FGT simulation: September, now, and December

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Near Detector meeting
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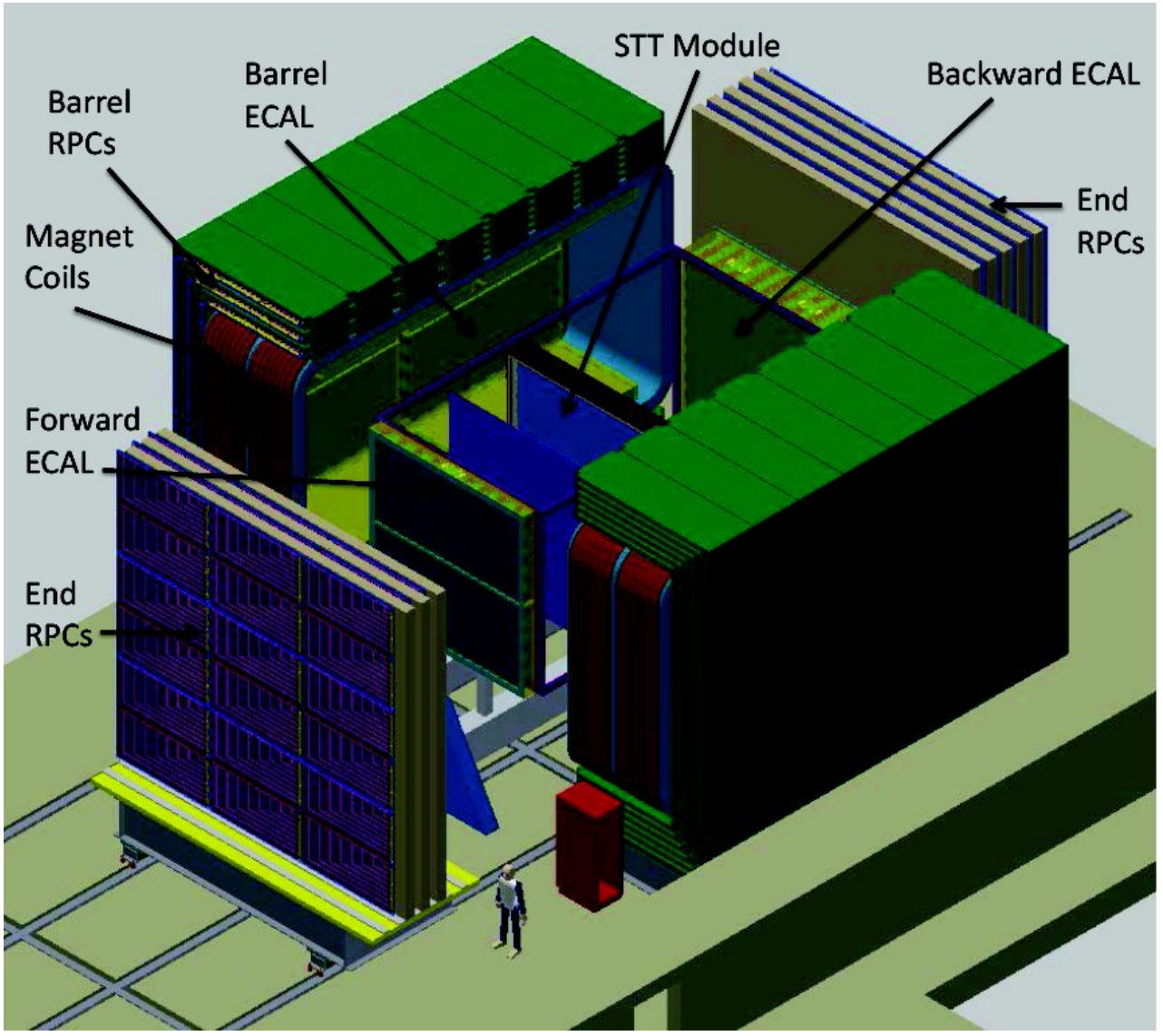
Outline

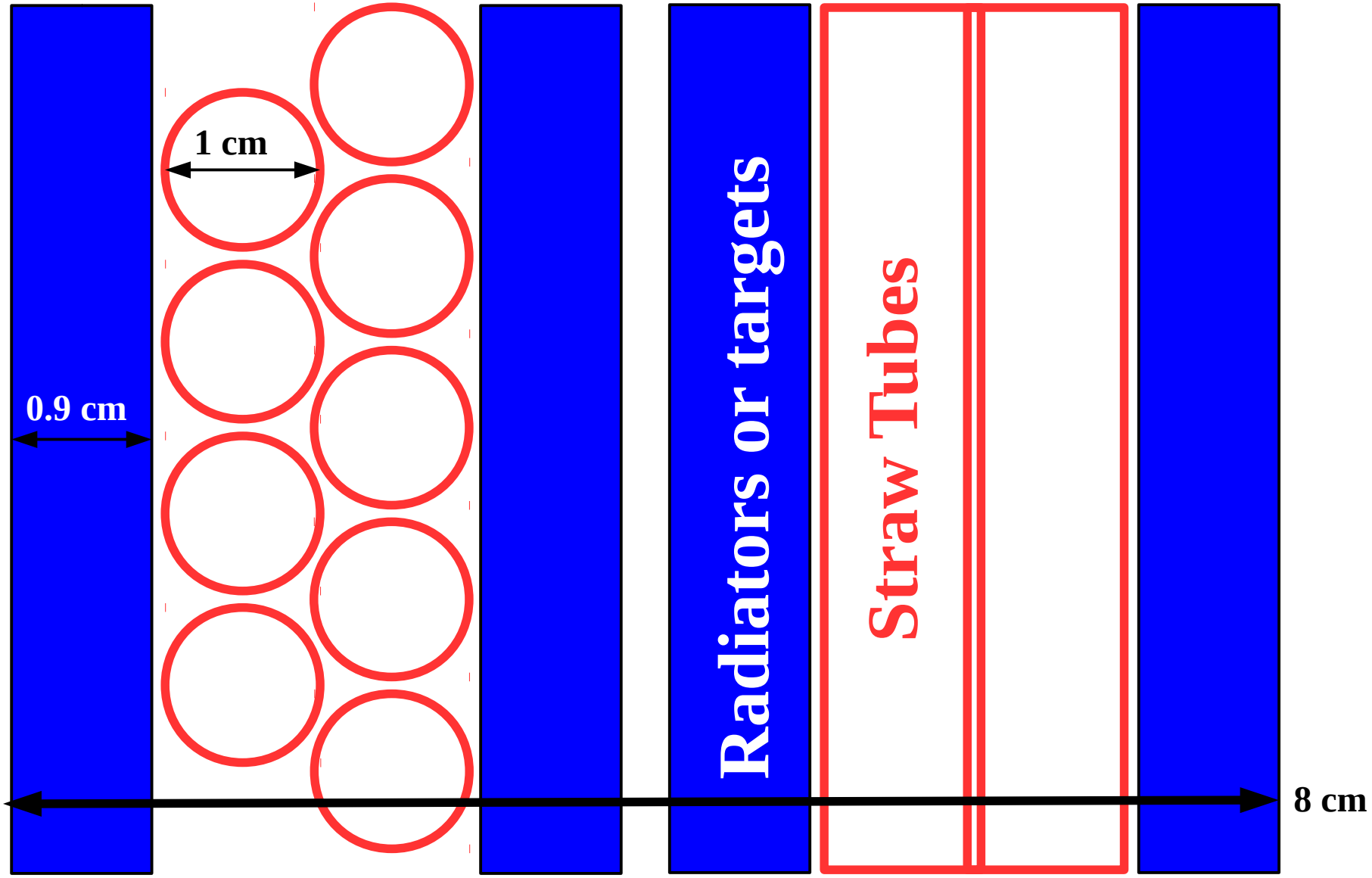
- Reminder of fine grained tracker (FGT)
- “Reconstruction” philosophy
- Status as of September collaboration meeting, now, and prospects for December deadline for pass through IV

Reminder: FGT



- Straw tube tracker (STT), surrounded by 4π ECAL and muon ID
- Special target modules of Ar pressurized to 140 atm

STT module



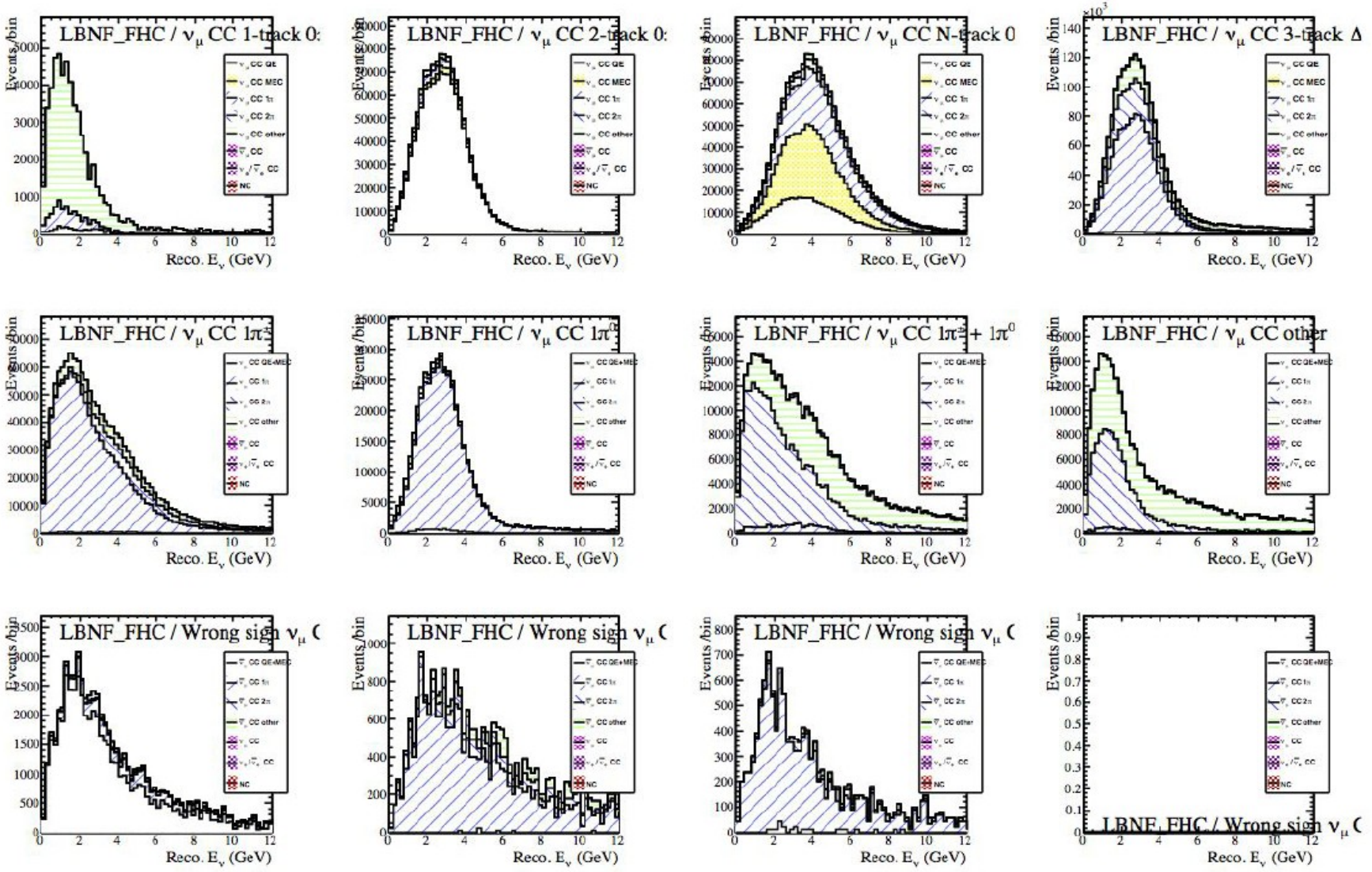
FGT specs

- Position:
  - < 200 μm for hit on track
  - sub-mm vertex resolution for multi-track events
- Timing:
  - few ns in ECAL and muon ID
  - few ns in STT with drift time fit
  - 125 ns maximum drift time
- Energy:
  - 5% resolution for Ee and Eμ
- Mass:
  - 8 tons STT mass, O(1 ton) Ar mass depending on what targets are included

“Reconstruction” philosophy

- Associate Geant4 energy depositions with true particle trajectories
- Smear single-particle momenta, using resolution estimates informed by NOMAD data
- Determine “reconstructed” neutrino energy by summing smeared momenta
- Classify events into the VALOR categories

Example output: from September



Particle ID – September

- Perfect separation between muon/electron/pion/proton
  - Smearing based on particle species, length of track, true momentum
- No confusion of neutrino flavor, perfect CC/NC separation
- Known bugs:
  - “Tracking” threshold way too low, so few MeV protons were getting tracked
  - Nucleon rest masses added to neutrino energy
  - π^0 photons missed when true converted electron showers before hitting 6 planes
  - Problem when muon isn't longest particle trajectory

Particle ID – for December

- In progress: dE/dx based pion/proton ID
- In progress: Electron ID based on transition radiation using tables from NOMAD
- CC events for muID tracks only
- Fixed bugs:
  - Require 3X + 3Y hits, or 2X + 2Y + vertex from other track
  - Nucleon rest masses added to neutrino energy fixed
  - π^0 photons missed when true converted electron showers before hitting 6 planes fixed
  - Problem when muon isn't longest particle trajectory fixed

Vertexing – September

- Perfect vertex resolution
- Used all interactions in STT
  - mostly carbon from straw tube frames
- As far as I know, no uncertainty for C → Ar was used

Vertexing – for December

- Define fiducial volume inside argon target modules
- Assume perfect vertexing for multi-track events only, and use only argon events for fit
- Do something about one-track events
  - Weight down so that sqrt(N) is what you will get after the statistical subtraction?
  - Produce two samples and do subtraction directly within VALOR?

“External” flux constraints

- Events that go into the VALOR fit should be on argon only
- But ν-e, inverse μ decay, low-ν, ν_e/ν_μ ratio could be powerful flux constraints, and could be done on carbon
- How to incorporate this into task force?

Pile-up: September

- Pile-up not simulated
- Max drift time is 125 ns
- ECAL timing resolution is much beter ~ few ns
- Pile-up is ~100x less than for TPCs which see entire 10 μs spill at same time

Pile-up: for December

- Add rock/magnet events to the record for Geant stage
- If time allows, include it in analysis, but PID work is higher priority
- Done: account for multiple hits in tube due to same neutrino interaction for tracking threshold

Summary

- Expect to have improved PID, event classification, and vertexing for next pass through
- Handful of bugs already fixed