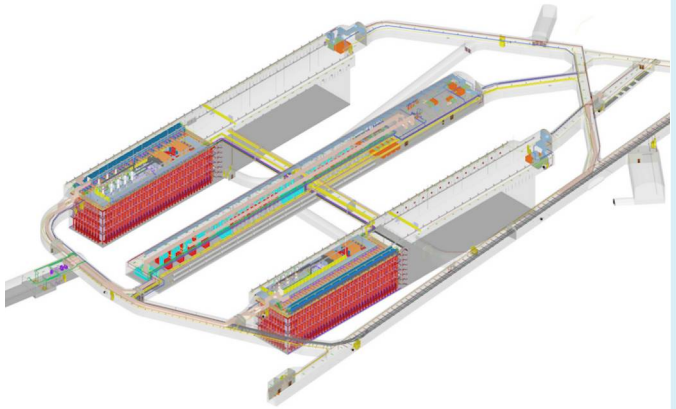
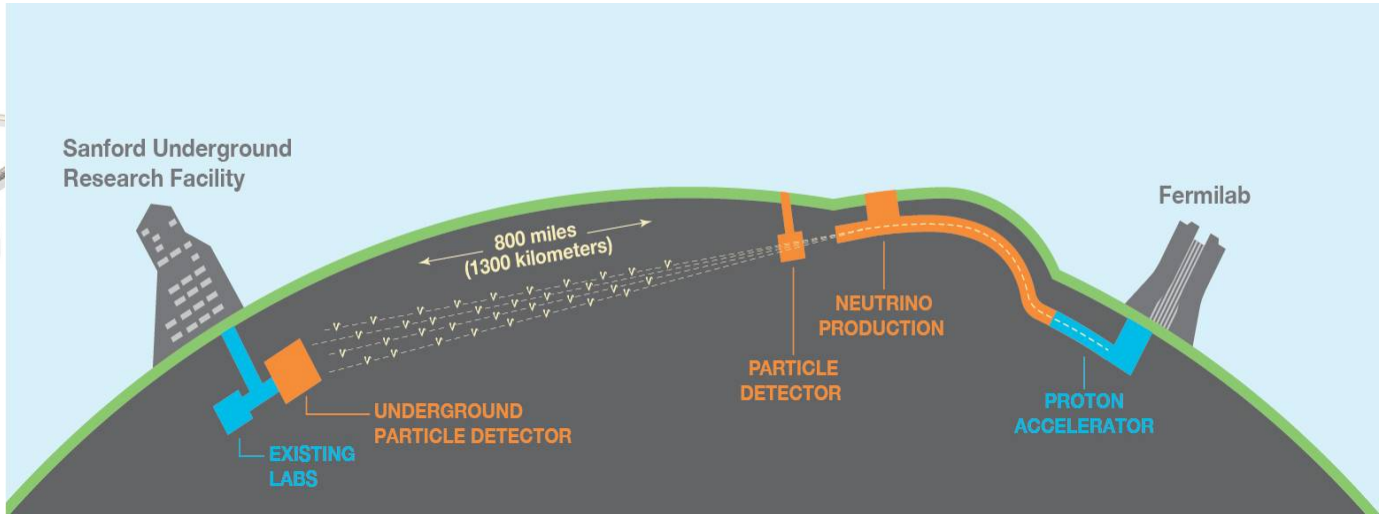
DUNE overview and schedule



(1.5 km underground)



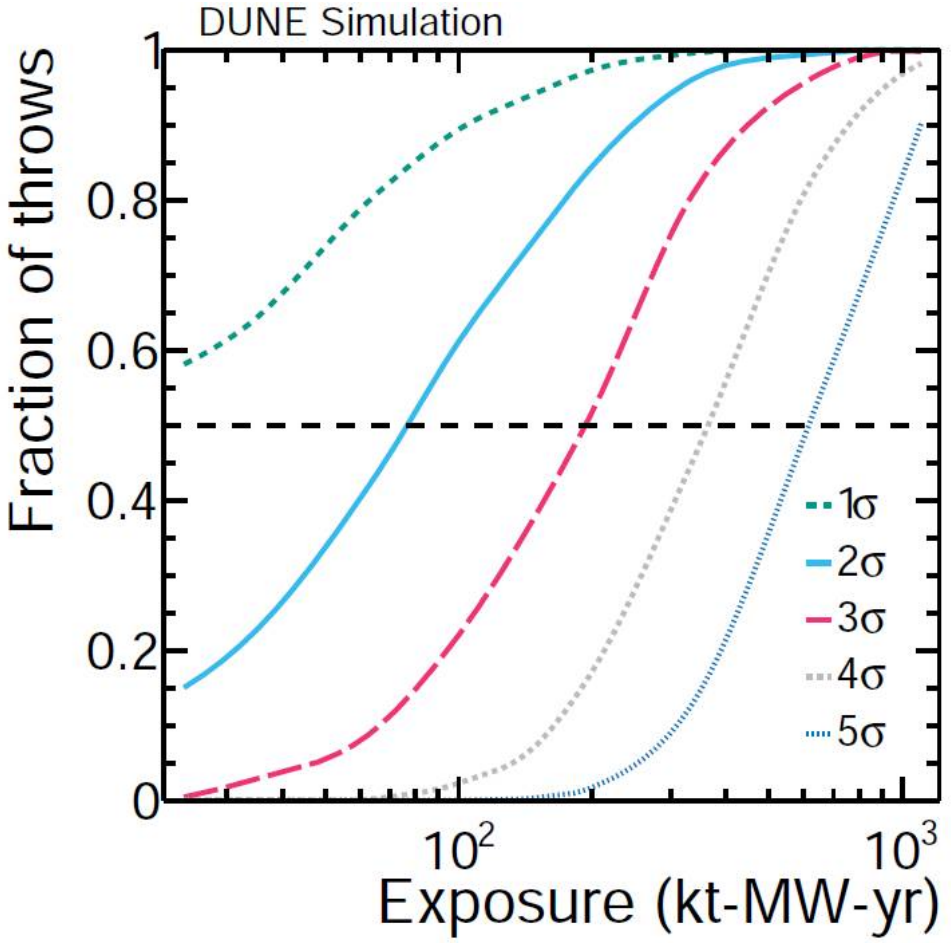
- **Phase 1 DUNE, late 2020s**: 2x 17 (~10) kt total (fiducial) FD modules; 1.2 MW beam; ND complex
- Halls for modules 3 and 4 available on a similar timescale:
  - Nominal module 3 plan for LArTPC module
  - Module 4 is the <u>“module of opportunity”</u>

The current DUNE physics program

- Three-flavor oscillation physics
  - CPV
  - Mass hierarchy
  - EPJC 80 (2020) 978; arXiv:2109.01304
- Low-energy physics: supernova and solar neutrinos
  - ≥5 MeV IBD threshold
  - ~20% resolution for few tens of MeV neutrino energies
  - EPJC 81 (2021) 5, 423
- Various (mostly) beam-related BSM searches
  - Proton decay searches: $p \rightarrow K^{+}\bar{\nu}$
  - EPJC 81 (2021) 322

Constraints: oscillation program needs

10+ kt fiducial mass to add statistics for DUNE's headline CP measurement, but doesn't *need* to be on argon



Fraction of universes for which DUNE's sensitivity exceeds Nσ for 50% of the true values of δ_{CP}, as a function of exposure [arXiv:2109.01304].

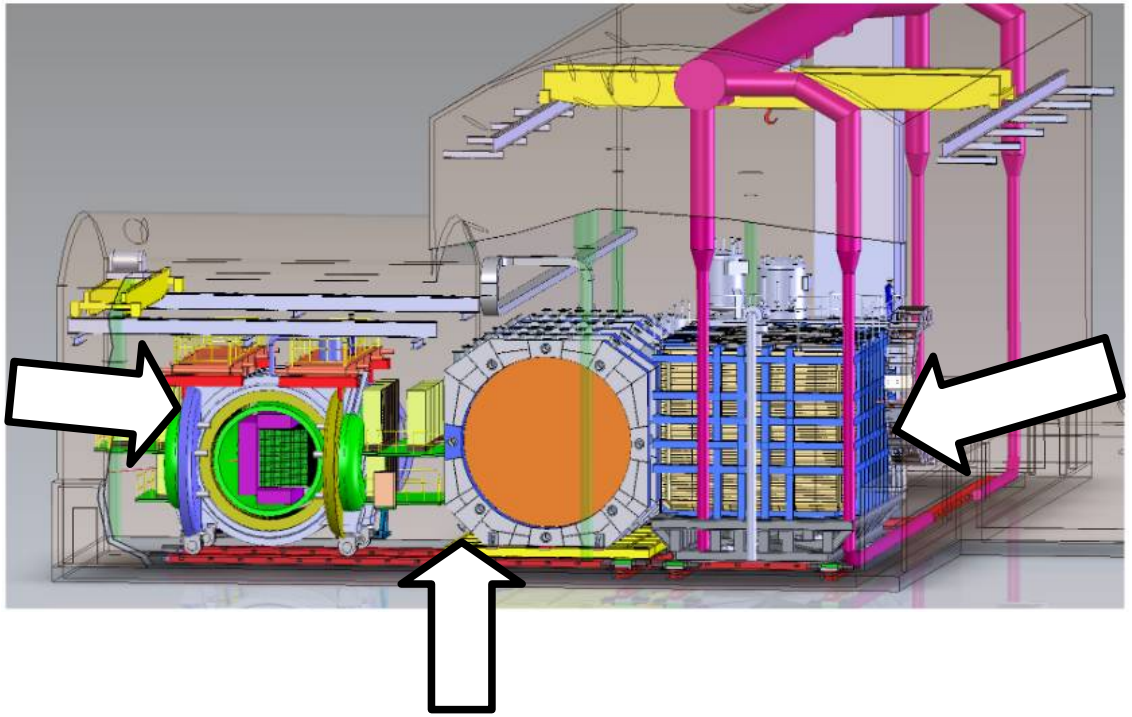
Nominal beam power ~1.2 MW, upgraded to 2.4 MW after ~6 years of operations

Constraints: oscillation program needs

Require **<u>neutrino interaction systematics</u>** to be under control → may imply a complementary ND component

Straw tube tracker with polypropylene (CH_2) radiator foils.

Alternative materials possible



~50 t fiducial LArTPC

Phase 1: magnetized range stack
Plans for high-pressure GArTPC upgrade →
other gas mixtures possible

Expanding DUNE's physics case

- Recent recommendations from review commitees for DUNE to avoid narrowly focusing on oscillation physics
- It's a good time to be talking about how to expand DUNE's physics program!
- Lots of interesting suggestions/information at from a workshop in 2019: https://www.bnl.gov/dmo2019/
  - Improved neutron detection
  - Lower energy tracking thresholds
  - Improved light collection
  - Different target materials for reduced systematics/ new physics directions

LBNL-DUNE current hardware activities

- ND-LAr and ND-wide engineering coordination
- Involvement in baseline electronics for FD#1 and FD#2 (coldADC)
- Exploring pixelization and scalable light readout for FD#3
  https://www.snowmass21.org/docs/files/summaries/IF/SNOWMASS21-IF7_IF8-NF10_NF0-UF3_UF0_Dan_Dwyer-171.pdf