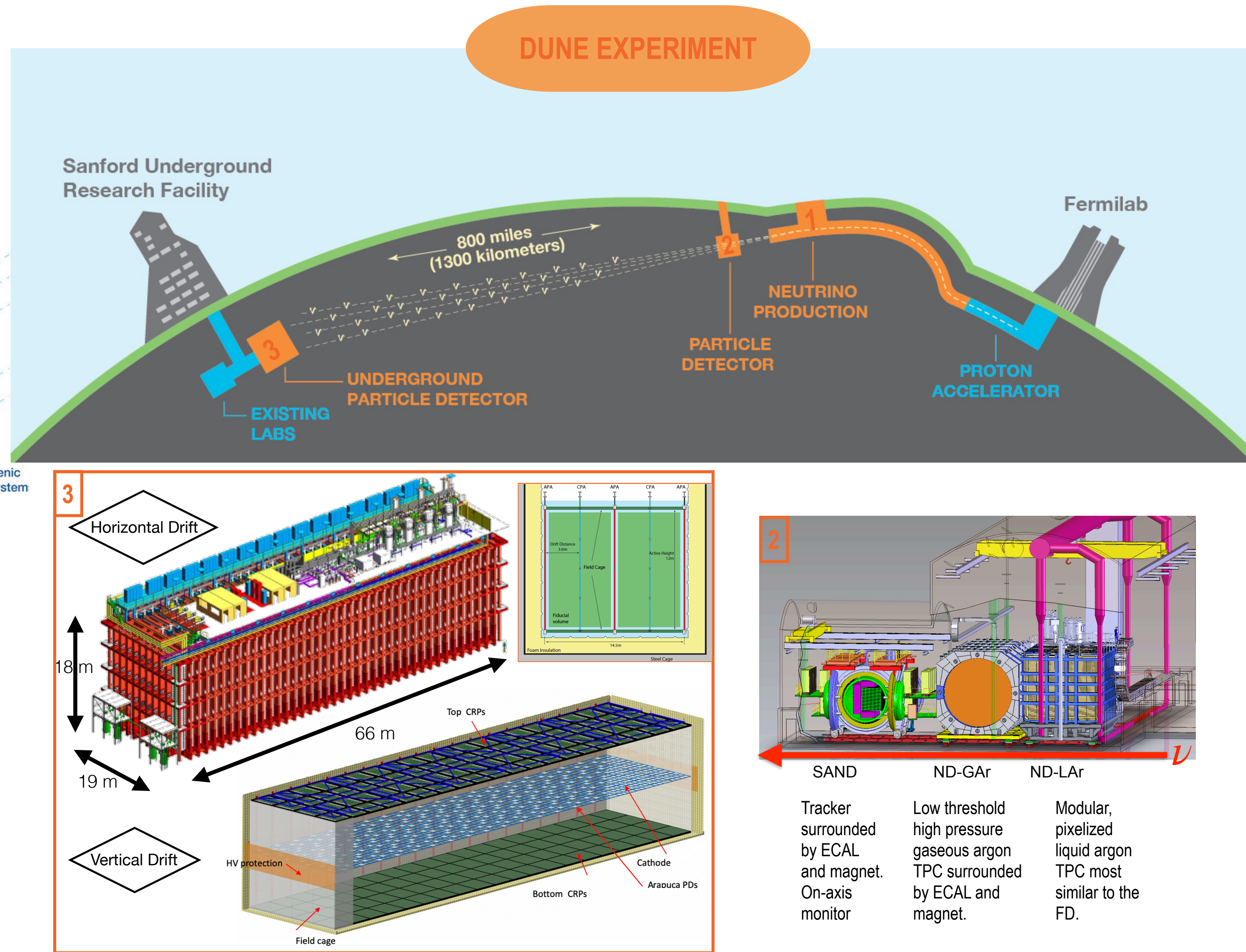


M. Nebot-Guinet for the DUNE Collaboration.

The Deep Underground Neutrino Experiment (DUNE) is a next-generation long-baseline (1300 km) neutrino oscillation experiment, for neutrino physics and proton-decay searches.



DUNE will answer the question about CP-violation in the neutrino sector as well as will carry out precision measurements of the neutrino mixing parameters. Besides this, DUNE will use the near and far detectors to study a very vast science program such as supernova burst signals or signatures of physics beyond the Standard Model.

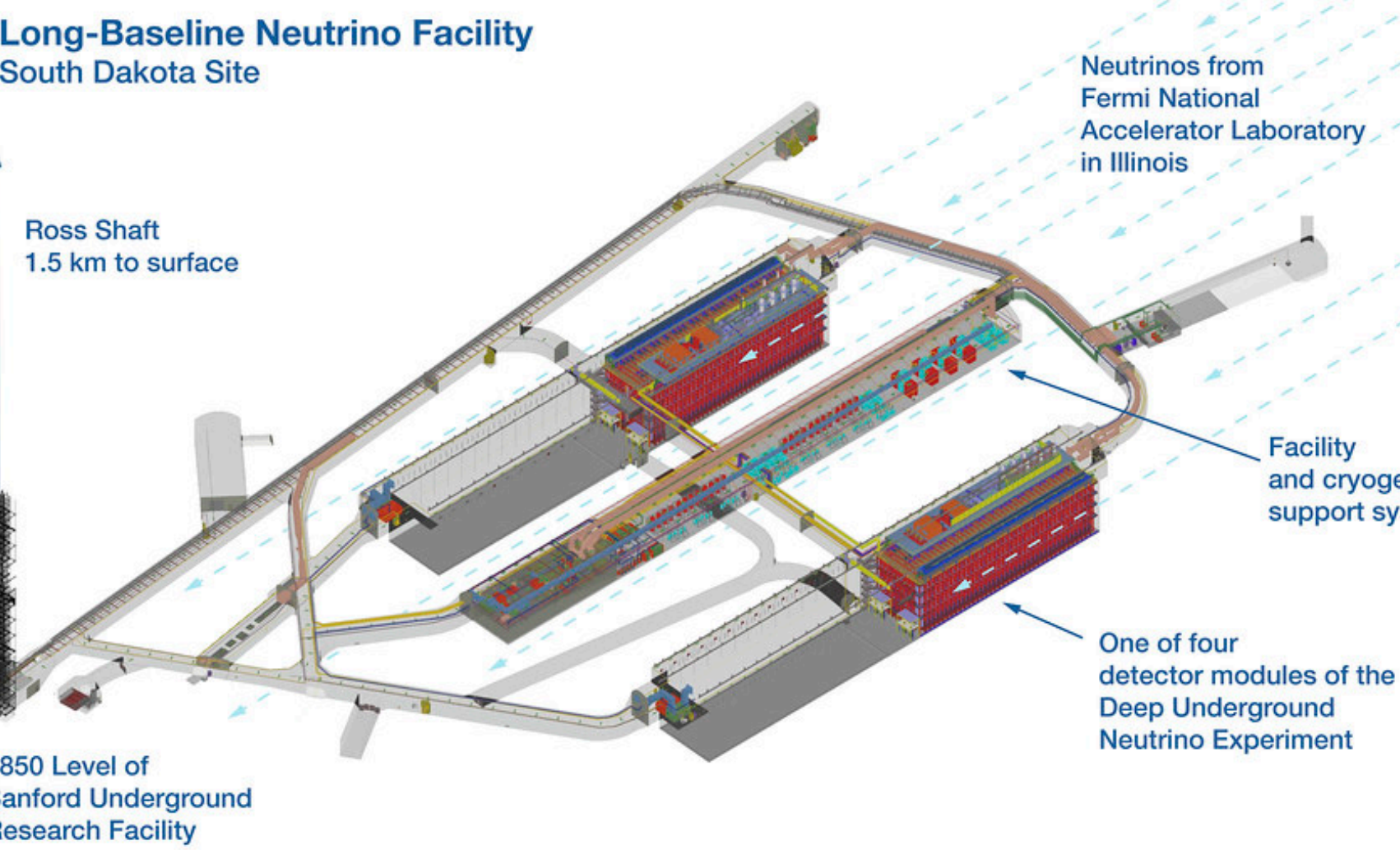
A new broadband high-intensity neutrino source (PIP-II / LBNF) and Near Detector complex will be located at Fermilab (Illinois).

### 1. SOURCE:

Fermilab's Main Injector accelerator will feature an 80-120 GeV proton beam (1.2 MW upgrade to 2.4 MW) to make the highest energy neutrino beam. The neutrino beamline has been designed to optimize CP violation sensitivity and it will run in neutrino (FHC) and antineutrino (RHC) modes.

### 2. NEAR DETECTOR:

It will be an integrated system composed of multiple detectors and located ~574 m from the neutrino beam target. The primary purpose is to constrain systematic uncertainty for the long-baseline oscillation analysis and predict beam composition at FD. ND-LAR & ND-GAR move off-axis to observe varied beam spectra.

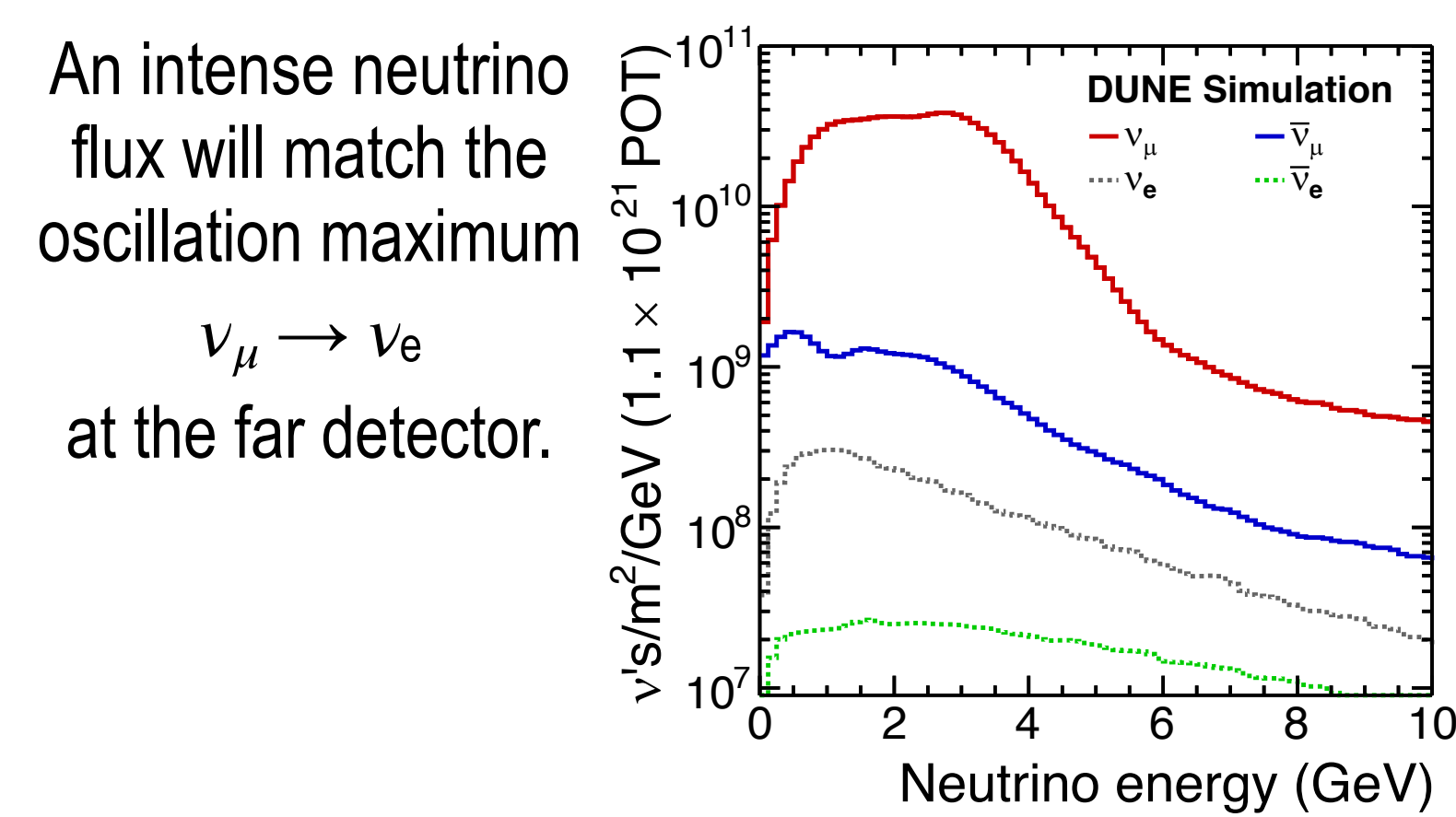


### 3. FAR DETECTOR:

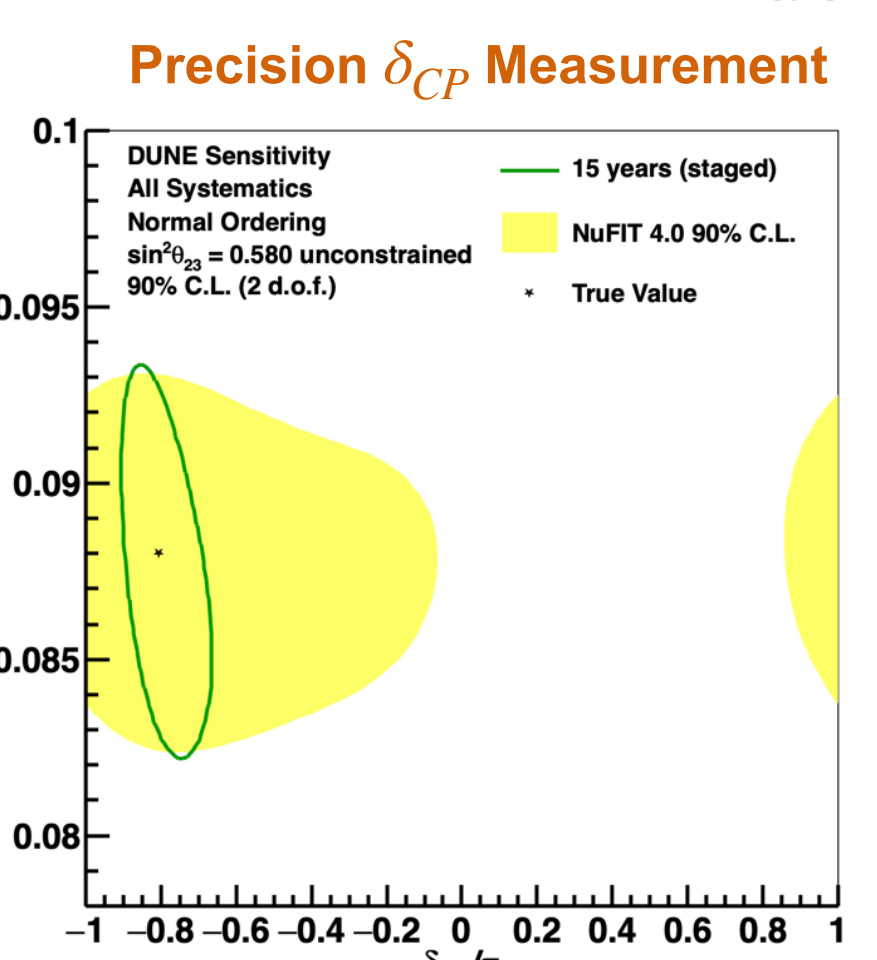
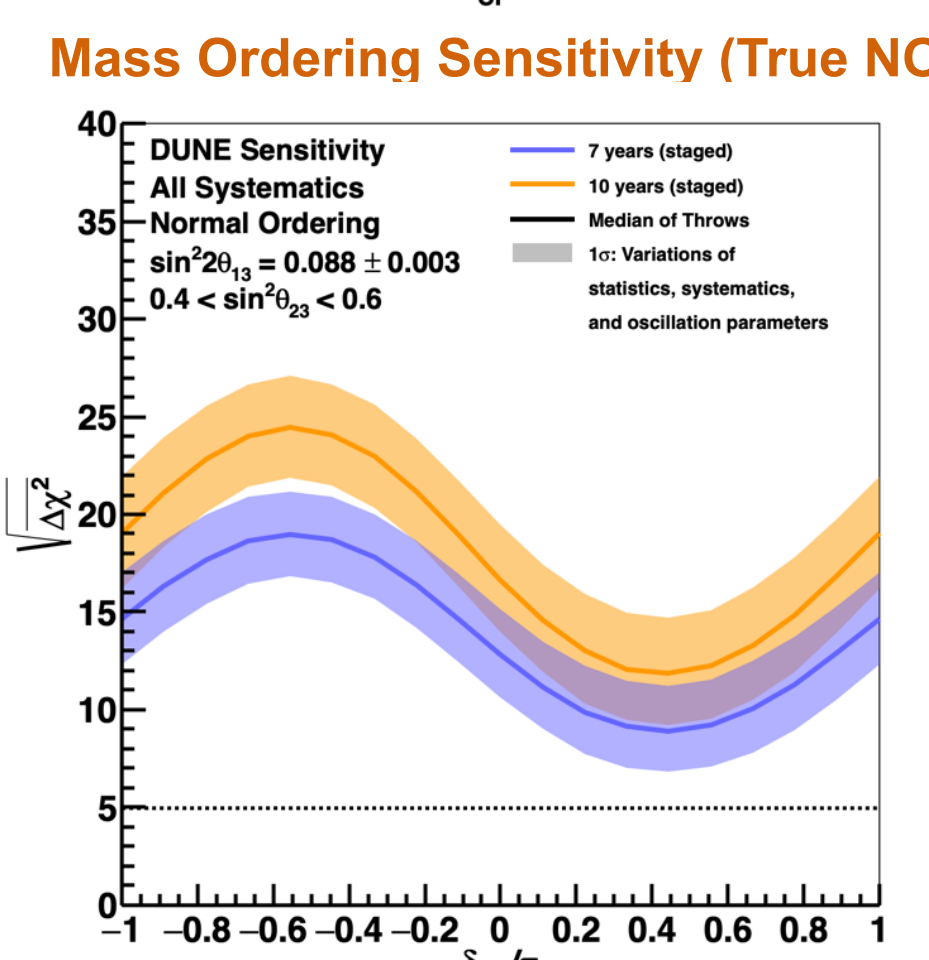
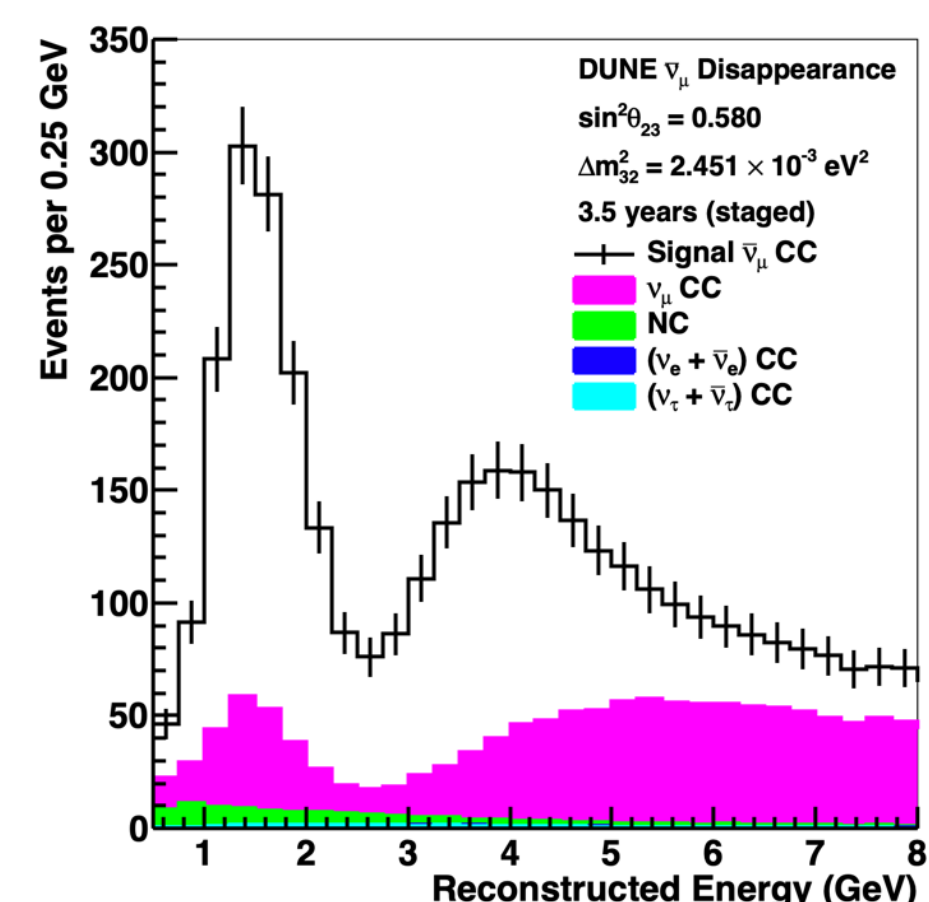
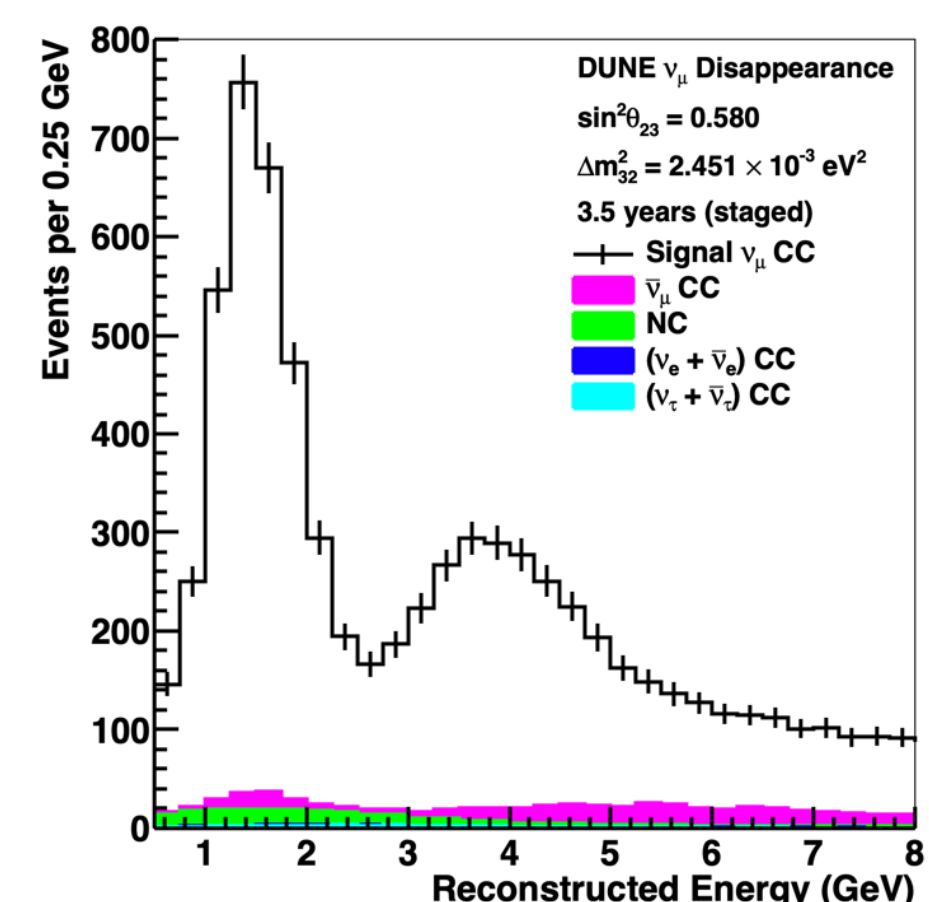
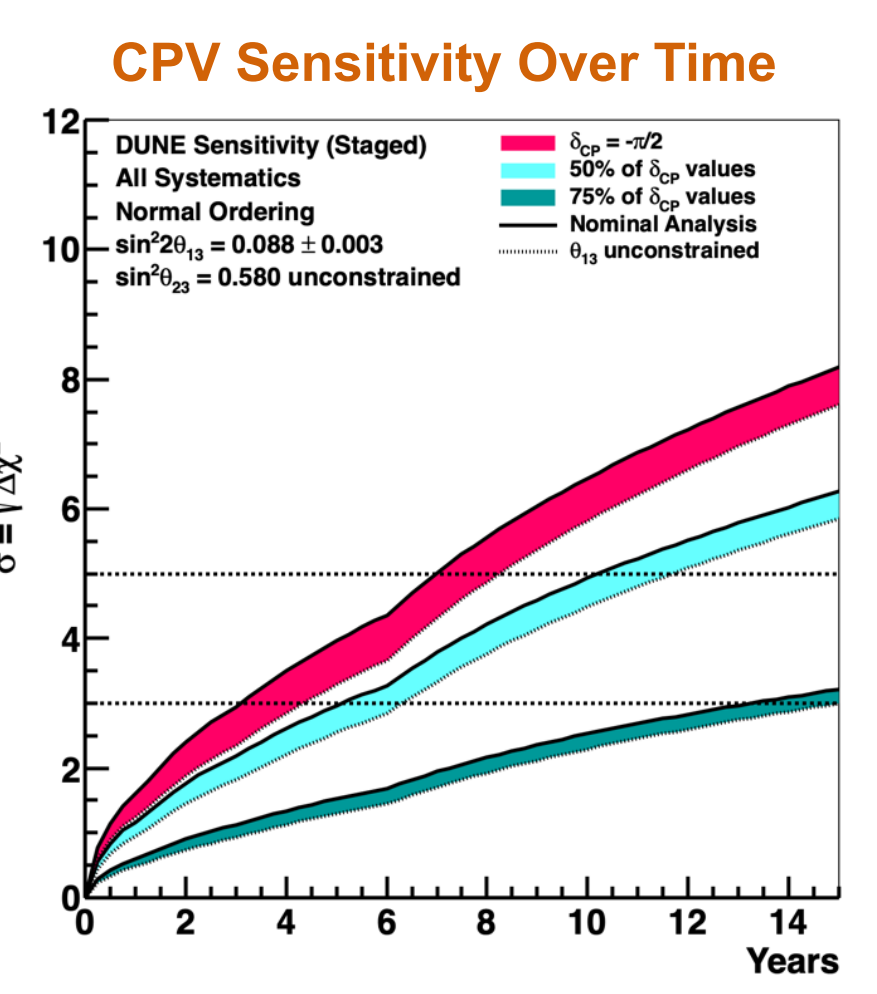
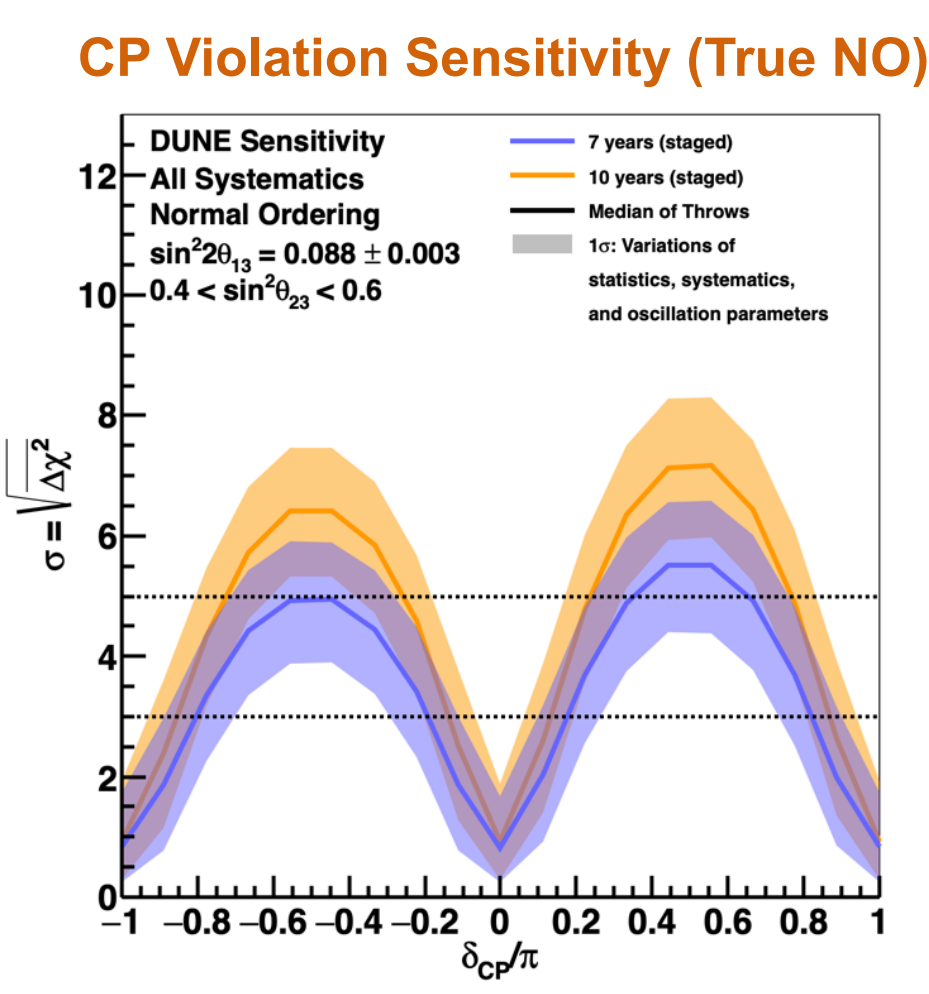
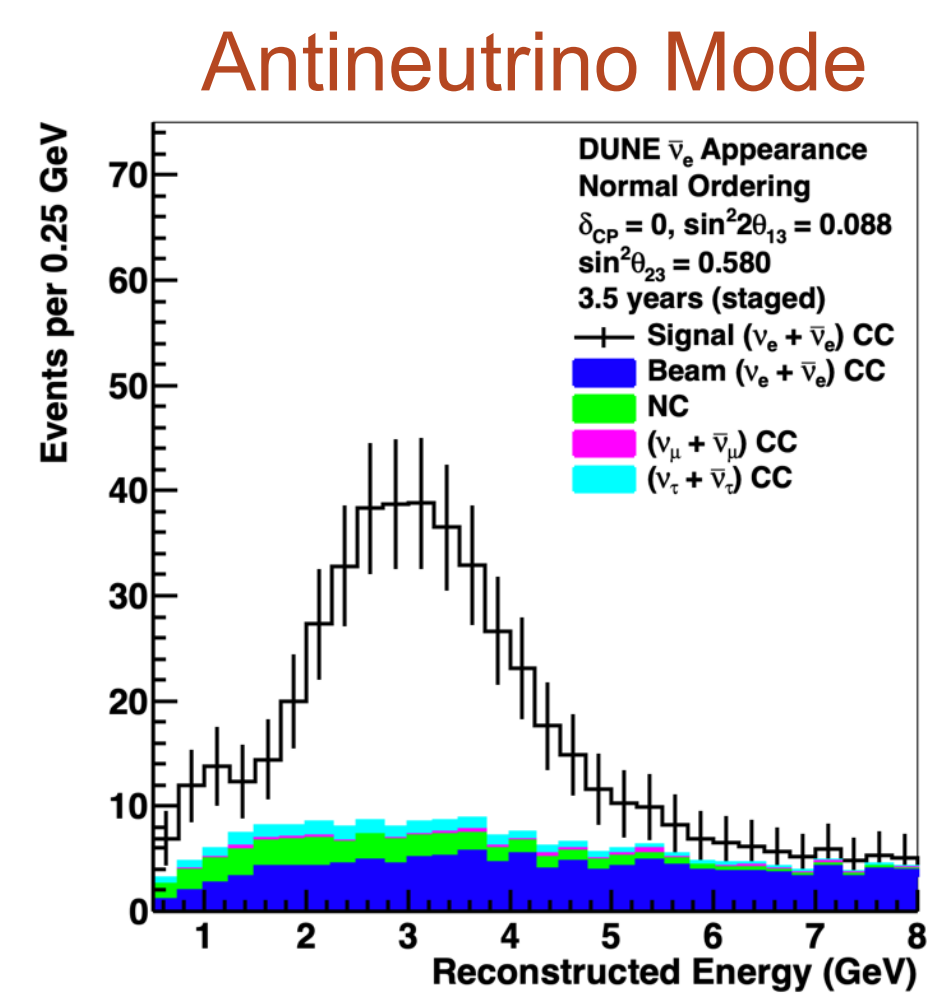
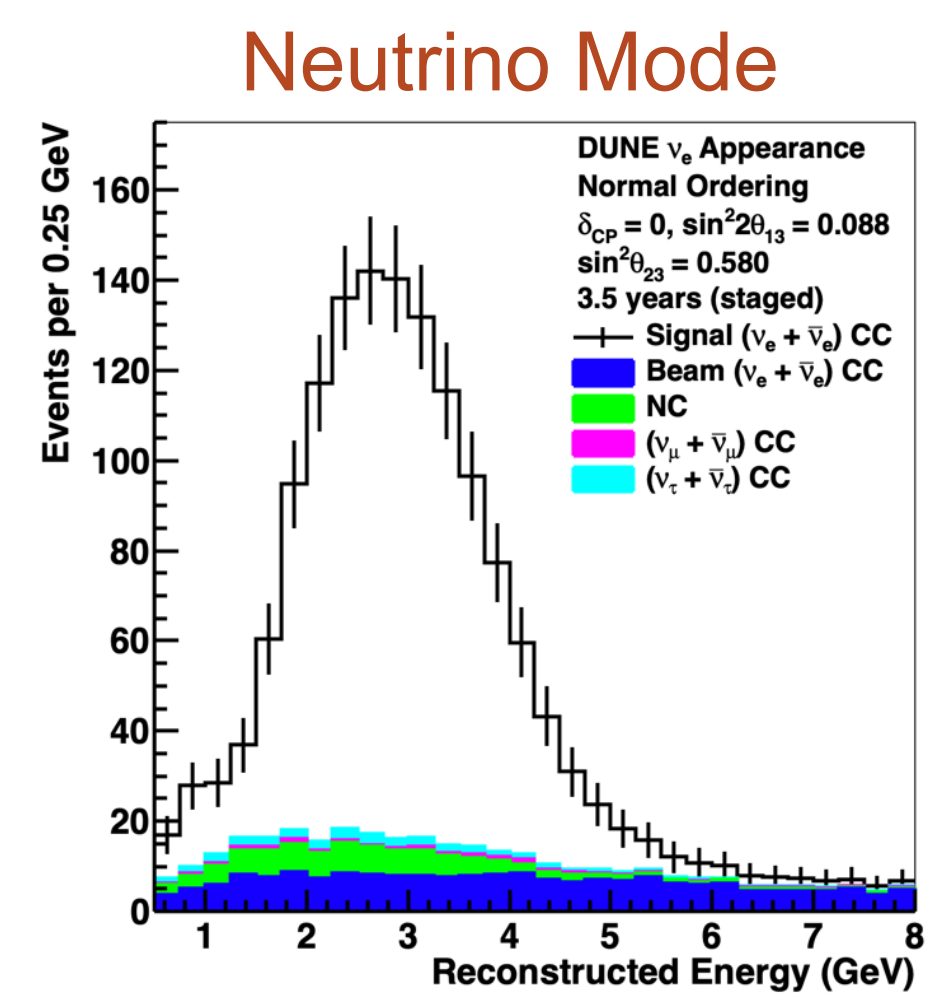
DUNE will feature four modules of 10-kt fiducial LAR TPC with integrated photon detection a mile below the surface at 4850L (4300 mwe) of Sanford Underground Research Facility (SURF), South Dakota.

## OSCILLATION PHYSICS

The above-described arrangement will provide unprecedented sensitivity in the search for neutrino CP violation, determination of the neutrino mass ordering, and precision measurements of neutrino mixing parameters.



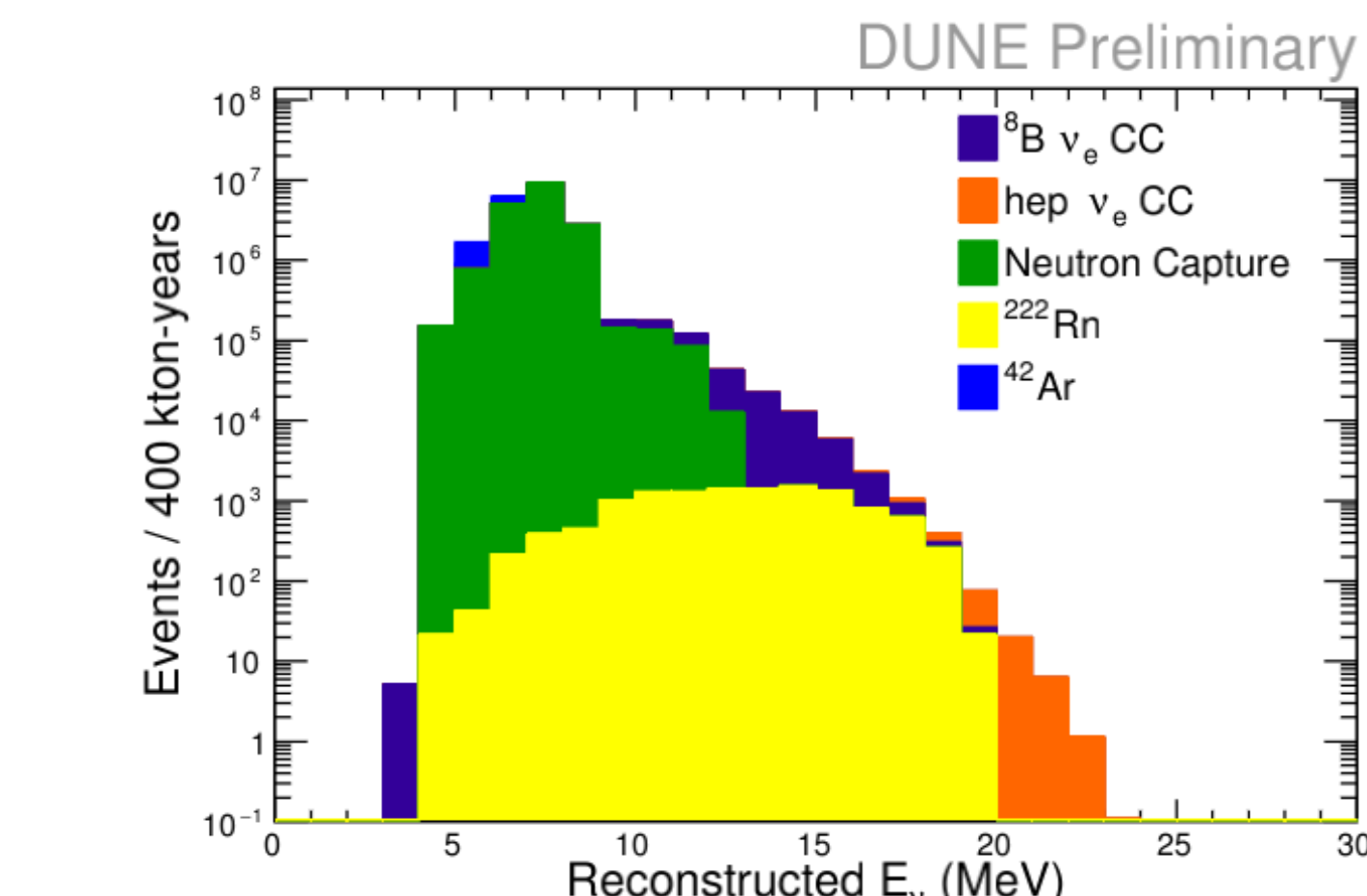
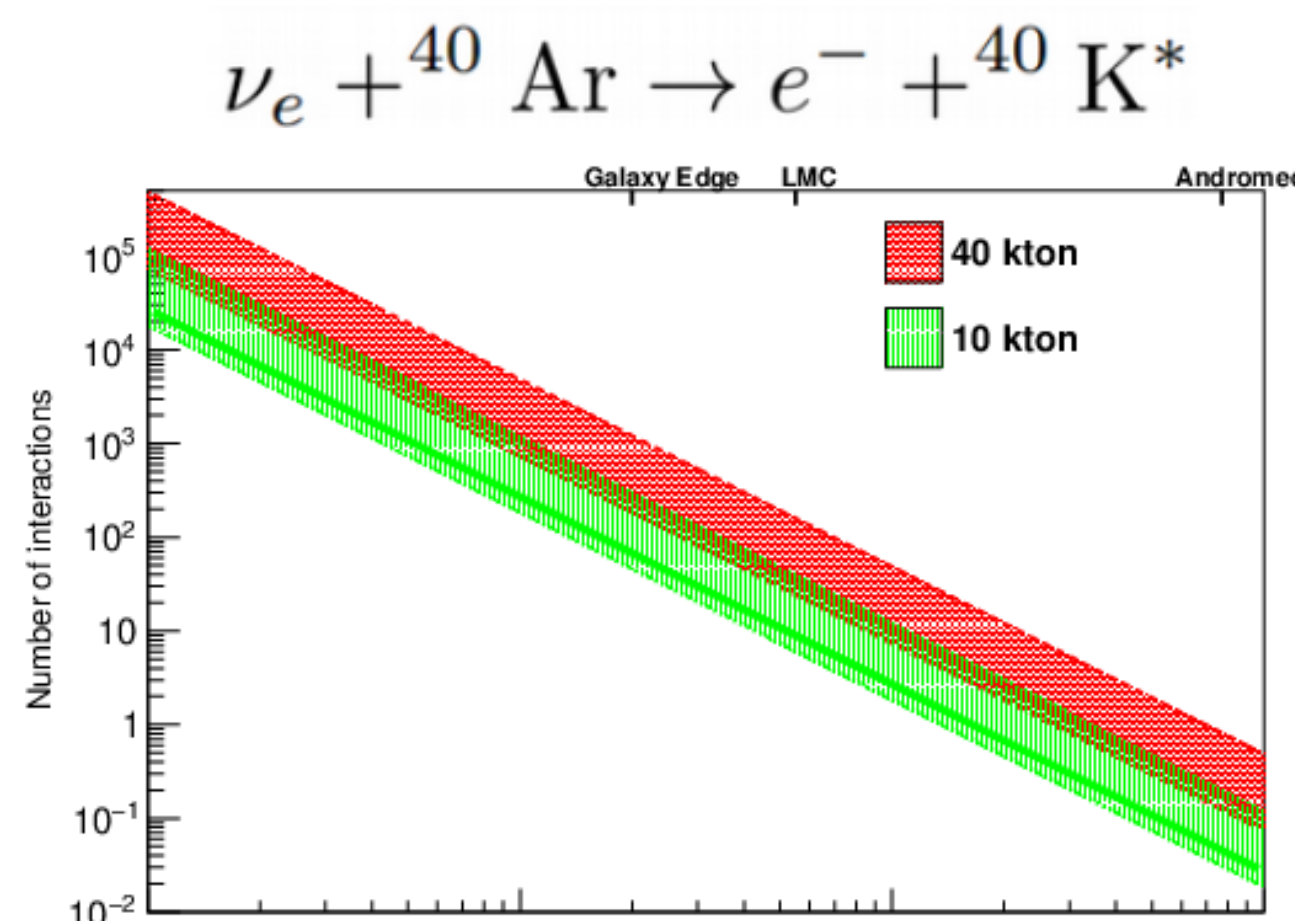
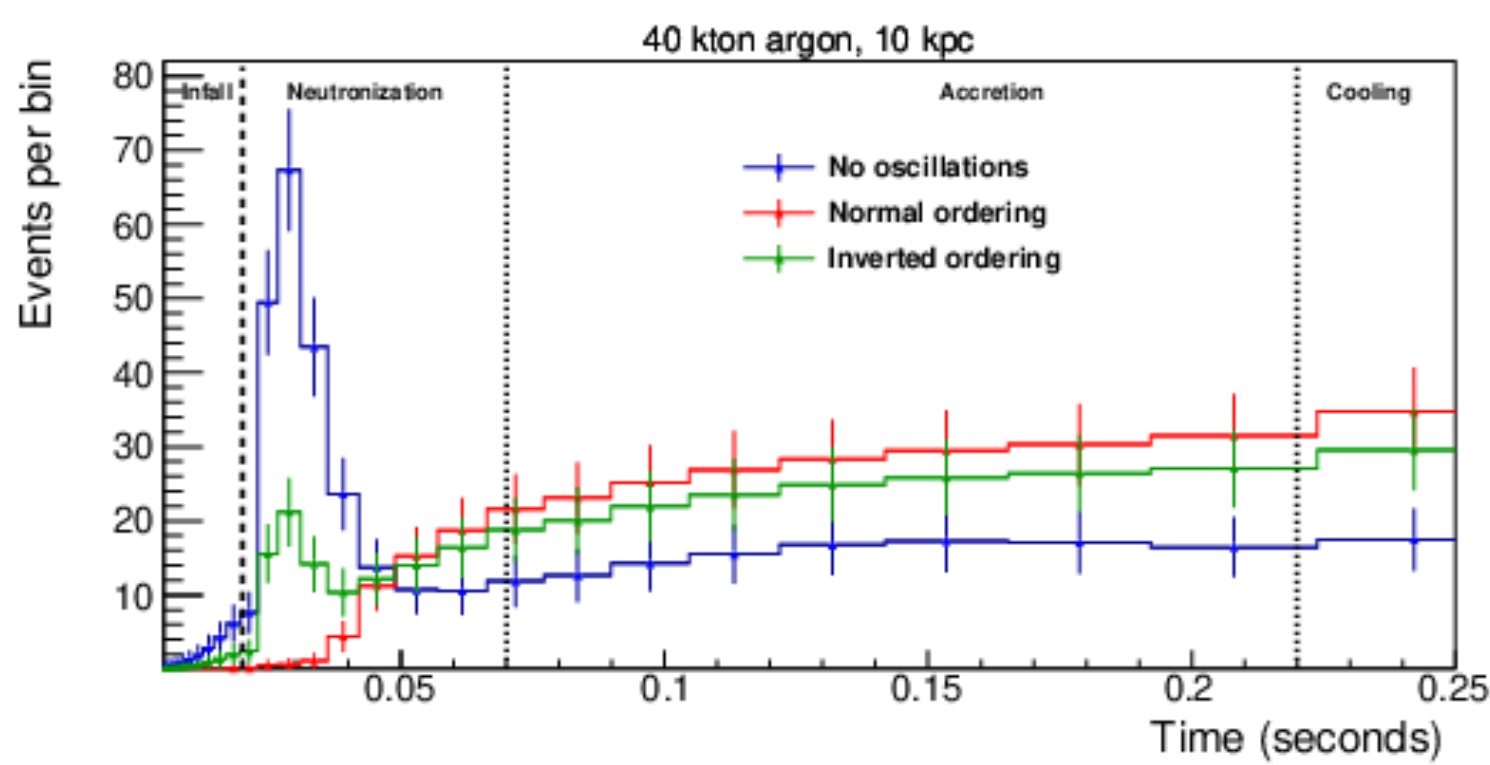
DUNE will compare FD data to FD predictions to measure the oscillation parameters, where the FD prediction comes from the combination of ND data, flux model, neutrino interaction and detector models. Individual sources of systematic uncertainty (flux, interactions, detector effects) are included in the analysis. High efficiency and purity have been achieved with complete simulations in the selections of  $\nu_e$  and  $\nu_\mu$  interactions in the FD using a convolutional neural network and 13% energy reconstruction resolution have been achieved for  $\nu_e$ .



## ASTRONEUTRINOS AND BSM

The underground Far Detector will allow for low background, low threshold observations of supernova neutrinos, with a unique sensitivity to the electron neutrino flux and solar neutrinos.

It will be sensitive to neutrino bursts from a stellar core-collapse supernova what is interesting in supernova physics, particle physics and multimessenger astronomy.

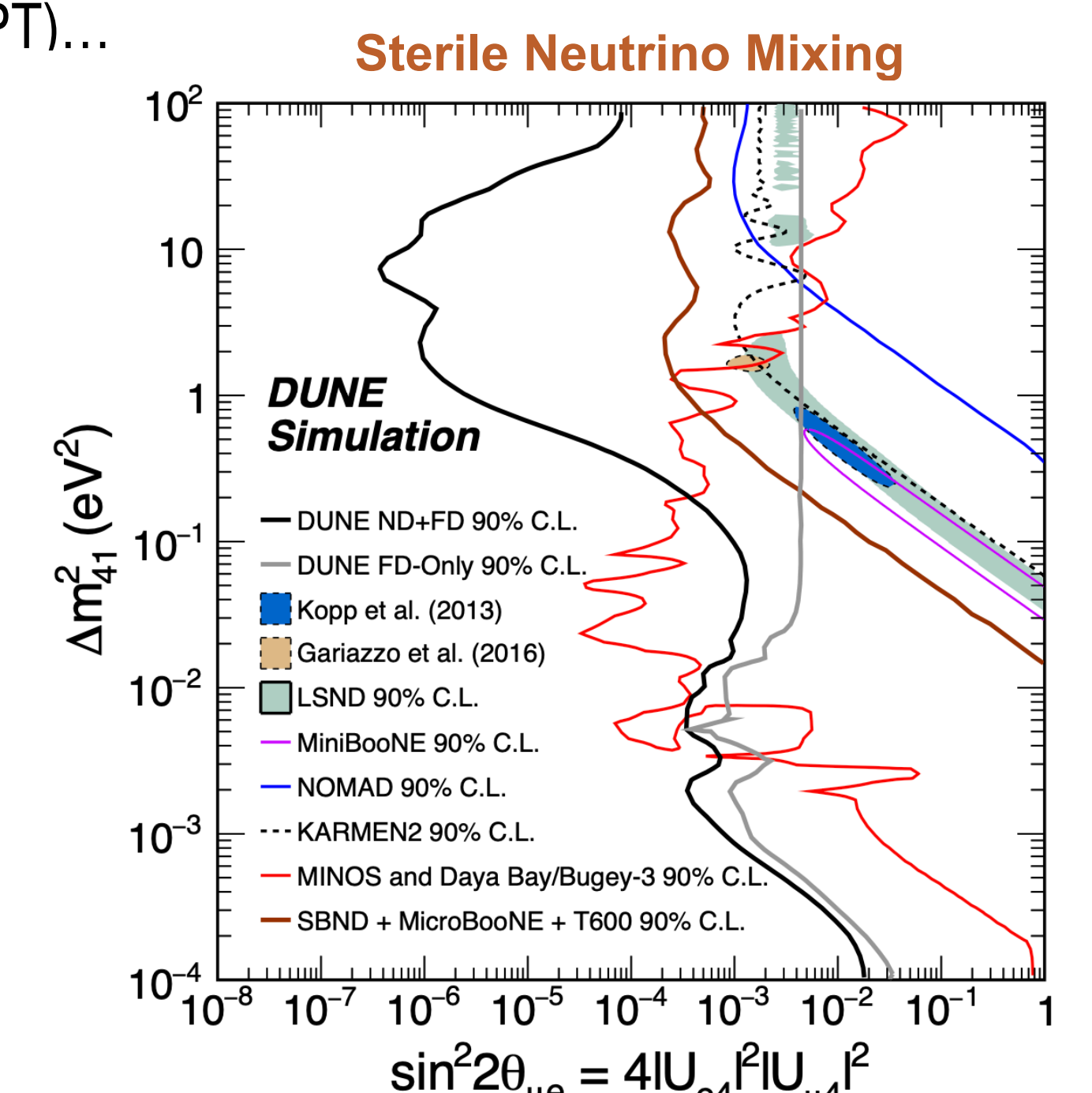
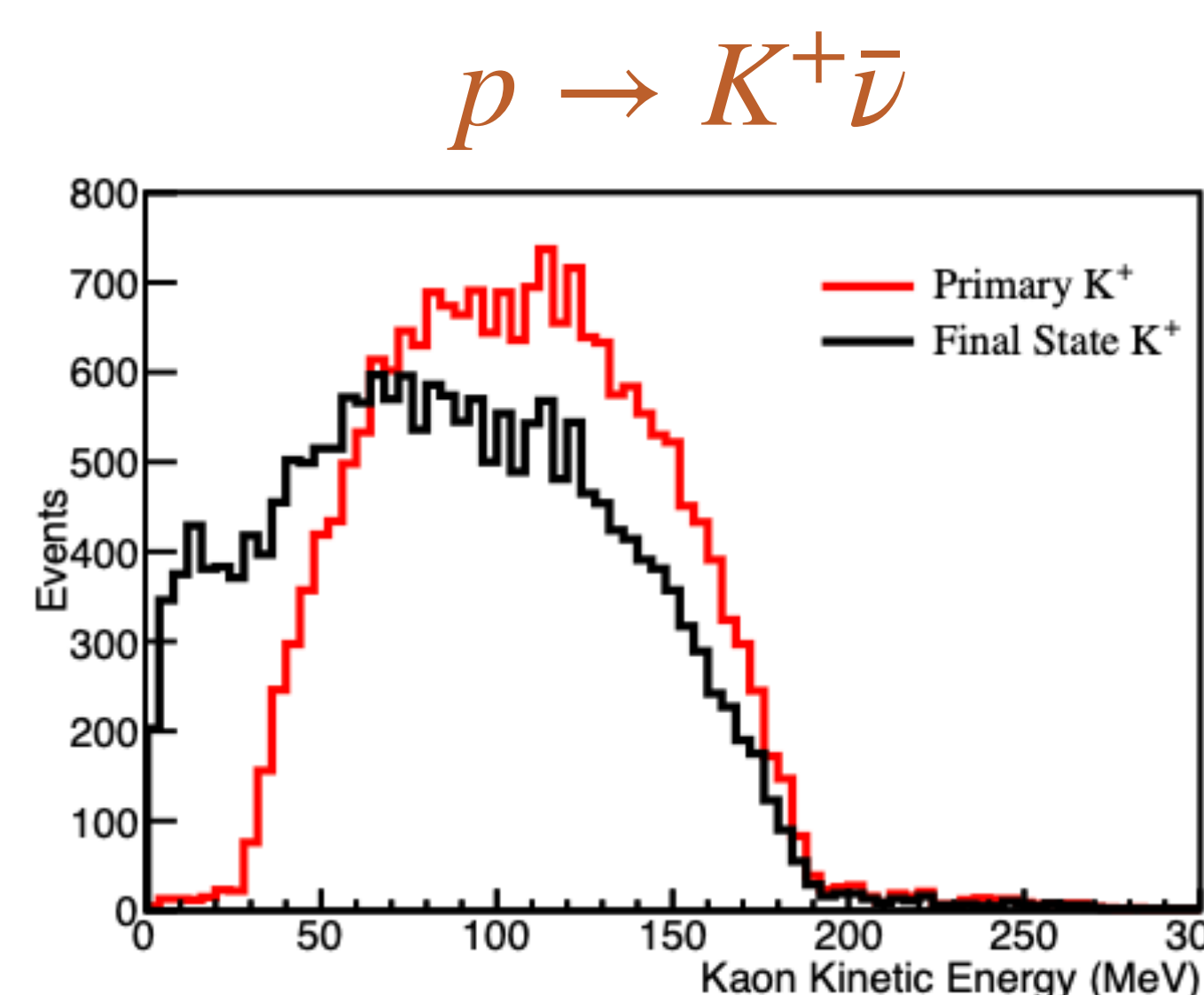


It will be also sensitive to Solar neutrinos thanks to the high granularity and mass of DUNE FD:

- $^8\text{B}$  solar neutrinos
- hep solar neutrinos

The unique combination of the high-intensity neutrino beam with DUNE's high resolution near detector and massive LAR TPC far detector enables a variety of probes of BSM physics, either novel or with unprecedented sensitivity.

- Searches for new phenomena at the FD benefitting from its large mass and resolution: nucleon decay, boosted dark matter ...
- Searches for new physics at the ND: light-mass dark matter, new physics via neutrino trident production, heavy neutral leptons...
- Searches beyond the standard three-neutrino-flavour paradigm (FD and ND): active-sterile neutrino mixing, non-unitarity of the leptonic mixing matrix, non-standard neutrino interactions (NSI); violation of Charge, Parity, and Time reversal symmetry (CPT)...



### References:

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 Deep Underground Neutrino Experiment (DUNE) Near Detector Conceptual Design Report <https://arxiv.org/abs/2103.13910>  
 Long-baseline neutrino oscillation physics potential of the DUNE experiment <https://arxiv.org/abs/2006.16043>

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 Supernova neutrino burst detection with the Deep Underground Neutrino Experiment. *Eur.Phys.J.C* 81 (2021) 5, 423  
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