ATMOPHERIC GAMMA-RAY OBSERVATIONS WITH BETS FOR CALIBRATING ATMOSPHERIC NEUTRINO FLUX CALCULATIONS

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The discovery of neutrino oscillation by the Super Kamiokande group is based on comparison of the observed neutrino flux with calculated ones. Although the conclusion of oscillation itself is not upset by the uncertanity of the absolute flux, it is desirable to obtain reliable expected neutrino flux for further detialed discussions.
In the last three years, we have performed atmospheric gamma-ray observations for calibrating the calculations of cosmic ray propagation in the atmosphere; in 1998 at Mt. Norikura (2770 m a.s.l) and in 1999 and 2000 at balloon altitudes (15 km to 25km). For the observation, we upgraded BETS detector developed for primary electron observation. It uses a number of scintillating fibers for detailed cascade imaging.
The observed results were compared with Monte Carlo calculations and we have found that an interaction model (Lund Fritiof 1.6) used in an old neutrino calculation (Phys. ReV.D 1995, Honda et al) is not well suited for describing the observed values. In stead, we found that Lund Fritiof 7.02 gives better agreement with the observation. Also newly developed code dpmjet3 (Roesler et al SLAC-PUB-8740, hep-ph/0012252) is found to be quite consistent with the observations. We have also compared the new calculations with other measurements on protons and muons (by BESS group) to find good agreement. Thus, we are ready to derive a reliable neutrino flux now.