EP 13: Astrophysics: Galaxies II

Time: Thursday 17:30–19:00 Location: ZEU/0160

Invited Talk EP 13.1 Thu 17:30 ZEU/0160

Time-dependent data analysis of a blazar flare — •Maximilian Albrecht and Felix Spanier — Universität Heidelberg - ITA

Active Galactic Nuclei (AGN) have been discussed as possible accelerators of ultra high-energy cosmic rays for quite some time. While direct observations of cosmic ray sources are still difficult, the emission of neutrinos could be observed directly. Various AGN emission models link the photon, cosmic ray and neutrino emission. Understanding and modeling the emission can help identifying AGN as cosmic accelerators. The available observational data does not yet allow for unique models, but considering also the time domain may aid in understanding the underlying emission mechanisms.

In this talk results of modeling the eruption of the blazar TXS 0506+056 in 2017 are discussed. This blazar was identified as the source of the high-energy muon neutrino IceCube-1709222A detected by the IceCube telescope. From a subsequent multimessenger-campaign a longer time series is available. Using the time-dependent, self-consistent, lepto-hadronic UNICORN-0D the observational data was simulated. We will discuss the possibilities of using time-dependent models to unveil the emission mechanisms and subsequently the associated spectrum of ultra-high energy cosmic rays.

EP 13.2 Thu 18:00 ZEU/0160

ExHaLe-jet: Modeling blazar jets with an extended hadro-leptonic radiation code — •Michael Zacharias — LSW, Universität Heidelberg

Blazars emit across all electromagnetic wavelengths. While the so-called one-zone model has described well both quiescent and flaring states, it cannot explain the radio emission and fails in more complex data sets, such as AP Librae. In order to self-consistently describe the entire electromagnetic spectrum emitted by the jet, extended radiation models are necessary. Notably, kinetic descriptions of extended jets can provide the temporal and spatial evolution of the particle species and the full electromagnetic output. Here, we present the initial results of a newly developed hadro-leptonic extended-jet code: ExHaLe-jet. As protons take much longer than electrons to lose their energy, they can transport energy over much larger distances than electrons and are therefore essential for the energy transport in the jet. Furthermore, protons induce injection of additional pairs through pion and Bethe-Heitler pair production, which can explain a dominant leptonic radiation signal while still producing neutrinos. In this talk, we discuss the differences between leptonic and hadronic dominated SED solutions, the SED shapes, evolution along the jet flow, and jet powers. We also highlight the important role of external photon fields, such as the accretion disk and the BLR.

EP 13.3 Thu 18:15 ZEU/0160

Improved numerical scheme for solving shock acceleration in jets using stochastic differential equations — •Patrick Günther, Sarah Wagner, and Karl Mannheim — Institute for Theoretical Physics and Astrophysics, University of Würzburg

Supersonic jets ejected from active galactiv nuclei show in situ acceleration of charged particles to ultrarelativistic energies far away from the central black hole. Diffusive shock acceleration and momentum diffusion, also known as 1st and 2nd order Fermi acceleration, are mechanisms that can explain the observed particle spectra. In the test-particle and diffusion approximation regime, the governing transport equations are Fokker-Planck equations equivalent to stochastic differential equations which can be solved numerically in a fast way. Advantages and disadvantages of this Monte-Carlo sampling method are discussed. The accuracy of the results depends on the choice of the numerical integrator used and a number of schemes are tested and compared. Basic integrators like the Cauchy-Euler scheme fail to predict the acceleration accurately in a scenario with steep shock gradients. It is shown that a semi-implicit second-order scheme can remedy this problem allowing for using the method in hybrid magnetohydrodynamical jet simulations in order to predict their non-thermal emissions.

EP 13.4 Thu 18:30 ZEU/0160

Beginning a journey across the Universe: the discovery of extragalactic neutrino factories — •Lenz Oswald[1], Sara Buson[1], Andrea Tramacere[2], Leonard Pfeiffer[1], Alessandra Azzollini[1], and Marco Ajello[3] — [1]Lehrstuhl für Astronomie, Universität Würzburg, Emil-Fischer-Straße 31, 97074, Würzburg — [2]Department of Astronomy, University of Geneva, Ch. d'Ecogia 16, Versoix, 1290, Switzerland — [3]Department of Physics and Astronomy, Clemson University, Kinard Lab of Physics, Clemson, SC 29634-0978, USA

Identifying the sources of extragalactic neutrinos is one of the foremost challenges in the astrophysics field. Amongst the most promising candidate sources that can be associated there are blazars, active galactic nuclei hosting a relativistic jet pointed towards us. In this work, we provide evidence for an association between high-energy (>100TeV) IceCube neutrinos and a well-defined, sample of blazars (5th Roma BZCat catalog) in the Southern celestial Hemisphere. This results in a probability to find such correlation by chance that is as low as 2 x 10-6.

EP 13.5 Thu 18:45 ZEU/0160

Investigating the blazar-neutrino connection with public IceCube data — •Julian Kuhlmann and Francesca Capel — Max-Planck-Institut fuer Physik

The IceCube collaboration has found evidence for two active galactic nuclei, NGC 1068 and TXS0506+056, being sources of high energy neutrinos. However, catalog-based searches have yet to yield conclusive evidence for the role of different source populations in contributing to the observed astrophysical neutrino flux.

We present two open-source statistical analysis frameworks for the investigation of possible sources with publicly available IceCube data, which implement complementary frequentist and Bayesian approaches. We first demonstrate the capabilities of these frameworks on simulated data, and then apply them to investigate blazars as possible neutrino sources. We focus on bringing more information from multi-wavelength studies into the analyses, and studying both individual sources and the population as a whole. We discuss the advantages of the novel Bayesian approach and the implications of our results for the blazar-neutrino connection.