

TAUP 2021 ONLINE

# Tribute to Masatoshi Koshihira

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Takaaki Kajita, ICRR, The University of Tokyo



**Masatoshi Koshihira**

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# *Outline*

- Brief CV of Masatoshi Koshiha before Kamiokande
- Kamiokande
- Kamiokande to Kamiokande-II
- Initial idea of Super-Kamiokande
- Closing remarks

(Let me allow to omit honorific titles throughout this talk.)

# Brief CV of Masatoshi Koshiba before Kamiokande

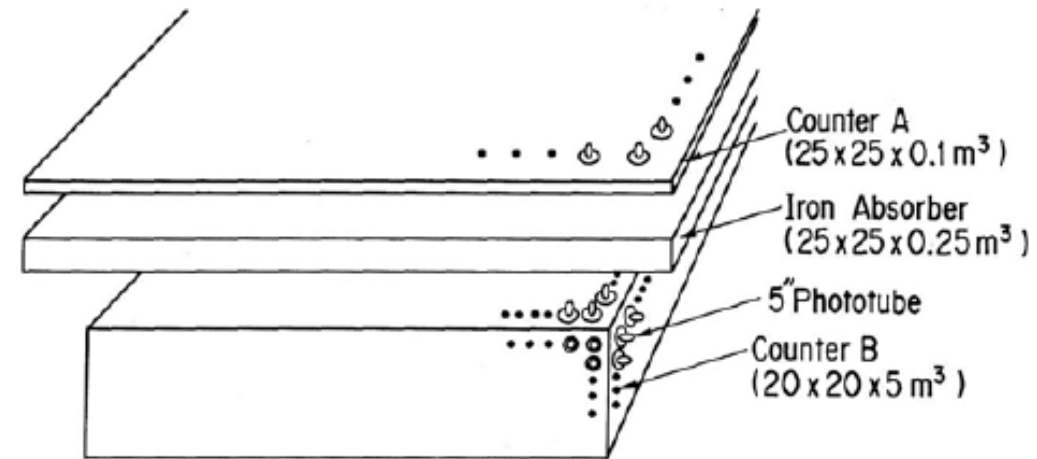
- Born in Toyohashi-city, Japan on September 19, 1926.
- BS in physics from the University of Tokyo in 1951.
- PhD in 1955 under the supervision of Morton Kaplon (Rochester). The thesis topic was on Ultra-High- Energy Phenomena in Cosmic Rays.
- Research associate at the University of Chicago for three years.
- Joined a cosmic ray emulsion experiment at the University of Chicago between 1959 and 1962. (Koshiba was appointed as the PI in 1960).
- Associate professor at the Univ. of Tokyo in 1962.
- Carried out an underground muon-bundle experiment in Kamioka (1960s).
- Realized the importance of  $e^+e^-$  experiment: joined the DASP experiment (1973~) and jointly formed the JADE experiment (1977~) both at DESY.



Masatoshi Koshiba (right) and his muon-bundle exp. In Kamioka in the 1960's

# Kamiokande

- There was a workshop on “The Unified Theory and the Baryon Number in the Universe” at KEK (1979). Koshiba proposed the initial concept of Kamiokande.
  - detector size :  $20 \times 20 \times 5 \text{ m}^3$  (2000 ton of water),
  - 5-inch PMTs
- Soon after, Koshiba heard that a similar but potentially larger experiment, later known as IMB, was being planned in the US.
- Koshiba revisited his original design and came up with the idea to develop PMTs with a 50 cm diameter.
- Koshiba knew “Hamamatsu” through the JADE experiment. In JADE, 3,000 PMTs were used for the EM shower counters. Koshiba and Hiruma (the President of the Hamamatsu company) discussed. Finally, Koshiba convinced Hiruma to develop 50cm diameter PMTs with the words (TK heard from Koshiba); “You are younger than me by one day. In this country, younger people listen to the older people. Please listen to me and develop 50cm diameter PMTs.”



Initial idea of the Kamiokande detector

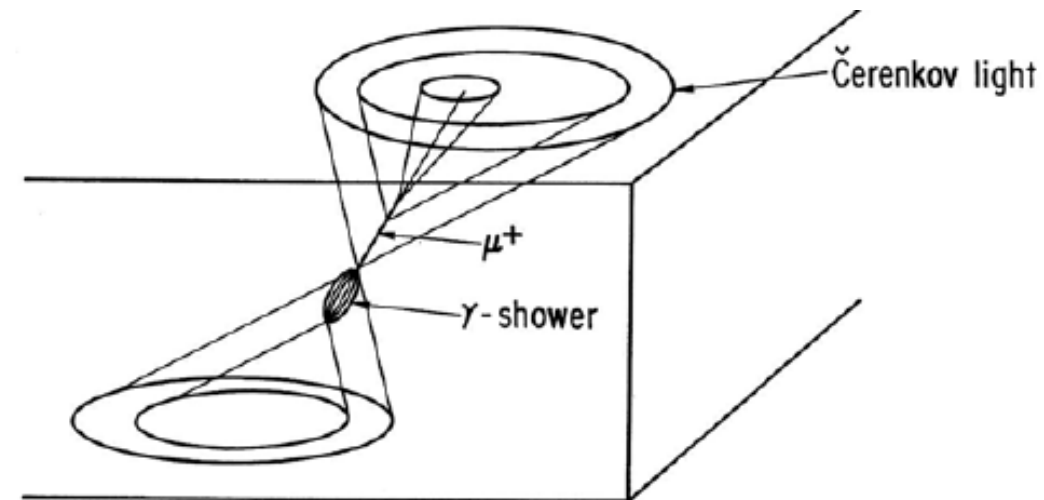


Image of the proton decay into  $\mu^+ + \gamma$  in the detector illustrated above

# Kamiokande

- Koshiba kept the personal connection to the people in the Kamioka mine since his first underground experiment in the 1960's. Therefore, he decided to construct the proton decay experiment in Kamioka. The name of the experiment was decided to be Kamiokande (Kamioka Nucleon Decay Experiment).
- In the spring of 1983, the Kamiokande members come to Kamioka to construct the Kamiokande detector.



Yoji Totsuka

Masatoshi Koshiba

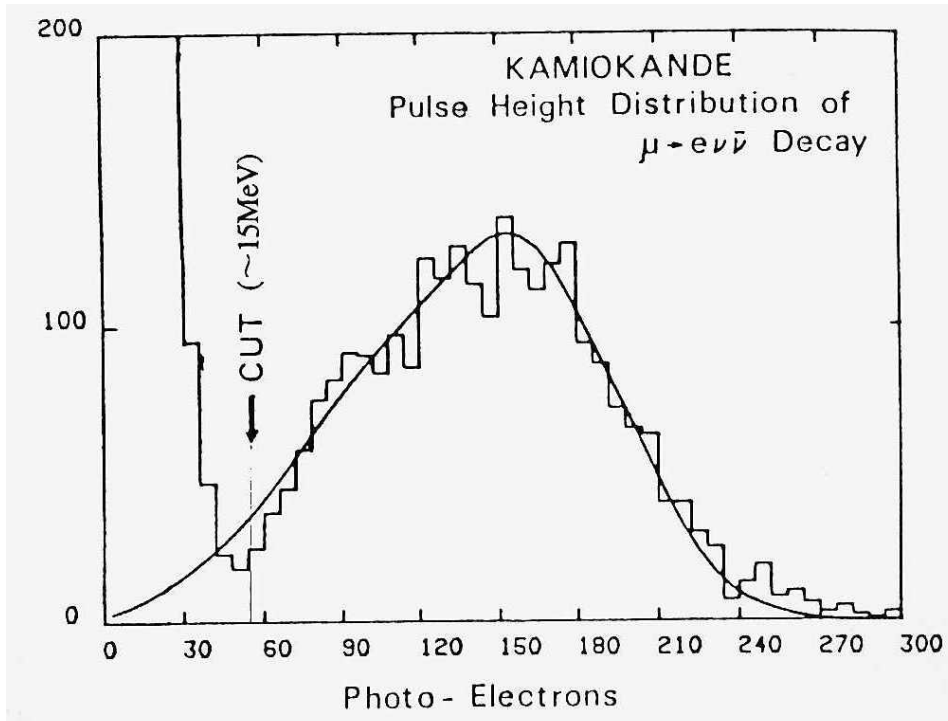
At the mine entrance, spring 1983



Masatoshi Koshiba in the Kamiokande detector during the construction.

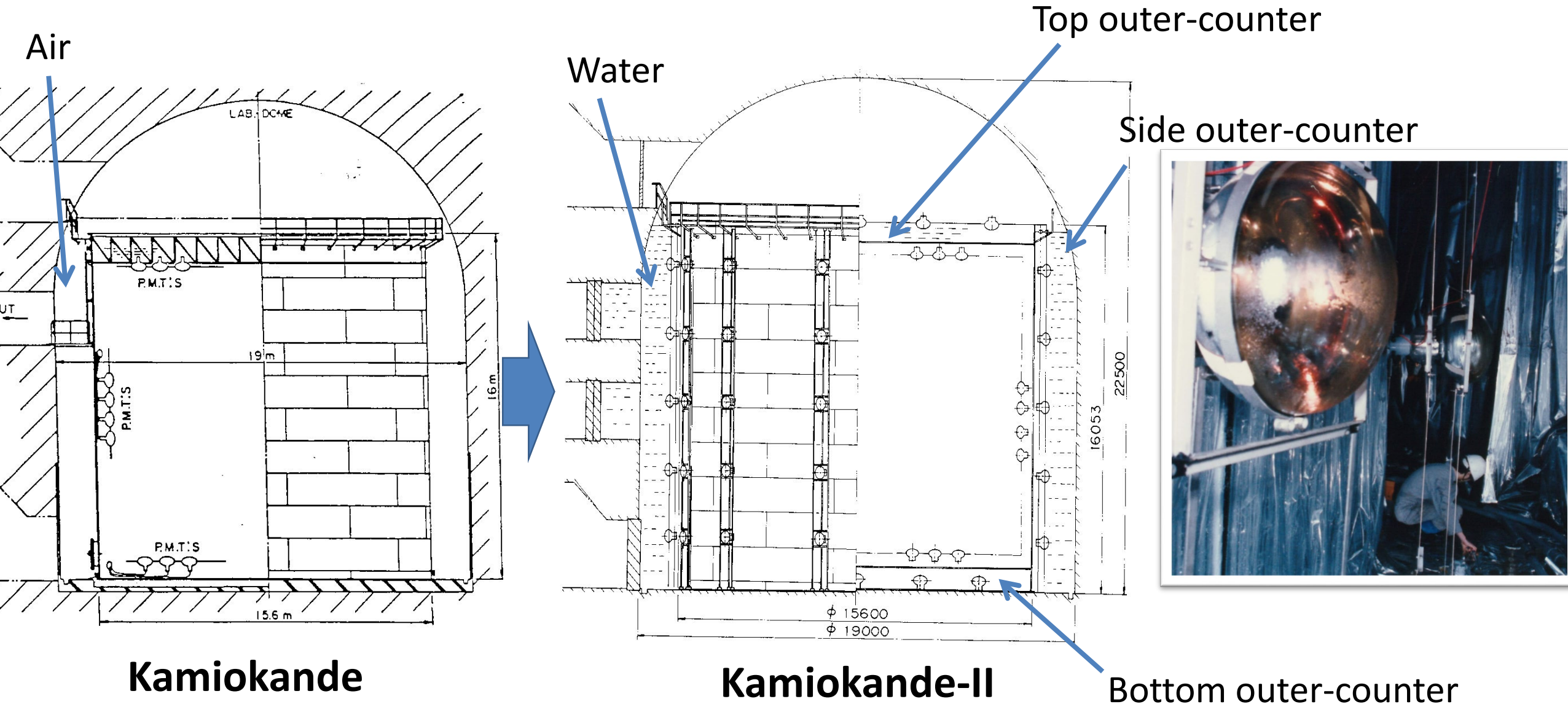
# Kamiokande to Kamiokande-II

- The Kamiokande experiment started taking data on July 6, 1983. Unfortunately, no clear evidence for proton decay was observed.
- Koshiba noted that Kamiokande observed the electron spectrum from the stopping cosmic rays down to 15 MeV, and therefore proposed to improve the Kamiokande detector to observe solar neutrinos. That was in the fall of 1983.
- Koshiba thought that he needed more collaborators to improve Kamiokande, and invited the Pennsylvania group to form Kamiokande-II.



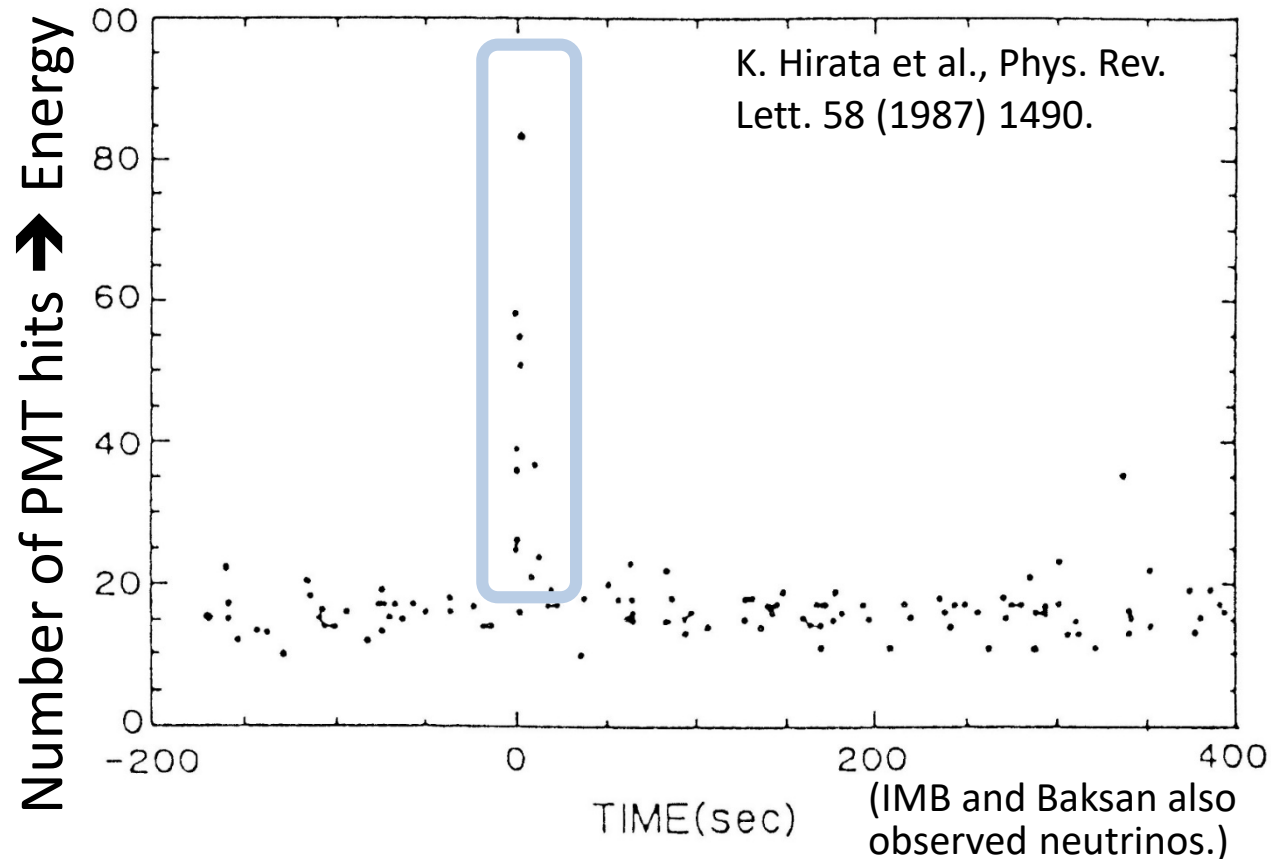
Al Mann, Masatoshi Koshiba and Gene Beier (from left to right)

# Kamiokande to Kamiokande-II



# Observation of Supernova neutrinos: SN1987A

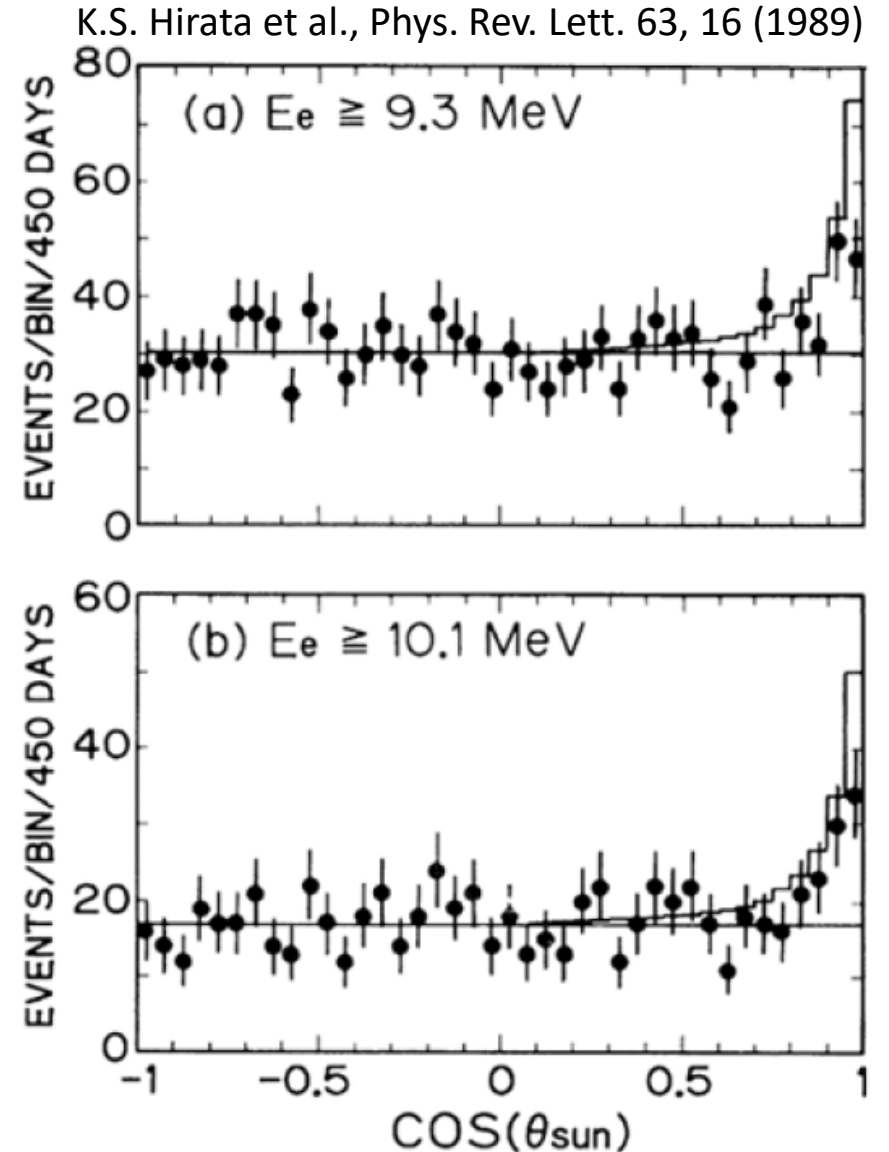
- Many hardware improvement works (construction of the outer detectors and the other improvements) in 1984 and 1985. The improvement of the water quality (reduction of radioactivity (Rn)) in 1985 and 1986.
- Kamiokande-II started the stable data taking in early 1987. Then, in Feb. 1987, ...





# Observation of solar neutrinos

- The main purpose of the Kamiokande-II experiment was the detection of solar neutrinos.
- Kamiokande-II published the observation of solar neutrinos in 1989.
- The Kamiokande's observation confirmed:
  - Neutrinos were coming from the Sun
  - The energy spectrum (shape) was consistent with the prediction.
  - There was a deficit of solar neutrinos as suggested by the Homestake experiment. (→ Later the solar neutrino deficit was concluded to be due to neutrino oscillations.)



# *Nobel Prize in Physics in 2002*

Raymond Davis Jr. and Masatoshi Koshihara received the Nobel Prize in Physics 2002 ***“for pioneering contributions to astrophysics, in particular for the detection of cosmic neutrinos”***.



Masatoshi Koshihara and Teruo Hiruma, former president of Hamamatsu Photonics Co.

# *Kamiokande and Koshihira*

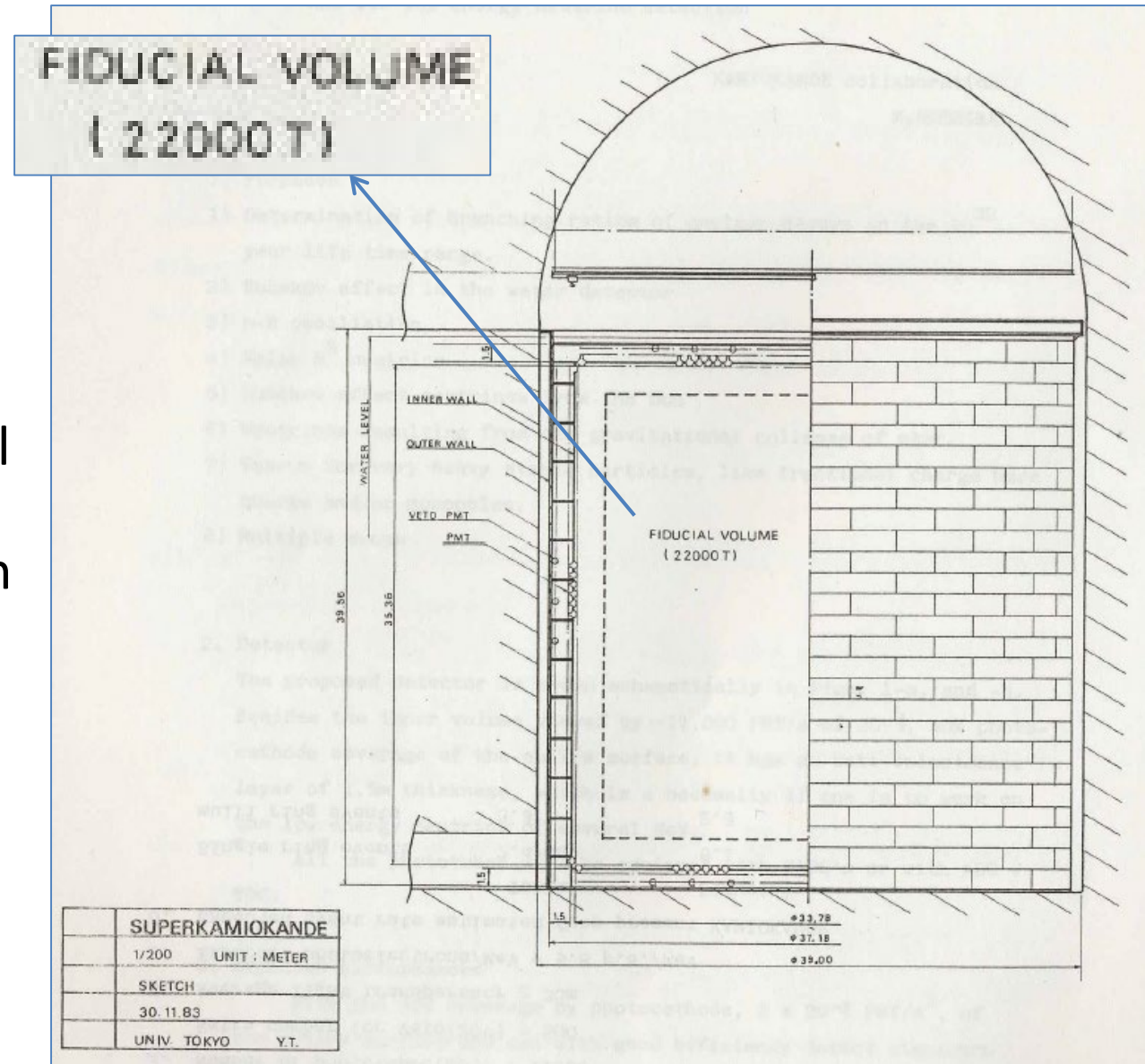
- Every morning, Koshihira started working by scanning the new Kamiokande data (candidate contained events). He continued this work style until he retired from the Univ. of Tokyo in March 1987. We learned a lot from his passion for physics.



Koshihira scanning the Kamiokande data.

# Initial idea of Super-Kamiokande

- In the fall of 1983, Koshiba proposed to observe solar neutrinos in Kamiokande.
- At the same time, he thought that the event rate of solar neutrinos with Kamiokande was too low to study solar neutrinos in detail. Therefore, Koshiba proposed Super-Kamiokande to study solar neutrinos in detail (and to search for proton decays).
- This idea was presented in December 1983 in a workshop in KEK. (Figure: The image of Super-Kamiokande presented in that workshop.)
- We would like to thank Prof. Koshiba for his pioneering idea. We have been enjoying the neutrino studies with Super-Kamiokande for many years.



# *Concluding remarks: Masatoshi Koshihara (1926-2020)*

- Koshihara always worked on his research with strong passion for physics and outstanding leadership.
- Koshihara was a great physicist who was able to feel the direction of physics.
- Koshihara told his younger colleagues that they should always have several “eggs” of research ideas because some of them could hatch in the future.



October 2014