LBL-group meeting

neutrino.lbl.gov/∼snoman/currat/talks/

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- Stopped muons: Nuance and Snoman

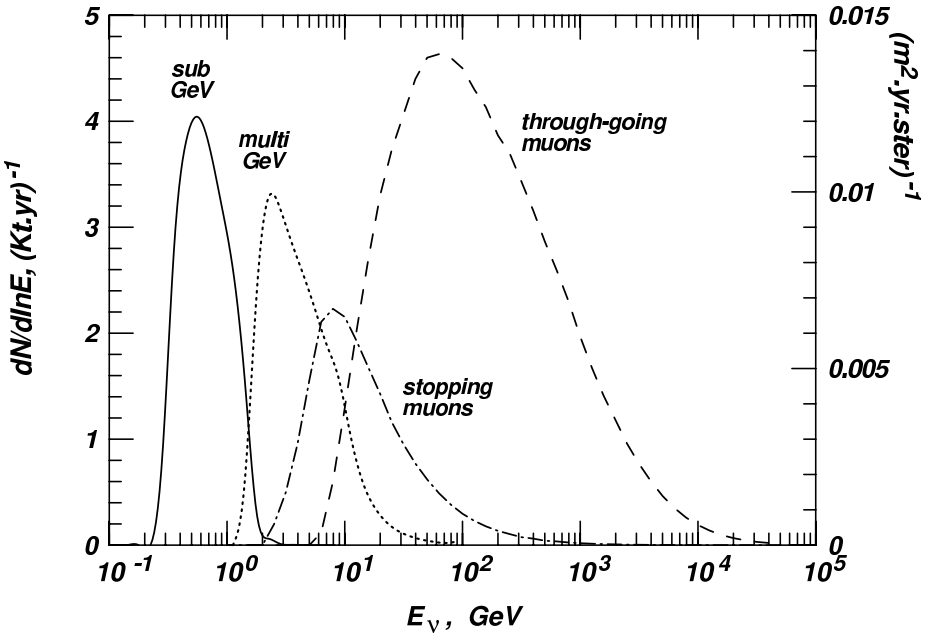
Nuance

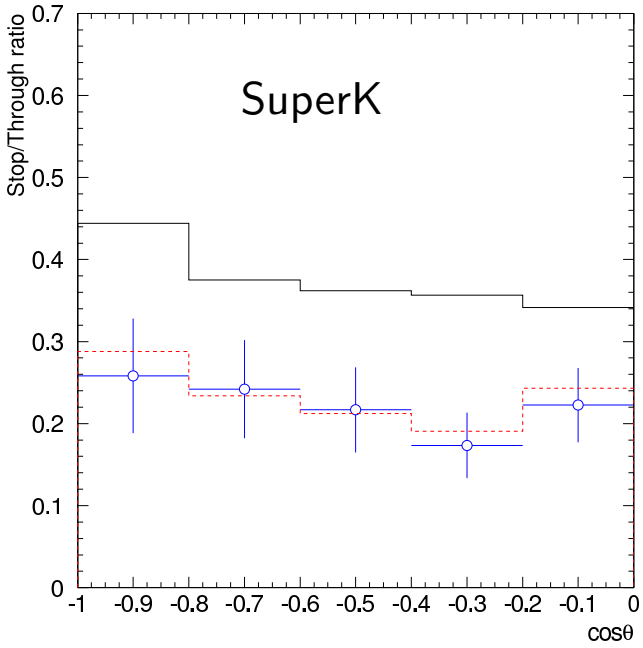
Nuance is a software tool for simulating neutrino interactions and related processes. Written by D. Casper, UCI (v2.003 released 2/1/03)
Pretty evolved (Pyhtia, Lepto, Tauola, Propmu libs) but not as much standard yet. Needs strong configuration/customization for each particular experiment.

- electron scattering (calculable but only important at low E)
- quasi-elastic scattering (CC+NC 2-body νN reactions)
- resonant processes ($E \gtrsim 1$ GeV, baryon resonances)
- coherent and diffractive reactions (off entire nucleus scattering rather than single nucleon)
- DIS (inclusive, special "approximation free" treatment)
- nuclear processes (final state interaction in nucleus, IMB's specific to ^{16}O)
- Two-steps process:
  - calculate cross section + rates for given geometry (GEANT-like)
  - generate events for specific config

Stopped muons

Interesting to look at stopped muons, or at least count them ⇨ stopping and thru-going samples come from different parent $E(\nu)$ distribution, $N_{\text{stop}}/N_{\text{thru}}$ ratio is a way of testing E dependence of oscillation hypothesis.

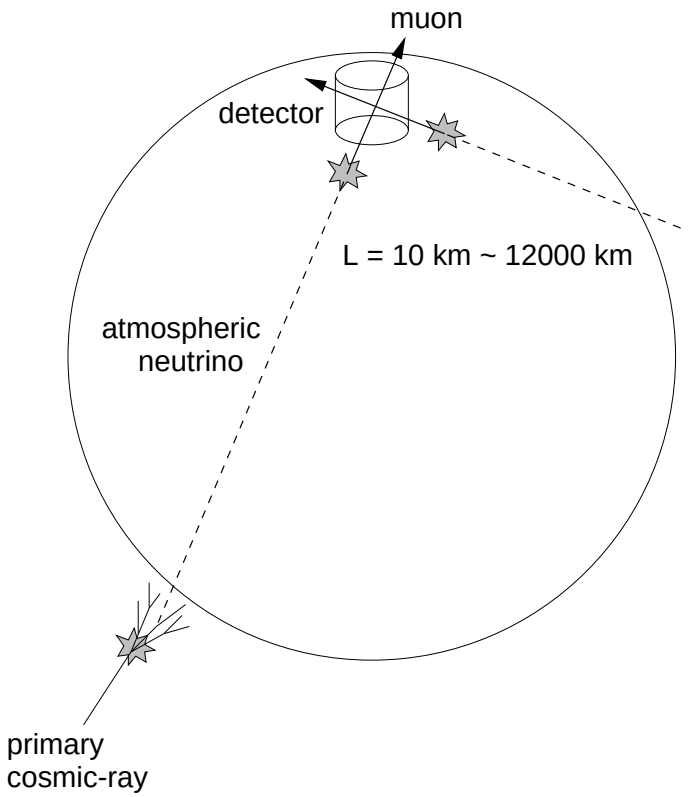


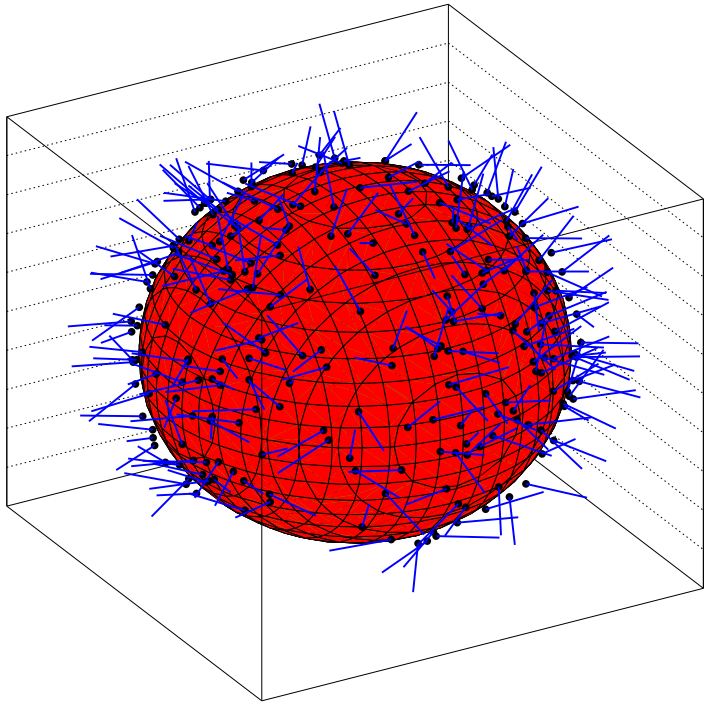


- SNO would be able to cover zenith up to $\cos(\theta) < 0.4$
- Key point is the OWL tubes! 91 tubes over ~ 1000 m^2 $\longrightarrow$ 11 m^2 per tube. No MC!

Nuance to Snoman

- 1st pass: Generate ν-induced upward going muon events with Nuance. Stopped (supposedly) at rock/water interface
- 2nd pass: Events injected into Snoman

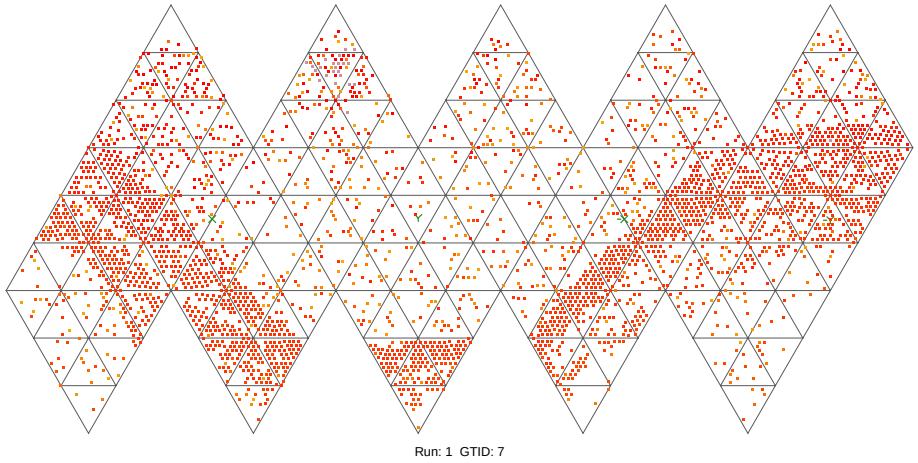


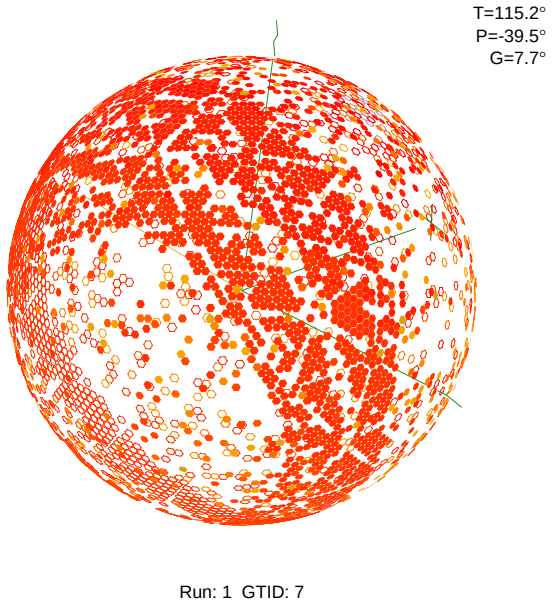


Nuance to Snoman kinIO

Stopped μ in Snoman

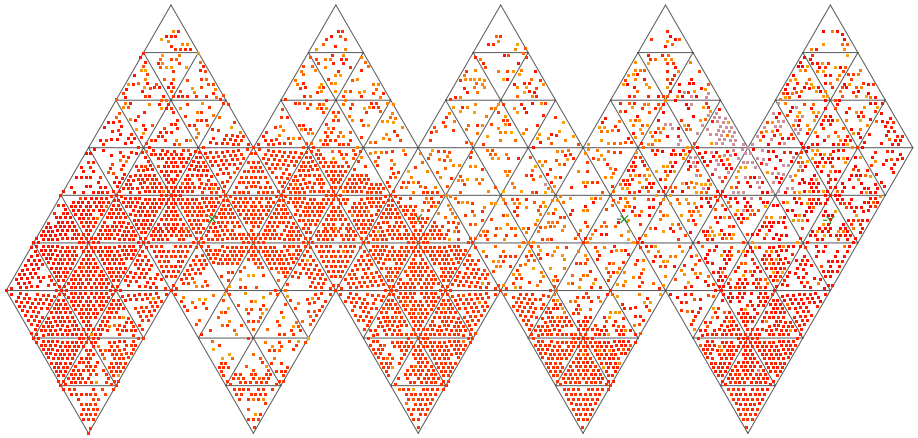
Displayed: 1083 MeV stopping muon, 1507 MeV parent neutrino, covered 563 cm (recognized by the fitter)

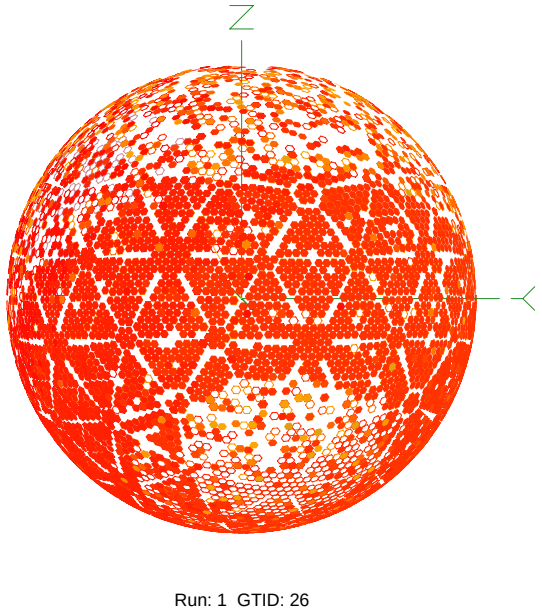




Stopped μ in Snoman

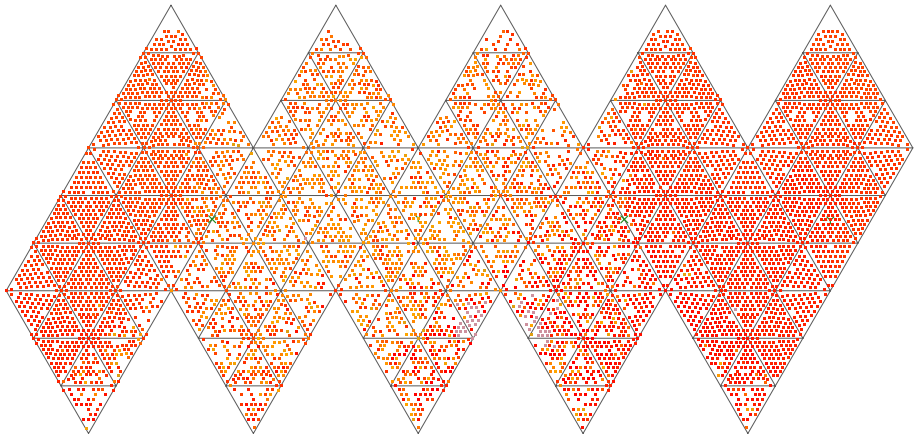
Displayed: 1959 MeV stopping muon, 8332 MeV parent neutrino, covered 1527 cm (recognized by the fitter)

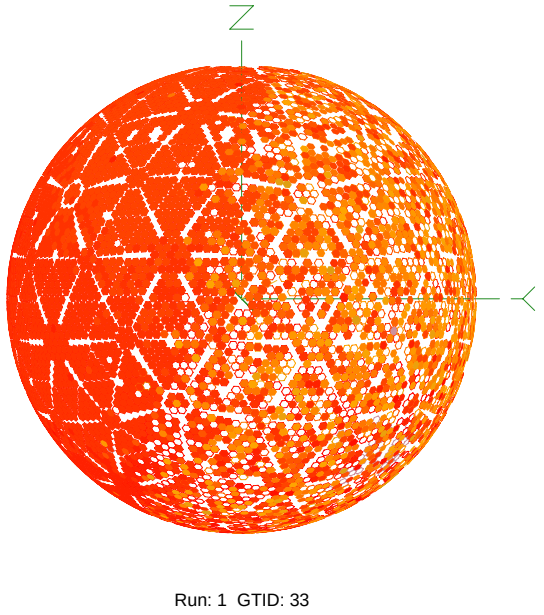




Stopped μ in Snoman

Displayed: 131 GeV thru-going muon, 259 GeV parent neutrino





Progress

- Massive generation being processed on PDSF w/wo oscillation
- First estimate gives $\sim 14\%$ of upwards going muons do stop in the detector, total O(50)*year (Bartol flux). Joe has 1.5 more.
- Joe F. doing sensitivity plots, including normalization/systematics. Thinking of including stop/thru ratio in the fit and assess its benefits

Progress

Snoman output from Nuance neutrino induced muon events. No oscillation.
Green = stop, yellow = thru