THE COMPOSITION OF COSMIC RAYS NEAR THE 'BEND' (10^{15}eV) FROM A STUDY OF MUONS IN AIR SHOWERS AT SEA LEVEL

Goodman, J.A.,[1] Gupta, S.C.,[1] Freudenreich, H.,[1] Sivaprasad, K.,[1] Tonwar, S.C.,[2] Yodh, G.B.,[1] Ellsworth, R.W.,[3] Goodman, M.C.,[4] Bogert, D.,[5] Burnstein, R.,[6] Fisk, R.,[5] Fuess, S.,[5] Morfin, J.,[5] Ohska, T.,[5] Bofill, J.,[7] Busza, W.,[7] Eldridge, T.,[7] Friedman, J.I.,[7] Kendall, H.W.,[7] Kostoules, I.G.,[7] Lyons, T.,[7] Magahiz, R.,[7] Mattison, T.,[7] Mukherjee, A.,[7] Osborne, L.,[7] Pitt, R.,[7] Rosenson, L.,[7] Sandacz, A.,[7] Tartaglia, M.,[7] Taylor, F.E.,[7] Verdier, R.,[7] Whitaker, S.,[7] Yeh, G.P.,[7] Strongin, B.,[7] Abolins, M.,[8] Brock, R.,[8] Cohen, A.,[8] Ernwain, J.,[8] Perkins, G.,[8] Hatcher, R.[8] and Werthmann, A.[8]

[1]Univ. of Maryland, College Park, MD 20742
[2]Tata Inst. of Fundamental Research, Bombay, India
[3]George Mason University, Fairfax, Virginia
[4]Argonne National Laboratory, Argonne, Illinois
[5]Fermi National Lab., Batavia, Illinois
[6]Illinois Inst. of Technology, Chicago, Illinois
[7]Mass. Inst. of Technology, Cambridge, MA
[8]Michigan State University, East Lansing, Mich.

ABSTRACT

A study of the distribution of muons near shower cores has been carried out at sea level at Fermilab using the E594 neutrino detector to sample the muons with E > 3 GeV. These data are compared with detailed Monte Carlo simulations to derive conclusions about the composition of cosmic rays near the bend in the all particle spectrum.

We report results from a set of Monte Carlo simulations generating EAS with primary energy in excess of 50 TeV. The set contains showers initiated by protons (A=1), alpha (A=4), CNO (A=14), medium (A=24) and heavy (A=56) primaries. For the primaries heavier than protons a successive breakup model for nucleii-air collisions is assumed. We have, in all, 2300 proton, 1400 alpha, 1000 CNO, 1000 medium and 1200 heavy initiated showers. Each shower record contains details of the electron lateral distribution and the muon and hadron lateral distributions as a function of energy, at the observation level of 1000g/cm.

To simulate experiment, each shower was thrown 500 times randomly over a square of 200 m x 200 m, centered on that of the detector system described elsewhere. For each throw, the electron in the 'trigger' detectors and the muons in the calorimeter were estimated from the lateral distributions. The number of 'detected' electrons and muons in each case was determined by a Poisson fluctuation of the number incident. This set of 'simulated data' was then subject to the same cuts as the data (with an additional upper limit of 100 on the number of muons to take into account the failure of the algorithm that estimates the muons). The resultant predicted distribution of muons, electrons, the rate of events etc. were then compared to those observed. Preliminary results on the rate favors a heavy primary dominated cosmic ray spectrum in energy range 50-1000 TeV.