

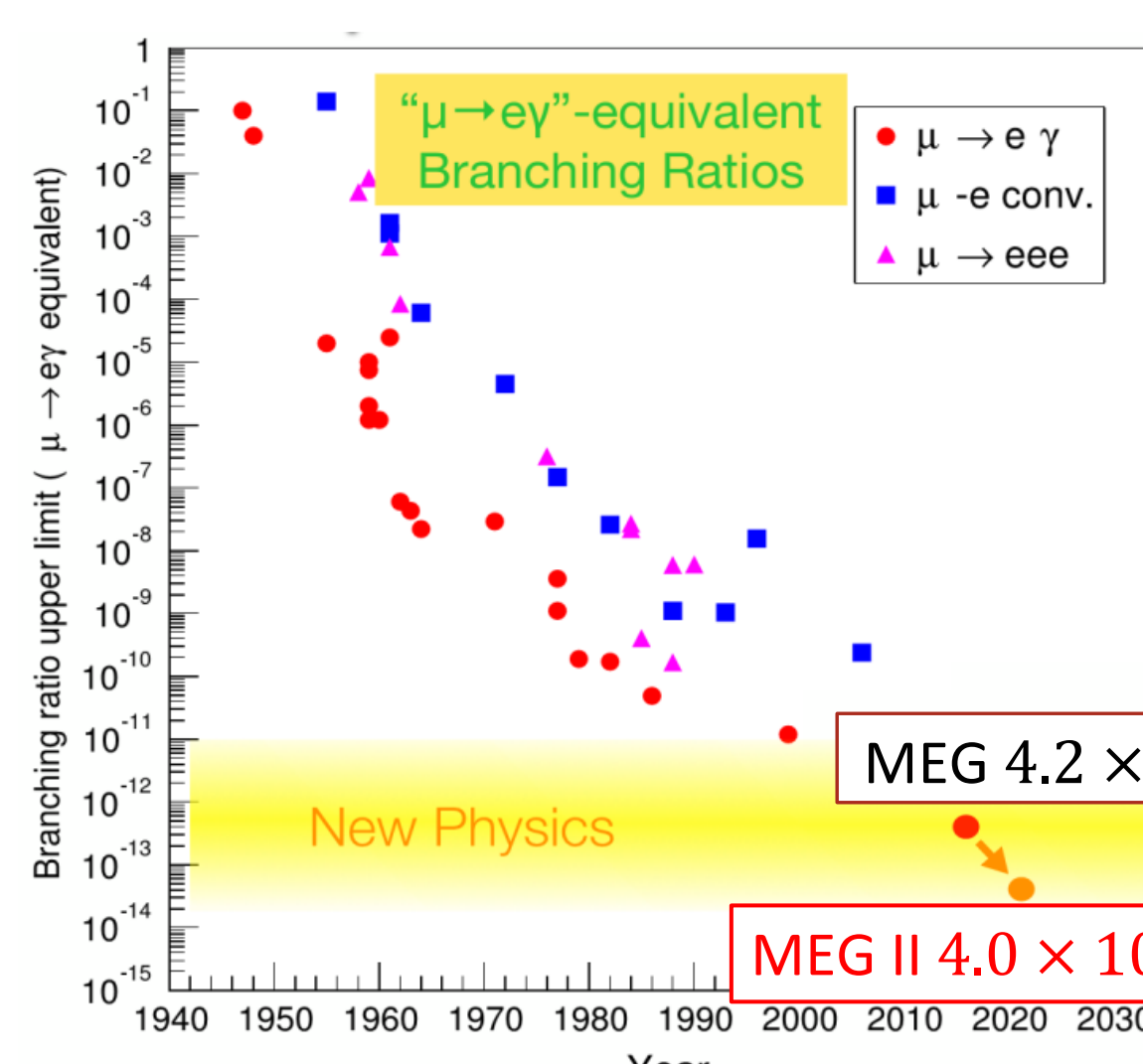
MEG II experiment: Upgraded Liquid Xe Detector with SiPM

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1 MEG II experiment

MEG II experiment will search for cLFV decay $\mu^+ \rightarrow e^+ \gamma$ with 10 times better sensitivity than MEG. Discovery of $\mu \rightarrow e \gamma$ will be a smoking gun signal of new physics.



SM + ν oscillation:
 $\text{Br}(\mu \rightarrow e \gamma) \sim 10^{-54}$
 BSM (e.g. SUSY-seesaw):
 $\text{Br}(\mu \rightarrow e \gamma) \sim O(10^{-14})$
MEG II sensitivity:
 4×10^{-14} (90% C.L.)

Overview of the MEG II experimental setup

In MEG II, we utilize μ^+ beam at PSI with 2 times higher intensity ($\sim 7 \times 10^7 \mu/s$). In order to cope with the increased amount of accidental BG, the detector resolutions (energy, position and timing resolution) will be improved by a factor of 2.

Upgraded detectors are expected to be ready by 2017.

3 Mass test of MPPCs

● Mass test in LXe

Operation test of ~ 600 MPPCs was done in LXe. We confirmed that the **MPPCs and their signal transmission scheme (see below) work OK in LXe**. Bad connection was found for $\sim 5\%$ of MPPCs and signal cables. \rightarrow Assembly procedure and connector design were revised.

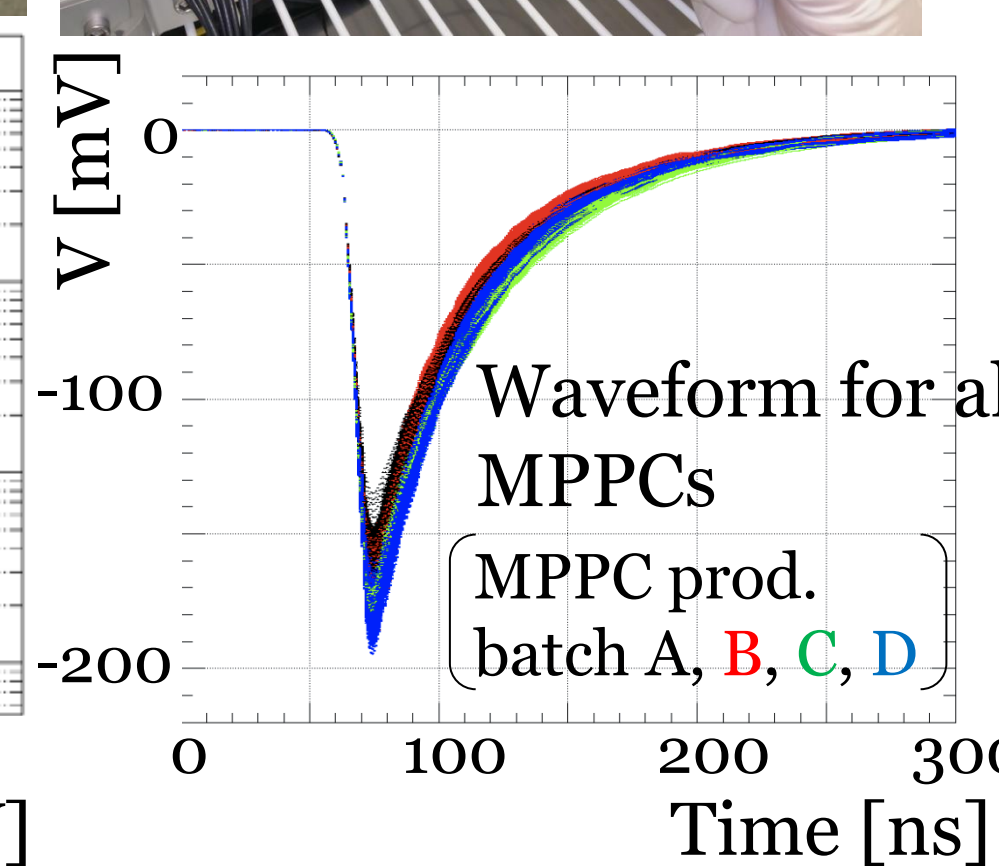
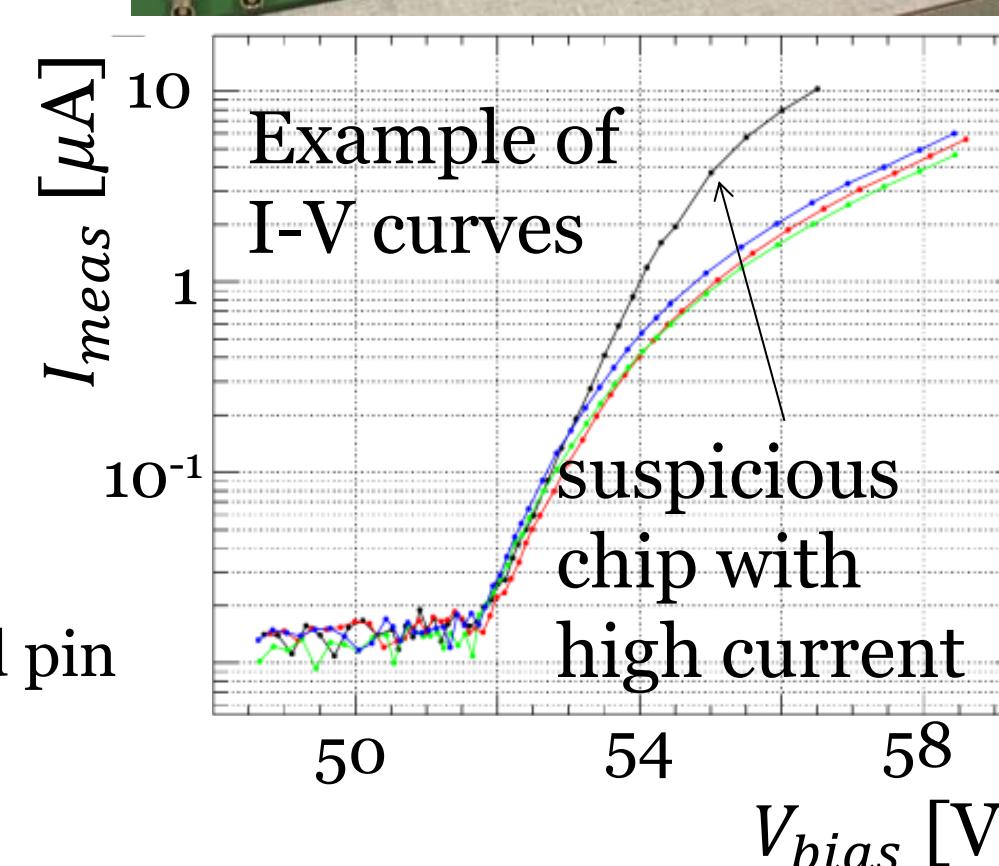
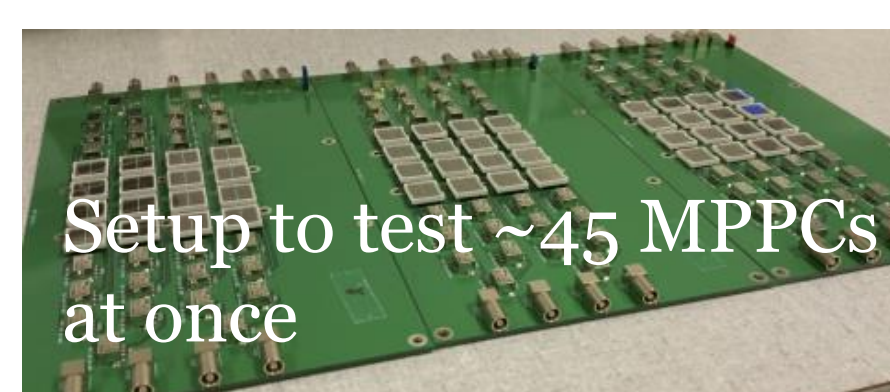
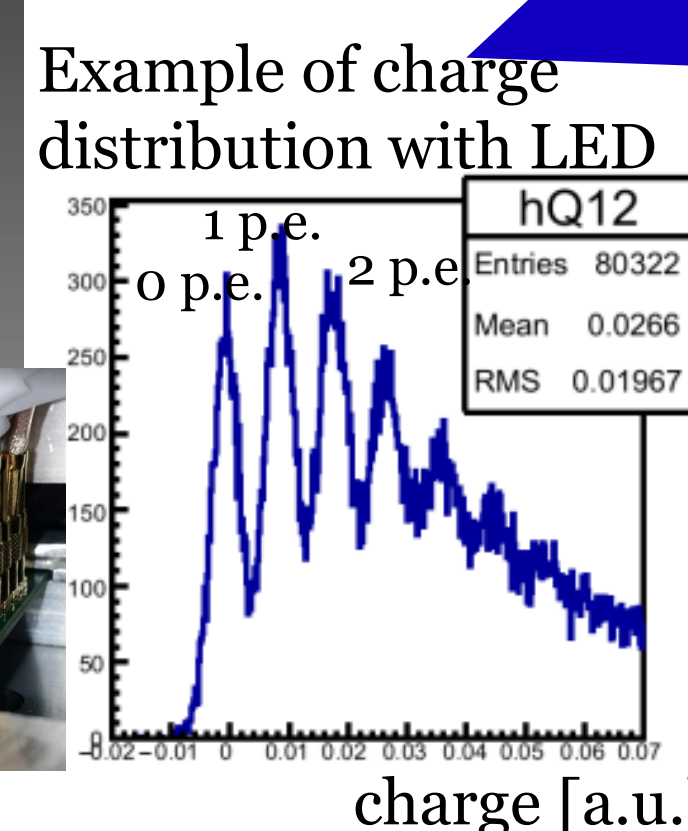
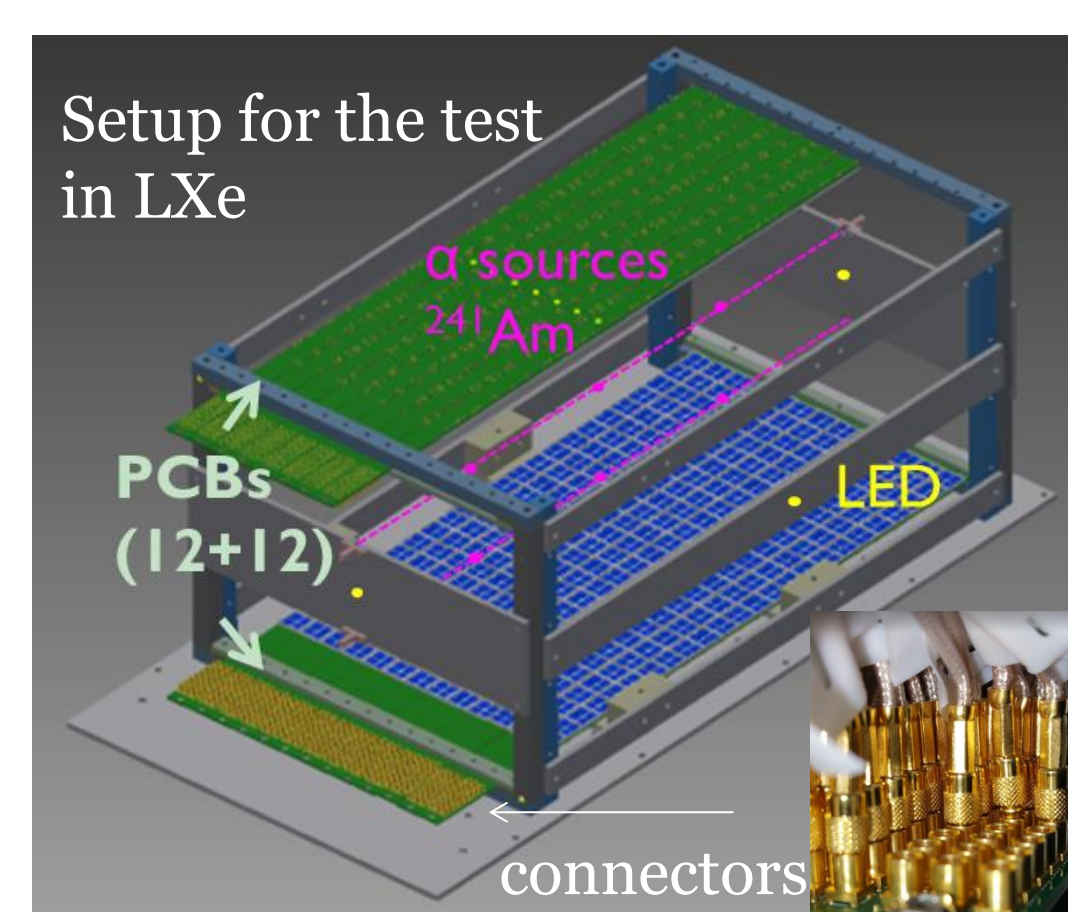
● Test of all MPPCs in room temperature

All of the MPPCs (4092 pcs + spare) were tested in room temperature before installation.

I-V curve measurement was performed for all chips on all MPPCs. Some of the chips were identified as "bad" due to unexpectedly high/low current. The **fraction of bad chips was only $\sim 0.2\%$** .

We mounted good MPPCs on the final PCBs. Waveform of all the channels was measured with LED light. There were **3 bad pins on the PCBs was found and replaced**.

bad pin good pin

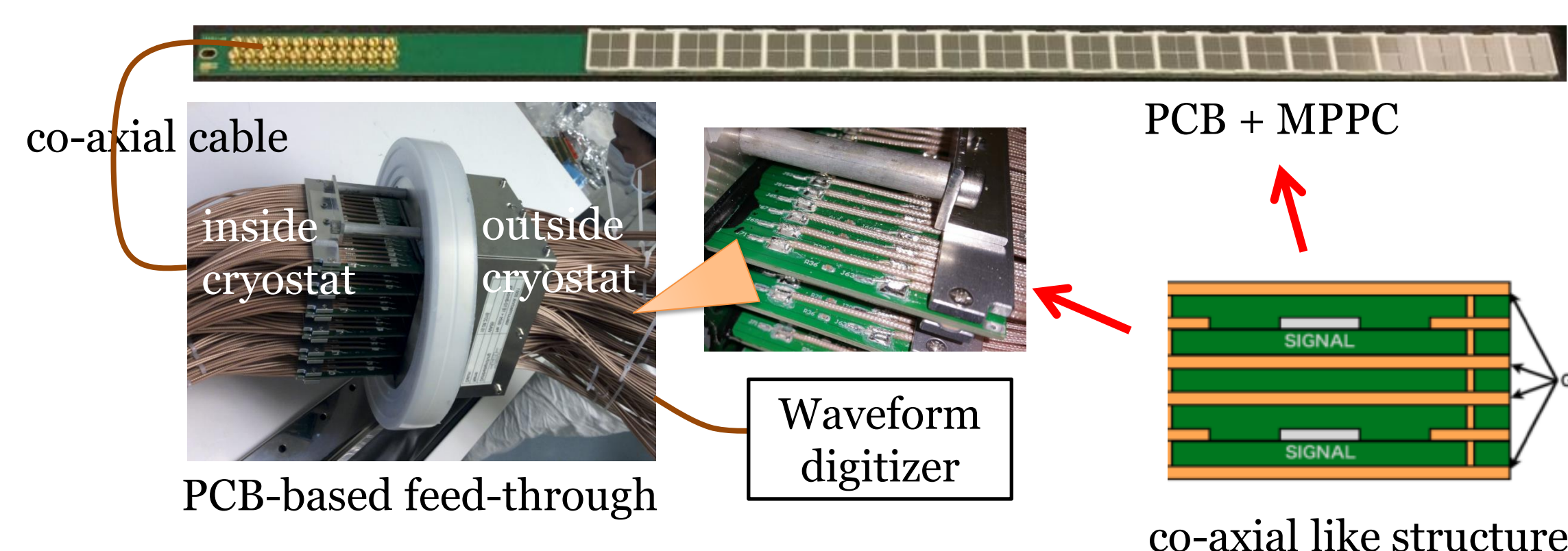


4 Construction of the detector

Construction is ongoing at the clean booth at PSI. All MPPCs and 60% of PMTs are installed.

● Signal transmission scheme

MPPC signal must be transmitted through a limited space of the cryostat. High density channels with small noise and small crosstalk is realized by using co-axial like structure PCB and PCB-based feed-through.

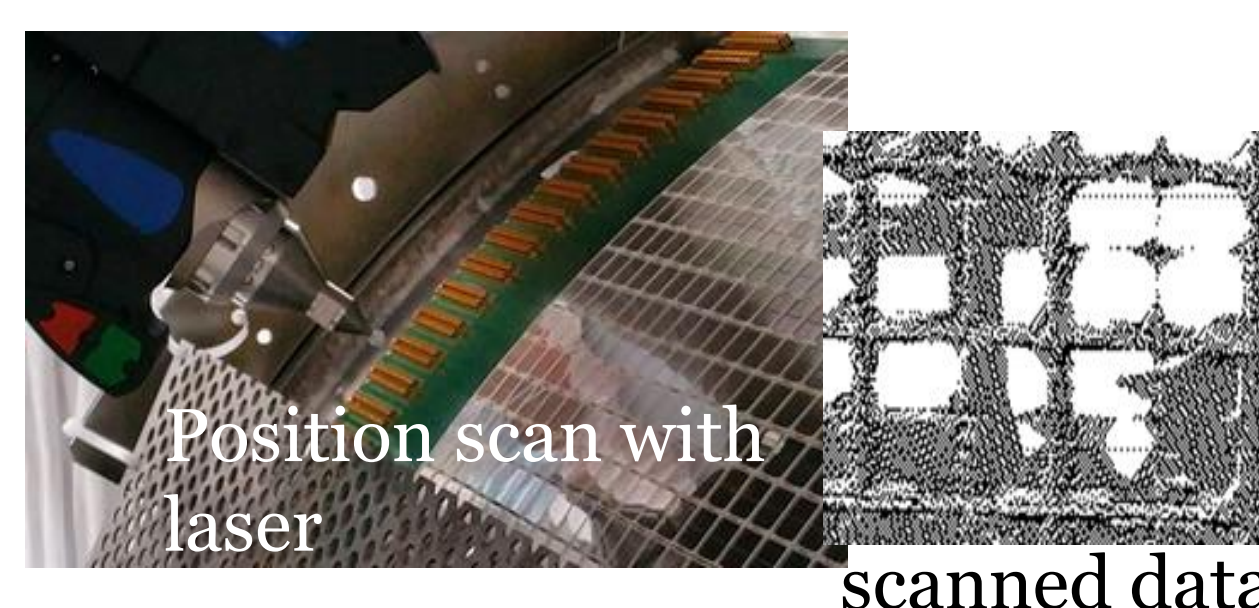


● Mounting & signal check

PCBs are aligned on the CFRP boards. Spacers made of FR4 are inserted to the dead space. This is to reduce the material between MPPC and target and to keep high detection efficiency for γ .

CFRP

Position of the MPPCs are scanned with a laser scanning device (FARO). Resolution of the position scan is $\sim 100 \mu m$.



FR4 spacers

Signal check



Cabling of MPPCs is ongoing. Signal check is being done with LED. MPPCs are illuminated by using a long bar which contains the LEDs and slits. Channel assignment of the cable is also checked.

LEDs Slits

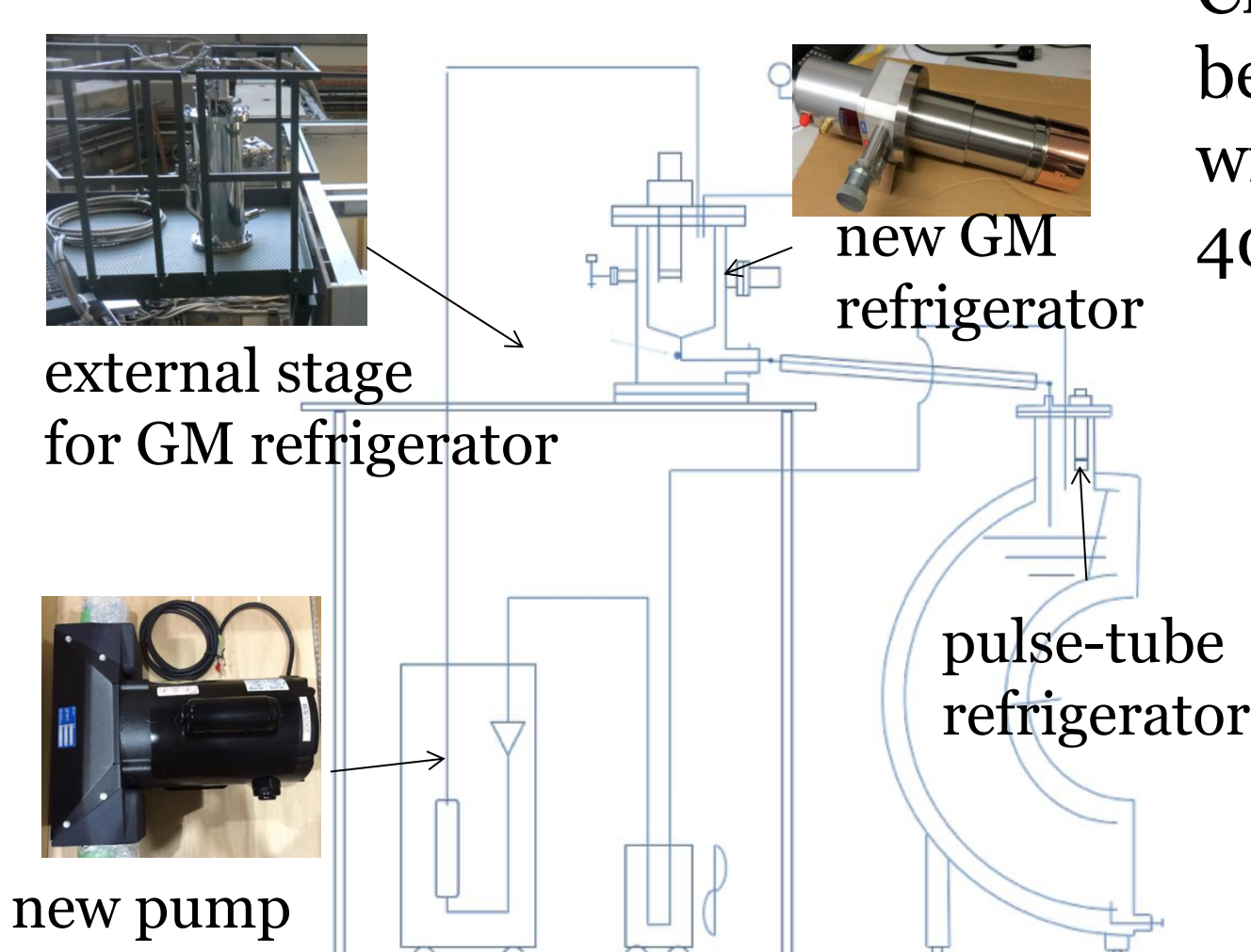
cabling work

5 Summary & prospect

The MEG II experiment will search for the $\mu^+ \rightarrow e^+ \gamma$ decay with unprecedented sensitivity. All of the detectors are being upgraded, aiming to start the operation in 2017.

We have developed VUV-sensitive MPPCs for the upgrade of the LXe γ detector. All of the MPPCs are tested and already installed to the cryostat. The energy and position resolution of the detector are expected to improve from MEG by a factor of 2.

We will complete the construction work and start the commissioning in this winter.



Cryogenics system is also being upgraded to cope with increased heat from 4092 MPPCs.

Additional GM refrigerator will be placed far from cryostat to prevent from noise. Sufficient power (430W @ 160K) of new GM refrigerator is already confirmed.