NOvA

- Long-baseline neutrino oscillation experiment
  - High power/high purity neutrino and antineutrino beams from Fermilab’s NuMI facility
  - At 14 mrad off-axis, energy peaked at 2 GeV
  - 2 Functionally identical detectors separated by 810 km
    - ND on site at Fermilab
    - FD in Ash River, Minnesota

- NOvA addresses many compelling questions surrounding the nature of neutrino mass
  - What is the Neutrino Mass Hierarchy?
  - Is there CP symmetry violation in neutrinos?
  - Is there more to it than 3x3 PMNS?
Best fit in Normal Ordering and Upper Octant

\[ \Delta m_{32}^2 = (2.41 \pm 0.07) \times 10^{-3}\text{eV}^2 \]

\[ \sin^2(\theta_{23}) = 0.57^{+0.03}_{-0.04} \]

\[ \delta_{CP} = 0.89^{+0.27}_{-0.87}\pi \]

NOvA data is consistent with no asymmetry between electron neutrino and antineutrino appearance probability

- In this region of phase space, we can not make strong statements on mass ordering, octant, or \( \delta \) individually
- We disfavor combinations of oscillation parameters that give large asymmetry (NO, \( \delta=3\pi/2 \) and IO, \( \delta=\pi/2 \))

NOvA will run until long shutdown for LBNF, expected to be through 2026. With beam improvements, we aim to at least double current data set

- Reach 3\( \sigma \) sensitivity to the mass ordering for 30-50% of \( \delta \) values
- Reduce largest systematics with results from testbeam program

NOvA Preliminary

arXiv:2108.08219
Global context

- World measurements of atmospheric mixing parameters show good agreement
- Some tension between NOvA and T2K appearance results
  - NOvA does not see strong neutrino/antineutrino asymmetry in electron neutrino appearance
  - T2K observes more electron neutrino appearance than electron antineutrino appearance
- NOvA and T2K have joined forces on a joint fit
  - Different baselines and energies provide complementary information
  - Results expected this year

- Error bars 20-25%, mostly statistical
  - Will decrease with more data