Overview
of
Hyper-Kamiokande R&D

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KEK

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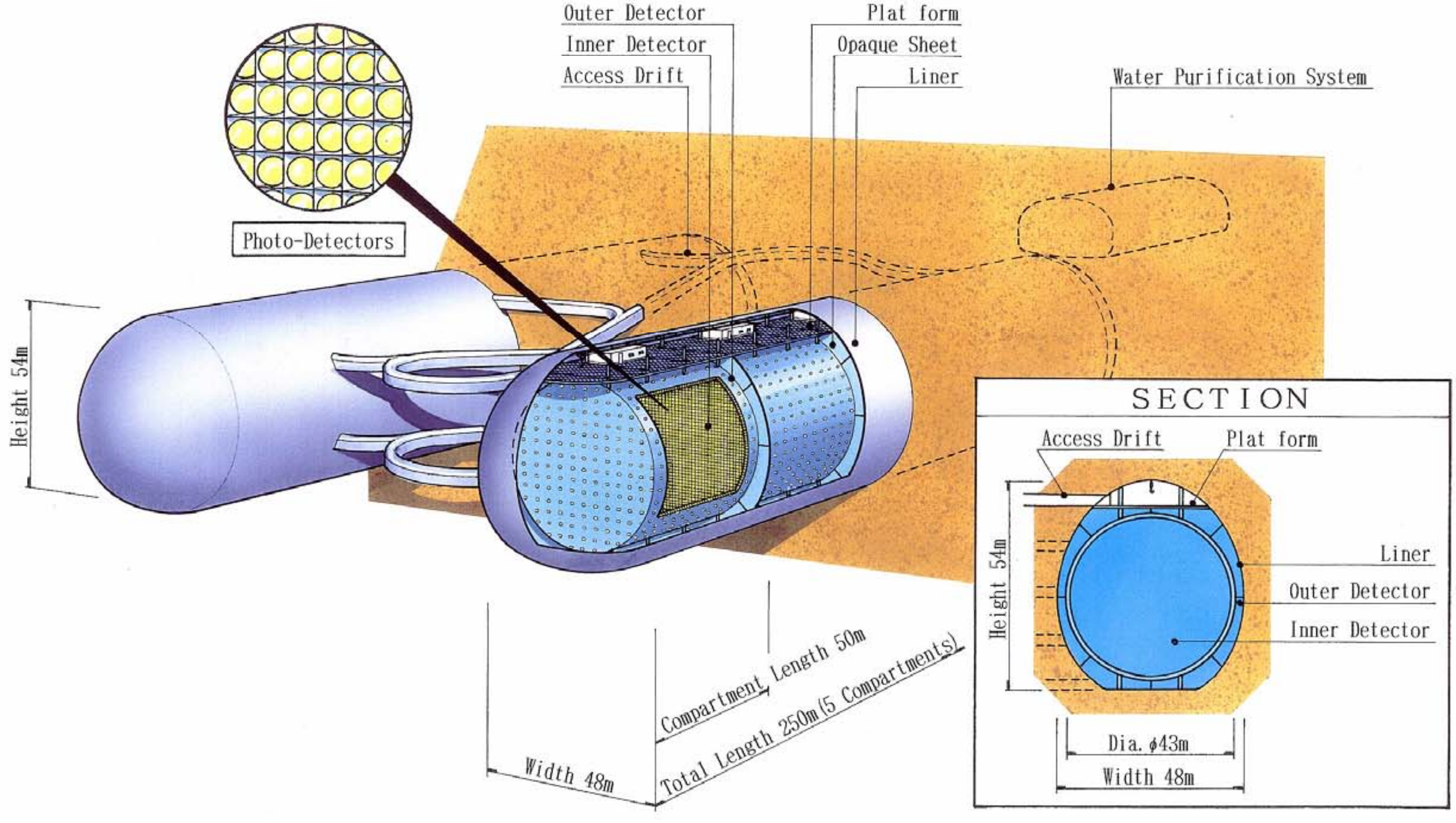
Mton Water Cherenkov Detector

- Concept of a Mton water Cherenkov detector dates back to 1992
  - M. Koshiba: "DOUGHNUTS"
    Phys. Rep. 220 (1992) 229
- Concept of Hyper-Kamiokande was first presented at NNN99 @ SUNY
- A recent write-up:
  - K. N., Int. J. Mod. Phys. A18 (2003) 4053

What is Hyper-Kamiokande ?

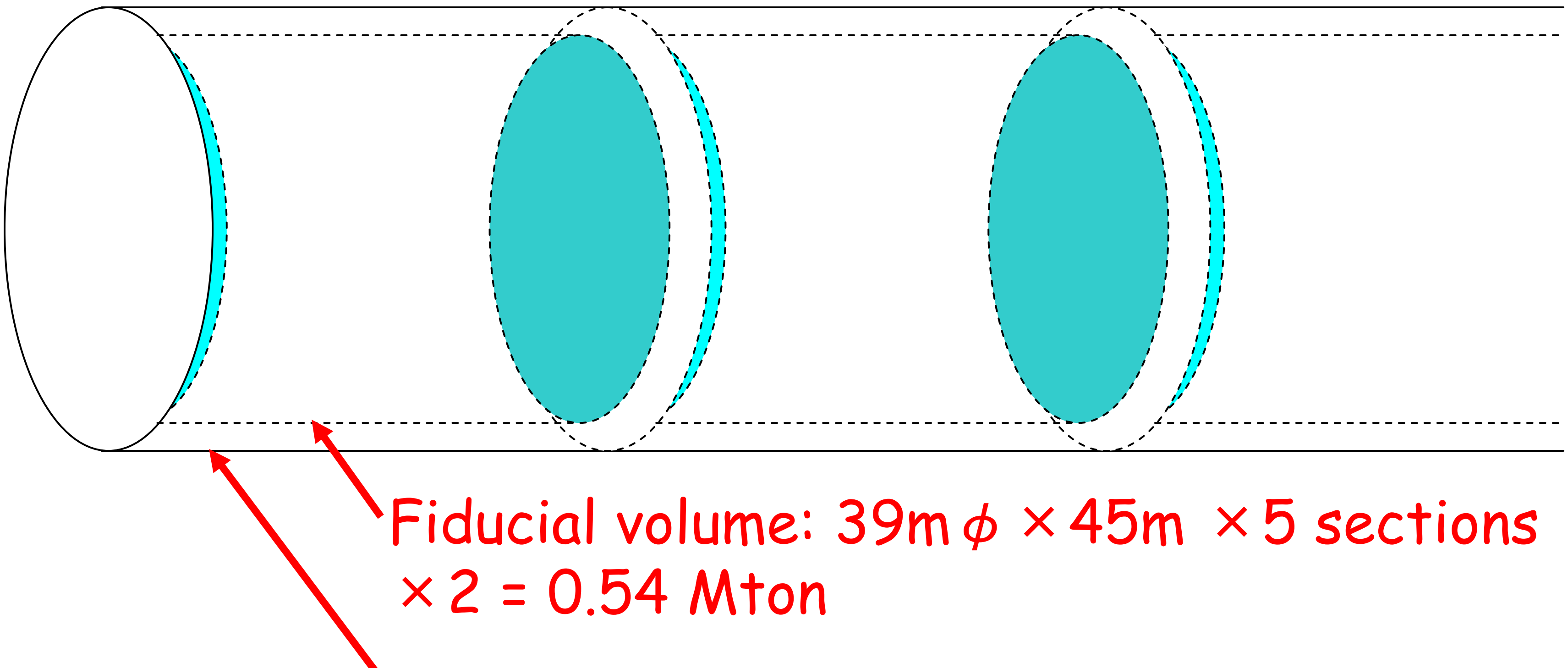
~1 Mton water Cherenkov detector at Kamioka



Why this design has been chosen ?

- Water depth < 50 m
  (If the present 20-inch PMT or similar one will be used.)
- Linear dimensions for light path < 100 m
- Optimization of M_{FID}/M_{TOTAL}
- Rock stability
  - Avoid sharp edges. Spherical shape is the best.
- Our solution: Tunnel-shaped cavity
- Single Cavity or Twin Cavities?
  - Single Cavity
    - M_{FID}/M_{TOTAL} is better
    - Cost is lower
    - Larger area of stable rock mass needed.
  - Twin Cavities
    - Two detectors are independent. One detector is alive when the other is calibrated or maintained.
    - Both cavities should be excavated at the same time. But staging scenario is possible for the later phase of the detector construction.
- Our solution: Twin cavities

Fiducial / Total



Fiducial volume: 39m ϕ × 45m × 5 sections × 2 = 0.54 Mton

Total Inner detector volume: 43m ϕ × 49m × 5 sections × 2 = 0.72 Mton

Total detector volume: 1 Mton

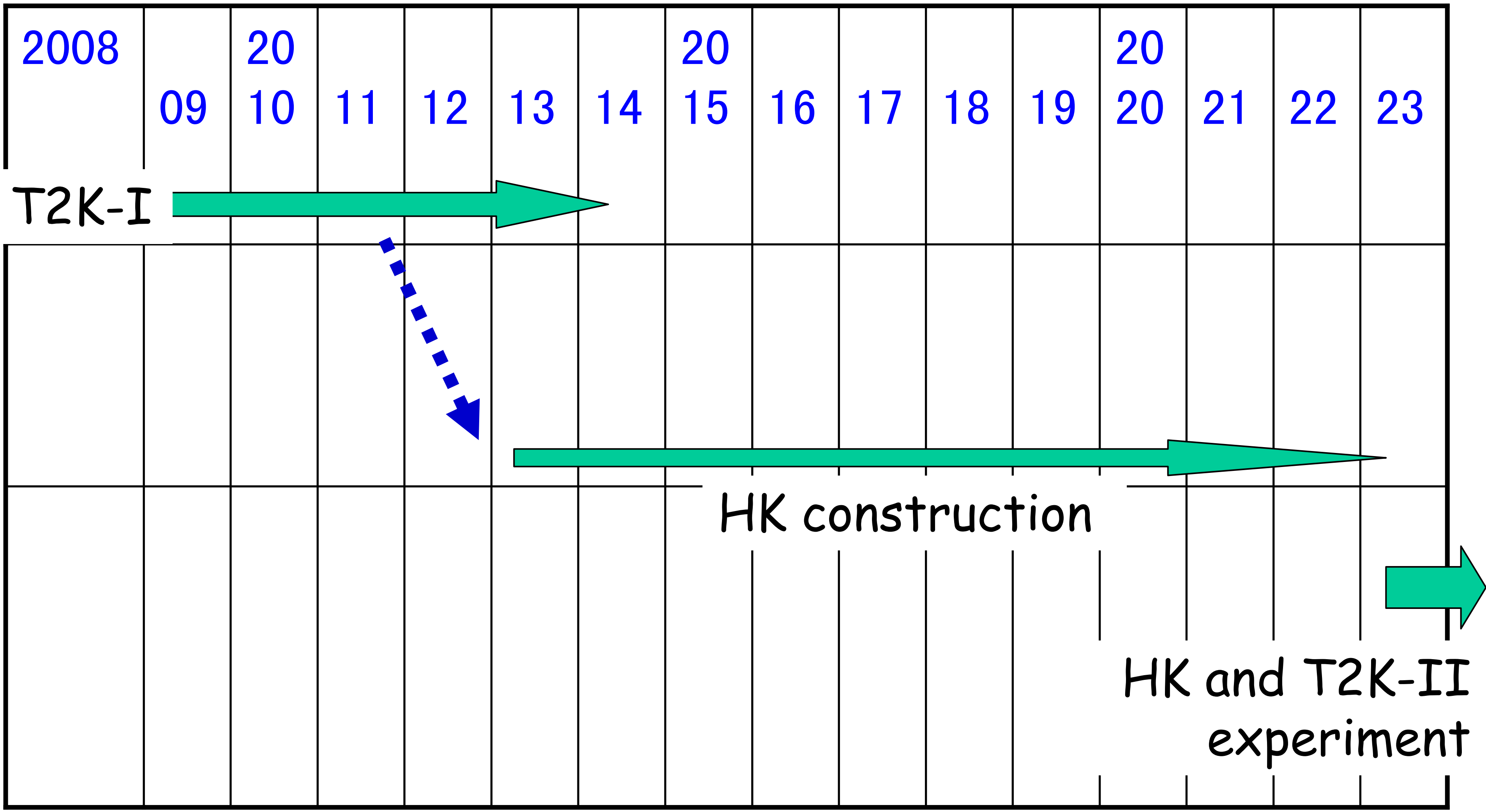
Total number of PMTs: 200,000 (if 2/m^2)

Comparison of 3 Generations of Kamioka Nucleon Decay Experiments

	Kamiokande	Super-Kamiokande	Hyper-Kamiokande
Mass	3,000 t (+1,500 t)	50,000 t	1,000,000 t
Photosensitive Coverage	20 %	40 % (SK-I and -III) 20 % (SK-II)	?
Observation Started	1983	1996	?
Cost (Oku-Yen)*	5	100	500?**

* 1 Oku-Yen ≈ 1M$
** Target cost; No realistic estimate yet

Construction Time Line



What can be done with Hyper-K ?

- T2K long bo... ...nt:
  - 2nd phase,
  - If the θ_{13} ... upper limit,
  - the 2nd ph...
  - νK^+
  - and other
- Neutrino os...
- ...
  - Supernova neutrino (~x10⁵ neutrinos for a SN at the center of the galaxy)
  - Relic supernova neutrinos
  - Solar neutrino measurements
  - Possible? : the Hyper-K site (600-700 m overburden)? Under study.

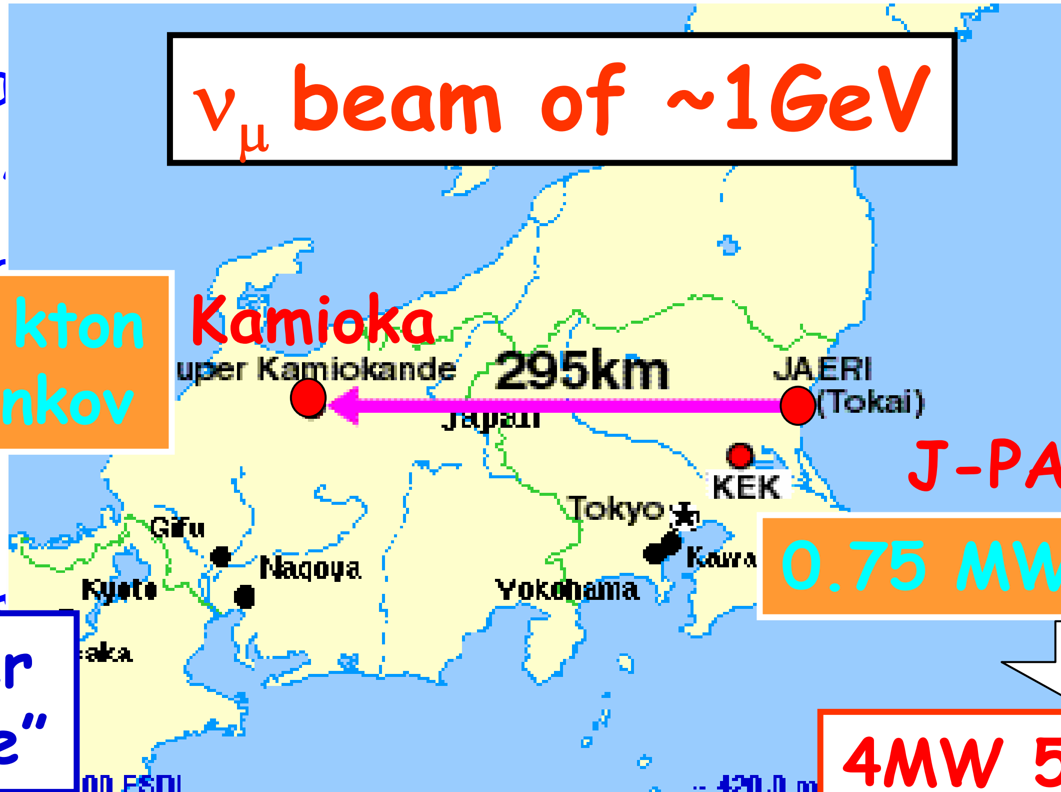
Kobayashi

Kajita

Super-K: 50 kton Water Cherenkov

~Mt "Hyper Kamiokande"

ν_μ beam of ~1GeV



J-PARC

0.75 MW 50 GeV PS

4MW 50 GeV PS

Nakahata's study for Mton water Cherenkov detectors in gereral

1st Phase

- $\nu_\mu \rightarrow \nu_x$ disappearance
- $\nu_\mu \rightarrow \nu_e$ appearance
- NC measurement

2nd Phase

- CPV
- proton decay

Kamioka Mine Geological Map

MOZUMI Mine

TOCHIBORA Mine