T 18: Neutrino Astronomy 1

Time: Monday 16:15–18:30 Location: T-H31

T 18.1 Mon 16:15 T-H31

Follow-up of high-energy neutrino events in IceCube — •Martina Karl for the IceCube-Collaboration — Max Planck Institute for Physics, Munich, Germany — Technical University of Munich, Department of Physics, Garching, Germany

We investigate the arrival direction of the most energetic track-like neutrino events in IceCube. These high-energy events allow for a good pointing back to their origin direction and have a high probability to be of astrophysical origin. Roughly 10 of these track-like high-energy neutrino events are detected per year. With these events acting as a source catalog, we present a search for cosmic neutrino emission on 11 years of IceCube neutrino-induced muon data. We explore the hypotheses of steady and transient neutrino emission, and present methods to find neutrino flares.

T 18.2 Mon 16:30 T-H31

High-Energy Neutrinos From Accretion Flares — •Jannis Necker for the IceCube-Collaboration — DESY, Zeuthen, Deutschland

The past two decades have seen a revolution in astronomy as for the first time it became possible to gain information about astrophysical processes not only from (low energy) photons but also from other messengers such as gravitational waves and neutrinos. The IceCube observatory is a cubic kilometre neutrino detector array in the antarctic ice, looking for astrophysical, high-energy neutrinos. The collected data reveal a diffuse flux of these neutrinos over the whole sky, indicating an extragalactic origin. Recent observations suggest a contribution to this diffuse flux from accretion flares, radiation outbursts from Super-Massive Black Holes that accrete at an enhanced rate. In this contribution I will present results from a stacking analysis looking for IceCube neutrinos from these accretion flares.

T 18.3 Mon 16:45 T-H31

A study to detect neutrino signals from AGN using machine-learning methods for source classification — •Sebastian Schindler for the IceCube-Collaboration — Erlangen Centre for Astroparticle Physics (ECAP), University Erlangen-Nürnberg, Germany

The IceCube Neutrino Observatory is currently the world's largest high-energy neutrino detector. After the initial detection of a diffuse astrophysical neutrino flux in 2013, one of the main goals has been to associate parts of this flux with specific source classes. A few tentative "hot spots" at the three-sigma level have been found and associated with certain classes of Active Galactic Nuclei (AGN), among them blazars and Seyfert galaxies. The underlying physical mechanisms of neutrino production, however, remain poorly understood. One problem for neutrino source searches comes from the use of historically-driven class definitions of AGN, which are based on specific spectral properties that are not necessarily optimal for the selection of potential neutrino sources.

This talk will motivate a study that aims to address this problem in two stages. The first stage will use multi-wavelength data to define a source selection using modern machine-learning approaches in a way that emphasizes intrinsic physical properties and mostly disregards the general AGN classification. This will allow us to identify potential neutrino sources similar in physical properties to those associated with the currently detected "hot spots". The second part will perform a statistical analysis in the form of a correlation analysis, for example a stacking search, using these previously defined source selections.

T 18.4 Mon 17:00 T-H31

Blazar stacking using new and improved neutrino point-source analysis method — •Tomas Kontrimas, Martina Karl, and Chiara Bellenghi for the IceCube-Collaboration — Physik-department, Technische Universität München, D-85748 Garching, Germany

The IceCube Neutrino Observatory has experienced remarkable success in the field of neutrino astronomy since its completion. One of the main goals is to identify sources of the diffuse astrophysical high-energy neutrino flux. In 2018, IceCube found evidence for a correlation between high-energy neutrinos and the blazar TXS 0506+056. Blazars, one of the most powerful objects in the universe, are among the most promising source candidates of high-energy neutrinos. We present a new method improving the accuracy of the likelihood function, including enhanced neutrino reconstruction and data calibration. Furthermore, we discuss a correlation study between IceCube high-energy neutrinos and different classes of blazars.

T 18.5 Mon 17:15 T-H31

Neutrino source searches with DNN based Cascade Dataset in IceCube — •Mirco Hünnefeld for the IceCube-Collaboration — Astroparticle Physics WG Rhode, TU Dortmund University, Germany

IceCube has discovered a flux of astrophysical neutrinos and presented evidence for one neutrino source, a flaring blazar known as TXS 0506+056. However, the sources responsible for the majority of the astrophysical neutrino flux remain elusive. While charged-current muon-neutrino datasets (track events) are predominantly used for source searches due to their superior pointing resolution, cascade events (neutral-current interactions of all neutrino flavors and charged-current interactions of electron- and tau-neutrinos) allow to lower the energy threshold in the southern sky for IceCube. In this contribution, searches for neutrino sources are presented utilizing an improved cascade dataset that builds upon recent advances in deep learning based reconstruction methods. The resulting dataset improves IceCube's sensitivity in the southern neutrino sky and is thus particularly promising for the identification of neutrino production from the galactic plane.

T 18.6 Mon 17:30 T-H31

Constraining populations of astrophysical neutrino sources with IceCube — •Chiara Bellenghi and Kristian Tchiorniy for the IceCube-Collaboration — Technische Universität München, Physik-Department, James-Franck-Str. 1, 85748 Garching

The discovery of a diffuse flux of high-energy astrophysical neutrinos in 2013 by the IceCube neutrino observatory has triggered a vast effort to identify the mostly unknown sources of this signal. We present an analysis optimized for identifying an excess of astrophysical neutrino clusterings produced by a population of sub-threshold point sources. We aim at testing the hypothesis of time-integrated emission in the Northern Hemisphere using 9 years of IceCube data. We present here the methods and the potential of the analysis on constraining the neutrino flux contribution from populations of neutrino point sources.

T 18.7 Mon 17:45 T-H31

Targeting luminous optical transients in the search for high-energy neutrinos — •Massimiliano Lincetto for the IceCube-Collaboration — Astronomisches Institut, Ruhr-Universität Bochum, Bochum, Germany

Years after the discovery of astrophysical neutrinos by the IceCube Neutrino Observatory, the dominant sources of the measured flux are still to be determined. Despite existing evidence in favour of blazars, multi-messenger considerations suggest the need of sources that do not produce high-energy gamma rays. Recent observations, following the detection of a high-energy neutrino in coincidence with a tidal disruption event, point to accreting black holes as promising candidate sources. With the rise of wide-field optical surveys such as the Zwicky Transient Facility, an unprecedented amount of optical transients is being observed on a regular basis. Among these, superluminous supernovae (SLSNe) stand out as the most luminous class. The power source behind such extreme phenomena is still unclear: magnetars, black hole accretion or CSM interaction have been proposed to explain their increased luminosity. In this contribution, the prospects for targeting SLSNe in a search for high energy neutrinos with IceCube data are presented, giving an overview of the candidate event catalogue and the proposed analysis methods.

T 18.8 Mon 18:00 T-H31

A Combined Analysis of IceCube's High Energy Muon Tracks and Cascades Neutrino Data — •Erik Ganster[1], Markus Ackermann[2], Jakob Böttcher[1], Philipp Fürst[1], Jonas Hellrung[1], Richard Naab[2], Georg Schwefer[1], Roman Suveyzdis[1], and Christopher Wiebusch[1] for the IceCube-Collaboration — [1]Physics Institute III B, RWTH Aachen University, Germany — [2]DESY, Zeuthen, Germany

The IceCube Neutrino Observatory is observing a diffuse flux of high-energy astrophysical neutrinos in multiple detection channels. We com-

bine two of these channels, through-going muon tracks and contained cascades, in a single analysis that employs a consistent treatment of signal and background as well as systematic uncertainties in a global fit. Then, the complementary information from the two channels reduces the overall uncertainties in signal and background. This improves our understanding of the astrophysical neutrino flux properties: measuring the energy spectrum and testing the flux composition. We will describe the method of this global fit and present first results from 10 years of IceCube neutrino data.

T 18.9 Mon 18:15 T-H31

Sensitivity of IceCube-Gen2 for the identification of high-energy tau neutrinos and for the measurement of the flavour composition — •Neha Lad[1], Maximillian Meier[2], and Markus Ackermann[1] for the IceCube-Collaboration — [1]DESY, Zeuthen, Germany — [2]Dept. of Physics and Institute for Global Prominent Research, Chiba University, Japan

The IceCube neutrino observatory at the South Pole has disfavoured the absence of an astrophysical tau-neutrino flux at the 2.8σ level. IceCube-Gen2 is the planned extension of current IceCube detector, which will be about 8 times bigger than the current instrumented volume. In this work, we study the sensitivity of IceCube-Gen2 to the astrophysical flavour composition and investigate it's tau neutrino identification capabilities. We apply the IceCube analysis on a Gen2 dataset that mimics the High Energy Starting Event classification. Reconstructions are performed using sensors that have 3 times higher quantum efficiency and isotropic angular acceptance compared to the current IceCube optical modules. We present results of this sensitivity study.