

# Previous Lecture

- Finish  $^{60}\text{Co}$  parity experiment

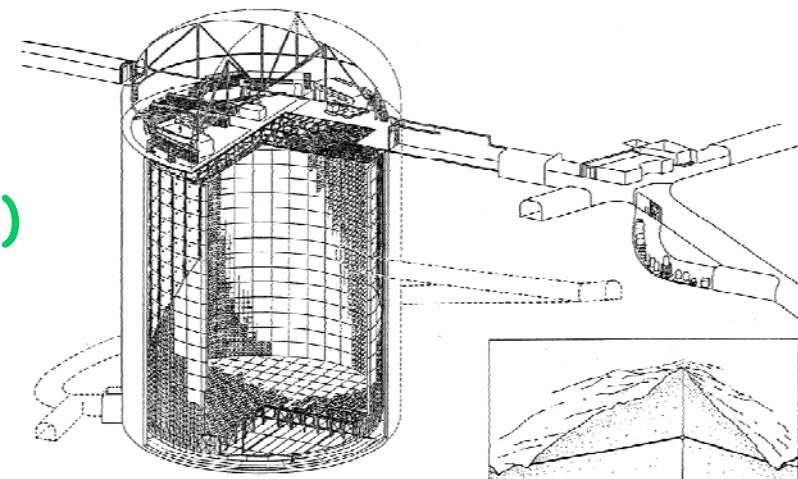
- Neutrino detection

- ▶ inverse  $\beta^-$  decay

- ▶ Radiochemical detectors

- (Homestake, Gallex, GNO, SAGE)

[see Kleinknecht, Sect. 8.8]



# Lecture Content

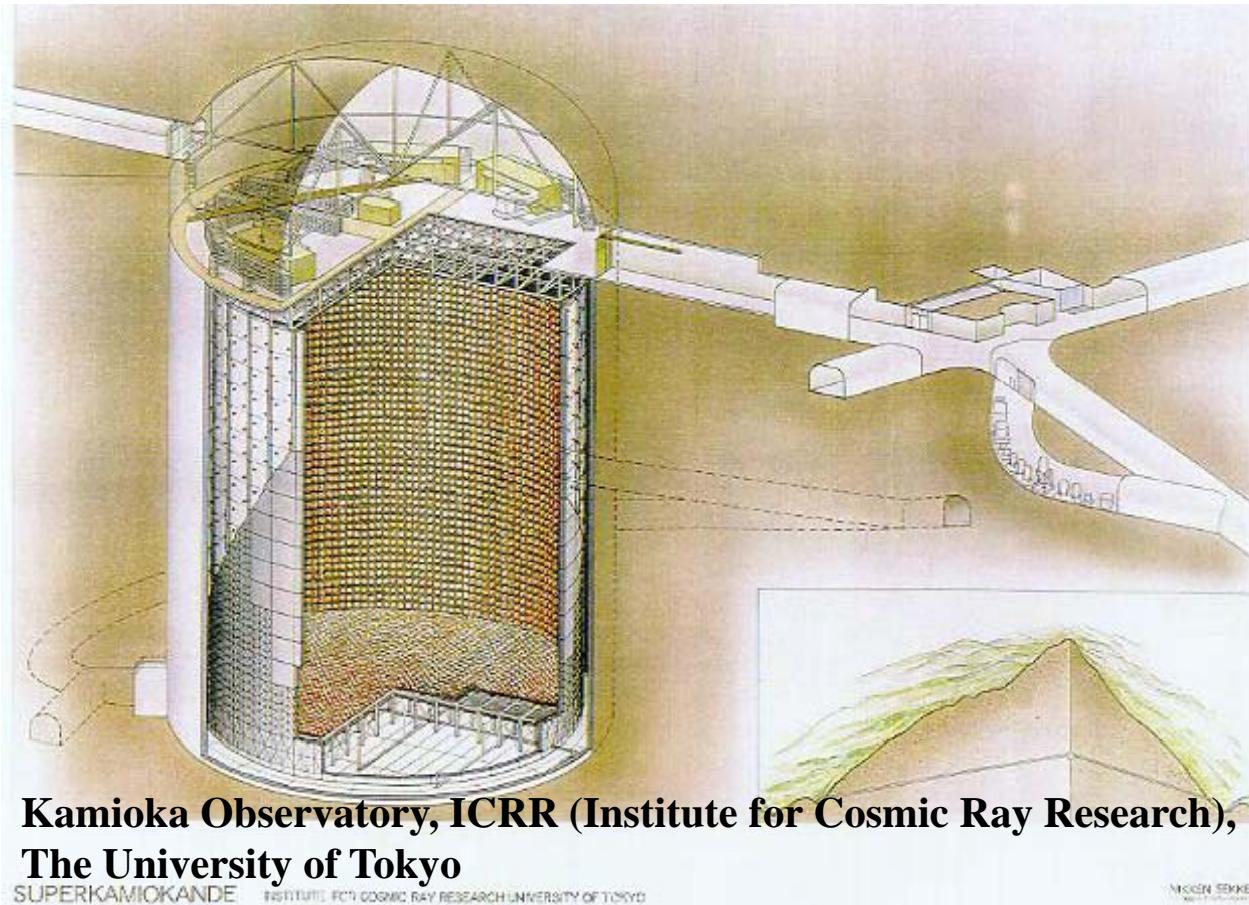
## ■ Approx. lecture content

1. PP intro
2. PP intro.
  - Feynman diagrams; strong/e.m./weak
3.  $\nu$  props 1:, baryon and lepton numbers; no. neutrino generations
4.  $\nu$  props 2:  $\nu$  existence
  - Examples of decay/production
5. Neutrino mass
  - Fermi-Kurie plot
  - Phase space kinematics/4-momentum
6. Parity and CP violation... (why so important in lepton sector?)
  - Wu et al., 60Co experiment
7. Detection & observation
  - Liquid, solid, bubble chamber
  - "Direct" methods
8. Atmospheric neutrinos
  - Cerenkov effect
  - SuperKamiokande
9. Neutrino oscillations and mixing
  - Possible solutions to solar/atm.  $\nu$  problems
10. Current and future experiments
  - SK, SNO, KAMLAND, CHOOZ
  - MINOS, miniBOONE,...
  - NDBD (NEMO, etc.)
  - JPARC, vF,
11. Implications for cosmology
  - Open vs. closed scenarios. various  $m_\nu$  regions
  - $\nu$  as DM candidate?
  - Subject outlook (JPARC, MICE, Neutrino Factory, ...)

# Today

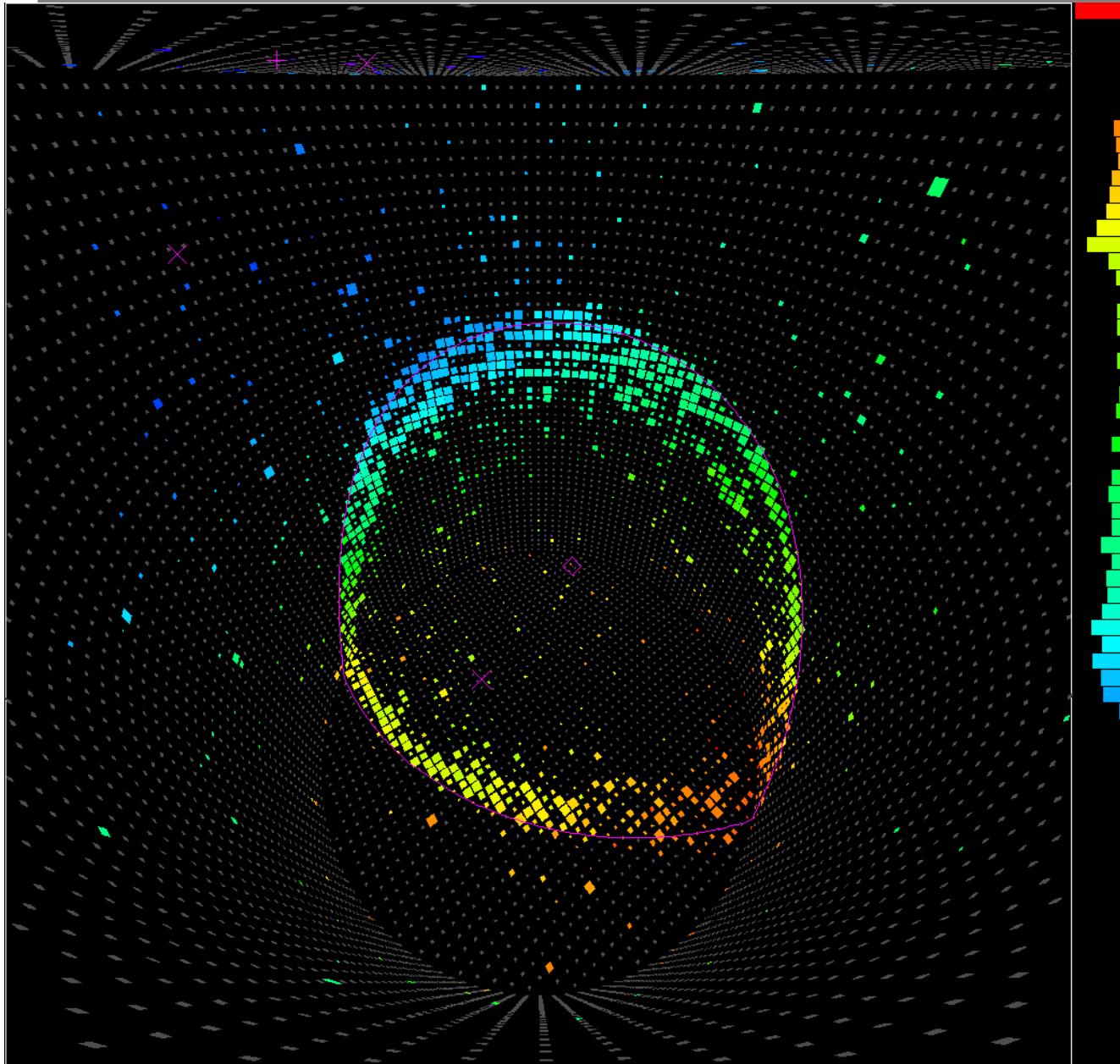
- Cerenkov detectors
  - ▶ See e.g. Perkins Sect. 2.4.6, 4<sup>th</sup> Edition
- Early Super-K atmospheric neutrino results

# Super-Kamiokande



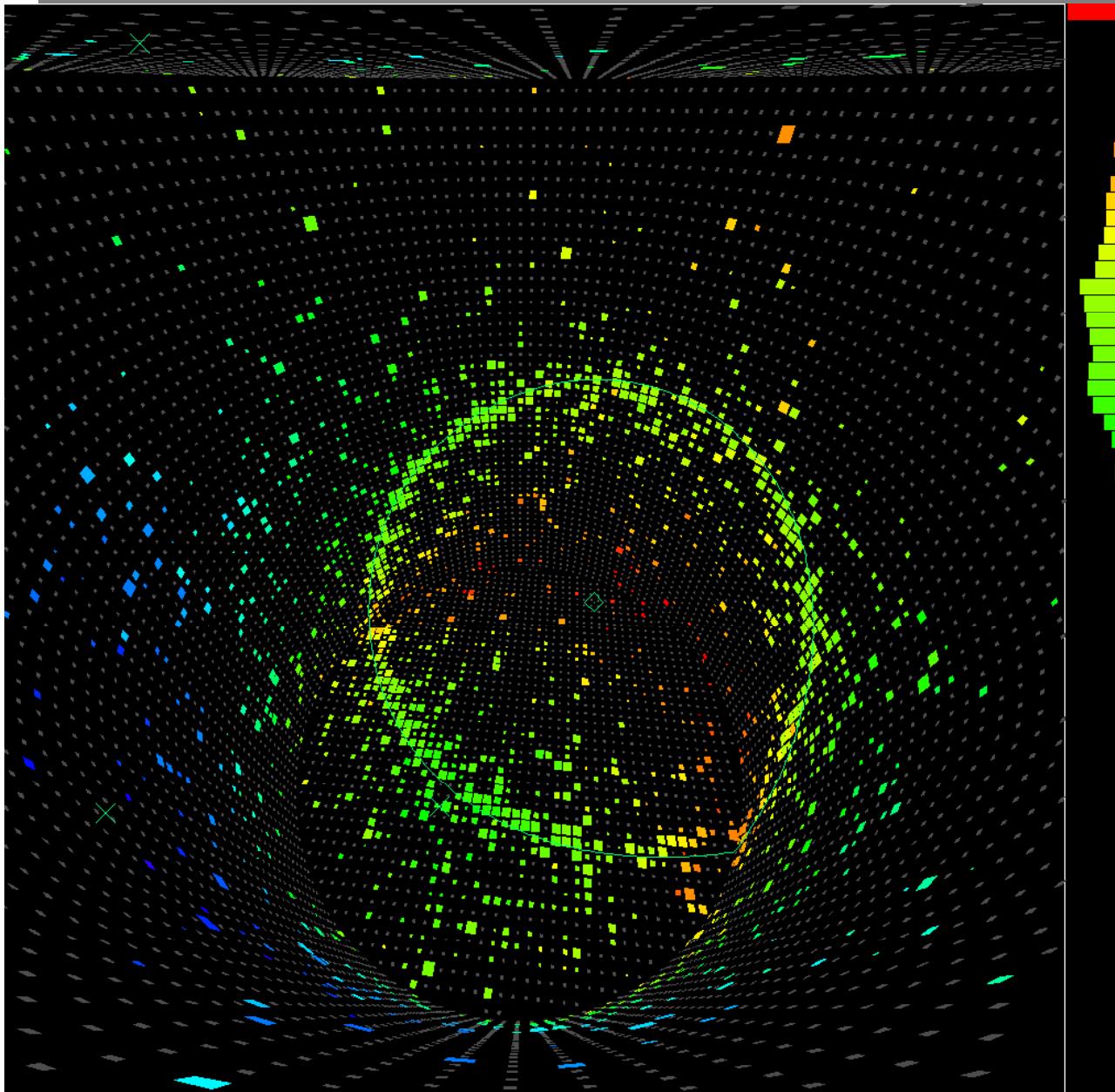
- 1000m below surface
- 41.4m (h) x 39.3 (d)
- mass: 50 000 tonnes  
pure H<sub>2</sub>O (32k/18k  
inner/outer)
- 11 200 x 50cm PMT
- Cerenkov detector

# Super-Kamiokande Cerenkov Images



603 MeV muon  
sharply defined  
ring edge

# Super-Kamiokande Cerenkov Images



492 MeV electron  
ragged ring edge

- because electrons produce e.m. showers