

DUNE-PRISM Workshop Preparation

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ND Decision Roadmap

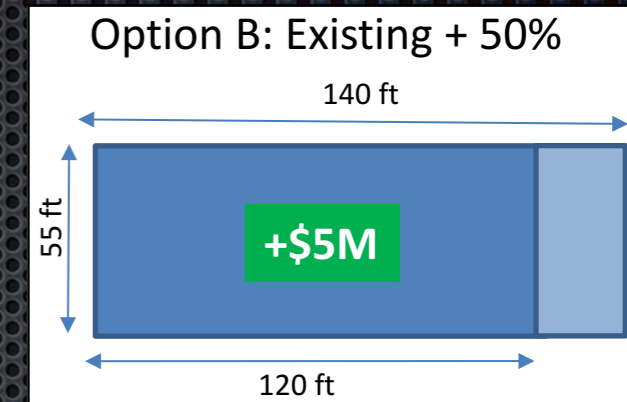
4) PRISM Concept

- At this point in time, the scientific benefits of a movable detector (PRISM concept) have not been quantified. The Near Detector Concept Study is asked to **demonstrate the document the benefits**
 - **November workshop:** The ND Concept study is asked to define and document a program of studies to demonstrate quantitatively the physics case for the PRISM concept. In addition, the ND Concept study should **agree the layout and footprint of the PRISM concept for further study.**
 - **December:** the Co-Spokespersons will work with LBNF to understand the cost implications.
 - **January:** the ND Concept Study leaders will draft a short report describing the proposed layout and results from any initial studies.
 - **January workshop:** the ND Concept Study is asked to make a **recommendation on whether to continue to pursue the PRISM concept.** This recommendation should take account of the physics case and the cost implications for the Near Site facilities. The recommendation will be considered by the EC.
- The following steps are contingent on a positive recommendation:
 - **March 2018:** draft a **report giving quantitative results** elucidating the benefits of PRISM concept, assuming the previously agreed layout.
 - **March workshop:** the ND Concept Study is asked to **make a recommendation on the PRISM concept, based on the scientific merits as documented in the report.** The report, including any recommendations, will be delivered to the EC.
 - **April 2018:** the EC will consider the recommendations of ND Concept Study.

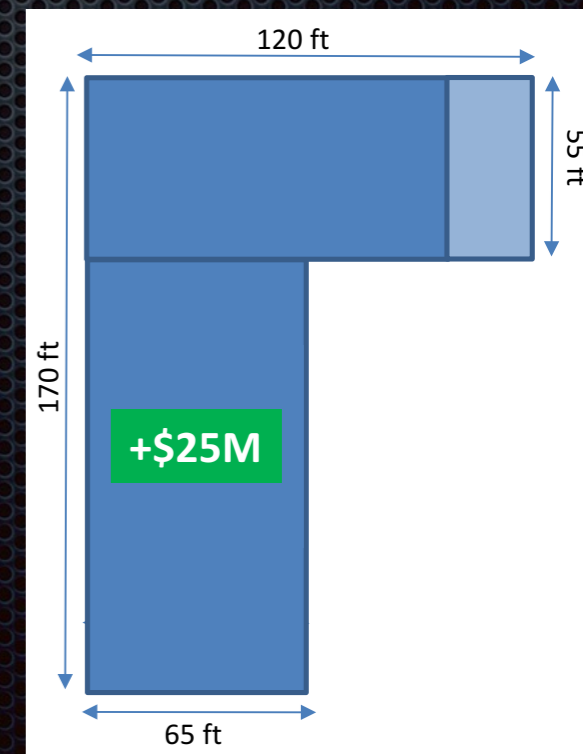
- At this workshop, we must determine ND hall requirements for DUNE-PRISM for engineering cost estimations

Basic ND Hall Parameters

- Currently planned ND consists of a LAr cryostat with an “integrated” magnet / low density tracker
 - Cryostat is currently 7 m long in the beam direction
 - KLOE magnet option has a 5.7 m diameter along the beam direction
 - (Length of dipole magnet option is currently unspecified; is 6 m enough?)
- This implies a ~13 m long apparatus along the beam direction
 - Additional muon range detectors, etc. may also need to be added
- The currently planned hall (option B) is 140/120 ft x 55 ft (= 42.7/36.6 m x 16.8 m)
 - 5 ft of the 55 ft dimension is reserved for an access hallway (safety)
 - This leaves 15.2 m in the beam direction for the detector, if the entire detector is made moveable
 - Wider halls have been discussed, but the exact width of the hall will depend on the quality of the rock (geological survey required)
 - The width is limited to ~the height of good-quality bedrock above the ceiling of the cavern without requiring enhanced reinforcement (which increases cost)

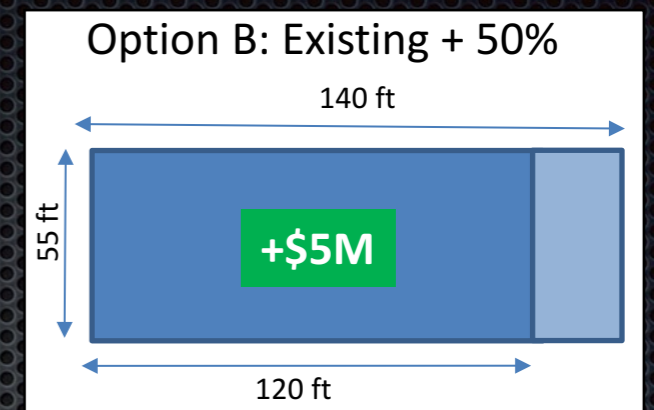


beam ↑

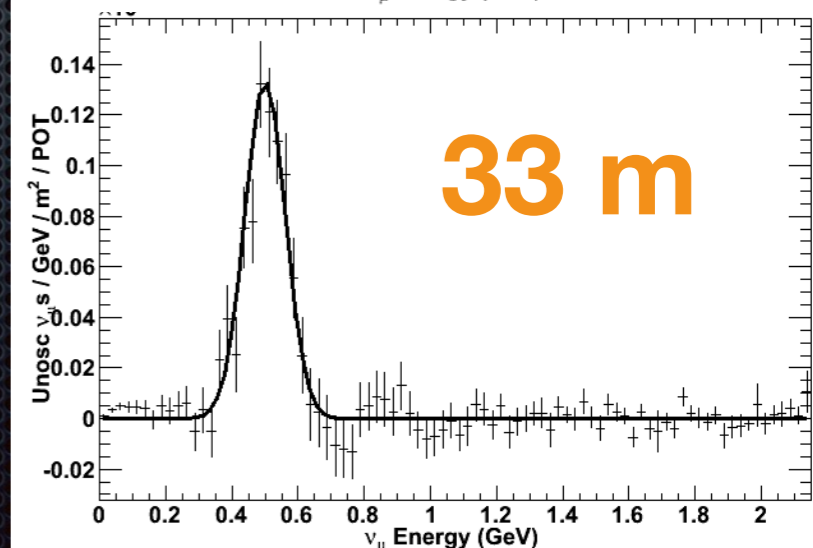
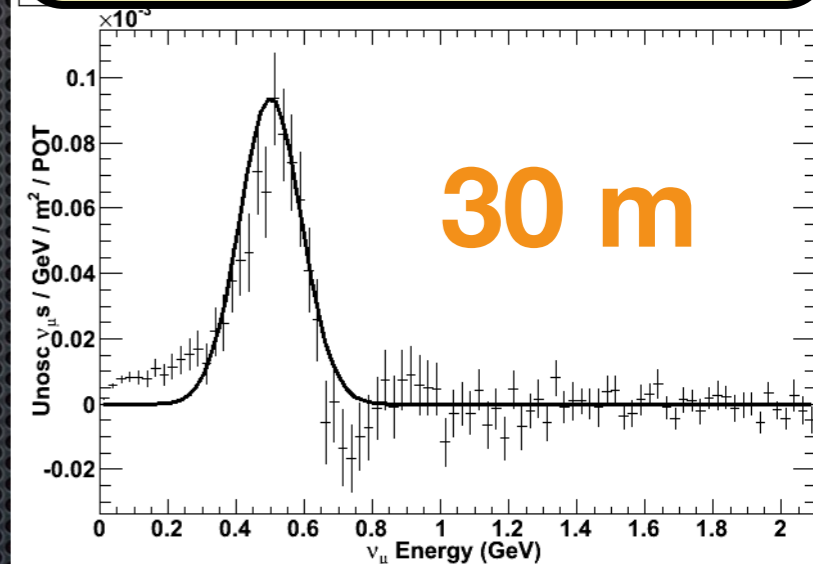


Hall Length

- An off-axis spanning detector is able to constrain neutrino interactions down to 500 MeV (i.e. below the 2nd oscillation maximum) with a range of around 30 m
- In principle, the hall cost is proportional to the hall length
 - Significant extra reinforcement is not needed to make the hall longer, since the width (i.e. the cost-limiting dimension) remains fixed
- There is likely not much motivation, even for DUNE-PRISM, to extend the hall beyond the currently planned 42.7/36.6 m

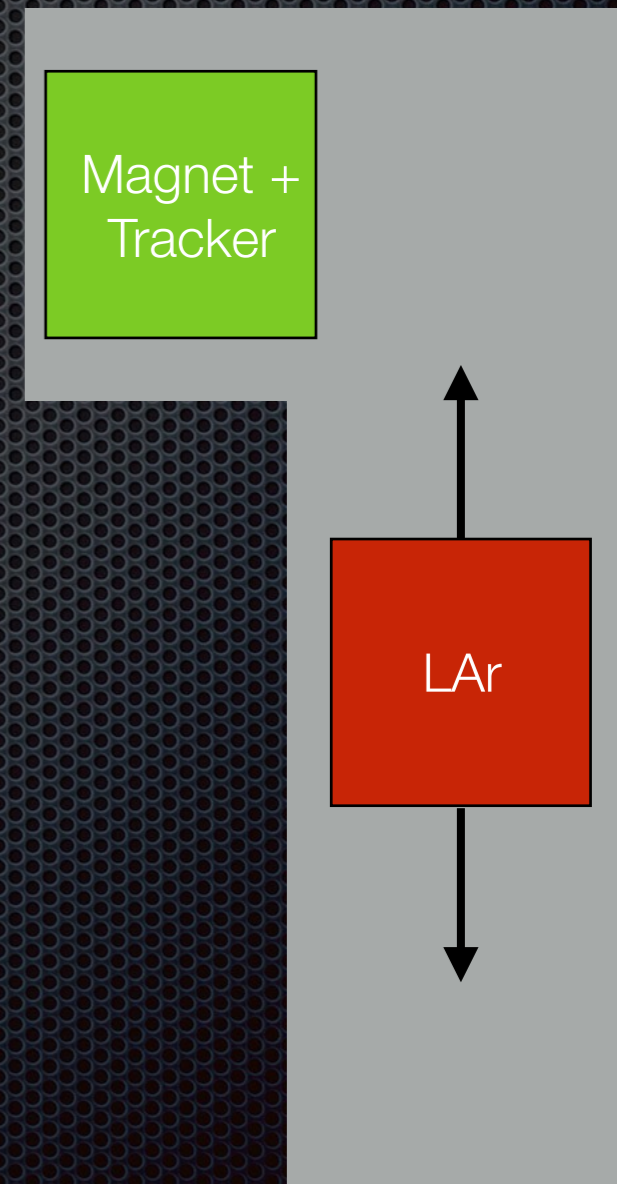


DUNE-PRISM 0.5 GeV



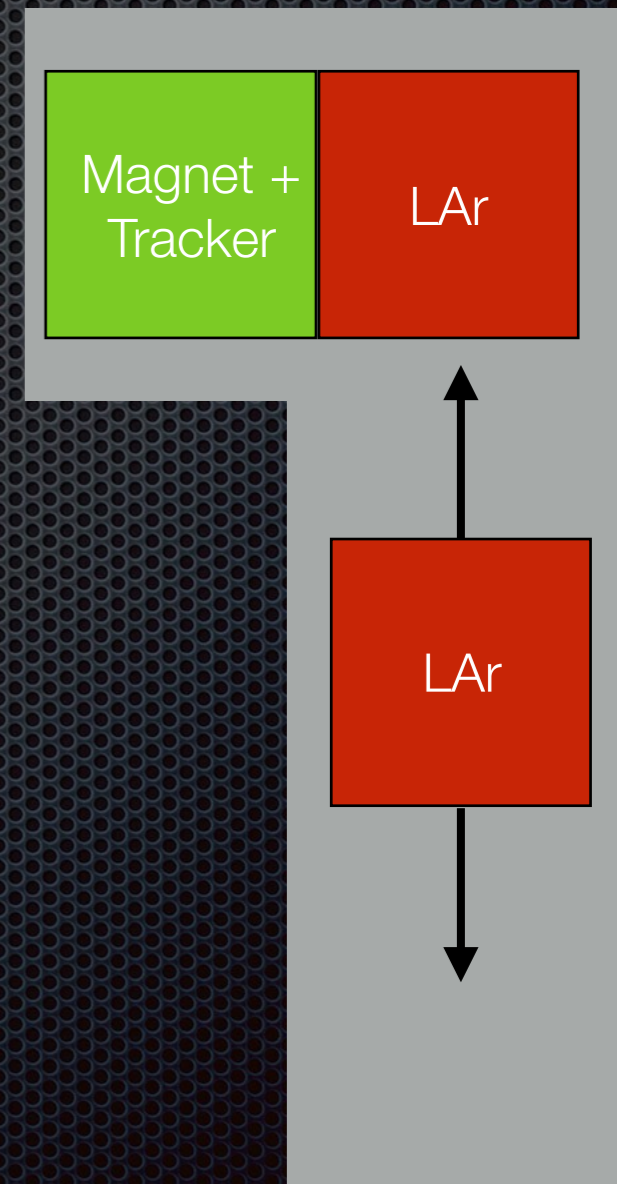
“Integrated” LAr + Tracker

- ✦ The ND group is currently pursuing an integrated LAr + tracker system
 - ✦ However, given the cryostat wall, magnet yoke, and possibly pressure vessel between the 2 detectors, it may be difficult to achieve integration in an effective manner
 - ✦ If so, it may be necessary to integrate (magnetized) muon range detectors directly with the LAr
- ✦ In such a case, the LAr could be decoupled from the downstream tracker, and only the LAr component would need to move to make effective DUNE-PRISM measurements
 - ✦ In this scenario, the width of the hall could be made even smaller (<10 m?) than the current design



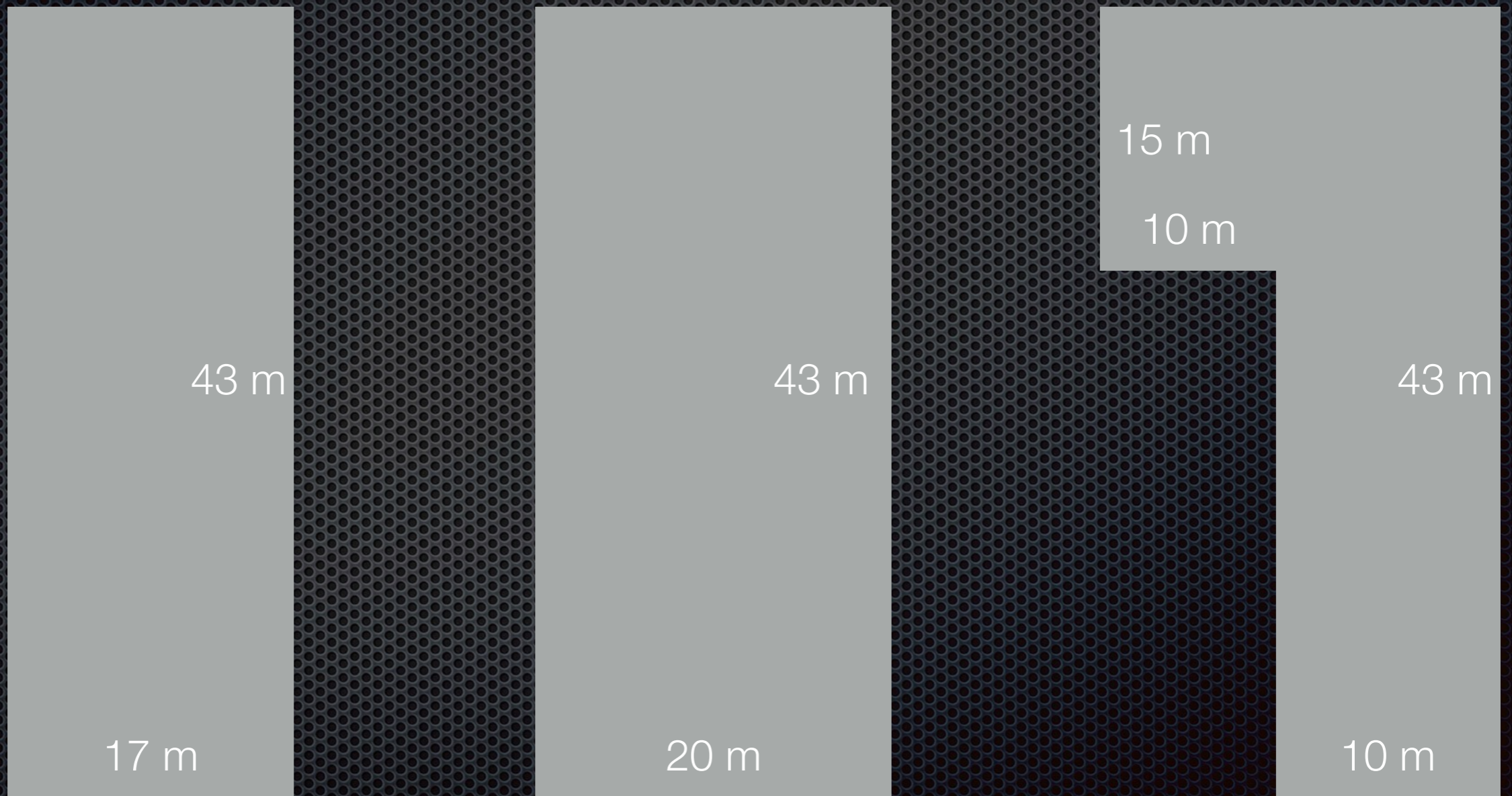
2 Detector Solution

- If integration is still desired, it may be possible to construct a separate LAr detector with an integrated muon range detector that moves
 - Need to understand the relative benefits of a (magnetized) muon range detector, integrated into the LAr, to a downstream tracker with significant material between the detectors
- This allows for a simultaneous traditional + DUNE-PRISM measurements (with added ND fiducial volume)



Proposal

- Produce cost estimates for 3 hall sizes:



Supplement

Ceiling Height

- Current height of LAr fiducial volume is limited by hall ceiling height
 - Need to place ArgonCubes into the top of the cryostat
 - floor 546, crane 586, springline 593, crown over 600
- If the LAr is on a moveable platform, it may be possible to load ArgonCubes into the cryostat within the access shaft
 - ~22 ft diameter currently planned, although ~half is needed for elevator
- As ceiling height shrinks, hall width can be expanded
 - Combined optimization is needed