T 73: Multi-messenger astronomy

Time: Thursday 16:30–19:00 Location: H-HS X

T 73.1 Thu 16:30 H-HS X

Investigation of the Neutrino Emission from Supermassive Black Hole Mergers and Starburst Galaxies — •Ilja Jaroschewski[1], Julia Tjus[1], and Peter L. Biermann[2,3,4,5] — [1]Theoretische Physik IV, Ruhr-Universität Bochum, Bochum — [2]MPI for Radioastr., Bonn — [3]Dept. of Phys., Karlsruhe Inst. for Tech., Karlsruhe — [4]Dept. of Phys.& Astron., U. Alabama, Tuscaloosa, AL, USA — [5]Dept. of Phys. & Astron., Univ. Bonn, Bonn

The first detection of non-terrestrial, high-energy neutrinos by IceCube in 2013 as well as the high-probability association of such a neutrino to the blazar TXS 0506+056 are fundamental achievements in neutrino Astronomy. Along with the successful detection of gravitational waves in September 2015 by LIGO and the clear identification of the neutrino merger GW170817, these detections opened both new branches in multi-messenger Astrophysics. With 10 binary black hole mergers already documented and more to come there are strong indications that supermassive black holes in galaxy centers also merge and had at least one merger in their lifetime.

Such a merger is almost always accompanied by a change of the jet direction leading to interactions of the jet with molecular clouds and therefore neutrino productions.

In this work, a connection between the radiated gravitational wave energy of supermassive black hole mergers and the high-energy neutrino flux is suggested. It is estimated, whether these mergers could contribute to the diffuse astrophysical neutrino flux that is measured by IceCube, with the rest contributed by starburst galaxies.

T 73.2 Thu 16:45 H-HS X

Bestimmung der zeitlichen Korrelation zwischen Gravitationswellen- und Neutrino-Emission durch das Spin-Flip Phänomen in supermassiven binären Schwarzen Löchern — •Oliver de Bruijn[1], Julia Tjus[1] und Imre Bartos[2] — [1]Theoretische Physik IV, Ruhr-Universität Bochum, 44780 Bochum, Germany — [2]Department of Physics, University of Florida, P.O. Box 118440, Gainesville, Forida 32611-8440, USA

Die hier vorgestellte Masterarbeit zielt darauf ab, die zeitliche Korrelation von Gravitationswellen- und Neutrino-Emission von supermassiven binären Schwarzen Löchern (SMBSL) zu bestimmen. Zur Bestimmung des Zeitpunktes des zu erwartenden Neutrino Signals dient das Spin-Flip Phänomen, als physikalische Grundlage. Dabei wird angenommen, dass während des Inspirals eines SMBSL der Jet des massiveren Schwarzen Lochs um den Gesamtdrehimpuls präzediert und sich der Richtung des Gesamtdrehimpulses annähert. Die Beschreibung dieses Prozesses erfolgt mittels der Post-Newtonischen Approximation, mit der ebenfalls das emittierte Gravitationswellen Signal berechnet wird. Es ist geplant das Modell auf transiente Objekte anzuwenden, wie z.B. den Blazar TXS 0506+056. Das Ziel dabei ist es eventuelle Kandidaten für eine Detektion durch LISA zu finden.

Das vorgestellte Modell ist in der Lage die Periodizität von AGKs zu erklären. Darüber hinaus könnte die Analyse von korrelierten Neutrino- und Gravitationswellendaten uns die Möglichkeit geben, Theorien der Quantengravitation zu testen.

T 73.3 Thu 17:00 H-HS X

Search for ultra-high energy neutrinos from binary black hole mergers* — •Michael Schimp — Bergische Universität Wuppertal, Gaußstr. 20, 42119 Wuppertal

The SD of the Pierre Auger Observatory is able to distinguish extensive air showers (EAS) induced by ultra-high energy neutrinos (UHE neutrinos; $E_\nu > 0.1$ EeV) from those induced by atomic nuclei, provided that they are highly inclined ($60° < \theta < 95°$ with zenith angle θ). While its sensitivity to a diffuse UHE neutrino flux is comparable to IceCube's, the dependences on arrival direction and flavor are very different. For instance, the Pierre Auger Observatory is the only operational instrument sensitive to UHE neutrinos from the Northern Hemisphere. Close to the horizon, the effective area is much enhanced, leading to unrivaled UHE neutrino sensitivities for searches following up transient sources in this part of the sky.

Binary black hole (BBH) mergers are among the most recently discovered classes of astrophysical objects but have not yet been successfully observed by any other means than gravitational waves. Using the sky localization probability distributions of the BBH mergers known so far, their most probable distances, and the assumption of a universal time-dependent luminosity per source, a combined search for UHE neutrinos emitted by the BBH mergers is performed. We present constraints on the time-dependent luminosity for the exemplary hypothesis of an emission lasting for 24 hours after each merger.

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T 73.4 Thu 17:15 H-HS X

Neutrino flux estimates for hadronic AGN models — •Felix Spanier[1,2] and Stephan Richter[2] — [1]Institut für Theoretische Astrophysik, Universität Heidelberg — [2]Centre for Space Research, North-West University, Potchefstroom, South Africa

Recent reports of possible correlations between high energy neutrinos observed by IceCube and Active Galactic Nuclei (AGN) activity sparked a burst of publications that attempt to predict the neutrino flux of these sources. However, often rather crude estimates are used to derive the neutrino rate from the observed photon spectra. In this work neutrino fluxes were computed in a wide parameter space. The starting point of the model was a representation of the full spectral energy density (SED) of 3C 279. The time-dependent hybrid model that was used for this study takes into account the full pγ reaction chain as well as proton synchrotron, electron-positron-pair cascades and the full SSC scheme. We compare our results to estimates frequently used in the literature. This allows to identify regions in the parameter space for which such estimates are still valid and those in which they can produce significant errors. Furthermore, if estimates for the Doppler factor, magnetic field, proton and electron densities of a source exist, the expected IceCube detection rate is readily available. An outlook on applications to TXS 0506+056 is given.

T 73.5 Thu 17:30 H-HS X

On the relative importance of hadronic emission processes along the jet axis of Active Galactic Nuclei — •Mario Hoerbe[1,2], Paul Morris[2,3], Garret Cotter[2], and Julia Becker Tjus[1] — [1]Ruhr-Universität Bochum, Germany — [2]University of Oxford, United Kingdom — [3]DESY, Zeuthen, Germany

We present a space and time-resolved model of the high-energy particle emission of a plasmoid assumed to travel along the axis of an AGN jet at relativistic speed. This was achieved by modifying the publicly available CRPropa (version 3.1) propagation framework which in our work is capable of being applied to sub-kpc scales. The propagation of a population of primary protons is modelled in a purely turbulent magnetic field and we take into account $p\gamma$-interactions of these protons either with photons scattered from the accretion disc or with synchrotron radiation emitted by ambient relativistic electrons. The significance of inelastic pp-collisions among primaries and energetically less significant hadronic matter is evaluated.

Our model produces a PeV-neutrino flare which is caused mainly by photo-hadronic interactions of primaries with the accretion disc field. A relative deficit of secondary high-energy gamma-rays to neutrinos is observed due to $\gamma\gamma$-pair-attenuation with the ambient photon fields whose combined optical depths achieve their minimal opacity for photons in the TeV-range. We warmly thank the Studienstiftung des deutschen Volkes (German Academic Scholarship Foundation) for the funding of this work.

T 73.6 Thu 17:45 H-HS X

3D-modeling of the Galactic Center explaining the diffuse gamma-ray emission — •Mehmet Guenduez[1], Julia Becker Tjus[1], and Dominik J. Bomans[2] — [1]Ruhr-Universität Bochum, Fakultät für Physik and Astronomie, RAPP Center, TP IV, 44780 Bochum, Deutschland — [2]Ruhr-Universität Bochum, Fakultät für Physik and Astronomie, RAPP Center, AIRUB, 44780 Bochum, Germany

The origin of high energy cosmic rays has not yet been entirely solved. Due to their accessibility, Galactic sources allow us to study the ambient conditions. The Galactic Center, on the one hand, shows a peculiar non-thermal emission. On the other hand, the crowded and emissively active vicinity makes modeling more challenging. Previous works discussed the origin of the diffuse gamma-ray emission detected by H.E.S.S. without considering the magnetic field, although the mag-

netic field has a significant impact on the CR spatial profile. In this work, we use for the first time recently developed 3D models of the ambient condition, including the magnetic field configuration, mass distribution, and the photon field. In doing so and using the propagation tool CRPropa, we can involve all relevant interaction processes in the TeV- PeV regimes such as hadronic pion production, inverse Compton scattering, and gamma-ray attenuation by electromagnetic pair production. In order to identify the real source, we further present five different source set-ups based on observational hints. Hereafter, we compare our results with the measured spatial as well as energy spectra.

T 73.7 Thu 18:00 H-HS X

On the origin of the diffuse Gamma-Ray Excess from the Galactic Center — •Joanna Berteaud, Iris Gebauer, and Wim de Boer — KIT, Karlsruhe, Germany

The Fermi-LAT has observed an excess in the diffuse emission from the Galactic center around a few GeV. Several interpretations of this excess exist, including the annihilation of dark matter, an undetected population of millisecond pulsars or the interactions of cosmic rays with molecular clouds. We have previously found a correlation of the GeV excess with the distribution of molecular clouds, traced by the CO emission line. However, what is called diffuse emission is subject to uncertainties originating from detector effects, such as the instrument response function and model uncertainties, such as the point source models. We have developed a novel technique to correct the Fermi-LAT data for the instrument response function. We have also studied the uncertainties originating from the point source model. We find that the GeV excess cannot be explained by these effects. After taking into account these uncertainties, we confirm the correlation between the GeV excess and the CO emission line.

T 73.8 Thu 18:15 H-HS X

Multiwavelength Analysis of NGC1275/3C84 — •Lena Linhoff and Simone Mender — TU Dortmund

Multiwavelength Analysis of NGC1275/3C84

The radio galaxy 3C 84 is a well studied source of radio emission and was detected as misaligned blazar NGC 1275 also in the very high-energy regime by gamma-ray detectors like MAGIC and FermiLAT. Unless the innermost structure of 3C 84 can be resolved with radio observations at 43 GHz, the mechanisms producing gamma-ray emission are still not fully understood. A necessary step to understand the production of high-energy photons, is to localize the emission region of gamma-rays in the central region of the source. For this aim, we use photo absorption and calculations of the optical depth within the broad line region to constrain the origin of the gamma-ray emission. In this talk we place our results in the context of theoretical models and other multiwavelength analysis results.

T 73.9 Thu 18:30 H-HS X

FACT-Variability of Blazar Light Curves — •Bernd Schleicher and Daniela Dorner for the FACT-Collaboration — University of Würzburg, Institute for Theoretical Physics and Astrophysics, Germany

Blazars are a subtype of Active Galactic Nuclei, where the relativistic jet is pointing towards the observer. They emit radiation over the whole electromagnetic spectrum up to TeV energies and their flux can be extremely variable on timescales from minutes to years. To investigate the variability characteristics bright TeV blazars like for example Mrk 421 and Mrk 501 are used. These sources are monitored in the complete electromagnetc spectrum with instruments like FACT, Fermi-LAT, SWIFT, OVRO and several optical telescopes like KVA, BOSS and the Hans-Haffner-Sternwarte. This gives a chance to study the light curve variability over the complete electromagnetc spectrum. To quantify the variability of a light curve, often the fractional variability is used. The different detection methods, sensitivities and observation strategies of the instruments influence the properties of the light curve for every instrument. The effect of these differences on the fractional variability needs to be studied and taken into account for the physics interpretation. On the one hand, systematic effects like cadence, binning and the completeness of the light curve and on the other hand, the fractional variability of the two sources depending on energy, time and flux is studied.

T 73.10 Thu 18:45 H-HS X

Long term variability study for the radio galaxy IC 310 with MAGIC — •Simone Mender and Lena Linhoff for the MAGIC-Collaboration — TU Dortmund, Otto-Hahn Str. 4a, 44227 Dortmund

The very-high-energy gamma-ray sky is dominated by jetted active galactic nuclei with a small viewing angle to the jet axis, where the gamma rays are doppler bosted towards Earth. So far, known VHE gamma-ray sources with a larger viewing angle are very rare as only six TeV gamma-ray emitting radio galaxies are detected up to now.

One of these TeV-gamma-ray emitting radio galaxies is the active galaxy IC 310 which was detected in 2010 by the MAGIC telescopes. In November 2012, an exceptionally bright flare from IC 310 was detected by MAGIC on timescales of minutes. To investigate the variability of IC 310 on large time scales, the long term variability study for the radio galaxy IC 310 with MAGIC will be presented in this talk.