

Large Format PMTs from Hamamatsu Photonics

<Contents>



What is Hamamatsu Photonics ??



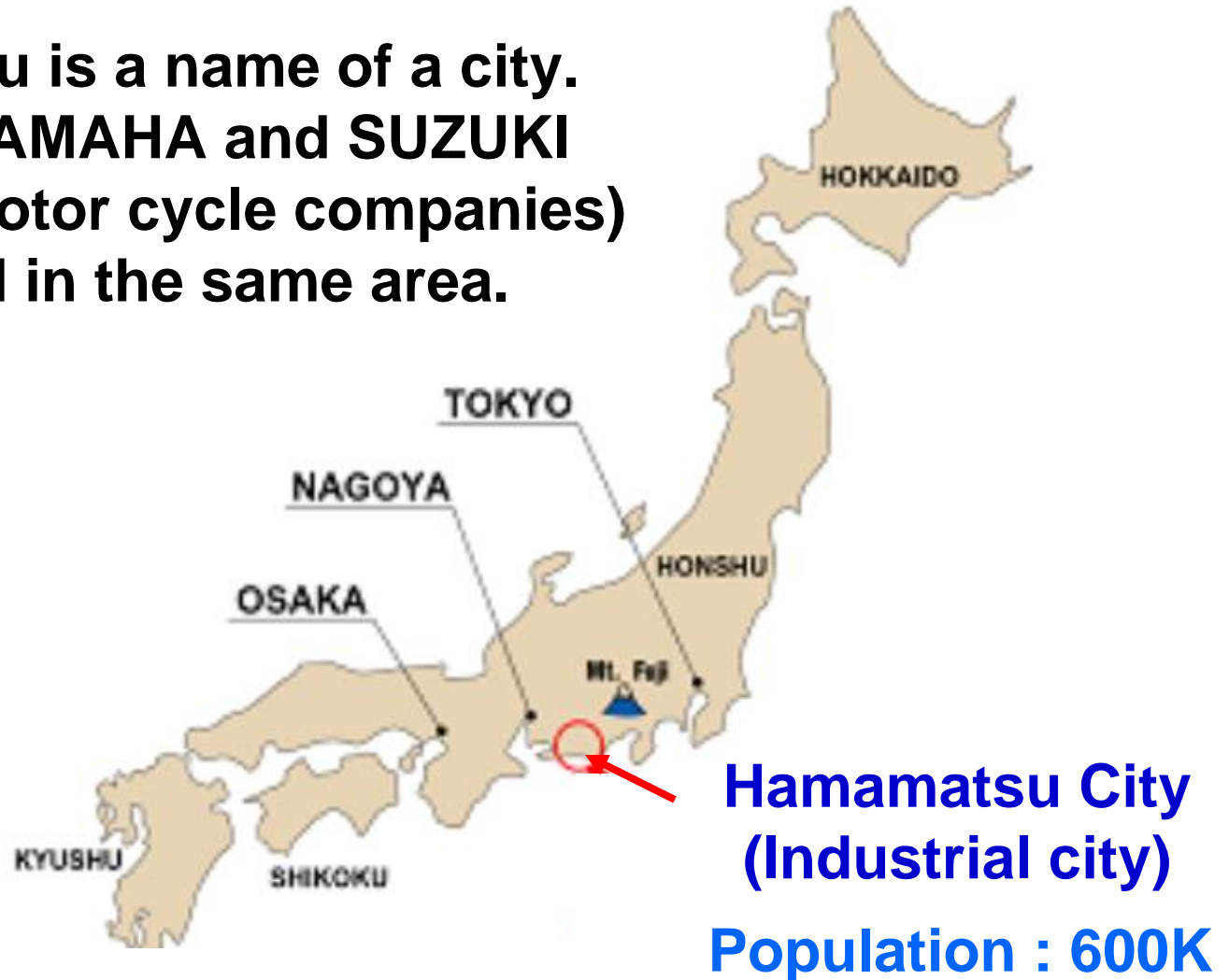
Large Format Photomultiplier

**Next Generation of Nucleon Decay
and Neutrino Detectors**

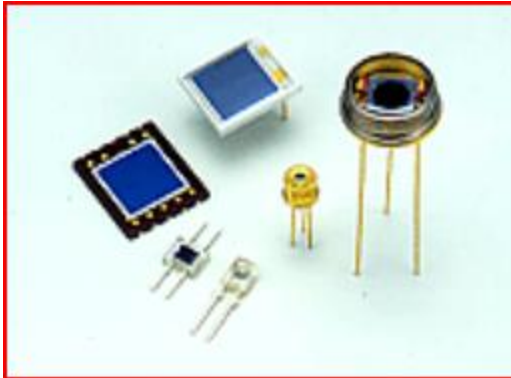
**Hamamatsu Photonics France
Alex Birkel**

Where is Hamamatsu Photonics ?

Hamamatsu is a name of a city.
HONDA, YAMAHA and SUZUKI
(famous motor cycle companies)
are located in the same area.



Hamamatsu Photonics



Solid State Division



Electron Tube Center



System Division



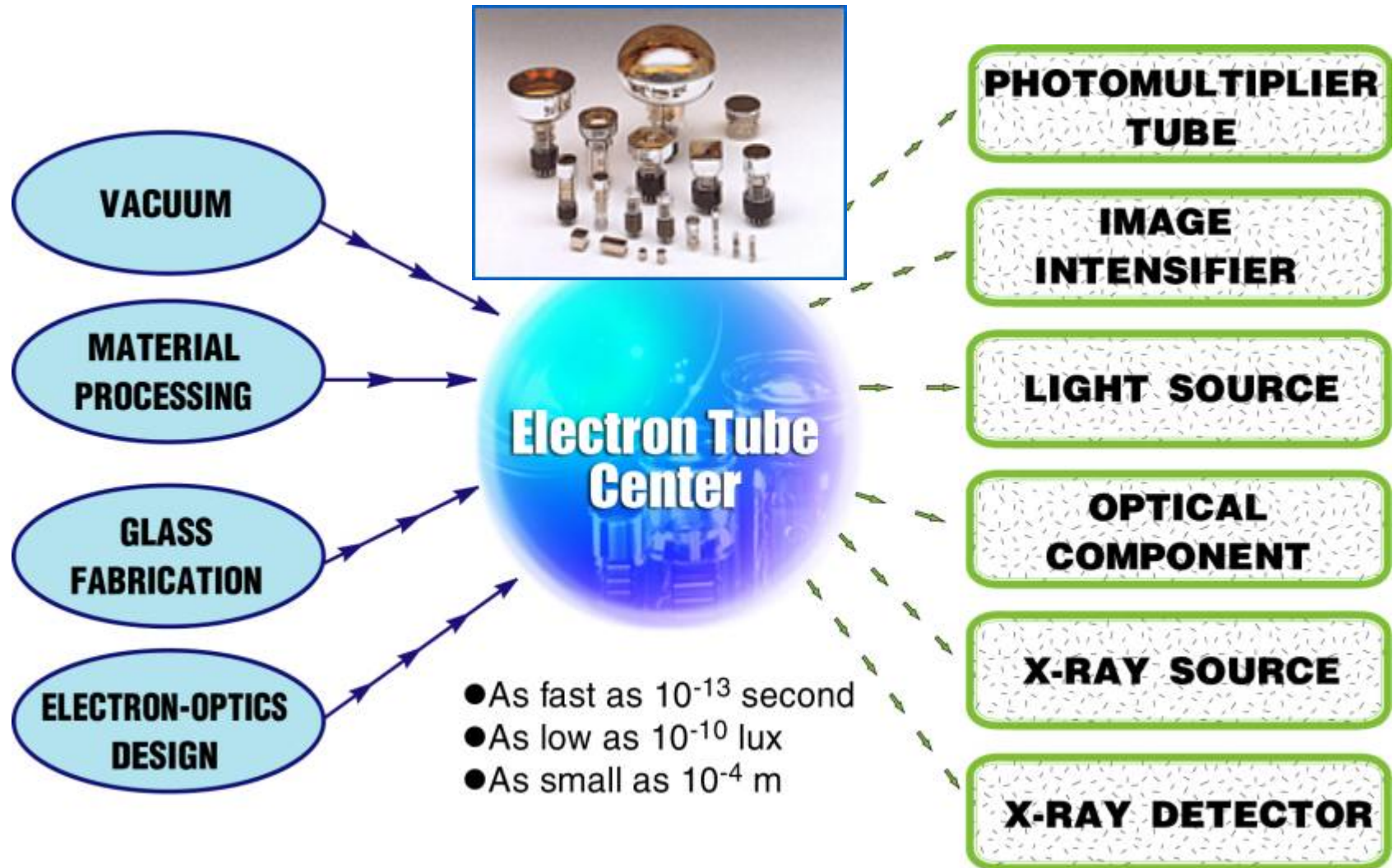
Central Research Lab



Laser Group

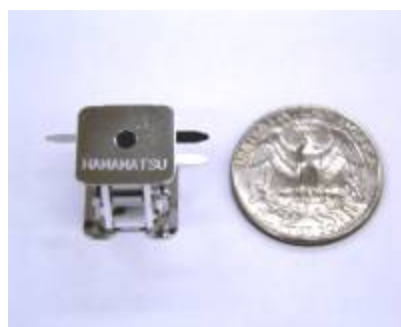
Established :
Sept 29, 1953
Net Sales : (2004)
62,245M yen
Employees : 2,500
(As of Sept. 2004)

Electron Tube Center





PMT's



Ion Detectors



***Fiber Optic Plates
with Scintillator's***



PMT Modules



***X-Ray Image
Intensifiers***



***Scientific
Light Sources***



Image Intensifiers



***Microfocus X-Ray
Sources***



UV Spot Light Sources



Large Format PMTs for Neutrino Experiments

Large Format PMT Lineup

8 inch



10 inch



13 inch

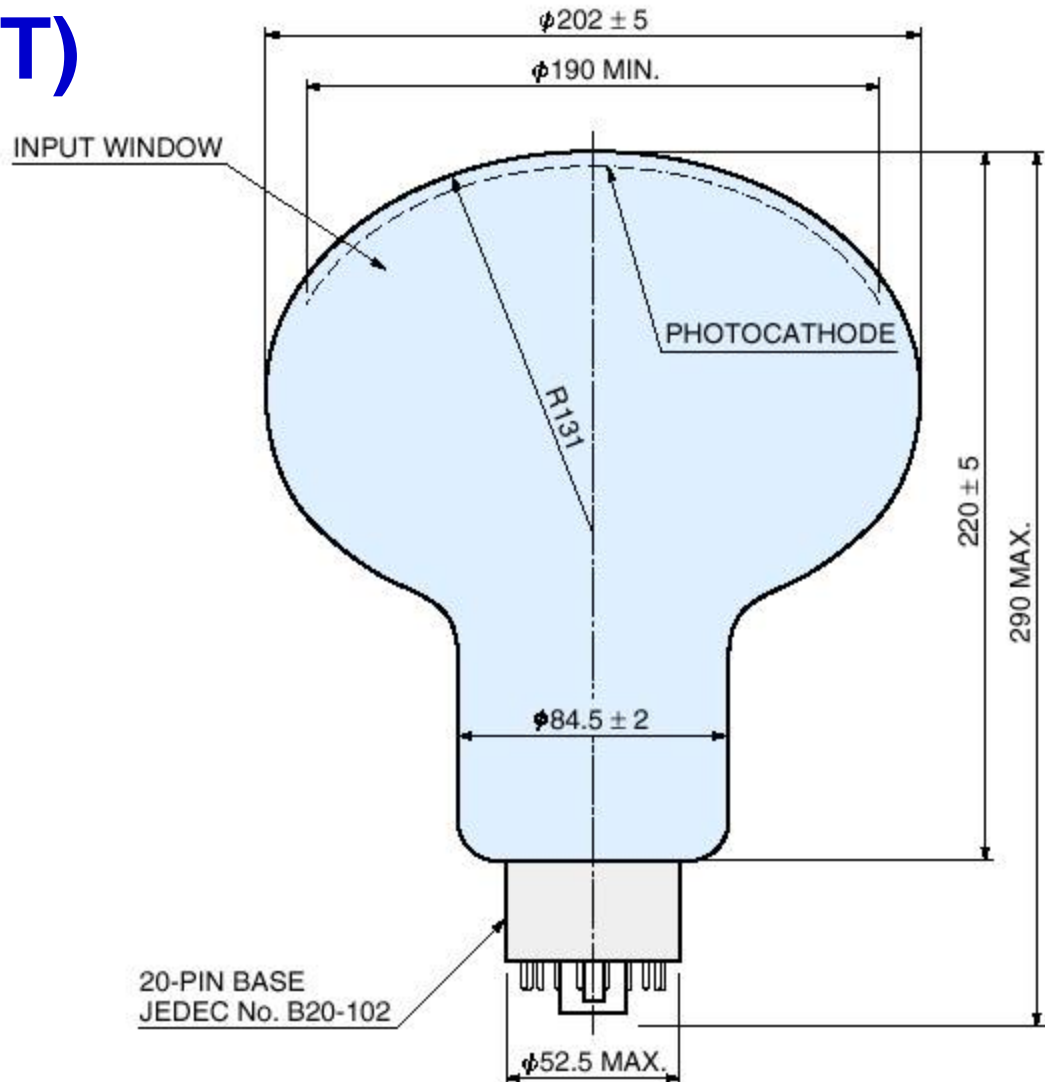


20 inch



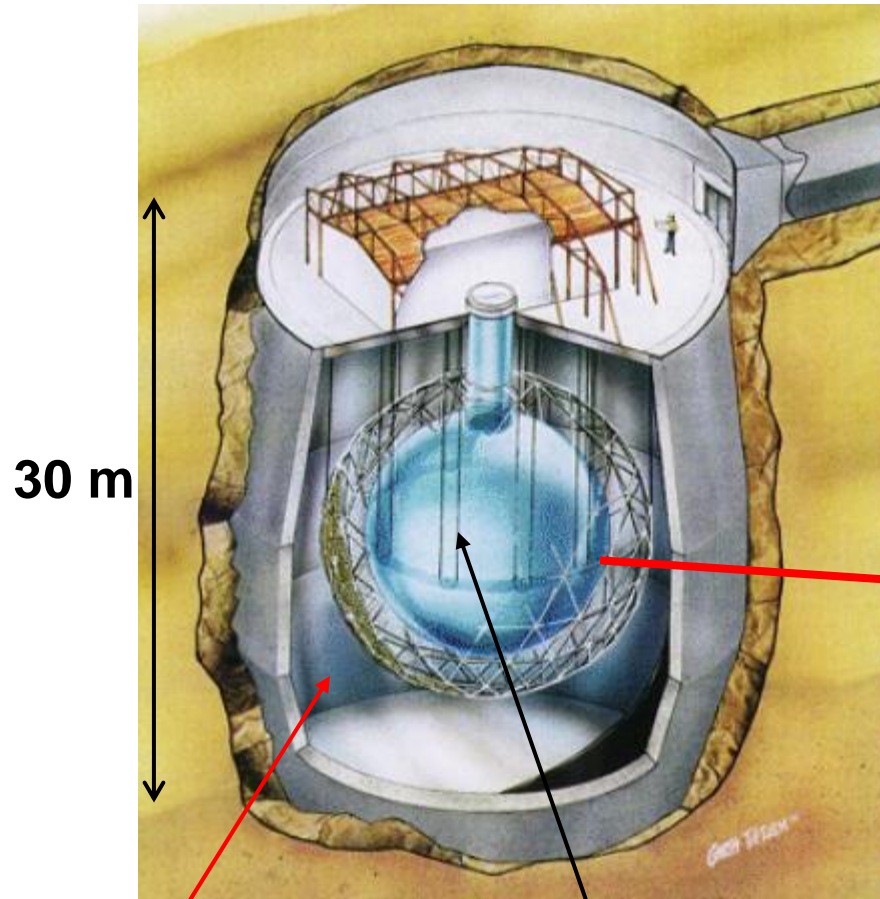
R5912 (8 inch) R5912-02 (14-ST)

Improved type
of former R1408



SNO at Sudbury/Canada

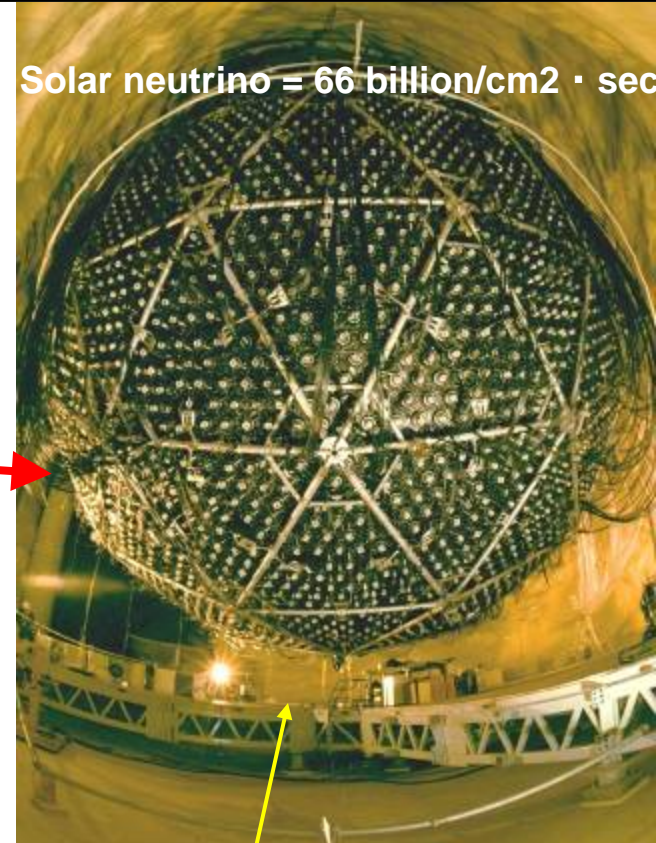
Solar Neutrino Experiment



30 m

Pure Water

**Heavy Water (1000 ton)
in 12 m acrylic vessel
(NaCl is included)**



Solar neutrino = 66 billion/cm² · sec

9,600 pcs of R1408

Solar neutrino = Electron neutrino

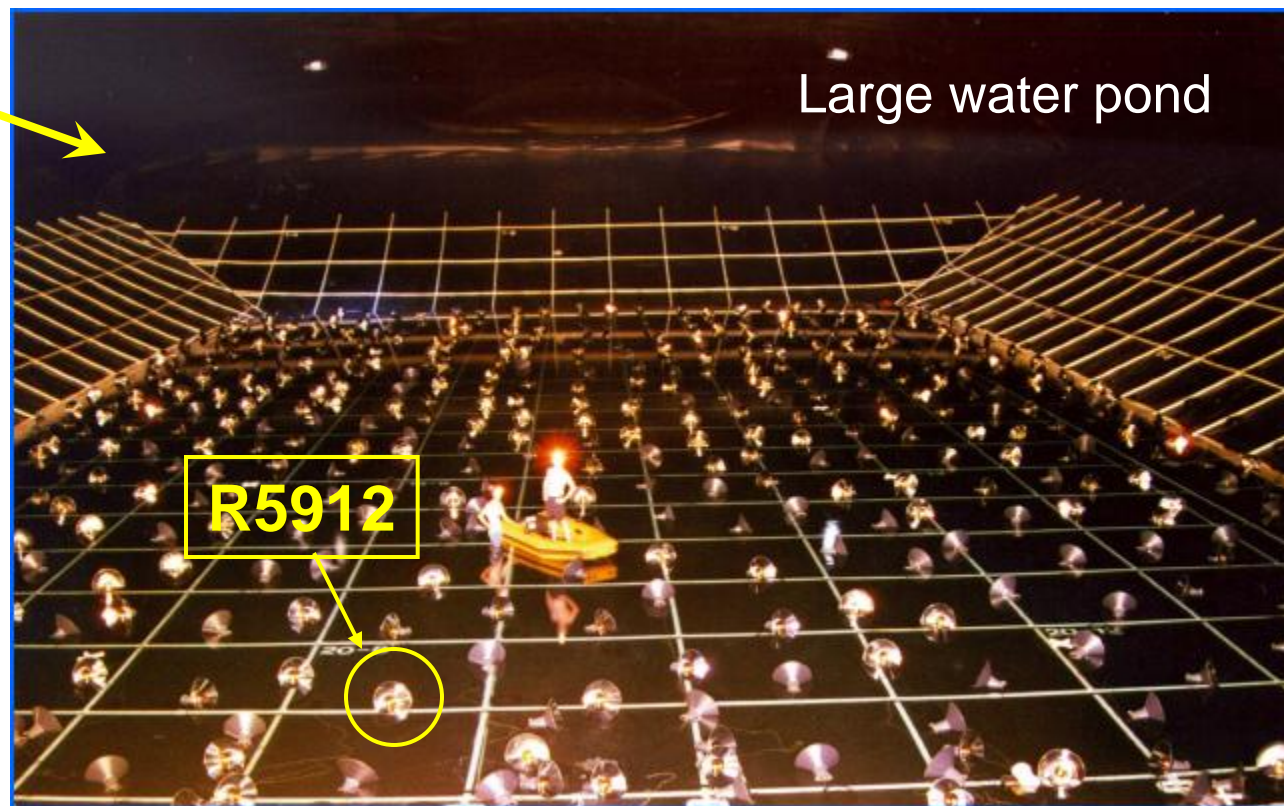
MILAGRO at LANL/USA

Research for VHE gamma ray
with its direction and energy



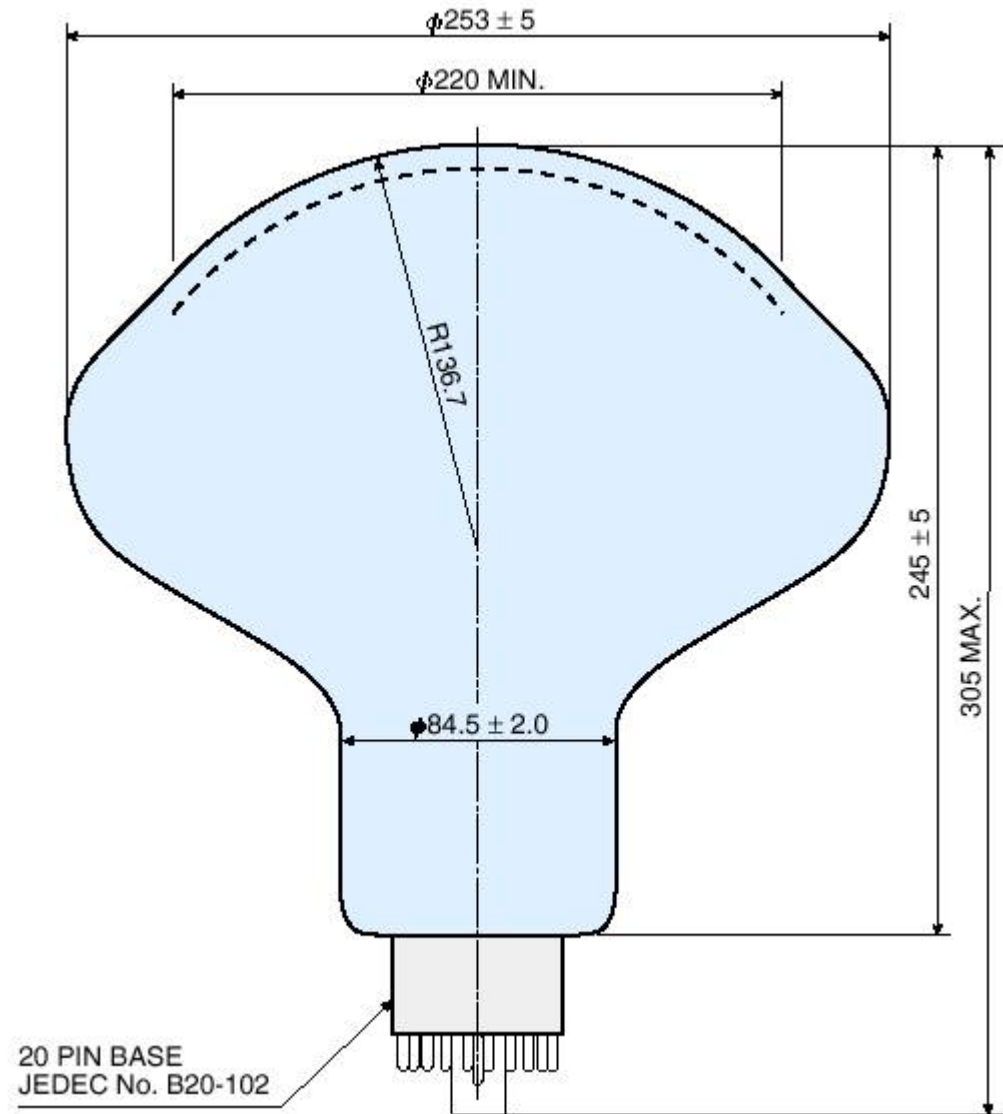
< Location >
The Jemez Mountains
near Los Alamos
New Mexico/USA

VHE gamma
=> Shower in air
=> Cherenkov



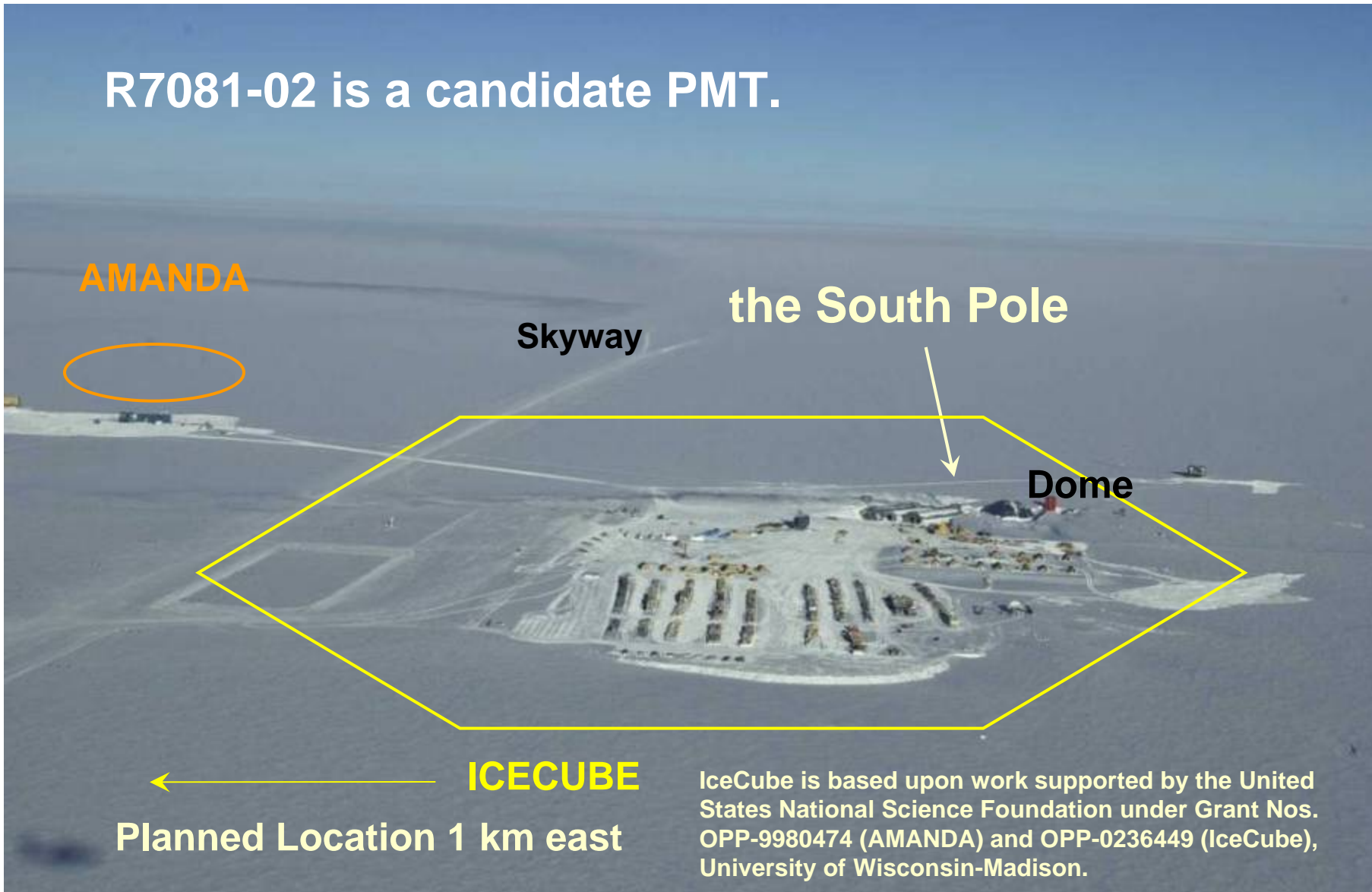
R7081 (10 inch) R7081-20 (14-ST)

Fits for 13 inch
Glass Sphere



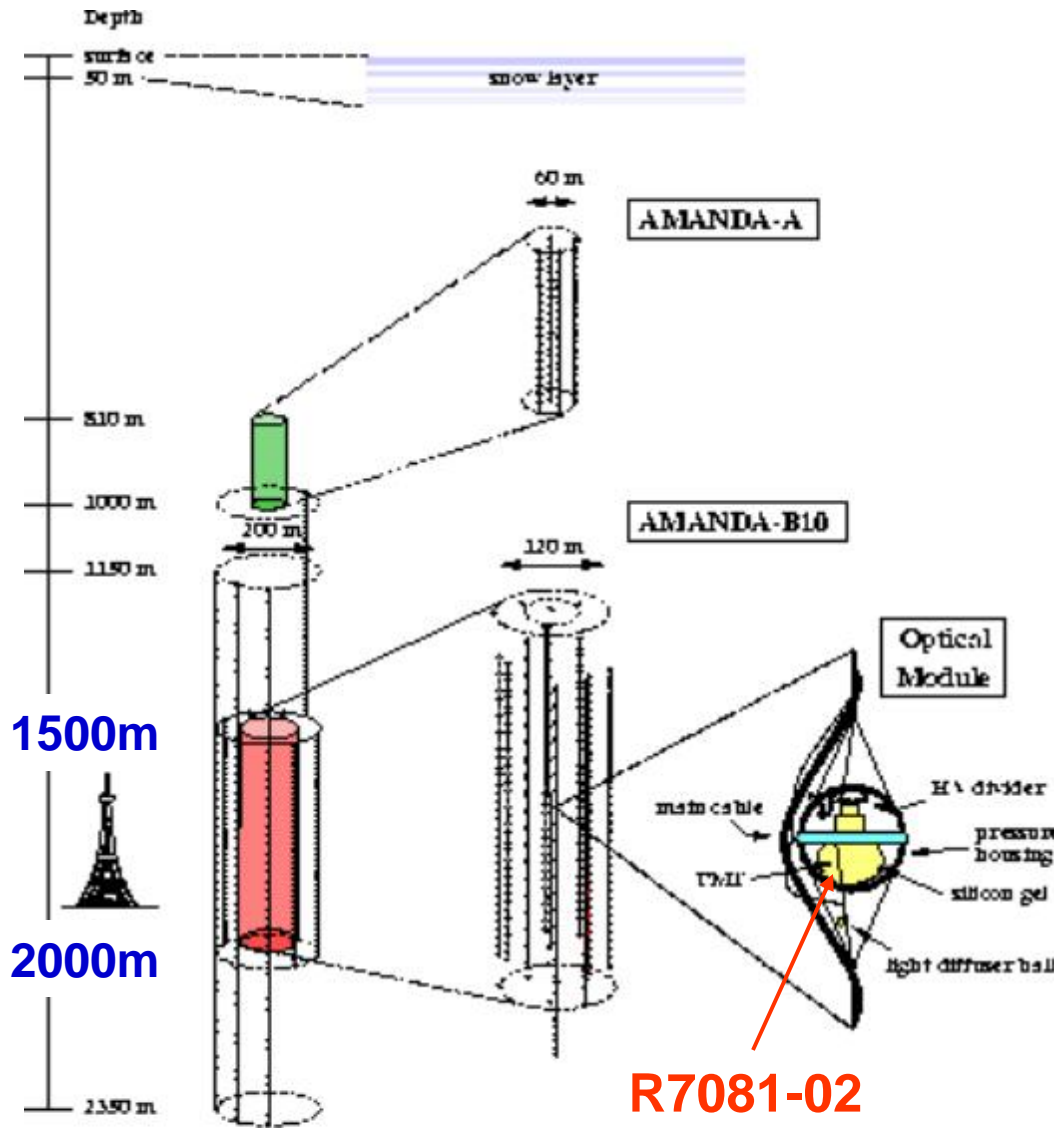
ICECUBE at the South Pole

R7081-02 is a candidate PMT.



IceCube is based upon work supported by the United States National Science Foundation under Grant Nos. OPP-9980474 (AMANDA) and OPP-0236449 (IceCube), University of Wisconsin-Madison.

ICECUBE at South Pole



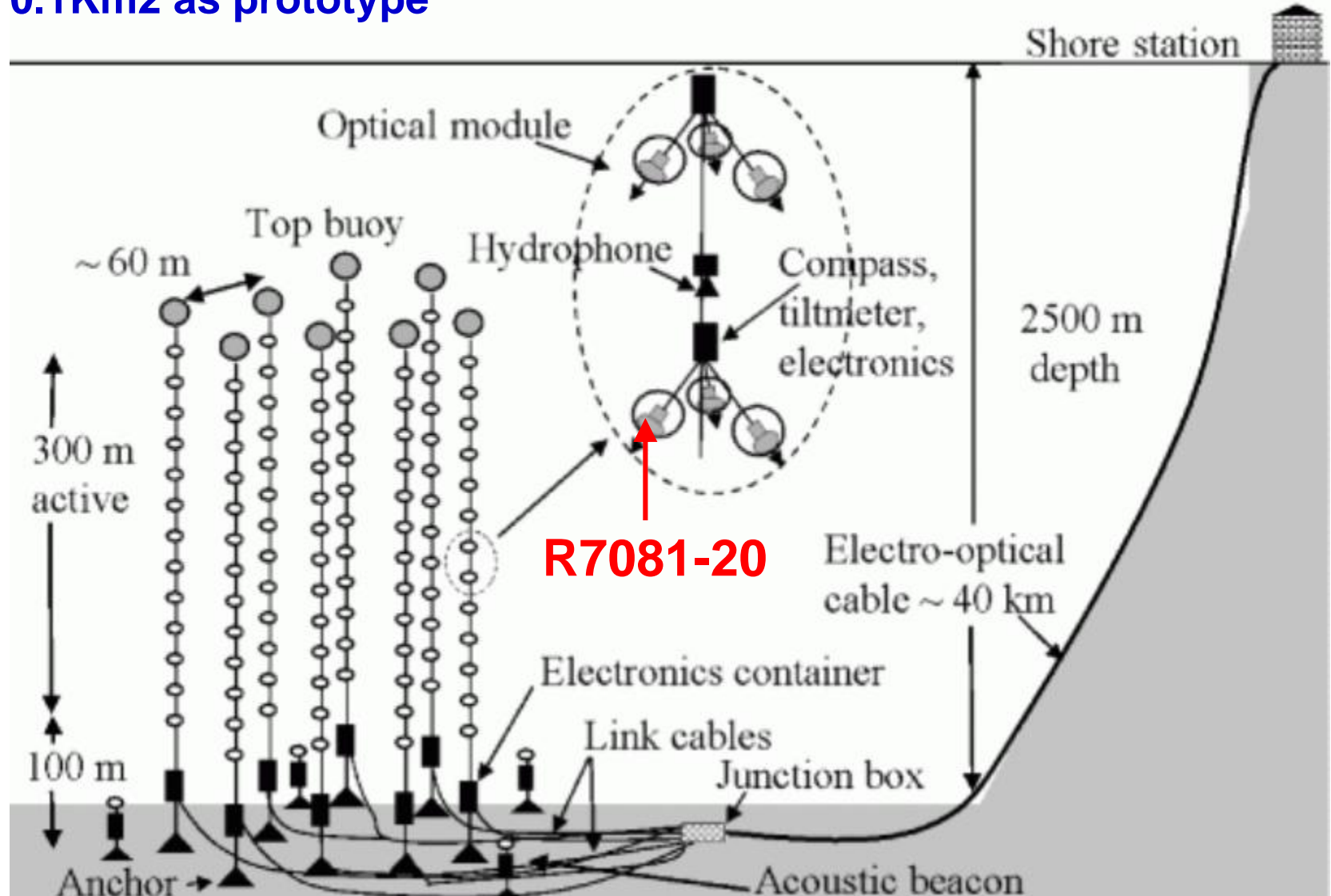
AMANDA as of 2000
Eiffel Tower as comparison
(true scaling)

zoomed in on
AMANDA-A (top)
AMANDA-B10 (bottom)

zoomed in on one
optical module (OM)

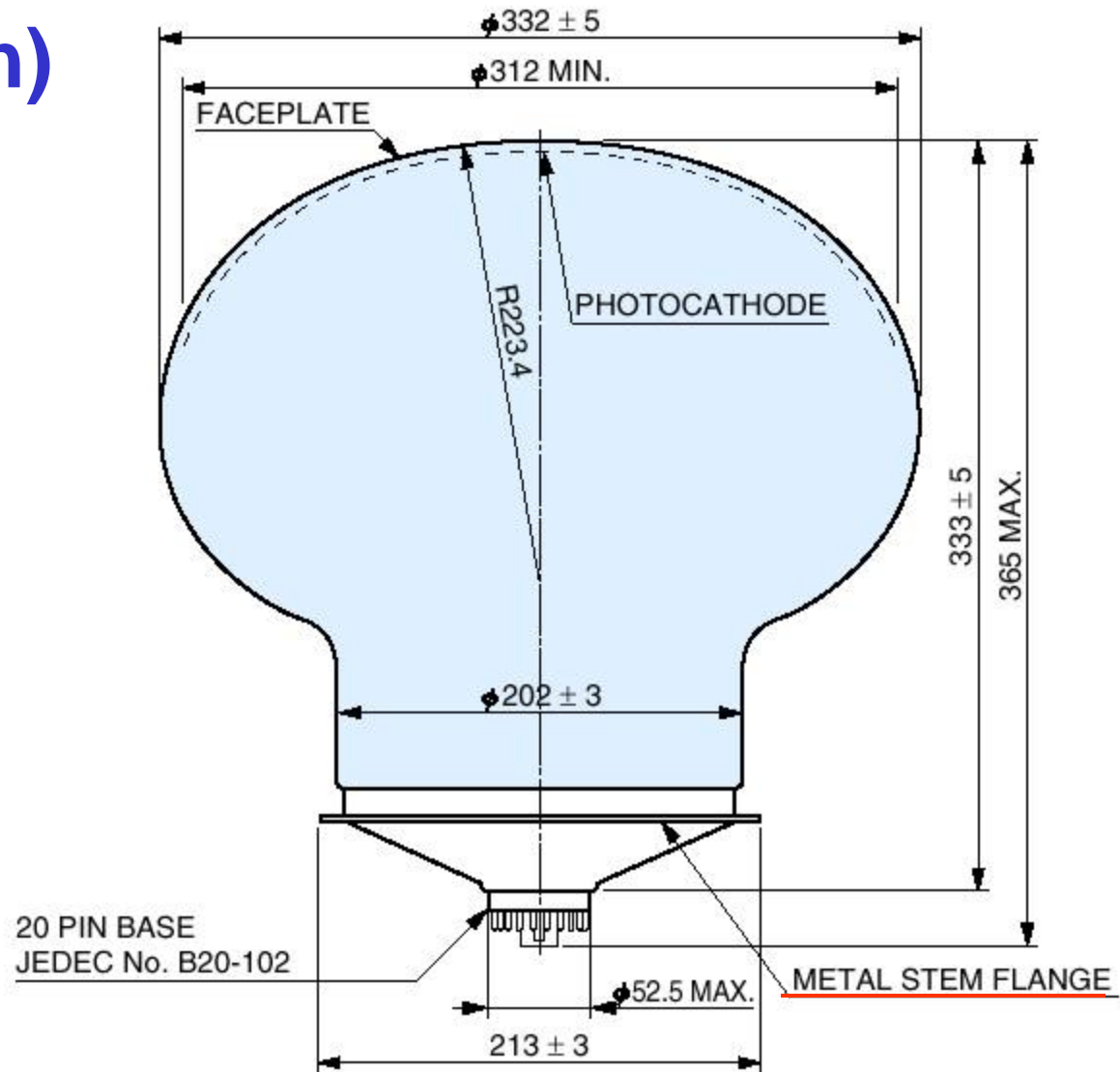
ANTARES at Marseille in the Mediterranean Sea

0.1Km² as prototype



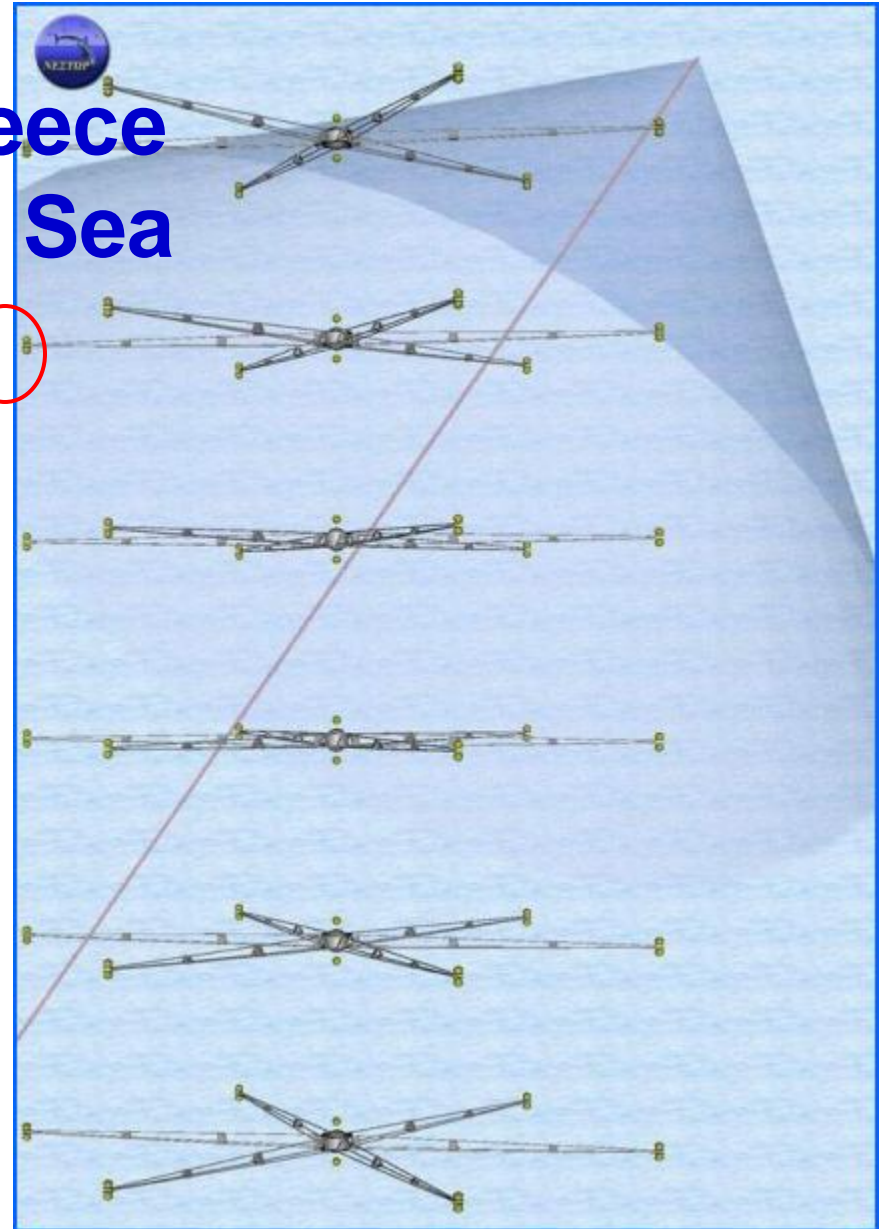
R8055 (13 inch)

Fits for 17 inch Glass Sphere

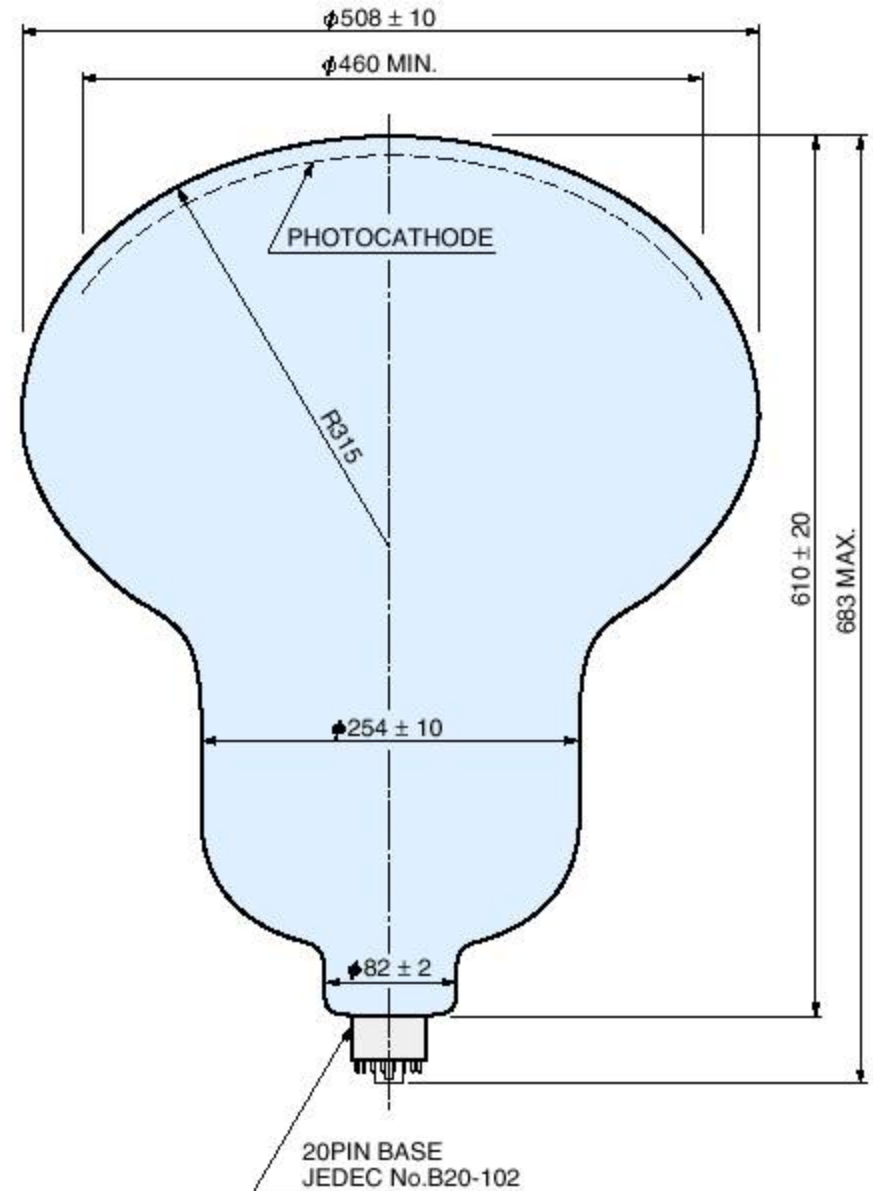


NESTOR at Pilos/Greece in the Mediterranean Sea

R8055 (2 tubes) → 



R3600-02 (20 inch)

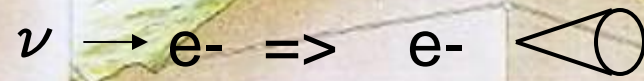


SUPER-KAMIOKANDE Kamioka mine in Japan

42 m

<Purpose>
Neutrino Astronomy
Neutrino Oscillation
Proton Decay

20 inch PMT
(11,200 pcs)



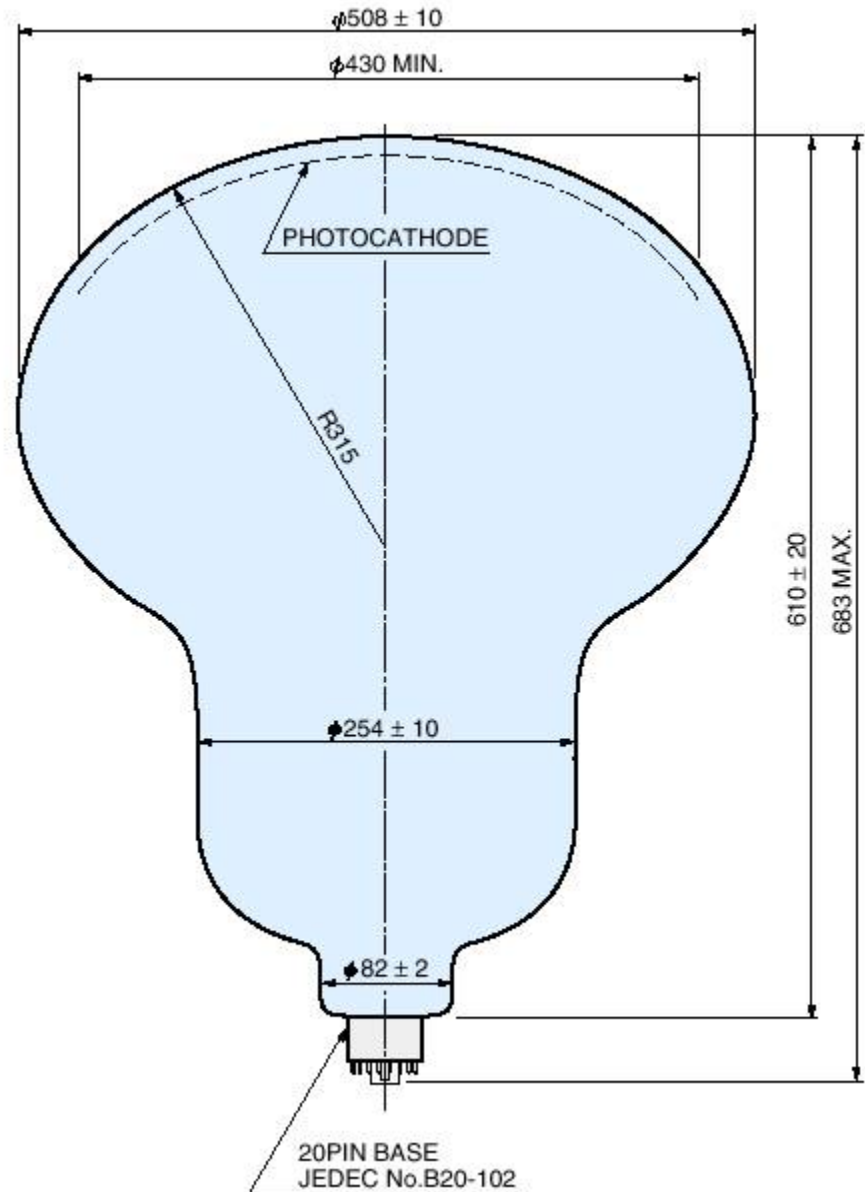
40 m



SUPER-KAMIOKANDE
Kamioka mine in Japan

R7250 (20 inch)

New electrode
for fast timing.
Effective area
is 17 inch.



KamLAND at Kamioka mine in Japan

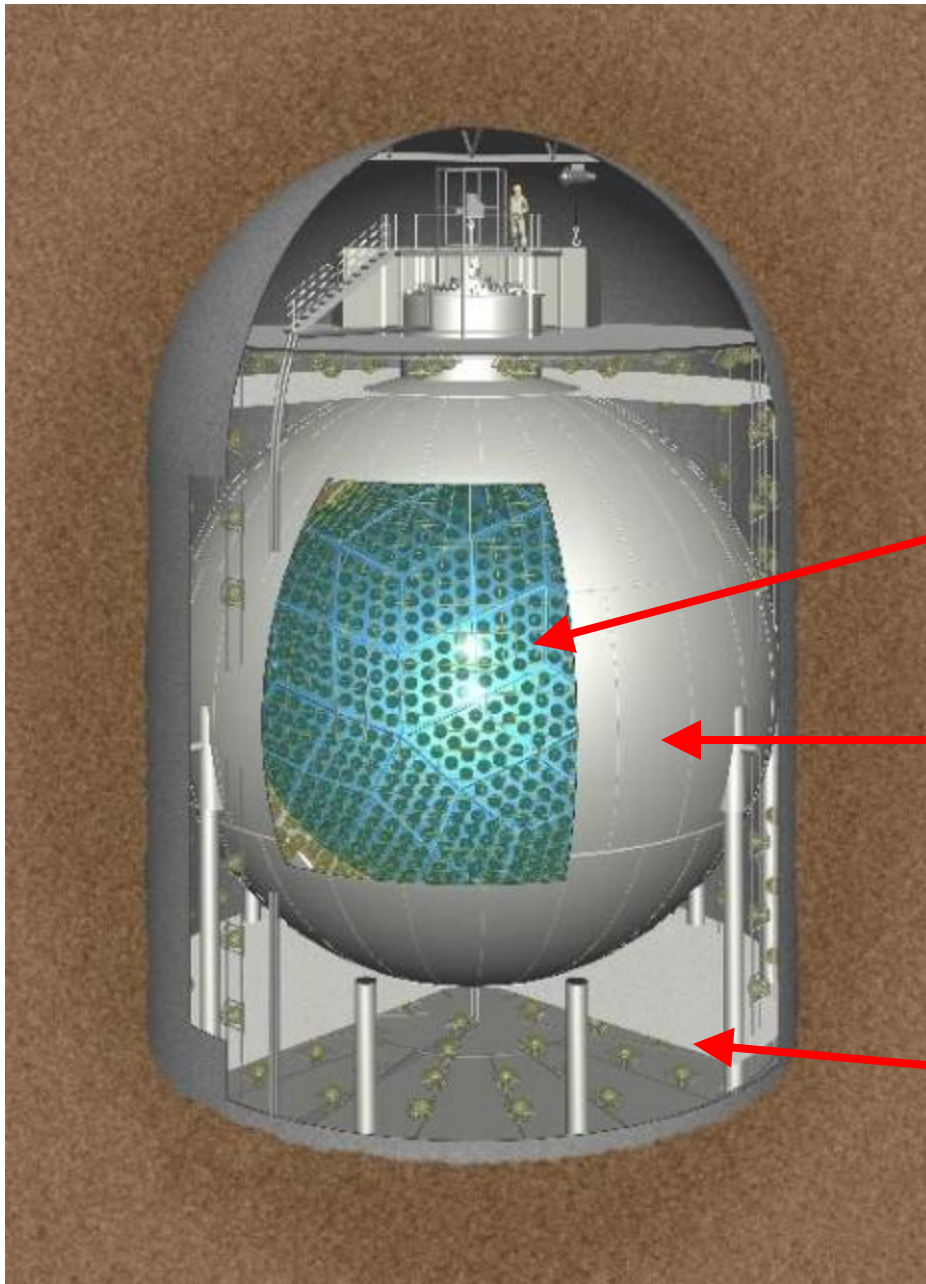
Detection of neutrinos come from Nuclear Power Plants

Liq. Scintillator (1000 ton) in 13 m dia. Balloon

Stainless Steel Tank with 1,330 pcs R7250 and 550 pcs of R3600

Pure water with 250 pcs of R3600

anti-electron neutrino



SUMMARY

< Type numbers and Examples of Experiments >

8 inch **R1408** : SNO / CANADA, LSND / LANL
R5912 : MILAGRO / LANL, mini-Boone / FNAL
R5912-02 : AMANDA / South-Pole

10 inch **R7081-02** : ICECUBE / South-Pole
R7081-20 : ANTARES (0.1km²) / Marseille

13 inch **R8055** : NESTOR / Pilos/Greece

20 inch **R7250** : KamLAND / Japan
R3600-02 : SUPER-KAMIOKANDE / Japan

?? Inch **XXXX** : KM3 EXPERIMENT

?? Inch **XXXX** : Other New Experiments