD)

**Classifica Sessioni:** Implications for Cosmic Rays and Future: Simulation of CR sea, CR leptons and prospects

ID contributo: **20**

Tipo: **non specificato**

## **Gamma-ray halos around pulsars: closing remarks**

**Relatore:** AHARONIAN, Felix (Dublin Institute for Advanced Studies)

**Classifica Sessioni:** Implications for Cosmic Rays and Future: Simulation of CR sea, CR leptons and prospects

ID contributo: 22

Tipo: **Theoretical Models: Halo classification and mechanisms**

## Discovery Prospects for TeV Halos and Physics Implications

Milagro and HAWC observations have revealed the existence of TeV halos around nearby, relatively old pulsars. We perform population modeling of TeV halos taking into account the age dependence of halo formation. Our analysis highlights the potential importance of TeV halos in existing and future observations by HAWC, HESS, and CTA. We quantify the contributions of TeV halos to the source counts and diffuse emission. Further, we show that future observations of TeV halos are useful to constrain the statistical properties of pulsars at birth.

**Autori principali:** Sig. SUDOH, Takahiro (University of Tokyo); Prof. BEACOM, John (Ohio State University); Dr. LINDEN, Tim (Stockholm University)

**Relatore:** Sig. SUDOH, Takahiro (University of Tokyo)

ID contributo: 23

Tipo: **Experimental part: Review of the latest results**

## **The energy-dependent morphology of the pulsar wind nebula HESS J1825-137 seen by the Fermi-LAT: investigating its PWN / gamma-ray halo nature**

Taking advantage of more than 11 years of Fermi-LAT data, we perform a new and deep analysis of the pulsar wind nebula (PWN) HESS J1825-137. We present the results of the spectral analysis and of the first energy-resolved morphological study of the PWN HESS J1825-137 from 1 GeV to 1 TeV. This PWN is an archetypal system making it a perfect laboratory for studying particle transport mechanisms. Combining this analysis with recent HESS results enables us to constrain the particle transport mechanisms and to investigate the PWN - TeV halo nature of this source

**Autori principali:** PRINCIPE, Giacomo (Istituto Nazionale di Fisica Nucleare); Dr. MITCHELL, Alison (ETH Zurich); FUNK, Stefan (ECAP - Erlangen Centre for Astroparticle Physics); HINTON, Jim (MPIK); CAROFF, Sami (PhD); PARSON, Daniel

**Relatore:** PRINCIPE, Giacomo (Istituto Nazionale di Fisica Nucleare)

ID contributo: 24

Tipo: **Experimental part: Review of the latest results**

## Study of the gamma-ray emission from 3HWC J1928+178

The gamma-ray source 3HWC J1928+178, discovered by HAWC, is coincident with PSR J1928+1746, a 82 kyr pulsar located 4 kpc away. It has not been reported by any IACT, until the recent detection by HESS of emission from this region using an analysis adapted to extended sources.

No counterpart in GeV gamma-rays from Fermi-LAT data or from X-ray observations has been reported so far. In this poster, we give the multiwavelength context of the region surrounding 3HWC J1928+178 and present a multi-component model of the region derived using the Multi-Mission Maximum Likelihood framework (3ML). We explore the possibility to model the gamma-ray emission of 3HWC J1928+178 by an extended source originated from continuous particle diffusion.

From the gamma-ray luminosity, I derive an energy density slightly smaller than the one of the ISM. Together with the age of the pulsar and its extended nature, it may indicate a transition from a pulsar wind nebulae to a halo, where the electrons started to cool and diffuse away from their source.

**Autori principali:** JARDIN-BLICQ, Armelle (National Astronomical Research Institute of Thailand (NARIT)); Dr. ZHOU, Hao (Tsung-Dao Lee Institute & School of Physics and Astronomy); MARANDON, Vincent (MPI, Heidelberg)

**Relatore:** JARDIN-BLICQ, Armelle (National Astronomical Research Institute of Thailand (NARIT))



ID contributo: 25

Tipo: **Theoretical Models: Halo classification and mechanisms**

## Radio synchrotron halos around pulsars: candidate selection and classification

The interpretation of large gamma-ray halos around middle-aged pulsars as electron/positron pairs emitting from inverse-Compton scattering of ambient photon fields naturally leads one to think about the necessary counterpart of such a system: radio synchrotron halos.

In this contribution, we introduce some first investigations of the detectability of such radio sources in the Milky Way. We developed a halo population model using as pair sources the pulsars listed the ATNF database, and assuming as transport process a simple diffusion-loss propagation in models for the interstellar and radiation fields of the Galaxy. The predicted halo synchrotron emission for each halo candidate is compared to a model for the thermal and non-thermal interstellar diffuse radiation of the Milky Way. From this, we discuss criteria for selecting and ranking the best targets for the detection of radio halos around pulsars, especially in view of the capabilities of the MeerKAT instrument.

**Autori principali:** Dr. CORIAT, Mickael (UPS/IRAP); Dr. MARTIN, Pierrick (CNRS/IRAP)

**Relatore:** Dr. MARTIN, Pierrick (CNRS/IRAP)

ID contributo: 26

Tipo: **Theoretical Models: Halo classification and mechanisms**

## Gamma-ray halos in the HE and VHE Galactic landscape

The recent discovery of long-lived and large-size gamma-ray emission structures around a handful of middle-aged pulsars raised the question of their actual place in the high-energy and very-high-energy landscape, first and foremost in the Milky Way but more generally in all star-forming galaxies. If most pulsars develop such gamma-ray halos over several 100kyr, harnessing the gamma-ray observations of our Galaxy might become challenging, especially at the highest energies: source confusion along the plane, observational strategy to allow safe background estimates, disentangling halo from larger-scale interstellar emission, ...

In this work, we aim at assessing the possible contribution of halos to the gamma-ray emission of the Milky Way. We have developed a galactic halo population model calibrated on existing observations, in order to address several questions: What are the best targets for study in GeV and TeV range ? How many halos may already be in reach of existing instruments ? How many will be in reach of future instruments, and under which conditions ? How do halos compare to the galactic interstellar diffuse emission ? In this poster, we present our population model together with a subset of preliminary results from the study.

**Autori principali:** Dr. MARTIN, Pierrick (CNRS/IRAP); Dr. ABDOLLAHI, Soheila (CNRS/IRAP)

**Relatore:** Dr. MARTIN, Pierrick (CNRS/IRAP)

ID contributo: 27

Tipo: **Experimental part: Review of the latest results**

## A 3D likelihood based approach for extended VHE source extraction

Ground based Imaging Atmospheric Cherenkov Telescopes have proven to be very powerful in detecting very high energy gamma-ray source (>100 GeV). Nevertheless, their limited field-of-view (~2 degrees in radius) makes the detection of large emission, as for pulsar halos, quite challenging. This is due to the presence of a strong residual hadronic background which is usually statistically removed using source free region in the FoV.

A 3D likelihood minimisation using field-of-view background models, eg: as implemented in gammapy and ctools, could overcome this limitation and yield significant improvement in the sensitivity of IACT to large scale emission. The efficacy of FoV background models in detecting extended sources in the galactic plane has been demonstrated by Jardin-Blicq et al, 2019.

In this contribution, we use the instrument response functions from the H.E.S.S. public data release to characterise the efficiency of 3D likelihood technique to detect pulsar halos. We also show the implementation of an energy dependent morphological model, which would be expected with advection or diffusion loss driven scenario in pulsar winds, and simulate what would be seen with the current generation IACTs.

**Autori principali:** SINHA, Atreyee (LUPM, CNRS, Université de Montpellier); GALLANT, Yves (LUPM, CNRS); MARANDON, Vincent (MPI, Heidelberg); MARTIN, Pierrick (CNRS/IRAP); LEMOINE--GOUMARD, Marianne (CENBG - CNRS); JARDIN-BLICQ, Armelle (National Astronomical Research Institute of Thailand (NARIT)); CHAMBERY, Pauline (CENBG)

**Relatore:** SINHA, Atreyee (LUPM, CNRS, Université de Montpellier)

ID contributo: 28

Tipo: **Experimental part: Review of the latest results**

## **Follow-up study of Geminga's Contribution to the Local Positron Excess with the High Altitude Water Cherenkov Gamma-Ray Observatory**

The PAMELA, Fermi-LAT, and AMS-02 experiments measured a local excess of positrons above energies of 10 GeV. This excess has been considered to be due to dark matter interactions or the presence of nearby astrophysical sources. Here, I present preliminary results on the follow-up study of diffusion in the region of the pulsar Geminga with approximately five years of HAWC data. I implement a new analysis with templates that contain spectral and spatial information of the Geminga pulsar using the HAWC Accelerated Likelihood (HAL) and the Multi-Mission Maximum Likelihood framework (3ML). With this template method, I study the diffuse gamma-ray emission of electrons from inverse Compton scattering with low energy photon fields, i.e., microwave background radiation, for different diffusion coefficients in the range of  $10^{25}$ - $10^{28}$  cm<sup>2</sup>/s and different electron spectral indices 1.5-2.4. The preliminary results using this method are in agreement with those of Fermi-LAT and HAWC.

**Autore principale:** Sig. TORRES ESCOBEDO, Ramiro (HAWC)

**Relatore:** Sig. TORRES ESCOBEDO, Ramiro (HAWC)

ID contributo: 29

Tipo: **non specificato**

## **The energy-dependent morphology of the pulsar wind nebula HESS J1825-137 seen by the Fermi-LAT: investigating its PWN / gamma-ray halo nature**

*martedì 1 dicembre 2020 13:00 (5 minuti)*

**Relatore:** PRINCIPE, Giacomo (Istituto Nazionale di Fisica Nucleare)

**Classifica Sessioni:** Poster

ID contributo: 30

Tipo: **non specificato**

## **Study of the gamma-ray emission from 3HWC J1928+178**

*martedì 1 dicembre 2020 13:05 (5 minuti)*

**Relatore:** JARDIN-BLICQ, Armelle (National Astronomical Research Institute of Thailand (NARIT))

**Classifica Sessioni:** Poster

ID contributo: 31

Tipo: **non specificato**

## **A 3D likelihood based approach for extended VHE source extraction**

*martedì 1 dicembre 2020 13:10 (5 minuti)*

**Relatore:** SINHA, Atreyee (LUPM, CNRS, Université de Montpellier)

**Classifica Sessioni:** Poster

ID contributo: 32

Tipo: **non specificato**

## **Follow-up study of Geminga's Contribution to the Local Positron Excess with the High Altitude Water Cherenkov Gamma-Ray Observatory**

*martedì 1 dicembre 2020 13:15 (5 minuti)*

**Relatore:** TORRES ESCOBEDO, Ramiro (HAWC)

**Classifica Sessioni:** Poster



ID contributo: 33

Tipo: **non specificato**

# Discovery Prospects for TeV Halos and Physics Implications

*martedì 1 dicembre 2020 13:20 (5 minuti)*

**Relatore:** SUDOH, Takahiro (University of Tokyo)

**Classifica Sessioni:** Poster

ID contributo: 34

Tipo: **non specificato**

## **Radio synchrotron halos around pulsars: candidate selection and classification**

*mercoledì 2 dicembre 2020 19:00 (5 minuti)*

**Relatori:** Dr. CORIAT, Mickael (UPS/IRAP); MARTIN, Pierrick (CNRS/IRAP)

**Classifica Sessioni:** Poster

ID contributo: 35

Tipo: **non specificato**

## **Gamma-ray halos in the HE and VHE Galactic landscape**

*mercoledì 2 dicembre 2020 19:05 (5 minuti)*

**Relatori:** MARTIN, Pierrick (CNRS/IRAP); Dr. ABDOLLAHI, Soheila (CNRS/IRAP)

**Classifica Sessioni:** Poster

ID contributo: 36

Tipo: **non specificato**

## Prospects for CTA - Source confusion

**Relatore:** ZANIN, Roberta (Universitat de Barcelona)

**Classifica Sessioni:** Implications for Cosmic Rays and Future: Simulation of CR sea, CR leptons and prospects

ID contributo: 37

Tipo: **non specificato**

## Prospects with SWGO

*giovedì 3 dicembre 2020 11:00 (30 minuti)*

**Relatore:** LOPEZ COTO, Ruben (PD)

**Classifica Sessioni:** Implications for Cosmic Rays and Future: Simulation of CR sea, CR leptons and prospects

ID contributo: 38

Tipo: **non specificato**

## **Gamma-ray halos around pulsars: closing remarks**

*giovedì 3 dicembre 2020 11:45 (30 minuti)*

**Relatore:** AHARONIAN, Felix (Dublin Institute for Advanced Studies)

**Classifica Sessioni:** Implications for Cosmic Rays and Future: Simulation of CR sea, CR leptons and prospects

ID contributo: **39**

Tipo: **non specificato**

## Welcome

*martedì 1 dicembre 2020 09:00 (5 minuti)*

**Autori principali:** DE ONA WILHELMI, Emma (DESY-Zeuthen); LOPEZ COTO, Ruben (PD)

**Relatore:** LOPEZ COTO, Ruben (PD)

**Classifica Sessioni:** Experimental part: Review of the latest results