

Super Kamiokande ~ Neutrino Detector ~

Nuclear Particle Physics

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Outline

- Super-Kamiokande?
 - Kamiokande → Super-Kamiokande
 - Purpose
- Decay of protons
- Detector

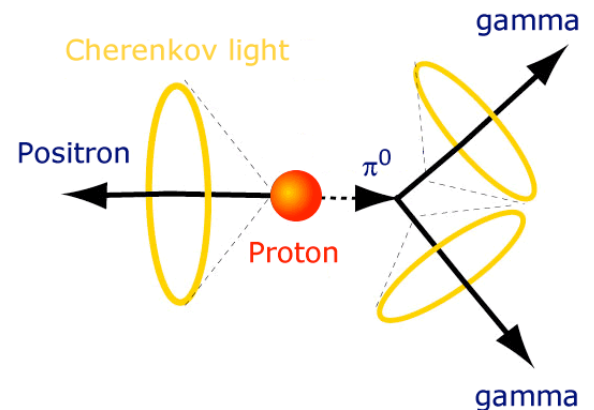
Why called “Super-Kamiokande”??

- Kamiokande – built to observe the decay of protons by Koshiba
- Kamioka – name of the city in Japan where the detector is.
- NDE – Nucleon Decay Experiment or Neutrino Detection Experiment



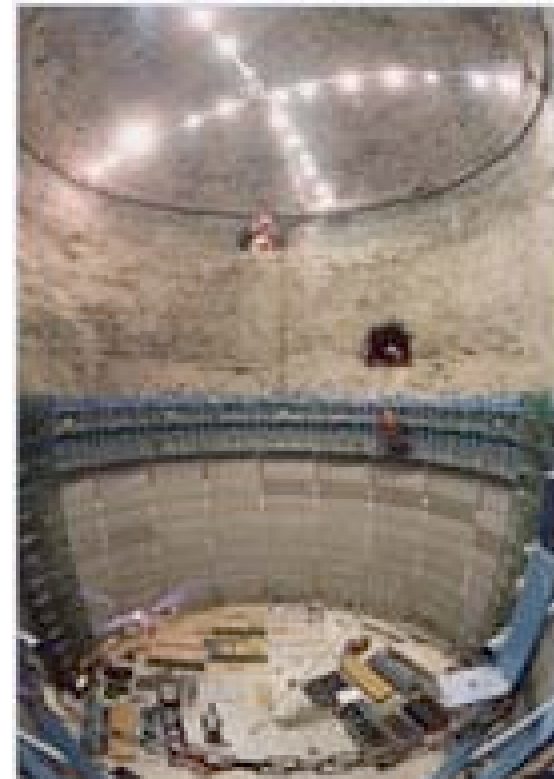
Decay of Proton

- According to Grand Unified Theory (GUT), protons decay.
- The lifetime: 10^{33} years (theory)
- We can observe at least one proton's decay within one year if there are 10^{33} protons.
 - So far no observation of proton decay = lifetime is more than 10^{34} years??



The detector, Super Kamiokande

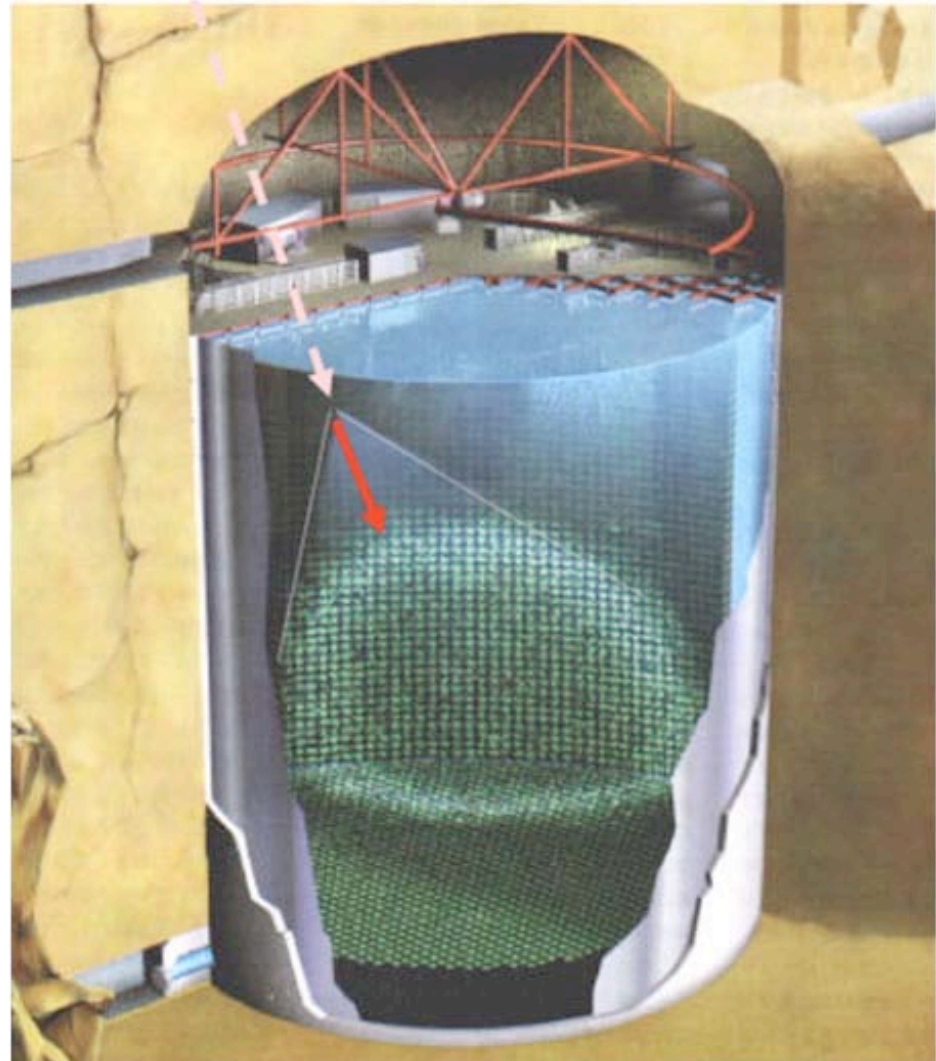
- The detector is built 1km under the ground.
- It is composed of
 - a cylindrical tank filled with ~ 50000 tons of ultra pure water.
 - The system to purify water and the air
 - Photomultiplier Tube (PMT)
 - Electronics
 - Online data gathering system
 - Offline calculating room etc.





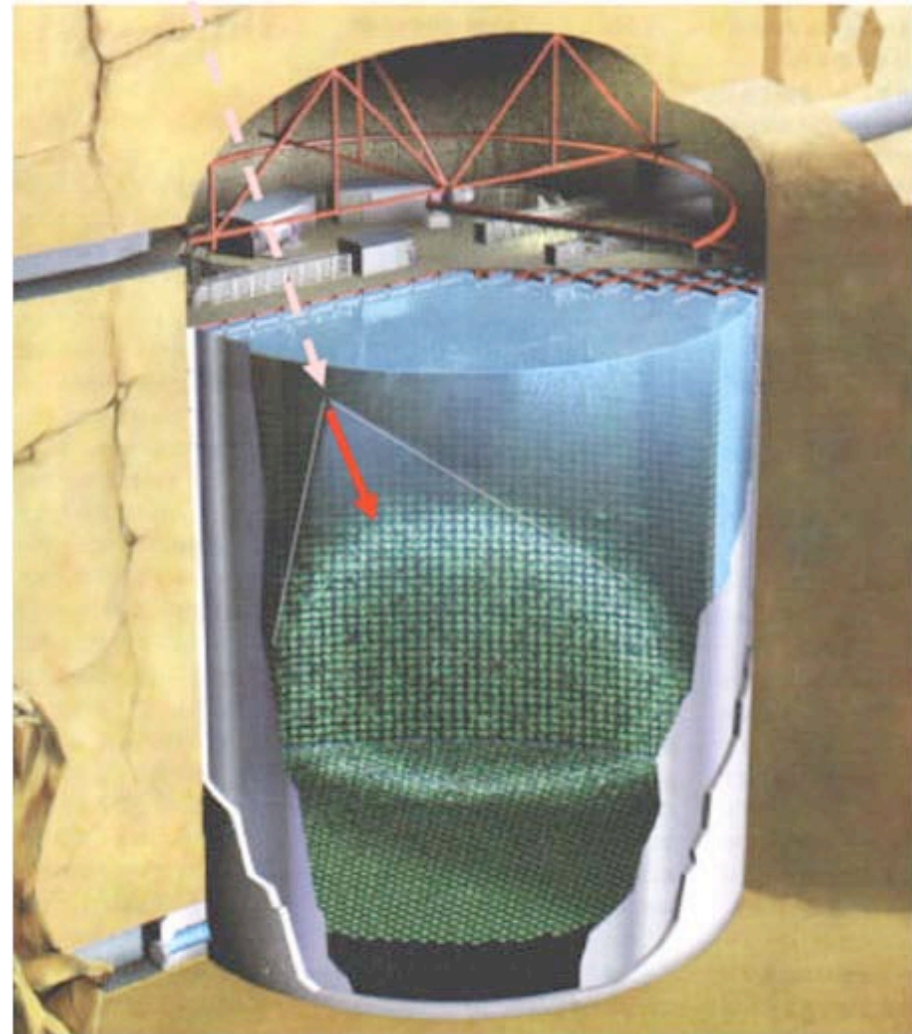
Why under ground?

- To avoid the muons which disturb observing neutrinos.
- The amount of muons under the ground is $1/100000$ compared with above the ground.
 - Still SK detects muons ~ 2 times per 1sec.
- Also the detector is located between mountains which work like umbrellas.



The tank

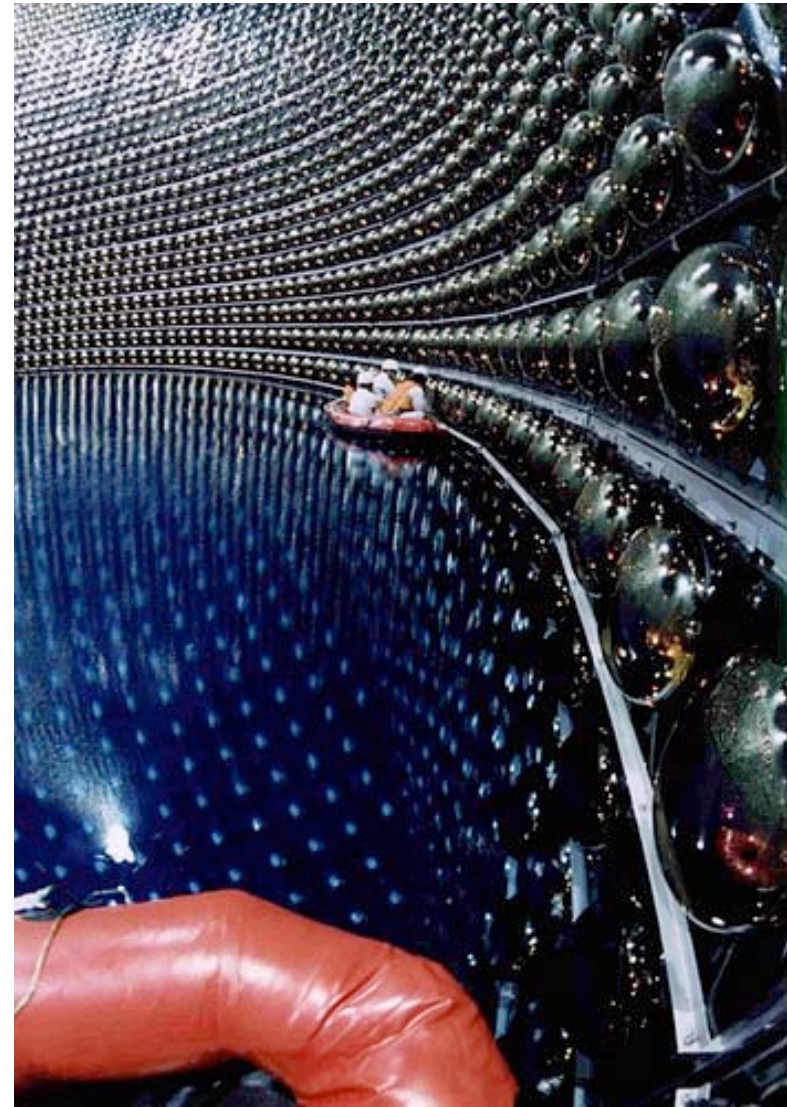
- The tank has two layers:
 - To distinguish if the date is due to muons from outside the tank
 - To prevent the invasion of the gamma ray or neutrons from the rocks surrounding the detector.





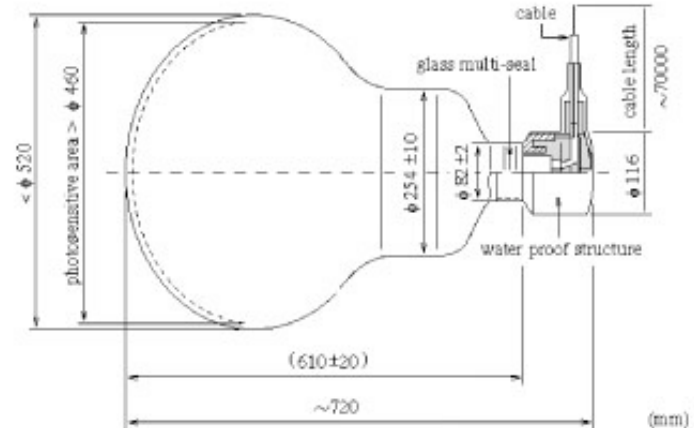
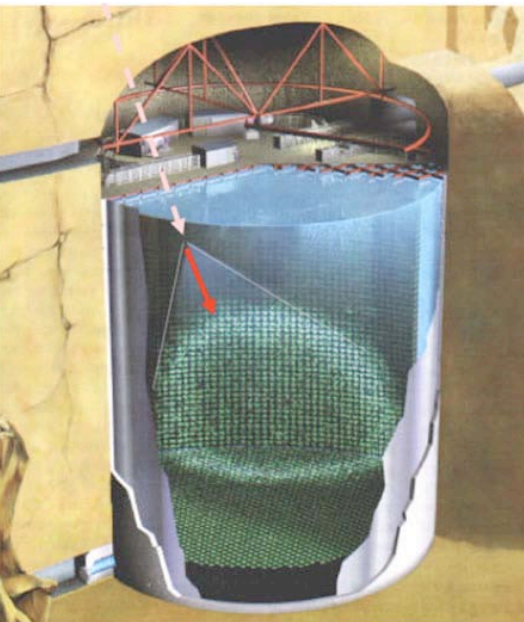
Water in the tank

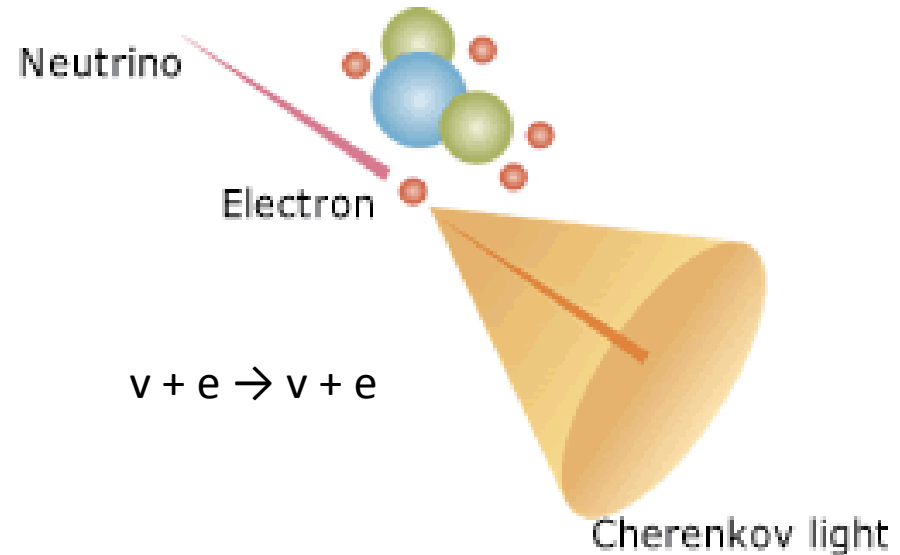
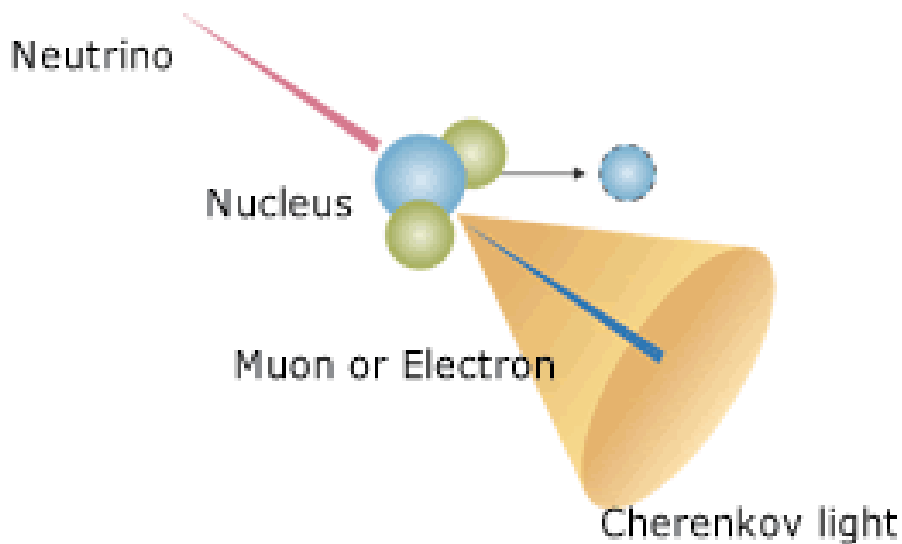
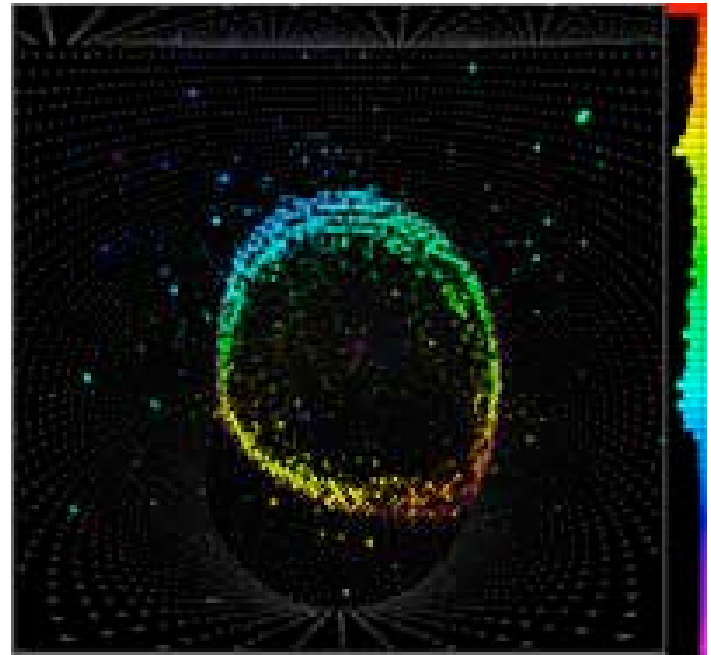
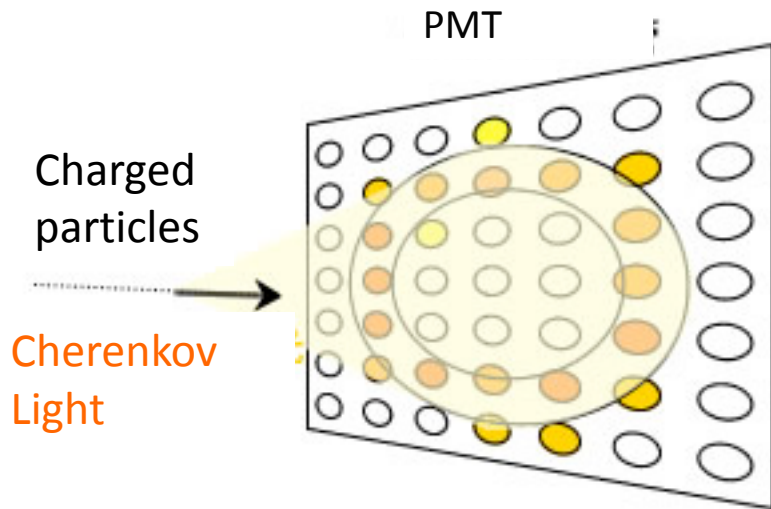
- Although possibility is low, neutrinos collide and emit charged particles, which are observable.
- This huge amount of water is the target for the collision.



PMT

- PMT detect the Cherenkov light, and the data is different depending on the amount of the light and time. They are used to determine the energy, directions, positions, and the kinds of the charged particles.





The generated charged particle emits the Cherenkov light.

Super-Kamiokande website

- <http://www-sk.icrr.u-tokyo.ac.jp/sk/index-e.html>