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Research of large balloon for KamLAND2

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Introduction

■KamLAND (2002~2024)

(the **Kam**ioka **L**iquid-scintillator **A**nti-**N**eutrino **D**etecter)

- Observations for low energy such as $0\nu\beta\beta$ or ν observation

■KamLAND2 (FY2027~)

Improvements:

- High light yield
- Low back ground (BG)

Make a cleaner Balloon

- Protection from **Rn** and **dust**
- Better material for **rope**

^{222}Rn attached during installation

source	origin	Decay rate [Hz]	
^{210}Po	balloon film	80	From Rn
^{210}Bi	balloon film	200	From Rn
^{238}U	balloon film	0.26	From balloon
^{232}Th	balloon film	0.054	From balloon
^{40}K	balloon film	14	From balloon
^{238}U	suspension rope	1.3	From rope
^{232}Th	suspension rope	2.97	From rope
^{40}K	suspension rope	34	From rope

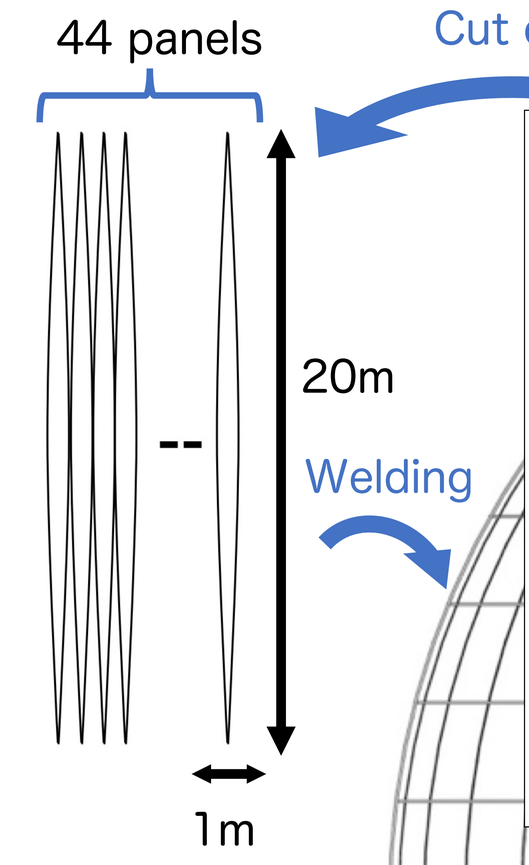
BG estimate at KL1

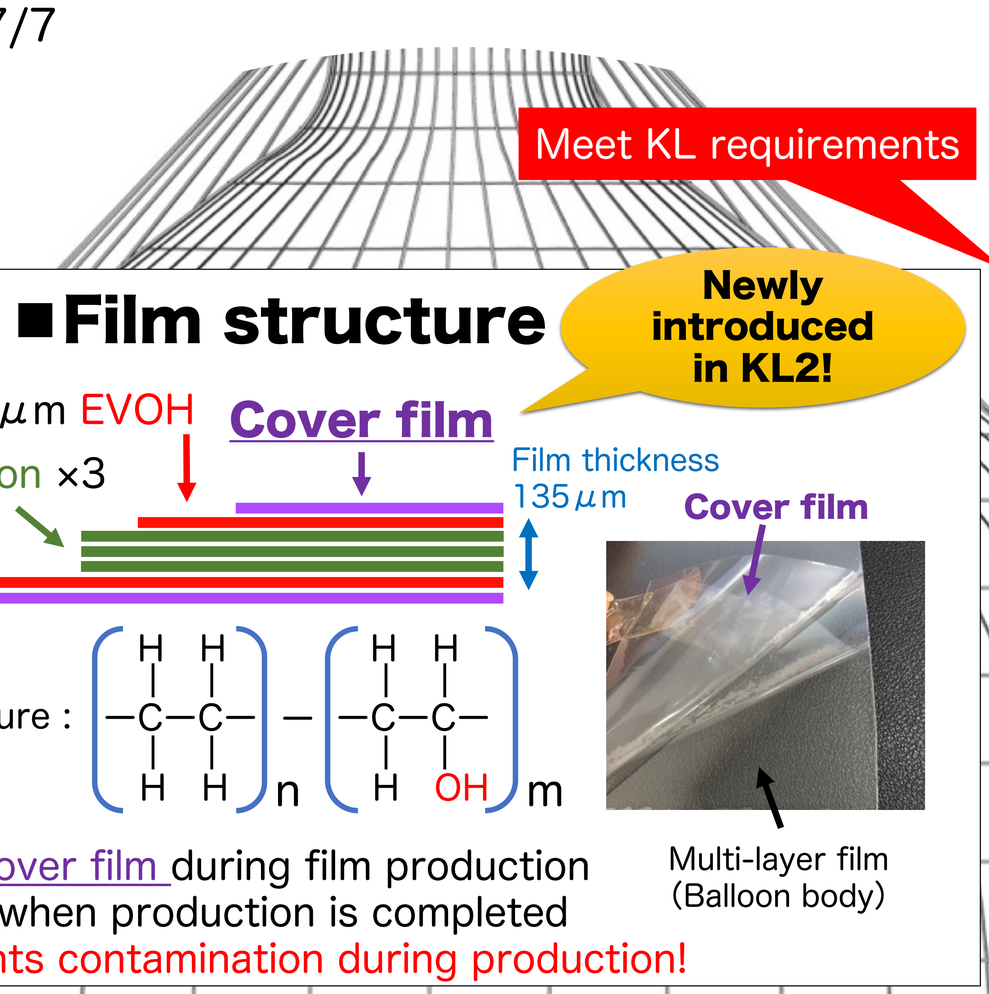
Production

■Plan

- Production : 2027/1-2027/3
- Balloon installation : 2027/4-2027/7

■Procedure





■Film structure

Newly introduced in KL2!

EVOH structure : $\left(\mathrm{CH_2CH(OH)}\right)_m\left(\mathrm{CH_2CH_2}\right)_n$

Multi-layer film (Balloon body)

- Attach a cover film during film production
- Remove it when production is completed

→This prevents contamination during production!

■Film features

Basic information

- Strength: 15.8 kgf/mm^2 Exceeding the required value of 2.4 kgf/mm^2 in KL
- Young's modulus: 196.5 kgf/mm^2
- Elastic limit: 41.0N

EVOH

- High gas barrier properties → Does not pass through ^{222}Rn
- High-frequency welding possible
- Hygroscopic

Confirmed to perform well even in high humidity environments

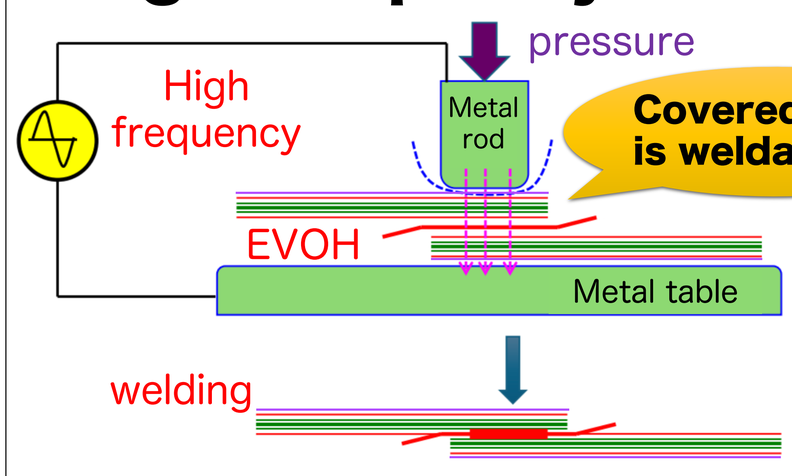
Diameter 13m

Large balloon

Inside: Liquid scintillator

Outside: Buffer oil

■High-frequency welding



The hydroxyl groups of EVOH absorbs microwaves, generates heat, and melts the film.

Welding tests in progress

■Rope

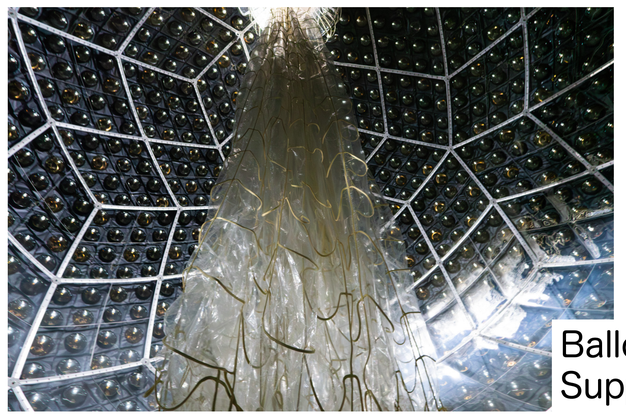
Purposes

- Reinforcement of film strength
- Stabilization of position

Improvements

- KL1: “Kevlar” rope
- KL2: new materials and thinner rope are under consideration

better strength and elasticity



Balloon after draining. Supported by rope.