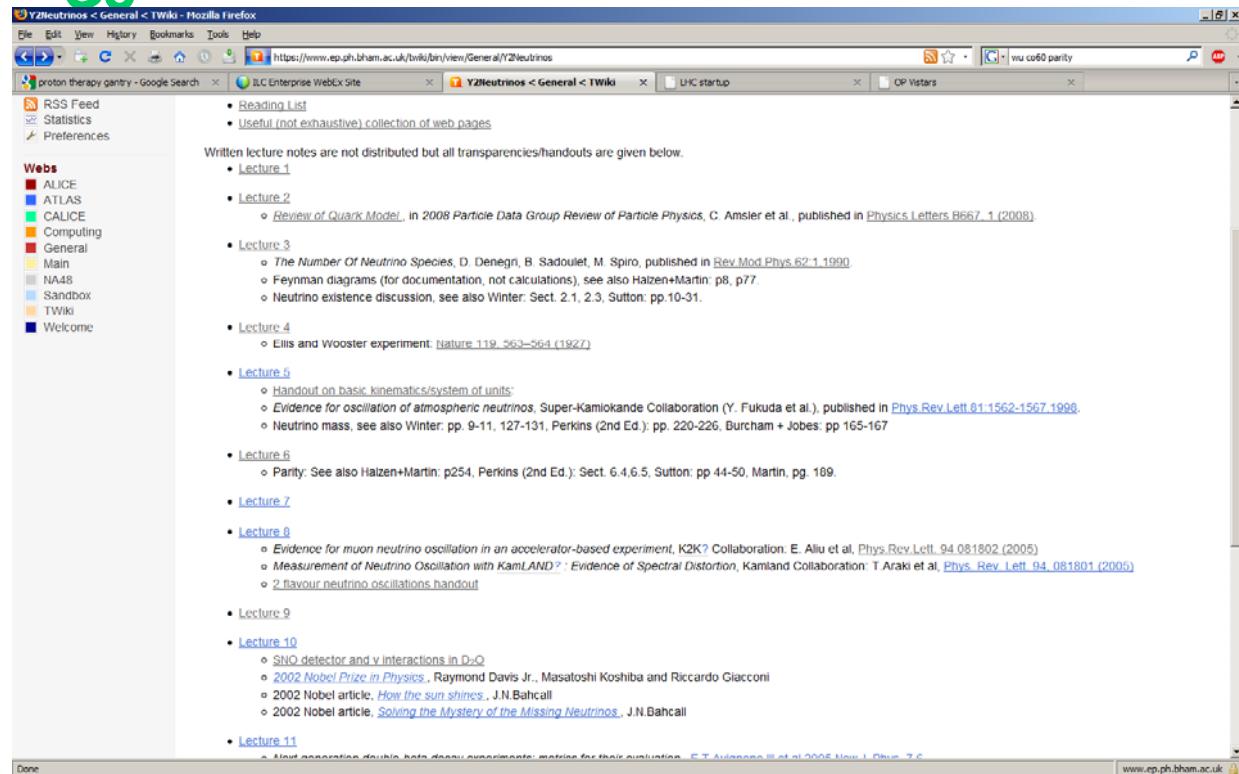


Previous lecture

- Parity and violation in weak decays
 - ▶ Started description of Wu et al. ^{60}Co experiment



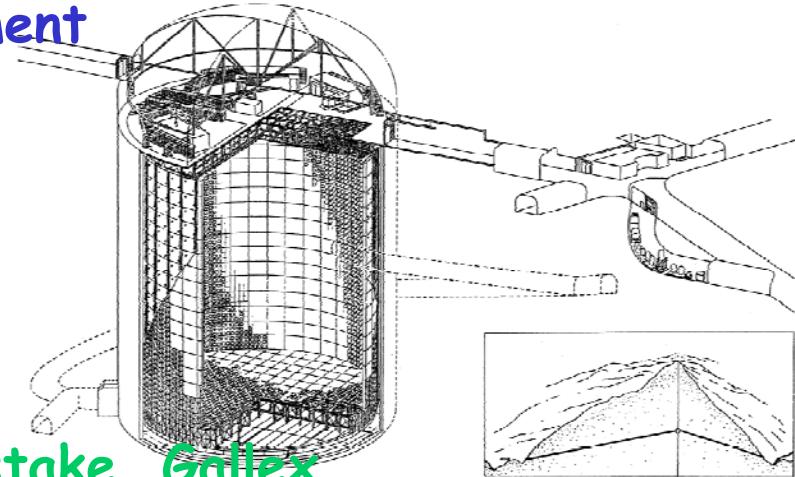
Lecture Content

■ Approx. lecture content

1. PP intro
2. PP intro.
 - Feynman diagrams; strong/e.m./weak
3. ν props 1:, baryon and lepton numbers; no. neutrino generations
4. ν props 2: ν 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. Solar and atmospheric neutrinos
 - Puzzle: relative abundances != SSM prediction
 - Two-flavour neutrino oscillation formalism
9. Neutrino oscillations and mixing
 - Possible solutions to solar/atm. ν problems
10. Current and future experiments
 - SK, SNO, KAMLAND, CHOOZ
 - MINOS, miniBOONE,...
 - NDBD (NEMO, etc.)
 - JPARC, ν F,
11. Implications for cosmology
 - Open vs. closed scenarios. various m_ν regions
 - ν as DM candidate?
 - Subject outlook (JPARC, MICE, Neutrino Factory, ...)

Today

- Finish Wu et al ^{60}Co parity experiment



- Neutrino detection

- ▶ inverse β^- decay
- ▶ Radiochemical detectors (Homestake, Gallex, GNO, SAGE)

- Superkamiokande introduction.

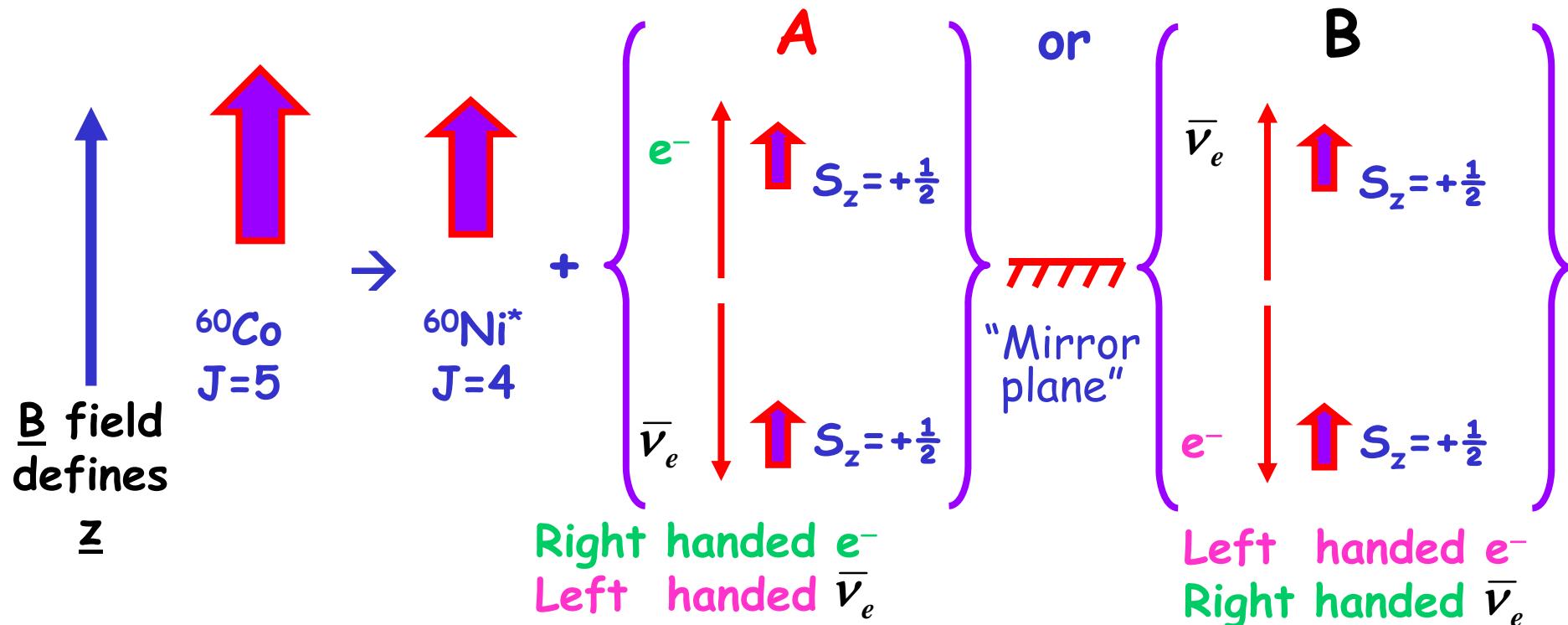
- Next lecture

- ▶ Water Cerenkov detectors
- ▶ Super-K data
- ▶ Oscillations

^{60}Co Parity violation experiment [Wu et al ,1956]

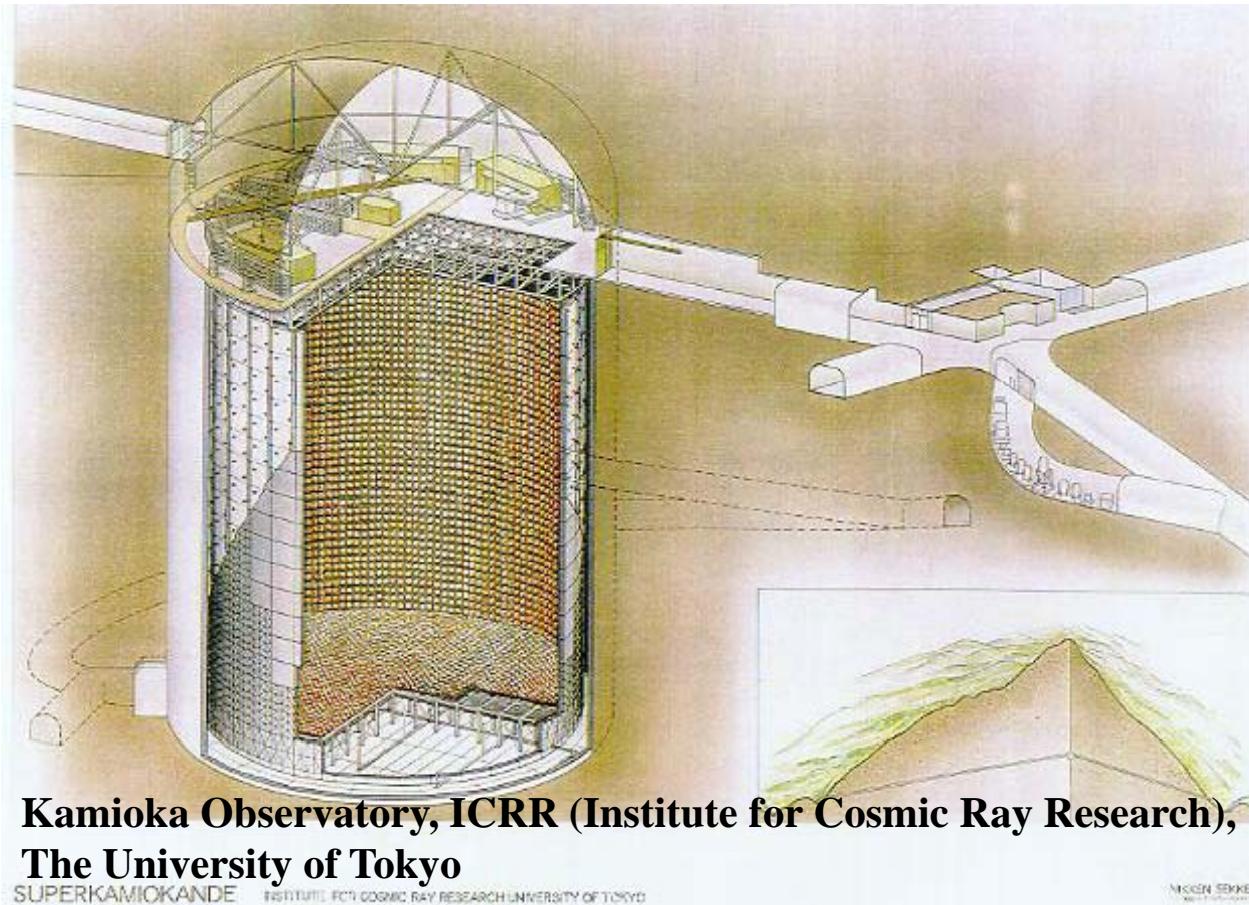
Basic process: $^{60}\text{Co} \rightarrow ^{60}\text{Ni}^* + e^- + \bar{\nu}_e$

Nuclear spins aligned along \underline{z} at low temperature ($\sim 0.01\text{K}$)



- When leptons emitted parallel to $\pm \underline{z}$, lepton spins constrained along $\pm \underline{z}$
- Scenario B is mirror reflection of A (in plane $\perp \underline{z}$), i.e. B is equivalent to parity transformed version of A.
- As scenario A is not observed, the weak interaction does change its behaviour during a parity transformation, i.e. parity is violated in the weak interaction

Super-Kamiokande



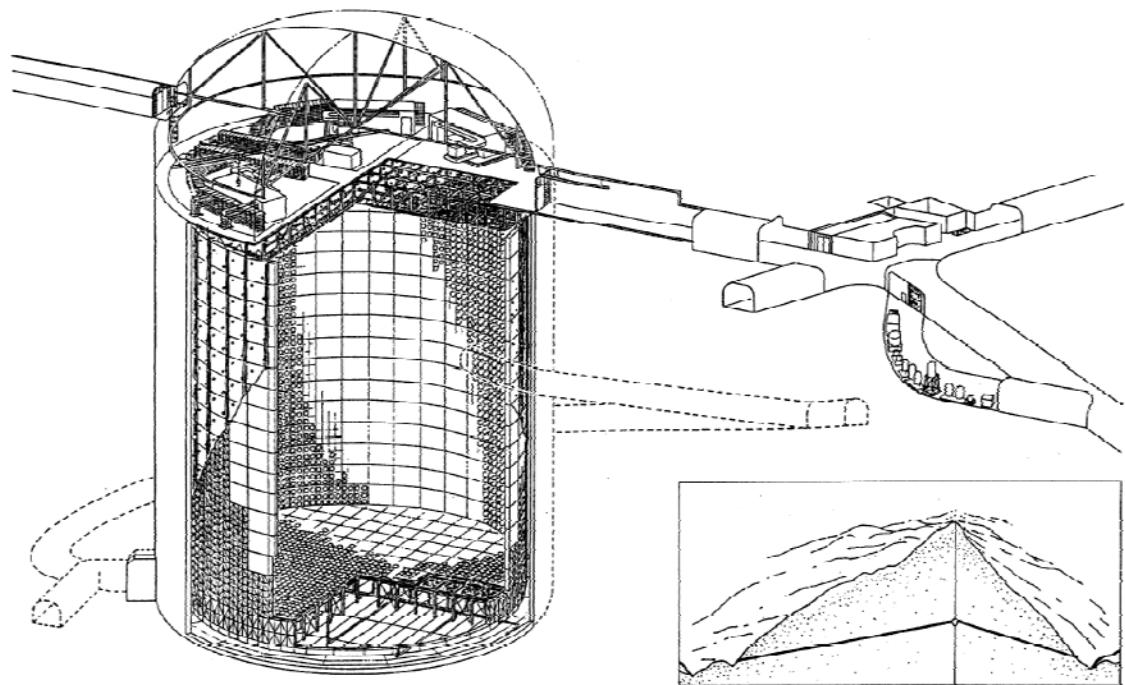
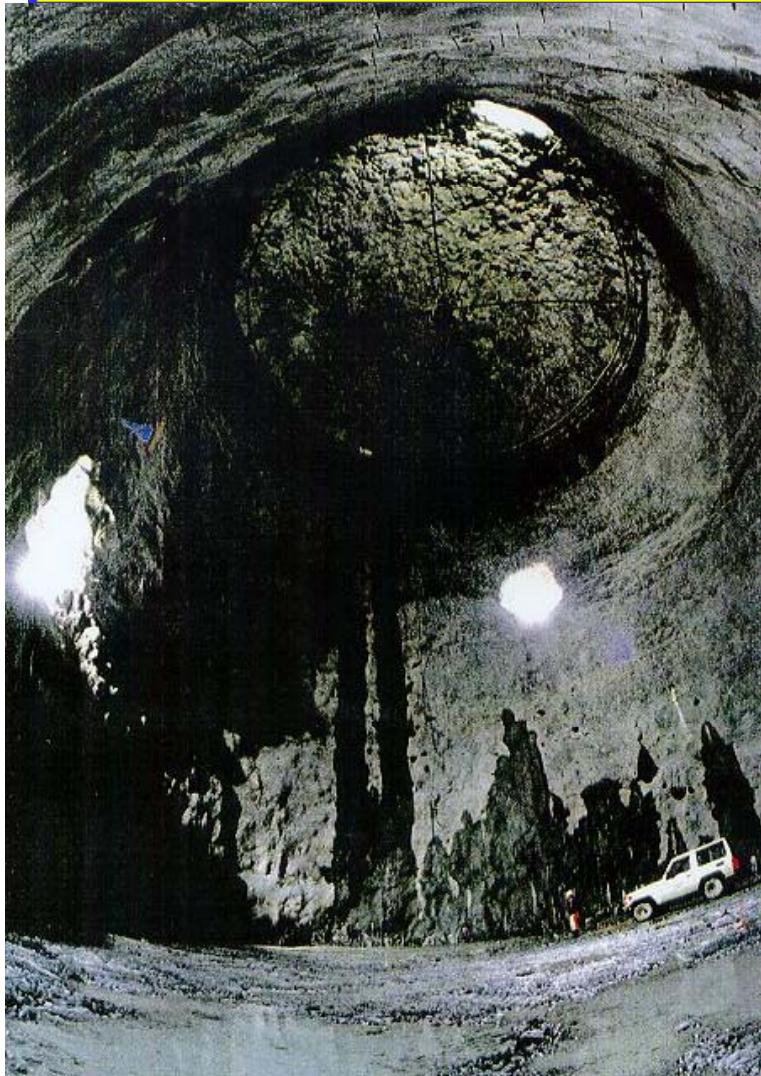
- 1000m below surface
- 41.4m (h) x 39.3 (d)
- mass: 50 000 tonnes
pure H₂O (32k/18k
inner/outer)
- 11 200 x 50cm PMT
- Cerenkov detector

Kamioka Observatory, ICRR (Institute for Cosmic Ray Research),
The University of Tokyo

SUPERKAMIOKANDE INSTITUTE FOR COSMIC RAY RESEARCH UNIVERSITY OF TOKYO

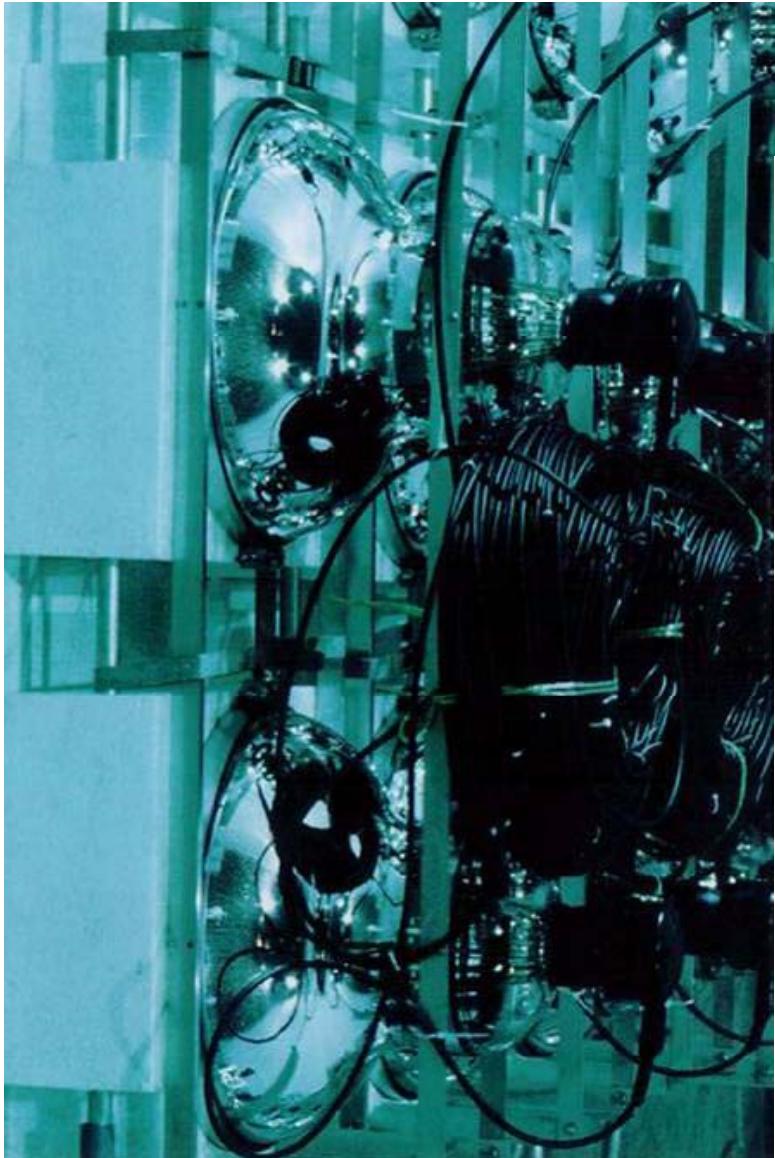
MITSUI SEMIKO
Semiconductor

Cavern before installation



Situated under mountain, 1km below surface

Photo Multiplier Tubes (PMT)



- 50cm diameter
- world's largest

Instrumenting (top dome)



