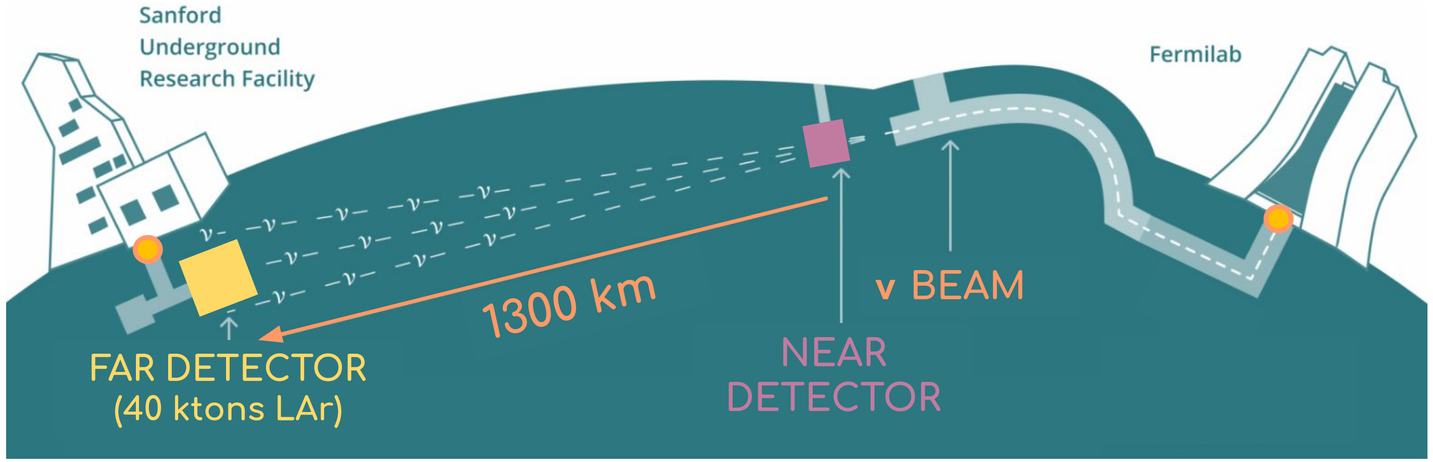
Dune Overview



Dune Science

Neutrino nature: Dirac or Majorana particles

Absolute mass scale

Mass generation mechanism

Mass ordering

Leptonic CP violation (δCP)

+ SuperNovas!

ProtoDUNE

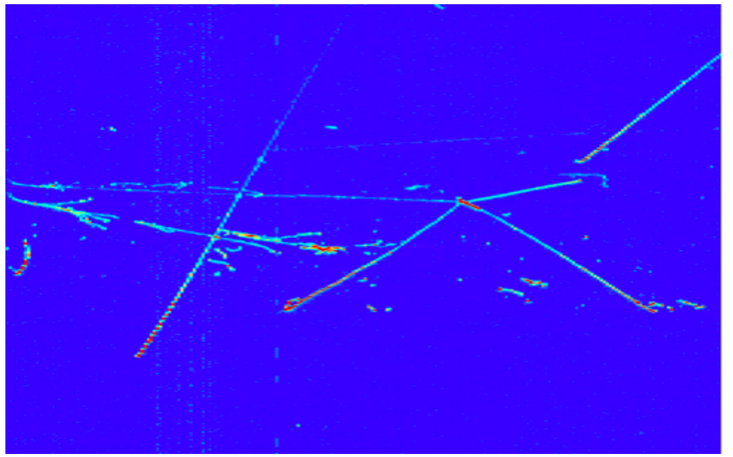
Development of Detector technology @ CERN

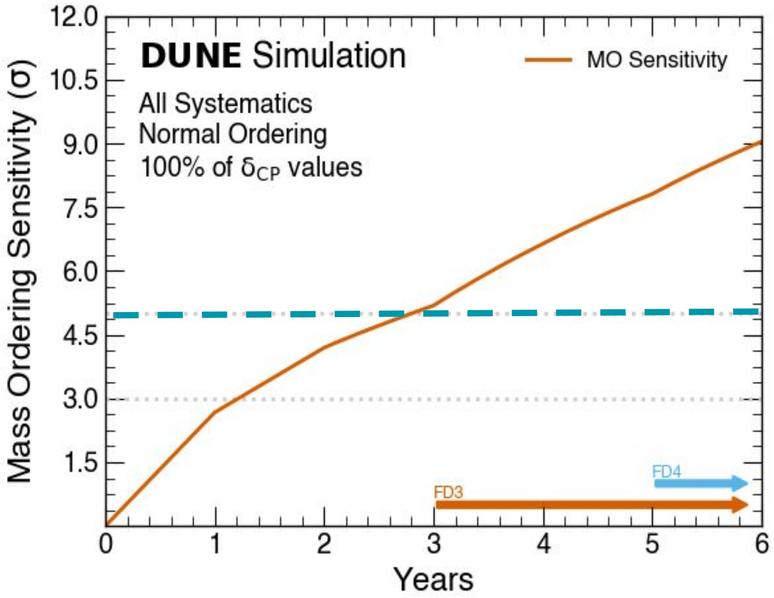
750 t LAr total (~5% of) + readout

- **Successful phase-I (2018 - 2020). Phase II 2024 - 2025**
  - **ProtoDUNE-HD campaign in 2024**
    - **Test upgraded components in their final design and take more beam data**
  - **ProtoDUNE-VD campaign in 2025**
    - **Test the VD concept for the first time at large scale**

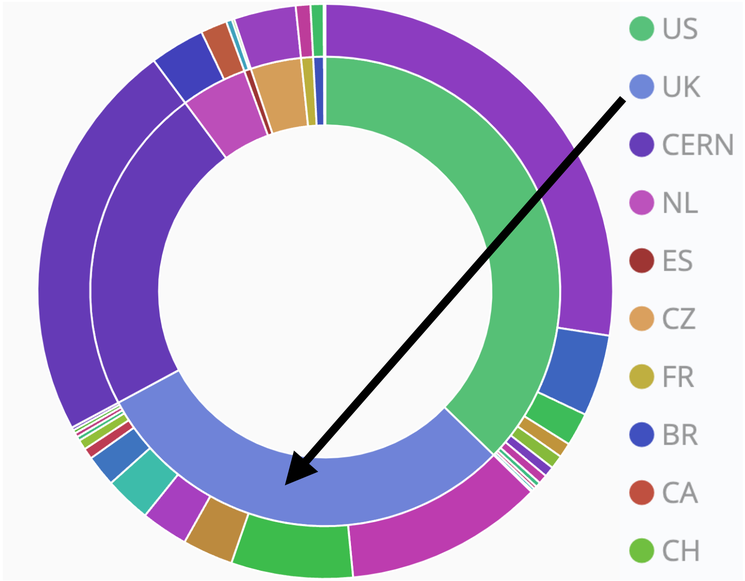
Compute Requirements

- Analysis of protoDUNE data. (I+II)
- Generation of both prototype data and simulation for detector design/ sensitivity studies. -> Feedback.
- Development (simulation) of final DUNE detector - physics reach/potential.
- Development of algorithms for reconstruction.
- Successfully utilising compute sites from around the world. Distribution of data and Network data challenge. Prove workflow will keep up with data flow. (JustIN)
- And Repeat…





IRIS Impact

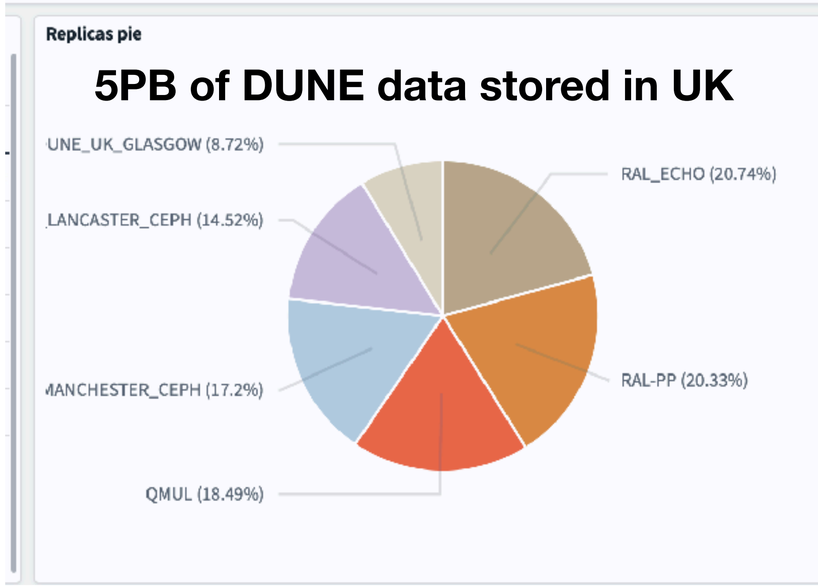


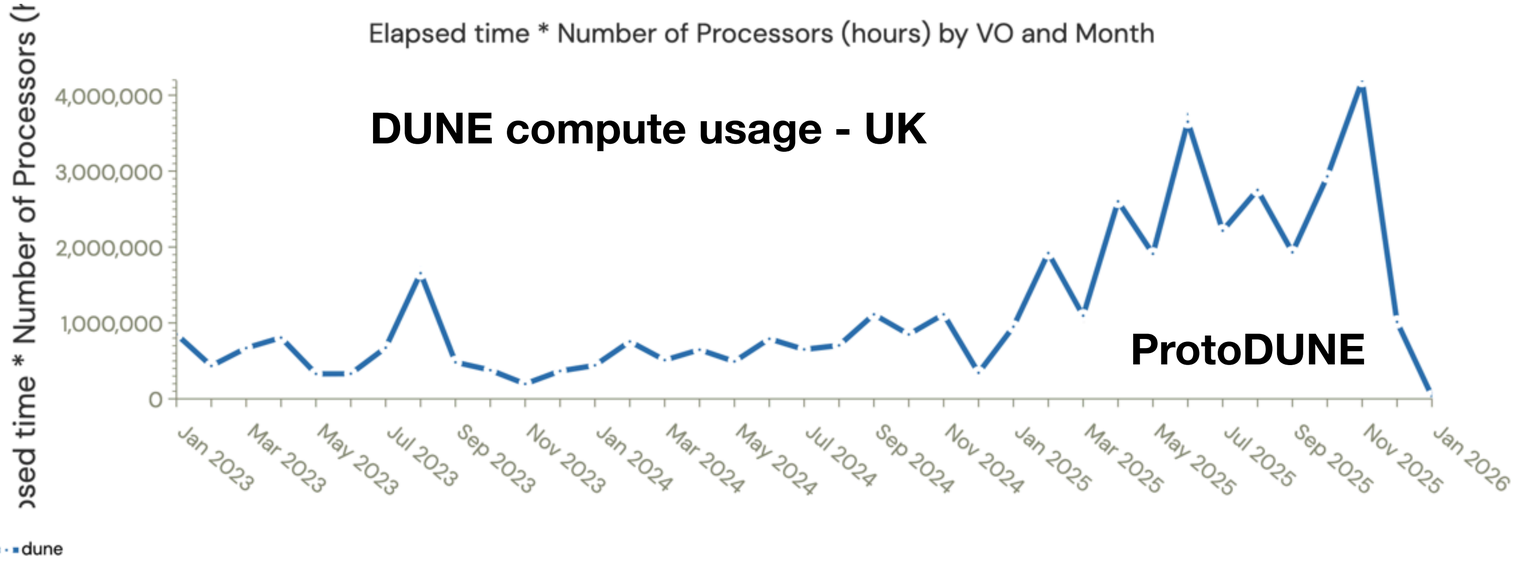
Dune production by country and site

13 UK sites

DUNE's not even built yet and is 2nd largest non LHC compute user in the WLCG

DUNE largest Non LHC user of compute resources on GridPP (UK / IRIS)



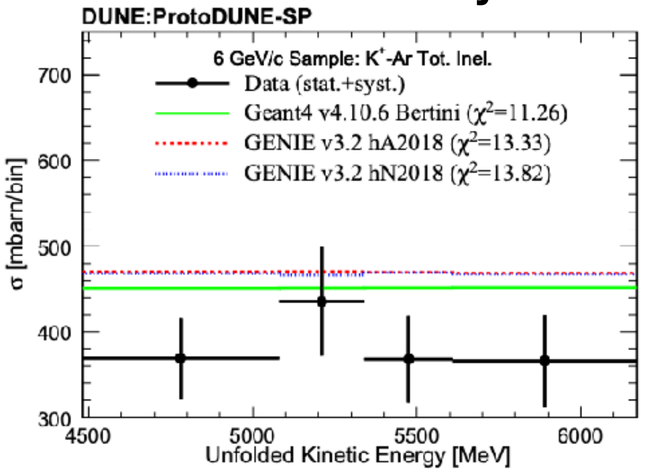


Recent DUNE publication

Journal Publications

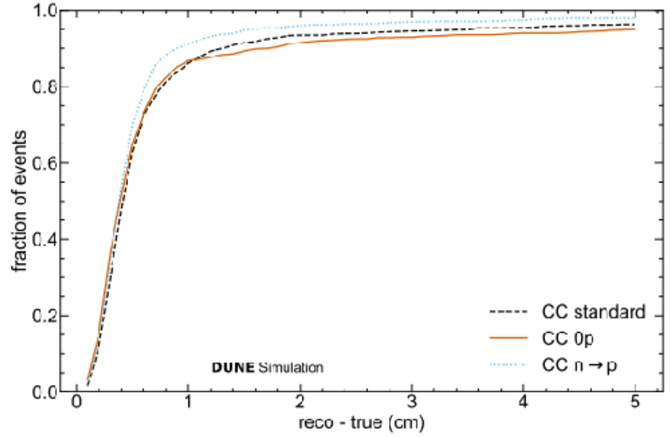
- DUNE Collaboration, "Spatial and temporal evaluations of the liquid argon purity in ProtoDUNE-SP", arXiv:2507.08586, JINST 20 P09008 (2025)
- DUNE Collaboration, "Neutrino interaction vertex reconstruction in DUNE with Pandora deep learning", arXiv:2502.06637, Eur.Phys.J.C 85 697 (2025)
- DUNE Collaboration, "The track-length extension fitting algorithm for energy measurement of interacting particles in liquid argon TPCs and its performance with ProtoDUNE-SP data", arXiv:2409.18288, JINST 20 P02021 (2025)
- DUNE Collaboration, "DUNE Phase II: scientific opportunities, detector concepts, technological solutions", arXiv:2408.12725, JINST 19 P12005 (2024)
- DUNE Collaboration, "First measurement of the total inelastic cross section of positively charged kaons on argon at energies between 5.0 and 7.5 GeV", arXiv:2408.00582, Phys.Rev.D 110 092011 (2024)
- DUNE Collaboration, "Supernova pointing capabilities of DUNE", arXiv:2407.10339, Phys.Rev.D 111 092006 (2025)
- DUNE Collaboration, "The DUNE-DAQ Application Framework", arXiv:2405.18583, IEEE Trans.Nucl.Sci. 72 (2025)
- DUNE Collaboration, "Performance of a Modular Ton-Scale Pixel-Readout Liquid Argon Time Projection Chamber", arXiv:2403.03212, Instruments 8 41 (2024)
- DUNE Collaboration, "The DUNE Far Detector Vertical Drift Technology. Technical Design Report", arXiv:2312.03130, JINST 19 T08004 (2024)
- DUNE Collaboration, "SPY: a conceptual design study of a magnet system for a high-pressure gaseous TPC neutrino detector", arXiv:2311.16063, JINST 19 P06018 (2024)
- DUNE Collaboration, "Impact of cross-section uncertainties on supernova neutrino spectral parameter fitting in the Deep Underground Neutrino Experiment", arXiv:2303.17007, Phys.Rev.D 107 112012 (2023)
- DUNE Collaboration, "Highly-parallelized simulation of a pixelated LArTPC on a GPU", arXiv:2212.09807, JINST 18 P04034 (2023)
- DUNE Collaboration, "DUNE Offline Computing Conceptual Design Report", arXiv:2210.15665, DOI: 10.2172/1895403
- DUNE Collaboration, "Reconstruction of interactions in the ProtoDUNE-SP detector with Pandora", arXiv:2206.14521, Eur.Phys.J.C 83 618 (2023)
- DUNE Collaboration, "Separation of track- and shower-like energy deposits in ProtoDUNE-SP using a convolutional neural network", arXiv:2203.17053, Eur.Phys.J.C 82 903 (2022)
- DUNE Collaboration, "Scintillation light detection in the 6-m drift-length ProtoDUNE Dual Phase liquid argon TPC", arXiv:2203.16134, Eur.Phys.J.C 82 618 (2022)
- DUNE Collaboration, "Low exposure long-baseline neutrino oscillation sensitivity of the DUNE experiment", arXiv:2109.01304, Phys.Rev.D 105 072006 (2022)
- DUNE Collaboration, "Searching for solar KDAR with DUNE", arXiv:2107.09109, JCAP 10 065 (2021)
- DUNE Collaboration, "Deep Underground Neutrino Experiment (DUNE) Near Detector Conceptual Design Report", arXiv:2103.13910, Instruments 5 31 (2021)
- DUNE Collaboration, "Prospects for beyond the Standard Model physics searches at the Deep Underground Neutrino Experiment", arXiv:2008.12769, Eur.Phys.J.C 81 322 (2021)
- DUNE Collaboration, "Supernova neutrino burst detection with the Deep Underground Neutrino Experiment", arXiv:2008.06647, Eur.Phys.J.C 81 423 (2021)
- DUNE Collaboration, "First results on ProtoDUNE-SP liquid argon time projection chamber performance from a beam test at the CERN Neutrino Platform", arXiv:2007.06722, JINST 15 P12004 (2020)

ProtoDUNE analysis



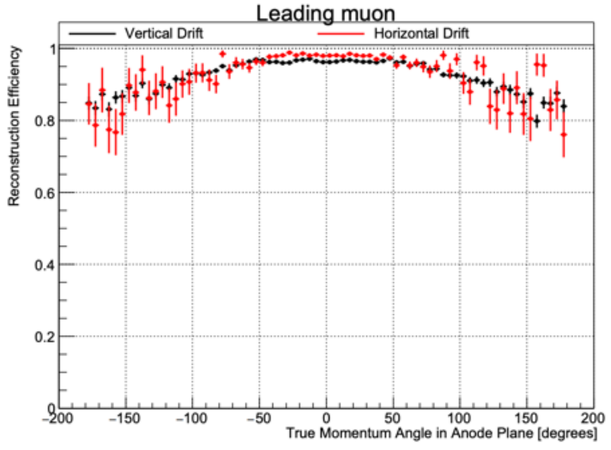
Extracted total inelastic cross section from beam kaons with comparisons to GENIE v3.2.0 and Geant4

Algorithm Development



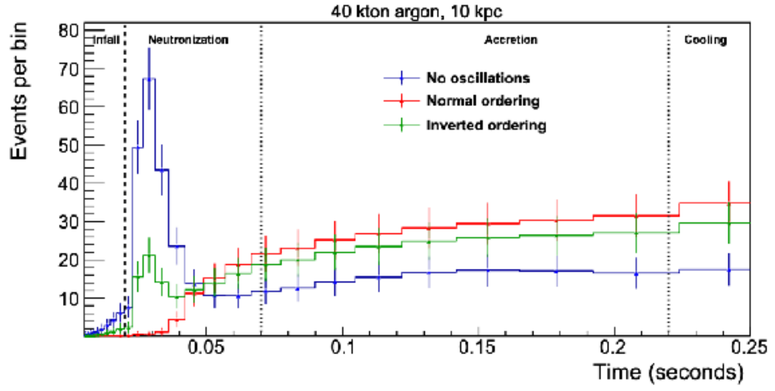
Fraction of reconstructed vertices as a function of distance to the true vertex

Detector Design



Reconstruction efficiencies of the leading μ – from CC neutrino interactions in FD1-HD and FD2-VD.

DUNE PHASE II



Expected event rates as a function of time for the electron-capture supernova model and for 40 kt of argon during early stages of the burst