Scintillator huts saturation and NKG reconstruction

J. Cortina, A. Moralejo, J.L. Contreras
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Saturation of Munich and Kiel scintillator huts has an effect on the fitting of the particle lateral distribution to the NKG function. We have used MC simulated protons to show that reconstructed age and shower size are affected depending on the extent of the scintillator huts.

1 Procedure

During the Madrid composition meeting, Andre Roehring's contribution showed that the saturation of the scintillator huts near the core affects the NKG fit. Saturated huts with more than 300 Mips must be removed from the fit. The fit is thus started at a radius further from the shower core and shower size and age are affected.

Our procedure in the analysis is to remove rings where saturated huts are present. We define a distance startnkg as that of the saturated hut which is furthest from the shower axis. NKG function is fitted from the next 10m-width ring up to a maximal distance of 200m.

2 Effects in MC

We have analised MC 10° protons of log E(TeV)=2.7-4.0 applying('cut')/not applying('no-cut') our procedure to remove huts over 300 Mips and start the NKG fit further from the core. Only event shifts 25 meters inside the array are considered. Effects are shown in the appended plots (plot1.ps files in the web server).

- **startnkg vs log E:** starting radius is found to grow with incident energy in a linear way (5 is lowest distance allowed in the fit).
- **s(cut) vs s(no-cut), s(cut)/s(no-cut) vs log E, s(cut)/s(no-cut) vs startnkg:** Reconstructed age is systematically overestimated with the new procedure. The amount of this overestimate is directly related to the starting fit radius. This allows to parametrize the effect in real data.

- **Ns(cut)/Ns(no-cut) vs log E, Ns(cut) /Ns(no-cut) vs startnkg:** Reconstructed shower size is underestimated with the new procedure. Ns(cut) /Ns(no-cut) is 1 at PeV (startnkg=5 m) falling down to 0.8 at 8 PeV (startnkg$\sim$35 m). This factor agrees with the one presented in Madrid by A. Roehring (in the order of 0.8 for 40 m cut). Dependence is also found on primary energy and startnkg. Law may be assumed linear and used to correct the effect in real data.

- **Ns(cut) /Ne(MC) vs log E, Ns(no-cut) /Ne(MC) vs log E, Ns(cut) /Ne(MC) vs startnkg:** Comparison with Ne(MC), MC number of electrons in the shower. no-cut reconstructed shower size is always found to be $\sim$2.6 times Ne(MC). This agrees well with results at all energies (see S. Martinez MC paper). On the other side, Ns(cut) /Ne(MC) goes from 2.6 at 1 PeV (no real cut applied) down to 2.1 at 8 PeV (startnkg$\sim$30 m). These figures agree well with the Ns(cut) vs Ns(no-cut) comparison.

In order to prove that this effect comes from changing the NKG fitting radial interval, we have fitted same events in the 0-200m radial interval (i.e. fixed startnkg=0m) and 20-200m (i.e. fixed startnkg=20m). We have studied the effects on age and shower size. Same study has been carried out for startnkg=40m. See plot2.ps. Effect on both age and shower size seems to be constant over the whole energy range: age is overestimated in a factor 1.1 (1.2) for startnkg 20m (40m), shower size is underestimated in a factor 0.95 (0.8) for startnkg 20m (40m). These figures agree well with the above obtained for changing startnkg.

3 Conclusion

Effects of saturation in scintillator huts on shower size and age have been shown to be important for protons at energies above 1 PeV. We suggest two ways of correcting these effects in real data: either the NKG fit is allowed to start at variable distances (startnkg) according to saturation and a MC-based correction is applied depending on startnkg, or a fixed startnkg safe up to 10 PeV (35 m) is selected and a fixed correction is applied.