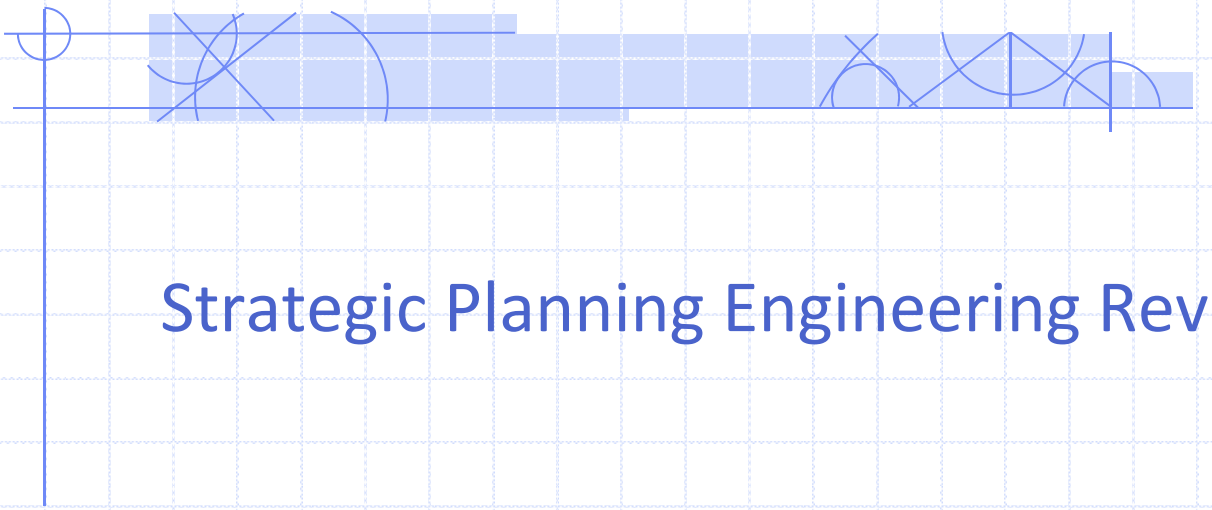
The MicroBooNE Project



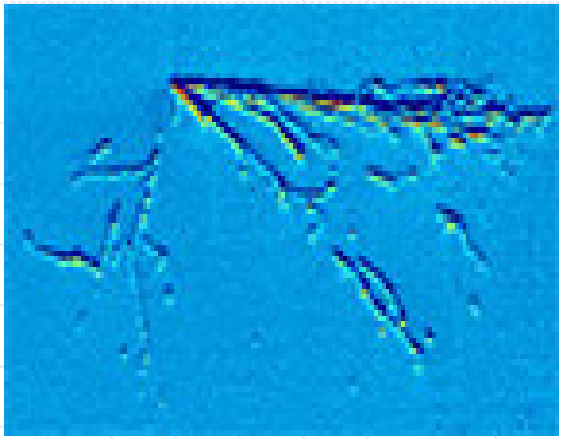
Strategic Planning Engineering Review

Outline

- Technical description of the Experiment & Detector
- Current Status
- FY10 Scope of FNAL work
- FY11 Scope of FNAL work
- Out years

The MicroBooNE Experiment

- A new detector located on the Booster Neutrino Beam
- A liquid argon Time Projection Chamber detector
  - LArTPC – a wire chamber inside a cryostat vessel
  - The liquid argon is both the target and the detection medium
    - Interactions in the argon volume produce ionization particles that drift along electric field lines to wire readout planes
- A detector technology well-suited to neutrino physics
  - Calorimetry information and excellent spatial resolution
  - Argon also produces scintillation light - triggering
- Both physics and detector R&D goals
  - Neutrino cross-sections and MB low-E excess events
  - If the detector can do this, then it can do what LBNE needs
  - In building and operating μB, learn how to scale up in size
    - μB -> proposed LBNE LAr detector is a factor of ~100

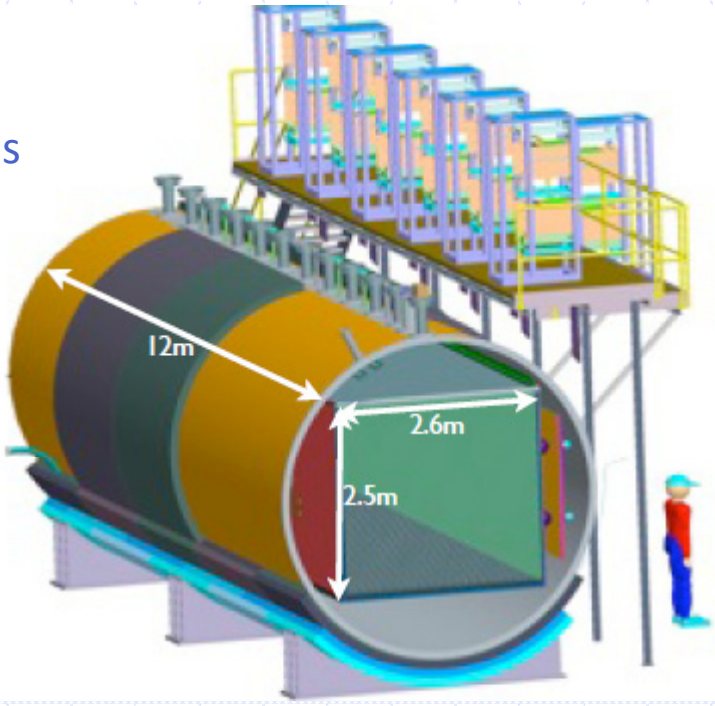


NuMI Beam neutrino interaction in the ArgoNeuT detector - Sep 16, 2009

The MicroBooNE Detector

- Detector Conceptual Design
  - ~12m long, ~3.8m diameter cylindrical cryostat
    - Single-walled, 16” of insulation
  - Rectangular box inside is the TPC
    - One long side is the wire planes.
      - 3 planes, Y,U,V, about 10,000 wires
    - Other sides are the E-field cage
      - Creates the force to drift ions to the wires
  - Electronics is fairly conventional
    - PAs sit inside, at cryo temperatures
    - Digitizing sit outside
    - Data rate can be high – use compression
  - PMTs in cryogen, for triggering
  - Cryogenics plant
    - Need high purity, ppt, ~170-tons of cryogen
    - **Detector doesn’t work without pure argon**

Located in a new Building, next to the MiniBooNE detector enclosure



Current Status

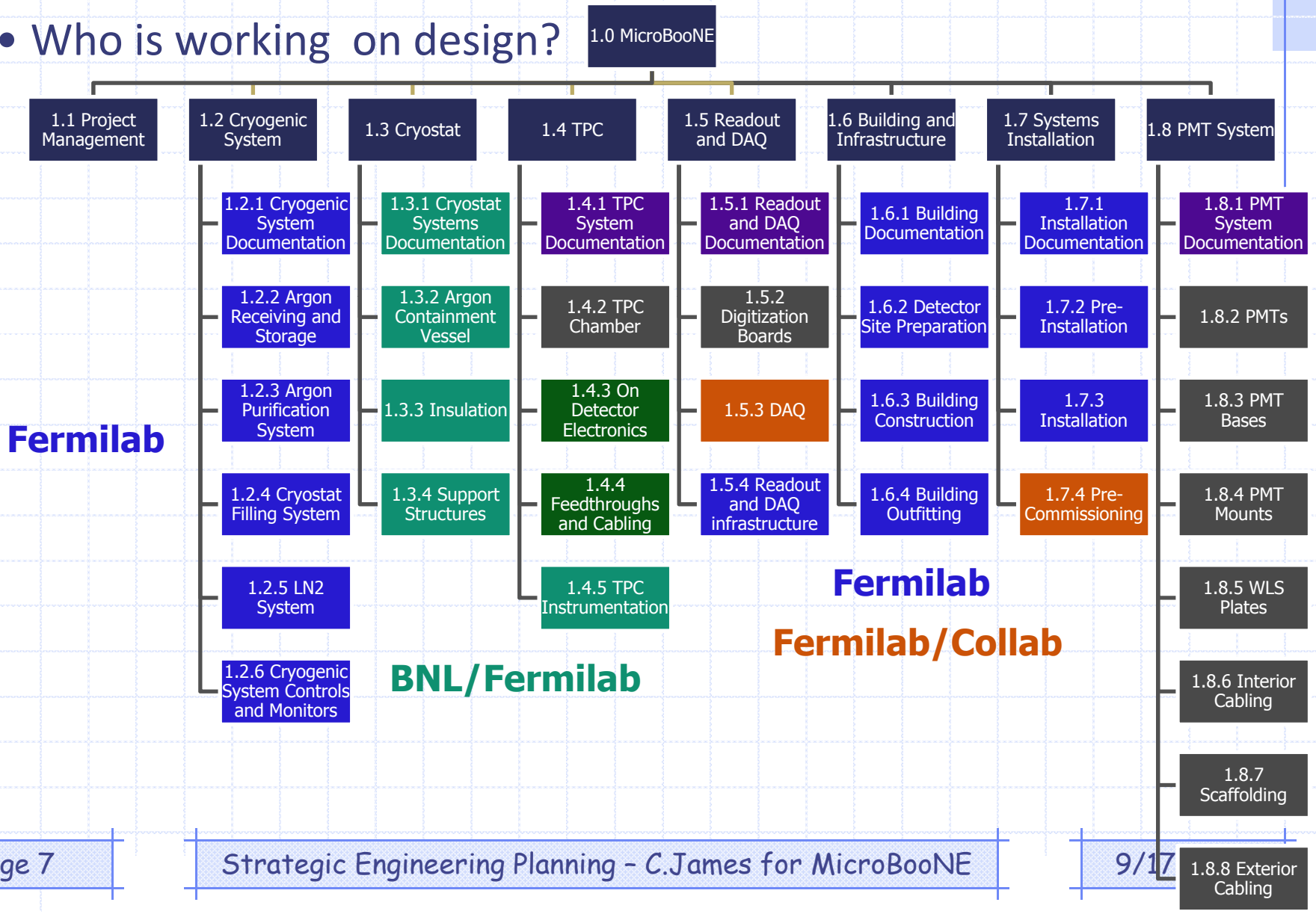
- History
  - Funding ceiling set at $20M. Timescale – Detector operating in 2013
  - Experiment was granted Stage 1 approval in July 2008
  - Project Manager appointed October 2008
- What has been accomplished?
  - Provided DOE with the information they need to form the Mission Need, CD-0
  - Project set-up: OPMO meetings, develop WBS, recruit sub-system managers from the collaboration, teach them what they need to do to meet the CD-1 requirements, prepare the CD-1 level project documents
  - Proceed with conceptual design work, to at least a CD-1-readiness level, as funding levels at collaborating institutions allow
    - Some parts of the detector had designs beyond the conceptual level when the experiment was proposed – TPC and some electronics for example
    - Other parts of the detector started with a less developed design; effort applied at FNAL during FY09 has helped these catch up

Current Status

- What stage is the Project in?
  - Pre-CD0 R&D. CD-1 preparation.
- Dates for CD milestones
  - CD-0 "soon". "The Mission Need is being read by all the right people".
    - Been hearing this since June, however……
  - I have requested a CD-1 Readiness Director's Review be scheduled for early November. DOE CD-1 Review in ? ? January ? ?
- Who is working on the Project?
  - Management – Request was 2.0 FTE, got about 1.25 FTE
  - all part-time, in varying degrees
    - C. James (PM), B. Baller (CDR editor), D. Boehnlein (Project documents preparation), Rich Krull & Ken Domann (schedule), Brian Rebel (Cryogenics manager), John Voirin (Installation manager)

Current Status - WBS

- Who is working on design?



Current Status

- Who is working on the Design (and some R&D)?
  - By WBS Sub-systems -
    - Cryogenics – Stephen Pordes, Brian Rebel, Dave Schmitz, Rich Schmitt, Bob Sanders, Dell Allspach, Jim Catalanello, Victor Majdanski
    - Cryostat – Stephen Pordes, Brian Rebel, Dave Schmitz, Rich Schmitt
    - TPC – small amount of Machine shop time for prototypes
    - Readout and DAQ – Jin-Yuan Wu; inquiries with PPD-EE on support for readout infrastructure (racks, PS, etc); inquiries with CD on DAQ support
    - Building – Dixon Bogert, Russ Alber
    - Installation – John Voirin, Bruce Baller, Stephen Pordes, Rich Schmitt
    - PMT – Sten Hansen (R&D base design); Eileen Hahn (R&D TPB coating setup)
  - Engineering request was 1.3 FTE; got ~0.5 FTE, with the missing part all in cryogenics.
  - Did not use all of the design/drafting request, because the cryogenic engineering effort wasn't there

Current Status

- Are there enough scientists assigned to guide the work?
  - FNAL scientists on MicroBooNE
    - B. Baller, C. James, S. Pordes, B. Rebel (Wilson Fellow), G. Rameika, D. Schmitz (Lederman Fellow), Jin-Yuan Wu
      - Dave Boehnlein helps with project documents development, but is not in the MicroBooNE collaboration
  - None of these are full-time. MicroBooNE Σ = 1.6 FTE
    - B. Baller – ArgoNeuT, LBNE
    - C. James – MINOS, ArgoNeuT
    - S. Pordes – Detector R&D, LAPD
    - B. Rebel – MINOS, NOvA, ArgoNeuT, LAPD
    - G. Rameika – MINOS, ArgoNeuT, LAPD, LBNE
    - D. Schmitz – MiniBooNE, MINERvA
  - Plenty of places to apply more scientific effort – no commitments

FY10 Scope of Work

- Overview
  - Continue preparations for Director's & DOE CD-1 Review
  - Carry designs to ~50% level, sufficient to set the baseline cost and schedule plan
  - CD-2 in FY10 Q2 or Q3, with all the preparation effort that implies, such as a Technical Design Report
  - FY-10 budget is about $2M. About right? Maybe……
    - All effort is in (what used to be called) EDIA – Engineering, Design, ….
    - Rule of thumb – EDIA was about 20% of total cost. Total cost is about $20M, then all EDIA is about $4M. Need to reach 50% design level in FY10, half of the EDIA, which is about $2M.
    - A good fraction of this goes to collaborating institutions……
  - Initial FY10 OHAP was 7.6 FTE; now at 9.26 FTE
  - Added: procurement; Mech and Cryo Engineering, Process Controls, Applications Development, Mechanical Technical Manager, Electronics Engineer to serve as a Project Integration Manager

FY10 Scope of Work

- Detailed List – Cryogenics – 50% design level on :
  - 1.2.1 Cryogenic System Documentation
    - Preliminary ODH analysis, fully developed specifications, TDR
  - 1.2.2 Argon Receiving and Storage
    - Transfer lines; equipment to test argon for levels of contaminants before it goes into the system; large dewar to hold purified argon from cryostat
  - 1.2.3 Argon Purification System
    - Circulation system (pumps), re-liquification, filtering arrays
  - 1.2.4 Cryostat Filling System
    - Gas purge, first warm, then controlled chill; vacuum system
  - 1.2.5 LN2 System
    - Used for argon liquification
  - 1.2.6 Cryogenic System Controls and Monitors
    - Purity monitors; temperature, pressure, level, etc; valve controls; process system controls
- .75 -> 1.0 FTE Cryo Engineer; .25 -> .5 Mechanical Engineer; Design & Drafting. Make up for FY09 missing effort

FY10 Scope of Work

- Detailed List – 50% design level on
  - Cryostat, with Insulation and Support
    - Assisted by BNL engineering
    - FY10 OHAP increase on FNAL Mech Eng, 0.25 FTE -> 0.5 FTE
  - TPC Instrumentation and Readout Infrastructure
    - FNAL portions are rack layout, rack cooling, rack monitoring, power supplies for electronics and TPC, cabling
    - FY10 OHAP, FNAL EE, 1 FTE (no change)
  - DAQ
    - Added Applications Development, 0.3 FTE
  - Installation
    - J. Voirin, Inst Mgr
    - Added Mechanical Technical Manager, 0.25 FTE

FY11 Scope of Work

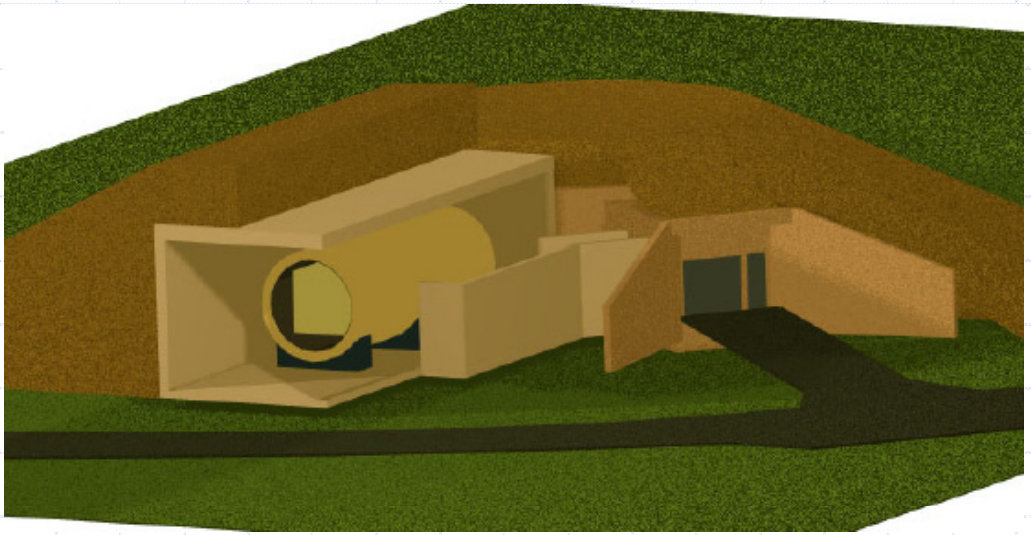
- Overview
  - Complete Designs
  - CD-3 in FY11 Q2, with all the preparation effort that implies
  - FY-11 budget will be (we hope) DOE MIE funds. $6M - $7M ?
  - Come down a bit in overall engineering, up a bit in overall design/drafting. Start technicians for construction phase.
  - Initial FY10 OHAP was 12.5 FTE; now at 14 FTE
  - Added: procurement; a bit more Mech Engineering, Applications Development, Mechanical Technical Manager, Electronics Engineer to serve as a Project Integration Manager, a bit more drafting
- The cryogenics system continues to be the main part of the FNAL effort – design completion and into fabrication & construction

How do things change in the Out Years?

- Not too many out-years out there. Just FY12 mostly. Hope to be running in 2013.
- More collaborators?
  - Just added Kansas State. Online Monitoring?
  - Plenty to do – collaboration needs more people & institutions. Might change the technical manpower needs from FNAL a bit. Could help with scientific oversight of design & construction tasks. But the experiment also needs scientists working on physics software – both simulation and reconstruction. Not part of the Project.

Backup slide(s)

Where



- On surface, next to MiniBooNE enclosure
  - An addition to that enclosure
- On the Booster Neutrino Beam axis (plan view, not elevation)
  - Will also see neutrinos from the NuMI beam