

# Seasonal variation of atmospheric muons

## --a theoretical review

- Integrate production spectrum of muons over slant depth
  - Production spectrum depends on temperature at each depth through critical energies of pions and kaons, which are proportional to  $T(X)$
  - Compare standard analytic formula with parameterization
- Calculate a  $T_{\text{eff}}$  for each day to quantify rate vs.  $T_{\text{eff}}$  each day
  - Compare two ways to weight muon production profile with  $T(x)$
  - New, simple derivation of a standard form that weights  $T(X)$  with the derivative w.r.t.  $T$  of the production spectrum
- Calculate the correlation of rate with  $T_{\text{eff}}$  for both rate formulas and for both definitions of  $T_{\text{eff}}$  for two energy ranges
  - TeV as at the MiNOS Far Detector at Soudan
  - 50 GeV as at the MINOS Near Detector at Fermilab