T 24: Neutrinoastronomie II

Zeit: Dienstag 16:30–19:00 Raum: Philo-HS1

T 24.1 Di 16:30 Philo-HS1

Laterally separated muons from cosmic ray air showers in IceCube — •Dennis Soldin for the IceCube-Collaboration — University of Delaware, Bartol Research Institute and Dept. of Physics and Astronomy, Newark, DE 19716, USA

Cosmic ray air showers with primary energies above $\gtrsim$ 10 TeV can produce high-energy muons with large transverse momentum ($p_\mathrm{T} \gtrsim$ 2 GeV). These isolated muons can have large transverse separations from the shower core, up to several hundred meters. Together with the muon bundle they form a double track signature in km^3-scale neutrino telescopes such as IceCube. The separation from the core is a measure of the transverse momentum of the muon's parent particle. For $p_\mathrm{T} \gtrsim 2$ GeV, particle interactions can be described in the context of perturbative quantum chromodynamics (pQCD). Hence, measurements of these muons may contribute to test pQCD predictions of high energy interactions involving intermediate nuclei.

We present a measurement of laterally separated muons using three years of IceCube data, taken between May 2012 and May 2015. The resulting lateral separation distributions of muons between 135 m and 450 m will be shown for various primary energies. These distributions are used to derive estimates of the transverse momenta of high-energy muons, which approximately correspond to the underlying hadron distributions. The resulting transverse momentum distributions are compared to Monte Carlo simulations and recent accelerator data of charged hadrons. In addition, we present studies of seasonal atmospheric effects on the production of muons at large altitudes.

T 24.2 Di 16:45 Philo-HS1

Improving the description of the astrophysical muon-neutrino spectrum with 9 years of IceCube data — •Jöran Stettner, Christian Haack, René Reimann, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

The IceCube Neutrino Observatory has observed a flux of high-energy astrophysical neutrinos compatible with an unbroken powerlaw energy spectrum. However, complementary analyses on different event topologies and hemispheres do not yield the same spectral index. Here, we focus on the muon-neutrino channel and explore models beyond an unbroken powerlaw to describe the high-energy spectrum. More flexible models, e.g. a broken powerlaw or a powerlaw with exponential cutoff, could both help to understand differences between the measured spectral indices and constrain the physics of cosmic-ray acceleration. The study is based on a high statistics sample of 9 years of muon-neutrinos from the Northern Hemisphere with very low background. We present sensitivities for different models and an approach to extract model-independent information on the flux of astrophysical neutrinos.

T 24.3 Di 17:00 Philo-HS1

Measurement of the Atmospheric Electron Neutrino Spectrum using Data from the IceCube Neutrino Detector — •Joshua Luckey, Felix Neubürger, Maximilian Meier, Jan Soedingrekso, Thobias Hoinka, and Thorben Menne for the IceCube-Collaboration — TU Dortmund, Dortmund, Deutschland

The aim of the work presented in this talk is to measure the atmospheric electron neutrino spectrum on data collected by the IceCube Detector. IceCube is a Cherenkov neutrino detector instrumenting 1 km^3 of ice at the South Pole. The Cherenkov light detected by IceCube is emitted by charged particles like atmospheric muons or the secondary particles of neutrino interactions passing through the detector. Events caused by neutrinos result in different event topologies, depending on the neutrino flavor and the kind of interaction. The events this analysis is interested in, the interaction of electron neutrinos, have a spherical topology in the detector. These events are referred to as cascade-like events. Muons, either atmospheric or from muon neutrino interactions, show an elongated event topology and are referred to as track-like events. The first part of this analysis is to build an event sample containing a high amount of cascade-like events with low amounts of track-like events, utilizing machine learning methods. Subsequently an unfolding approach will be used to obtain to the atmospheric electron neutrino spectrum. This analysis is currently planned to encompass one year of data from the year 2012, however a extension to multiple years may be possible in the near future. This talk will give an overview over the current status of this analysis and its prospects.

T 24.4 Di 17:15 Philo-HS1

IceCube Neutrino Meteorology: Correlation Between Atmospheric Neutrinos and Atmospheric Temperature — •Philipp Fürst, Pascal Backes, Jakob Böttcher, Christian Haack, Denise Hellwig, Jöran Stettner, and Christopher Wiebusch — III. Physikalisches Institut B, RWTH Aachen University

The IceCube Neutrino Observatory, located at the Geographic South Pole, measures an all-sky atmospheric neutrino flux. These neutrinos are created in cosmic-ray-induced air showers and their production rate depends on local atmospheric conditions, causing neutrino rate changes throughout the local seasons.

Five years of neutrino data from IceCube and temperature data from NASA's atmosphere-observing Aqua-Satellite are used to measure the correlation coefficient of relative neutrino rate change and relative temperature change.

This correlation coefficient can be used to constrain neutrino production yields of pions and kaons.

We present method and results of calculating the neutrino-temperature correlation coefficient and further outlooks.

T 24.5 Di 17:30 Philo-HS1

Measuring the Flavor Ratio of High-Energy Neutrino Events in IceCube — •Juliana Stachurska — DESY Zeuthen

The IceCube Neutrino Observatory at the South Pole detects Cherenkov light from charged particles produced in neutrino interactions. At the highest energies, the neutrino flux is of cosmic origin, with an expected flavor ratio of ν_e:ν_μ:ν_τ of 1:1:1, but its astrophysical sources are yet unknown. A measurement of the flavor ratio on Earth can provide important information to constrain sources and production mechanisms. But as of today, no high energy tau neutrino interaction has been identified in the IceCube data, leaving the $\nu\tau$ fraction of the cosmic neutrino flux largely unconstrained. This work aims at identifying high-energy tau neutrino interactions creating tau leptons with a mean decay length of 50m per PeV neutrino energy. Above energies of $\sim$ 100 TeV they produce a unique and resolvable Double Cascade signature which together with the Single Cascade, and Track event topologies will be used to measure the flavor ratio of IceCube's high-energy events.

T 24.6 Di 17:45 Philo-HS1

New results from the search for steady point-like sources of astrophysical neutrinos with IceCube — •René Reimann, Christian Haack, Lisa Schumacher, Jöran Stettner, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

IceCube, a cubic-kilometer sized neutrino detector at the geographic South Pole, is measuring a flux of high-energy astrophysical neutrinos. However, their sources have not been identified yet. We present the results of a search for steady point-like sources based on an eight year sample of up-going muon-neutrinos optimized for good pointing and low background contamination. The signature of point-like sources is clustering of observed arrival directions with respect to the background from atmospheric neutrinos. To improve the sensitivity, the likelihood approach has been optimized on the properties of the measured astrophysical muon-neutrino flux. The analysis includes an all-sky search, testing a pre-defined source catalog and a search for a population of weak sources.

T 24.7 Di 18:00 Philo-HS1

Stacking point source search of a lower energy neutrino contribution at the HESE track positions using IceCube data — •Thorben Menne, Mathis Börner, Maximilian Meier, Tobias Hoinka, and Jan Soedingrekso for the IceCube-Collaboration — TU Dortmund

The IceCube detector is a cubic kilometer sized neutrino telescope located at the South Pole. One important goal is to observe neutrinos originating from a single or multiple sources in the sky. Despite the discovery of multiple neutrinos of astrophysical origin no significant source of these high energy events has been found yet. Also no significant clustering of lower energy neutrinos at a single point has been found in a all sky search with 7 years of IceCube data. Nevertheless recently found correlations between a high energy IceCube neutrino and a flaring Blazar makes correlation searches in different messenger particles and energies even more promising. This analysis aims to find a signal from lower energy neutrinos originating from the positions of high energy starting track events measured in IceCube which have possible astrophysical origin. A stacking approach is used to collectively search for multiple weak emissions from the proposed source class. Both a time dependent and steady flux scenario are investigated using multiple years of IceCube neutrino data.

T 24.8 Di 18:15 Philo-HS1

Search for neutrino emission in the Galactic plane with IceCube using starting events — •Kai Krings for the IceCube-Collaboration — Technische Universität München, Physik-Department, James-Franck-Str. 1, D-85748 Garching

The IceCube Neutrino Telescope has observed a diffuse all-sky all-flavor astrophysical neutrino flux above 30 TeV; no sources have been identified yet. We want to challenge the question if the flux is partly of Galactic origin, by searching for neutrino emission in the Galactic plane. Complementary to the search with up-going muon neutrinos, which is constrained to the northern sky only, we use events from both hemispheres with energies above 1 TeV and interaction vertices inside the fiducial volume of the IceCube detector. Thus, the entire Galactic plane can be observed, including the Galactic Center. We present the sensitivity of a likelihood-based analysis to models that predict cosmic-ray induced neutrino emission in the Galactic plane, using seven years of data.

T 24.9 Di 18:30 Philo-HS1

Search for High Energy Astrophysical Tau Neutrinos using IceCube Data — •Maximilian Meier, Thorben Menne, Mathis Börner, Mirco Hünnefeld, Tobias Hoinka, Jan Soedingrekso, and Alexander Sandrock for the IceCube-Collaboration — TU Dortmund

The IceCube Neutrino Observatory at the South Pole is a Cherenkov detector designed to measure astrophysical neutrinos of all flavors. High energy tau neutrinos interacting inside the detector produce two cascades separated by the tau lepton decay length. At energies above 100 TeV the spatial separation can be resolved within the waveform of one IceCube optical module and identified as a double pulse signature. This work aims to select events with a cascade-like topology that contain at least one double pulse signature. This talk will give an overview over the current status of this analysis and its prospects.

T 24.10 Di 18:45 Philo-HS1

Constraints on the neutrino emission of short-lived transient sources from IceCube's follow-up program — •Nora Linn Strotjohann for the IceCube-Collaboration — Desy Zeuthen

IceCube's optical and X-ray follow-up program searches for short-lived transient neutrino sources by looking for several events that are consistent with a single source origin. Since the start of the program in 2008 only one neutrino triplet, i.e. three events within 100s and within 3.5 degrees of each other, was detected. This rate is consistent with the expected rate of chance coincidences of atmospheric events.

The lack of more such neutrino multiplets allows us to constrain the neutrino emission of short-lived transient neutrino source populations like gamma-ray bursts or choked-jet supernovae. This analysis does not rely on the detection of the sources via their electromagnetic emission which means that the limits also apply to photon-dark or unknown sources.