
Cosmic Ray Background Test (CRBT)

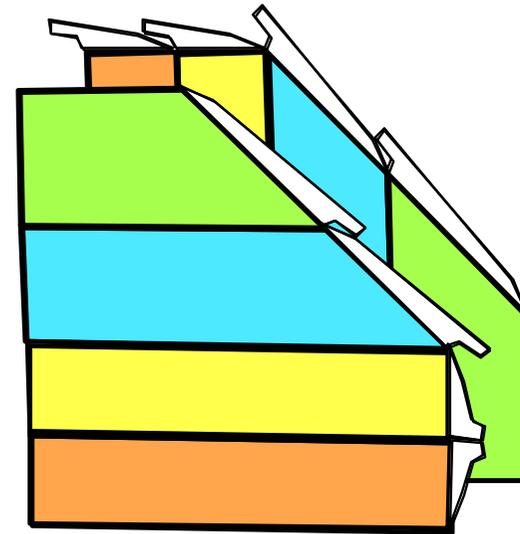
Carl Bromberg
NOvA meeting, October 2-3, 2004

General comments

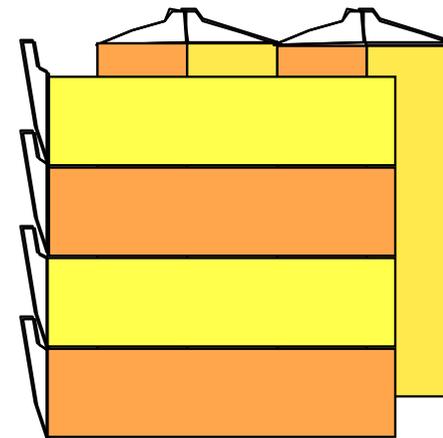
- We have been talking about a CRBT for 2 years.
- We have less than 9 months to make it a reality
- Use as much existing equipment as possible.
 - scintillator, cables, PMTs, electronics, etc., from Minos
 - CalDet "Mux Boxes" to route fibers to PMT (M16)
 - keep it simple
- Muons are (likely) not a problem for NOvA
 - track most (nearly all for T ASD) muons.
 - remainder can't produce 1 GeV showers pointing toward FNAL
 - only neutral hadrons can generate these em showers.
- Muons will limit CRBT sensitivity to hadronic interactions
 - can't "track" muons before entering CRBT
 - veto 97% muons entering top and sides (sample for analysis)
 - veto, tag, or track ~ horizontal muons entering front or back with high efficiency -- rate is ~10 Hz, need ~ 10^6 rejection.

Calorimeter size options

- Minos scintillator cut in 1/2
 - "4" plane proto & Minos "spares"
 - use 16 in calorimeter, rest for mu tagging
 - odd shape, and not really enough to cover with muon tagging
 - may not be enough M16 PMTs
 - problem of 28 ch --> 24 ch. mux box



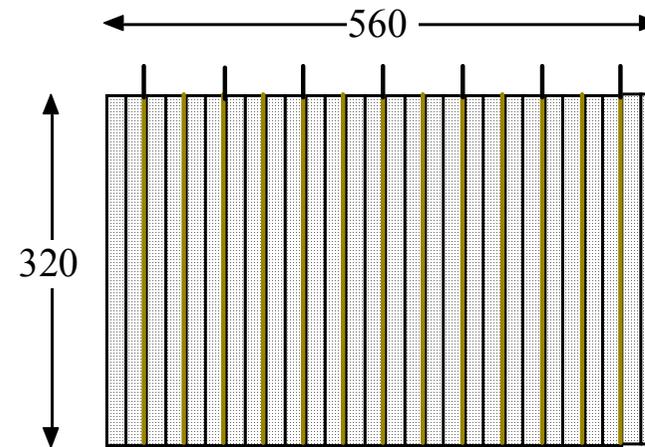
- Use rectangular (20 ch.) modules for calorimeter, 3.2m x 3.2m
 - get 13 planes, 80 ch./plane
- Use wedges (28 ch.) into one 2" PMT for muon tagging



CRBT

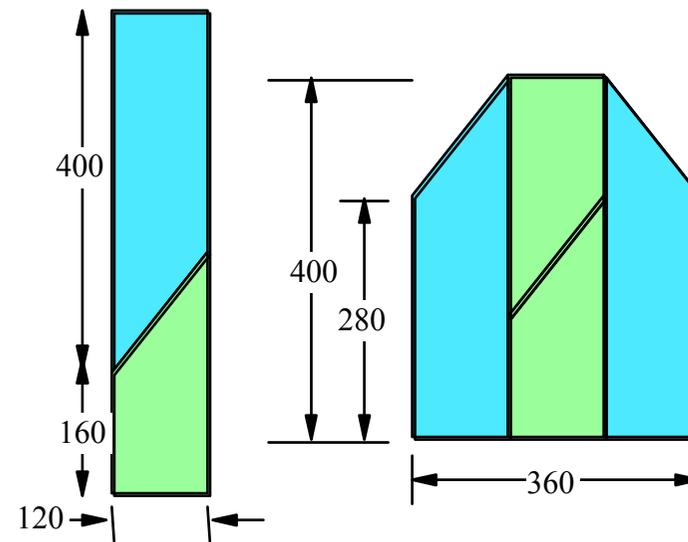
■ Calorimeter

- 13 planes (7x, 6y) , 12 absorbers, 40 cm thick, 20 cm thick end plates
- 52 fiber cables -> 26 CalDet Mux -> 78 M16 PMT
- Mux boxes mounted on absorber between manifolds



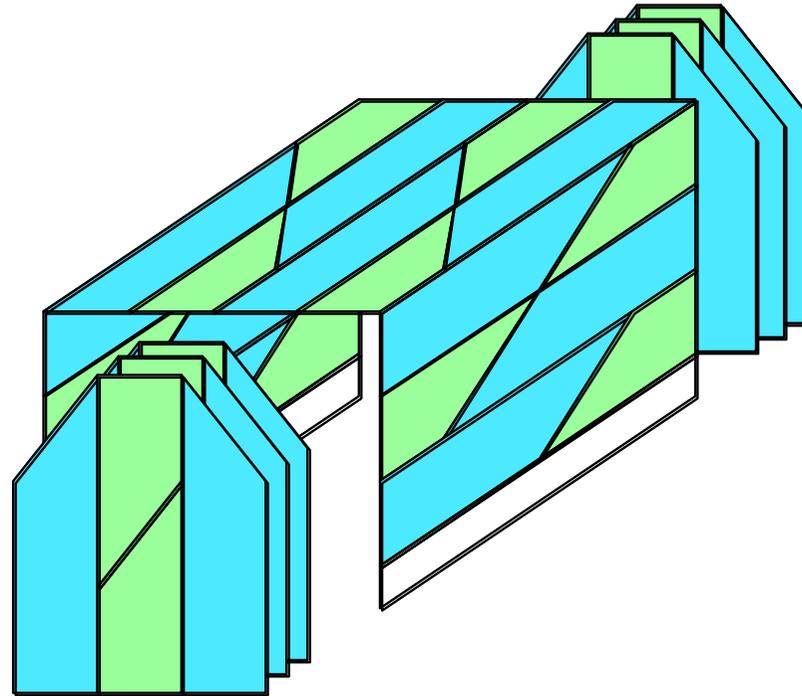
■ Muon Tagging

- bundle 28 fibers from a wedge onto a single PMT
- two wedges make a 560cm x 120cm rectangle.
- four wedges can cover the front or back of calorimeter



Muon tagging

- 26 wedge pairs
- 3 walls each for front and back, use 12 wedge pairs.
- one layer covering top and sides uses 10 wedge pairs
- 4 more wedge pairs to add second layer to top



- Muon tagging house
4.8m x 4.0m x 5.6m
rolls over the calorimeter

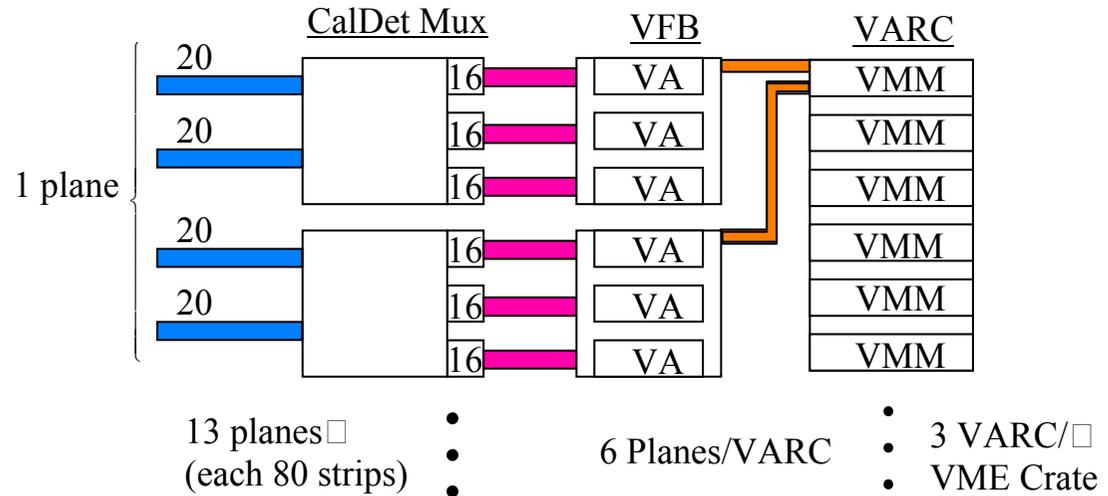
DAQ and analysis scheme

- Online
 - Trigger on events with hits in at least 2 sequential planes
 - Reject most events with top or side muon tagger hit
 - take a prescaled sample to evaluate vertical muons
 - kills real showers with transverse leakage, reduces acceptance
 - Reject most events with hits in front AND back muon taggers
 - Take a prescaled sample to evaluate horizontal muons
 - Cannot reject event with hits only in front OR back muon tagger
 - End of EM shower leaks out and hits muon tagger
 - Could be a stopping muon, to be removed offline
 - Offline
 - Reject events that intersect or project to top, bottom or sides
 - Reject events that look like stopping muons
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Electronics

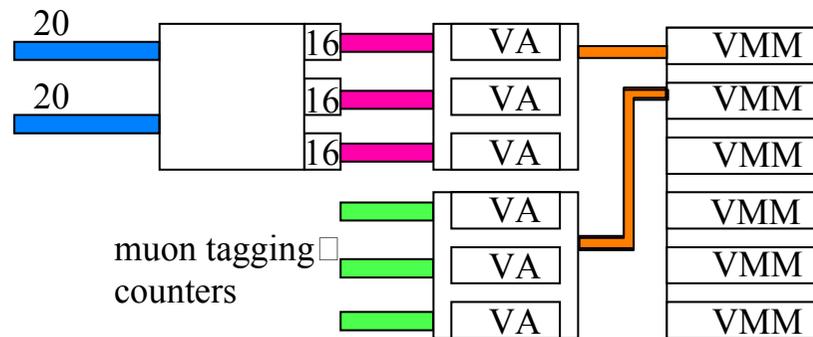
■ Minos Readout

- 13 scintillator planes
- 52 optical cables
- 26 Mux (CalDet)
- 78 PMT (from KL)
- 28 VFB w 80 VA (incl. 2 muon)
- 15 VMM (incl. 2 muon)
- 1 TRC (timing)
- 1 RIO
- 2 PCs



■ Muon Tagging

- 52 2" PMT/Bases
- HV, cables, attenuators



Warnings from Jeff Nelson

- **Electronics**

- Control cables, 6V supply,
- Fan packs, HV, serial control, UPS, Ethernet, racks
- Rack protection system
- RIO VME processors (2-3)
- PVIC's, cables
- crate power supplies (in repair)
- Timing module (in Oxford)
- etc.