Status and issues about potting the electronics on PMT

Zhonghua Qin

On behalf of potting group

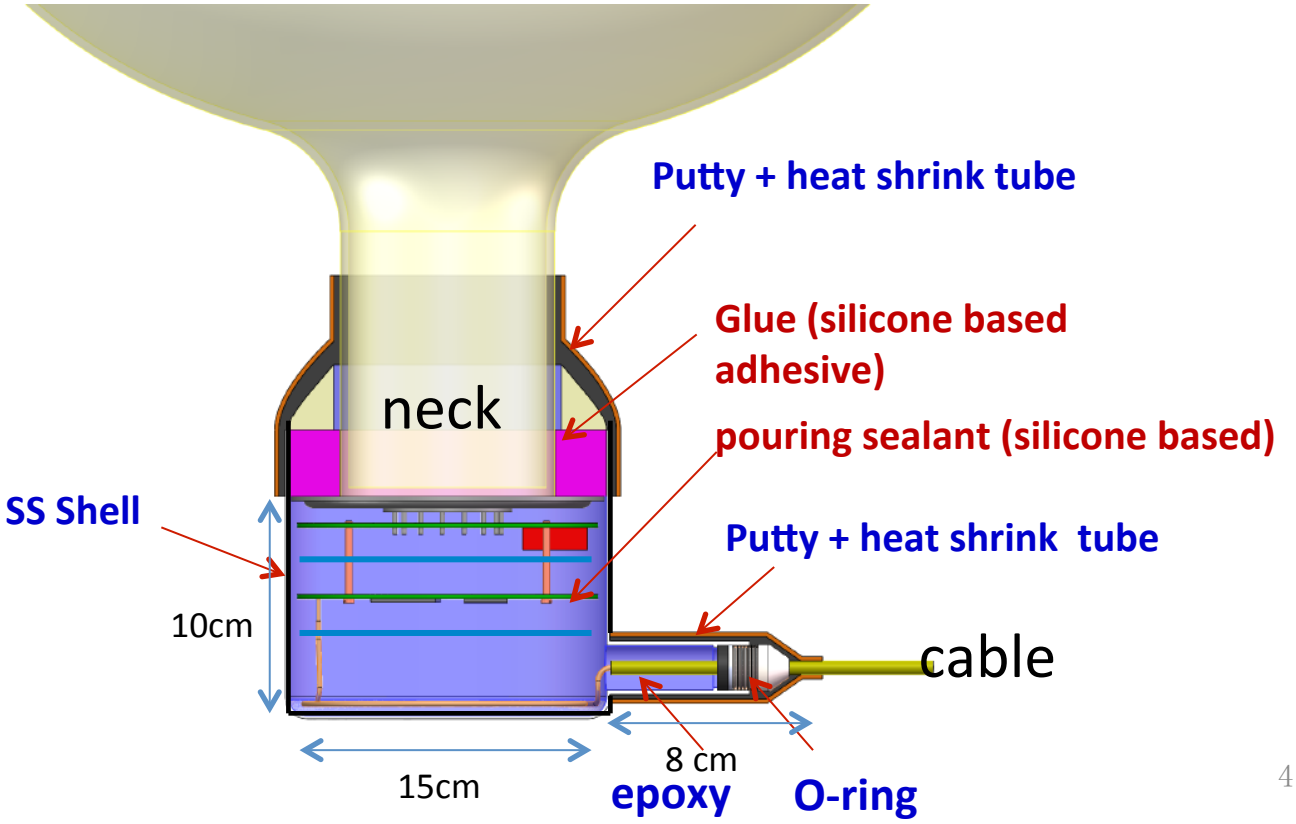
outline

outline

- The baseline potting design:
- The cable outgoing option:
- The connector:
- Thermal conduction issue:
- Issues for 100/10 PMT+ electronics potting
- schedule

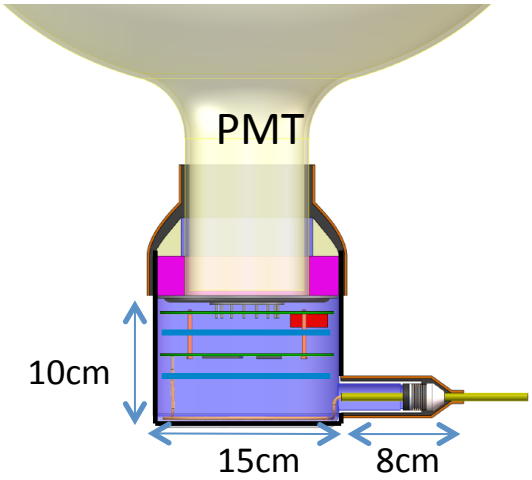
The baseline scheme of potting

- Only neck and cable need to be sealed;
- at least three waterproof layers to ensure the high reliability;
- Recent thinking: use silicone based adhesive for glue and the pouring sealant, so repair of the HV module and electronics is possible before the final water filling.
- Heat removing: sealant is not sufficient, need metal conductor design.

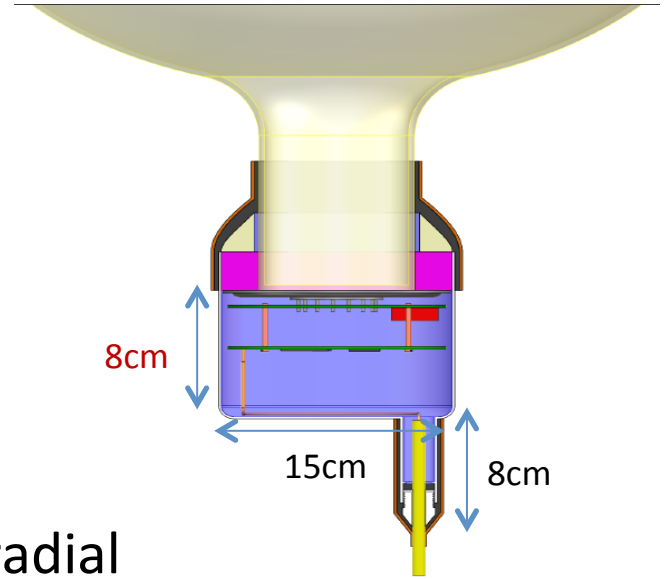


Cable outgoing

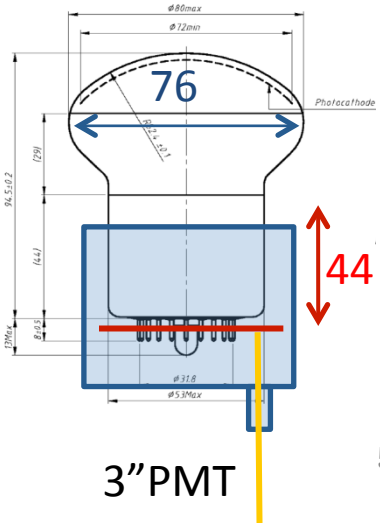
- Horizontal or vertical outgoing



or

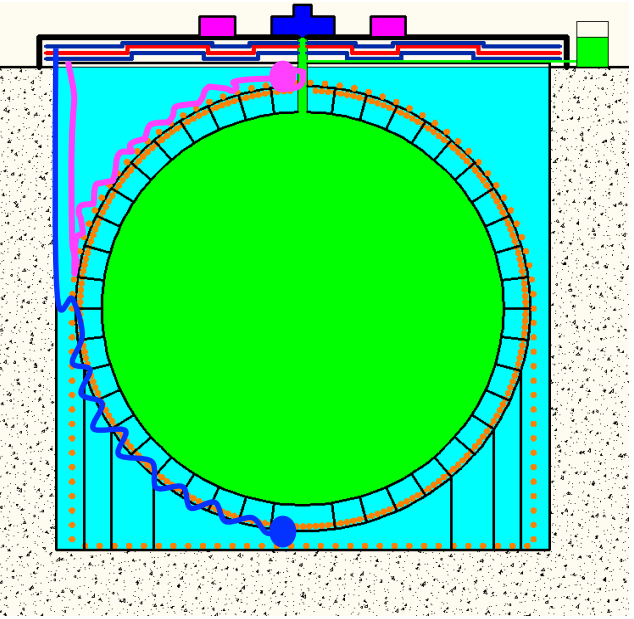


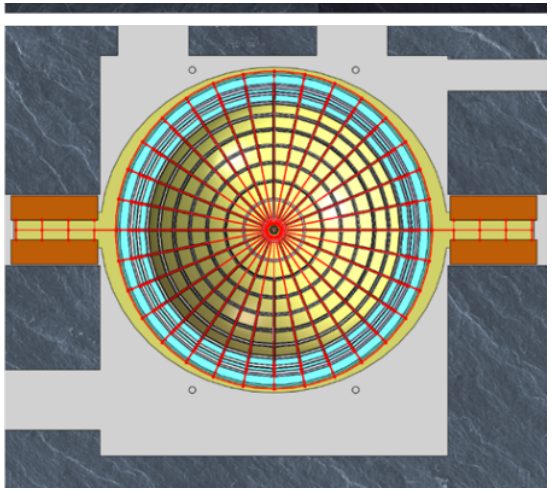
- Horizontal is the baseline option to save the radial space (~20cm) of the whole detector;
- Vertical option is more convenient for filling the sealant into the shell, and also the steel shell manufacturing;
- 3-inch PMT better to use the vertical option, due to the limit space
- If vertical for 20” PMT, can the height of potting shell be reduced by a few cm (10cm -> 8cm)?

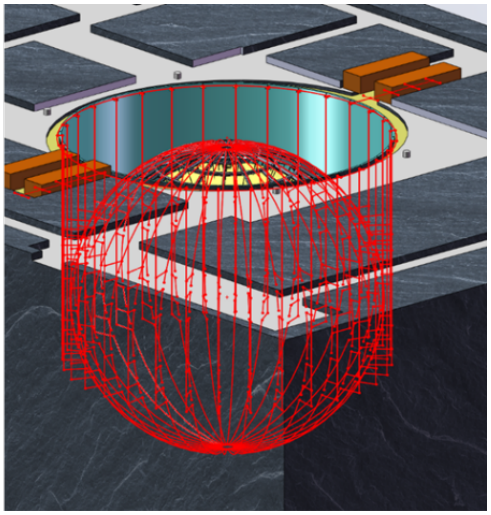


3”PMT

PMT installation and cabling

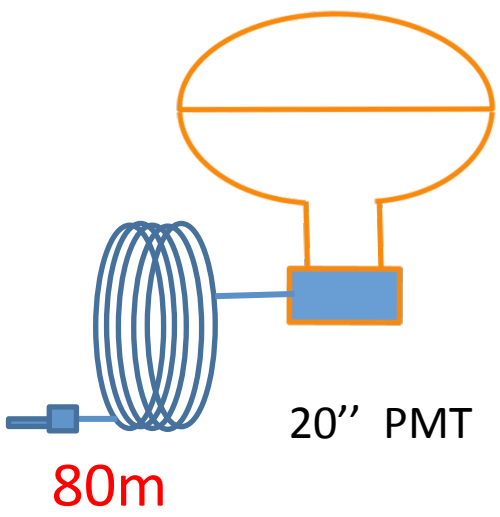


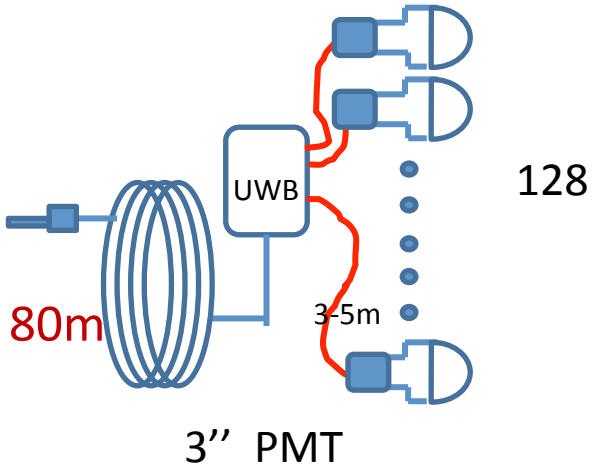




For the baseline option: long cable fixed to PMT once potted:

- make it complicated for testing, storing, transportation, especially for PMT installation and cabling.

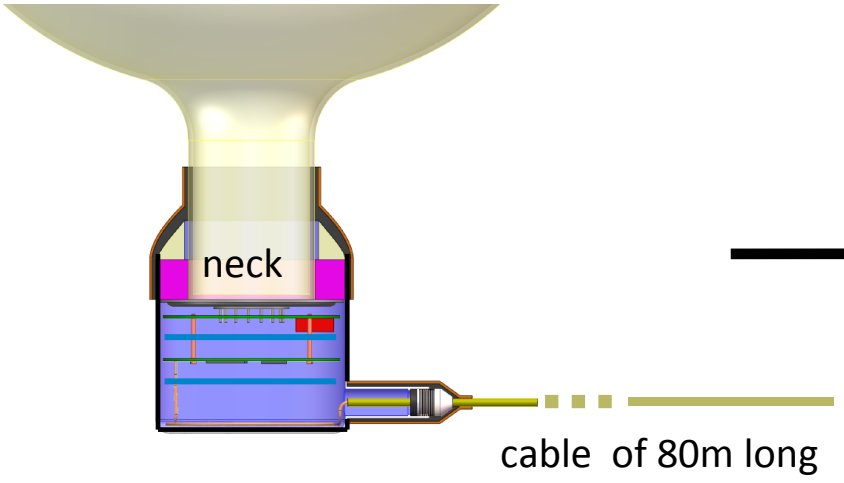


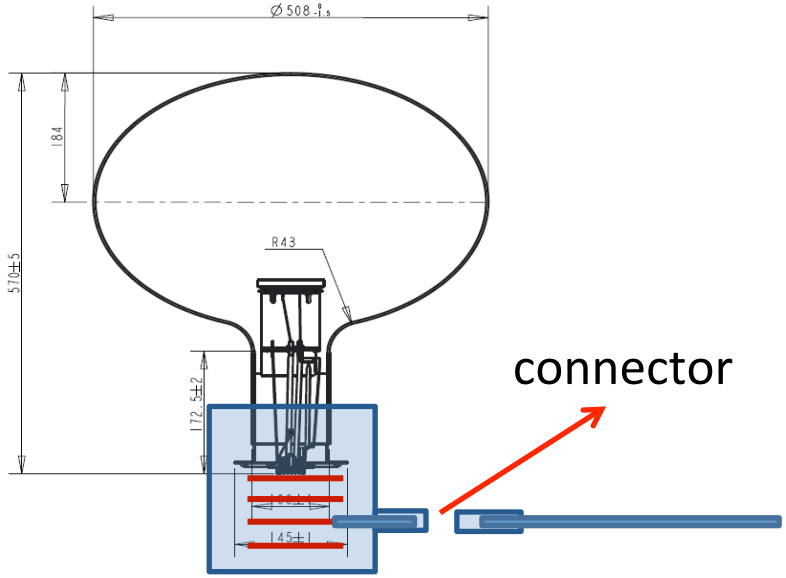


The connector

The scheme:

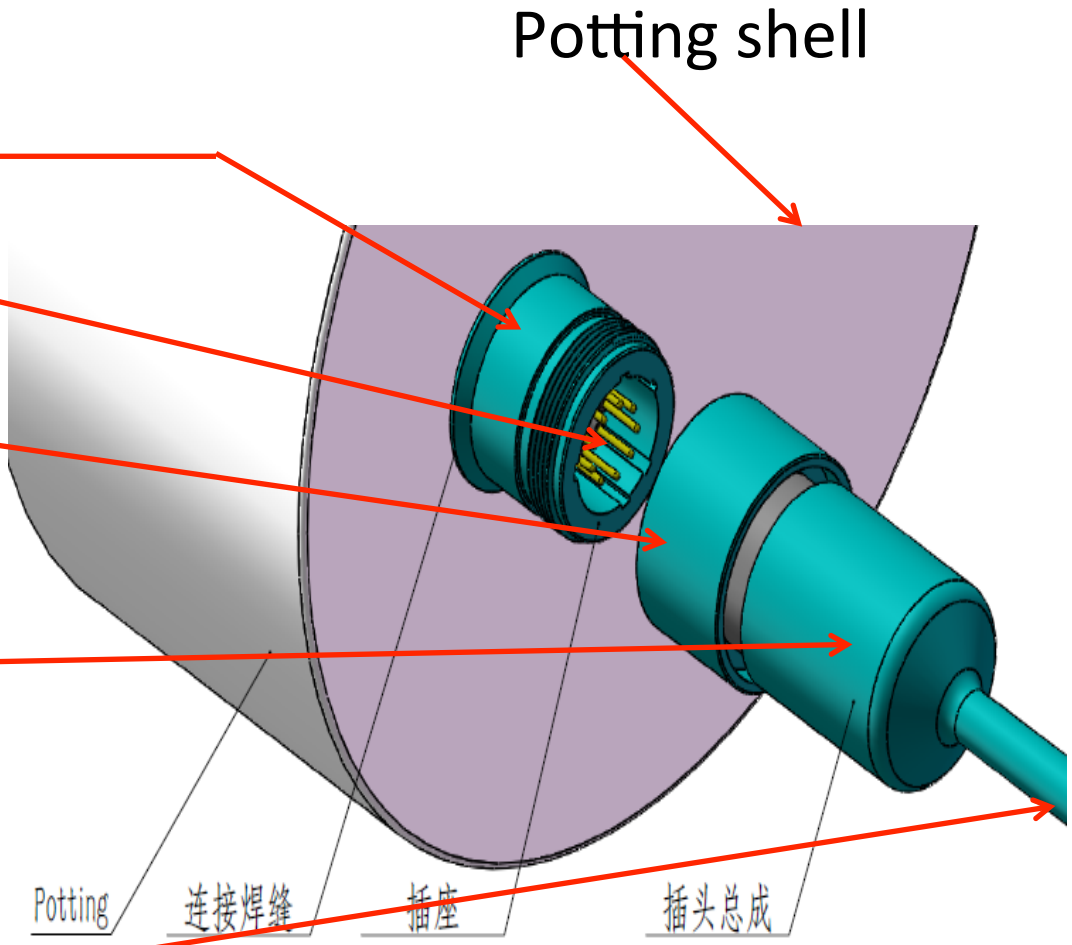
- a waterproof connector applied,
- cable plug to PMT only when it's needed
- make PMT installation and cabling much easier





the concept of connector

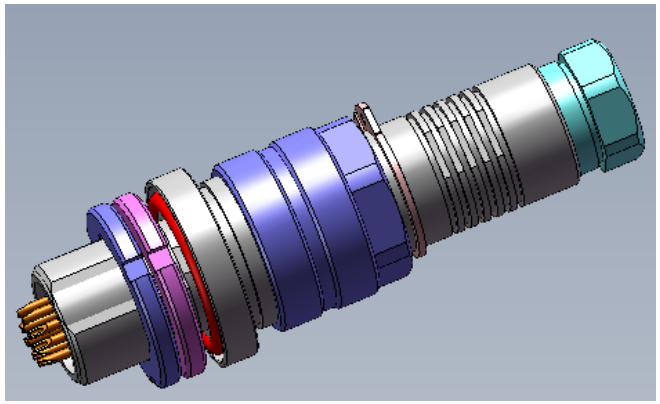
- Socket
- male pin
- nut
- Plug with female pin (not shown)
- Cable



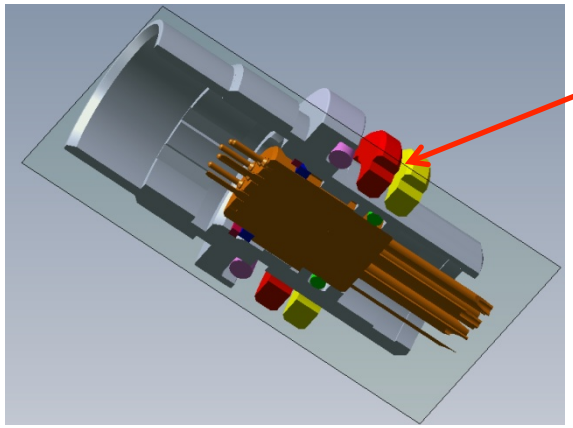
recent study on connector

- Design and prototyping from different companies

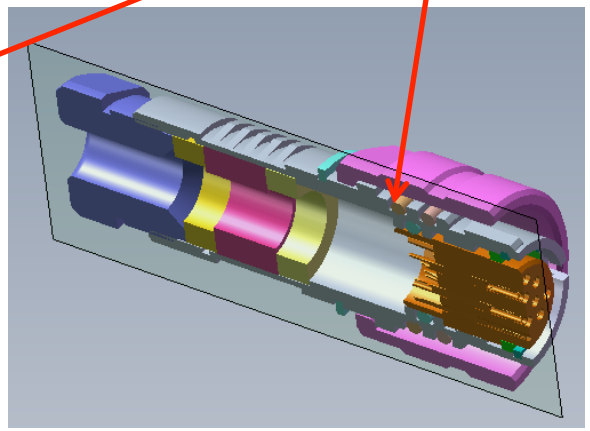
  1) from AVIC JONHON OPTRONIC TECHNOLOGY CO.,LTD (中航光电)



double O-rings for water-tightness sealing

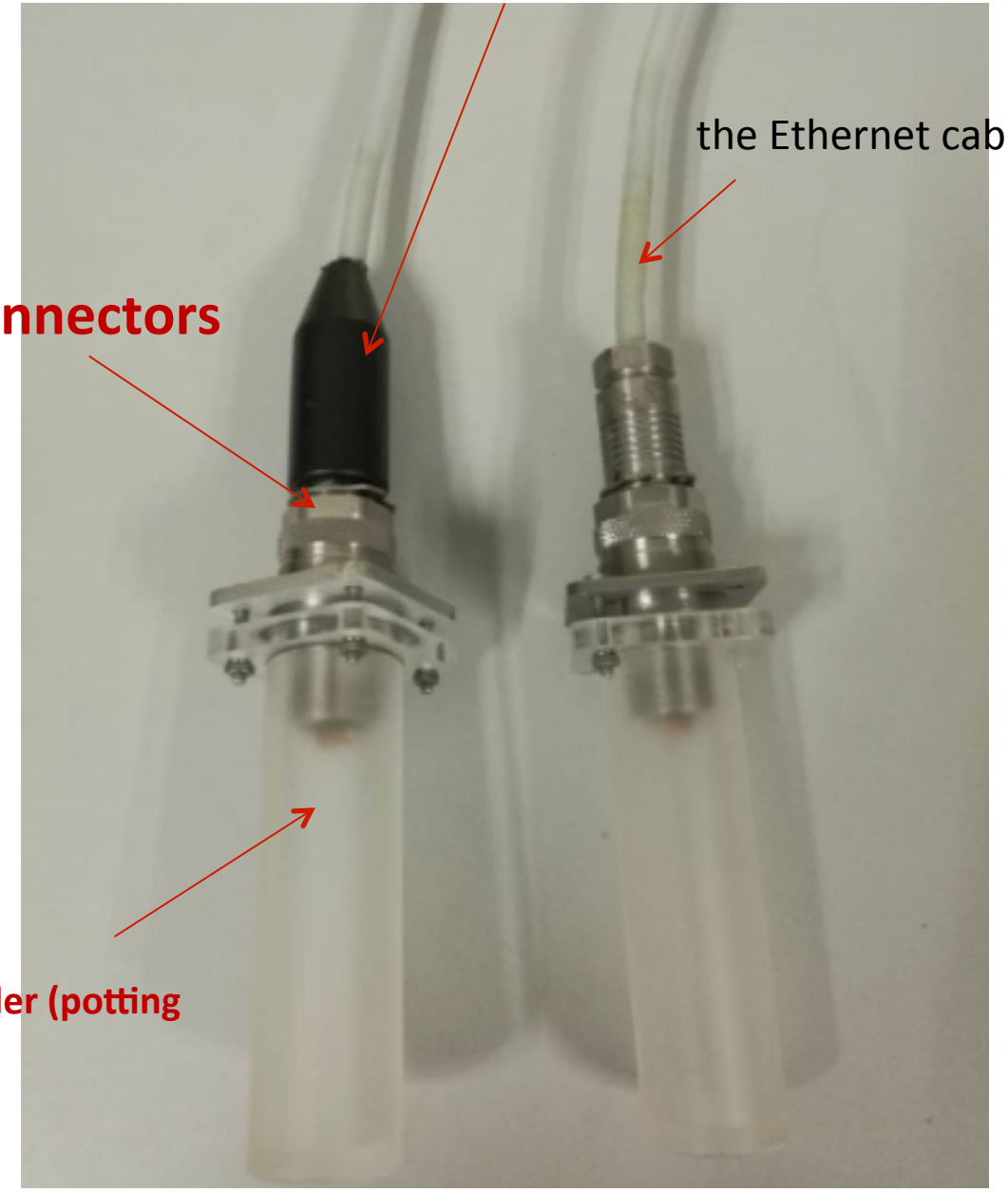


Socket



plug

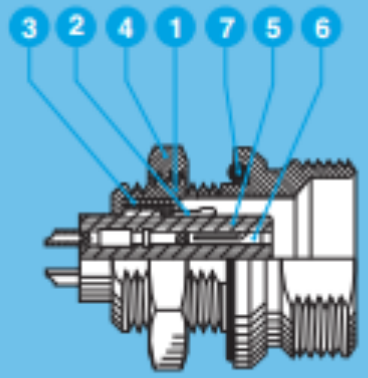
- Water-tightness test
  - Produced 8 connectors with the Ethernet cable included;
  - All pass the water-tight test under 0.5~0.8 MPa for 72 hours;

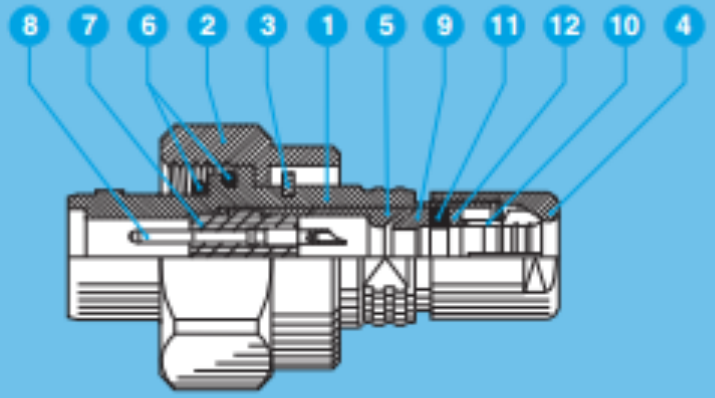


- LEMO connector design

Fixed socket

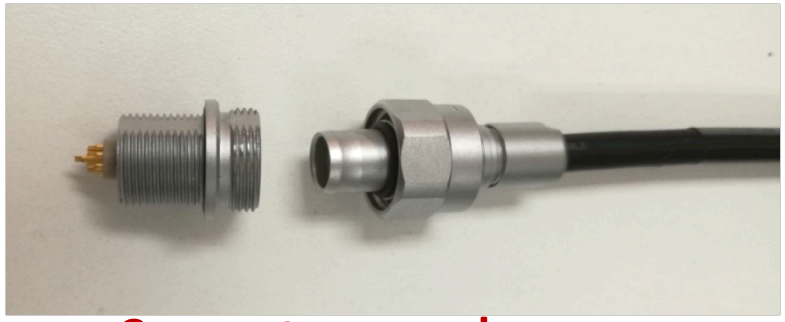
1. outer shell
2. earthing crown
3. retaining ring
4. hexagonal nut
5. insulator
6. female contact
7. O-ring





Straight plug

1. outer shell
2. coupling nut
3. circlip
4. collet nut
5. split insert carrier
6. o-ring
7. insulator
8. male contact
9. earthing cone
10. collet
11. gasket
12. washer



Connector sample

- Water-tightness test

- All three samples are failed from the place between connector and potting shell ;

- the reason could be the surface of shell is not smooth, the O-ring is not good;

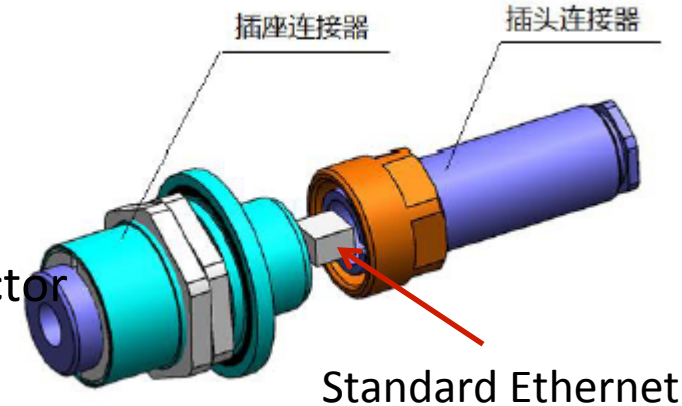
- does not mean that the connector itself not reliable ;

- anyway need very delicate design to match different parts;

- Connector from Pan-Asia cable company（中山泛亚）

- Standard Ethernet cable plug

- The rest parts are similar to other connector design



Standard Ethernet cable plug

Water-tight test:

- Tried four connectors, all failed;

-water go inside in between the socket and plug

water go inside

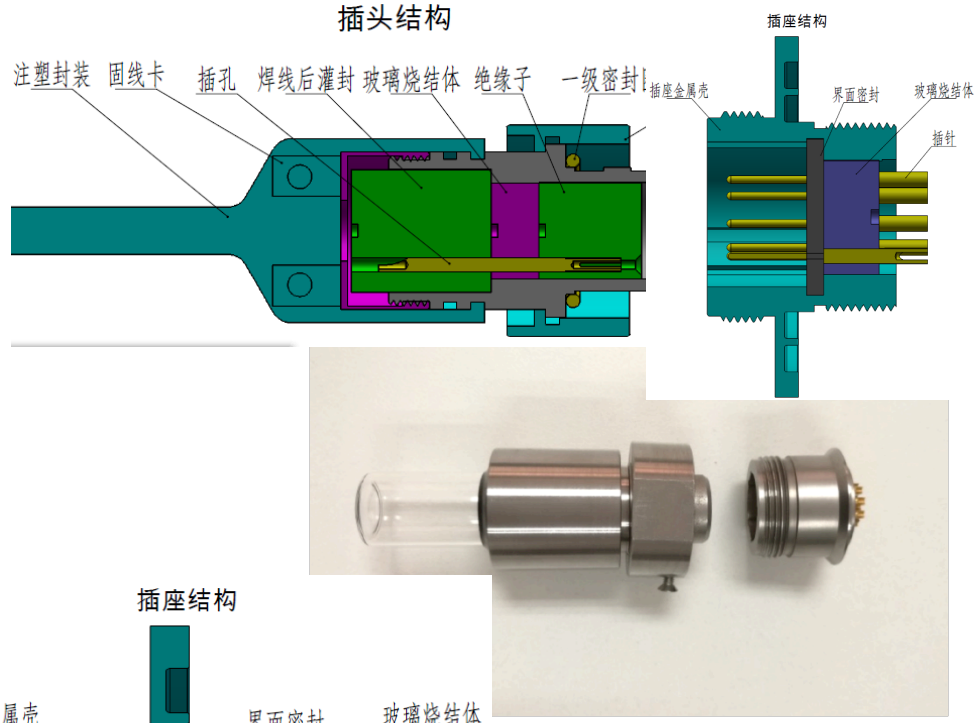
- Tomny advanced material company （成都同明）

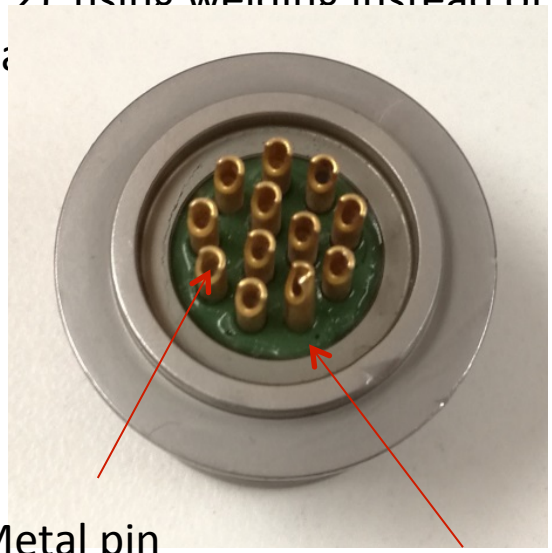
- work ongoing, no complete prototype provided;

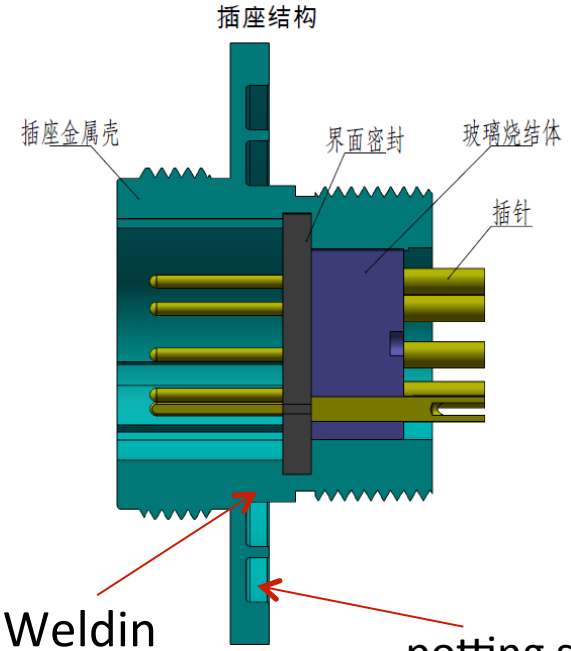
- new features:

1) Glass Sintering Connector (i.e, metal pin penetrating glass)；

2) using welding instead of O-ring sea







Pin design and arrangement

questions:

- How to design and arrange the metal pin to meet the requirement on signal transmission (for example: impedance matching, bandwidth);
- Other requirement?

Open questions on connector

Still a lot of questions:

- How about the waterproof reliability of the connector?

  - they can survive for 20 years under the water?

- How to test the connector water-tightness during PMT installation and cabling?

  - or, even do we need to test each connector before installation and how to do ?

  -now it's also not clear to me whether each potted PMT need to be tested under 0.5MPa pressure. Sample test is the baseline.

- Do we use the connector for 100+10 PMT/electronics potting soon?

- Responsibility: PMT group or electronics group?

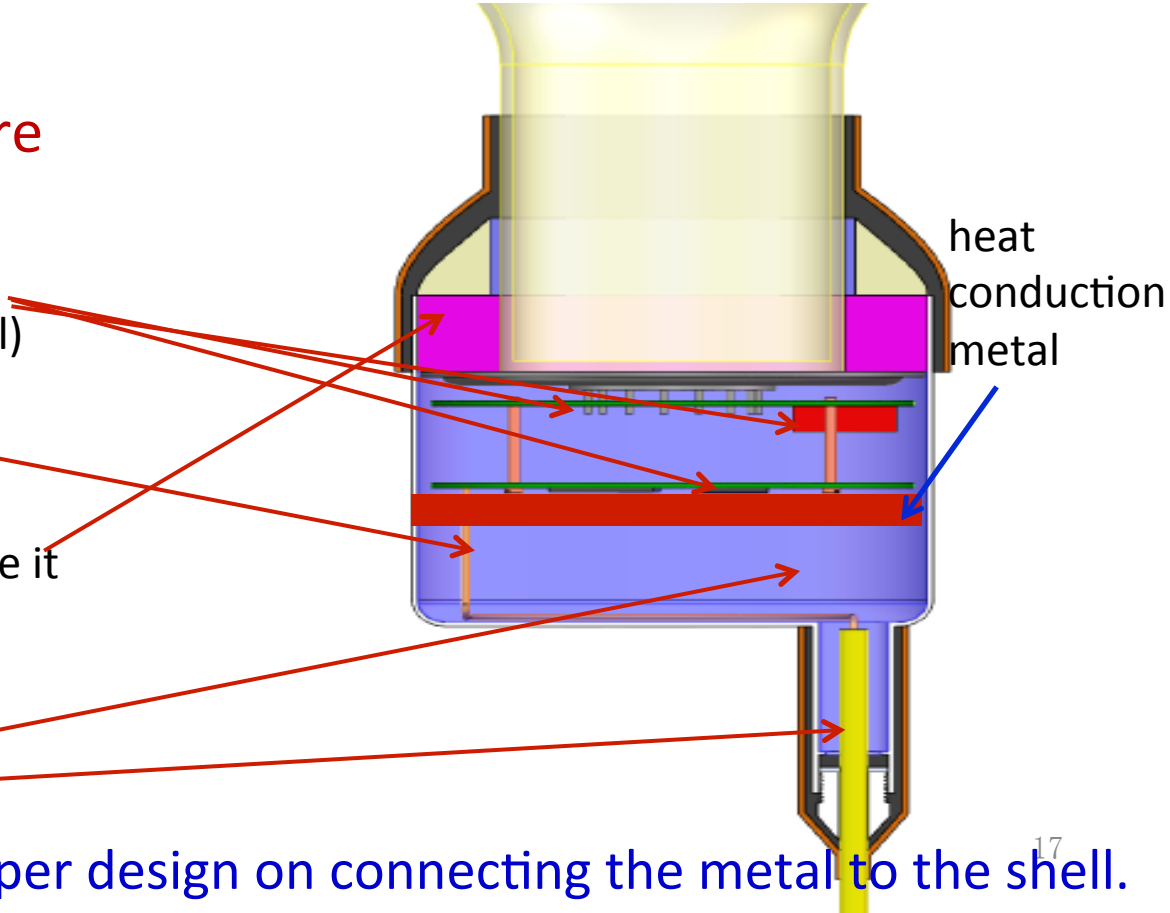
  - anyway, joint effort always needed.

Some other important issues

- About the heat conduction metal:
  - very important but less discussed:
    for example: how to fix it to the potting shell?
  - please specify the interface, give a first idea how it looks like;
  - it's crucial for the potting design (mechanical structure, procedure …)

To be clear, the current sequence for potting (there is no cap for the shell) :

1) install the parts of base, HV ,electronics (including the metal) to PMT ;
2) soldering or plug the cable to electronics;
3) mount the potting shell and glue it to PMT neck, applying putty+ heat shrinking tube
4) filling the sealant into the shell
5) seal the cable;



We need a proper design on connecting the metal to the shell.

Some other important issues

- For the potting of 100 PMT samples + dummy electronics:

  any dummy electronics boards , HV modules are there so far?

  which cable should we use?

- For the potting of 10 real PMTs + real electronics:

  when all parts (base, HV module, electronics boards, cable, connectors) are available ? (if there are no MCP PMTs , we can use dynode PMTs for part of them)

  what's the design for the integration and plan for joint test?

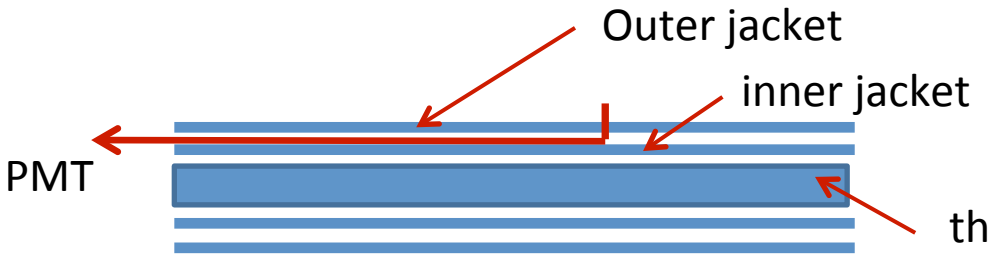
  when the potting can start?

One comment for cable

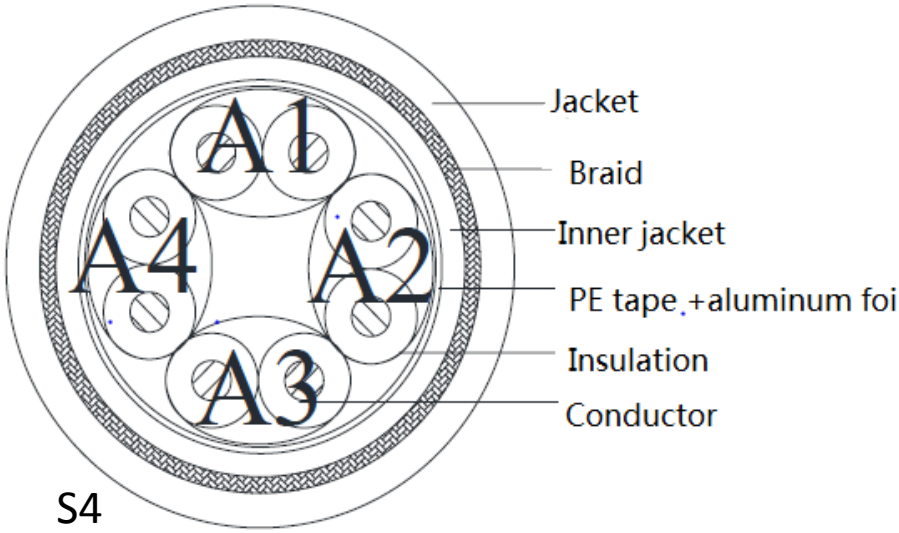
From Yunhua's talk

One more requirement:

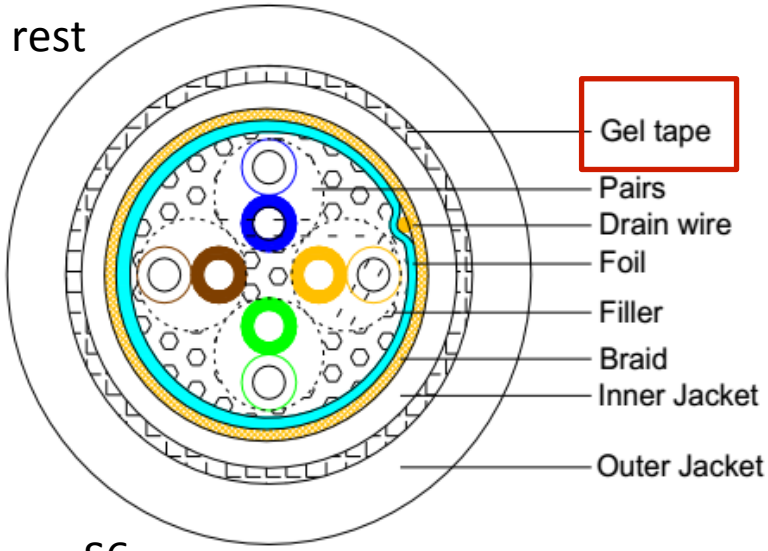
- Prevent water going to PMT when outer jacket is damage;



- S6 better than S4 for this purpose



S4



S6

schedule

Task list	Starting time	Finishing time
JUNO prototype potting	2015-1-1	2015-9-30
JUNO PMT potting design	2015-10-1	2016-7-15
Aging test of the sealant	2016-8-1	2016-12-31
20 PMT samples potting	2016-9-1	2016-12-31
review	2016-1-31	2017-1-31
100 (200)/10 PMT + electroncis	2017-2-1	2017-5-31
testing	2017-6-1	2017-6-29
PDR	2017-6-30	2017-6-30
300 PMT +electronics?	2017-7-1	2017-11-30
PDR	2017-12-1	2017-12-1
On-site potting preparation (lab, manpower..)	2017-12-1	2018-6-30
Potting	2018-7-1	2019-6-31

Summary

Topics focused on the interface between electronics and PMT:

- The baseline potting design:
  - repairable
  - heat removing not sufficient by sealant, need metal conductor
- The cable outgoing option:
  - horizontal or vertical
- The connector:
  - design, prototyping and test from different companies
  - open questions
- Thermal conduction issue:
  - design of the metal conductor need to start now
- Issues for 100/10 PMT+ electronics potting:
  - for detailed plan
- schedule

questions and discussions?