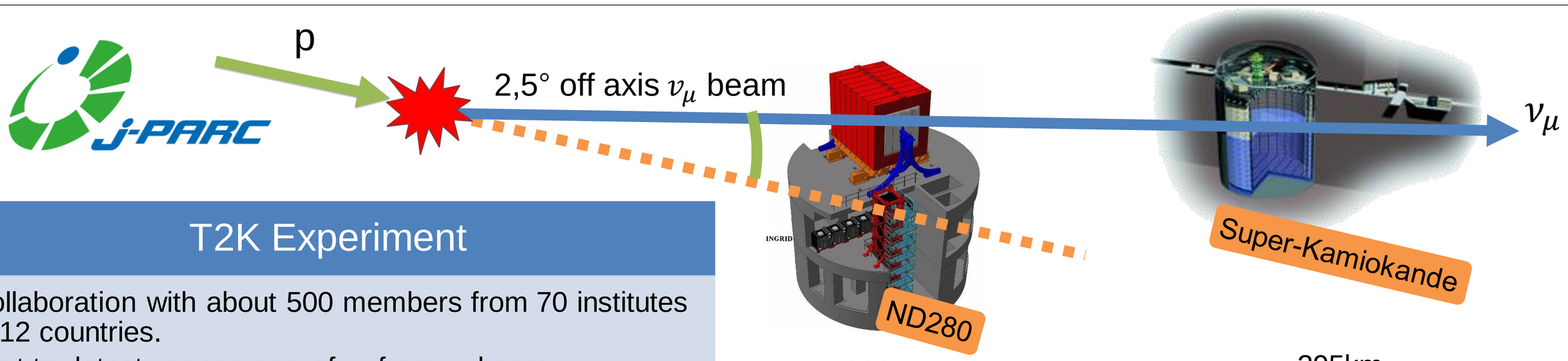
The T2K ND280 upgrade

Nick Thamm on behalf of the T2K collaboration



T2K Experiment

- Collaboration with about 500 members from 70 institutes in 12 countries.
- First to detect appearance of ν_e from ν_μ beam
- Precise measurement of oscillation parameters
- Search for CP violation
- Measurements of interaction cross-sections

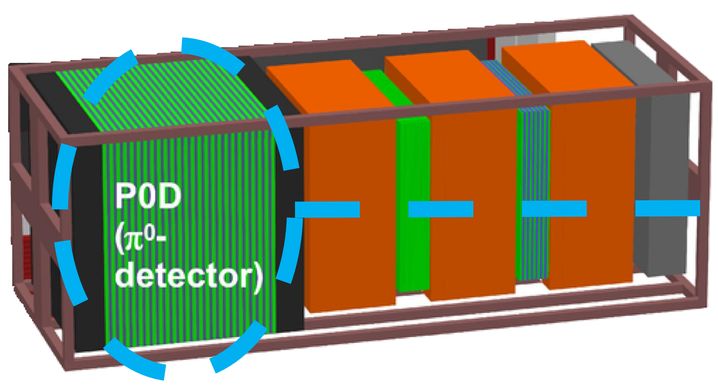
ND280

- Set of sub-detectors placed inside 0.2T magnetic field from UA1 magnet
- Main tasks:
  - Measure flux and beam composition
  - Study neutrino interaction cross-sections

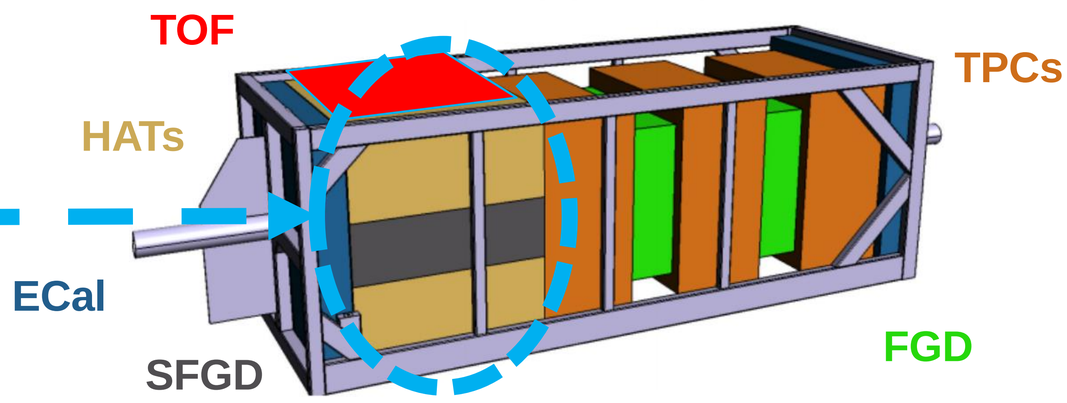
T2K-II

- Extension of T2K to 2026 with 10×10^{21} POT
- Proton beam upgrade to 1.3MW
- Super-Kamiokande Gd-doping approved and ongoing
- Partial replacement of ND280 until end of 2022
- First data-taking early 2023

ND280 v1.0

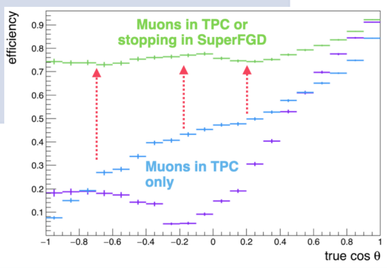


ND280 v2.0



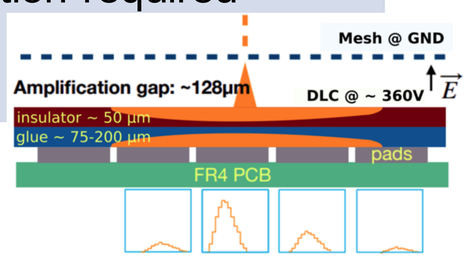
SFGD

- 3D active target detector
- Polystyrene scintillator cubes (1 cm³)
- WLS fibres for readout
- Baseline configuration 184 x 192 x 56 cubes (~2 tonnes material)



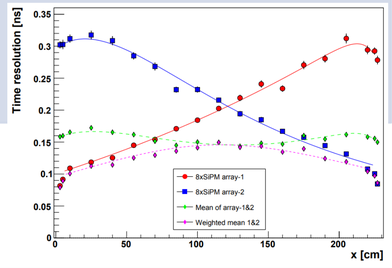
High Angle TPC

- Particle identification via dE/dx
- Using T2K-Gas
- 36864 channels with ~1cm² pads
- Resistive Bulk Micromegas
  - No spark protection required
  - Charge spread



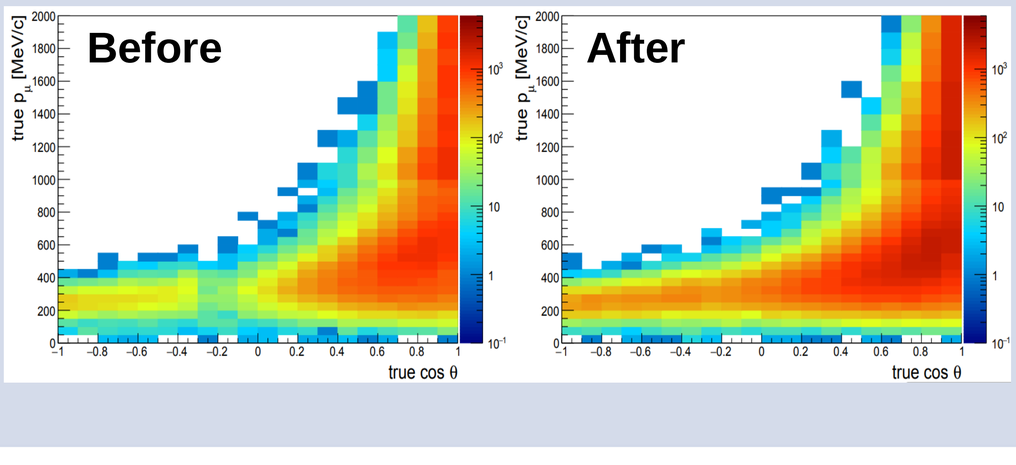
TOF

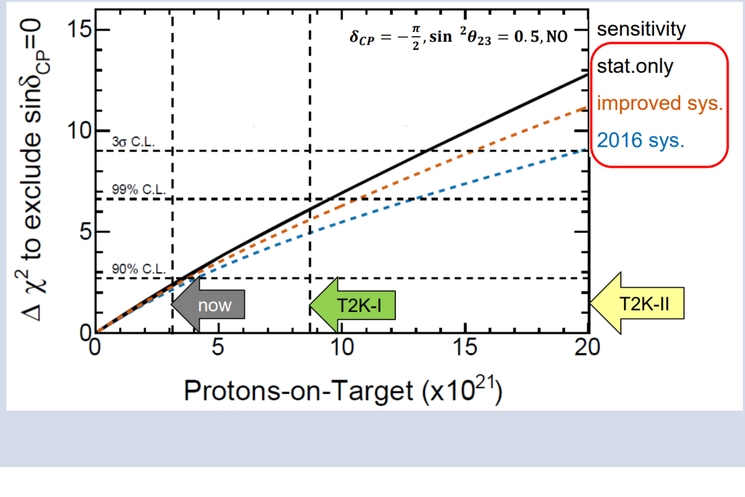
- 2.3m long scintillating bars with 8MPPCs per end
- Time resolution 150ps
- Timing for track reconstruction
- Rejects out-of-fiducial volume interaction



Performance gains

- Flux and cross-section systematic uncertainties reduced by 30-40%
- Reducing systematic error to 4%
- >90% muon detection efficiency increases event-rate by 15-20%
- Increased acceptance for large scattering angles and lower detection threshold
- Measurement of CP violation better than 3σ





References:
- K. Abe et al, „The T2K Experiment “, arxiv:1106..1238, 2011
- K. Abe et al, „T2K ND280 Upgrade -- Technical Design Report“, arxiv:1901.03750, 2020
- The T2K Collaboration, „Constraint on the matter–antimatter symmetry-violating phase in neutrino oscillations”, Nature 580, 339–344 (2020). https://doi.org/10.1038/s41586-020-2177-0

DFG Deutsche Forschungsgemeinschaft
Physics Institute III B
RWTH AACHEN UNIVERSITY