T 59: Neutrino astronomy II

Time: Wednesday 16:30–19:00 Location: L-2.004

T 59.1 Wed 16:30 L-2.004

Search for high-energetic neutrino sources — •Martina Karl[1,2], Anna Schubert[2], Theo Glauch[2,3], Paolo Giommi[3,4,5], Elisa Resconi[1,2], Paolo Padovani[6,7], Andrea Turcati[2], and Yu-Ling Chang[5,8] — [1]Max-Planck-Institut für Physik, München, Germany — [2]Technische Universität München, Germany — [3]Institute for Advanced Study, Technische Universität München, Germany — [4]Associated to Agenzia Spaziale Italiana, Roma, Italy — [5]ICRANet, Pescara, Italy — [6]European Southern Observatory, Garching, Germany — [7]Associated to INAF - Osservatorio Astronomico di Roma, Monteporzio Catone, Italy — [8]Tsung-Dao Lee Institute, Shanghai, China

IceCube is a cubic-kilometer scale neutrino detector instrumenting a gigaton of ice at the geographic South Pole in Antarctica. On average, 8 track-like high energetic neutrino events with a high probability of being of astrophysical origin are detected per year. The bright appearance of these events in the detector allows for a good pointing to their origin. We present several searches for the production sites of these cosmic neutrinos. The first analysis uses IceCube's high-statistics, neutrino-induced through-going muon samples to search for sources specifically in the vicinity of the arrival directions of the single most high-energetic events. Complementary, we also present a multi-wavelength search for the counterparts of the high-energy tracks. As a result we find that there is a 3 sigma over-fluctuation of HBL/IBL Blazars. Which makes them one of the most promising candidates for a fraction of the astrophysical neutrino flux.

T 59.2 Wed 16:45 L-2.004

Real-time identification of transient neutrino sources — •Richard Naab for the IceCube-Collaboration — Deutsches Elektronen-Synchrotron DESY, Platanenallee 6, D-15738, Zeuthen

The identification of the sources of astrophysical neutrinos is one of the main motivations behind the IceCube real-time follow-up programs. A high duty cycle and all sky coverage make the neutrino observatory at the South Pole an effective trigger for follow-up searches aiming at finding electromagnetic counterparts. Telescopes used for this usually have a limited sky coverage due to their small field of view and thus depend on trigger input.

There are two approaches to distinguish astrophysical neutrinos from atmospheric background. The first is to select single high-energy neutrinos assuming that the signal neutrino spectrum is harder compared to the background. The second is to search for neutrino events clustering in time and space. The latter approach is used by IceCube's optical follow-up programs, which aims to probe gamma-ray bursts and choked-jet supernovae as possible neutrino source candidates. In my talk I will outline the performance and prospects of improvement in sensitivity to transients, which flare on a timescale of 100 seconds.

T 59.3 Wed 17:00 L-2.004

Stacking Point Source Search for a Neutrino Contribution at 27 Track-Like EHE Positions using Six Years of IceCube Data — •Johannes Kollek[1], Jan Soedingrekso[1], and Alexander Sandrock[1,2] for the IceCube-Collaboration — [1]TU Dortmund, Dortmund, Germany — [2]Now at National Research Nuclear University MEPhI, 115409 Moscow, Russia

Neutrino point source searches could help understanding cosmic ray acceleration. With past all-sky searches not revealing any point sources so far, a higher sensitivity can be achieved with time-dependent stacking searches on predefined source positions. A previous analysis on high energy starting events (HESE) positions with 21 different non-overlapping time windows issued no significant lower-energy excess. The analysis is repeated using the positions of extremely high energy events (EHE) and extended to test also overlapping time windows. In this talk, the methods of the analysis and the progress on the sensitivity for the EHE case is presented.

T 59.4 Wed 17:15 L-2.004

Neutrinos from Choked-Jet Supernovae — •Jannis Necker for the IceCube-Collaboration — DESY, Zeuthen, Germany

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. A possible contribution to this diffuse flux could stem from choked-jet core collapse supernovae, which occur when the jet emanating from a massive star's collapsing core gets stuck in the star's envelope. In this talk I will present preliminary results on a search for IceCube neutrinos from choked-jet supernovae candidates. The neutrino emission is expected during the supernova explosion time, which I estimate from optical light curves recorded by the Zwicky Transient Facility (ZTF), a large field-of-view optical observatory.

T 59.5 Wed 17:30 L-2.004

A new and improved IceCube point-source analysis — •Chiara Bellenghi, Hans Niederhausen, Martin Wolf, Theo Glauch, and Tomas Kontrimas — James-Franck-Straße 1, 85748 Garching bei München

The IceCube Neutrino Observatory is a one cubic kilometer neutrino telescope deployed deep in the Antarctic ice at the South Pole. The general aim of IceCube is to investigate high energy astrophysical phenomena by studying the corresponding high energy neutrino signal. One of the main goals is to identify the sources of the diffuse astrophysical neutrino flux, that IceCube discovered in 2012. We present a new method to search for neutrino point-sources that improves the accuracy of the likelihood function in the low energy regime, where the usual gaussian approximation of IceCube's point spread function breaks down. The new method includes multidimensional KDE based probability density functions, angular error estimates using a BDT as well as a new DNN energy estimator. We will present the performance of the updated analysis including sensitivity and discovery potential for point-like sources in the sky.

T 59.6 Wed 17:45 L-2.004

Event Reconstruction for the Cascade Real-Time Alert Stream in IceCube — •Mirco Hünnefeld and Jan Soedingrekso for the IceCube-Collaboration — TU Dortmund, Germany

IceCube is a neutrino detector located at the geographic South Pole, instrumenting a cubic kilometer of glacial ice. A major goal of IceCube is the detection of astrophysical neutrino sources. Therefore, a real-time alert system was implemented to enable multi-messenger astronomy. Events that pass certain selection criteria are reconstructed in real-time on-site at the South Pole. If these events meet the requirements, they are sent out as alerts to telescopes around the world, enabling follow-up observations. Precise and fast reconstruction methods are necessary to abide the harsh resource constraints given on-site. The inclusion of cascade-like events harbors further challenges due to their inherently difficult angular reconstruction. In this talk, a deep learning-based reconstruction method is presented, which enables the accurate and fast reconstruction of cascade-like events and thus the implementation of a cascade alert stream.

T 59.7 Wed 18:00 L-2.004

Perspectives of a Global Fit of IceCubes Diffuse Neutrino Flux — •Erik Ganster, Christian Haack, Jöran Stettner, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

The IceCube Neutrino Observatory has first observed a flux of high-energy astrophysical neutrinos in 2013. Since then, this observation has been confirmed in multiple analyses based on different event selections and topologies such as: high-energy starting events (HESE), cascades and throughgoing muon-tracks. This diffuse flux is typically modelled by a power-law energy spectrum. However, the measured flux properties differ between these complementary analyses. We will report on the status of a combined analysis of all high-energy neutrino data from IceCube which is currently being prepared. First studies on the sensitivity of this 'global fit' to improve the measurement of the flux properties will be shown.

T 59.8 Wed 18:15 L-2.004

Towards a Global Fit of the Diffuse Neutrino Flux with Ice-

Cube: Novel Simulation Techniques — Jöran Stettner, Erik Ganster, and •Christian Haack for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen

The IceCube Neutrino Observatory at the South Pole discovered a flux of astrophysical neutrinos at TeV − −PeV energies and started the era of neutrino astronomy. However, the energy spectrum of the observed diffuse flux is not yet fully understood: The measured fluxes differ between multiple detection channels such as high-energy starting events (HESE), cascades and through-going muons from the Northern Hemisphere. Here, we present the status of a combined analysis of all high-energy event samples which is currently being prepared. One important ingredient is a joint Monte-Carlo (MC) simulation that enables a consistent treatment of systematic uncertainties throughout the different event topologies. We present novel ideas how to efficiently produce large-scale MC-simulations covering a wide range of systematic uncertainties and how to apply it in likelihood analyses.

T 59.9 Wed 18:30 L-2.004

The Radio Neutrino Observatory in Greenland — •Zachary Meyers for the RNO-G-Collaboration — DESY, Zeuthen, Germany — Erlangen Center for Astroparticle Physics, Friederich-Alexander-Universitat Erlangen-Nurnberg, Erlangen, Germany

Ultra high energy (UHE) neutrinos play a vital role in the new age of multi-messenger astronomy. While light can be bent or absorbed by intervening dust and cosmic rays can be significantly deflected by magnetic fields, UHE neutrinos make their journey to us nearly unimpeded, revealing a direct line to their source and providing insight into the mechanisms of their creation. With projects including IceCube, ARA, ANITA and ARIANNA, neutrino astronomy has made great strides in the past decade. However, energies beyond 100 PeV cannot cost efficiently be targeted with with optical sensors due to the relatively short attenuation length of light. Radio arrays searching for Askayran emission can cover a much larger effective area for a fraction of the price. The Radio Neutrino Observatory in Greenland (RNO-G) will be capable of detecting these cosmogenic neutrinos with a view of the northern sky, acting as a pathfinder for the radio component of IceCube Gen-2. We explore the inspiration, design, and rollout of this new observatory, which will deploy 35 stations over the next 3 years.

T 59.10 Wed 18:45 L-2.004

Reconstructing Neutrino-induced Particle Showers in Ice from their Radio Emission — •Christoph Welling for the RNO-G-Collaboration — DESY, Platanenallee 6, Zeuthen

For the detection of astrophysical neutrinos with energies beyond 10 PeV, a detection volume of several cubic kilometers is required. One solution to overcome this challenge is the detection of radio emission from neutrino-induced particle cascades in glacial ice. Starting in summer 2020 a first discovery-scale radio detector will be deployed in the Greenland ice sheet. In this talk, we present how the detector will be used to detect neutrinos and how their properties can be reconstructed from the data obtained.