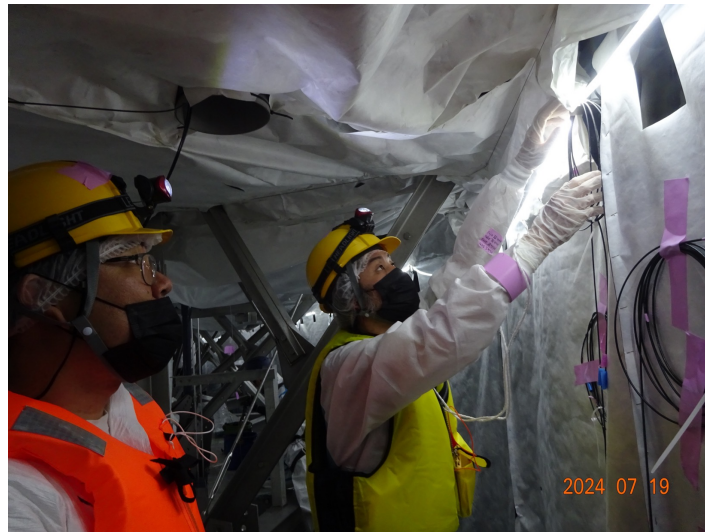


Installation of Super-Kamiokande outer detector (OD) laser system

2024i-A-004

Allocated research fund: 280,000JPY

Will be used: 280,000JPY for the OD fiber fixing work



Thank for all your help!
Mine, Yano (ICRR)

Teppei Katori on behalf of the SuperK OD group
King's College London

ICRR Research result presentation meeting, Jan. 29, 2025

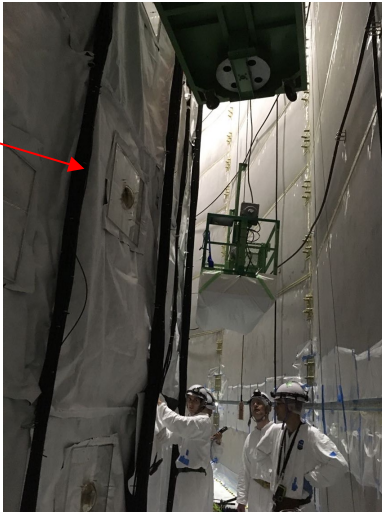
Super-Kamiokande Outer Detector (OD) calibration system

~2000 outer detector (OD) PMTs in veto region of SuperK

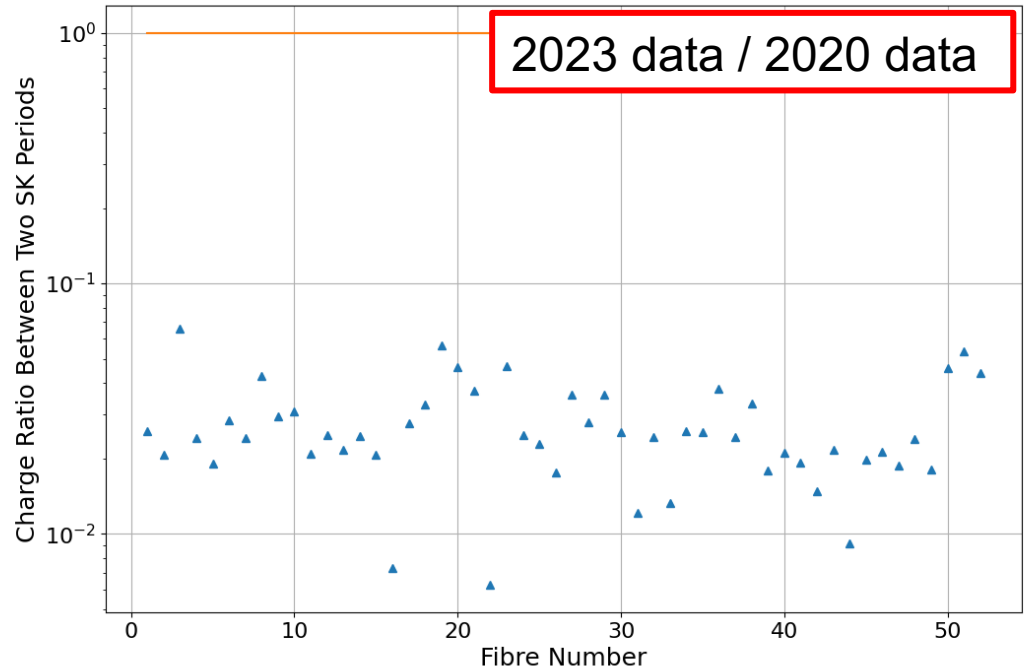
- OD PMTs are monitored by a Class 3B laser through 52 optical fibers
- The laser intensity dropped ~2% from the original intensity after ~20 years of operation
- We need to install a new laser

New laser has been identified and under the procurement process

OD calibration optical fibers



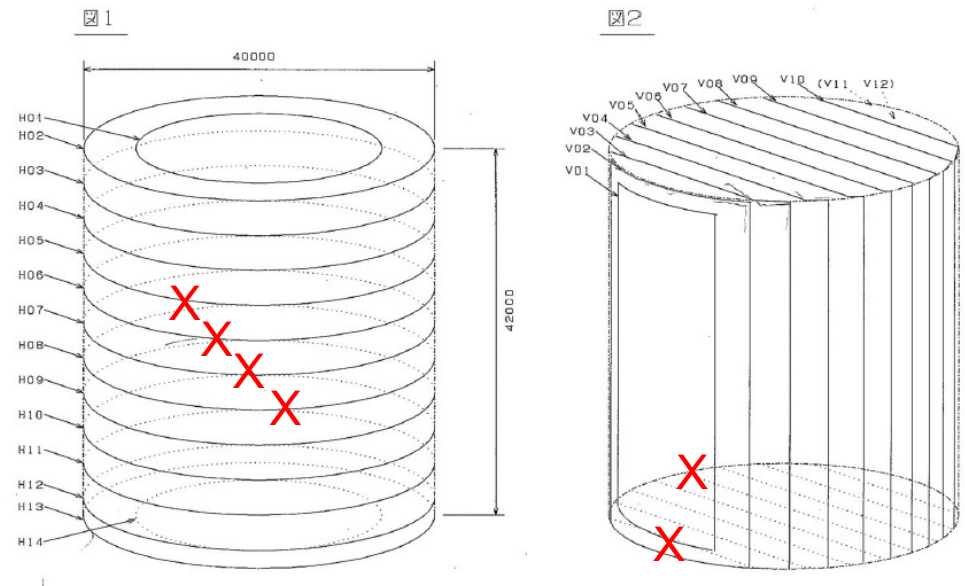
OD calibration optical fibers



Super-Kamiokande magnetic field compensation coils

2024 magnetic field compensation coil replacement work

- Vertical coils or either bypassed or turned off
- Horizontal coils have up to 20% effect on collection efficiency
- New 6 horizontal coils are planned to be installed
- For this work, we need to cut 9 OD calibration fibers and later splice (reconnect) them



OD calibration optical fibers



Impact of SK OD calibration fiber cut

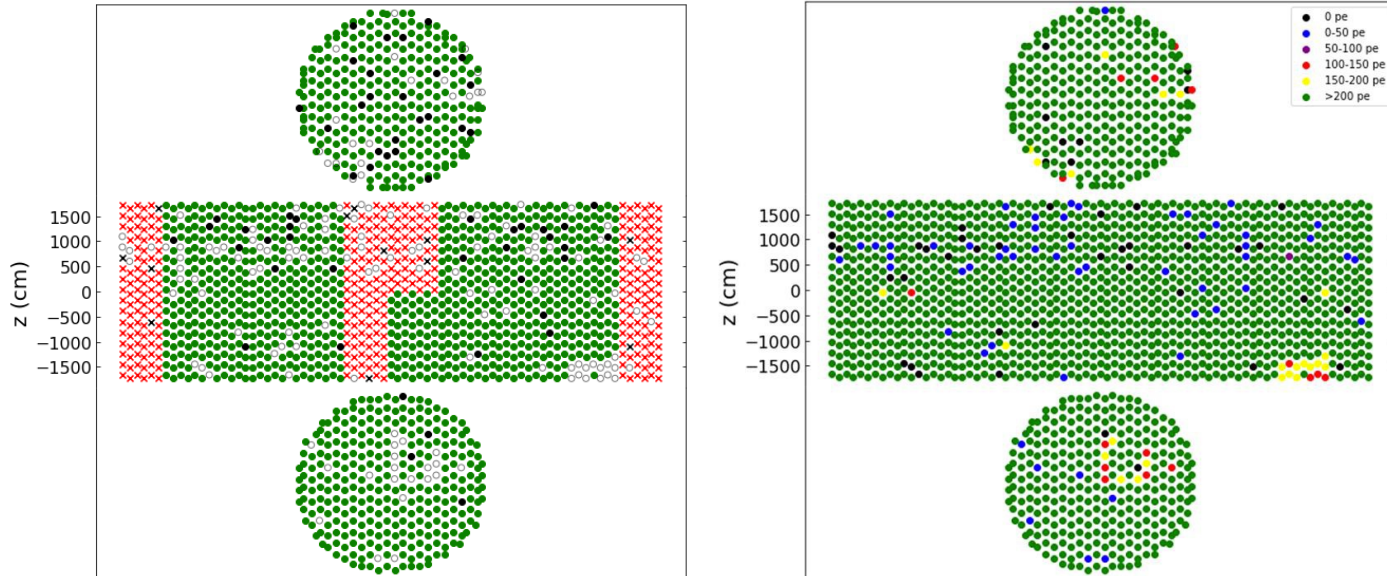
OD PMT saturation measurement relies on the OD laser and OD calibration fibers

With new OD laser, we expect least x100 improvement of the laser intensity

- 78% OD PMT saturated

→ 97% OD PMT saturated, assuming all fibers are working

We decided to splice (reconnect) 9 OD fibers

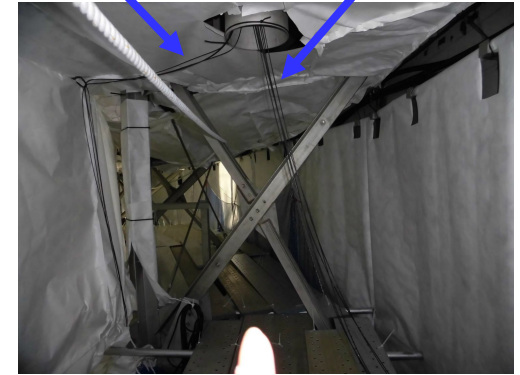


OD calibration fiber cut

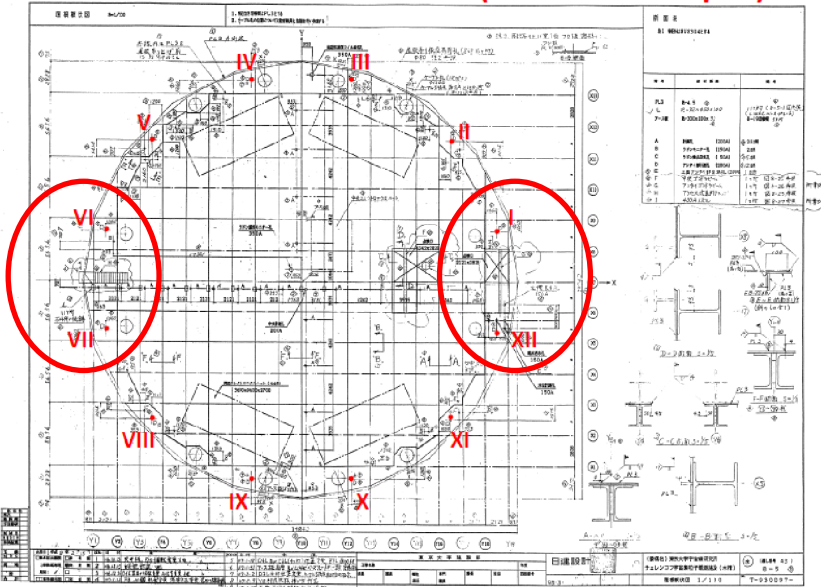
We need to cut several OD calibration fibers for coil installation work

- Labels, and secure fiber ends
- Splice fibers later
- Our fibers (large core, ceramic core, etc) are special, we asked a contractor to splice them

Od PMT fiber (no cut) Barrel fiber (cut)



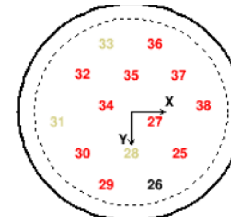
- "D": OD calibration hole (SK-calib-hole.pdf)



$$5(I) + 2(VI) + 3(VII) + 4(XII) = 14$$

Fiber position & status (June '17)

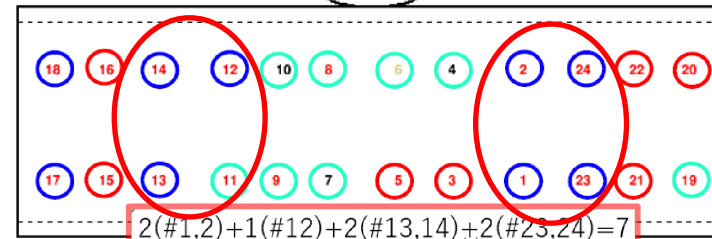
(plot by Shige)



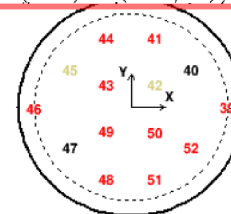
Barrel Status today:

- Good
- Good Candidate
- Bad/Weak

(Sep.14, 2018)



$$2(\#1,2) + 1(\#12) + 2(\#13,14) + 2(\#23,24) = 7$$

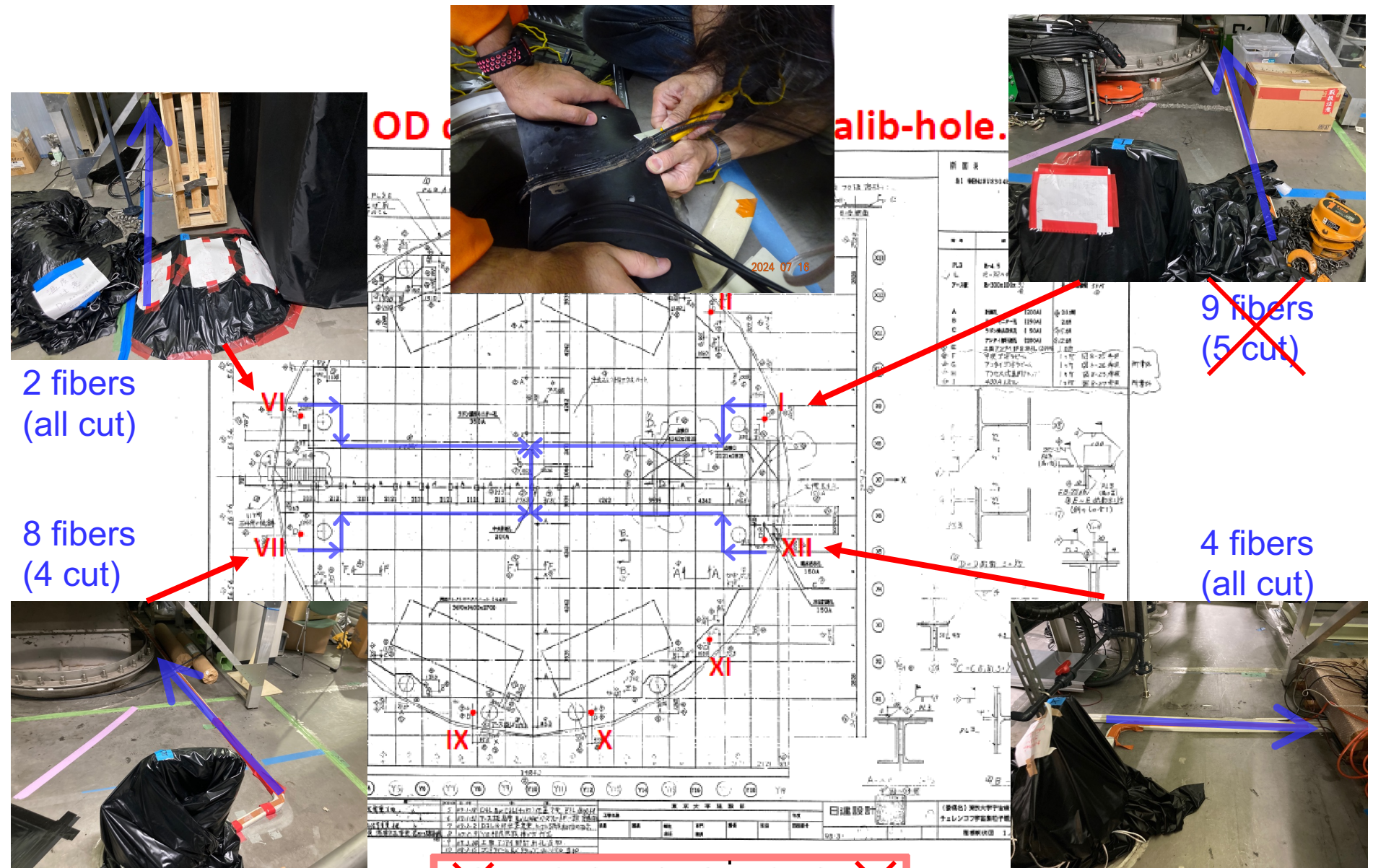


Fiber status (June '17)

- Live
- Weak
- Dead

2 September 14th, 2018

6



OD of ... alib-hole.

2 fibers
(all cut)

8 fibers
(4 cut)

~~9 fibers
(5 cut)~~

4 fibers
(all cut)

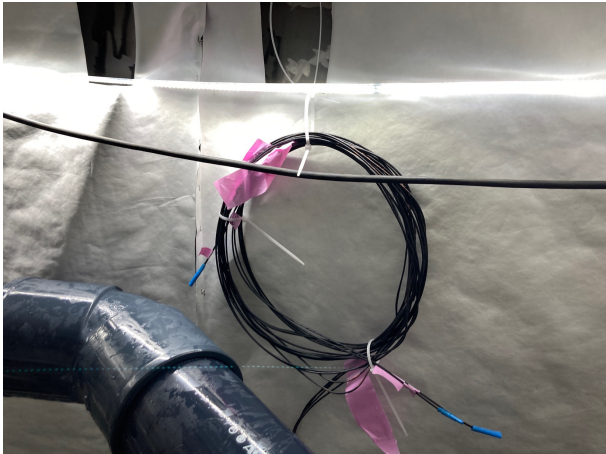
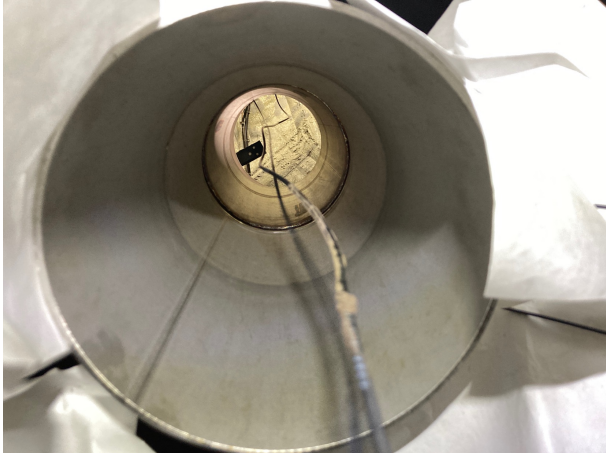
Dec.27, 2018

$$\cancel{5(X)} + 2(VI) + 3(VII) + 4(XII) = \cancel{14} \times 9$$

2

All fibers are running inside of the tight routes of fiber cases. We re-route fibers to gain extra fibers for splicing).

OD calibration fiber cut



OD calibration splicing work status

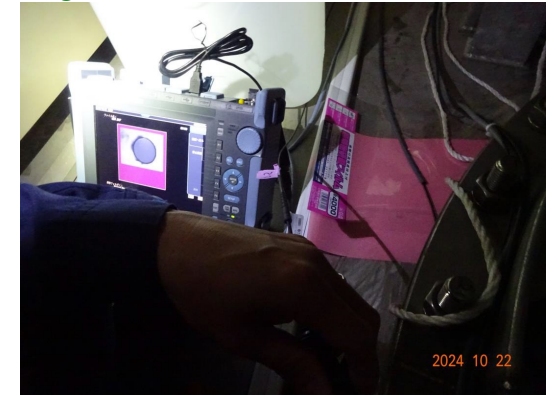
Splicing work status

- 4 thin fibers are all being fixed by a contractor
- 5 thick fibers will be fixed soon
- new OD laser installation

Polishing the fiber



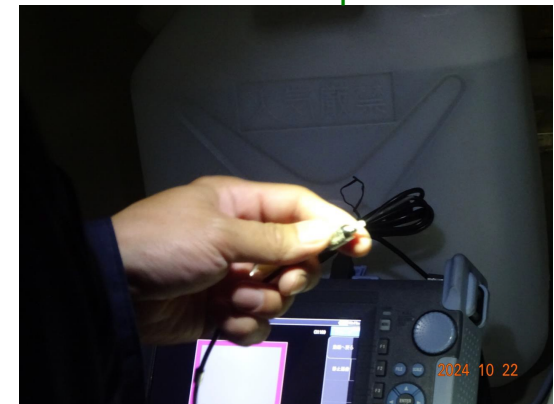
Checking the fiber surface with camera



Cutting the fiber (jacket?)



Fiber core is exposed



2025/01/29

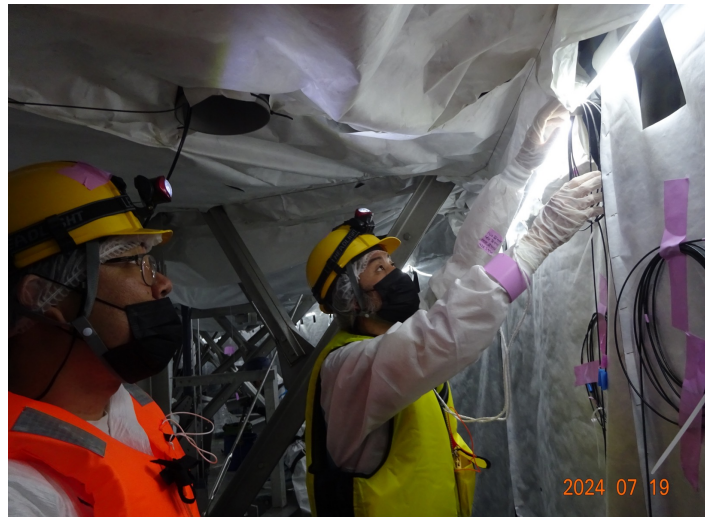
New OD laser system installation

New OD laser + safety system

- Next trip to see the current system with engineers
- Installation trip after the laser is arrived

FY2025 plan

- Design the interlock system, test at the UK
- Refurbish the dye laser module (337nm→405nm)
- Install the full safety system at Kamioka, turn ON the laser



Thank you for your attention

Backup

Fiber connection methods

Fiber splicing methods

1. Connectors

- Connectors are attached on fiber ends (FC, SMA, etc)
- Time consuming and large loss
- We don't need connectors unless we detach the cable again

2. Mechanical splicing

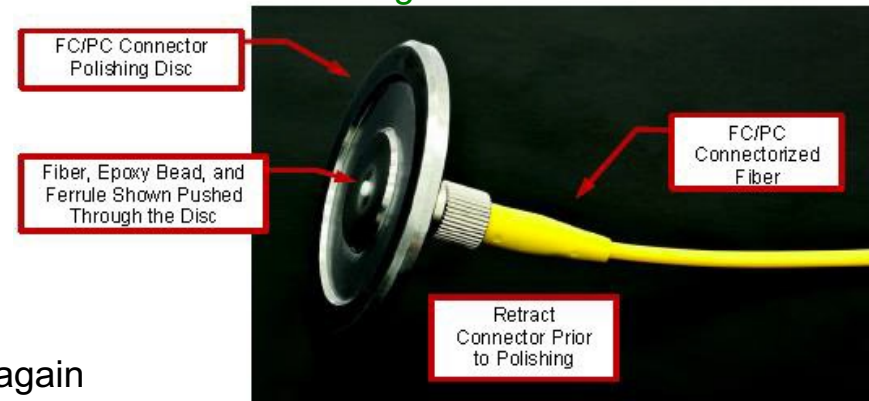
- Fiber ends meet and fix mechanically
- It requires some skill and cheaper kits
- So far, I don't find any kits for 200um core fibers

3. Fusing splicing

- Fuse fiber ends by heat
- It requires some skill and expensive machine
- High quality finishing
- Machines capable for 200um core fibers are expensive
- It cannot be used for ceramic core fibers

Fusion splicing is preferred, but only connector method works for us

Attaching a connector on a fiber end



Mechanical splicing



Fusion splicing

