EP 15: Astrophysics: Cosmology

Time: Friday 14:00–15:30 Location: HSZ/0004

EP 15.1 Fri 14:00 HSZ/0004

Searching for sub-TeV neutrino counterparts for sub-threshold GW events — •Tista Mukherjee — Institute for Astroparticle Physics (IAP), Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany

Neutrinos have been identified as promising cosmic messenger which can carry useful information about their astrophysical sources. Similarly, gravitational wave (GW) and photons can also serve the same purpose. By combining information from two or more than two messengers, we can perform multi-messenger studies which in principle, can provide us more complete information about an astrophysical site. So far, we have been able to correlate photons and neutrinos emitted from a blazar, now very famously known as the 'TXS blazar' in 2017. We also identified photons emitted from a binary neutral star (BNS) system, which was also the progenitor of GW, marked as GW170817 event by the LIGO-Virgo collaboration. But, a correlation between GW and neutrinos is yet to be identified, which serves as the motivation for my ongoing work. Here, I present the current status of it, where I am looking for sub-TeV neutrinos detected by IceCube, spatially and temporally correlated with sub-threshold GW events identified from the Gravitational Wave Transient Catalog (GWTC) 2.1.

EP 15.2 Fri 14:15 HSZ/0004

Determining H_0 without a distance ladder — •Hanna Belgardt and Dieter Horns — Institut für Experimentalphysik, Universität Hamburg, Luruper Chausseee 149, D-22761 Hamburg

The Hubble constant H_0 gives the present expansion rate of the universe. The value of H_0 is commonly determined using the cosmic distance ladder. Here, we present a method to measure H_0 via the distance-dependent attenuation of very-high energy (VHE) gamma-ray photons propagating in the extra-galactic background light (EBL).

We use a sample of VHE photon spectra of extragalactic sources including active galactic nuclei and gamma-ray bursts. We fit spectral models, which include the attenuation due to the pair production with the EBL photons. This attenuation can be characterized by an optical depth $\tau(H_0)$. We perform a fitting procedure to minimise the χ^2 and hence obtain an estimator for the Hubble constant.

Using the Domínguez et al. (2010) EBL model our preliminary analysis yields a best fit value of $H_0 = 76 \pm 6$ km/s/Mpc. This result is close and competitive to the value found with the cosmic distance ladder technique, e.g., $H_0 = 73(+2.6/-2.3)$km/s/Mpc (Kenworthy et al. 2022.) Final results will be shown at the conference.

EP 15.3 Fri 14:30 HSZ/0004

Modeling the extragalactic background light — •Devesh Chopra and Dieter Horns — Institut für Experimentalphysik, Universität Hamburg, Luruper Chausseee 149, D-22761 Hamburg

The Extragalactic Background Light(EBL) consists of the background light from all of the stars throughout the history of universe and hence contains a great deal of information about the evolution of galaxies from very early times up to the present. Although it is difficult to observe the EBL directly it could me modeled using various methods. Here, we present an updated model of the EBL computed directly from the global SFR.

We use the Starburst99(STScI) to generate simple stellar population spectra (SSPS) for which the IMF and metallicity are the most important parameters. The updated Cosmic Star-Formation History is used and a minimal set of assumptions are used so that it clearly connects the input physics to the output EBL. For all the input parameters of our model depending upon cosmological parameters a 737 cosmology is used but the resulting EBL intensity do not explicitly the cosmological parameters.

All the input parameters for our model are based on the most recent data hence yielding a very dependable EBL model. Our results provides a reliable lower-limit flux for the evolving Extragalactic Background Light up to redshift of 5 using minimum of parameters and assumptions. It allows a practical estimate of attenuation length for GeV-to-TeV gamma-rays. The comparison of our model with observed data points and other EBL models would be presented.

EP 15.4 Fri 14:45 HSZ/0004

Cross-Correlation of Artificial Diffuse Gamma-Ray Background Radiation and Corresponding Simulated Cosmic Shear — •Tristan Gradetzke and Stefan Fröse — TU Dortmund University

The cross-correlation of the diffuse gamma-ray background and cosmic-shear obtained from weak-lensing surveys yields the possibility to constrain dark-matter properties. This has been done already using Fermi-LAT data. Since Imaging Atmospheric Cherenkov Telescopes have a large effective area and are able to detect very-high energy gamma rays, the usage of their data for cross-correlation analyses is investigated. In this talk, a feasibility study, consisting of the cross-correlation of mock shear and diffuse gamma-ray background maps generated from a common mass distribution is discussed. We present the current state of the project.

EP 15.5 Fri 15:00 HSZ/0004

WISPFI: WISP searches on a fiber interferometer — •Josep Maria Batllori Berenguer, Yikun Gu, Rebecca Harte, Dieter Horns, Marios Maroudas, and Johannes Ulrichs — Institut für Experimentalphysik, Universität Hamburg, Luruper Chausseee 149, D-22761 Hamburg

The search for new physics at the sub-eV scale has been particularly active in the last years. Our principal aim is the detection of the QCD axion although our design is applicable to other axion-like particles (ALPs). We introduce a new table-top experiment to detect photon-axion conversion: WISP Searches on a Fiber Interferometer (WISPFI).

The experimental setup consists of a partial free-space Mach-Zehnder-type interferometer. In one of the arms, the fiber is coiled and placed inside the bore of a superconducting solenoid magnet (14 T, 140 mm diameter warm bore), where mixing occurs. The photon-axion oscillations would be detected by measuring changes in phase/amplitude.

For the detection at resonant mixing, we will use hollow-core photonic crystal fibers (HC-PCF), taking advantage of their unique guiding and optical properties. In particular, a large axion mass range (10 meV–100 meV) is achievable by regulating the air pressure inside the core of the HC-PCF. The effect of the core radius, wavelength and bending in the mode propagation is also discussed. Finally, implementations of squeezed light, higher-power laser or the application of an external electric field can improve the sensitivity even further.

EP 15.6 Fri 15:15 HSZ/0004

Searching for photon-ALPs mixing effect in AGN gamma-ray spectra — •Qixin Yu and Dieter Horns — Institut für Experimentalphysik, Universität Hamburg, Luruper Chausseee 149, D-22761 Hamburg

High energy gamma-rays propagating in external magnetic fields may convert into axion-like particles (ALPs). We use the energy spectra of 20 extra-galactic gamma-ray sources recorded during 10 years of Fermi-LAT observations. We define a test statistics based upon the likelihood ratio to test the hypothesis for a spectral model without vs. a model with photon-ALPs coupling. The conversion probability is calculated for fixed values of the mass and two-photon coupling of the pseudoscalar particle while the external magnetic field is characterized by the additional free parameters length scale s and average field strength B. We find for 20 of the 20 sources a favorable fit. The test statistics of the sources are combined and estimated to correspond to a significance of 2.7 sigma (test statistics summed in local maxima of all sources) and 4.9 sigma (global maxima). The locally best-fitting values of B and s fall into the range that is expected for large scale magnetic fields present in the intra-cluster medium of galaxy clusters and in large scale filaments.