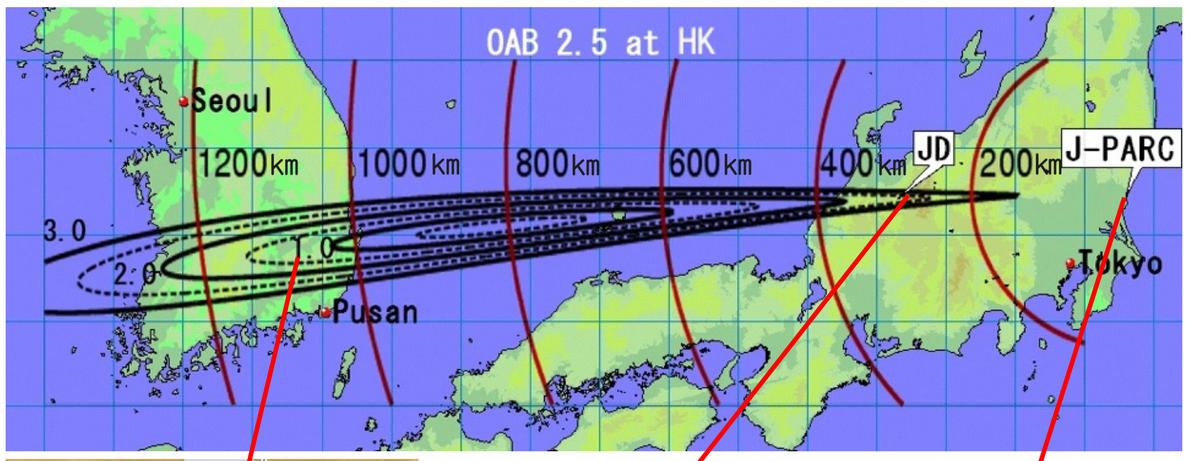
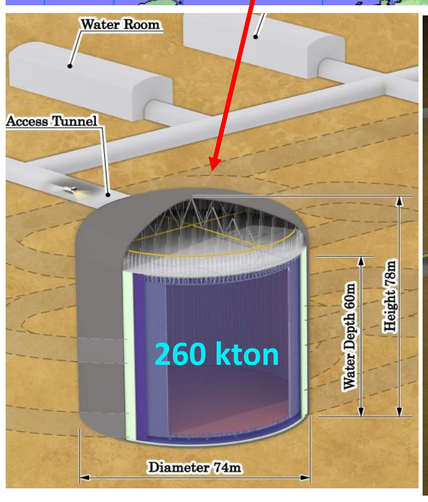
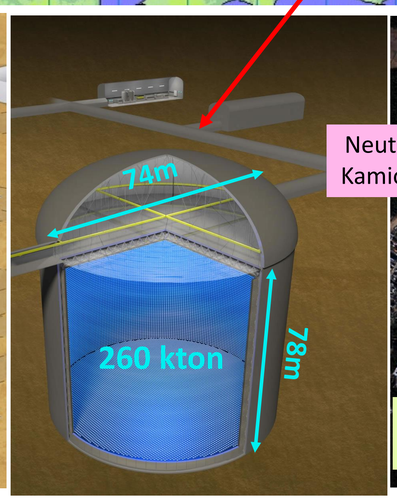
Physics Sensitivity Studies at Korean Neutrino Observatory

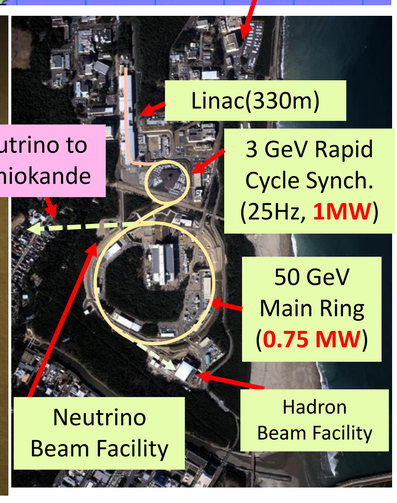
Sanghoon Jeon (Sungkyunkwan University)
on behalf of the KNO (Korean Neutrino Observatory) group
Heidelberg, NEUTRINO2018

KNO (Korean Neutrino Observatory)





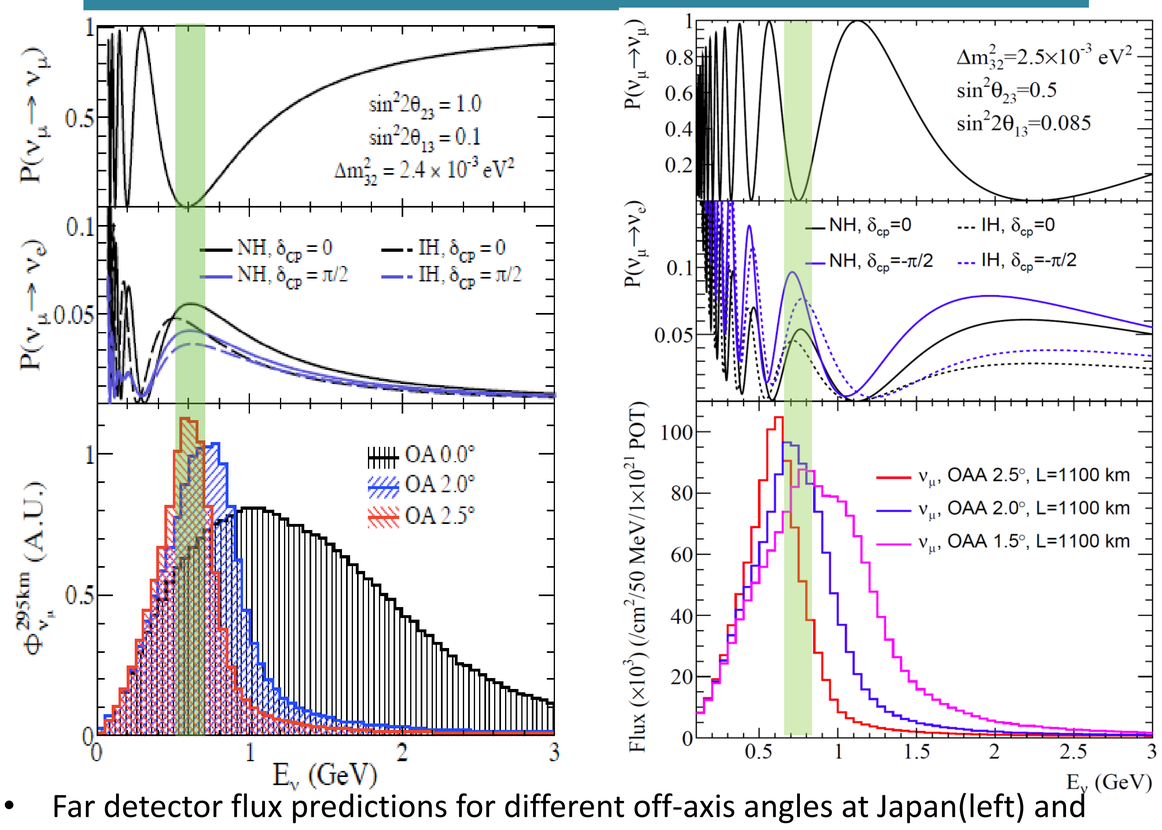




Physics Goals of KNO
- Neutrino mass ordering determination & δ_{cp} measurement
- Non-standard neutrino interaction
- Supernova burst, relic neutrinos, solar neutrinos, geo-neutrinos

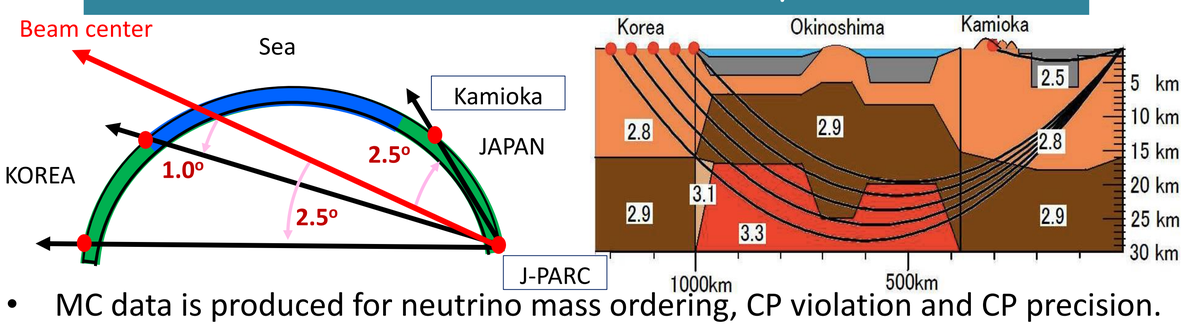
Motivation and Simulation Setup

comparison of neutrino oscillation maxima in Japan and Korea



- Far detector flux predictions for different off-axis angles at Japan(left) and Korea(right).
- Both 1st and 2nd neutrino oscillation maxima can be measured by Korean detector.

cross sectional view of the KNO experiment



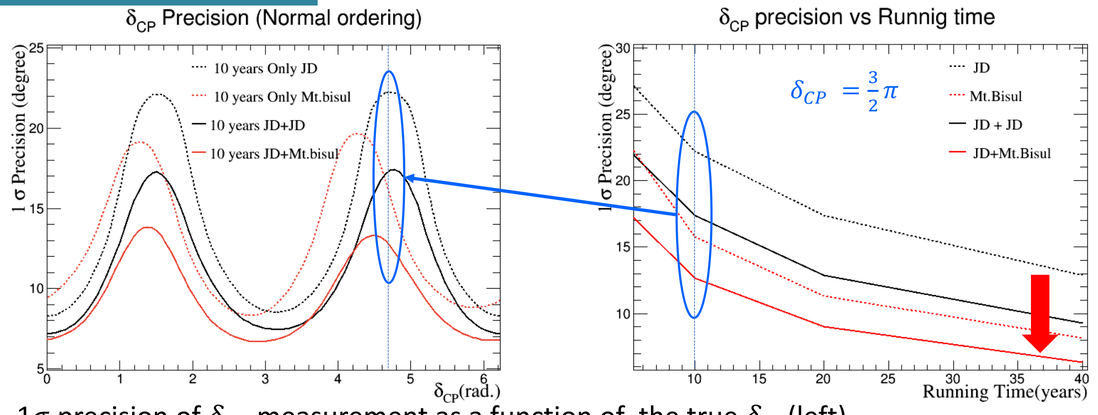
- MC data is produced for neutrino mass ordering, CP violation and CP precision.
- T2K error model is used and implemented for the systematics in the Korean sites.

Sensitivity Studies

- 2.7 x 10^{22} POT, ν:$\bar{\nu}$ = 1:3, (1.3 MW x 10 years operation
- matter density values
  JD(Japan Detector) = 2.6g/cm^3, KD(Korean Detector) = 3.0g/cm^3
- Mt.Bisul (KD candidate site) : OAA(off-axis angle) 1.3°, 1088km
- The same systematics are assumed for all plots.

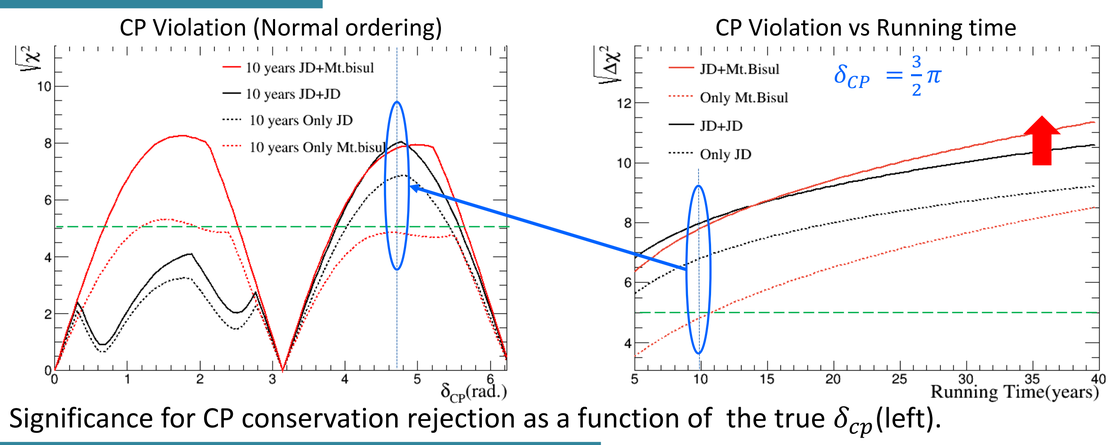
$|\Delta m^2_{32}|$ = 2.5x10^{-3} eV^2
$sin^2\theta_{23}$ = 0.5
$sin^2 2\theta_{13}$ = 0.085
Δm^2_{21} = 7.53x10^{-5} eV^2
$sin^2\theta_{12}$ = 0.304

precision of CP phase



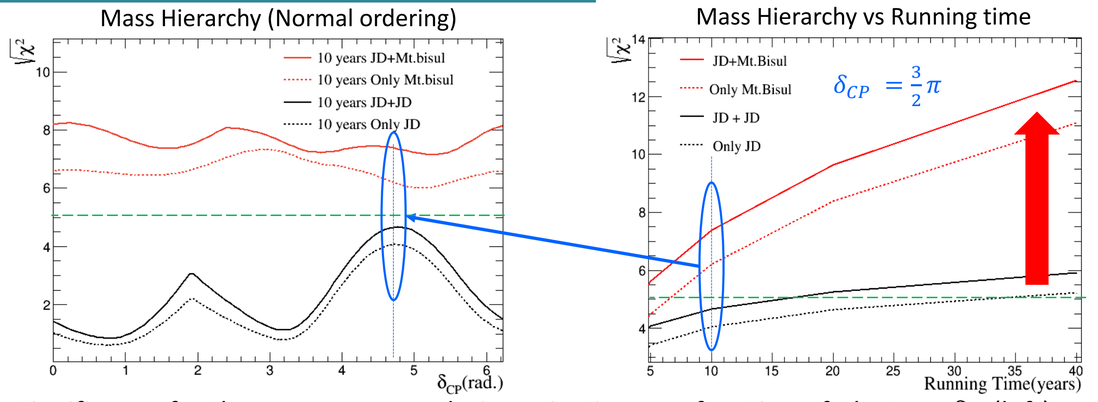
- 1σ precision of δ_{cp} measurement as a function of the true δ_{cp}(left).

CP violation sensitivity



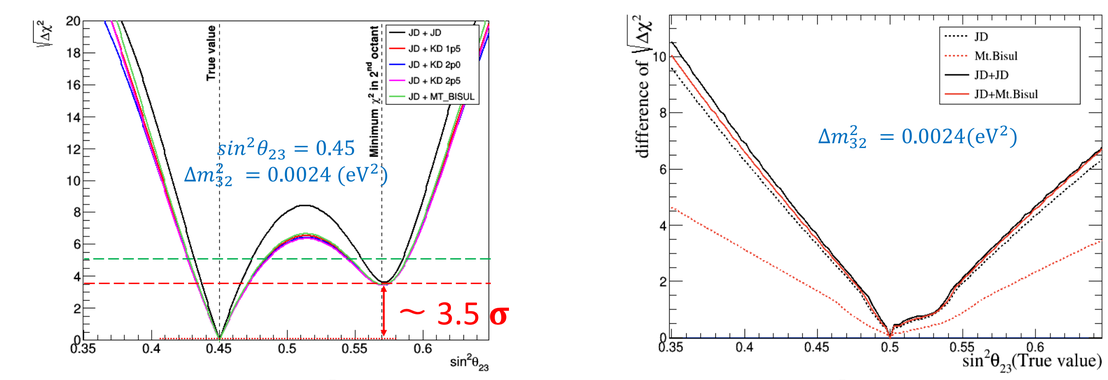
- Significance for CP conservation rejection as a function of the true δ_{cp}(left).

determination of neutrino mass ordering



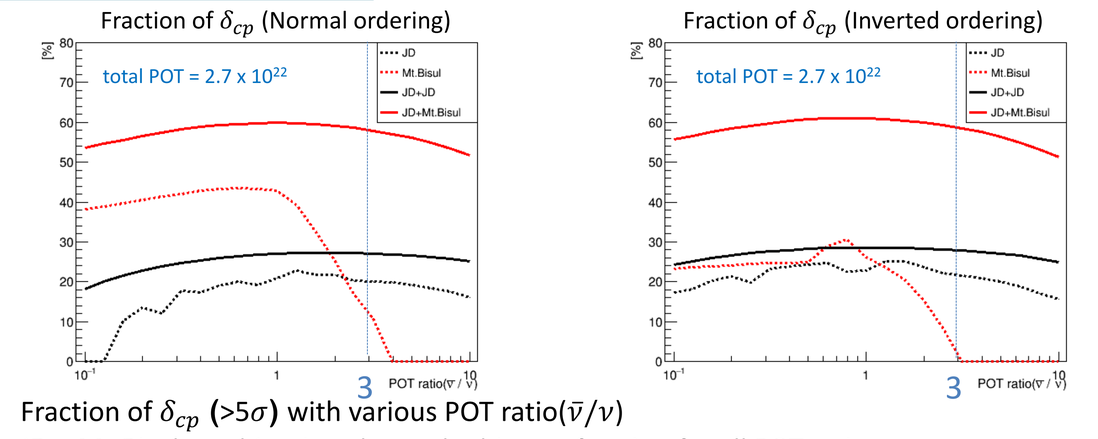
- Significance for the wrong mass ordering rejection as a function of the true δ_{cp}(left).

resolving the octant θ_{23} degeneracy



- Difference of minimum χ^2 at opposite octant with various true $sin^2\theta_{23}$(right)

fraction of δ_{cp} ($\sqrt{\chi^2} > 5\sigma$)



- Fraction of δ_{cp} (>5σ) with various POT ratio($\bar{\nu}/\nu$)
- JD + Mt.Bisul combination shows the biggest fraction for all POT ratio.

Reference

[1] K. Abe et al, Hyper-K design report , arXiv:1805.04163v1 [physics.ins-det], 9 May 2018
[2] K. Abe et al, Physics Potentials with the Second Hyper-Kamiokande Detector in Korea, arXiv:1611.06118v3 [hep-ex], 26 Mar 2018
[3] N. Okamura, The earth matter effects in neutrino oscillation experiments from Tokai to Kamioka and Korea, arXiv:1107.5857v2 [hep-p], 8 Sep 2011
[4] "T2HKKSensitivity-master" – Anaysis package by M. Hartz

Summary

- **Among various detector configurations, Japan + Mt.Bisul combination gives the best sensitivities for δ_{cp} precision, CP violation, and mass ordering.**