LAr1 Plans at FNAL

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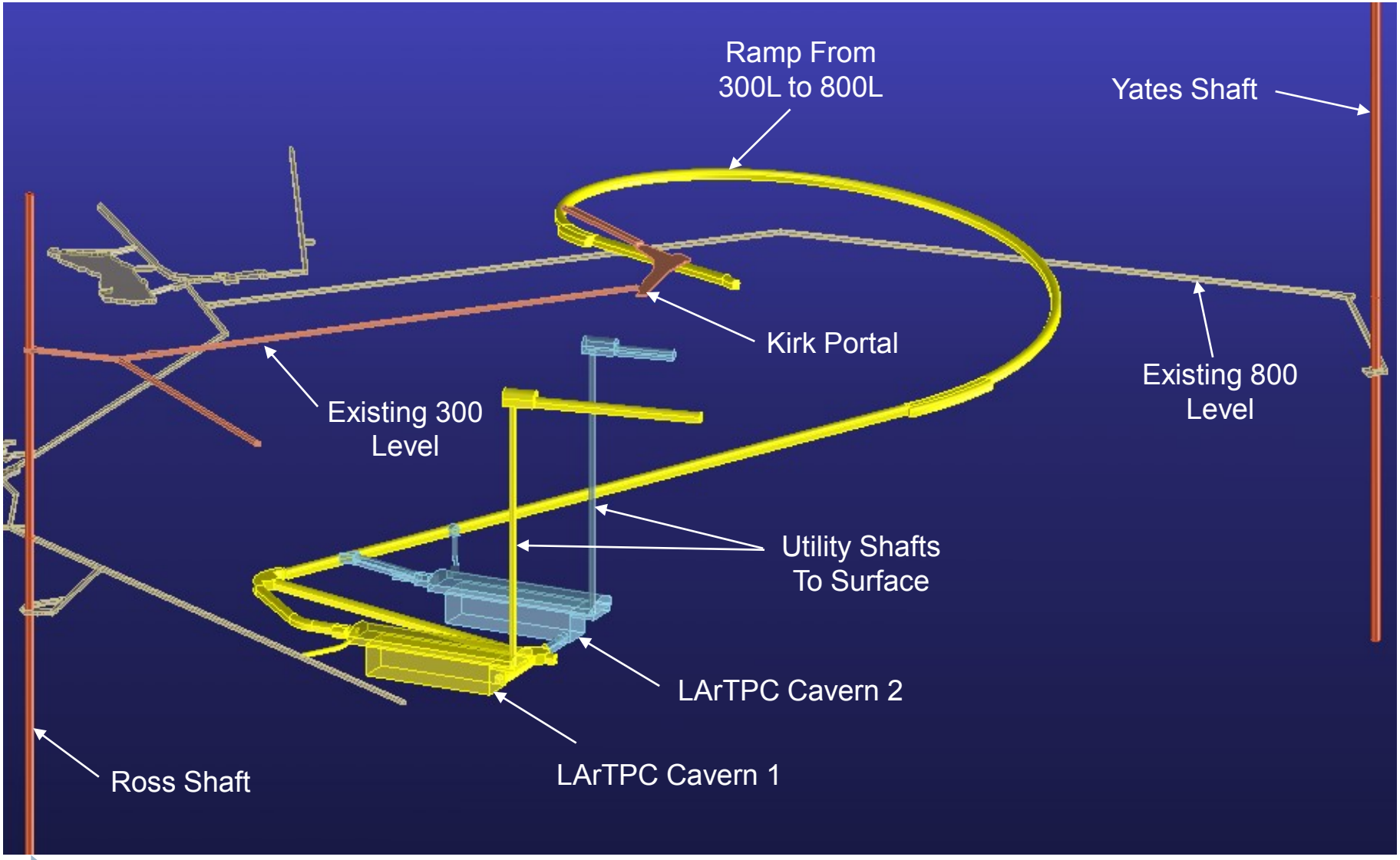
Outline

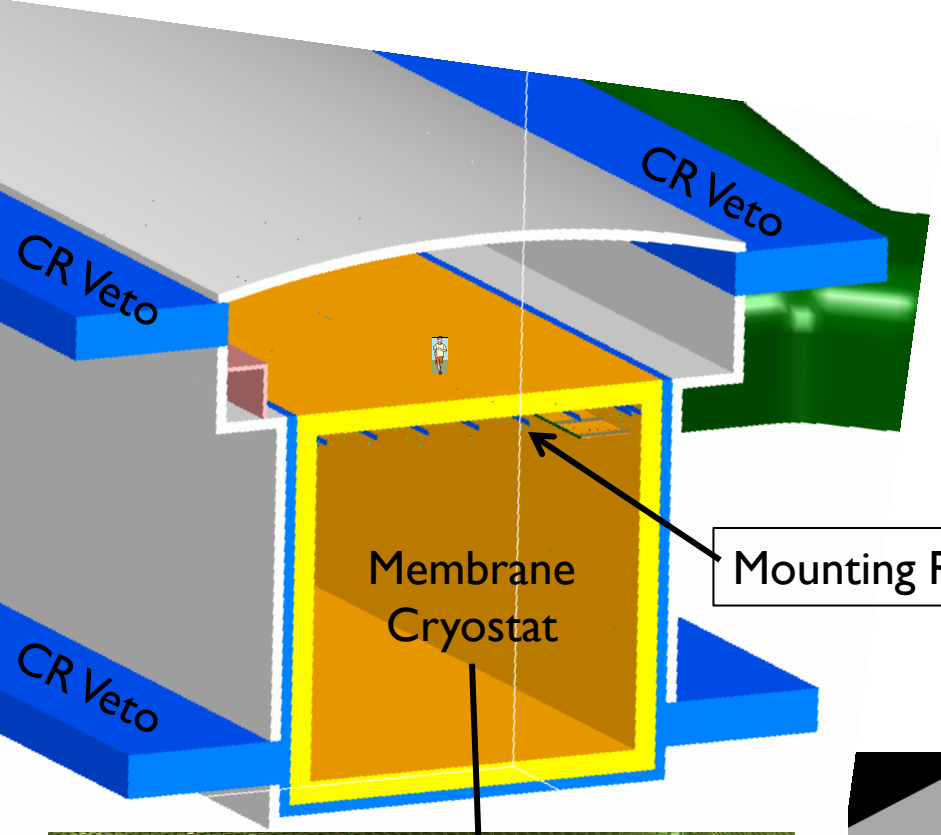
- LBNE LAr detector overview
- Prototyping plan
- 1 kton prototype

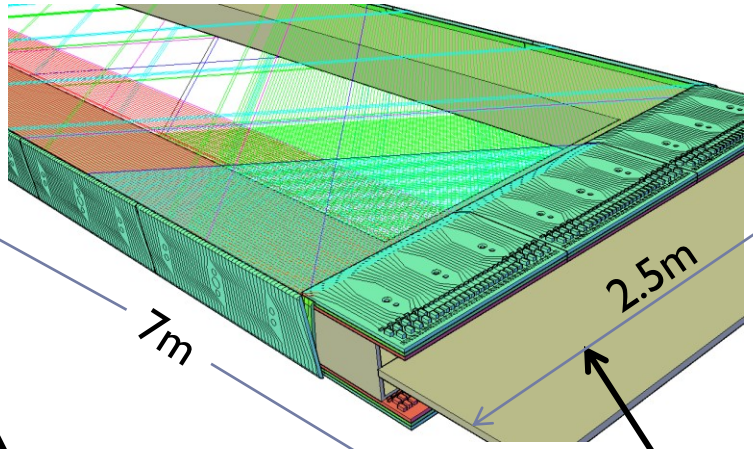
LBNE, LArTPC, 300L – 800L Plan



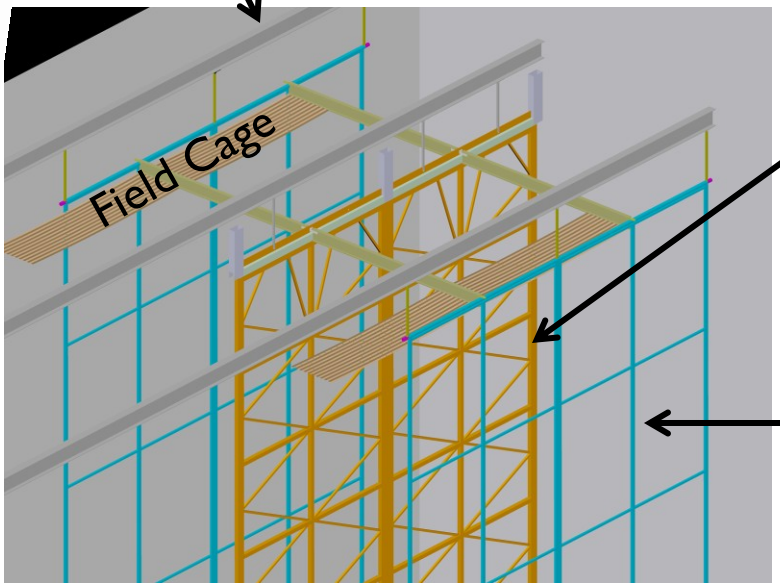
SITE PLAN


Access Ramp
Access Portal
Utility Shaft Access Portal, Cryogenics Building
Cavern
Existing 800 Level
Existing 300 Level
Ross Shaft





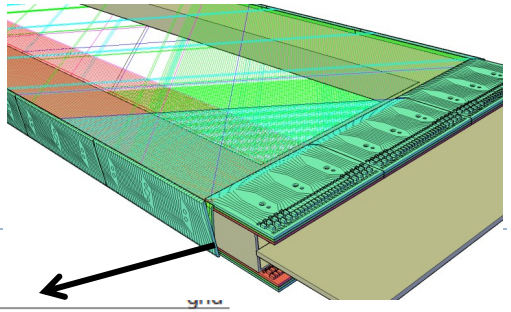
Mounting Rails

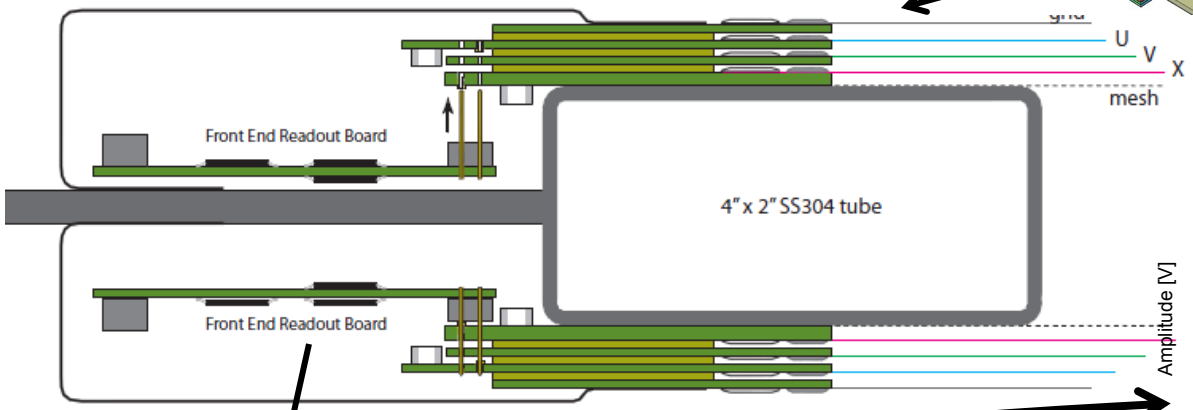


Anode Plane Assembly (168)

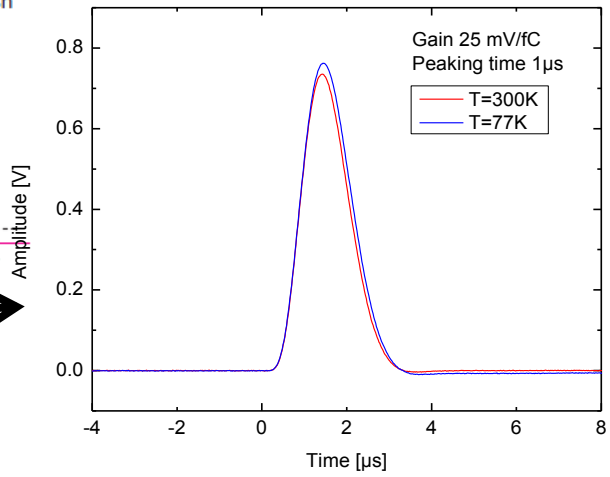
Cathode Plane Assembly (224)

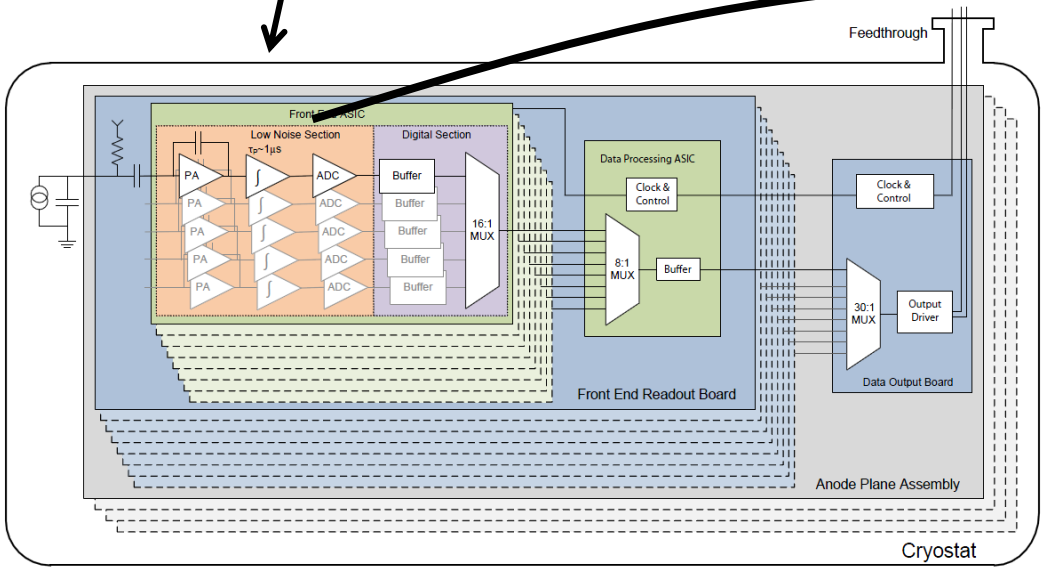
Cold Electronics

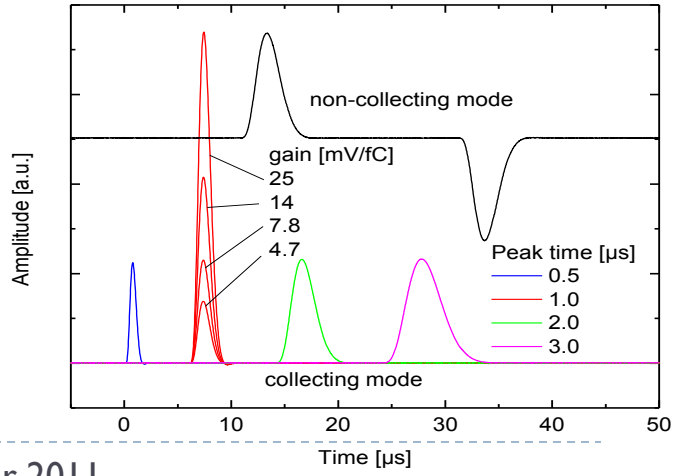




Analog ASIC Tested







Reference Design - Key Parameters

- One detector module
  - 2 high x 3 wide x 26 long = 168 Anode Plane Assemblies (APA)
    - APA → 3840 instrumented wires @ 3mm wire spacing (5mm?)
    - Four wire planes: Grid, Induction 1, Induction 2, Collection
  - 2.5m drift (3.5m?)
  - 16.7 kton fiducial mass, 20 kton active mass, 25 kton total mass
  - Heat load = 31 kW insulation + 12 kW electronics + 6(x4) kW LAr pump ~ 50 kW → 0.5 MW power consumption (cooling!)
  - Light detection system? - A "desirement"
- Two detector modules in one cavern – 34 kton
  - Cavern 184m x 24m x 25m

Issues & Prototyping Plan

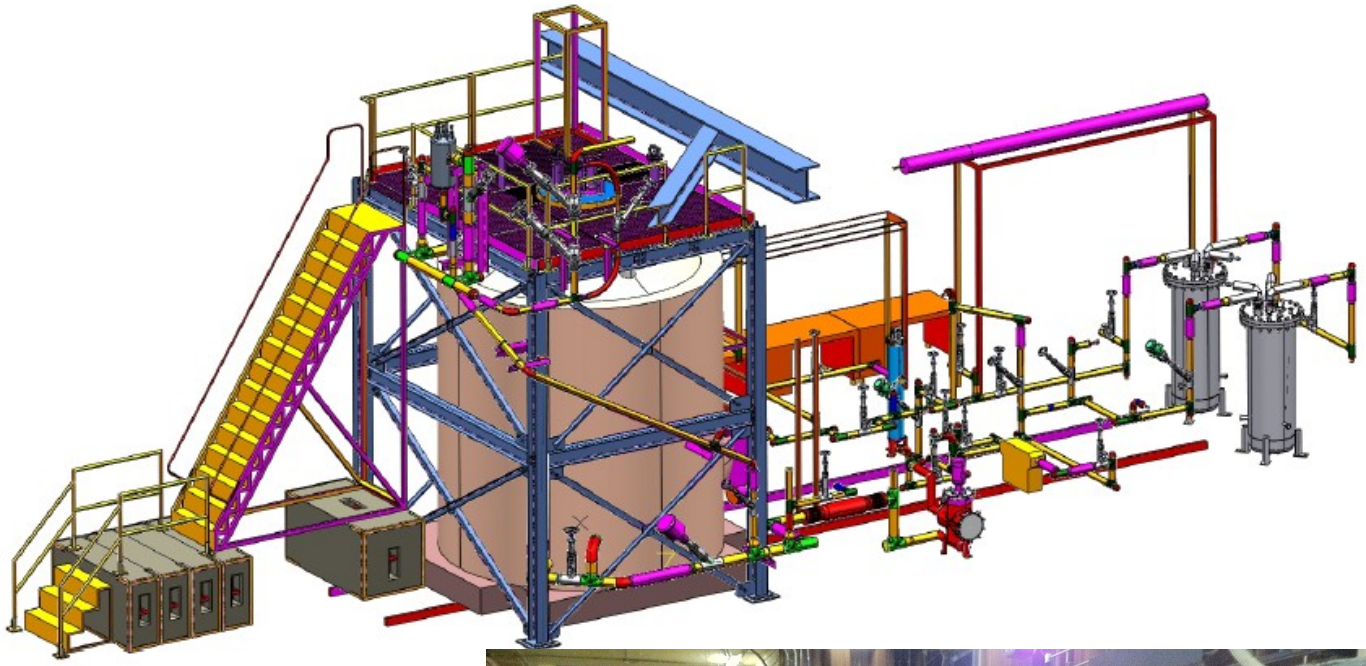
- Achieving argon purity without vacuum pumping
  - Liquid Argon Purity Demonstrator (LAPD)
- Achieving argon purity in a membrane cryostat
  - 3m x 3m wall panel
    - Leak testing
  - LAPD → 35 ton prototype (purity monitors)
- Engineering and integration prototype
  - 3 – 4 full scale APAs, 6 – 8 CPAs, field cage, full readout chain
  - "1 kton prototype" ≠ SBL LAr1 (Project Manager opinion)
- Electronics reliability
  - 20 year lifetime design rules for150 μm CMOS process, stress test

3m x 3m Membrane Cryostat Wall Panel

- Compare He sniffing and ammonia calorimetric leak checking
- Max δp across membrane if we need to vac pump
- Under construction at Fermilab
- GTT visit next week

Panel built at Samsung (Korea)

LAPD



- 10’ dia x 10’ high SS tank
- 2x20cm, 2x50cm purity monitors, RTD’s
- Test in summer 2011

35 Ton Prototype

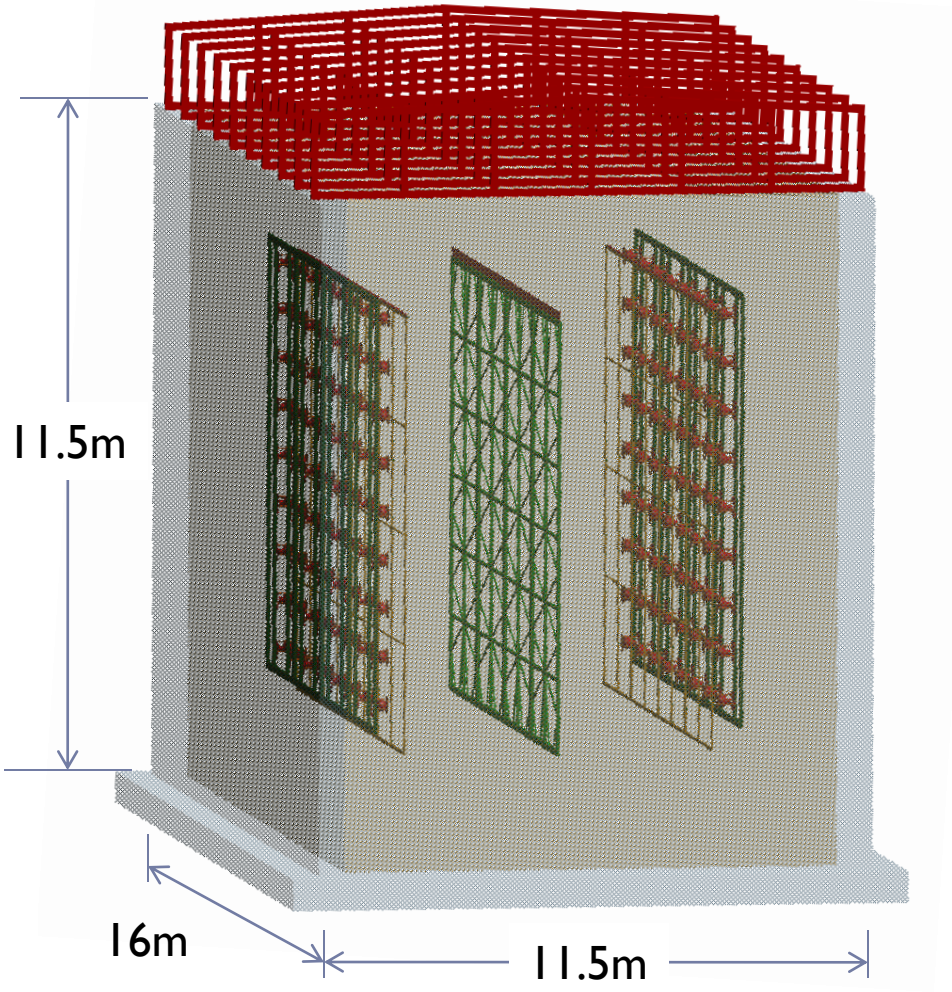
- 3m x 3m x 3m membrane cryostat
- Use LAPD cryogenics system and instrumentation
- Side benefit: prototype cryostat procurement
  - Engineering – Arup
  - Procurement & Construction – Fermilab or construction management firm

"1 kton Prototype" Example

- 1.2 kton LAr total
- 730 ton active
- 3.8m drift
- 6 kW cooling req'd

<u>Attractive site</u>

- DZero Ass'y Hall pit
- Use DZero calorimeter cryo system, ODH system



DAB Pit

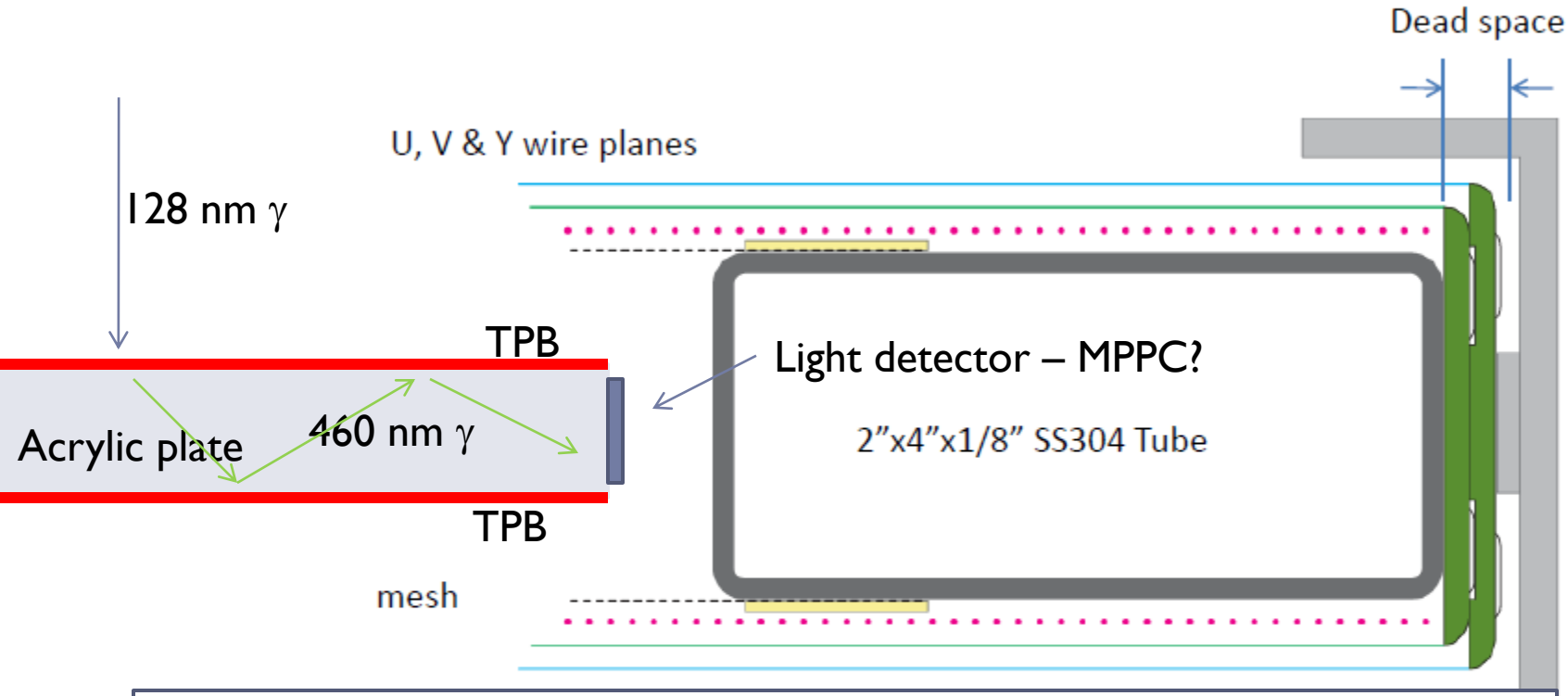
14m x 21m floor

18m depth

Prototype or Physics Experiment?
My Understanding

- "Physics experiment rules"
  - Fermilab: Experiment proposal approved by the director after consideration by the Physics Advisory Committee
    - Time…
  - DOE: Detector constructed using capital equipment funds if the cost exceeds $5M → project management structure (CD-0, etc)
    - Time & money…
- "Prototype rules"
  - DOE: Constructed using R&D funds
    - Under the aegis of the parent project
- A Utopian vision
  - Fermilab constructs a LAr TPC test facility that just happens to be located in a neutrino beam

Backup Slide – Light Collection



Doc 3303, "Demonstration of a Lightguide Detector for Liquid Argon TPC's", arXiv 1101.3013

Key result: Observe 7 – 8 pe from 5.3 MeV α in LAr using a cryogenic PMT. (Expected 10 pe). 50 cm < attenuation length < 200 cm

Backup Slide – Veto Drifts