IceTop as Veto Shield for Downgoing Neutrino Events

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- IceCube 80 string AMASIM data were used for this study.

- Multiplicity trigger: 24

- Local coincidence by Coincify in Icetray.

- The codes I used can be found in sandbox:
  http://code.icecube.wisc.edu/svn/sandbox/mu-bundle
Down-going Neutrino Events

**Particles**
- Cosmic rays: Yes
- Gamma rays: Yes
- Neutrinos: No

**Triggering**
- IceTop trig: Yes
- IceCube trig: Yes
- Geo reco:
  - Hybrid
  - IceTop
  - IceCube

(above certain energy threshold)
How To Distinguish...

IceTop threshold energy: 300 TeV

Expected nch distribution for background
Air Shower Generation

- There is only muon information in MC data.

- From true energy and zenith angle, particle density at the surface can be calculated by using NKG function.

- No IceTop tank simulation (but not too wrong!).

NKG function

\[ S = N R^{-1.2} (1+R)^{1.2-e} (1+(r/1000)^2)^{-0.6} . \]

\[ R = r / R_{\text{Moliere}} \]

\[ e = 3.97 - 1.79 (\sec(\theta) - 1) \]

Energy determination

\[ E = 3 \times 10^{17} S (600 \text{ m}) \]

\[ S = f(E, r, \theta) \]
IceTop trigger efficiency
Nch Vs. Energy
Extension of IceTop to 2 km in radius

- Discontinuity at edge of the array
- Only high energy events are triggered by the outer rings
Extension of IceTop

Zenith angle from IceCube center