T 66: Neutrino astronomy 3

Time: Wednesday 16:00–18:00 Location: Geb. 30.23: 6/1

T 66.1 Wed 16:00 Geb. 30.23: 6/1

The Galactic Diffuse Neutrino Emission in a Combined Fit of Muon Tracks and Cascades with IceCube* — •Jonas Hellrung[1,2], Philipp Fürst[3], Niclas Krieger[1,2], Lukas Merten[1,2], and Julia Becker Tjus[1,2,4] for the IceCube-Collaboration — [1]Theoretical Physics IV, Plasma Astroparticle Physics, Faculty for Physics and Astronomy, Ruhr University Bochum, 44780 Bochum, Germany — [2]Ruhr Astroparticle and Plasma Physics Center (RAPP Center), Germany — [3]III. Physikalisches Institut B, RWTH Aachen University, 52062 Aachen, Germany — [4]Department of Space, Earth and Environment, Chalmers University of Technology, 412 96 Gothenburg, Sweden

The measurement of diffuse neutrino emission from the Galactic plane provides unique information on the distribution of cosmic rays in our Galaxy. The IceCube collaboration has published a first measurement of this neutrino flux in 2023. IceCube can measure neutrinos through two main experimental signatures: The so called cascades arise from neutral current interactions of all flavors or charged current interactions from electron and tau neutrinos while tracks are produced in charged current interactions from muon neutrinos. The first measurement of the Galactic plane used the cascade channel, but since then hints for the Galactic plane where also found in a track sample. A combined measurement of both detection channels can help to understand the properties of the Galactic diffuse neutrino emission better. Sensitivities and model discrimination power of such a combined measurement are discussed here. *Supported by BMBF and SFB 1491

T 66.2 Wed 16:15 Geb. 30.23: 6/1

A model-independent measurement of the Galactic neutrino flux with IceCube — •Mirco Hünnefeld[1] and Ludwig Neste[2] for the IceCube-Collaboration — [1]TU Dortmund University, AG Rhode, Dortmund, Germany — [2]Oskar Klein Centre, Stockholm University, Stockholm, Sweden

The IceCube Neutrino Observatory recently published results on the observation of high-energy neutrinos from the Galactic Plane. These neutrinos can be produced when cosmic rays interact at their acceleration sites and during their propagation through the interstellar medium. The observed neutrino signal appears consistent with diffuse emission from the Galactic Plane, potentially in combination with emission by a population of unresolved sources. Additional follow-up studies are required to further investigate the production mechanisms of the Galactic neutrino flux and to adequately correlate this observation with measurements by gamma-ray experiments. In this contribution, the development of such a follow-up analysis with IceCube is presented. The goal of the analysis is to provide a spatially-resolved, model-independent measurement of the Galactic neutrino flux.

T 66.3 Wed 16:30 Geb. 30.23: 6/1

Numerical Investigation of Bursting Sources as Potential Accelerators of Ultra-High-Energy Cosmic Rays* — •Leander Schlegel[1,2], Julia Becker Tjus[1,2,3], and Marcel Schroller[1,2] — [1]Theoretical Physics IV, Plasma Astroparticle Physics, Faculty for Physics and Astronomy, Ruhr University Bochum, 44780 Bochum, Germany — [2]Ruhr Astroparticle and Plasma Physics Center (RAPP Center), Germany — [3]Department of Space, Earth and Environment, Chalmers University of Technology, 412 96 Gothenburg, Sweden

Since their discovery over a century ago, the origin of cosmic rays (CR) of the highest energies is still widely uncertain. A promising class of source candidates are Active Galactic Nuclei (AGN), whose subclass of blazars shows strong temporal variability as they appear in quiescent and flaring states. The goal of this work is trying to understand the detailed behaviour of these bursting sources and their possible contribution to the ultra-high-energy CR flux, by numerically simulating the time resolved propagation of a relativistic plasmoid inside the jet of an AGN. In foregoing work, a tool for cosmic-ray propagation and interaction in these local environments was implemented into the open-source code CRPropa, that is now further improved and applied. During this work, contributions could also be made to the development of CRPropa 3.2. With our framework, we apply the model to observed data of bursting sources, aiming to fit both their spectrum and light curve and try to predict their multi-messenger signatures, in order to get a more detailed understanding of this source class. *Supported by DFG (MICRO and SFB 1491)

T 66.4 Wed 16:45 Geb. 30.23: 6/1

Stacking Analysis of Extreme Blazars as Neutrino Source Candidates — •Juan Manuel Cano Vila[1,2], Chiara Bellenghi[1], Paolo Padovani[3], and Elisa Resconi[1] — [1]Technical University of Munich, TUM School of Natural Sciences, Department of Physics, James-Franck-Straße 1, D-85748 Garching bei München, Germany — [2]Arnold Sommerfeld Center, Ludwig-Maximilians University, 80333 Munich, Germany — [3]European Southern Observatory, Karl-Schwarzschild-Straße 2, D-85748 Garching bei München, Germany

Since IceCube Neutrino Observatory confirmed the existence of high-energy astrophysical neutrinos, enormous efforts have been made to determine which kind of objects emit them. Blazars constitute one of the most promising candidates as astrophysical neutrino sources, with evidence of emission from TXS 0506+056. Although it has been shown that blazars can only account for a fraction of the astrophysical diffuse flux, it remains open whether they can be identified as sources of high-energy neutrinos, especially the most energetic ones. One way to tackle this problem is to study the joint signal from multiple selected sources through an unbinned stacking log-likelihood analysis, enhancing the statistics by a population-wide study in this way. In this work, we perform such analysis with the IceCube 10 yr public data sample to a catalog of these extreme blazars.

T 66.5 Wed 17:00 Geb. 30.23: 6/1

Search for neutrinos from AGN using a data-driven source selection — •Sebastian Schindler[1] and Thorsten Glüsenkamp[1,2] for the IceCube-Collaboration — [1]ECAP, FAU Erlangen-Nürnberg, Germany — [2]Uppsala University, Sweden

The IceCube Neutrino Observatory is a gigaton-volume high-energy neutrino detector. One of the main goals is the association of the previously discovered astrophysical neutrino flux with specific source classes. A few sources have been found (NGC 1068 and TXS 0506+056), which belong to certain classes of Active Galactic Nuclei (AGN). However, the underlying physical processes of neutrino production 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.

Using multi-wavelength data in a data-driven approach, we aim to define a source selection in a way that emphasizes intrinsic physical properties and mostly disregards the general AGN classification. This will allow to identify potential neutrino sources similar in physical properties to those associated with the currently detected sources. Later, a statistical analysis will be performed to test the correlation of neutrinos with these previously defined source selections.

This talk will present the recent progress in this study consisting of exploratory data analysis of some multi-wavelength data. Cross-matched x-ray (2RXS) and infrared (AllWISE) catalogs are analyzed using the clustering algorithm HDBScan in a high-dimensional space.

T 66.6 Wed 17:15 Geb. 30.23: 6/1

Investigating the contribution of Seyfert galaxies to astrophysical neutrino observations using source population simulations — •Lena Saurenhaus and Francesca Capel — Max-Planck-Institut für Physik, Boltzmannstr. 8, 85748 Garching b. München, Germany

Active galactic nuclei (AGNs) are among the most powerful objects in the Universe and are suspected to be sources of astrophysical neutrinos. Recently, the IceCube Collaboration reported an excess of neutrino events with energies between 1.5 and 15 TeV associated with NGC 1068, a nearby Seyfert galaxy with an extraordinarily high intrinsic X-ray flux. The lack of observable gamma rays in this energy range indicates that these neutrinos are likely to be produced in the AGN corona, which is opaque to high-energy gamma rays. Motivated by these findings, we explore the prospects of observing other hidden neutrino sources with similar neutrino production mechanisms. Assuming a correlation between the intrinsic X-ray luminosity and the neutrino luminosity of a source, we build a simple neutrino emission model that accounts for both photohadronic and hadronuclear interactions. Using this model in combination with publicly available detector information, we then make predictions about the detectability of the neutrino emission from a selection of other nearby Seyfert galaxies with IceCube and its planned extension IceCube-Gen2. In addition, we simulate an entire population of Seyfert galaxies and estimate the resulting diffuse neutrino emission to draw a coherent picture of the contribution of these sources to astrophysical neutrino observations.

T 66.7 Wed 17:30 Geb. 30.23: 6/1

Modelling an Orphan Flare from Blazar 1ES 1959+650 on 4th of July 2002 using CRPropa* — •Vladimir Kiselev[1,2], Marcel Schroller[1,2], and Julia Becker Tjus[1,2,3] — [1]Theoretical Physics IV, Ruhr University Bochum — [2]RAPP Center, Ruhr University Bochum — [3]Department of Space, Earth and Environment, Chalmers University of Technology, 412 96 Gothenburg, Sweden

1ES 1959+650 is a blazar, which is known to emit high-energy gamma rays. On the 4th of July 2002, a so-called orphan flare occurred, where a high-energy signal was detected by several Cherenkov observatories with no corresponding X-ray counterpart. Additionally, in later analysis, several neutrinos consistent with the direction of the blazar have been reported by the AMANDA collaboration. Both peculiar signatures could hint at a hadronic origin of the flare, instead of a synchrotron self-Compton scenario often used to model SEDs of blazars. Although not statistically significant, this flare has long been discussed as an early hint of the correlation between gamma rays and neutrinos. Here, we want to pick up on this source and use today's possibilities of 3D theoretical modelling to test how the orphan flare and the neutrino signal, unmasked by the AMANDA collaboration, can be explained. For this purpose, we utilise a modified version of CRPropa with a hadronic model with propagation in a 3D magnetic field. We present the first results of how this flare and the neutrino signal can be explained within the model of emission from a magnetized, relativistic plasmoid travelling along the AGN jet. *Supported by DFG (SFB 1491)

T 66.8 Wed 17:45 Geb. 30.23: 6/1

Extending Hadronic Test Particle Simulations by Non-Linear Leptonic Processes — •Marcel Schroller[1,2], Julia Becker Tjus[1,2,3], and Lukas Merten[1,2] — [1]Theroretical Physics IV, Ruhr University Bochum, 44780 Bochum, Germany — [2]Ruhr Astroparticle and Plasma Physics Center (RAPP Center), Germany — [3]Department of Space, Earth and Environment, Chalmers University of Technology, 412 96 Gothenburg, Sweden

Active galactic nuclei (AGN) and the accompanying jets are candidates for the engine of ultra-high-energy cosmic rays, gamma rays, and neutrinos. In 2017, IceCube observed an extragalactic high-energy neutrino event with a strong hint of a directional coincidence with the position of a known jetted AGN TXS0506+056. A deep understanding of the processes related to jets will fuel the field of high-energy cosmic rays, fundamental plasma, astro, and particle physics. However, an AGN jet's physical and mathematical modelling is challenging, with ambiguous signatures that need to be understood by numerical simulations of cosmic-ray transport and interactions. In this context, we present a simulation framework based on CRPropa 3.2 for hadronic constituents and their interactions inside a plasmoid boosted along the AGN jet axis. Consequently, the framework was utilised to investigate the impact of spacetime-dependent photonic and hadronic target fields on hadronic interactions. Furthermore, we will present the results of our simulations and discuss how to implement non-linear leptonic radiation processes into our test particle simulation framework, enabling us to construct an improved physical description of AGN jets.