ESTIMATION OF VERTICAL SEA LEVEL MUON ENERGY SPECTRA FROM THE LATEST PRIMARY COSMIC RAY ELEMENTAL SPECTRA

MALA MITRA, N.H. MOLLA AND D. P. BHATTACHARYYA
DEPARTMENT OF THEORETICAL PHYSICS,
INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE,
JADAVPUR, KOLKATA 700 032

The directly measured elemental spectra of primary cosmic rays obtained from Webber et al., Seo et al., Menn et al., Ryan et al. and experiments like JACEE, CRN, SOKOL, RICH on P, He, CNO, Ne-s and Fe have been considered to estimate the vertical sea level muon energy spectra. The primary elemental energy spectra of P, He, CNO, Ne-S and Fe available from the different experimental data duly fitted by power law are given by

$N_p(E)dE = 1.2216\ E^{-2.68}\ dE\ [cm^2.s.sr.GeV/n]^{-1}$
$N_{He}(E)dE = 0.0424\ E^{-2.59}\ dE\ [cm^2.s.sr.GeV/n]^{-1}$
$N_{CNO}(E)dE = 0.0026\ E^{-2.57}\ dE\ [cm^2.s.sr.GeV/n]^{-1}$
$N_{Ne\text{-}S}(E)dE = 0.00066\ E^{-2.57}\ dE\ [cm^2.s.sr.GeV/n]^{-1}$
$N_{Fe}(E)\ dE = 0.0056\ E^{-2.55}\ dE\ [cm^2.s.sr.GeV/n]^{-1}$

Using the conventional superposition model the all nucleon primary cosmic ray spectrum has been derived which is of the form $N(E)dE = 1.42\ E^{-2.66}\ dE\ [cm^2.s.sr.GeV/n]^{-1}$ We have considered all these spectra separately as parents of the secondary mesons and finallty the sea level muon fluxes at 0^0 from each species have been derived. To evaluate the meson spectra which are the initial air shower interaction products initiated by the primary nucleon air collisions, the hadronic energy moments have been calculated from the CERN LEBC-EHS data for pp collisions and FNAL data for $\bar{p}$ p collisions. Pion production by secondary pions have been taken into account and the final total muon spectrum has been derived from $pp \rightarrow \pi^{\pm} x$, $pp \rightarrow K^{\pm} x$, $\bar{p}\ p \rightarrow \pi^{\pm} x$ channels. The Z-factors have been corrected for p-air collisions. We have adopted the constant values of $\sigma_{p\text{-}air}$ and σ_{p-air} cross-sectionswhich are 273 mb and 213 mb, respectively. The adopted inelastic cross-sections for pp and $\bar{p}p$ interactions are 35 mb and 22 mb, respectively. The Q-G plasma correction of Z-factors have also been incorporated in the final form. The solution to the standard differential equation for mesons is considered for muon flux estimation from N-generations of the parent mesons. By this formulation vertical muon spectra from each element along with the total primary nucleon spectrum have been derived. We wanted to observe the different shape of the muon spectra evaluated from different elemental spectra and to make a comparative study of that. In this energy range (10^2 - 10^4) GeV we have observed that the majority of the total muon flux is coming from the proton spectra. The contribution from the other elemental spectra to the total muon flux is not at all comparable with that of proton spectra.