Chapter-6

SUMMARY

The NBU EAS array has been operated in two different layout for the work described in the thesis. In the array layout that existed up to 1994, the direct measurement of the energy spectrum and lateral distribution of muons in the showers of size range ($3.15x10^4$ - $1.79x10^6$) particles were made. It has been shown from the analysis of such muon data ("part-B", chapter-5) that,

The effective primary cosmic ray mass decreases in the 'knee' energy region between $3.4x10^{14}$eV. and $4.6x10^{16}$eV.

A new electronic system (section-2.1, chapter-2) developed to operate the new array layout as an EAS telescope for primary cosmic gamma ray search, is described in "part-A" (chapter-2, 3 & 4). The electronic system has improved stability and instrumental accuracy (section-2.7, chapter-2). The telescope has been operated at a site near sea level (altitude ~1000 gm/cm^2, latitude 26^{o}42'N, longitude 88^{o}21'E) and its characteristics have been determined (section-3.2 & 3.3, chapter-3). Two muon magnetic spectrographs set up within the array area have been in operation for detection of muons above 2.5GeV in the showers of size range $2X10^4$ - $3X10^6$ particles.

The analysis so far of 14,260 showers is presented in the thesis. The main results and the facts found are the following-

(i) The lateral structure of showers in the size range $7x10^4$ -$1x10^6$ particles is independent of shower size for any zenith angle between 0^o- 60^o and also independent of zenith angle for any size in the specified range (section-4.1.1, chapter-4).

(ii) 3.6 % of showers detected at sea level have been found to be young showers with the age parameter in the range $0.6 < s < 1$ (section-4.1.2, chapter-4).

(iii) The age distribution of showers in the size range $2x10^4$-$3x10^6$ particles is Gaussian with the mean value of age 1.39 (section-4.1.2, chapter-4).

The width of the shower age distribution for different shower size groups decreases with the increase of shower size (section-4.2.1, chapter-4).

(iv) The average age of each of shower groups decreases slowly with increasing average shower size, the variation remaining within 15% (section-4.2.1, chapter-4).

(v) The variation of the age parameter of showers with zenith angle is found to be slow and is in accordance with the photon-electron cascade theory (section-4.2.2, chapter-4).

(vi) The local age (or lateral age) of a shower is minimum at around 32m from the shower core and the difference between the lateral age at the minimum and the observed (longitudinal) mean shower age is 0.35 (section-4.2.3, chapter-4).

(vii) The zenith angle distributions of showers in the size range $4x10^4$ - $5x10^5$ particles observed in the angular range 0^o-60^o fit to a cosine power law with the power index increasing with shower size (section-4.1.3, chapter-4).

(viii) The barometric coefficient derived from the zenith angle distribution increases with increasing shower size, indicating increase of primary spectral index with energy (section-4.1.3, chapter-4).

(ix) The absorption length of EAS derived from power index of zenith angle distribution of showers shows a slow variation with shower size in the range $4x10^4$ - $5x10^5$ particles (section 4.1.3, chapter-4).

(x) The integral size spectrum of EAS of size range $8x10^4$ - $1.2x10^6$ particles shows a 'knee' in the region $(5\text{-}7)x10^5$ particles with the value of spectral index changing from (1.41 ± 0.07) to (2.16 ± 0.19) (section-4.1.4, chapter-4).

(xi) The observed feature of 'knee' of the primary spectrum appears to correspond to the 'knee' of the size spectrum observed in the present experiment (section-4.1.4, chapter-4).