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Reconstruction and identification methods of sub-PeV gamma rays at the IceCube Neutrino Observatory

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The IceCube Neutrino Observatory is situated at the geographic South Pole. IceCube is composed of two detectors. One is an in-ice optical array that is sensitive to high-energy muons from air showers as well as particle cascades that are induced by high-energy neutrino interactions in the ice. The other detector, called IceTop, is an array of ice-cherenkov tanks on the surface above the in-ice array detecting cosmic-ray air showers.
The current surface and in-ice detectors of IceCube has been utilized to study cosmic rays and to search for PeV gamma rays. Previous IceCube gamma-ray searches started at 2 PeV.
With the aim to enhance the sensitivity of IceCube for detecting gamma rays, the reconstruction method of surface events is optimized for gamma rays below 1 PeV. Additionally, the gamma-hadron separation needed for the search for gamma-ray point sources is improved. To achieve this, machine learning techniques, including deep learning, are utilized to effectively separate gamma rays from hadronic cosmic rays.

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