APR10-2009-000482

Abstract for an Invited Paper
for the APR10 Meeting of
the American Physical Society

Composition Studies of the Highest Energy Cosmic Rays with the High Resolution Fly's Eye Observatory

JOHN BELZ, University of Utah

The existence of a strong break at 6×10^{19} eV in the cosmic ray energy spectrum may be most simply explained by the Greisen-Zatsepin-Kuzmin (GZK) mechanism of interactions with the cosmic microwave background (CMB), provided the highest energy particles observed are both protons and extragalactic in origin. Mass studies of cosmic rays can test both of these conditions, by observing a transition from a heavy galactic to light extragalactic composition and the persistence of the light composition at the highest energies. Air fluorescence observatories such as the High Resolution Fly's Eye (HiRes) probe primary cosmic ray composition by studying of the shape of cosmic-ray induced extensive airshowers. The average depth of airshower maximum X_{max} depends logarithmically on the primary energy and atomic mass, and the *elongation rate*, $d{<}X_{max}{>}/d\log E$, will be constant for unchanging primary compositions. Further, shower-to-shower fluctuations in X_{max} will be smaller in airshowers induced by heavy nuclei due to averaging effects. We report the results of composition studies of ultra-high energy cosmic rays observed by the stereoscopic HiRes observatory, for particles with energies above 1.6 EeV. The mean shower maximum, elongation rate, and fluctuations observed by HiRes are all consistent with a predominantly protonic composition when interpreted via the QGSJET01 and QGSJET-II high energy hadronic interaction models. The HiRes data thus supports the CMB-interaction explanation of the end of the energy spectrum and severely constrains models in which the galactic-to-extragalactic transition occurs above 10^{18} eV.