PROCEEDINGS OF SCIENCE

ONLINE ICRC 2021
THE ASTROPARTICLE PHYSICS CONFERENCE
Berlin | Germany
37th International Cosmic Ray Conference
12–23 July 2021

Executive Summary

Direct Determination of a Bare Neutron Counter Yield Function

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Ground based neutron counters are a standard tool for detecting atmospheric showers from GeV-range primary cosmic rays of either solar or galactic origin. Bare neutron counters, a type of lead-free neutron monitor, function much like standard neutron monitors but have different yield functions primarily because they are more sensitive to neutrons of lower energy. When operated together with standard monitors the different yield functions allow estimates to be made of the energy spectrum of galactic or solar particles. In 2010 a new array of twelve bare neutron detectors was installed at the South Pole to operate together with the neutron monitor there. Prior to installation, two of the detectors were operated on a ship that traveled from Sweden to Antarctica and back from November 2009 to April 2010. The purpose of this latitude survey was to use Earth's magnetic field as a spectrometer, blocking cosmic rays below the local cutoff rigidity (momentum per unit charge), from which we determined the response function vs. rigidity of these bare counters. By comparing that measured response function to direct measurements of the cosmic ray spectrum taken by the PAMELA spacecraft, we were able to make a direct determination of the yield function for these detectors. We are currently simulating to understand the response of different types of neutron detectors and find a link between the actual experimental yield function obtained from the latitude survey and the simulated yield function to understand the details of the detector response to primary cosmic rays.

37th International Cosmic Ray Conference (ICRC 2021)
July 12th – 23rd, 2021
Online – Berlin, Germany

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