T 17: Neutrino Astronomy I

Time: Monday 16:15–18:15 Location: KS H C

T 17.1 Mon 16:15 KS H C

Search for coincidences between IceCube sub-TeV neutrinos and sub-threshold Gravitational Wave events in the LIGO-Virgo-KAGRA third observing run — •Tista Mukherjee for the IceCube-Collaboration — Institute for Astroparticle Physics (IAP), Karlsruhe Institute of Technology (KIT), Hermann-von-Helmholtz Platz 1, 76344 Eggenstein-Leopoldshafen, Germany

Since the first direct detection of gravitational waves (GW) by the LIGO-Virgo-KAGRA detectors, the IceCube Neutrino Observatory has actively participated in identifying their neutrino counterparts. The sub-threshold GW alerts from the third observation run of LIGOVirgo-KAGRA, identified by both template-based searches and minimally modelled pipelines, have also been examined in follow-up analyses with TeV-PeV neutrinos, but no correlations were found. This work presents a systematic search for lower-energy neutrino emission from the sub-threshold GWs, utilising the archival all-flavour, sub-TeV neutrino sample from the IceCube Neutrino Observatory. From the public GW catalogues, we identify 103 promising candidates, comprising a mixture of compact binary mergers and GW burst triggers. After conducting a catalogue search to identify correlated sub-TeV neutrinos within a 1000 s time window, employing an unbinned maximum likelihood method, no significant coincidences are found. Hence, we report neutrino flux upper limits from the sub-threshold GW sources followed up in this analysis within sub-TeV neutrino energy.

T 17.2 Mon 16:30 KS H C

Improving Measurement of Astrophysical Neutrino Flux with Advanced Northern Tracks Selection in IceCube — •Shuyang Deng, Lasse Düser, Sönke Schwirn, Philipp Soldin, Christopher Wiebusch, and Marco Zimmermann — III. Physikalisches Institut B RWTH Aachen University, Aachen, Germany

The IceCube Neutrino Observatory is a large neutrino detector at the South Pole. One of its main detection channels is via neutrino-induced muon tracks, which provide a large effective area and high angular resolution. The Advanced Northern Track Selection (ANTS) framework uses a graph convolutional neural network to improve the selection of these events, as well as to perform reconstructions of their physical parameters. Furthermore, these events show different topologies and signatures within the detector, which can be classified with ANTS, enabling dedicated handling of these topologies in analyses. In this talk, we will show the performance of ANTS and the improvement in sensitivity it provides for the measurement of the astrophysical neutrino flux.

T 17.3 Mon 16:45 KS H C

Understanding Wind Related Background Radio Pulses at the Radio Neutrino Observatory in Greenland — •Pascal Schriefer for the RNO-G-Collaboration — ECAP, Friedrich-Alexander-Universität Erlangen-Nürnberg

The Radio Neutrino Observatory in Greenland (RNO-G) aims to detect ultra-high energy ($>$ 10 PeV) neutrinos through pulsed radio signals generated by in-ice particle showers on the basis of the Askaryan effect. 35 independent detector stations are to be built on a grid with a spacing of $\sim$ 1.2 km, eight of which are already operational and equipped with antennas at shallow depths in the ice. Even though the detector is being constructed at the very remote summit of Greenland, approximately 3200 m above sea level, background radio signals of different origins are detectable. Especially during periods with high wind speeds ($> 8 - 10$ m/s), an overwhelming number of radio pulses with signatures comparable to those of neutrino events are detected. This poses a significant issue for the identification of cosmic particles as high wind speeds are not only very common in Greenland, but during the polar winter, wind is the only power source available to keep the stations operational. In this contribution, RNO-G is being introduced and the current state of knowledge about wind-related backgrounds is discussed, including the theorized mechanism and origin of these signals as well as unexplained features and plans of how to further investigate them.

T 17.4 Mon 17:00 KS H C

Downward ultra-high-energy neutrino detection in the atmosphere with radio antenna at the ground-based observatories — •Yue Baobiao for the Pierre Auger-Collaboration — Bergische Universität Wuppertal

Ultra-high-energy (UHE) neutrinos are unique cosmic messengers offering direct insight into the most energetic processes in the universe. Radio detection promises significant advantages for detecting highly inclined air showers induced by UHE neutrinos, including a larger exposure range compared to particle detectors, which is due to minimal atmospheric attenuation of radio signals combined with good reconstruction precision. Furthermore, this technique improves the air shower longitudinal reconstruction, which can be used to identify neutrinos with their first interaction far below the top of the atmosphere. In this work, we present a method to reconstruct the radio emission maximum ($X_{\max}^{\text{radio}}$) and demonstrate its power in distinguishing deeply developing neutrino-induced showers from background cosmic rays. Using the Pierre Auger Observatory as a case study, we evaluate the detection efficiency of the ν_e-CC, and the resulting effective area. Our results show that radio detection significantly enhances the sensitivity to very inclined showers above $1\,EeV$, complementing traditional particle detectors. This technique is highly scalable and applicable to future radio observatories such as GRAND. The proposed reconstruction and identification strategy provides a pathway toward achieving the sensitivity needed to detect UHE neutrinos. **Supported by BMBF Verbundforschung Astroteilchenphysik (Vorhaben 05A23PX1)*

T 17.5 Mon 17:15 KS H C

Modeling Gamma-Ray Bursts Using CRISP — •Therese Paulsen, Leonel Morejón, and Karl-Heinz Kampert — Bergische Universität Wuppertal, Gaußstraße 20, 42119 Wuppertal, Germany

Astrophysical neutrinos are a clear identifier of photohadronic interactions in sources of Ultra-High-Energy Cosmic Rays (UHECRs). As the Pierre Auger Observatory has shown that UHECRs exhibit a composition heavier than protons at Earth, we expect that these heavy primaries undergo nuclear cascades due to photodisintegration in the dense source environments from which they originate.

In this talk, we will derive the neutrino spectra produced by these heavier primaries undergoing photohadronic interactions. This will be explored in the context of modeling the emission region of a gamma-ray burst. Photohadronic interactions will be modeled using the new framework for "Cosmic Ray Stochastic Interactions for Propagation" (CRISP), which employs an analytic approach to compute the underlying probabilistic description of UHECR interactions.

T 17.6 Mon 17:30 KS H C

Prospects for Combined Hadronic Emission Analyses with KM3NeT and CTA — •Shivani Padma Mohan for the KM3NET-ERLANGEN-Collaboration — ECAP, FAU Erlangen-Nürnberg, Erlangen, Germany

Multi-messenger analysis is becoming essential to probe the fundamental astrophysical processes in distant astrophysical sources. In particular, hadronic processes, where both neutrinos and high-energy gamma rays can be simultaneously produced, motivate the combined analysis of these two messengers. KM3NeT (cubic kilometre neutrino telescope) and CTA (Cherenkov Telescope Array) are next-generation instruments with increased sensitivities in neutrino and gamma-ray astronomy, respectively, making them ideal for such joint studies. A previous study demonstrated the feasibility of a combined CTA-KM3NeT analysis using GAMMAPY, an open source Python package widely used in gamma-ray astronomy. Due to its flexible framework, it can also incorporate neutrino data and was used in the study to determine the contribution of hadronic processes in well-known galactic gamma-ray sources. To facilitate future studies involving different messengers, source classes and detector configurations, the analysis pipeline has now been updated to the latest GAMMAPY 2.0 framework. Based on the current Monte-Carlo simulations, the updated Instrument Response Functions (IRFs) for KM3NeT will be presented in comparison with earlier results.

T 17.7 Mon 17:45 KS H C

Framework for Gravitational-Wave and Neutrino stacking Analysis — •Chloe Fisher[1,2] and Tista Mukherjee[1,2] for the IceCube-Collaboration — [1]Karlsruhe institute of Technology —

[2]Institute of Experimental Particle Physics (ETP)

Cosmic rays are charged particles whose trajectories are scrambled by magnetic fields, obscuring direct associations with their astrophysical origins. Identifying the engines capable of accelerating them therefore relies on neutral messengers such as neutrinos and gravitational waves. Compact binary coalescences, with or without neutron stars, are promising source candidates in this regard, as they may produce both gravitational-wave emission and hadronic outflows capable of generating high-energy neutrinos under suitable conditions. The joint interpretation of these signals within a multi-messenger framework enhances our ability to probe the physical conditions of their potential common source environments. However, no individual common source of gravitational waves and neutrinos has been identified with a global significance exceeding 3σ after trial correction. This motivates a population-level analysis to search for correlated neutrino emission from the ensemble of observed compact binary coalescences.

T 17.8 Mon 18:00 KS H C

Multi-Messenger Synergies at the Pierre Auger Observatory: Archive Expansion and Real-Time Neutrino Follow-Ups[*,†] — •Srijan Sehgal for the Pierre Auger-Collaboration — Bergische Universität Wuppertal, Germany

The Pierre Auger Observatory, the world's largest cosmic-ray detector, is designed to study the highest-energy particles in the universe and also has a remarkable capability to detect ultra-high-energy neutrinos. Operating continuously since 2004, it has made major contributions to cosmic-ray physics and to the growing field of multi-messenger astronomy. The Observatory is part of the Astrophysical Center for Multi-messenger in Europe (ACME), an infrastructure initiative aimed at facilitating data sharing among major observatories and improving the coordination of multi-messenger observations.

Within ACME, the Pierre Auger Observatory is expanding access to its extensive archive of data and preparing to provide real-time follow-ups by utilizing its sensitivity to neutrino-induced air showers. These efforts are intended to support the rapid identification and characterization of astrophysical sources. This talk will summarize the efforts undertaken within ACME, with particular emphasis on the planned expansion of the public data archive and the current status and development of Auger's real-time alert system.

**Supported by BMBF Verbundforschung Astroteilchenphysik (Vorhaben 05A23PX1)*

†*This work is supported by the EU Horizon Europe Research and Innovation Programme, Grant No. 101131928.*