Korea Neutrino Observatory (KNO)

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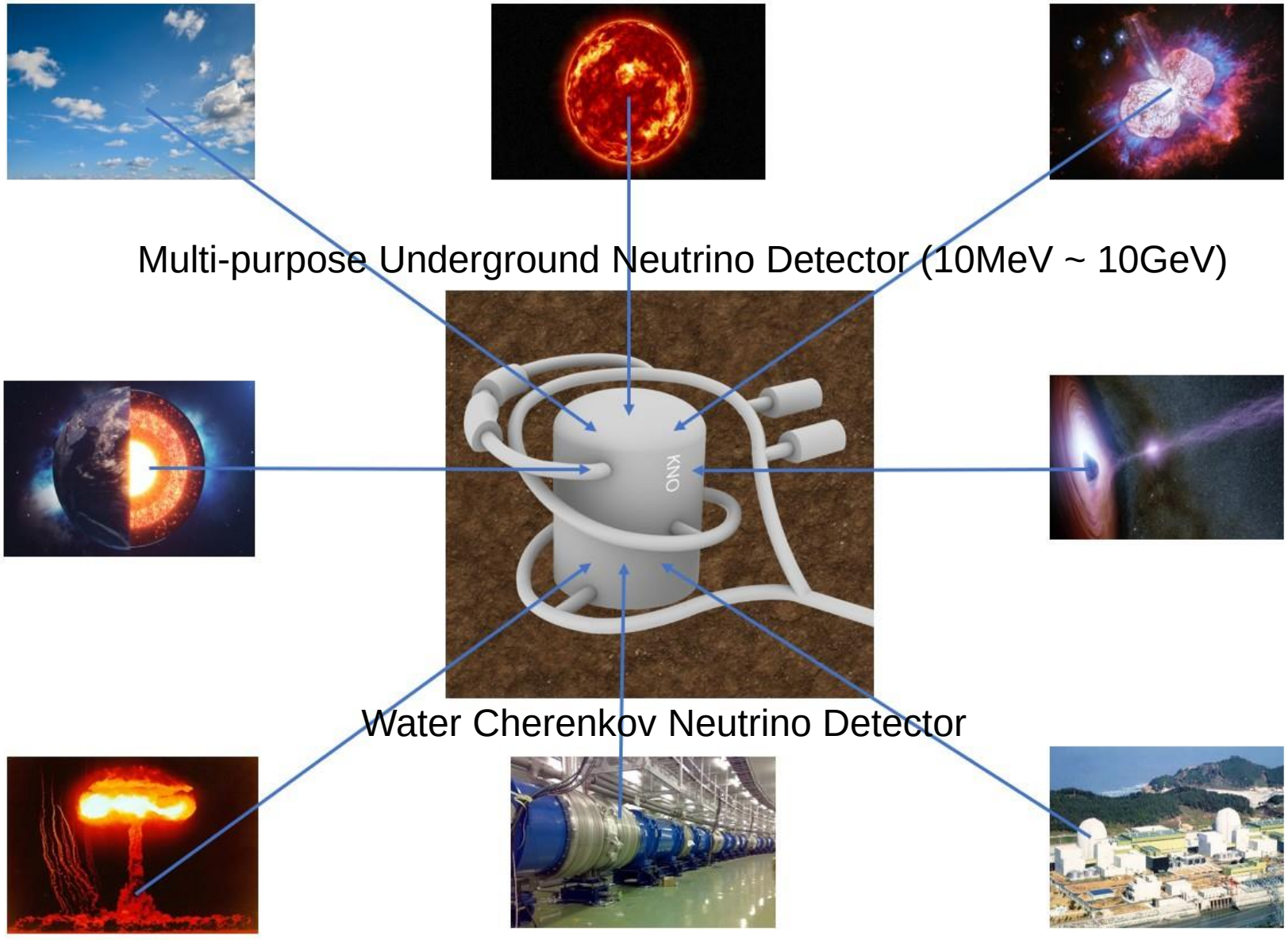
SKKU, Korea

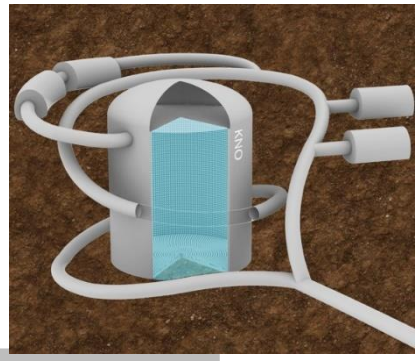
2023. 8. 24 NuFACT2023

KNO Detector

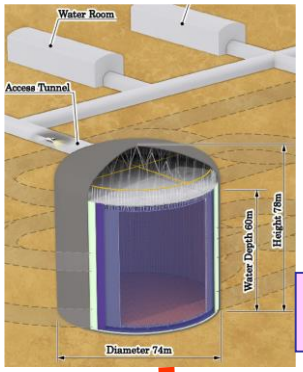


KNO and HK

KNO
(a.k.a T2HKK)



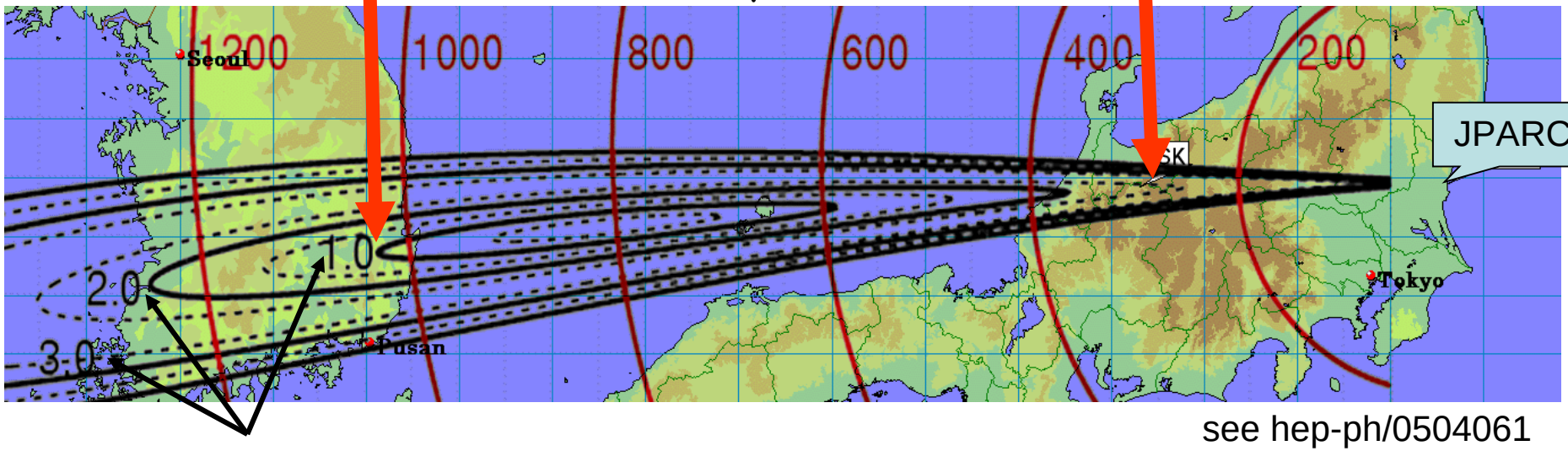
~1.5 deg. off axis



Hyper-K

2.5 deg. off axis

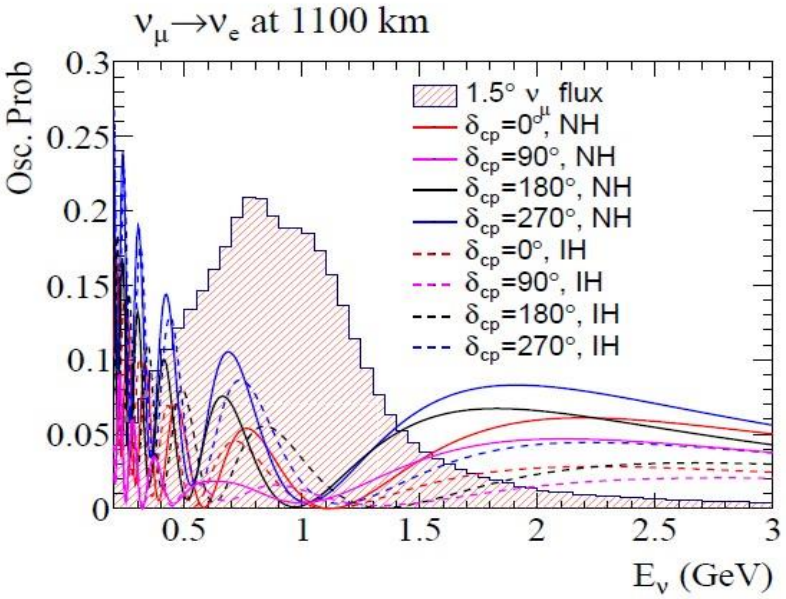
The J-PARC ν_μ beam comes to Korea.

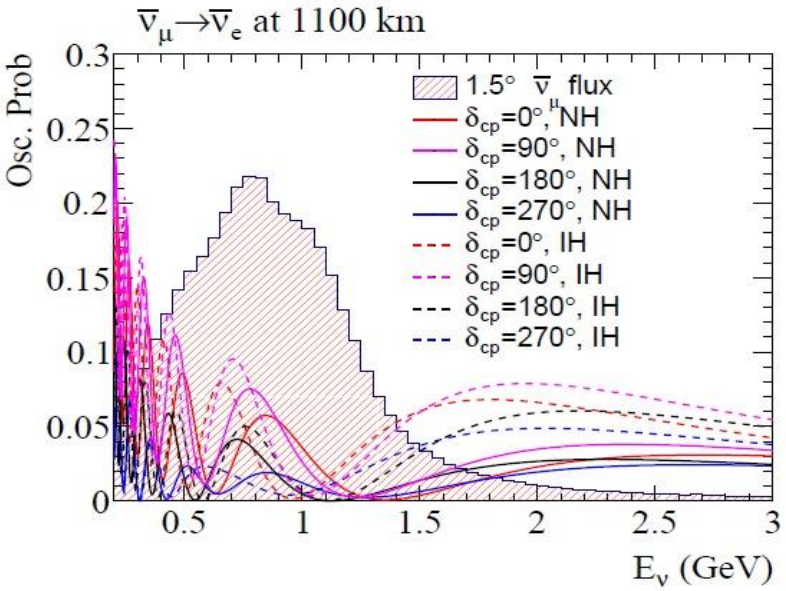


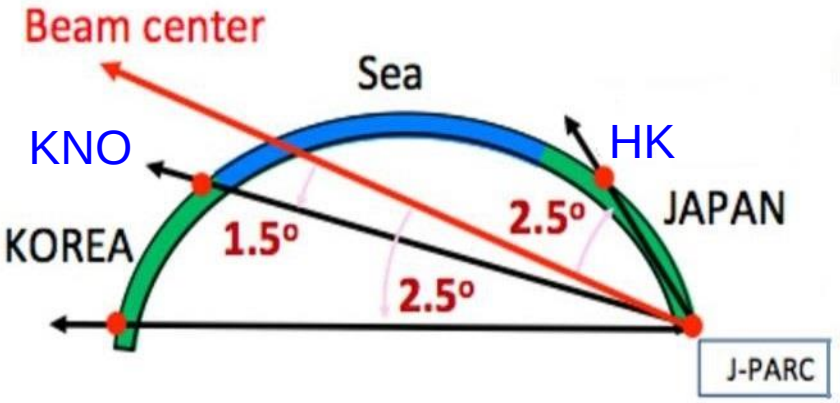
Off-axis angle

see hep-ph/0504061
By K. Hagiwara, N. Okamoura, K. Senda

Neutrino Oscillations in KNO & Kamioka





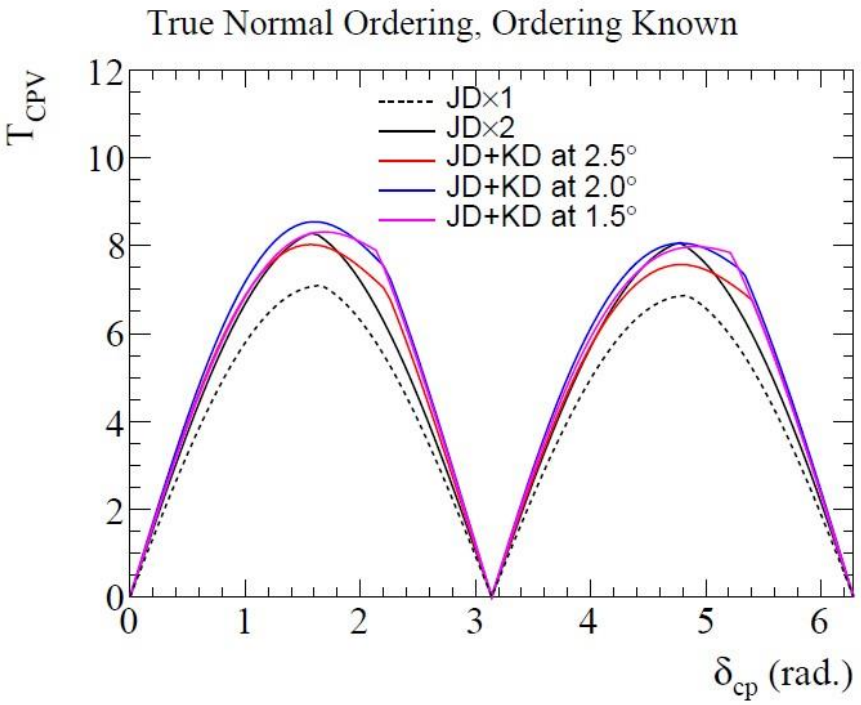


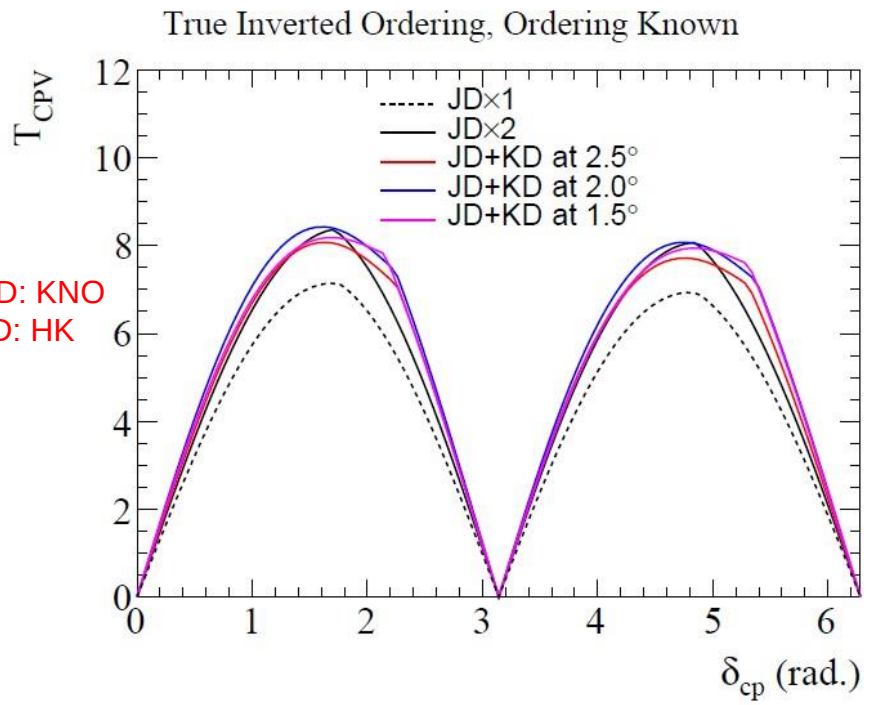
Comparison of KNO and HK

- Several oscillation maxima covered by KNO and mainly 1st oscillation maximum covered by HK
- Larger differences between $P(\nu_\mu \to \nu_e)$ and $P(\bar{\nu}_\mu \to \bar{\nu}_e)$ at KNO
- Smaller neutrino flux at KNO

Physics Potential at KNO

- Significance of CP conservation rejection





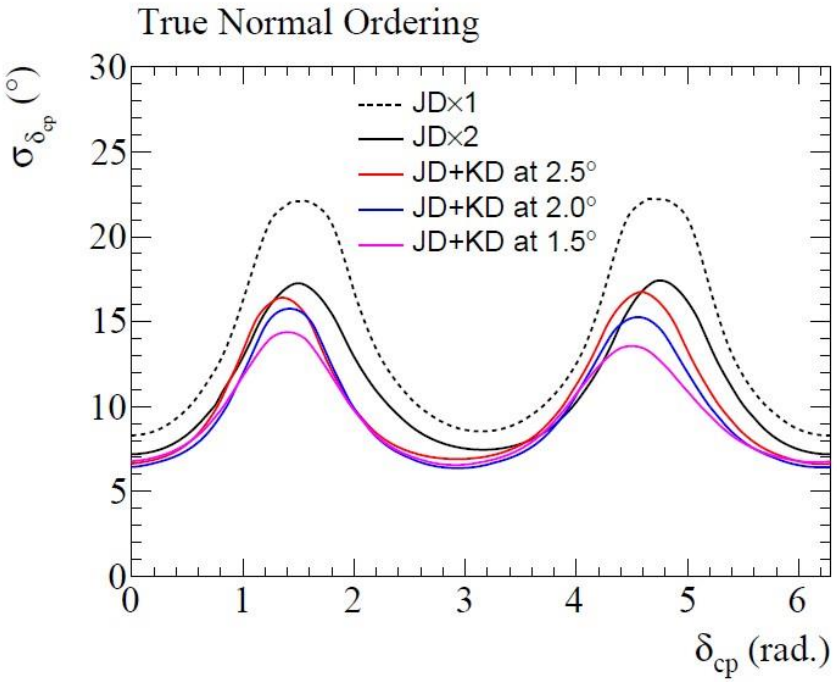
KD: KNO
JD: HK

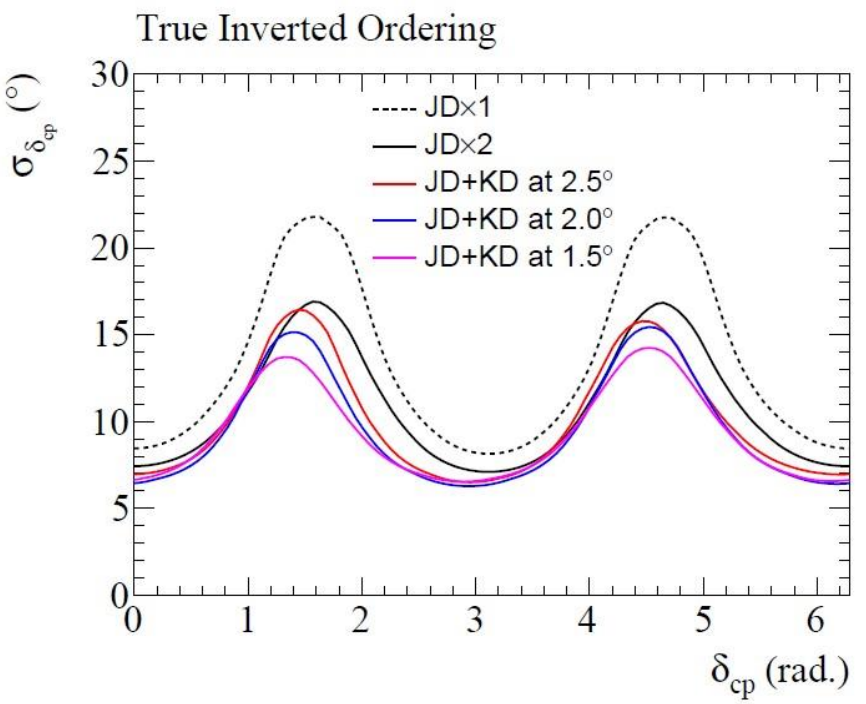
PTEP 063C01 (2018), T2HKK White Paper

- 10 years of Operation with 1.3MW of J-PARC Beam ($\bar{\nu}:\nu = 3:1$)
- HK (0.26Mt) and KNO (0.26Mt)

Physics Potential at KNO

- 1σ precision of δ_{cp} measurement





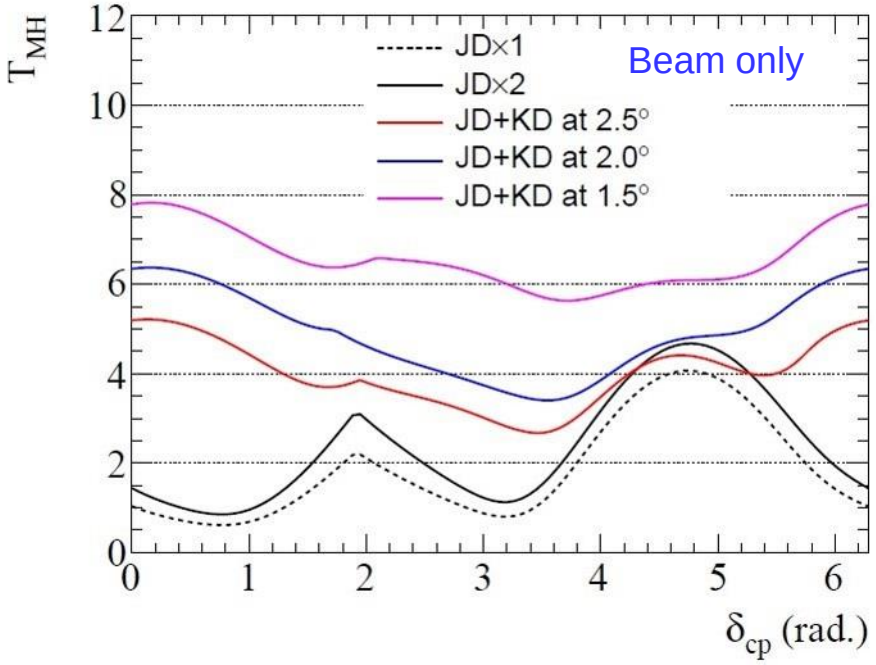
PTEP 063C01 (2018), T2HKK White Paper

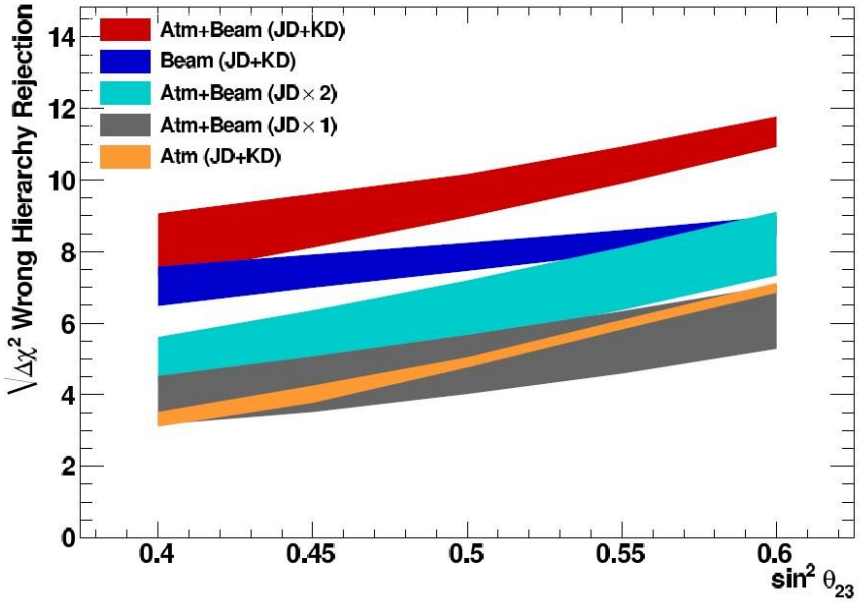
- 10 years of Operation with 1.3MW of J-PARC Beam ($\bar{\nu}:\nu = 3:1$)
- HK (0.26Mt) and KNO (0.26Mt)

Physics Potential at KNO

- Significance of mass ordering measurement

Normal Mass Ordering





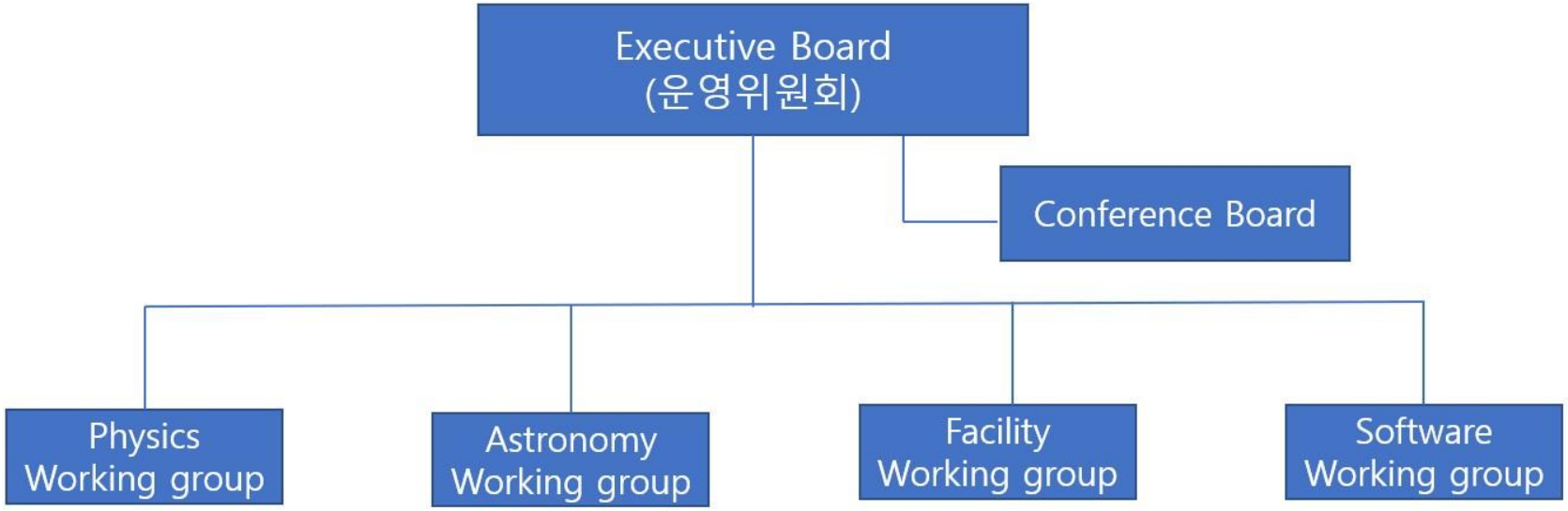
PTEP 063C01 (2018), T2HKK White Paper

- 10 years of Operation with 1.3MW of J-PARC Beam ($\bar{\nu}:\nu = 3:1$)
- HK (0.26Mt) and KNO (0.26Mt)

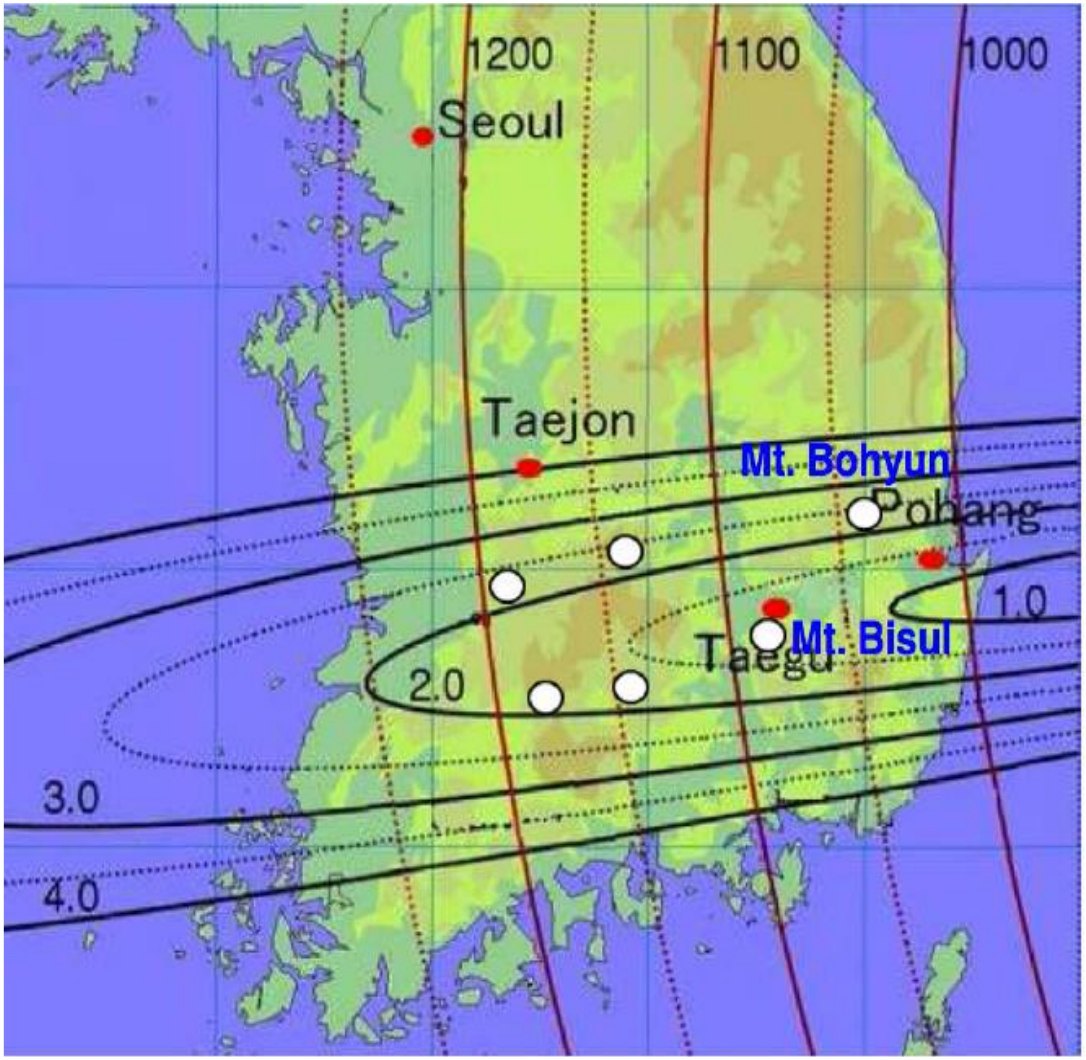
KNO Organization

- KNO working groups have been organized and active (2018~)
- KNO web site is open (www.kno.or.kr)

KNO Organization Chart



KNO Candidate Sites

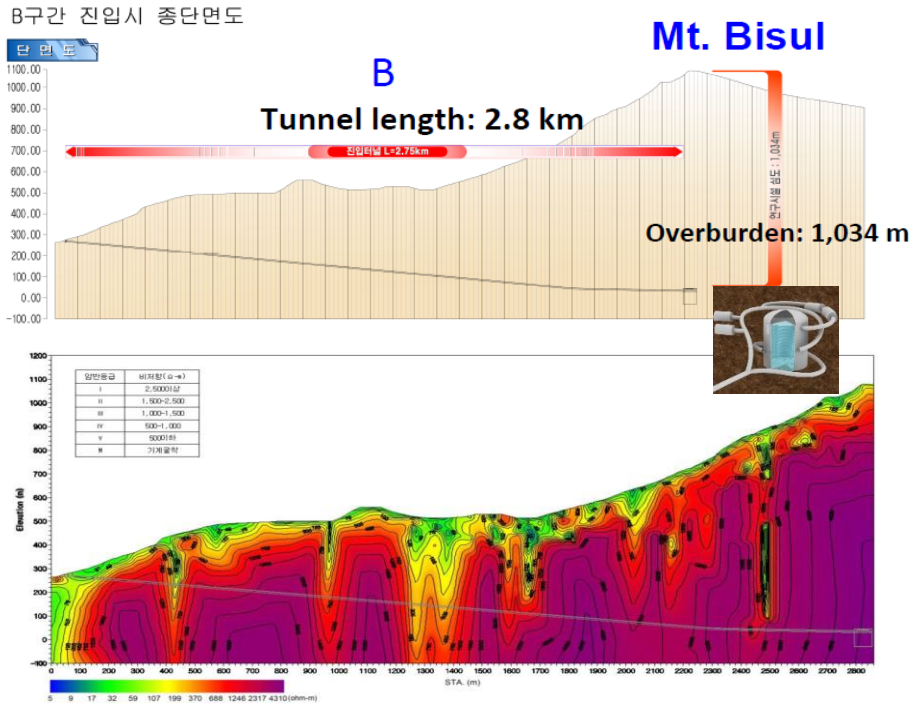


- Off-axis angle: 1.5°~2.5°
- Baseline : 1000 ~ 1200km
- Top candidate sites :
  - Mt. Bisul
  - Mt. Bohyun

Site	Height (m)	Baseline (km)	Off-axis angle (degree)	Elements of rock
Mt. Bisul	1084	1088	1.3°	Granite porphyry, Andesitic breccia
Mt. Hwangmae	1113	1140	1.8°	Flake granite, Porphyritic gneiss
Mt. Sambong	1186	1180	1.9°	Porphyritic granite, Biotite gneiss
Mt. Bohyun	1124	1040	2.2°	Granite, Volcanic rocks, Volcanic breccia
Mt. Minjuji	1242	1140	2.2°	Granite, Biotite gneiss
Mt. Unjang	1125	1190	2.2°	Rhyolite, Granite porphyry, Quartz porphyry

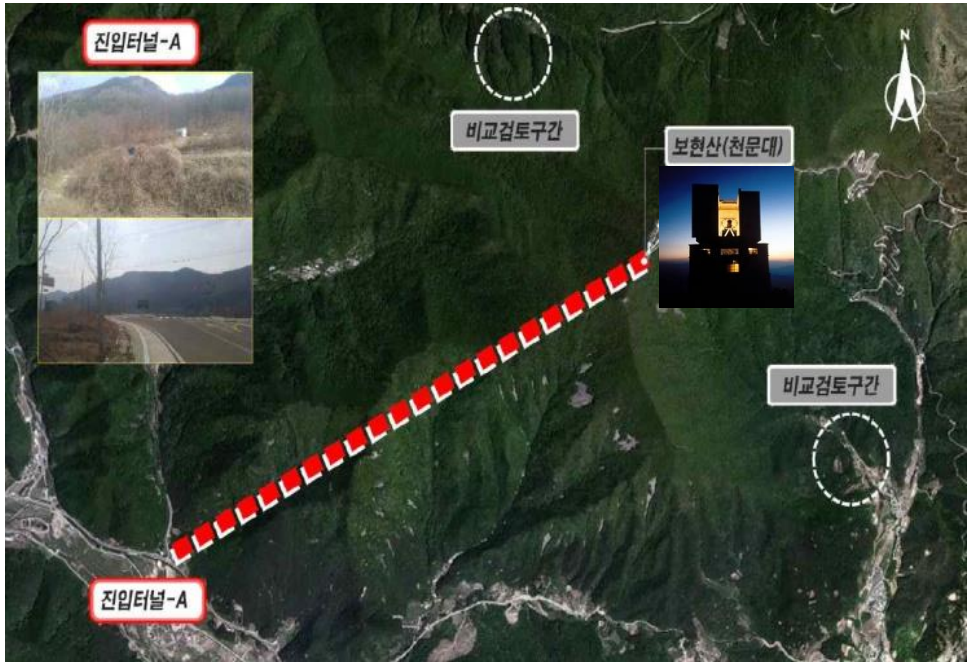
Candidate Sites : Mt. Bisul

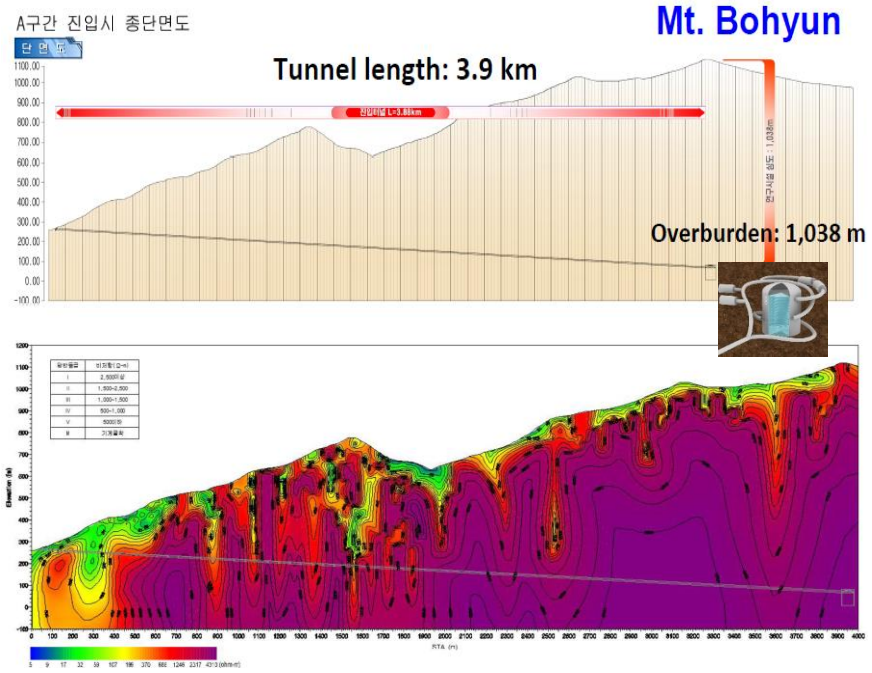
- Height : 1084m, Baseline : 1088km, Off-axis angle : 1.3°
- Good accessibility / excellent water quality



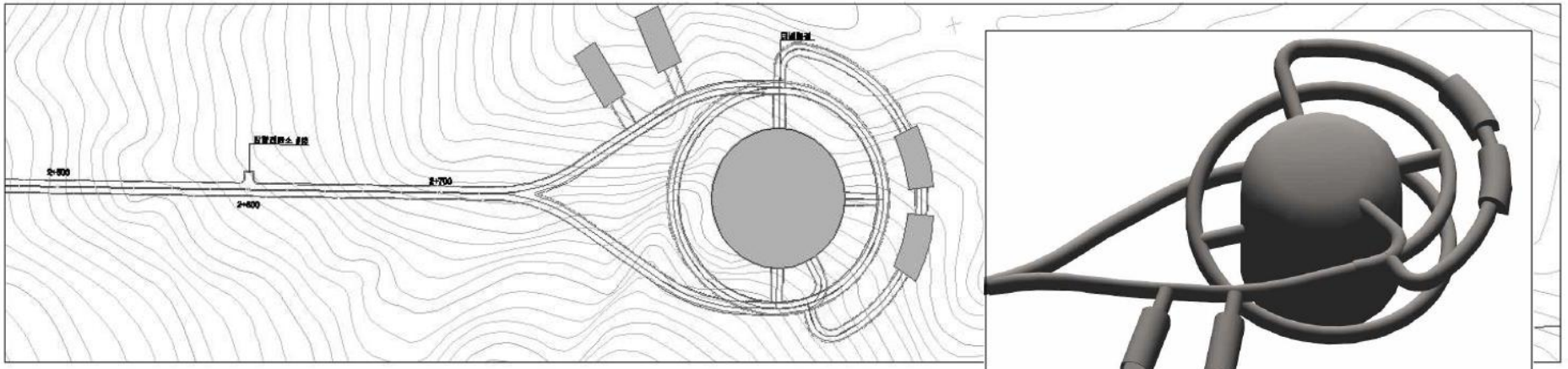
Candidate Sites : Mt. Bohyun

- Height : 1124m, Baseline : 1040km, Off-axis angle : 2.2°
- Good accessibility / Optical observatory on the mountaintop

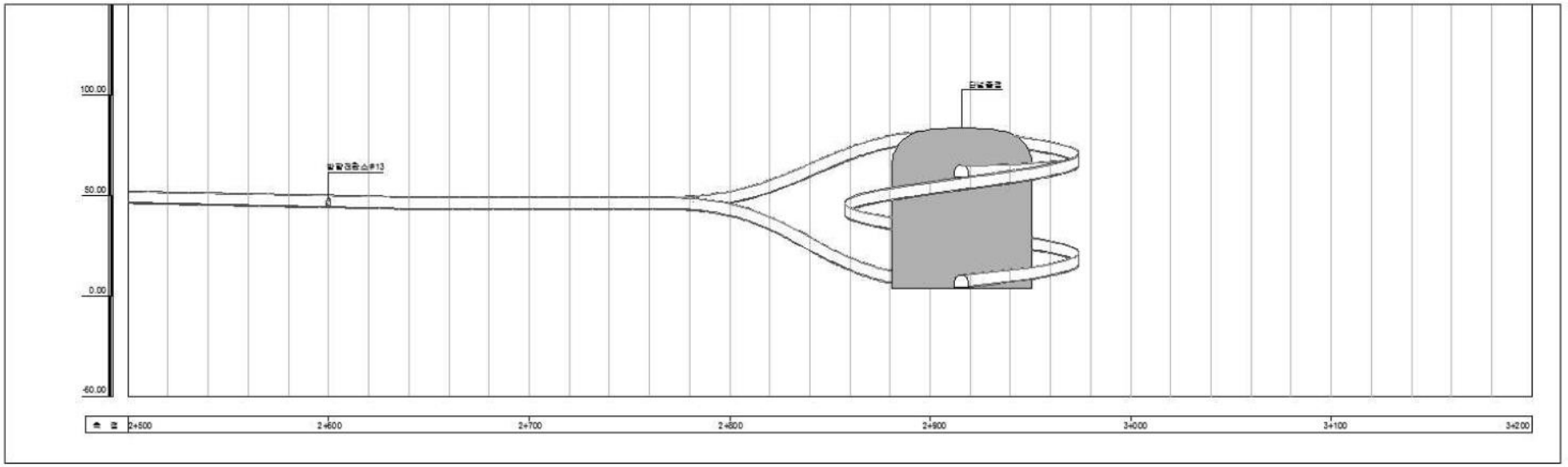




Conceptual Design of Underground Facility

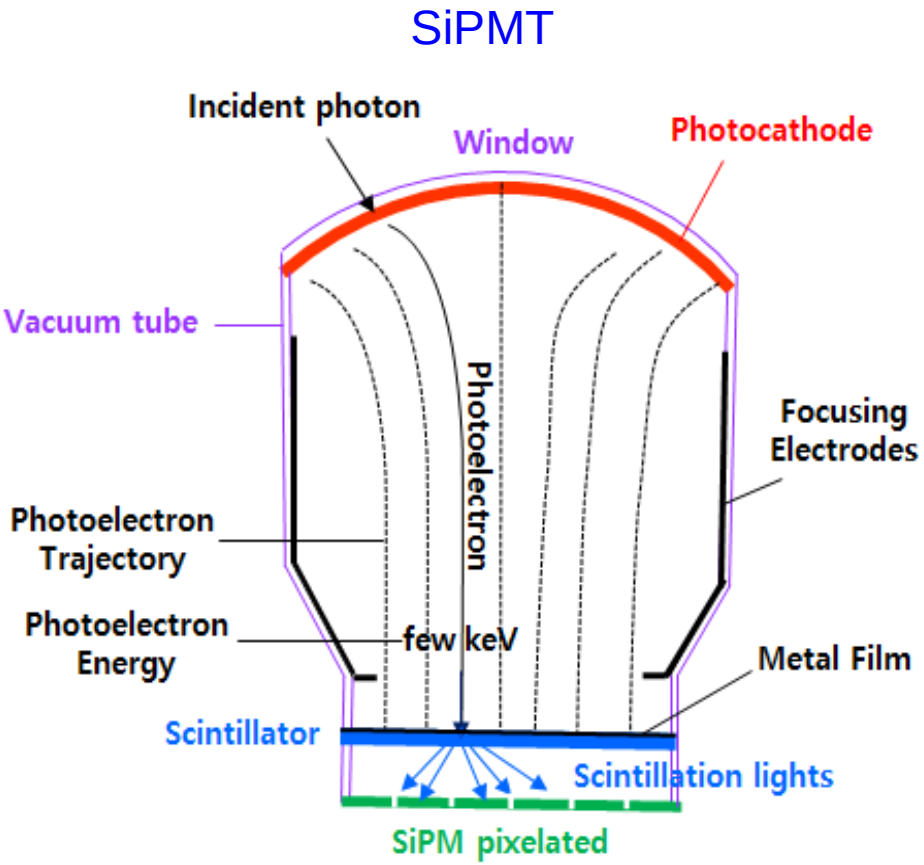


종단면도



Detector R&D on PMT

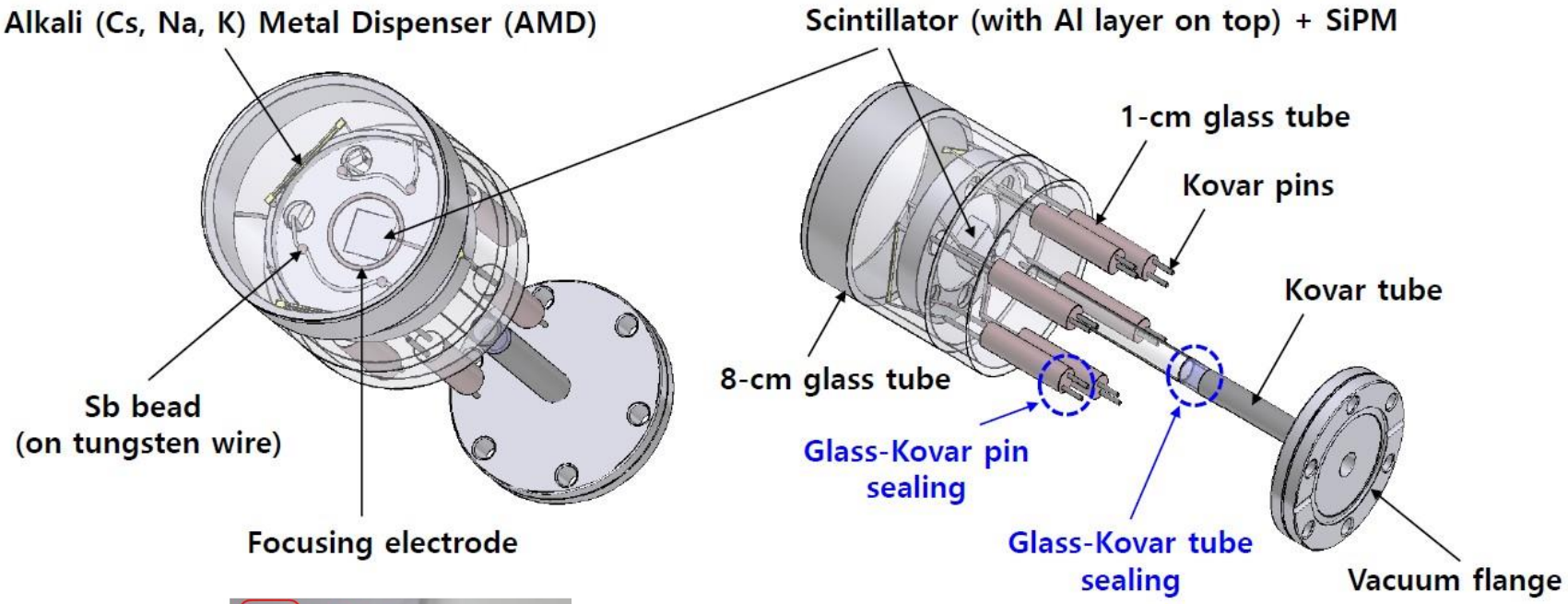
- R&D on new type of PMT in progress
- Being developed for the outer detector PMTs

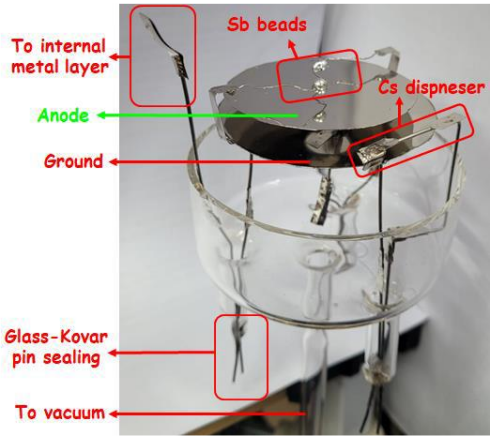


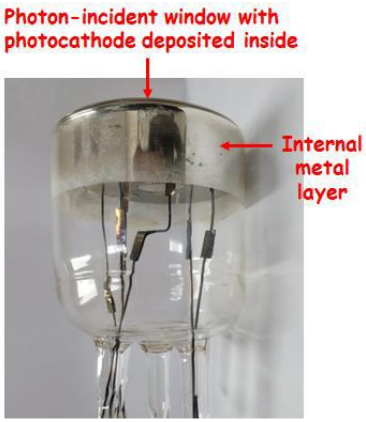
- Fast response time : ~ few ns
- Large detection area
- High multiplication : 2×10^7

Detector R&D on PMT

- Design and fabrication of 8 cm SiPMT prototype in progress

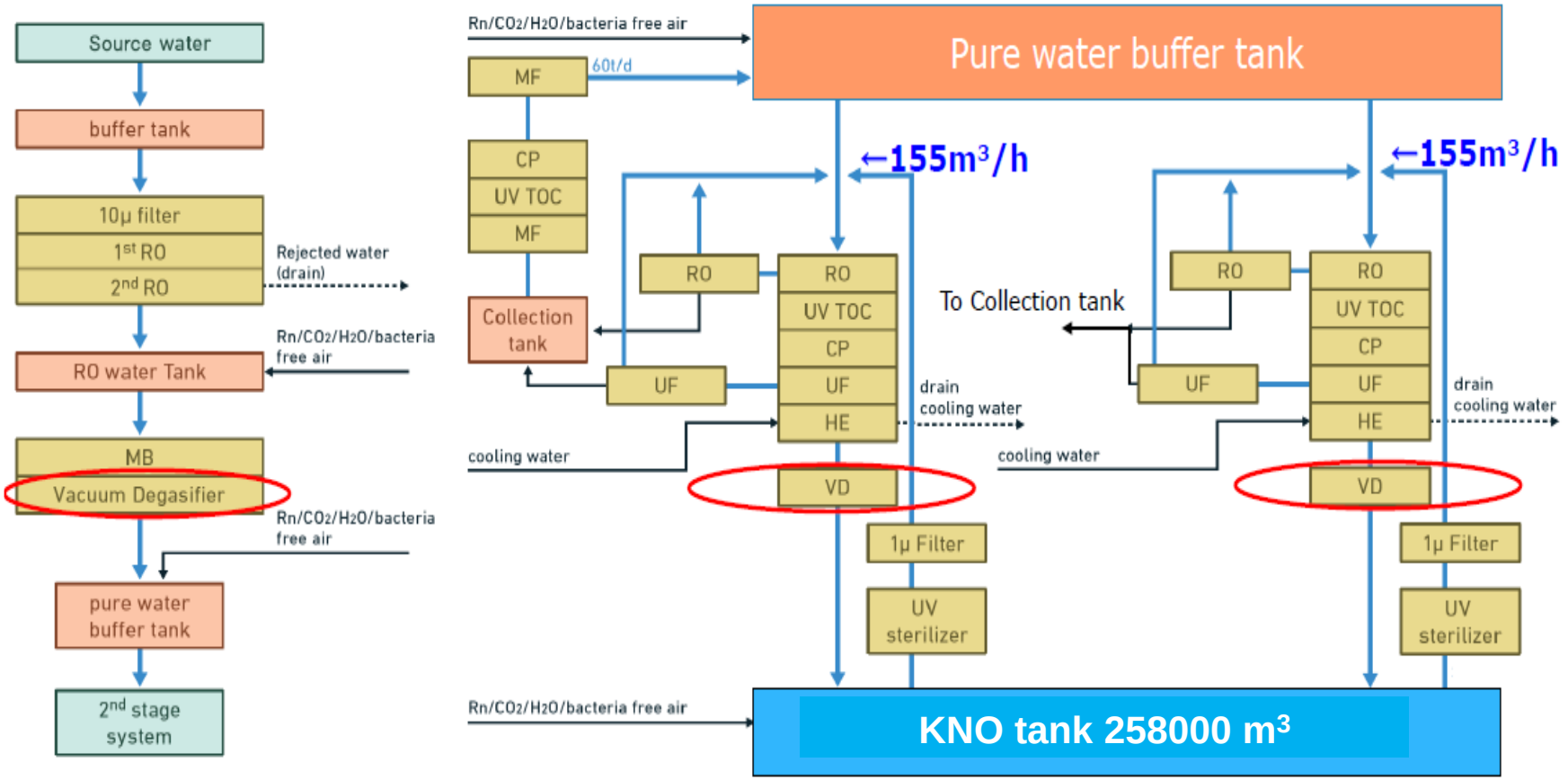






Design of Water Purification System

- Water Purification System
  - Based on SK/HK system
  - Designed by DICOTECH



Detector R&D on Radon System

- Development of Radon System

  - Radon vacuum degasifier (DICOTECH) for radon removal
  - Highly sensitive radon detector (DAON)
  - prototype construction

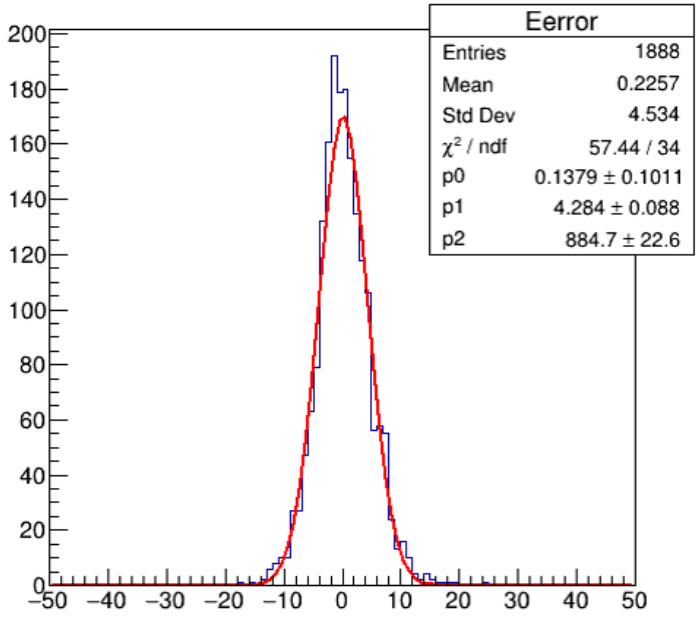
radon degasifier prototype

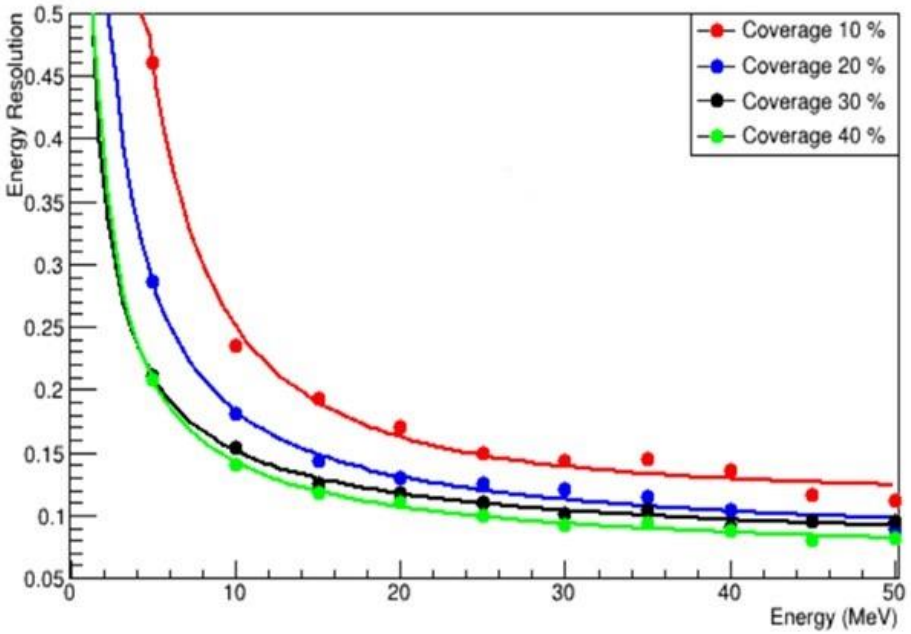
radon detector

Software Development

- KNO reconstruction package being developed
- Separate reconstruction packages for low energy and high energy neutrinos being developed

600 MeV muon





Realization of KNO

- The process for big science projects in Korea is different from those in other countries.

- Steps to secure the full funding for KNO
  1. Obtain the seed funding from the government (early 2023)
  2. Write an extensive report on the project using the fund. The report includes scientific programs, construction plans, economic effects, legal issues and etc (in progress)
  3. Review of the report by the government
  4. Final decision by the government

Summary

- KNO greatly enhances physics sensitivities in the measurements of leptonic CP violation, mass ordering and many others.
- The KNO organization was established and very active
- Detector R&D and software development is in progress
- The process to apply for the full funding has been started