T 39: Methods of astroparticle physics III

Time: Tuesday 17:00–18:30 Location: L-3.002

T 39.1 Tue 17:00 L-3.002

Particle Identification using Deep Learning with AMS — •Robin Sonnabend — 1. Physikalisches Institut B, RWTH Aachen

The Alpha Magnetic Spectrometer (AMS-02) on the International Space Station performs precision measurements of cosmic rays in the GeV to TeV energy range. One of the challenges of measuring the electron and positron fluxes is rejecting the proton background. The published analyses of these fluxes rely on Multivariate Analyses (MVA) using shower shape observables from the electromagnetic calorimeter (ECAL) for particle identification and background rejection.

New methods to identify particles with Deep Convolutional Neural Networks using the energy depositions measured by the AMS-02 ECAL directly will be presented.

T 39.2 Tue 17:15 L-3.002

Classification of Cosmic Rays on the basis of raw data of the IceCube Array — •Johannes Bartl, Gerrit Wrede, Thorsten Glüsenkamp, and Gisela Anton — Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Deutschland

In this paper, a classification of the primary particles of cosmic rays is performed using the measured signal within the IceCube array. This classification is the first separation only based on the detected photons generated by the interaction of the air shower in the ice. The distribution of the photons and thus the measurement signal of the detector depends on the mass and energy of the triggering primary particle. Using simulation data, a neural network was trained to distinguish between hydrogen and iron showers. Subsequently, the predictions of the network were weighted according to reality using a model. It was possible to classify 80% of the air showers correctly and the neural network was able to extract the primary energy and the energy distribution as classification criteria.

T 39.3 Tue 17:30 L-3.002

Supernova interactions in IceCube and reconstruction improvements — •David Kappesser and Lutz Köpke for the IceCube-Collaboration — Johannes Gutenberg-Universität, Mainz

The IceCube Neutrino Observatory is capable of detecting supernova neutrinos with energies around 10 MeV by observing an excess in the overall rate of the detector. This method allows for a particularly precise measurement of the supernova neutrino lightcurve. Due to IceCube's sparse Instrumentation with Digital Optical Modules (DOMs), only in rare cases, more than one Cherenkov photon is detected per supernova neutrino interaction. Still, the number of coincidences is sufficiently large in order to estimate the average neutrino energy by analyzing the energy dependent rate increase of coincidences between neighbouring DOMs. To calibrate and evaluate such a measurement and to carefully study the passage of particles through the ice and the related detector response, a Geant4 based Monte Carlo was developed and tested.

T 39.4 Tue 17:45 L-3.002

Search for hidden Supernovae and frequency space analysis with IceCube — •Alexander Fritz and Lutz Köpke for the IceCube-Collaboration — Institut für Physik, Staudingerweg 7, 55128 Mainz

By measuring a rate excess on top of dark noise in 5160 optical modules, IceCube offers the best resolution of the neutrino light curve for galactic Supernovae. First results on the frequency of optically obscured galactic Supernovae or Supernovae that end up in a black hole are presented for 11 years of IceCube data. For the search for periodic signals in the IceCube rate data in various time bins, Lomb-Scargle and fast Fourier transformations are used.

T 39.5 Tue 18:00 L-3.002

A study of the detectability of the DSNB through high resolution convolutional neural networks for next generation neutrino experiments — •David Maksimovic, Michael Wurm, and Michael Nieslony for the ANNIE-Collaboration — Johannes Gutenberg-Universität, Mainz, Deutschland

The ANNIE experiment (Accelerator Neutrino Neutron Interaction Experiment) at Fermilab is a 26-ton Gadolinium-loaded water Cherenkov detector. Its scientific aim is to study cross-sections and neutron multiplicity from the interactions of GeV neutrinos in the Booster Neutrino Beam. Moreover, ANNIE serves as test bench for new experimental techniques, e.g. the application of Convolutional Neural Networks (CNN) for event classification based on detector hit maps.
Here, we report on the performance of a CNN being developed to distinguish the signals of positrons emitted in Inverse Beta Decays from a background of neutral current interactions induced by GeV neutrinos. The resulting event classifier is of high relevance for the detection of the Diffuse Supernova Neutrino Background (DSNB) in the current Super-Kamiokande+gadolinium phase as well as for future water-based liquid scintillator experiments like THEIA.

T 39.6 Tue 18:15 L-3.002

Reconstruction of Supernova Burst Neutrinos with JUNO — •Thilo Birkenfeld, Max Büsken, Shivani Ramachandran, Achim Stahl, Christopher Wiebusch, and Sivaram Yogathasan — III. Physikalisches Institut B, RWTH Aachen

The Jiangmen Underground Neutrino Observatory (JUNO) is a 20kt liquid scintillator neutrino detector, which is currently under construction in China. It will lead the next generation of liquid scintillator neutrino experiments with its large target mass and total photo coverage of about 77%. A major physics goal is determining the neutrino mass hierarchy from the measurement of reactor electron anti-neutrinos with unprecedented precision. To accomplish this goal it is designed to have an energy resolution of $< 3\%$ at 1MeV and an energy non-linearity better than 1% in the MeV region. Due to its long lifetime JUNO is a promising observatory for measuring the neutrino burst from a galactic supernova explosion. High statistics and the excellent energy reconstruction will unravel the details of the neutrino-driven supernova mechanism. As the flux of such a burst comprises all different neutrino flavours, the expected signal consists of different detection channels, which include the inverse beta decay, elastic scattering on protons and electrons and various interactions with carbon. Separating these channels is crucial for a flavour dependent analysis. In this talk a method for distinguishing the different channels and reconstructing the low energy events from elastic scattering is presented.