Neutrino Flavor Identification in SalSA

P. Miočinović

University of Hawaii at Manoa, Honolulu, Hawaii, USA

ARENA Workshop, DESY Zeuthen

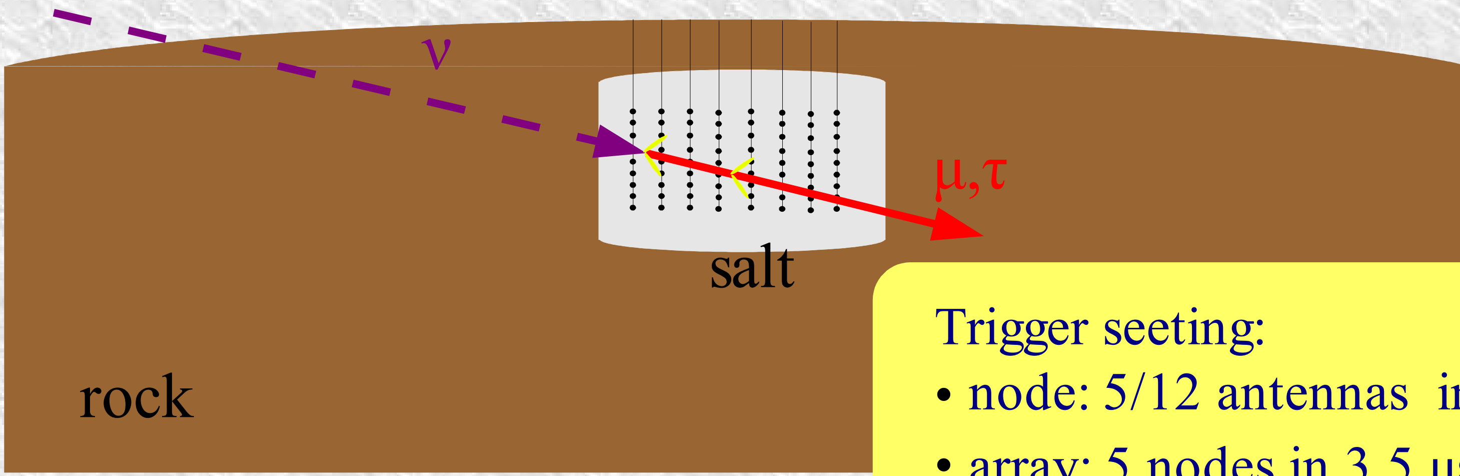
May 19, 2005

Outline

- MC setup description
- Radio signature in the detector
- Means of flavor identification
- Preliminary results
- Summary

MC simulation setup

1) Neutrino generator ANIS
2) Lepton propagator MMC
3) Trigger simulator SMC

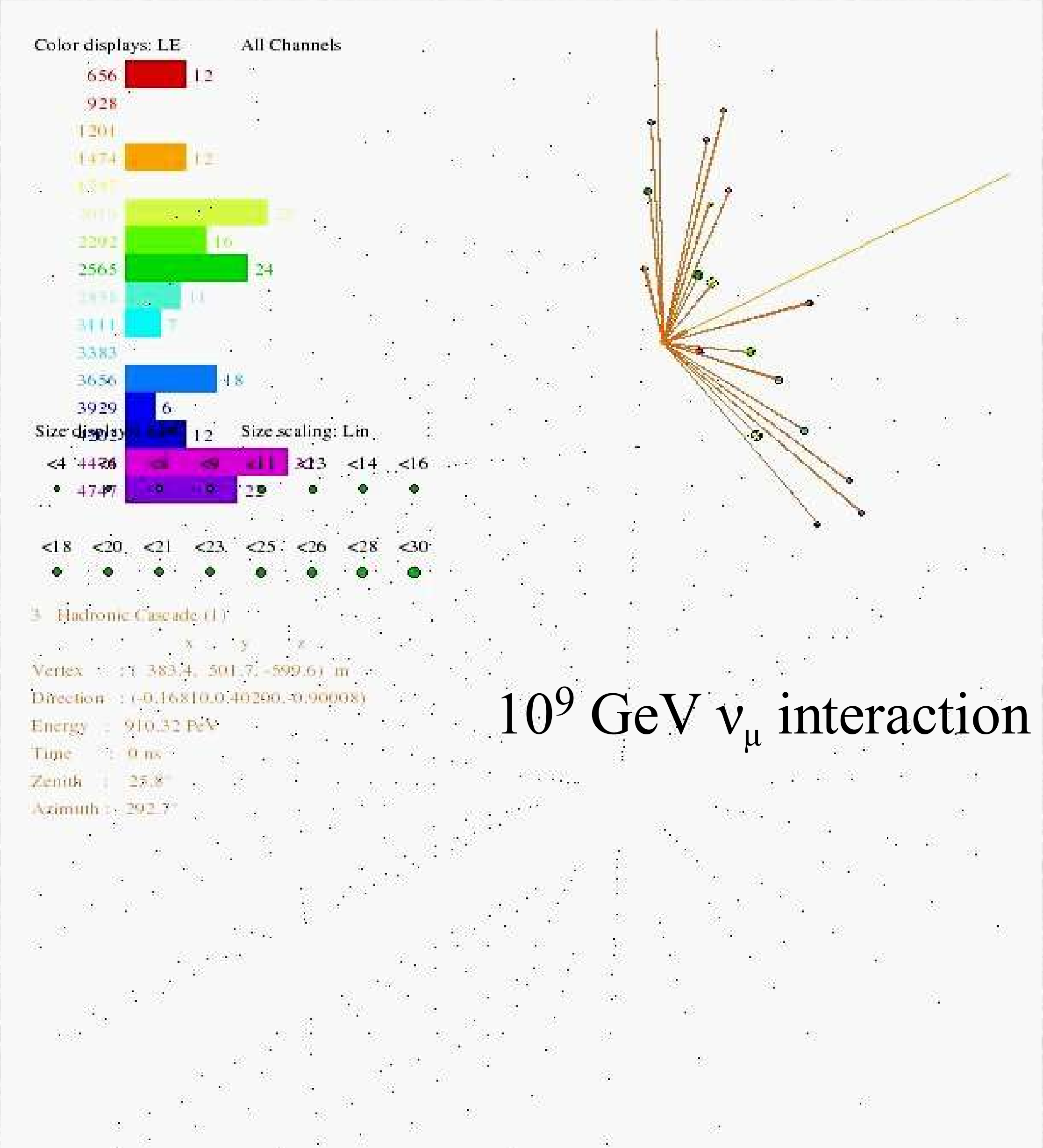


Trigger seeting:
- node: 5/12 antennas in 80 ns
- array: 5 nodes in 3.5 μs

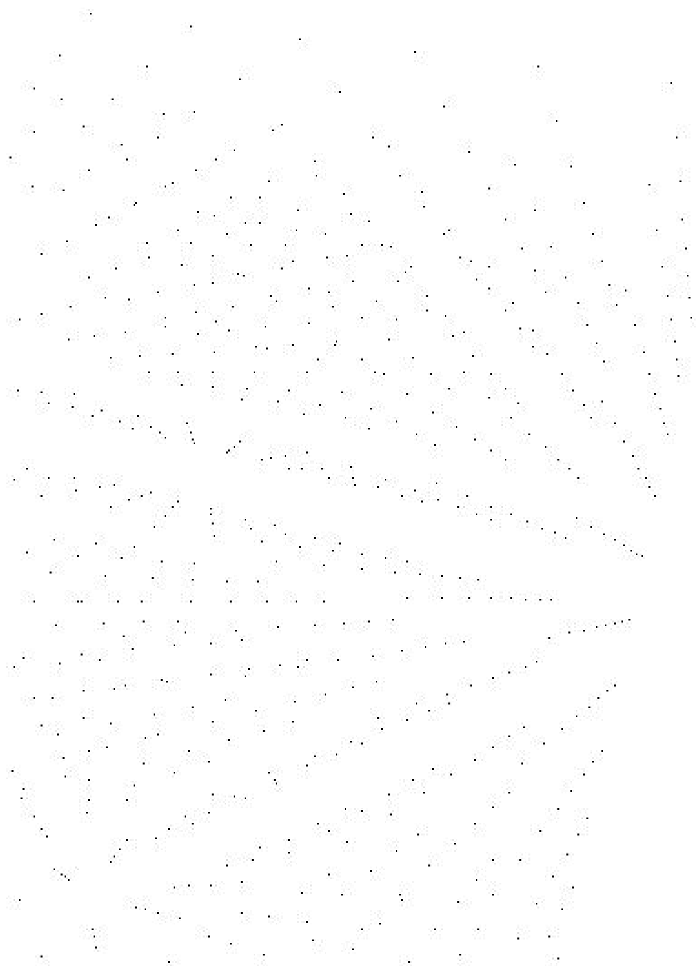
RF signal signature

- on a scale size of the detector (~250 m antenna node separation) RF emitting region is point-like
- no scattering and long attenuation length preserve cone-like RF signal
- the width of the cone is correlated with the intrinsic length of the RF emitting region (i.e. single slit diffraction)
- due to LPM effect EM showers will be longer than hadronic showers of the same energy

→ **measuring the strength and the width of the cone differentiates hadronic and EM showers**

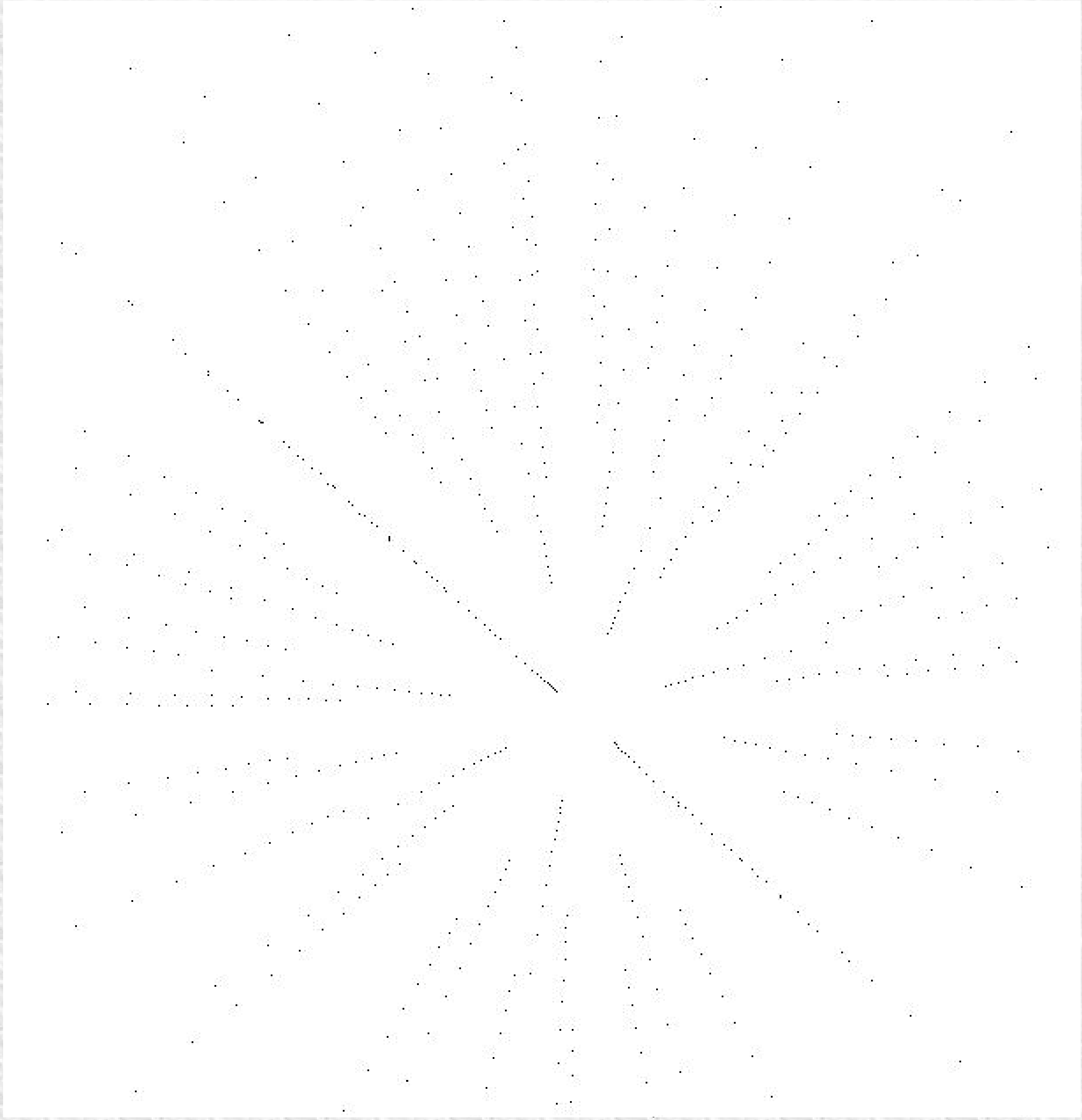


10^9 GeV ν_μ interaction



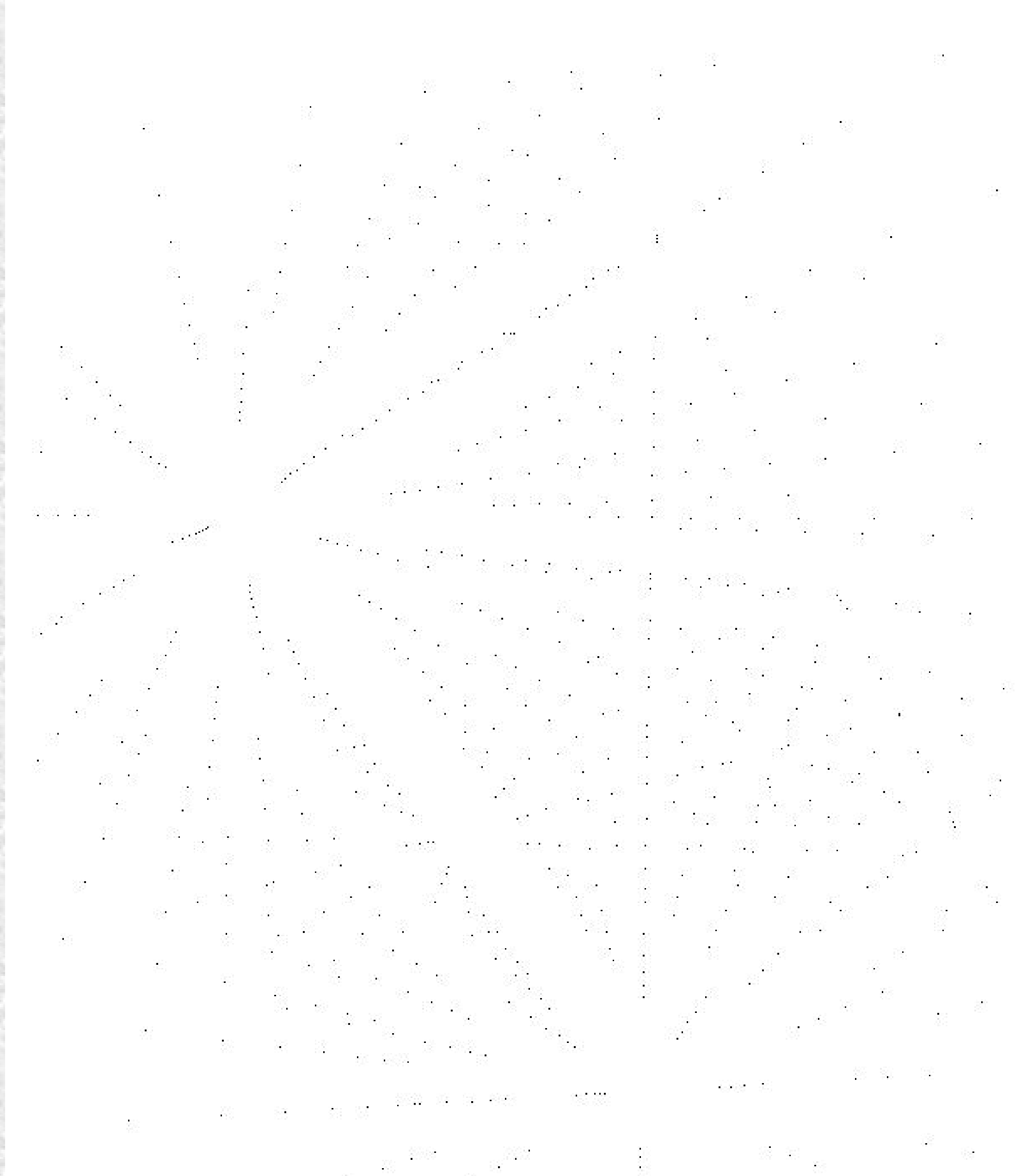
Flavor ID Table

	CC	NC
ν_e	hadronic and EM shower from the same vertex	single hadronic shower
ν_μ	hadronic shower + secondary shower at distance, likely EM	single hadronic shower
ν_τ	hadronic shower + secondary shower at distance, likely hadronic, or τ decay	single hadronic shower



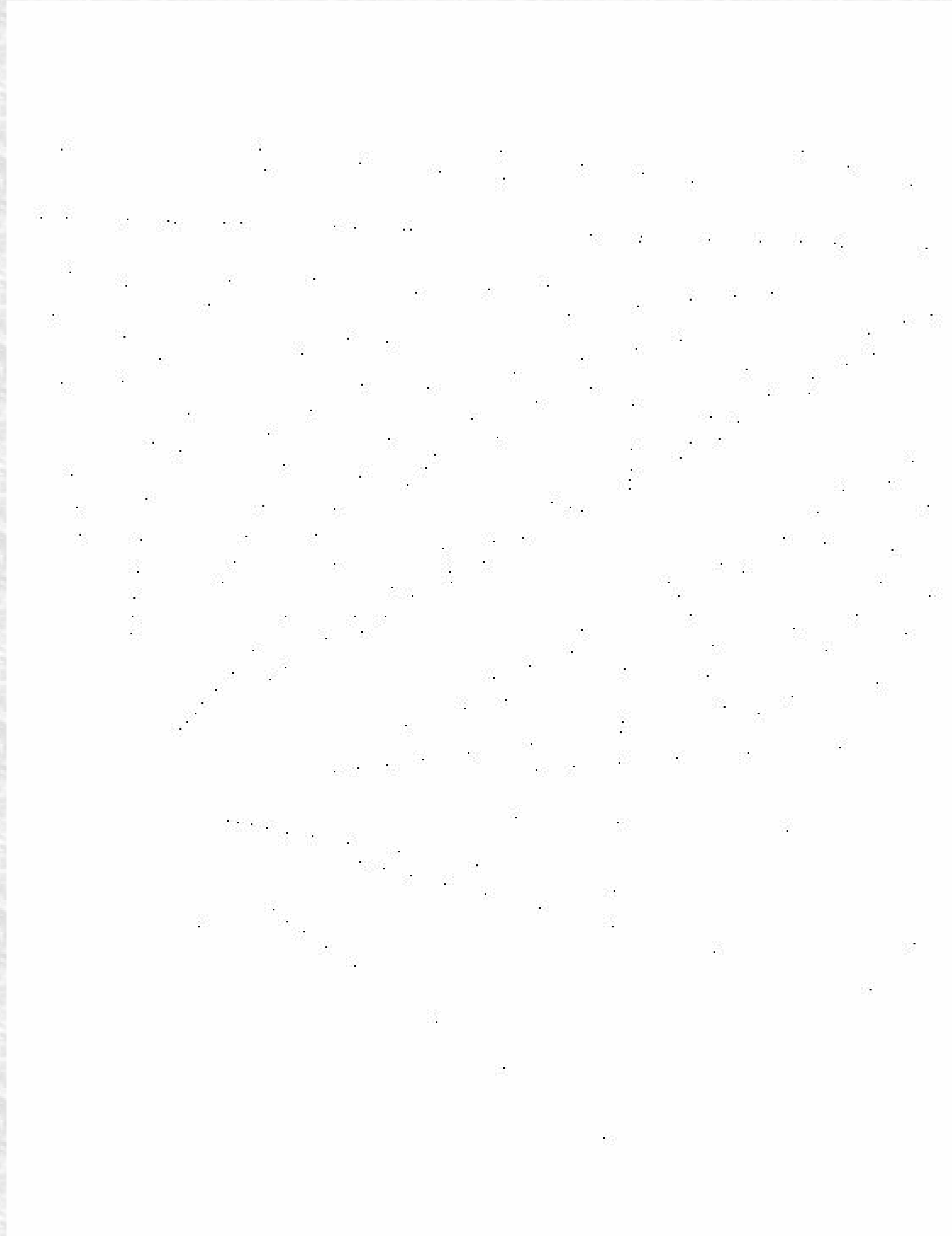
10^9 GeV

ν_μ CC

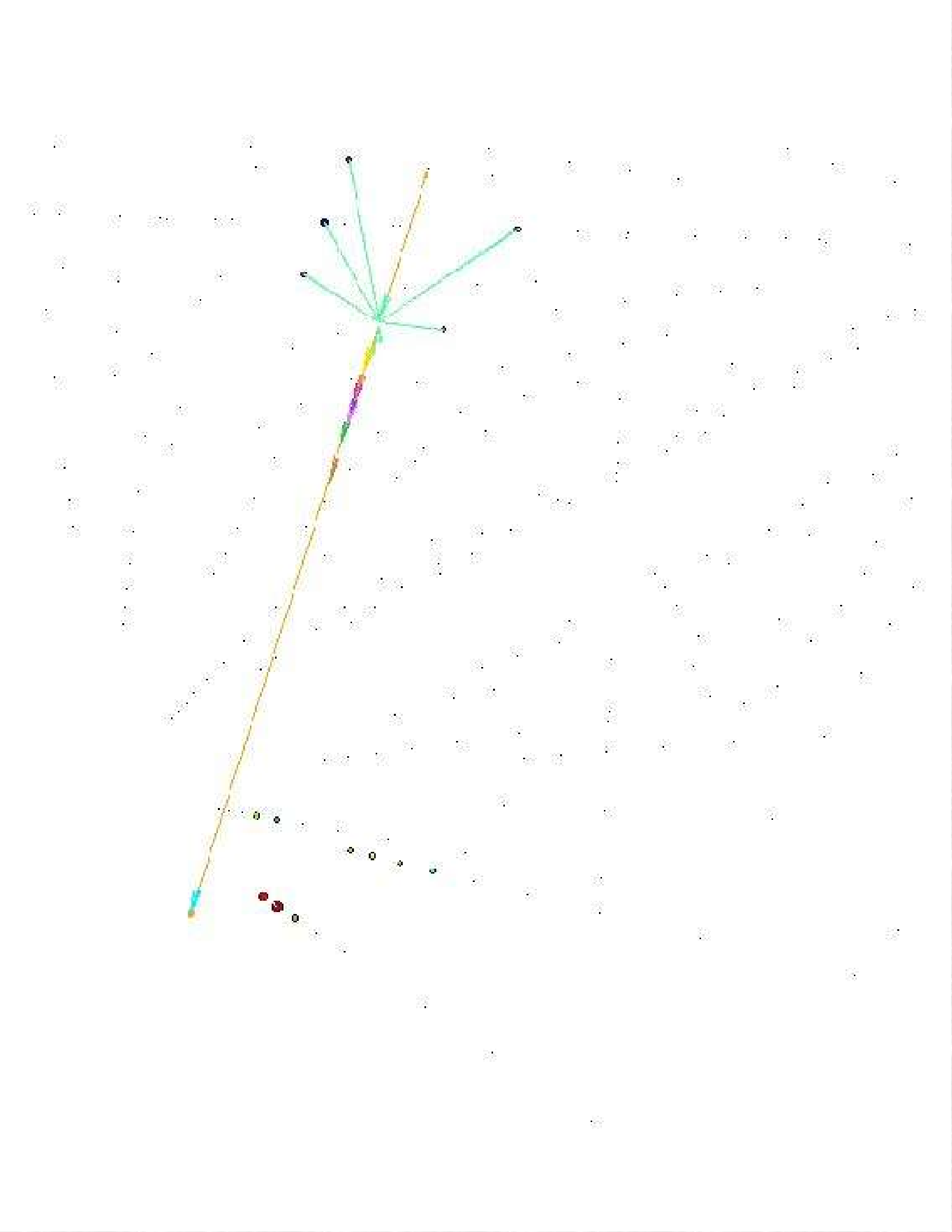


10^9 GeV

ν_μ CC



Lines show expected line-of-flight of RF pulse triggering an antenna node



Preliminary results

- 10-15% of ν_μ events at 10^9 GeV have secondaries large enough to trigger several antenna nodes
- the remainder of the events studied either:
  - have large Y-factor (little energy given to lepton)
  - secondaries are not seen due to "skin losses" (i.e. neutrino interacts as it exits the detector volume)
- more formal RF cone reconstruction needs to be developed to further quantify the flavor resolution potential of this approach

Summary

- Neutrino **flavor identification is possible** in radio Čerenkov neutrino detectors
- Accurate reconstruction of primary hadronic vertex allows for virtually **noise free** search for secondary RF emitting showers
- Comparison with MC models will provide **measure of flavor content** of incoming ultra-high-energy (>$10^{8.5}$ GeV) neutrino flux