Neutrino-Argon interaction measurements using the NuMI beam at ICARUS

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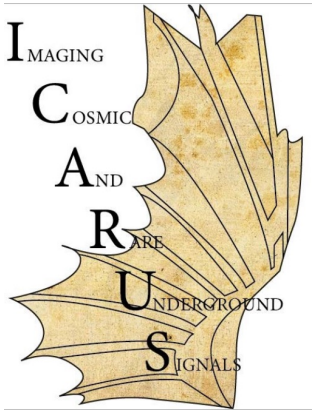
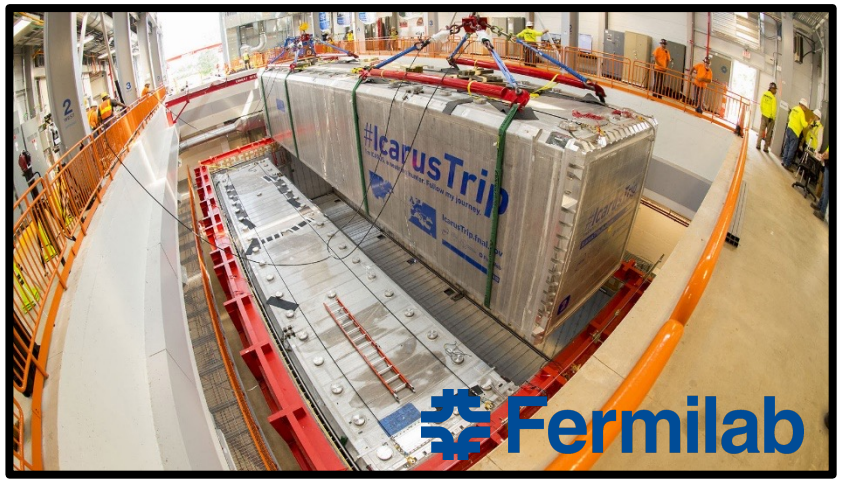
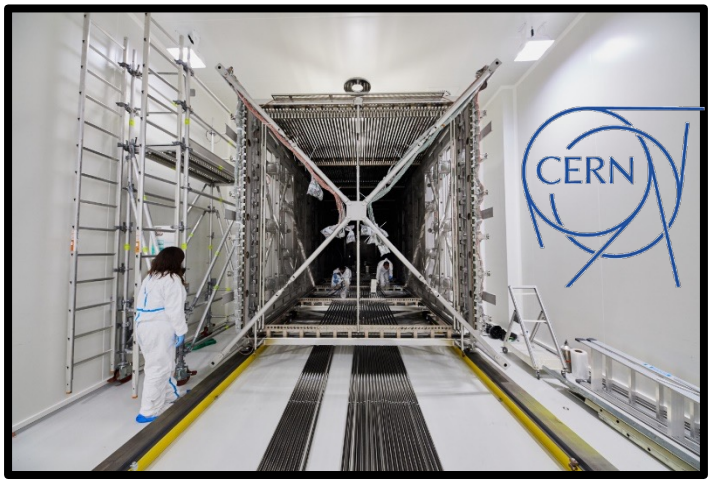


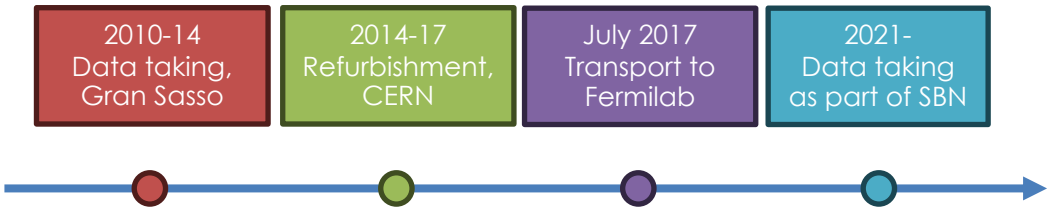
The ICARUS experiment





ICARUS

- The first large LArTPC: 476 ton active mass
- 2 modules; 4 TPCs; 360 PMTs, surrounding CRTs



The ICARUS experiment

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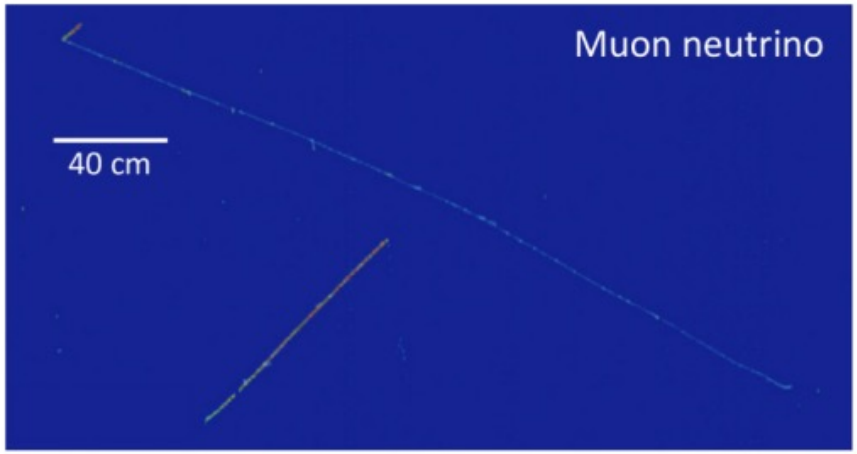
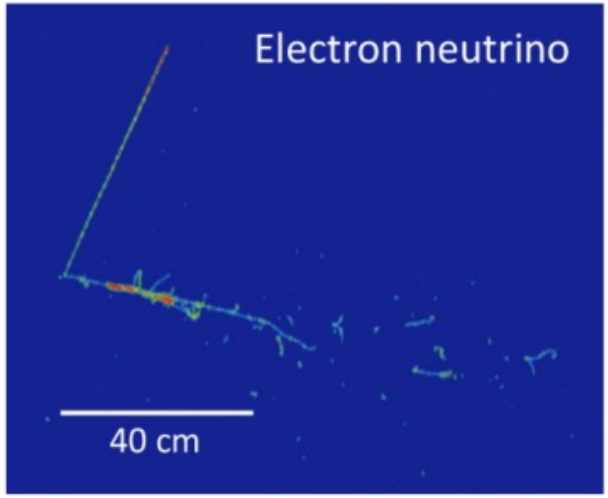
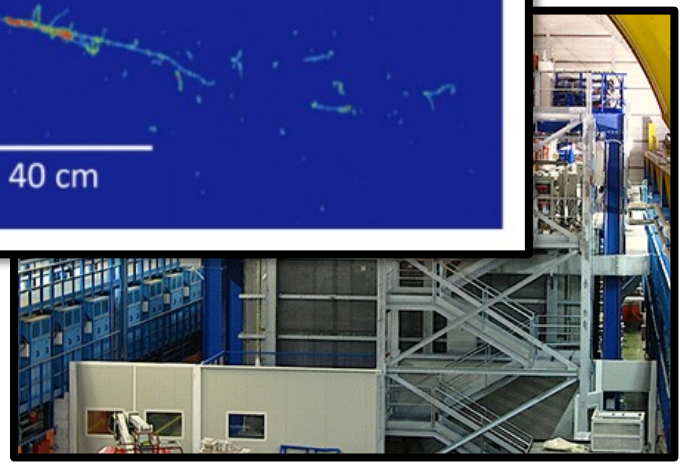
Muon Neutrino candidate from data



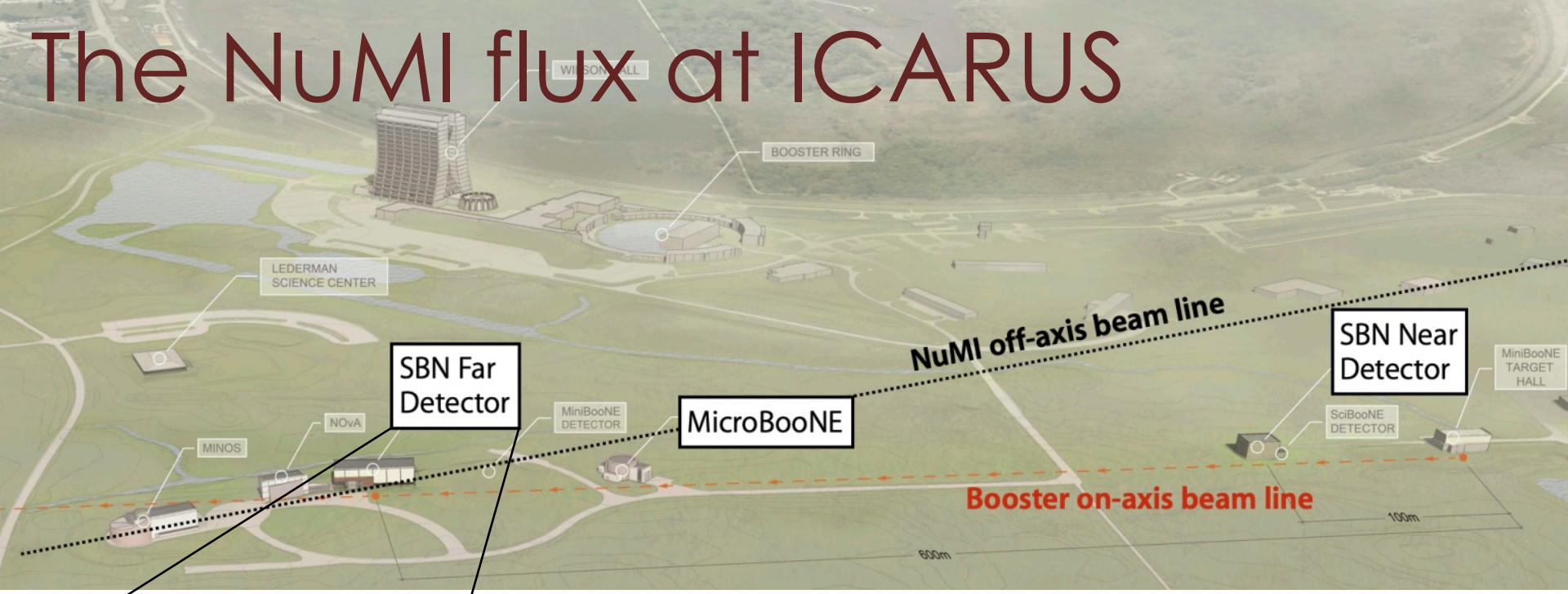
Electron Neutrino candidate





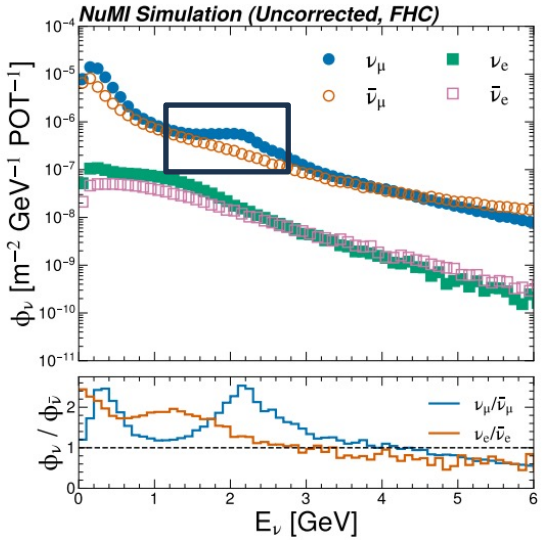
2010-14 Data taking, Gran Sasso	2014-17 Refurbishment, CERN	July 2017 Transport to Fermilab	2021- Data taking as part of SBN

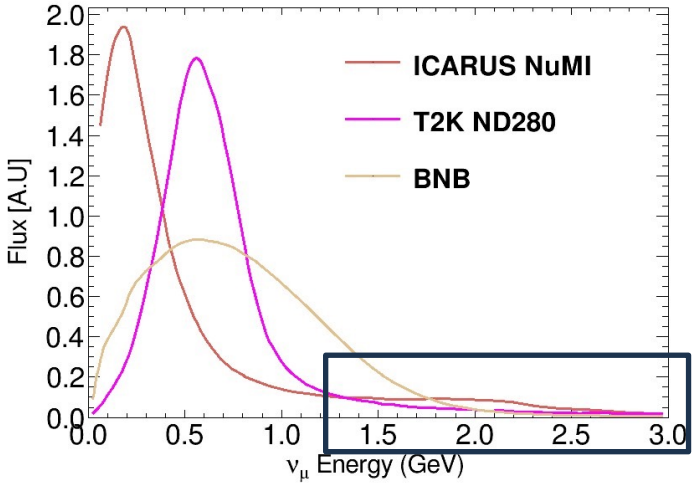
The NuMI flux at ICARUS



ICARUS-T600

BNB baseline: 600 m
Total LAr: 760 ton
Active LAr: **476 ton**
NuMI off-axis angle*: 5.9°



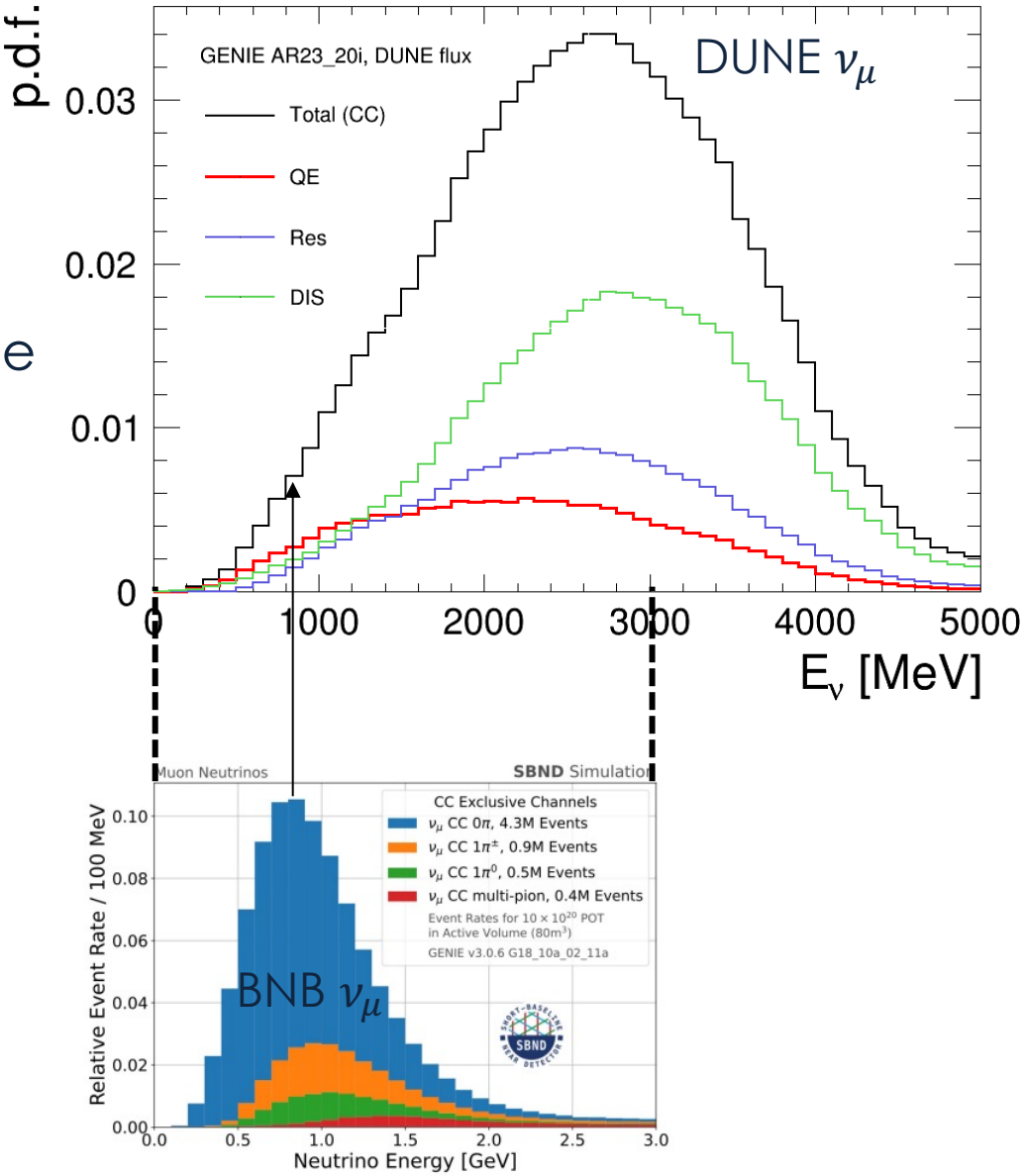


* As measured from close to the target, observed neutrinos come from a wide range of angles

Why NuMI?

(Why are you measuring cross sections?)

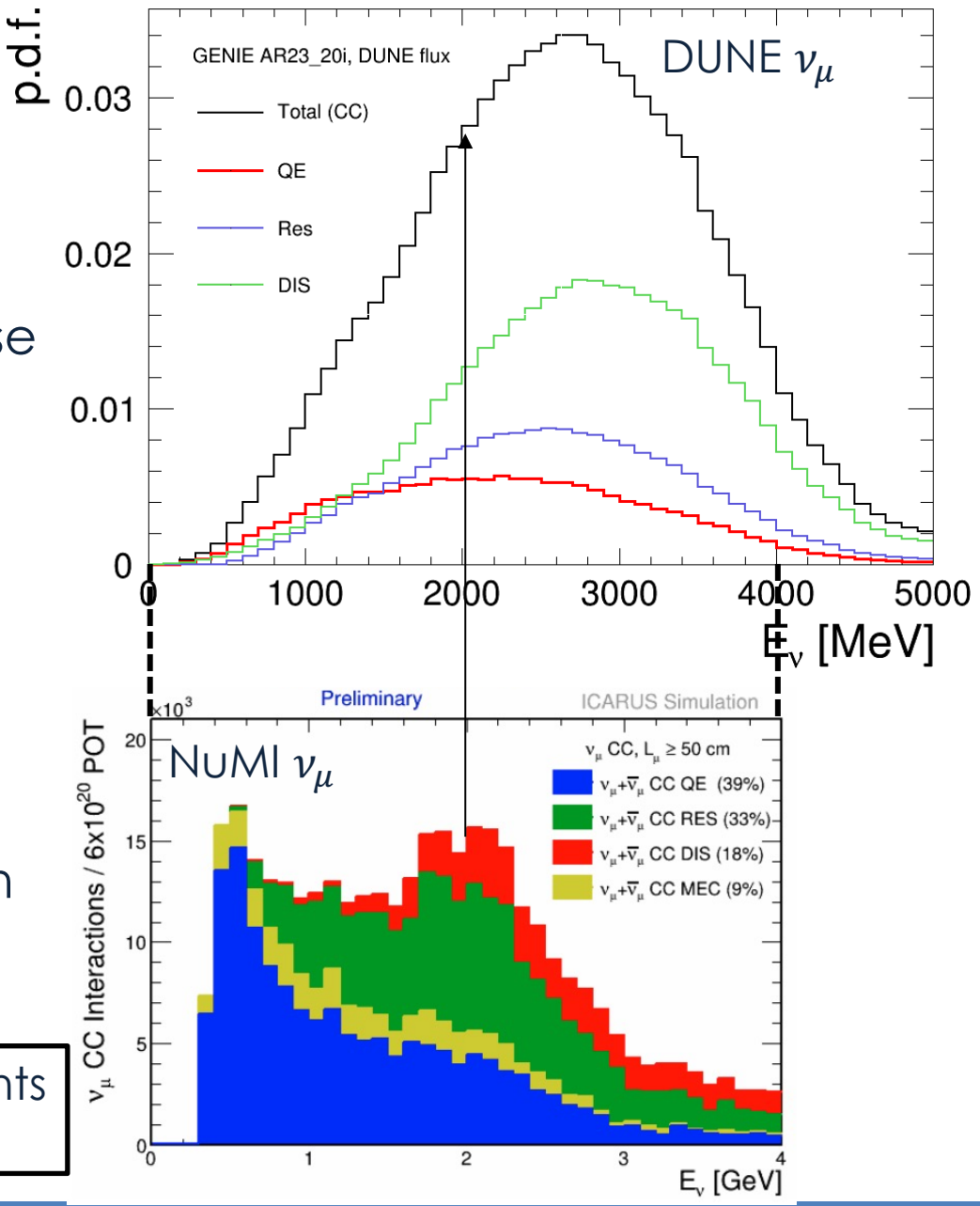
- Interactions in the Booster beam are limited in their phase space coverage for DUNE



Why NuMI?

(Why are you measuring cross sections?)

- Interactions in the Booster beam are limited in their phase space coverage for DUNE
- NuMI at ICARUS offers additional complementary phase space coverage
- Expect to make leading contributions for ν_μ-Ar interactions at E_ν greater than ~2 GeV!



~500k CC events / 6×10^{20} PoT

Approach to result longevity

(How do you expect your measurements to be used when DUNE and Hyper-K are running?)

- ICARUS results ***must*** be quantitatively useful when DUNE is building and tuning its interaction model for real data analysis
  - Sufficiently robust results for model benchmarking and parameter tuning in a decade or more time
- To achieve this, avoidance of model bias will be crucial. We are building a framework to allow:
  - Data driven background constraints
  - Provision of unregularised results
  - Multi-dimensional efficiency corrections
  - Tailored control samples to characterise detector response
- Plan for comprehensive data releases including:
  - Covariance matrices as well as the Universes/toys used to build them
  - Correlations between flux shape and measured cross section
- Possibility of joint/correlated measurements
  - Joint NuMI+BNB, joint ICARUS+SBND
  - Allows easier use of multiple data sets in future DUNE model tuning