DUNE Phase 2 Integration

Mike Wilking
Theia LBL Meeting
April 28th, 2023

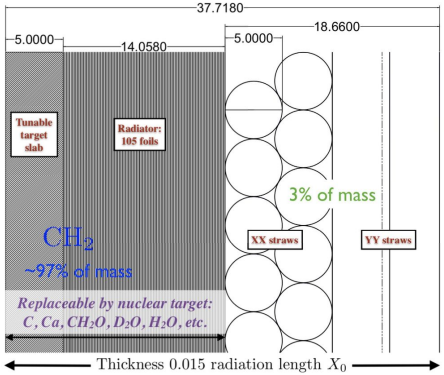
DUNE Phase 2 Working Group

- Led by Michel Sorel (Valencia) and Stefan Soldner-Rembold (Manchester)
- Meets alternating Mondays at 9 am EDT / 6 am PDT
- Meetings usually involve a few talks about various upgrade ideas
  - The meeting is limited to 1 hour, so only ~1-3 topics per meeting
    - Thus far, we have mostly heard high-level repeats of the topics discussed in Valencia
  - We should consider what types of Theia talks would be useful for this group
    - This is a topic for the entire Theia group, but we also need to consider LBL-specific topics
      - Especially near detector concepts (more on this in later slides)
- Next major task is a document on ND and FD for DUNE Phase 2
  - An outline can be found here: https://indico.fnal.gov/event/59549/
  - Includes “baseline” detector options and perhaps some “potential upgrades”
  - They are asking for volunteers to participate in writing (some of us should volunteer)
- Key upcoming meetings:
  - DUNE Phase 2 ND Workshop at Imperial College June 20-22
  - DUNE collaboration meeting at Fermilab May 22-26

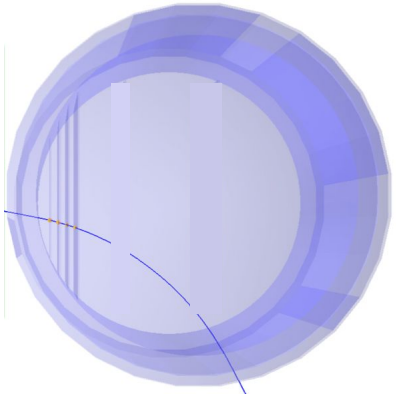
Near Detector Concepts

- At a previous LBL meeting, we discussed some initial Theia ND concepts
- SAND already exists, so adding targets for studying WbLS nuclei is possible
  - No off-axis measurements
- ND-GAr is a primary target for a DUNE Phase-2 ND
  - Adding WbLS targets may be possible (next slides)
- If detector “garages” can be carved into the ND hall, a dedicated Theia ND can be considered
  - TMS can then be retained instead of scrapped when ND-GAr is installed

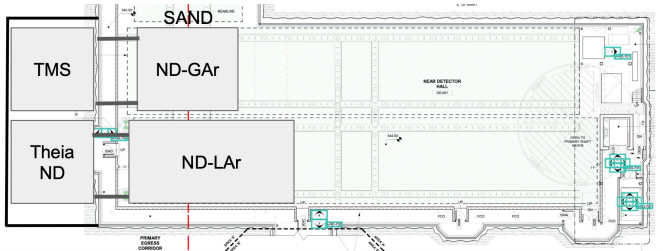
Additional nuclear targets in SAND



WbLS targets in ND-GAr



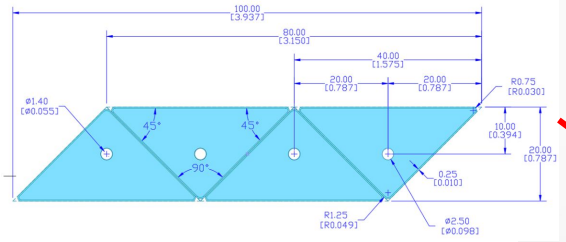
Slightly expand the ND hall for a dedicated Theia ND

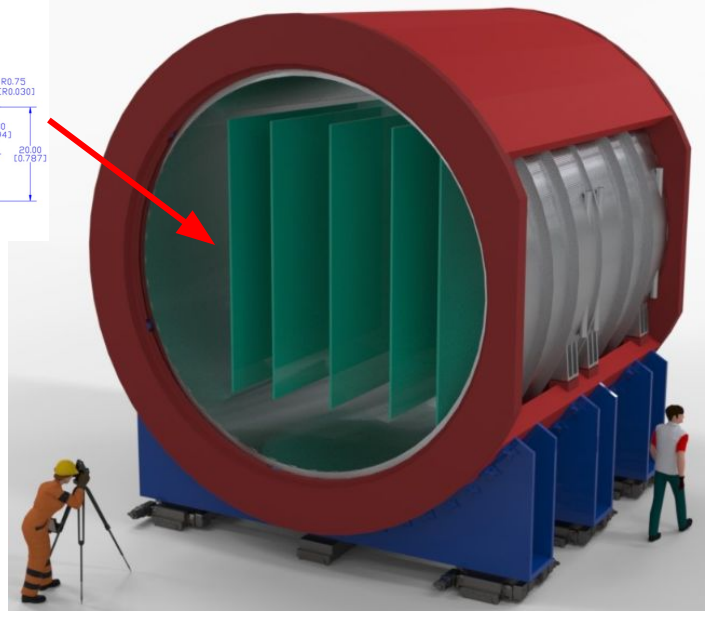


Least invasive

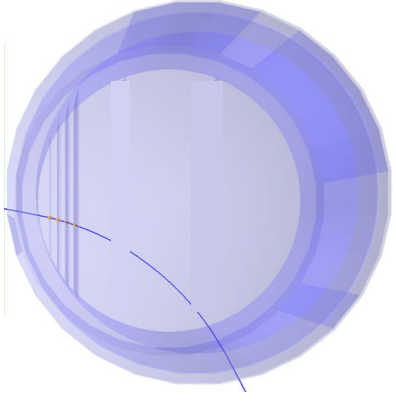
Most invasive

ND-GAr-Lite





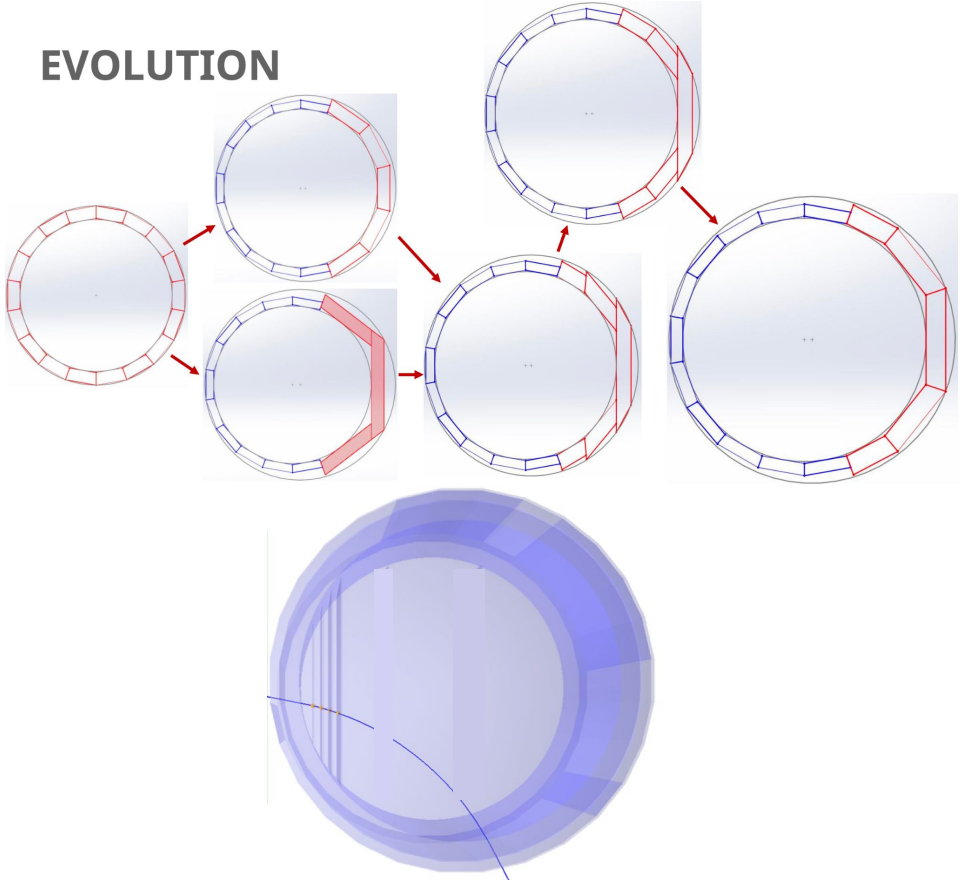
- There was a proposal to build the ND-GAr magnet and install tracking planes for the DUNE Phase-1 muon catcher (instead of TMS)
- The tracking planes were ~5-cm-thick xy-layers of triangular scintillator bars
- The proposal envisioned an intermediate stage where the tracking planes were run in conjunction with the fully installed ECAL
  - https://docs.dunescience.org/cgi-bin/sso/ShowDocument?docid=24984
- Proposal: a configuration with upstream WbLS layers in conjunction with HPgAr-TPC
  - (similar to T2K FGD2 water layers)



ND-GAr “Thin” Upstream ECAL

ND-GAr ECAL Design Evolution
https://indico.fnal.gov/event/50217/contributions/241513/attachments/155287/202160/220517_DUNE_CM_Talk_ECAL_Concepts.pdf

- The ND-GAr ECAL is most needed in the downstream direction (largest showers to contain)
- The upsteam portion has been redesigned to be “thin”
  - Saves cost on ECAL coverage
  - Performance requirements for upstream ECAL are less stringent than downstream ECAL
- WbLS layers would have to function as inner-most layers of upstream ECAL
  - Should be instrumented
  - Need to optimize for sufficient light collection (channel count, WbLS fraction, etc.)



Next Steps

- I'll be presenting at an upcoming ND-GAr working group meeting (May 9th)
  - Already some discussion with conveners (Alysia Marino, Patrick Dunne, Jen Raaf)
- I have been invited to present Theia ND options at the upcoming DUNE Phase 2 ND workshop at Imperial College
  - So far, within the ND-GAr session, but I will continue to negotiate talk content to possibly include other options
- Some discussion has taken place with current DUNE ND Phase-1 project manager / technical coordinator
  - It's unclear how straightforward hall modification would be after detectors are installed
  - Time is really running out for any kind of modification to the Phase 1 excavation plan
  - Will continue to follow up prior to, and during, the DUNE collaboration meeting