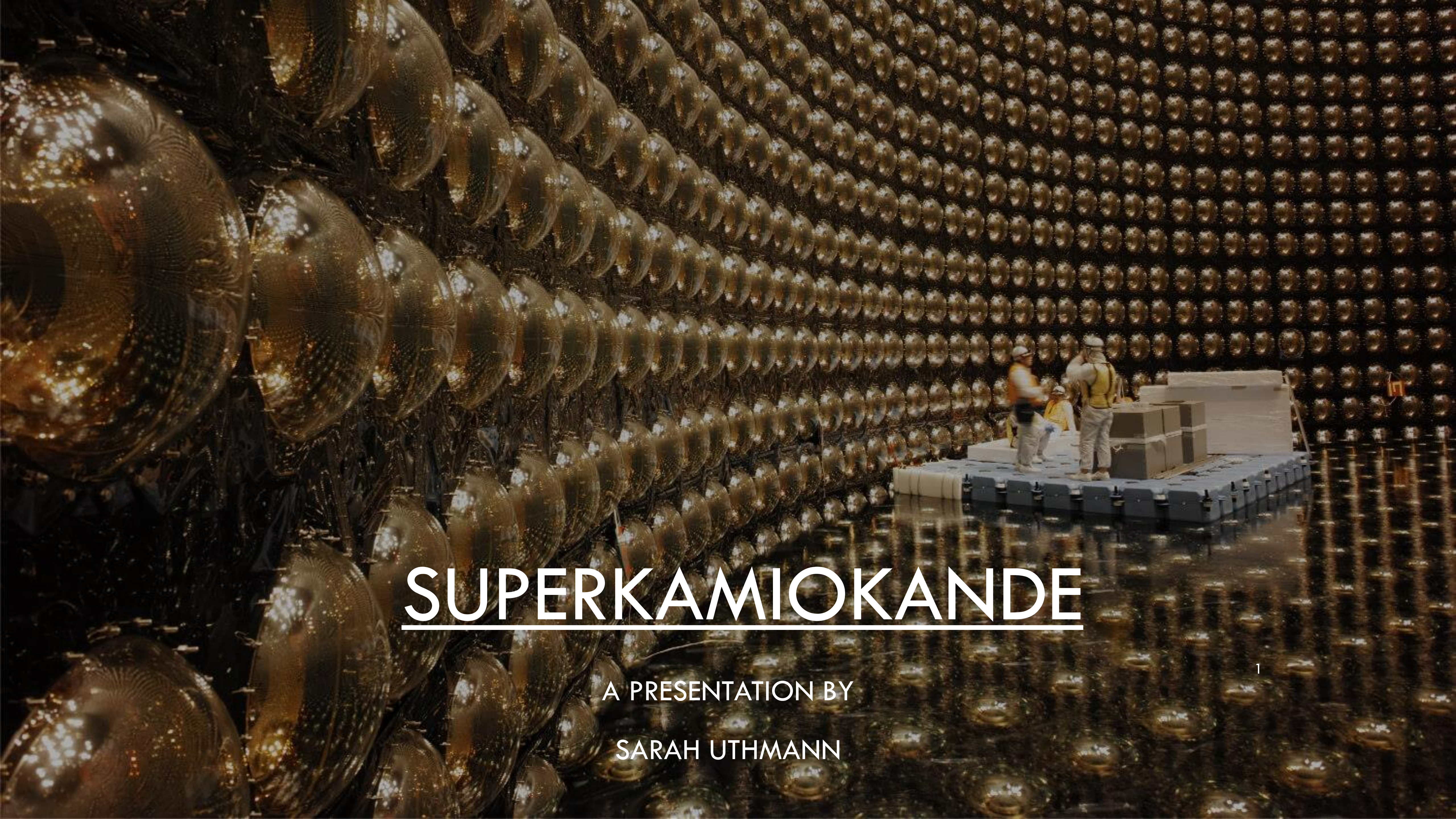


SUPERKAMIOKANDE

A PRESENTATION BY

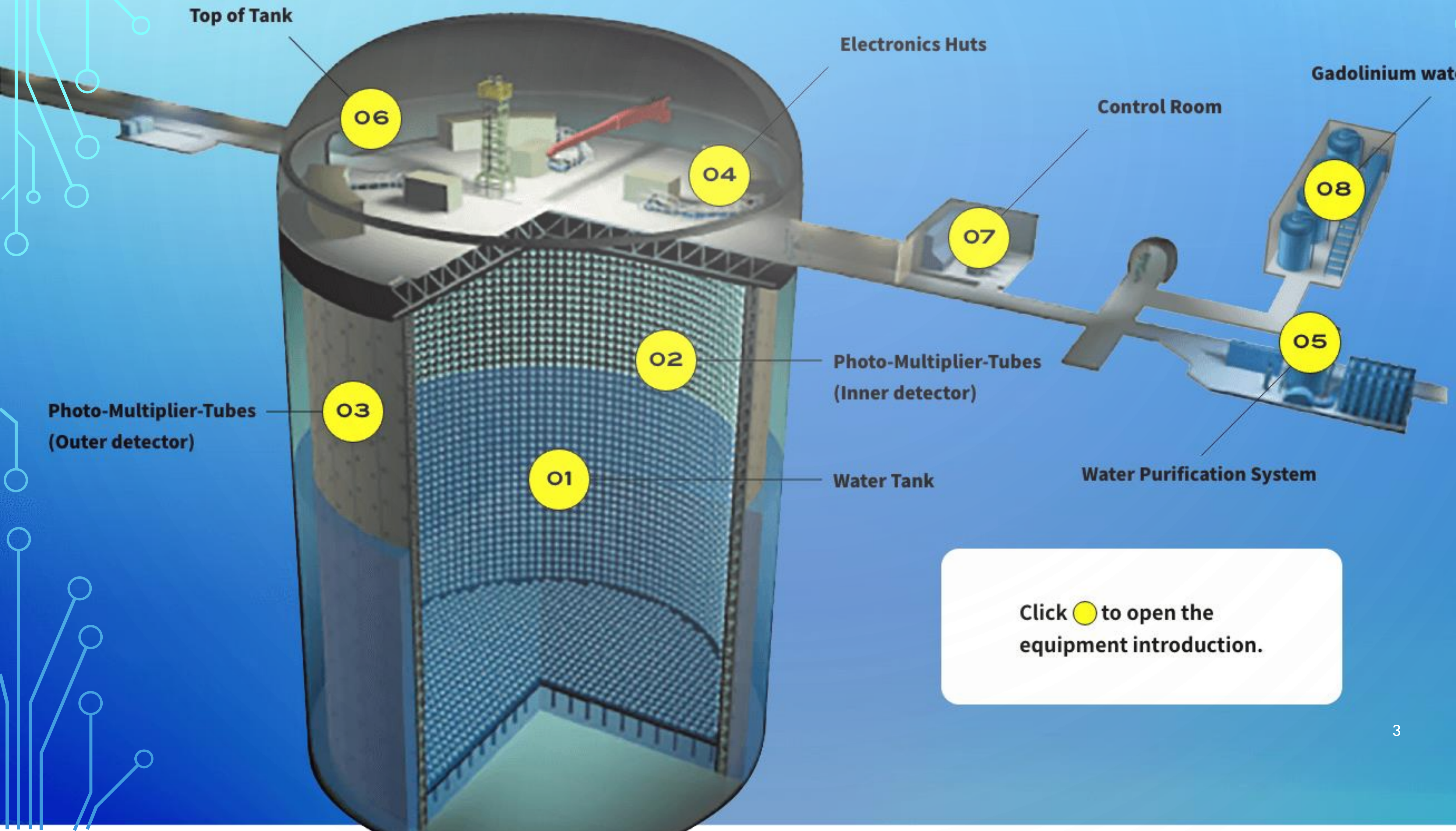
SARAH UTHMANN

TECHNICAL ADVICE

- The world's largest water Cherenkov detector

→ Observation of Neutrinos

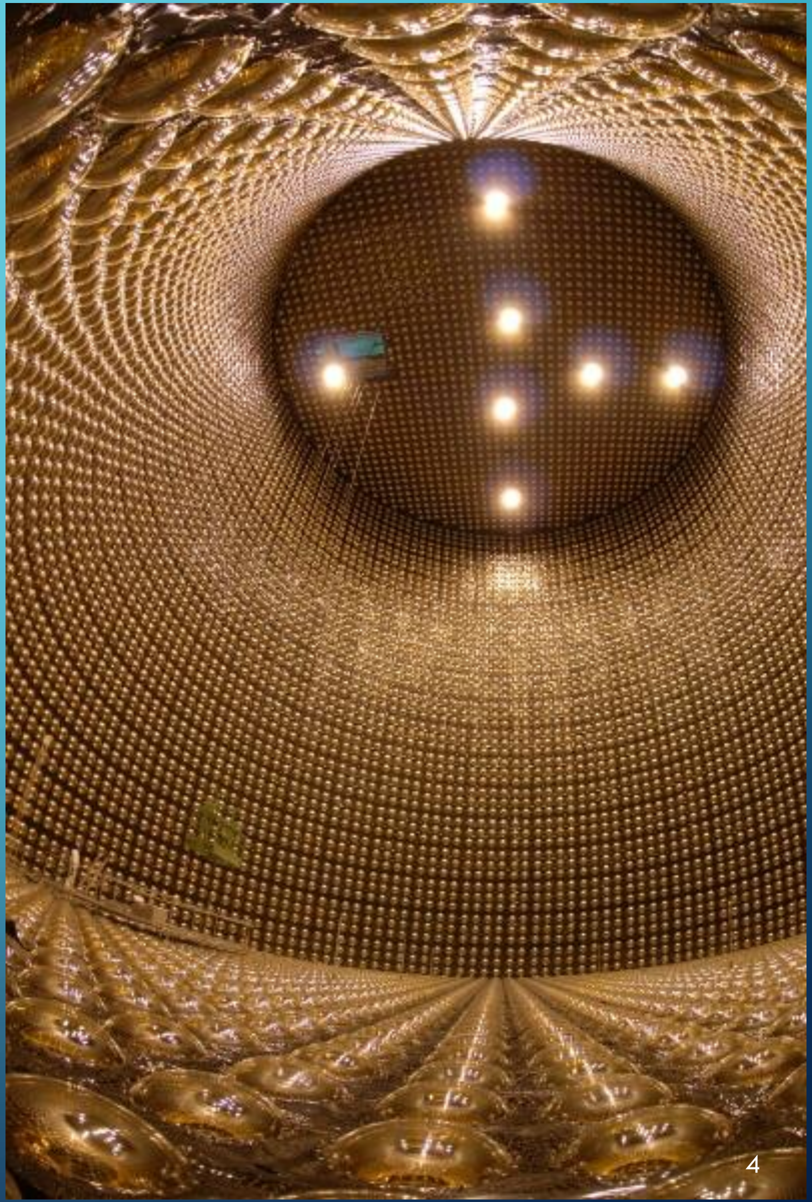
- Construction began in 1991
- The observation started on April 1st, 1996
- International collaboration of about 200 people and about 50 institutes



Click ● to open the equipment introduction.

WATER TANK

- Cylindrical stainless steel tank
- 39.3 m in diameter and 41.4 m in height
- Photosensors installed on the detector wall
- Filled with 50 tons of water



INNER DETECTOR

- The inner tank contains 11129 inward-facing photo-sensors
- The photosensors detect Cherenkov light
- Detect charge and timing information → energy and direction of particles

OUTER DETECTOR

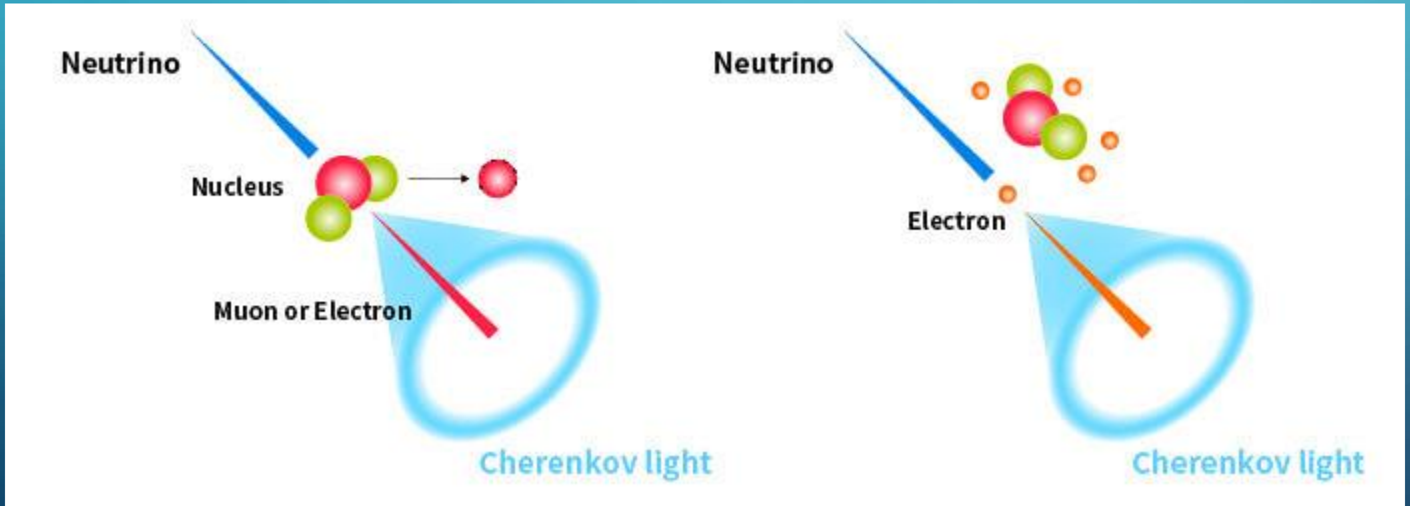
- 1885 outward-facing PMTs
- 20 cm diameter detectors are attached to a 60 x 60 cm wavelength shifter plate → Collect photons efficiently
- The walls were covered with reflective white sheets
- Purpose: Distinguish neutrino events from cosmic ray muon events

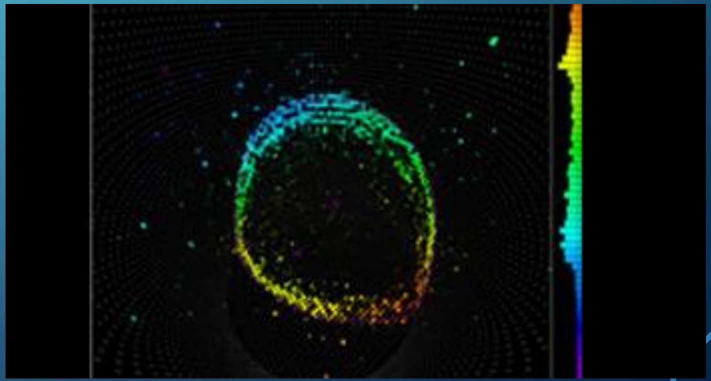
DETECTION METHOD

- Detect charged particles generated by interactions with neutrinos

→ Cherenkov light

- Information: energy, direction, interaction point and type

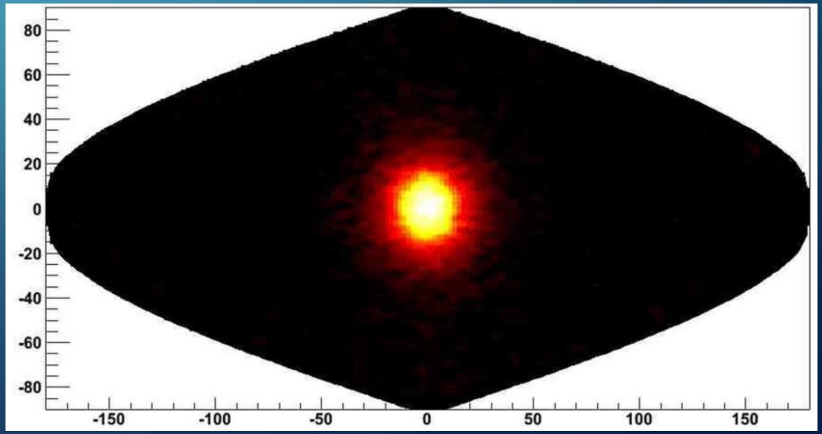




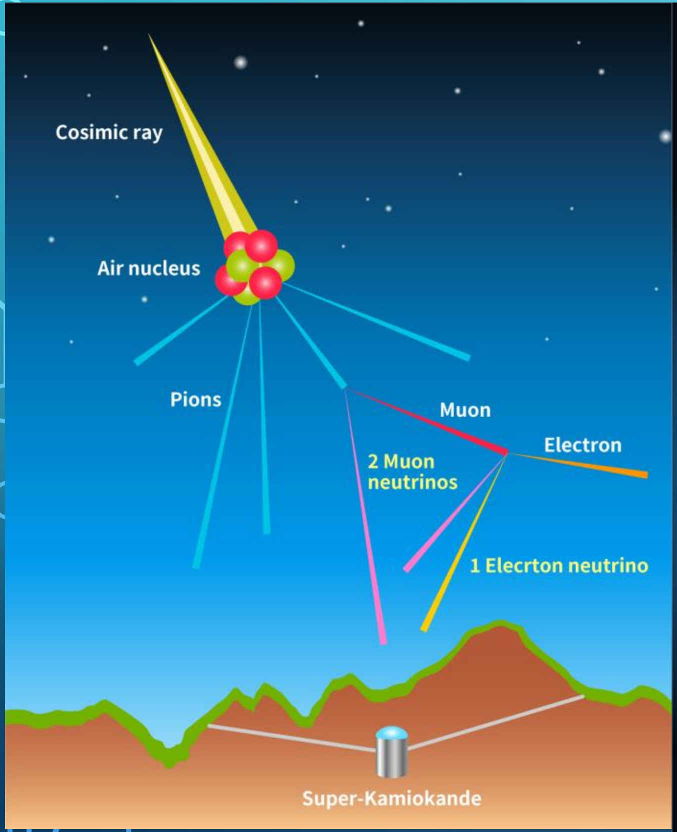
SOLAR NEUTRINOS

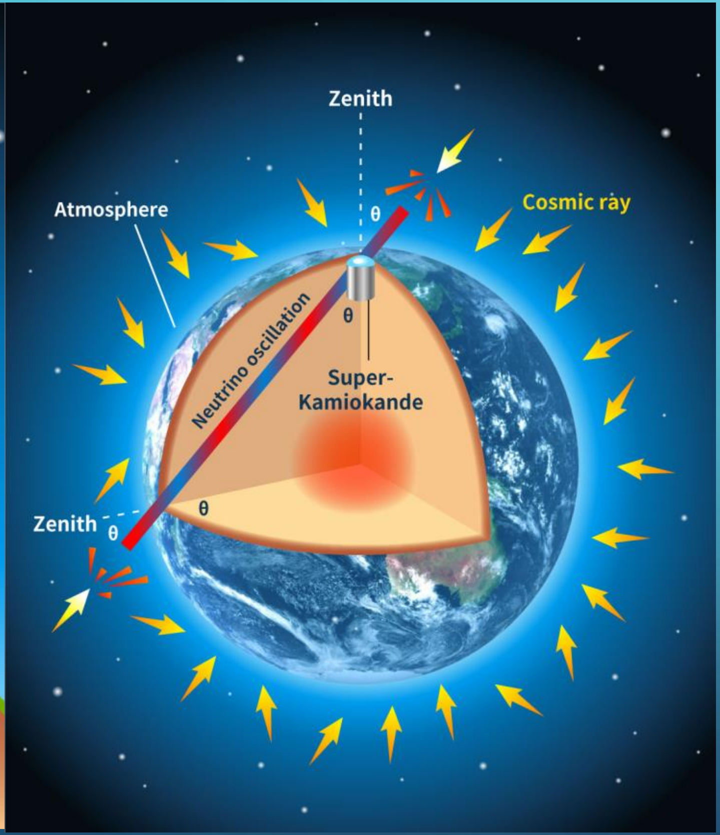
- Reaction: 4p → He + 2e + 2ν_e + fusion energy
- Solar neutrino flux on earth: 66 billion per second and square centimeter
- Travel time from sun to earth: 8 min
- The observed solar neutrino flux was about 45% of the expected flux

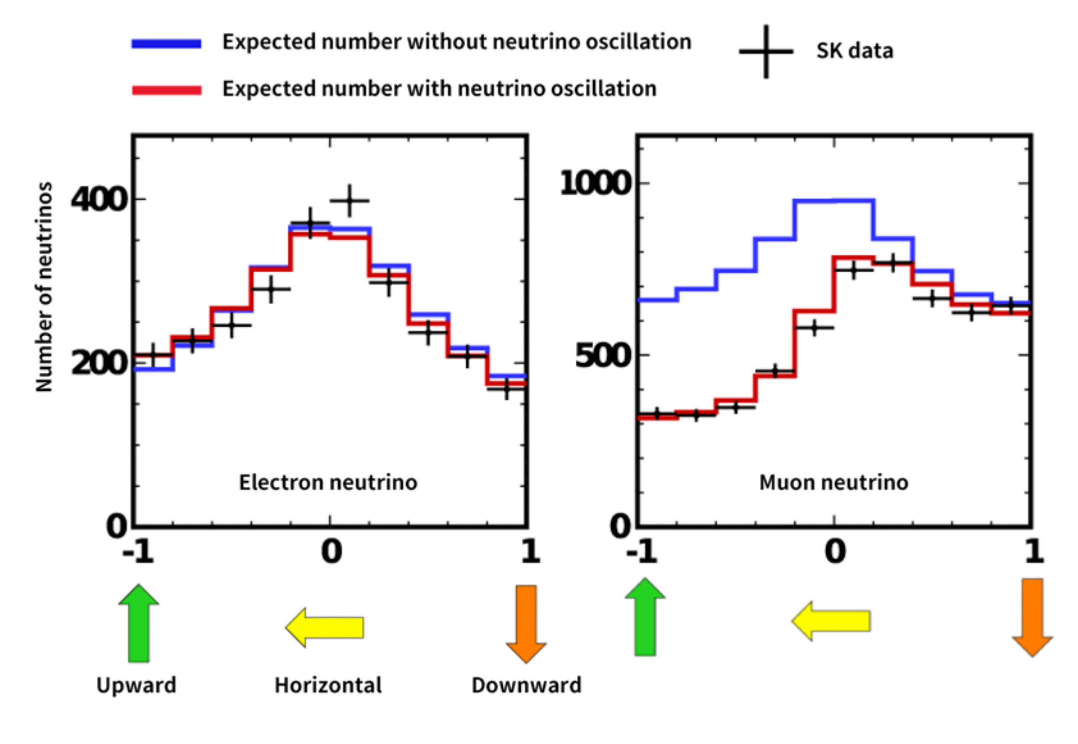
→ Neutrino oscillation



ATMOSPHERIC NEUTRINOS

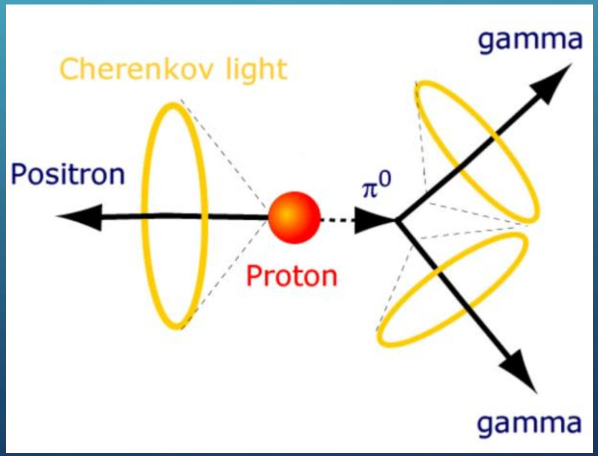




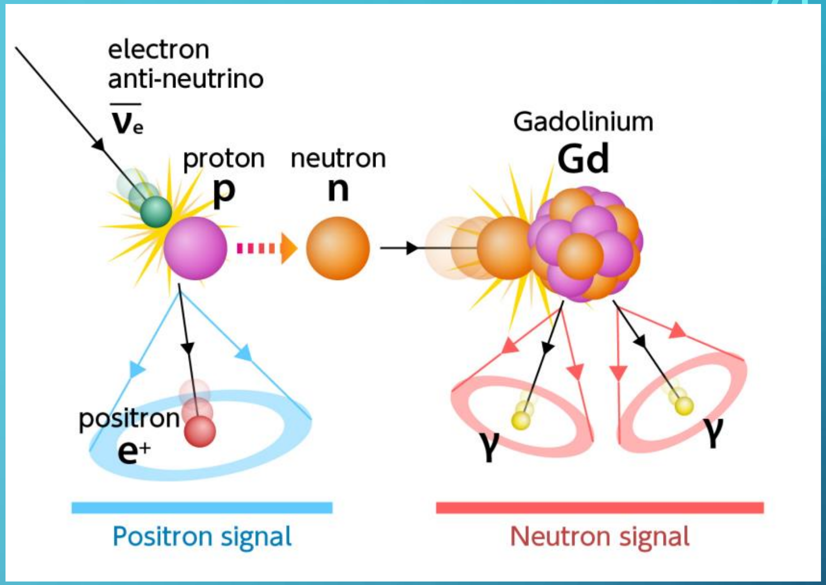


PROTON DECAY

- Grand Unified Theory: Unifies strong, weak, and electromagnetic interactions
- Prediction: Proton decay into lighter particle
- Proton lifetime is estimated to be longer than 2×10^{34} years
- Super-Kamiokande uses 50,000 tons of pure water and it contains 7×10^{33} protons



SUPERNOVA RELIC NEUTRINOS



- Neutrinos are emitted from all core collapse supernova
- Investigate the history of star formation, a key factor in cosmology, nucleosynthesis and stellar evolution
- The flux of the supernova relic neutrinos is very weak compared to the flux of higher energy neutrinos
- About 80% of the detectable supernova neutrino events are inverse β decay
- 0.2% concentration of a gadolinium compound to detect the neutron

LITERATURE

- https://www-sk.icrr.u-tokyo.ac.jp/en/sk/