Kamioka Underground Lab.

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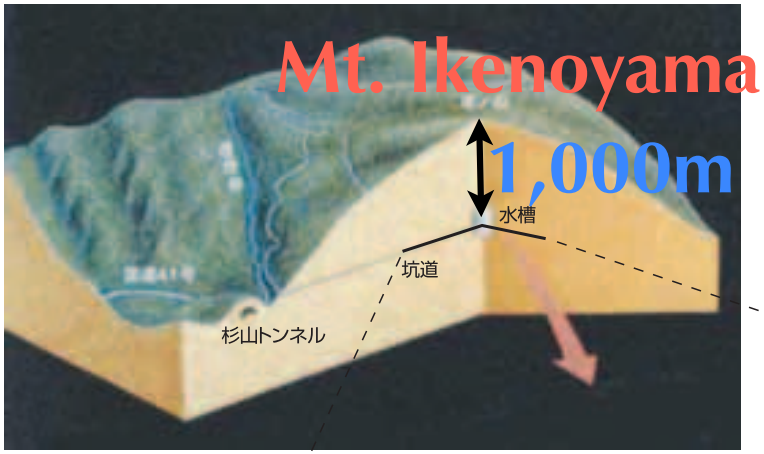
Phone discussion, U.S. Snowmass planning process
April-12-2013



KamLAND (Tohoku Univ.)
post-Kamiokande

Lab.A

Super-Kamiokande

Clean room

XMASS

CANDLES

Gd R&D

Water purification
room No.1

IPMU Labs.

Water purification
room No.2

2km from Atotsu entrance

Workshop

Newage

CLIO GW detector
prototype

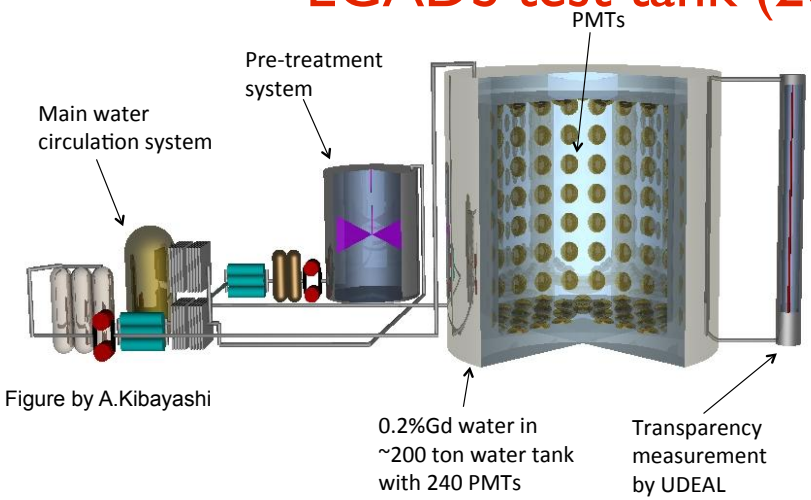
100m

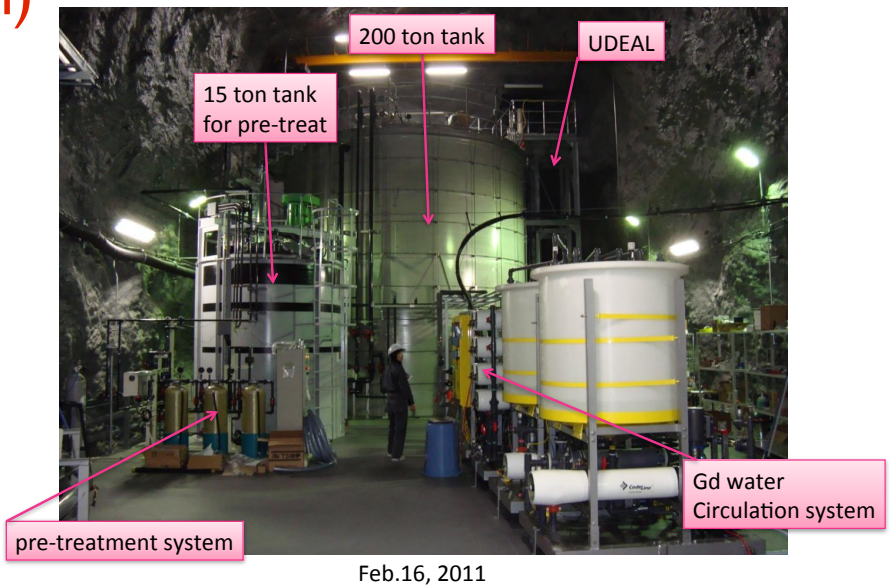
Summary of experiments (ongoing, planned, under discussion) in Kamioka

- Neutrino Oscillation experiments
  - Ongoing experiments: *Super-Kamiokande*, *T2K (J-PARC +SK)*
  - Near Future: Upgraded SK w/ Gadolinium
  - Next generation detector: *Hyper-Kamiokande*
- Double beta decay searches
  - *KamLAND-Zen, CANDLES*
- Direct detection of Dark Matters
  - XMASS, *NEWAGE*
- Gravitational Wave Astronomy
  - *CLIO(prototype), KAGRA*

Gd doping in Super-K (Gadzooks!)

EGADS test tank (200ton)





Feb.16, 2011

- 0.2%w $Gd_2(SO_4)_3$ solution
  - neutron tagging for $\overline{\nu}_e + p \rightarrow e^+ + n$
  - bunch of γs w/ E_{total} =8MeV, τ~20μs
- relic SN $\overline{\nu}$
- high statistic reactor $\overline{\nu}$
- BG rejection in proton decay searches

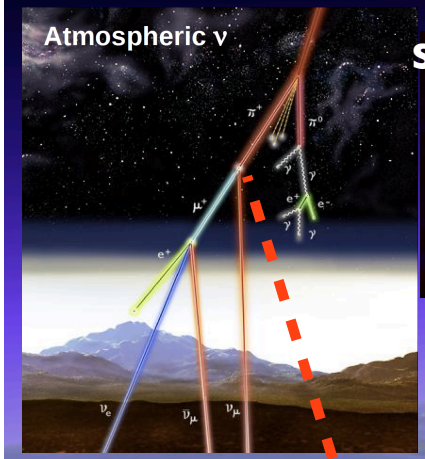
- EGADS construction is going on
- Mount PMTs in summer 2013, and full test is expected in 2014.
- put Gd into SK in a few years.

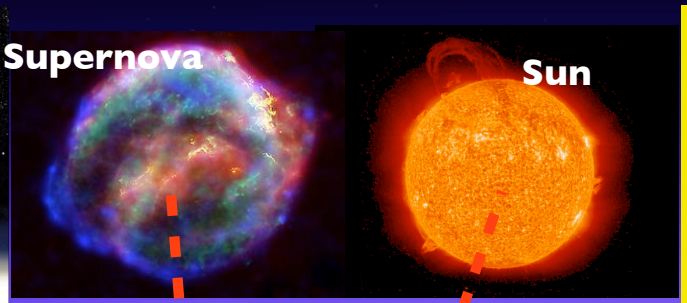
Future of Super-K

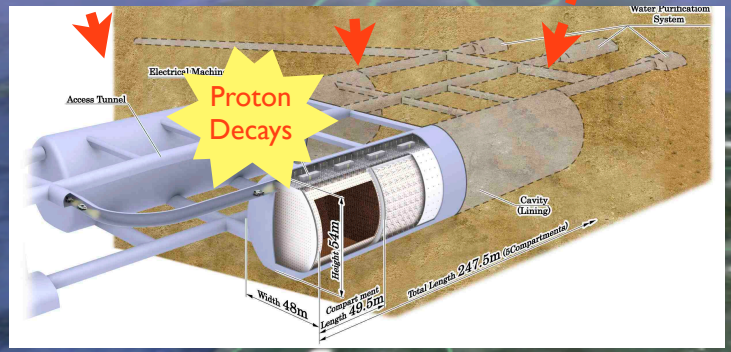
- sub-dominant effect (θ_{13},hierarchy,δ_{CP}) in atmospheric ν
- Upturn of low energy solar ν
- Past and realtime Supernova ν→Gadolinium doping
- Proton Decay ($2\sim3\times10^{34}$ yrs for $p \rightarrow e^+ + \pi^0$)
- T2K to establish nonzero θ_{13} and precise measurement of (Δm^2_{32}, θ_{23})

Hyper-Kamiokande
(25 x Super-K)

- Quest for leptonic CP Violation
- Proton Decay Searches
- Astrophysical ν's







Hyper-K

Super-K

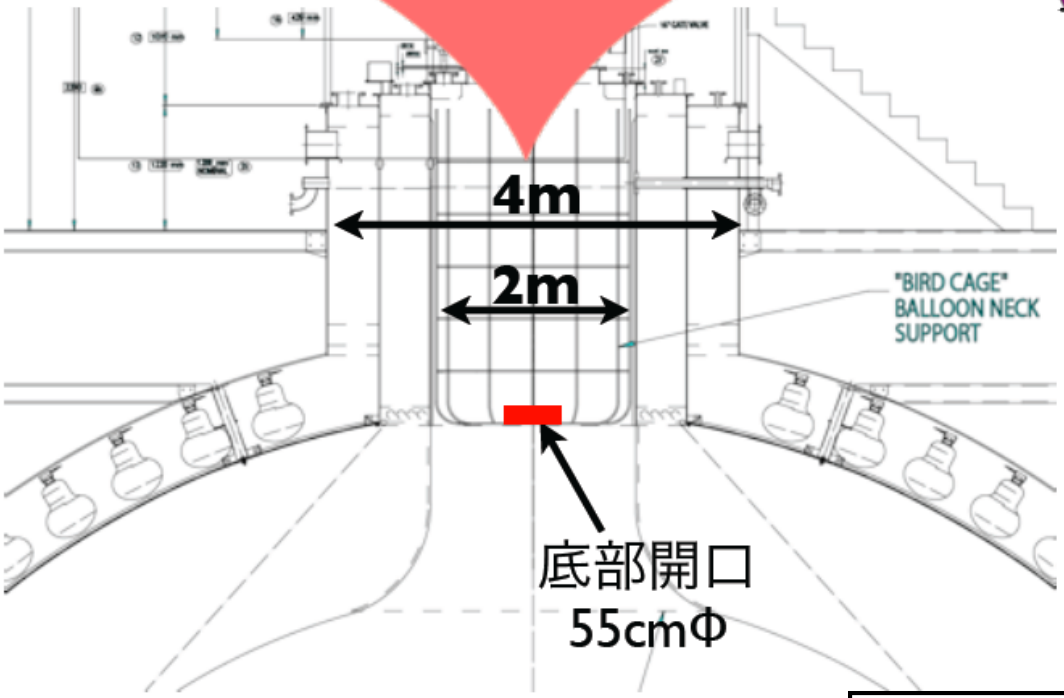
~0.6GeV ν_μ

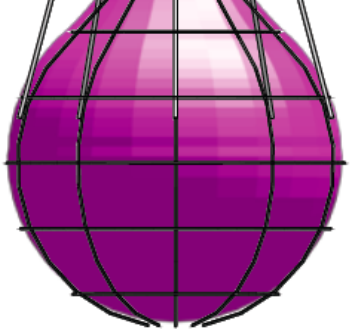
J-PARC

- R&D going on
  - New high QE photo-detectors
  - Detector design under optimization
  - Water flow control
  - DAQ under water
  - Calibration source deployment system
  - Physics sensitivity study

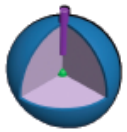
- Aim to start construction in 2016
- Start data taking in 2023

KamLAND-Zen



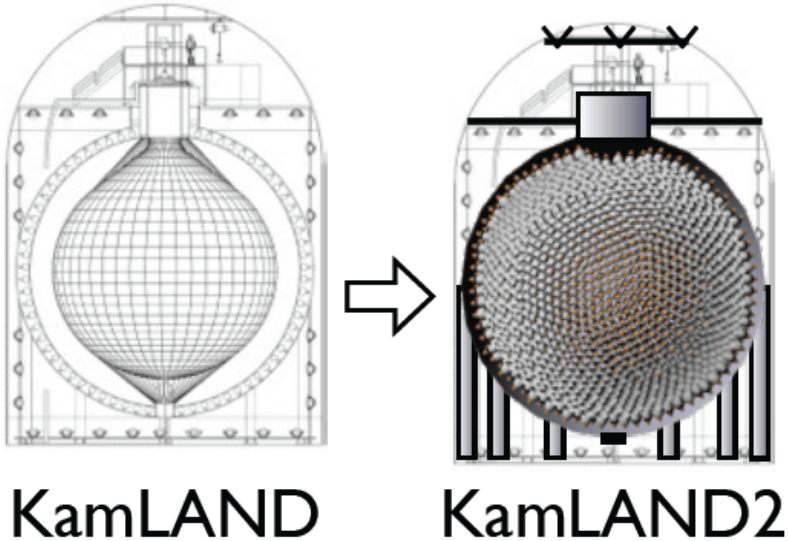


Large Balloon
beyond 1000kg Xe



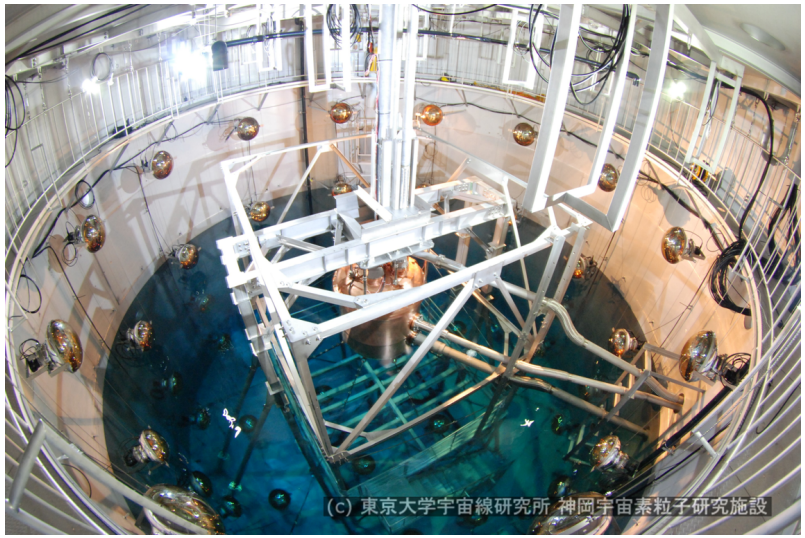
$\bar{\nu}$ source

Dark Matter
Detector



- Double-Beta experiment
  - Now and near future: Xe purification, new cleaner balloon, ~1000kg Xe
    ~40 meV in 5 years
  - Future: light concentrators and brighter LS for σ(E)~2.5%
    ~20 meV in 5 years
  - Other ββ decay sources
- Geo-neutrino
  - less reactor ν BG in Japan
- Sterile ν searches with putting ^{144}Ce or cyclotron
- Dark Matter searches w/ NaI
- solar CNO neutrinos

XMASS

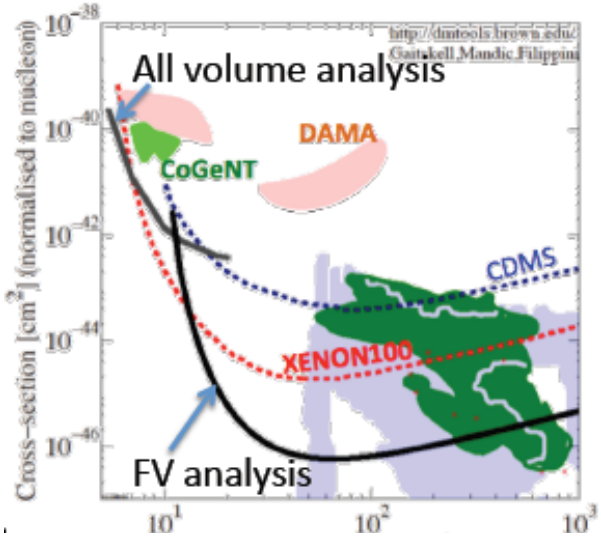


XMASS-1 (FV=100kg, under improvement)

- BG reduction is in progress.
  - BG sources are now well understood and can be addressed.
  - XMASS is going to be assembled under strict environmental control.
    - Rn free air
    - Class 1~10 environment
    - Scheduling to minimize exposure time to the air and cosmic rays.
  - Target for the BG reduction is around two orders of magnitude.
- Resuming XMASS in this autumn.

XMASS-1.5 (FV=1000kg)

- We are preparing for **XMASS-1.5** (Fiducial M=1t ,Full M=5t) to start construction in a few years.
  - An improved PMT with less RIs
- Expected sensitivity:
  $\sigma=10^{-46}\mathrm{cm}^2$ (@M~100GeV)



XMASS-2 (FV=10,000kg)

Multi-purpose detector for DM search, $0\nu\beta\beta$, solar pp ν, etc.

KAGRA (Gravitational Wave Detection, ICRR)

- construction JFY2010-2015
- 3km x 3km laser interferometer
- underground
- with cryogenic system