

Simulated :  $\nu_\mu$  and  $\bar{\nu}_\mu$  from 2005 fluences , 0-400 GeV  
Interactions in “average” rock material : A=21, Z=10  
Transport in realistic rock composition,  $\rho = 2.765 \text{ g/cm}^3$   
Event rate for  $\nu_\mu = 614 \text{ CC/kton}/10^{19}\text{pot}$   
Event rate for  $\bar{\nu}_\mu = 14.5 \text{ CC/kton}/10^{19}\text{pot}$   
Interactions up to a distance = 300 m from exit wall  
All particles from the neutrino interaction are transported  
Neutrino beam assumed uniform, parallel, with an upgoing angle of  $3.265^\circ$  Results:  
 $\mu^-$ :  $43.8 \mu^-/\text{m}^2/10^{19} \text{ pot}$   
 $\mu^+$ :  $1.8 \mu^+/\text{m}^2/10^{19} \text{ pot}$   
total :  $45.6 \mu^+/\text{m}^2/10^{19} \text{ pot}$   
Error: 2% stat 20% syst (muon pits still to be fully checked)

produced : muon ntuple with these variables:

**primary** PDG id of interacting neutrino

**energy** neutrino energy (GeV)

**vertex(3)** interaction position x,y,z Axis are x==along the hall, y=vertical, x=horizontal. Z=0 is hall wall. all in centimeters

**n\_muons** = number of muons exiting from rock for this interaction

**muon(n\_muons)** = PDG muon id

**p\_muon(5,n\_muons)** = px,py,pz,E,p ( E=total energy, p=3-momentum)

**mucos(3,n\_muons)** = direction cosines of the muon

**mugen(n\_muons)** = generation depth ( 1=from primary vertex, 2= from reinteraction or decay etc)

**n\_leptons** = number of leptons generated by the neutrino interaction

**lepton(n\_leptons)** =PDG id of lepton generated by the neutrino interaction

**p\_lepton(5,n\_leptons)**= px,py,pz,E,p

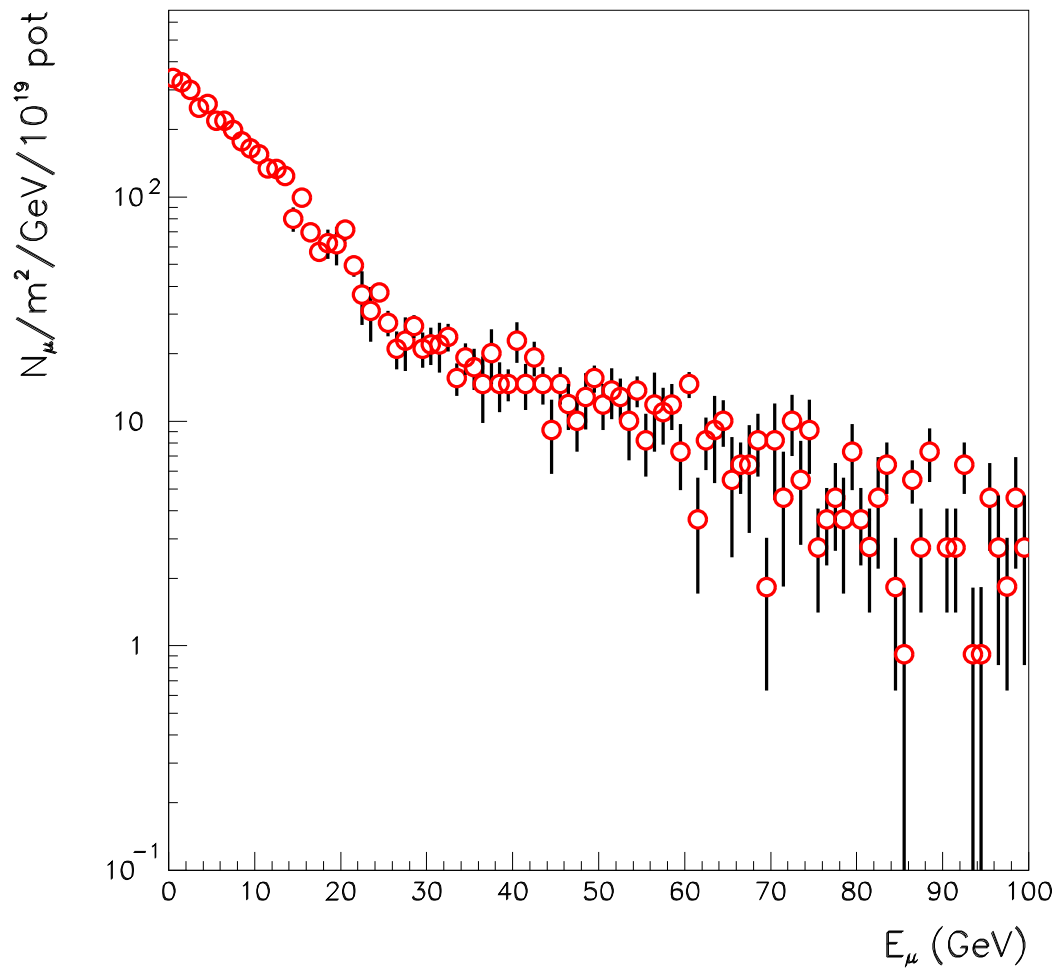


Figure 1:  $\mu^-$  spectrum at rock exit

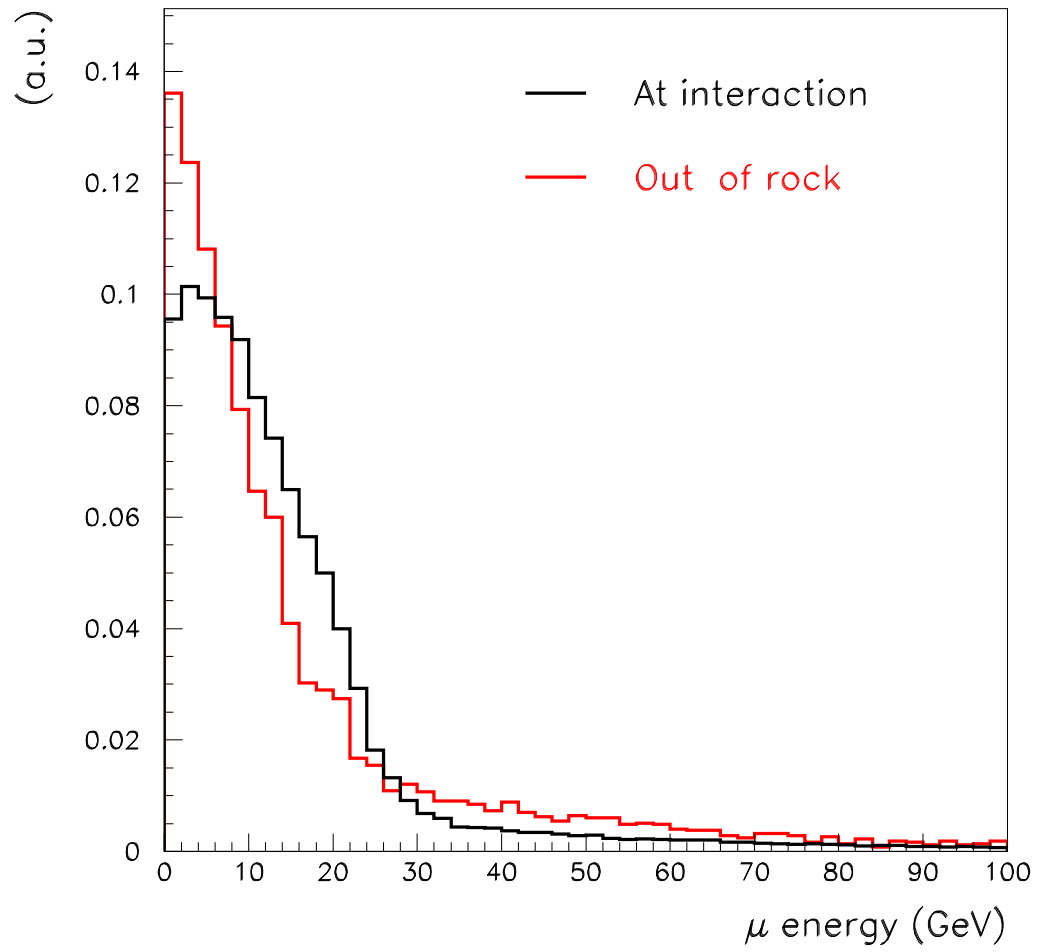


Figure 2: comparison of muon spectra at interaction and at exit from rock, both normalized to 1.

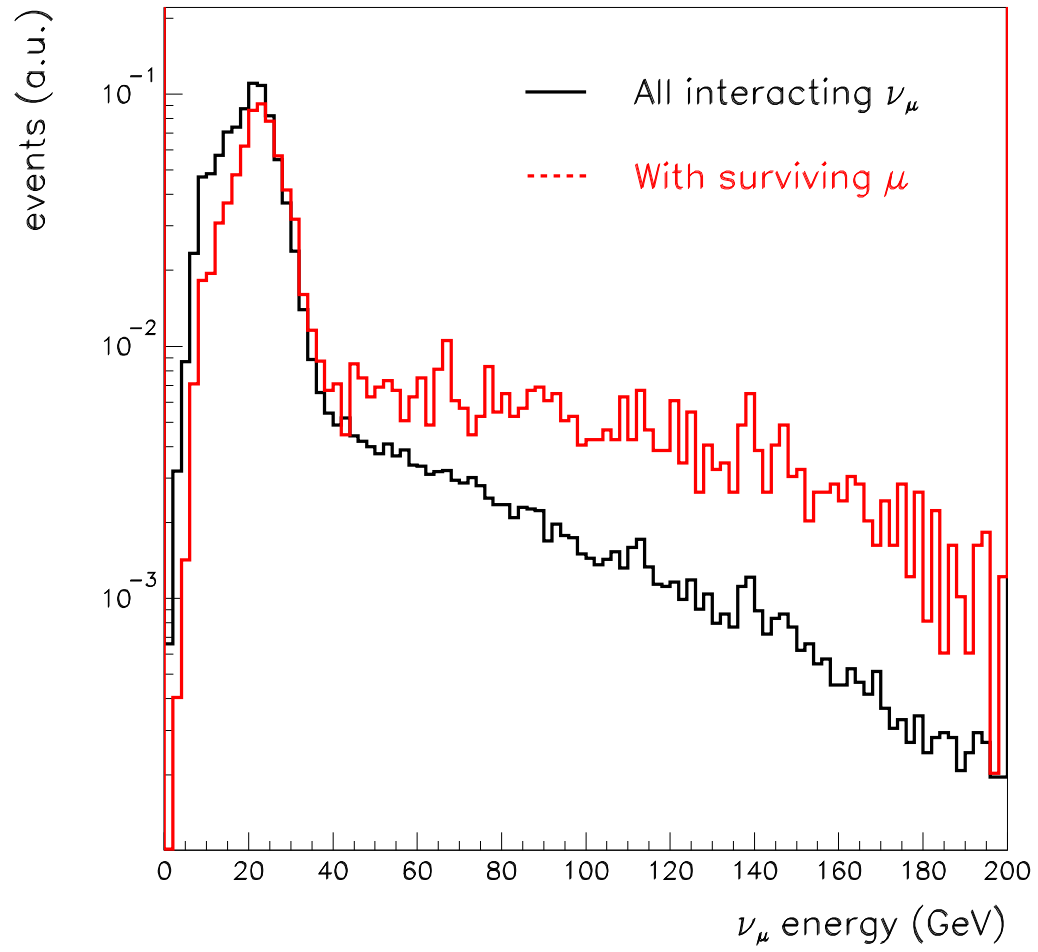


Figure 3: Neutrino spectra: all interaction neutrinos and only those neutrinos producing at least one muon that arrives to the hall