

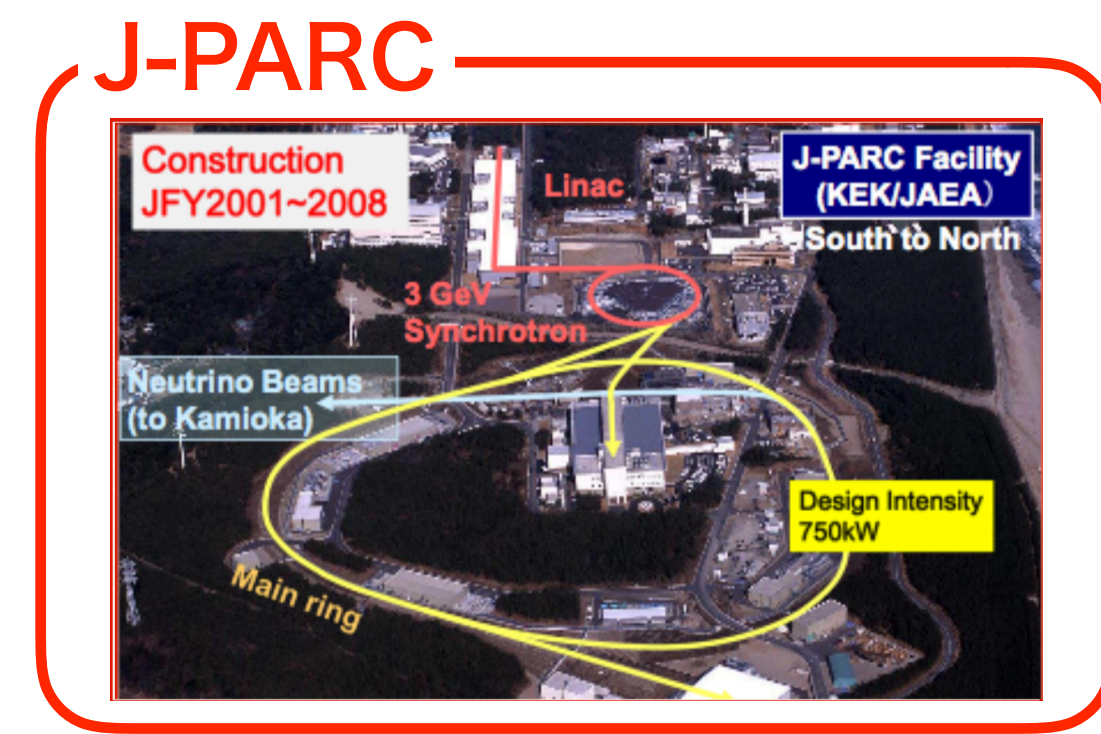
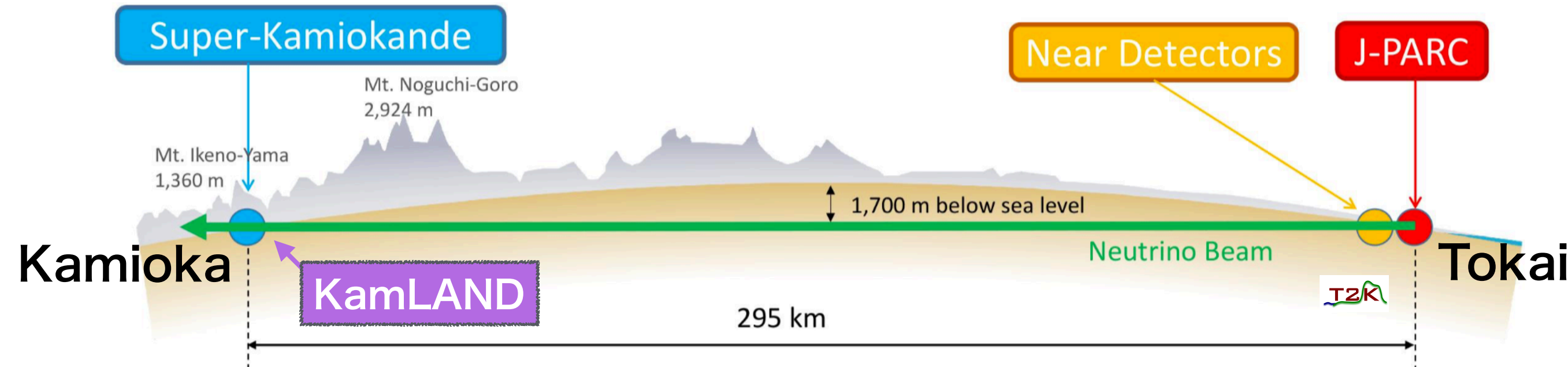
Study on T2K neutrino at KamLAND



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T2K neutrino at KamLAND



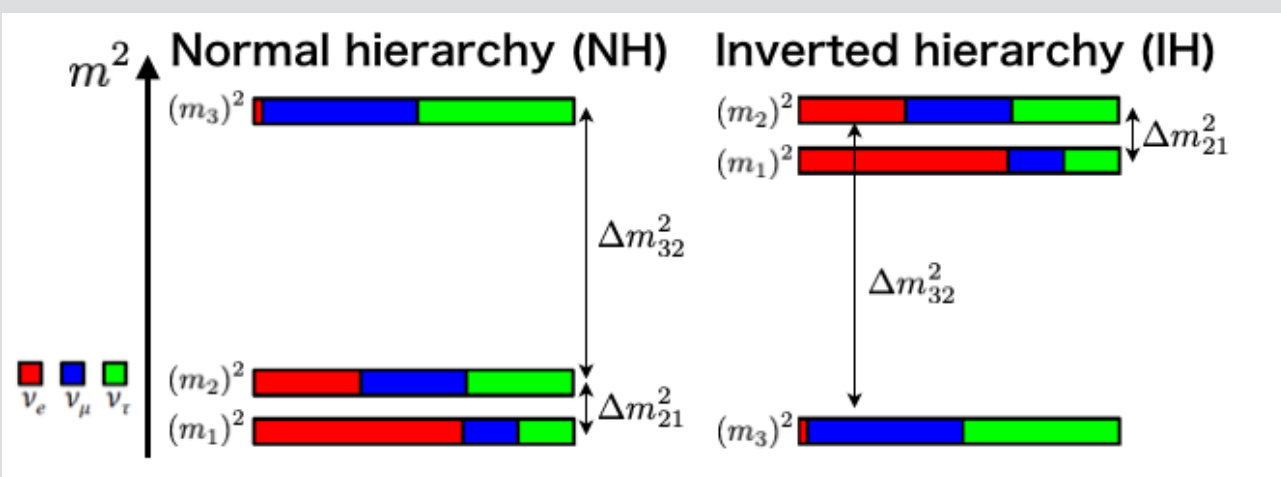
Physics

- ▶ CP violation in leptonic sector ?
- ▶ What's the neutrino mass hierarchy?

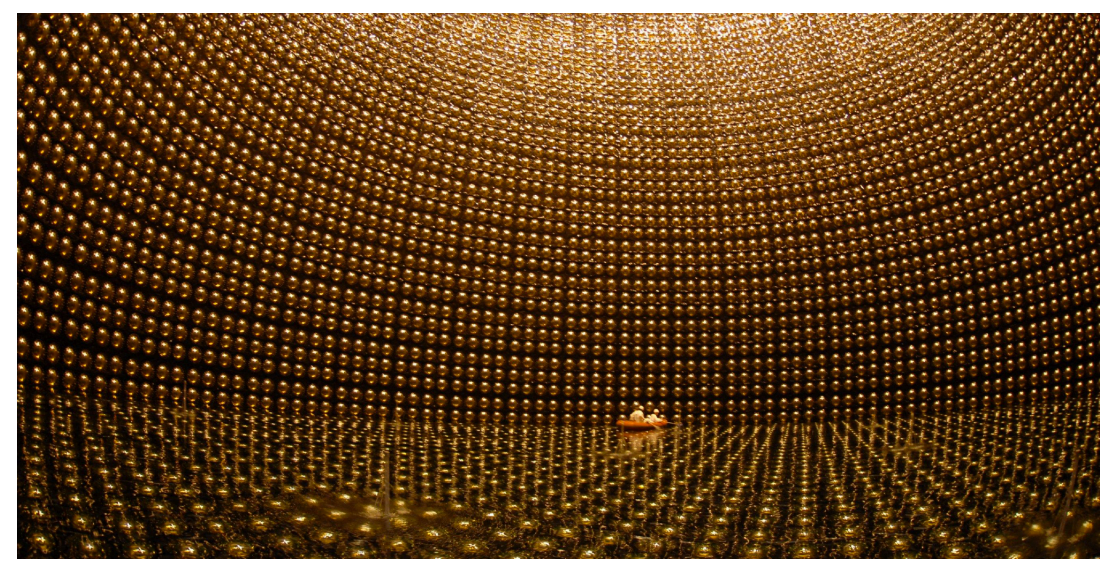
Flavor (interaction) $\begin{pmatrix} |\nu_e\rangle \\ |\nu_\mu\rangle \\ |\nu_\tau\rangle \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & c_{23} & s_{23} \\ 0 & -s_{23} & c_{23} \end{pmatrix} \begin{pmatrix} c_{13} & 0 & s_{13}e^{i\delta_{cp}} \\ 0 & 1 & 0 \\ -s_{13}e^{-i\delta_{cp}} & 0 & c_{13} \end{pmatrix} \begin{pmatrix} c_{12} & s_{12} & 0 \\ -s_{12} & c_{12} & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} |\nu_1\rangle \\ |\nu_2\rangle \\ |\nu_3\rangle \end{pmatrix}$

Mass (propagation)

$c_{ij} = \cos \theta_{ij}$
 $s_{ij} = \sin \theta_{ij}$
 $\Delta m_{ij}^2 = m_i^2 - m_j^2$

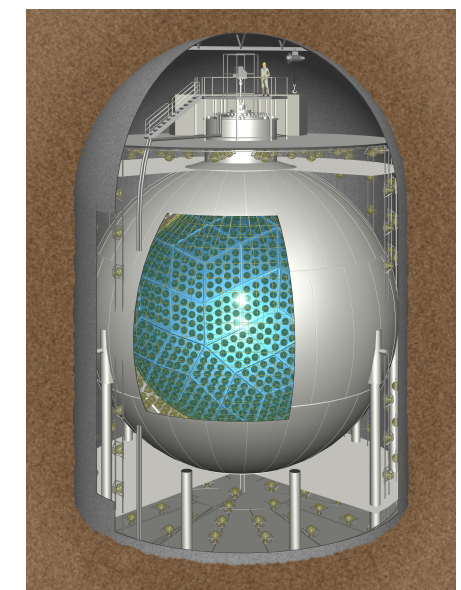


Super-Kamiokande



- ▶ 50kt water Cerenkov.
- ▶ e/μ PID
- ▶ Low efficiency for low energy events and neutrons.
- neutron tagging efficiency ; ~ 20 %

KamLAND



- ▶ 1kt liquid scintillator.
- ▶ High efficiency for low energy events and neutrons
- neutron tagging efficiency ; ~ 99 %
- ▶ T2K beam is available (SK ⇔ KL ; ~ 200m)

- ▶ Possible 2nd far detector for T2K as a complementary measurements
- ▶ With extremely low cost and NO R&D phase.

Primary goal and status

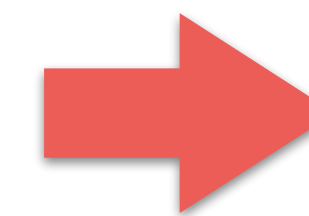


Primary goal ; “Inform T2K collaboration of this study and get official information”

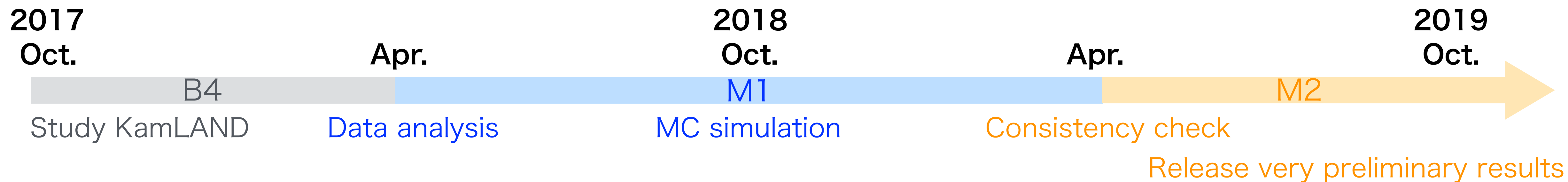
- ▶ To achieve this study, we have to cooperate with each other and get some official information (POT, run period, etc).
- ▶ However, KamLAND did't so far.

- ▶ I started to work on the data analysis and simulation targeting this primary goal.
- ▶ I prepared very preliminary (w/o official information) results and presented them at T2K Collaboration meeting on 27 Jul. 2019.

- ▶ KamLAND and T2K decided to exchange MoU (Memorandum of Understanding).
 - Now writing MoU
 - Official information is available now !

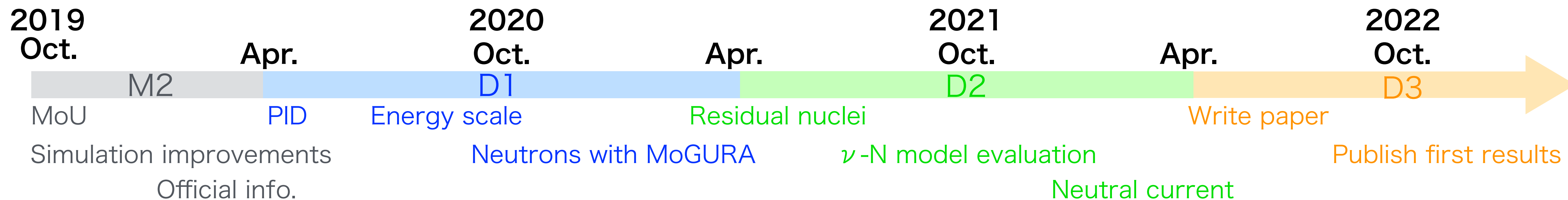


Achieved the primary goal !



Next step : “Precise analysis and publish paper”

- ▶ Analysis with official information is ongoing with tool improvement.
- ▶ Physics target,,,
 - ✓ Neutron production yield
 - Reduce the uncertainty of Neutrino-Nucleus interaction modeling.
 - ✓ Neutral current measurements
 - Reduce the uncertainty of atmospheric neutrino BG events estimation in proton decay and supernova relic neutrino search.



- ▶ I want study event reconstruction or cross section modeling in ν oscillation experiments.
- ▶ I got some connection to T2K collaboration.
- ▶ One of the T2K analysis coordinators (Michigan State Univ.) listed up some candidates.
- ▶ Also I will contact to the T2K spokes person and ask some advices and candidates.

- ▶ Not decided yet, but keep this discussing...