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Direct and Indirect Detection of Cosmic Rays by HAWC¹

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The High Altitude Water Cherenkov (HAWC) observatory detects extensive air showers initiated by cosmic rays and gamma rays with energies from less than 100 GeV to greater than 100 TeV. More than one third of the HAWC array has been collecting data since August 2013 and the full array will be operational by March 2015. HAWC has detected an anisotropy in the arrival directions of the cosmic rays that has power on angular scales smaller than 10 degrees, which is difficult to explain given the propagation of these charged particles through the expected magnetic fields between the nearest sources and Earth. HAWC has also detected multiple Galactic gamma-ray sources, which are indirect probes of the sources of cosmic rays, because the cosmic rays interact in the sources to produce gamma rays, that unlike the charged cosmic rays, point back to their source. With future HAWC observations we will constrain the spectrum of these sources at the highest energies to look for signatures of gamma rays produced by interactions of hadronic cosmic rays. And HAWC has detected the extragalactic source, Mrk421. With longer exposures HAWC will likely detect more of these active galactic nuclei which may be the sources of the highest energy cosmic rays. We will search for indirect evidence of hadronic cosmic-ray acceleration in these sources as well, by studying their gamma-ray spectral and temporal signatures.

¹For the HAWC Collaboration