Preparation, testing and assembling of the inner **LArGe** infrastructure

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with the support of
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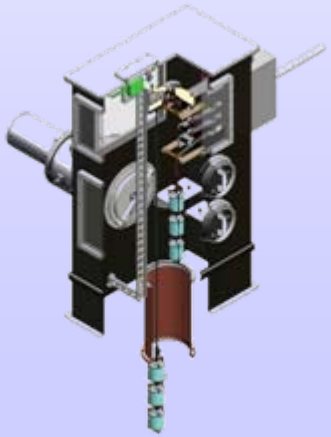
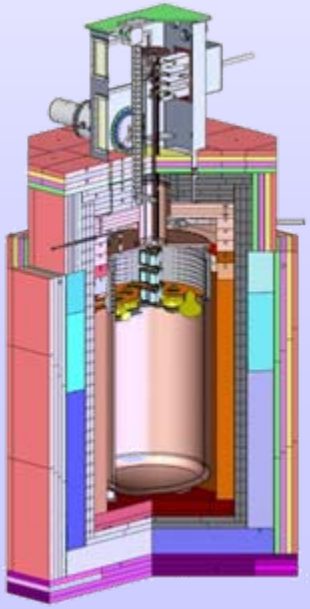
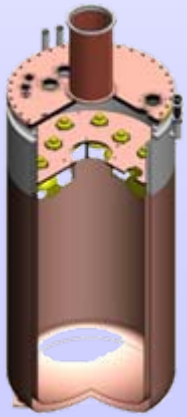
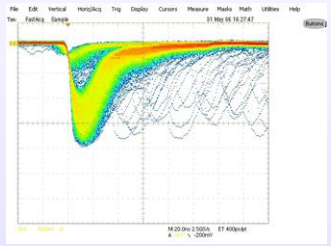
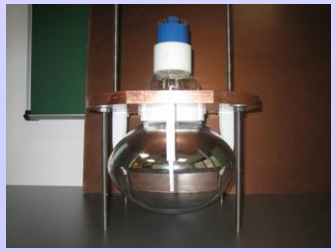


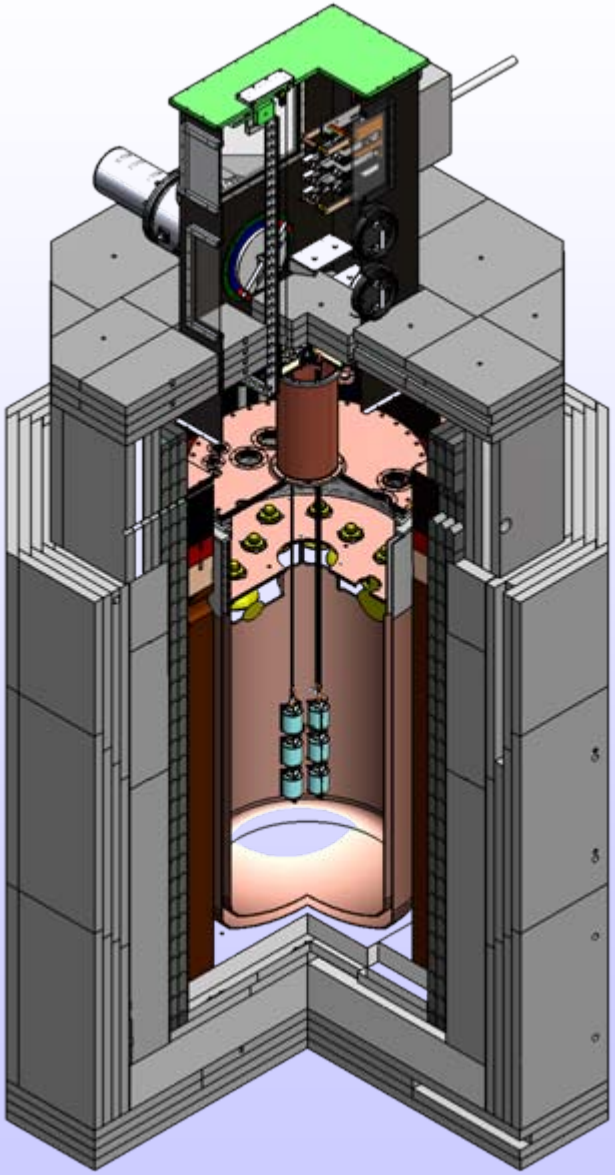








The LArGe Setup



Lock: Can house up to 3 Phase 1 strings (9 detectors)

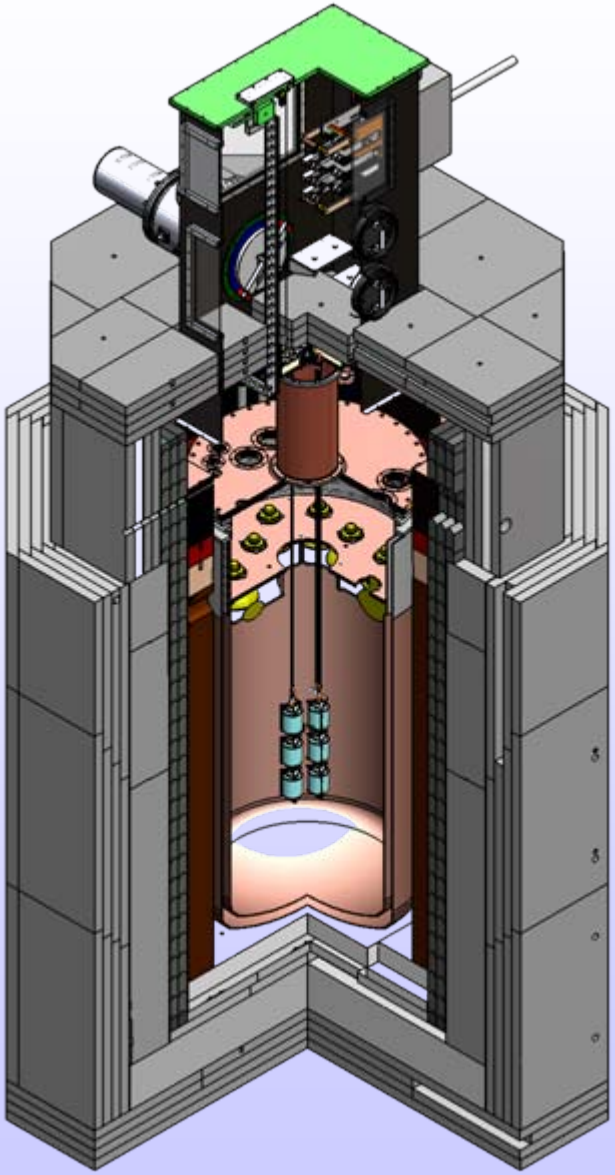
PMTs: 9 x 8” ETL 9357

VM2000 & **wavelength shifter**

Cryostat: Inner diameter: 90 cm,
Volume: 1000 liter

Shield:	Cu	15 cm
	Pb	10 cm
	Steel	23 cm
	PE	20 cm

Outline



- coating of VM2000 reflector foil
- PMT voltage devider & pulse shape tests
- Light yield & PMT performance in LAr
- PMT mounting into LArGe
- α-source manipulator

VM2000 coating with wavelength shifter

Why wavelength shifting?

- scintillation light of argon: **128 nm** / **40 γ/keV**
- PMT blind @ 128 nm / max. sensitivity: 350 nm

$\Rightarrow$ wavelength shifter (WLS) required !

What to use as WLS ...

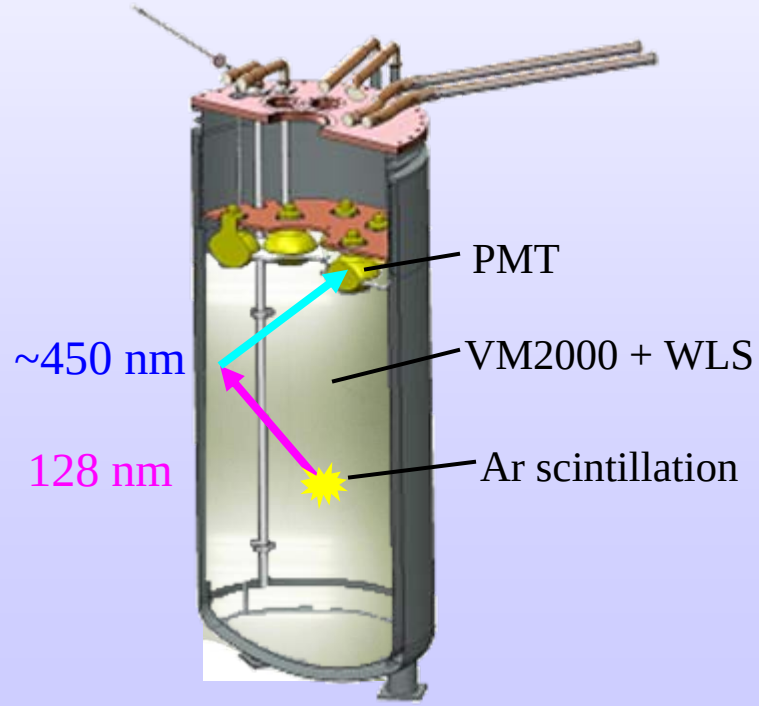
- VM2000 is reflective foil & WLS by itself:

  → ~0.4 pe/keV

- <u>in addition</u> coating with WLS:

  TPB (as WLS) on a polymer matrix (PST) solved in toluene

  → ~1.8 pe/keV

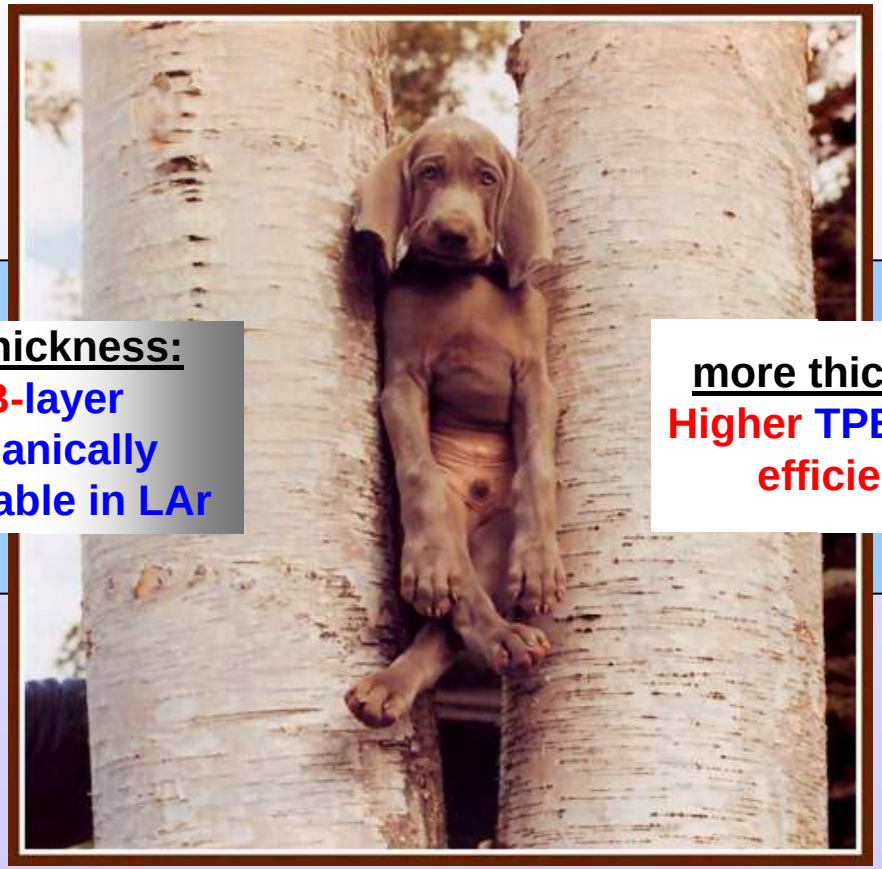


the coating challenge ...

thickness of TPB-layer:

1 µm

less thickness:
TPB-layer mechanically more stable in LAr



more thickness:
Higher TPB-shifter efficiency

4 µm

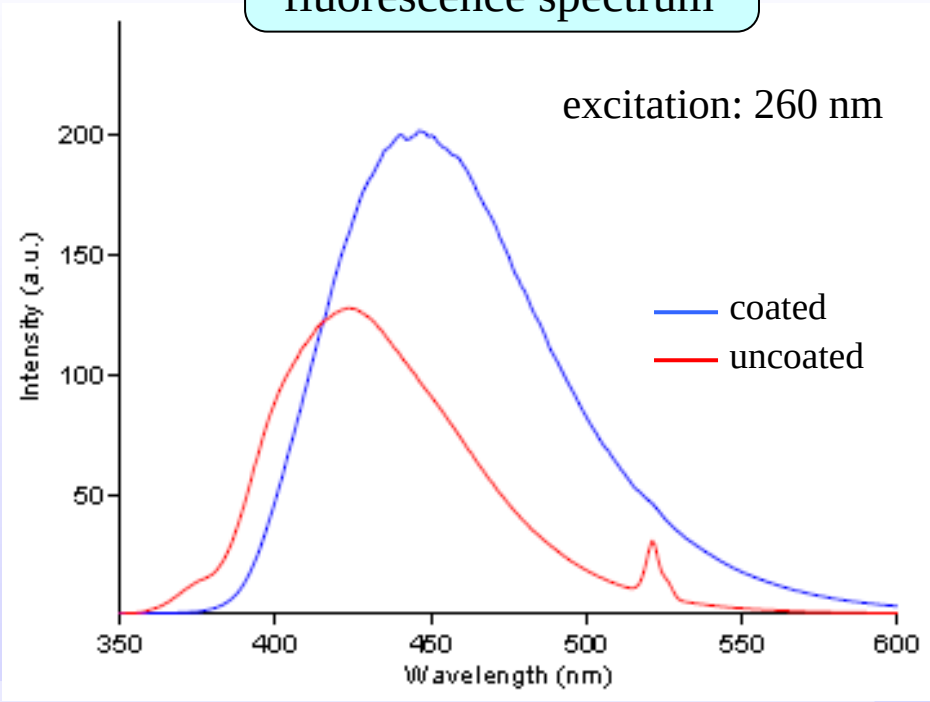
for 10 sq.meters of VM2000 !!!???

VM2000 coating with wavelength shifter

coating machine

2nd version Aug.`08

fluorescence spectrum



- construction of “coating machine“
- coating performed in april and august 2008 (in cleanroom)

→ VM2000 pieces are ready for mounting.

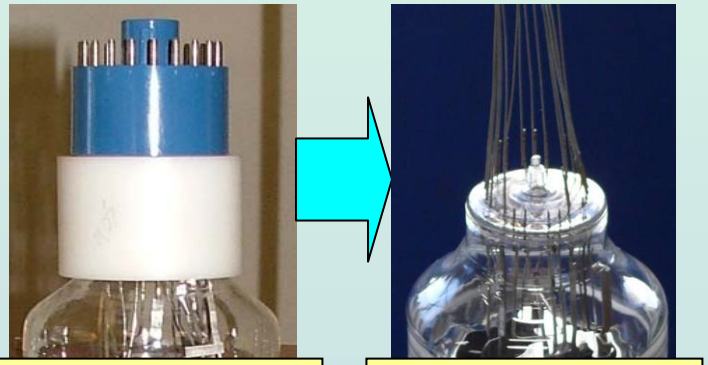
PMT voltage devider & pulse shape tests

The voltage devider for LArGe

Designed by JINR and MPIK:

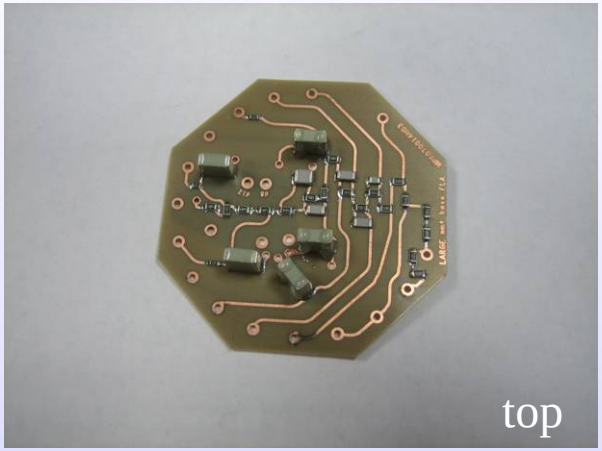
- based on thin (0.5 mm) CuFlon (PTFE) PCB
- negative HV on cathode (for pulse shape quality)
- readout for anode and last dynode (D12)
- progressive type → dynamic range: 2mV – 4V

→ modified design of voltage devider due to change of PMT connector type

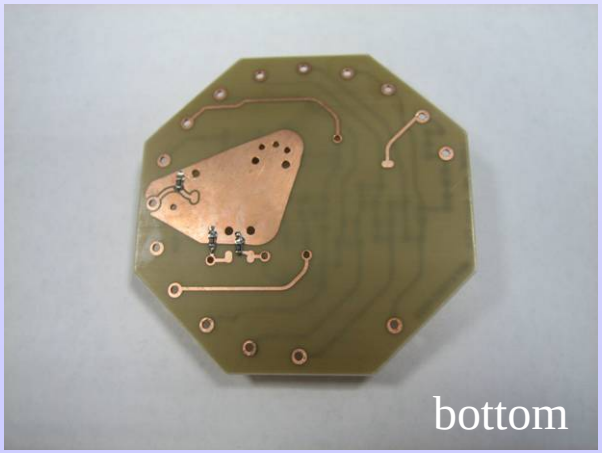


KFLB /w socket

FLB flying leeds

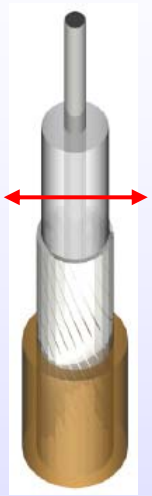


top

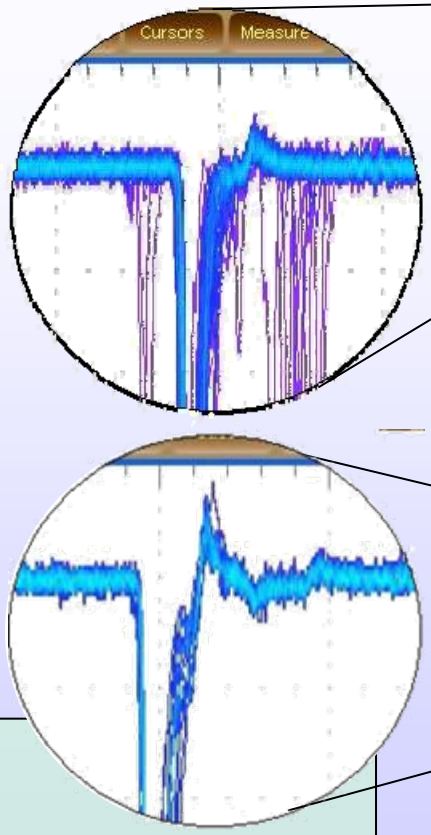


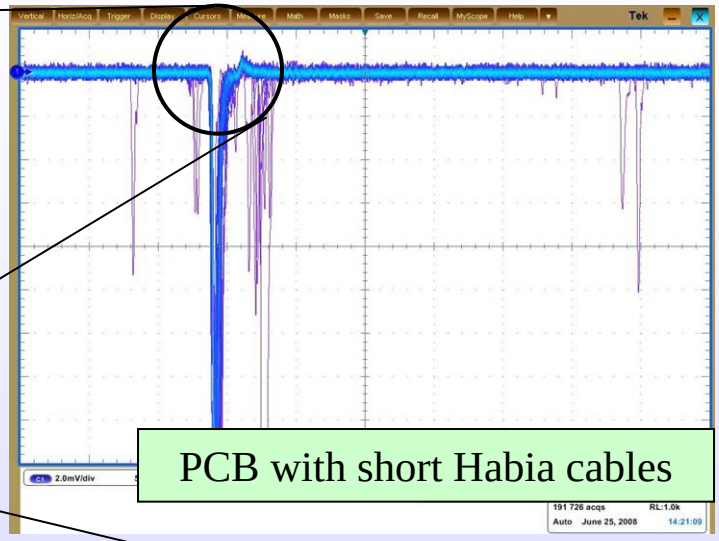
bottom

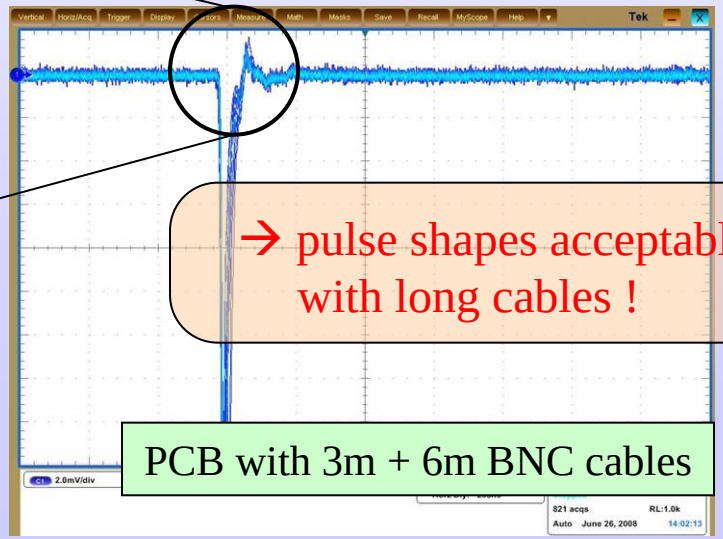
PMT pulse shapes

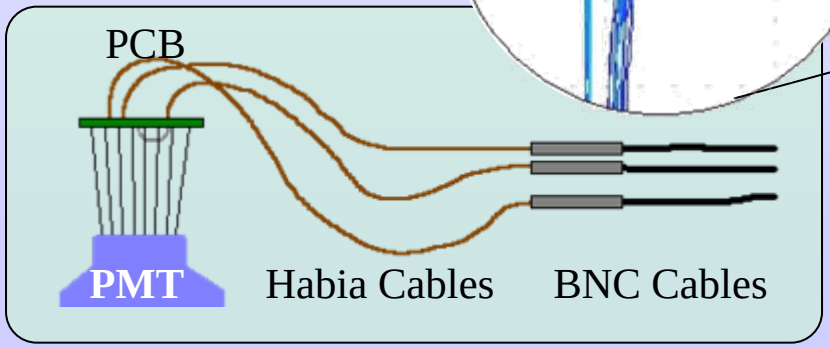


Habia Cable SM 50
for signal and HV





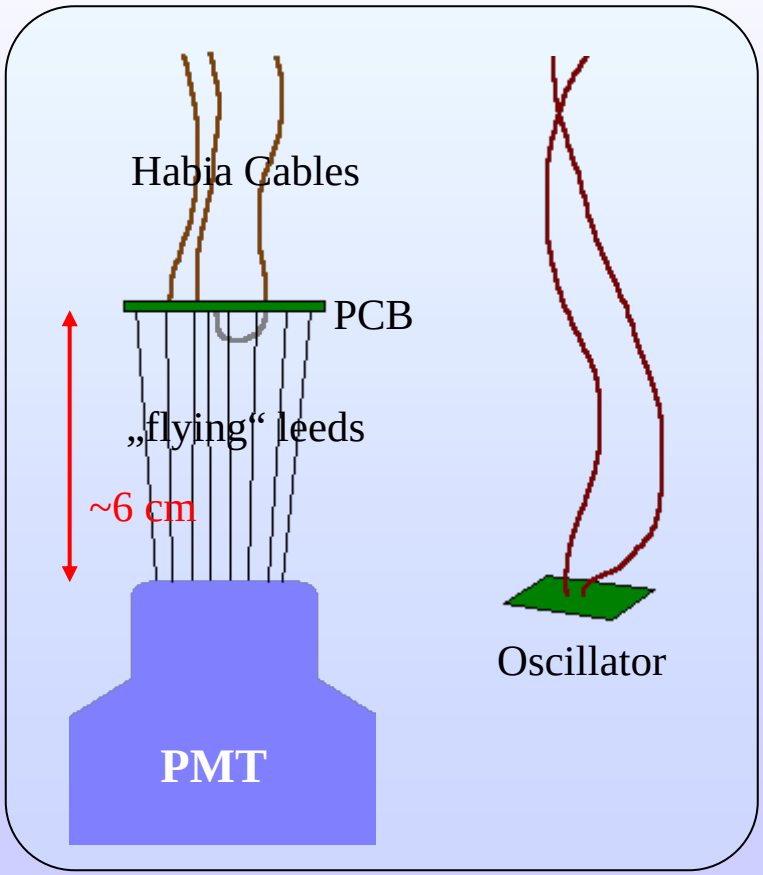




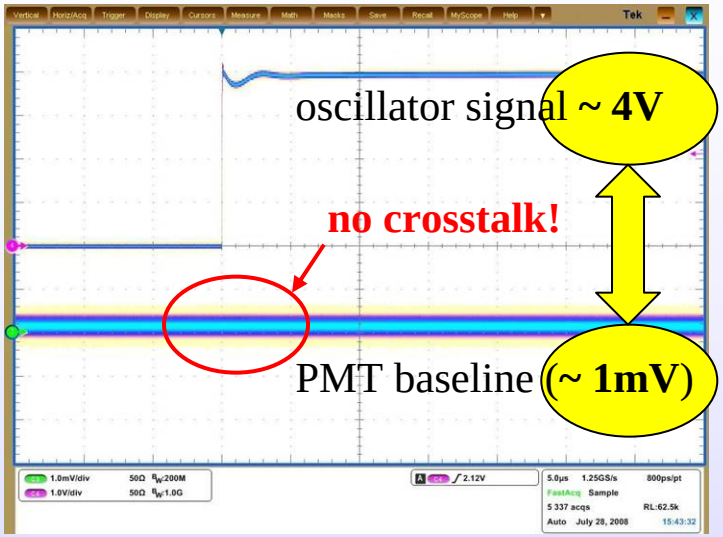
→ pulse shapes acceptable with long cables !

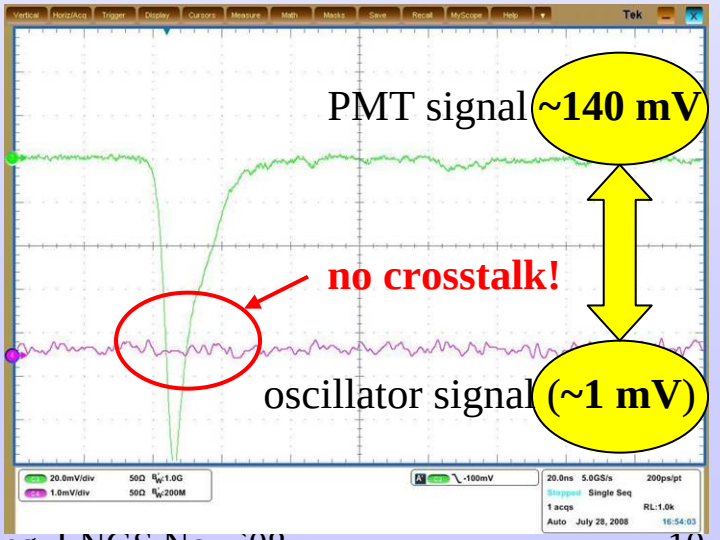
PMT crosstalk test

- introduce interference signal with oscillator & unshielded cables



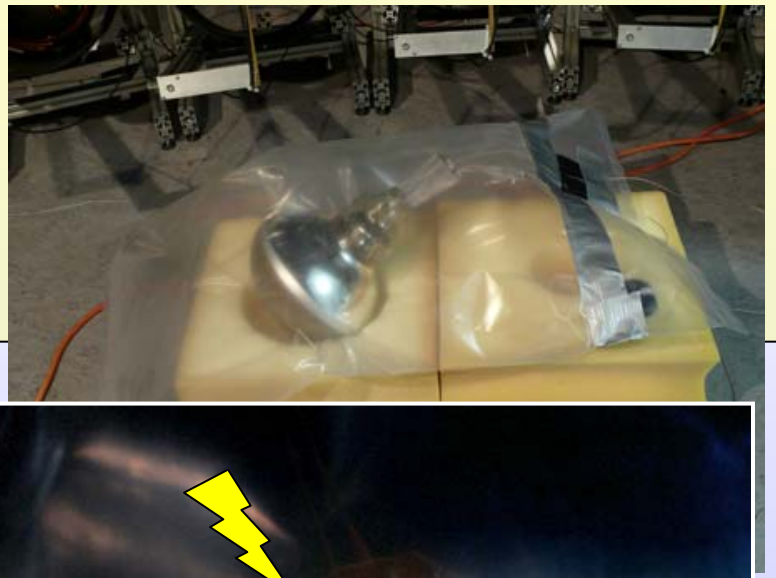
Mini-LArGe

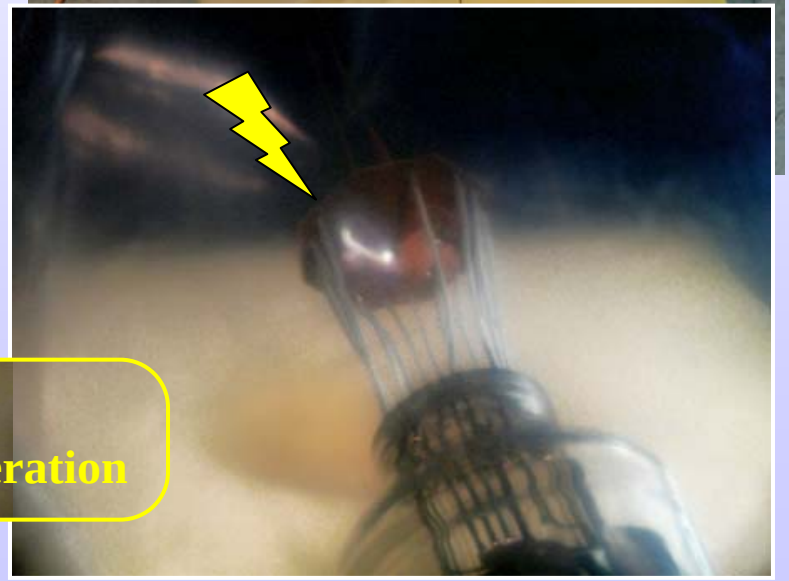




PMT/PCB sparking tests in argon gas

- sparking test in argon gas atmosphere:
  - → sparking occurs!
  - → breakdown of HV
  - → sparking is irregular in time and HV

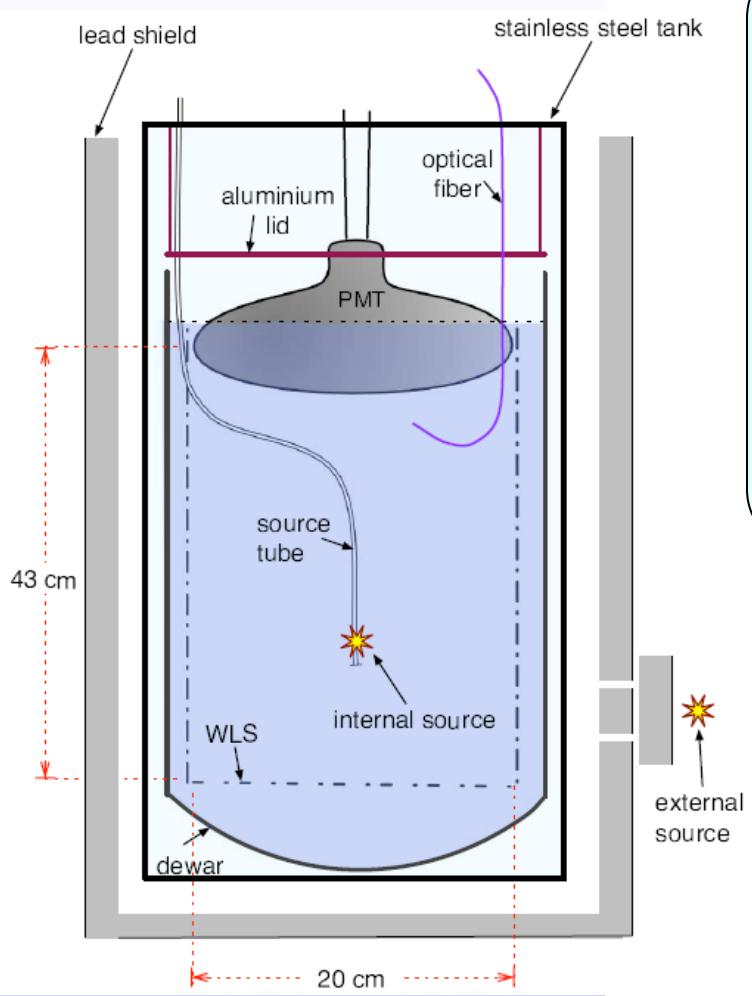




→ origin identified – problem solved
→ no sparking since 3 months of operation

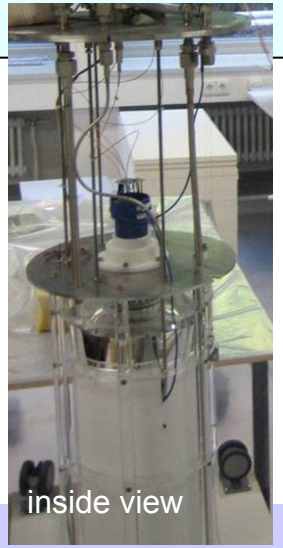
Test of PMT #1142 in Mini-LArGe

Mini-LArGe @MPIK
Schematic system describtion



- Dewar: ∅29 cm, h=65 cm
  ≈ 60 kg **LAr** (43 L) total volume
- Light detection: wavelength shifter/reflector foil (VM2000 + TPB/PST)
  + PMT(8“, ETL 9357-FLB)
- Active volume: ∅20 cm, h=43 cm
  ≈ 19 kg **LAr** (13,5 L)
- Shielding: 5 cm lead (+ 10 cm BP for n)
  +15 mwe underground


outside view w/o shield


inside view

Optimize PMT coating with wavelength shifter

- goal: try to apply 1-4 µm thick layer of TPB/PST to (sandblasted) PMT glass surface
- test painting of flat glass samples:

attempt	concentration of TPB/PST	layers of paint	applied solution	thickness
1st	11 g/l	2	~ 2.1 ml	~ 1.3 µm
2nd	11 g/l	4	~ 3 ml	~ 1.8 µm
3rd	33 g/l	1	~ 0.5-1 ml	~ 0.8-1.8 µm
4th	33 g/l	4	~ 3 ml	~ 5.5 µm

→ test of WLS on glass samples in LN for mechanical stability

- test painting of PMT
- now: test of light yield in Mini-LArGe

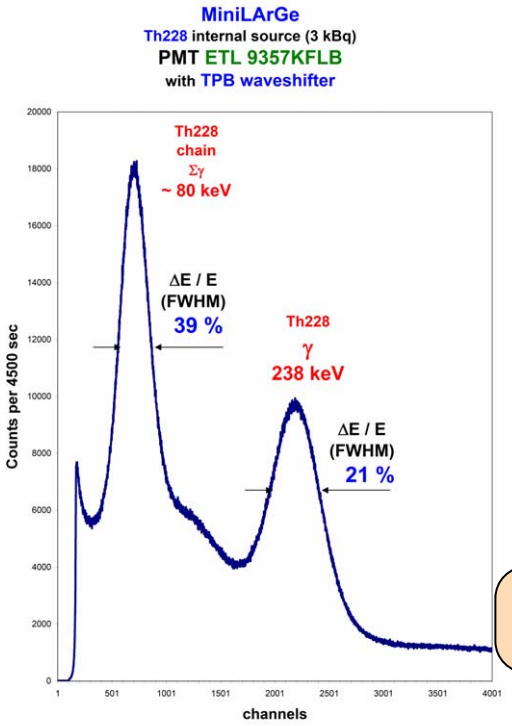
Improvement of light yield

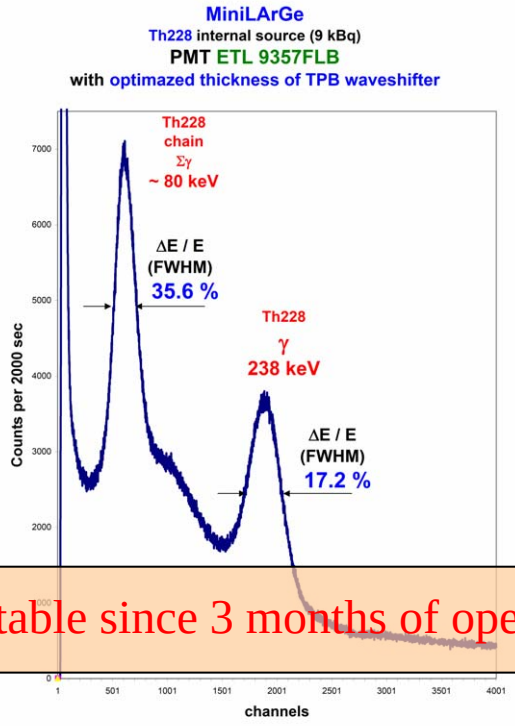
from previous TPB waveshifter on PMT ⇒ to optimized TPB thickness on PMT

light yield: 1240 pe / MeV ~ **1.5** times → 1850 pe / MeV

ΔE / E: 21.0 % (FWHM) ~ **1.2** times → 17.2 % (FWHM)

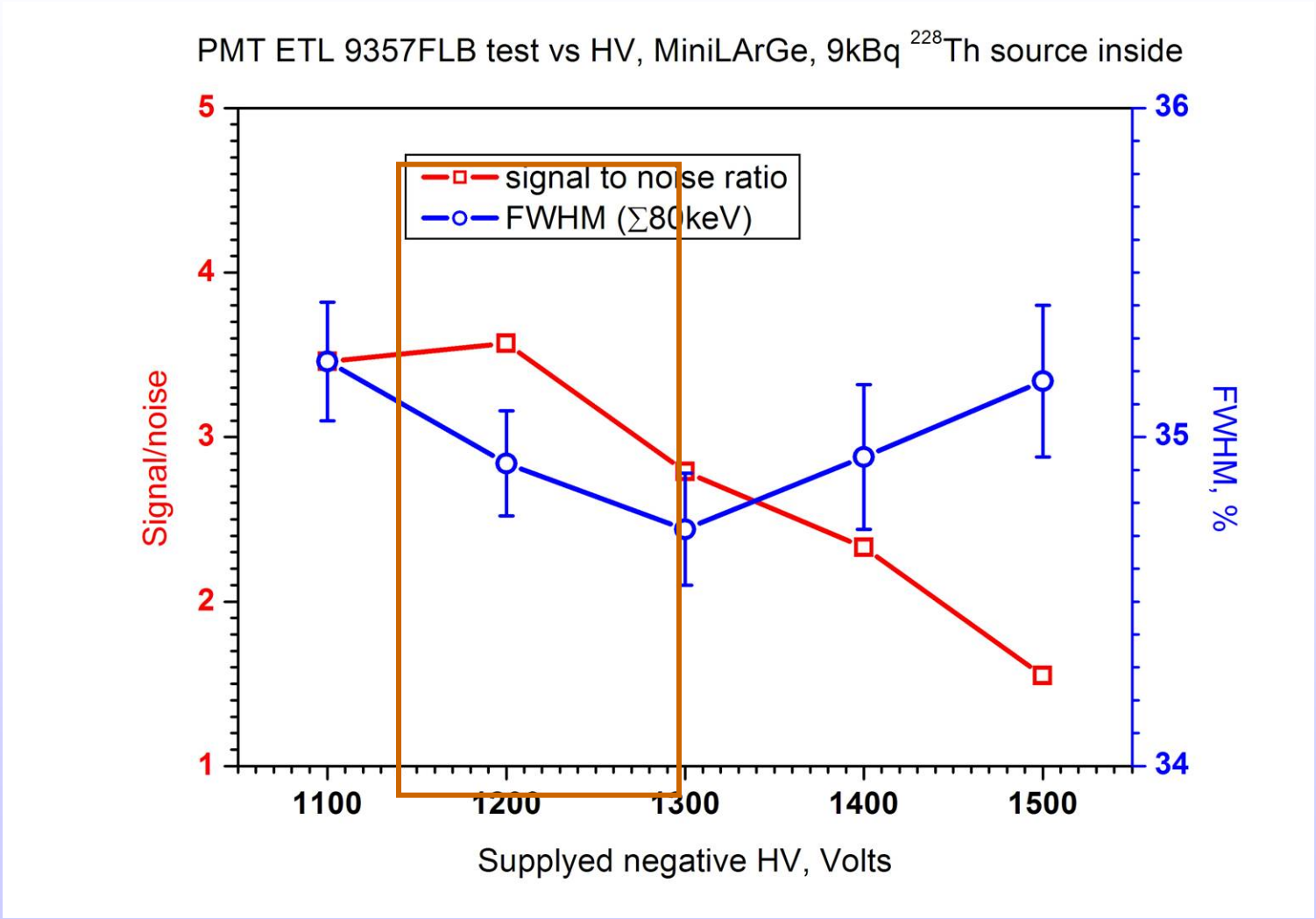
(at 238 keV)





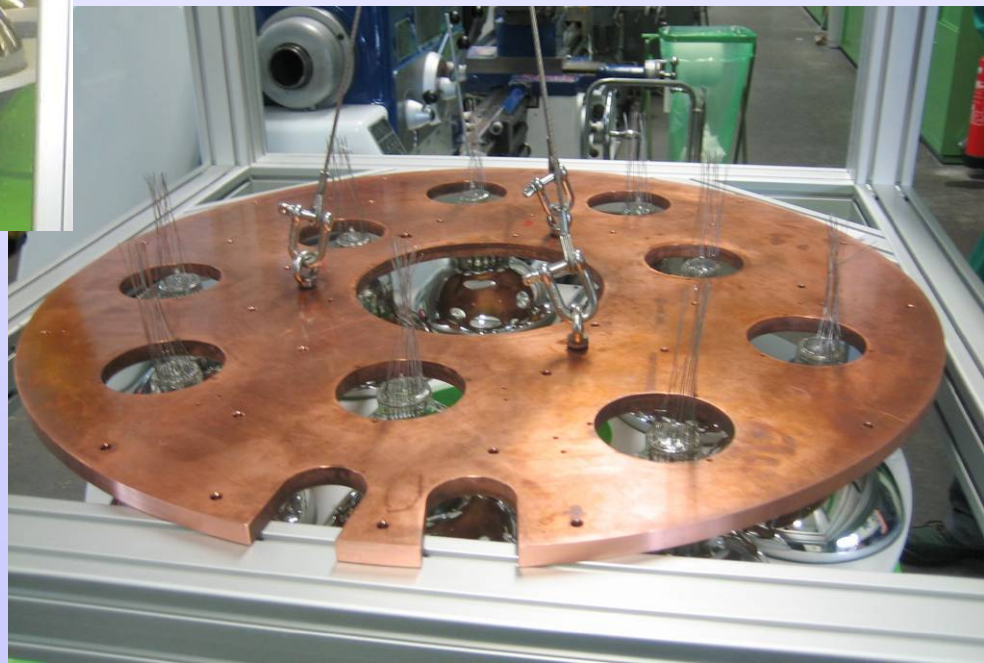
→ TPB coating stable since 3 months of operation

Signal-to-noise-ratio & energy resolution



PMT holder system in LArGe

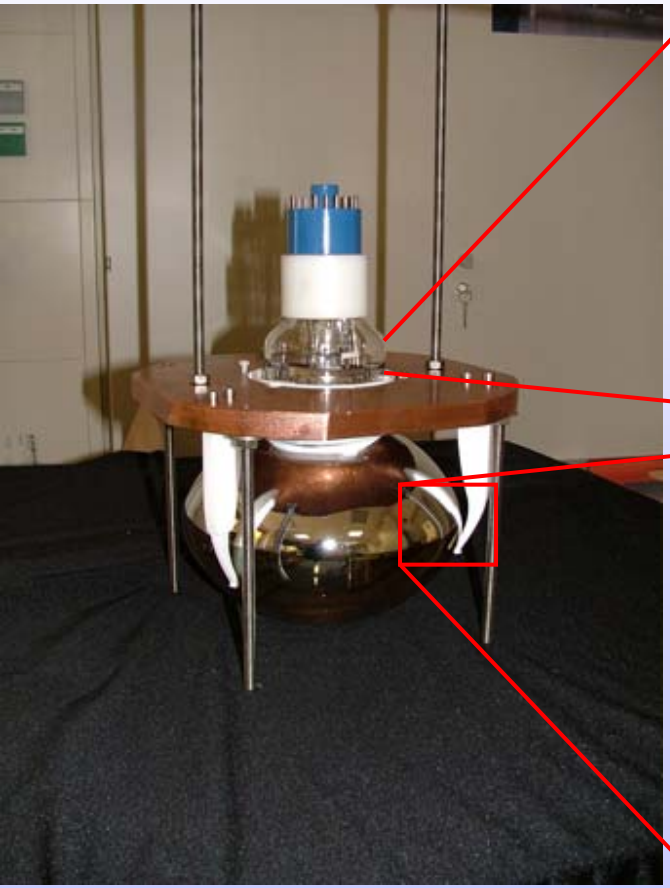
⇦ 9 PMTs without cabling sitting in the lower Teflon plate



the PMTs are lifted upwards into the holes in the upper copper plate ⇨

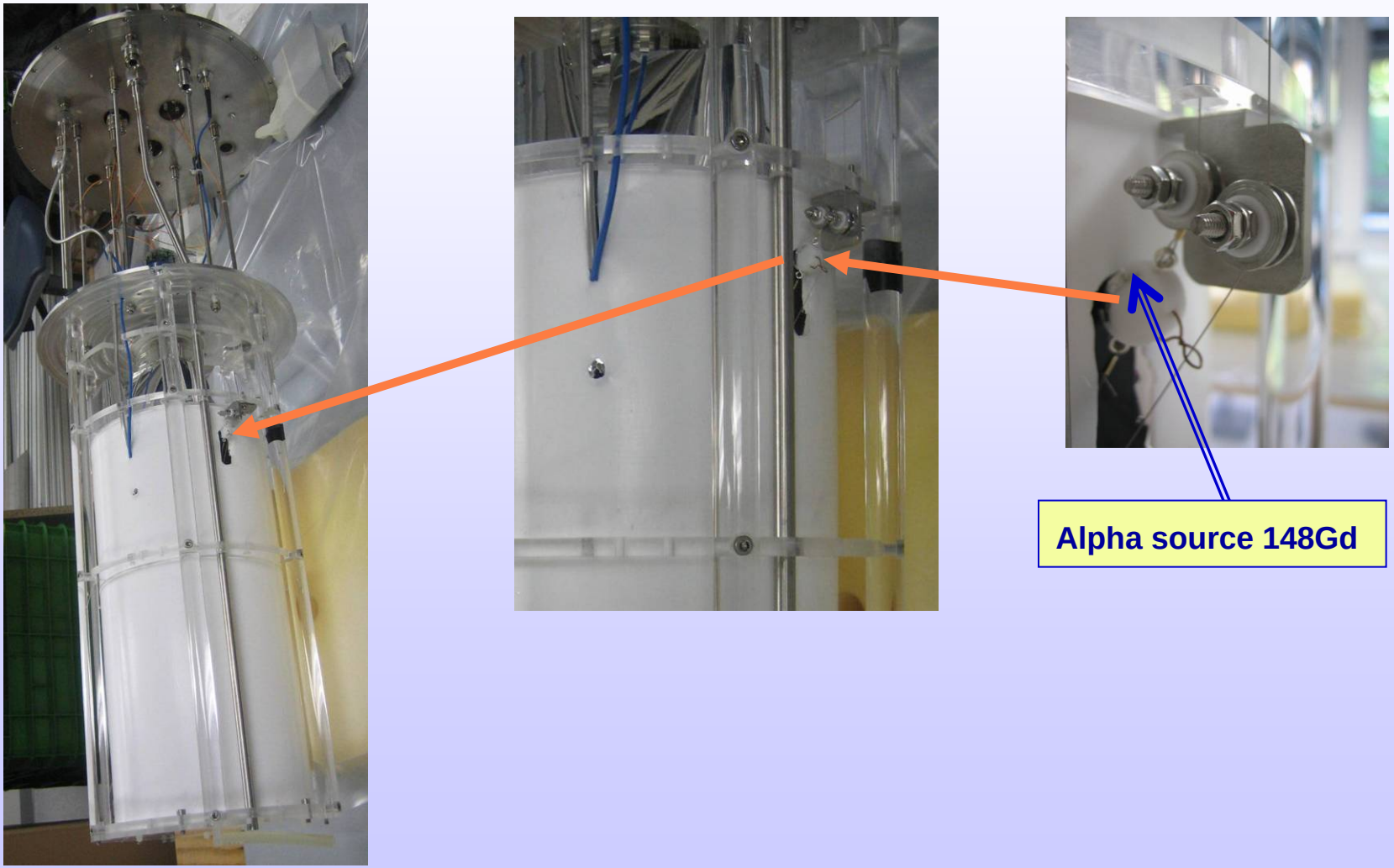
PMT holder system in LArGe

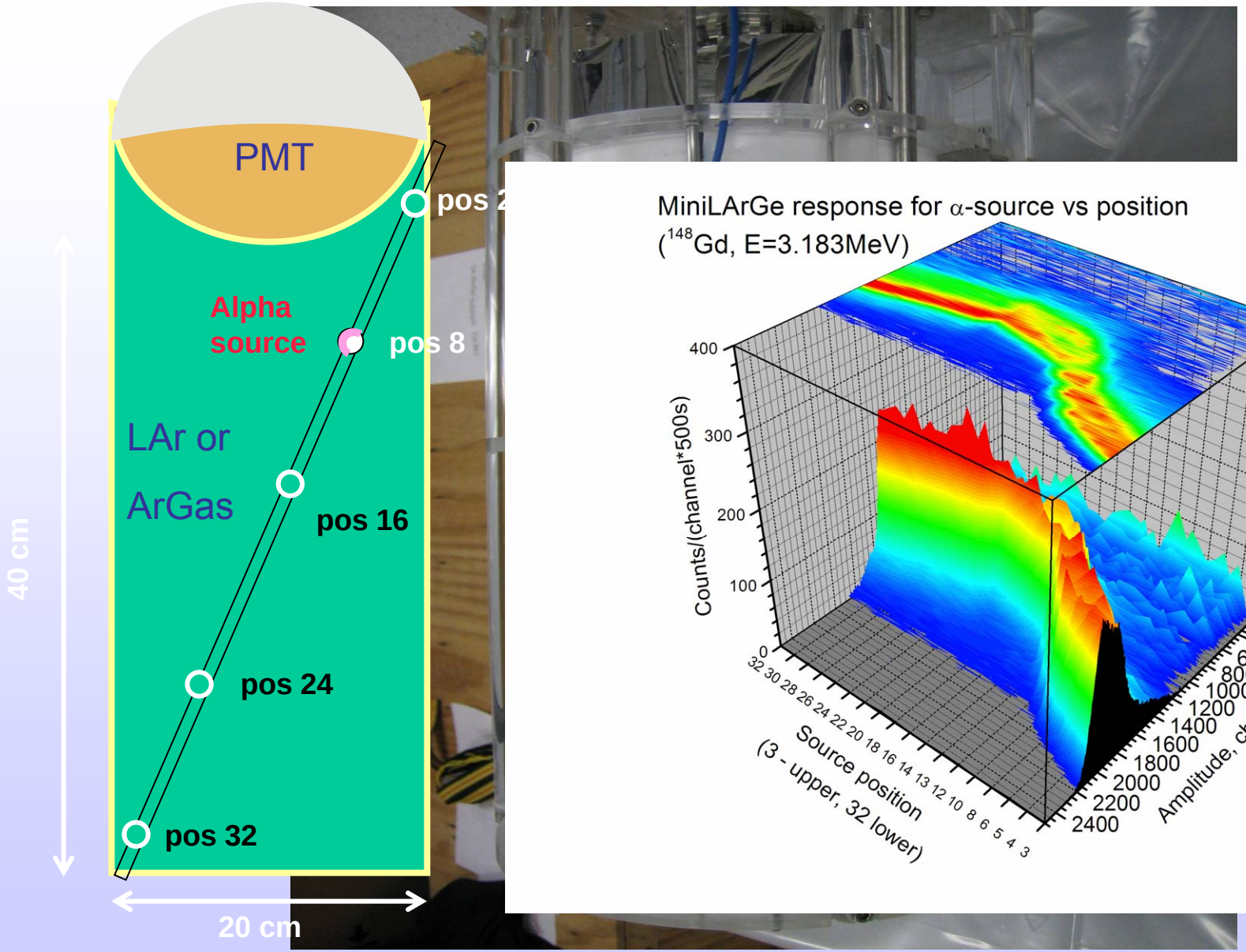
mockup of holder design with
flexible Teflon brackets



test in LN successful

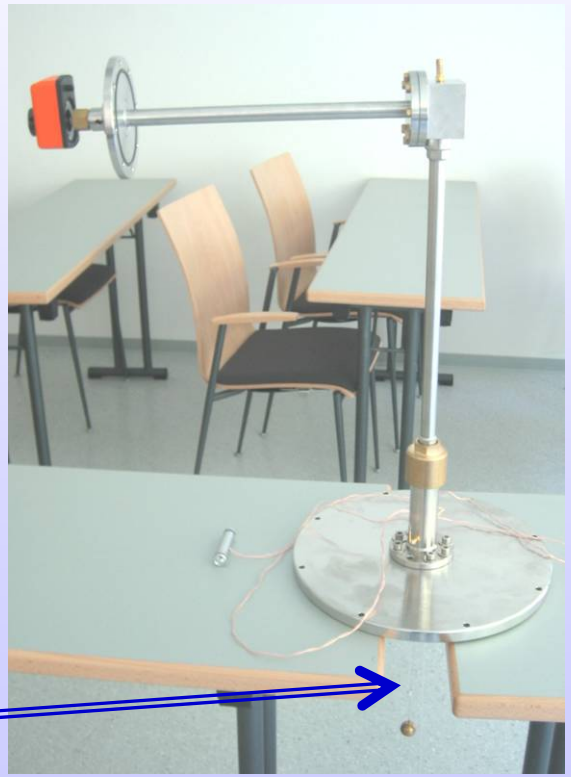
Alpha source manipulator for position calibration in MiniLArGe





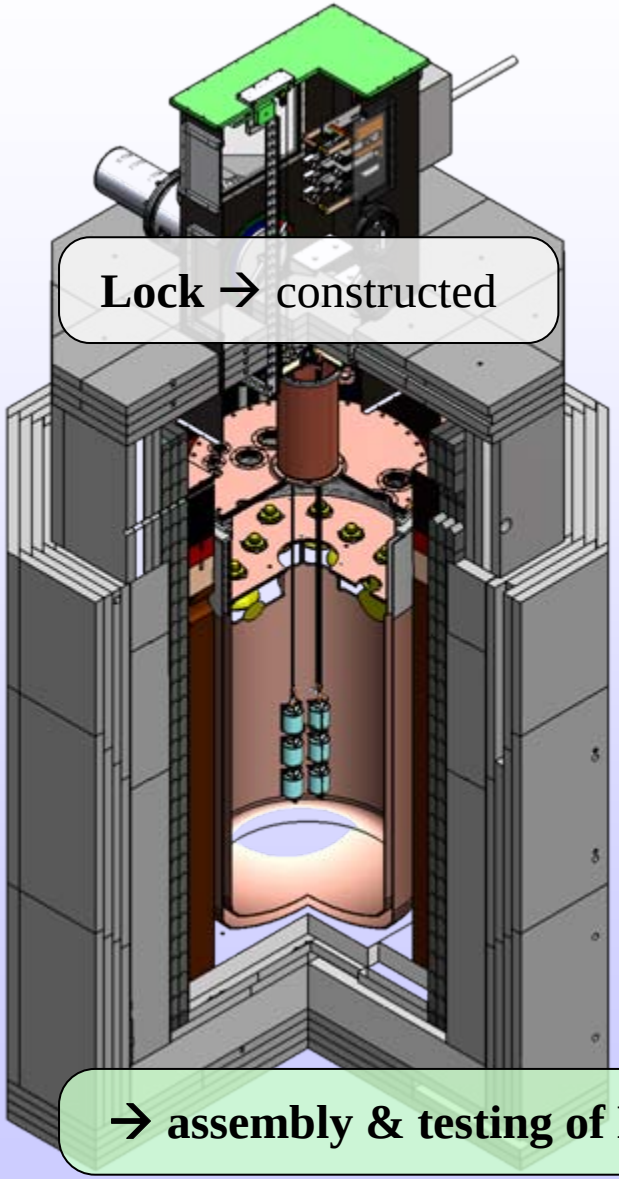
→ for more details see TG10 status report, Luciano Pandola, tomorrow

Alpha source manipulator for position calibration in LArGe



Alpha source 148Gd

Conclusions



Lock → constructed

coating of VM2000 reflector foil	**ready & tested**
PMT voltage devider & pulse shape tests	**ready & tested**
Light yield & PMT performance in LAr	**tested & stable for 3 months**
PMT mounting into LArGe	**final design tested**
α-source manipulator	**ready & tested**

→ assembly & testing of LArGe planned before Christmas @ MPIK