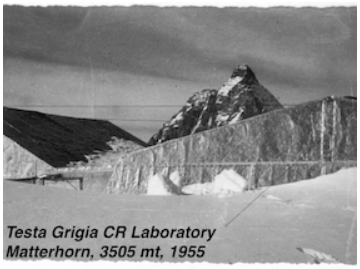

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Development of a Machine Learning Based Analysis Chain for the Measurement of Atmospheric Muon Spectra with IceCube

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IceCube is a cubic kilometer detector array located at the geographic South Pole. Its 5160 Digital Optical Modules (DOMs) are used to detect secondary muons produced either in neutrino interactions with ice or bedrock, or in cosmic ray air showers. In recent analyses of the overall neutrino flux the astrophysical component outweighs the expected prompt component which is produced mainly by charmed hadron decays in the atmosphere. Therefore an accurate measurement of the prompt flux magnitude is a difficult task for a large-volume neutrino detector. Since the energy spectrum of atmospheric muons has no astrophysical component, this flux can be studied to determine the magnitude of the prompt flux which consits of charmed hadron decays and an unflavored contribution. To analyze the atmospheric muons we developed a data mining based analysis scheme. In general high energy muons from air showers are accompanied by a bundle of low energy muons. Therefore, the detection of HE muons within a muon bundle is a challenging task because the IceCube detector cannot geometrically resolve individual muons within a bundle.
In this analysis HE muons are selected from air shower events using state of the art machine learning algorithms. Attributes to distinguish a high energetic muon event from background are selected by the mRMR algorithm and the events are classified by a random forest. In a subsequent analysis step the obtained sample is used to reconstruct the atmospheric muon energy spectrum, using the unfolding software TRUEE. The reconstructed spectrum covers an energy range from 10 TeV to 1 PeV. The general analysis scheme is presented, including results using the first year of data taken with IceCube in its complete configuration with 86 instrumented cables.

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