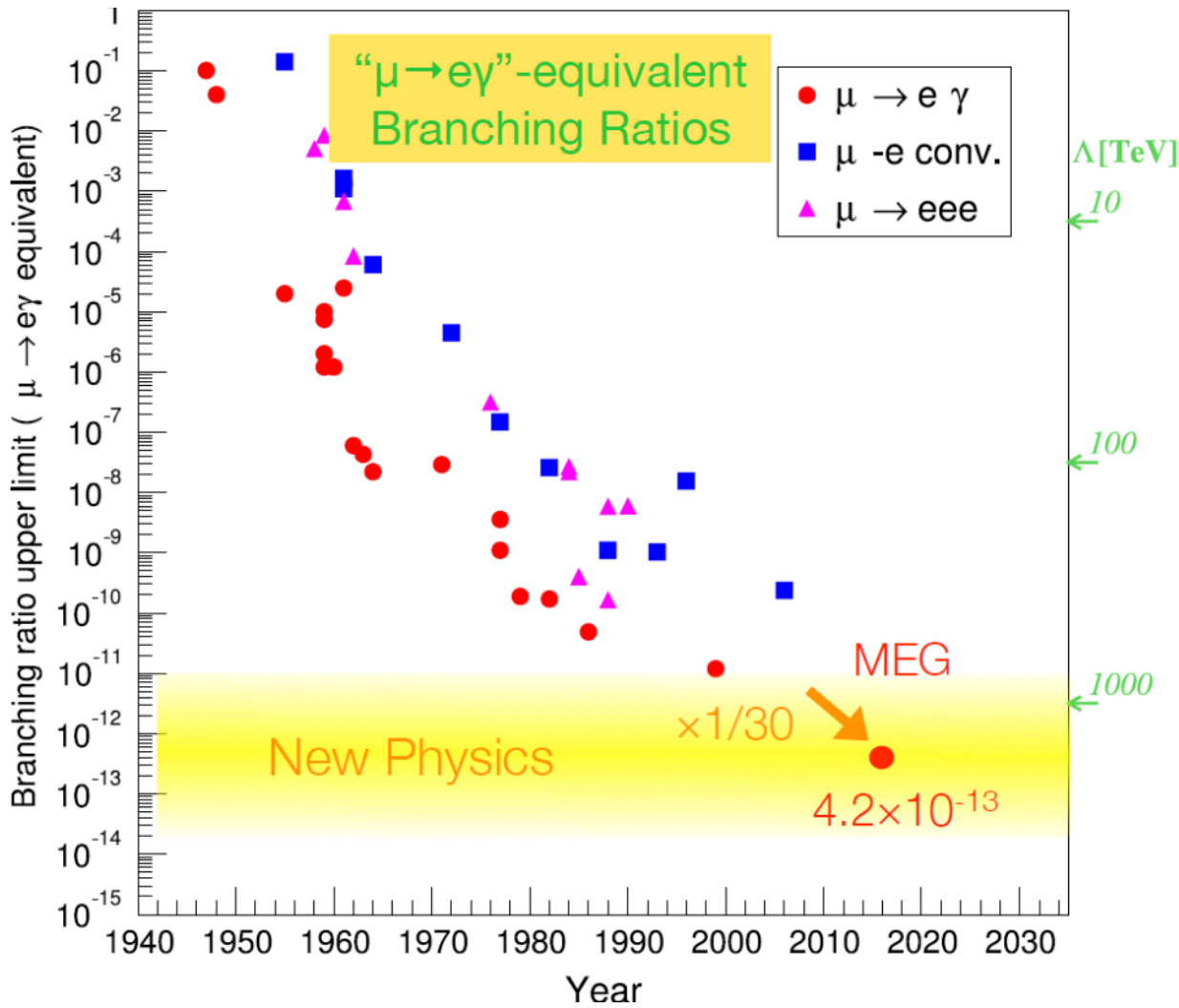


$\mu^+ \rightarrow e^+ \gamma$ 探索実験 MEG II の 2015年コミットメントの 結果と2016年の計画



- Y. Uchiyama (The University of Tokyo)
for MEG II collaboration
- The 71st JPS Annual Meeting (19 Mar, 2016)



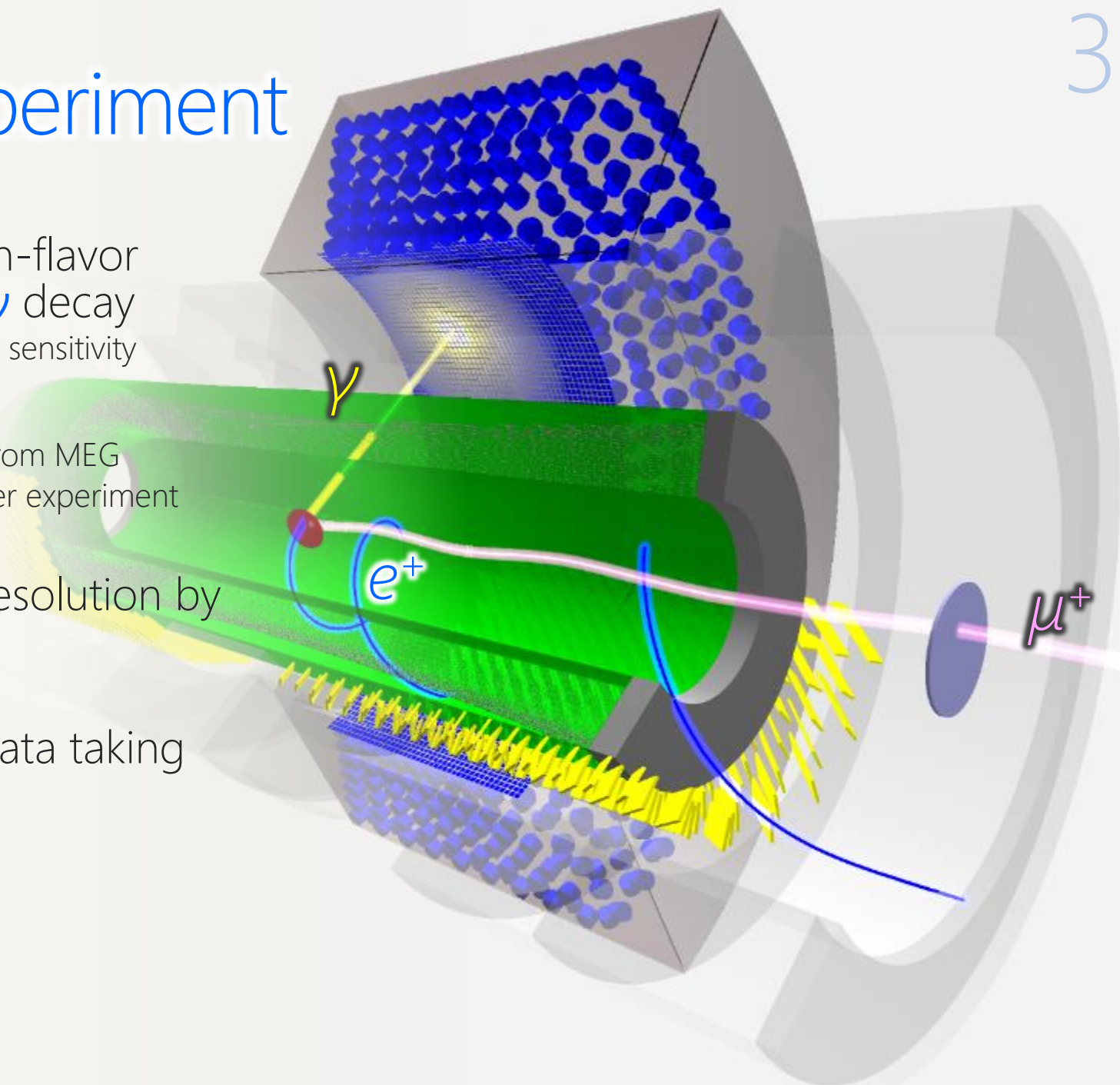
MEG final results are published.

But, this is not the end.

$\times 10$ improved sensitivity by MEG II

MEG II Experiment

- Search for lepton-flavor violating $\mu \rightarrow e \gamma$ decay
 - With unprecedented sensitivity
$$4 \times 10^{-14}$$
 - $\times 10$ improvement from MEG
 - *High-intensity* frontier experiment
- Improve every resolution by factor 2
- Aim at physics data taking from 2017



What we did in 2015

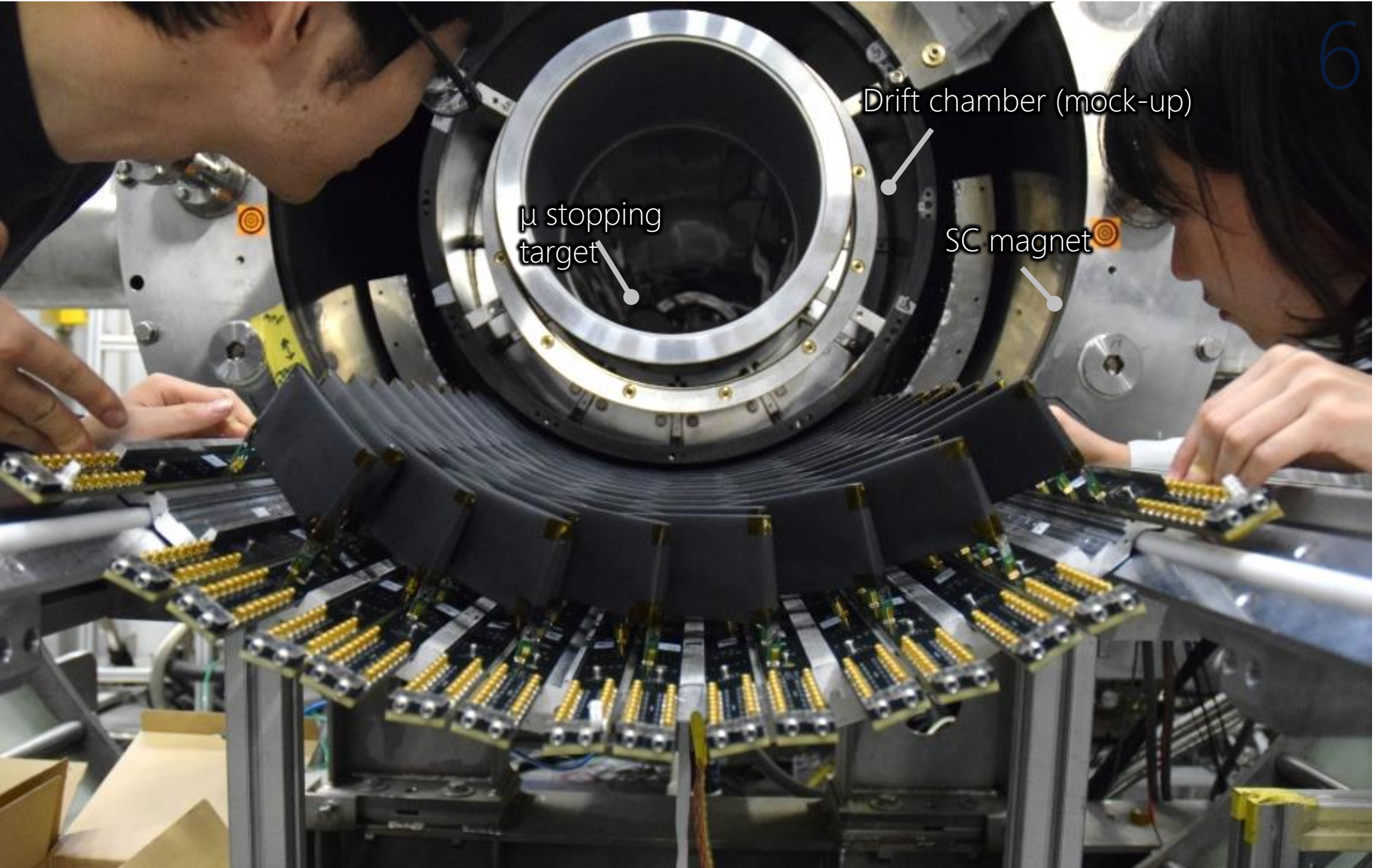
- Test the **mechanical integrity** of the MEG II design
 - ▣ Complicated system of beamline–spectrometer
- **Beam** study, tuning.
- Then, finally a beam test with e^+ s from muon decays and a part of **final timing counter**.

- In parallel, carry forward all the detector construction.

Best achievement in 2015



128 counters (half of downstream module)



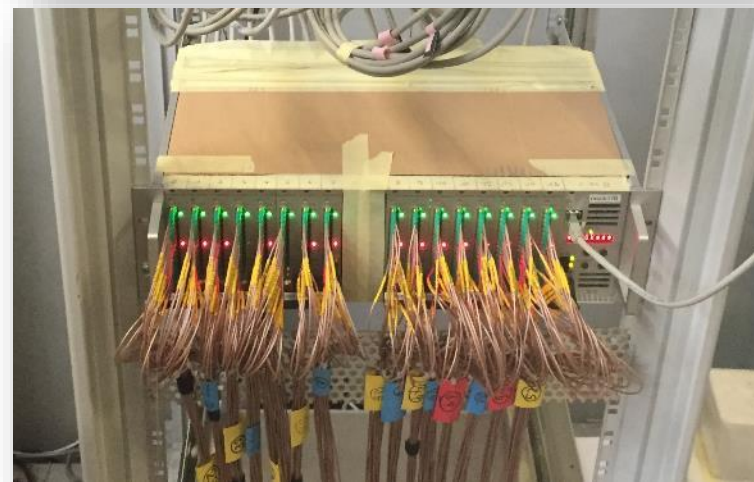
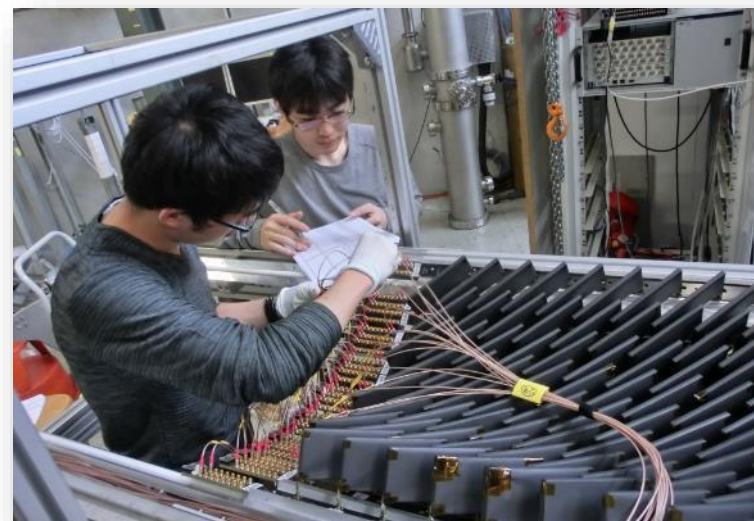
March 19, 2016
YUSUKE UCHIYAMA

Spectrometer installation

Pilot Run in 2015

We achieved

- Build $\frac{1}{4}$ detector
- Hardware works properly
 - ▣ NO dead channel
- Test Laser calibration system
 - ▣ Laser pulse distribution into 8 counters.
- Test MEG-II electronics system
 - ▣ Biasing OK, trigger works well.
 - ▣ Figured out **several problems** in readout system.
- Test counters in **MEG-II beam** (Dec.)
- ◆ Analysis of the data underway
 - 19pCA-11 – 3



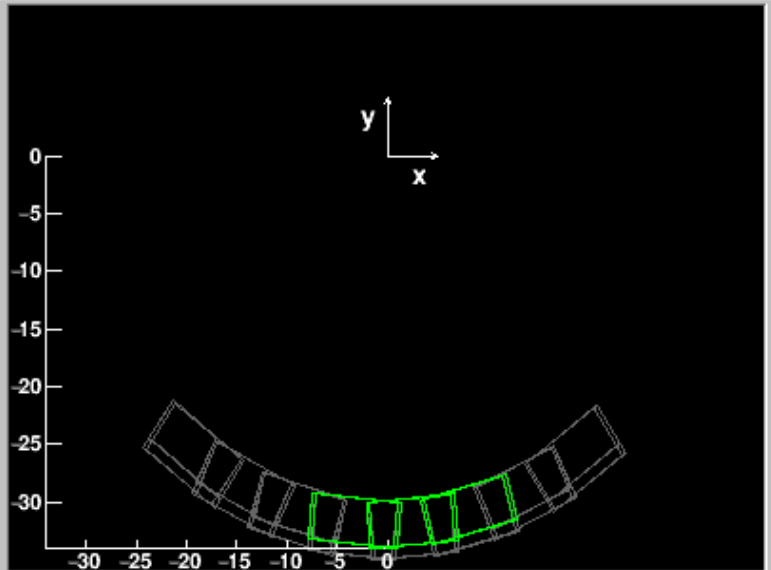
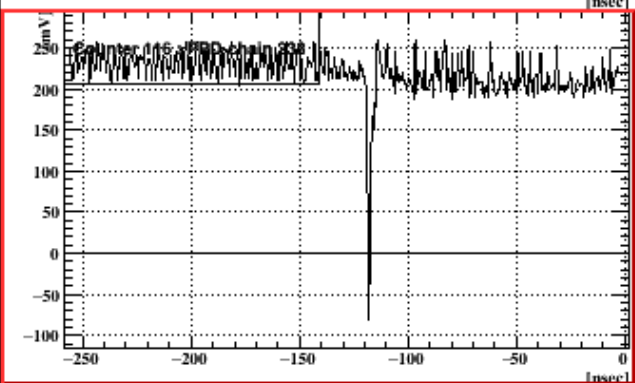
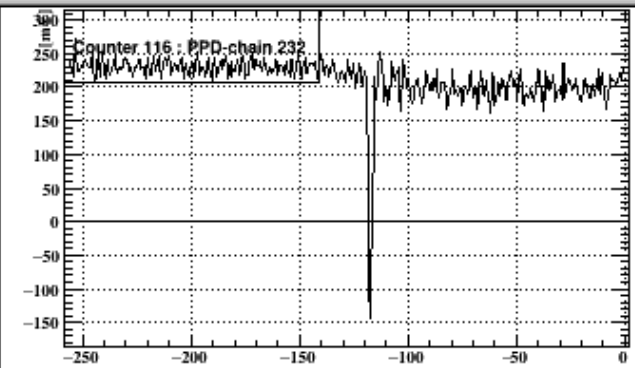
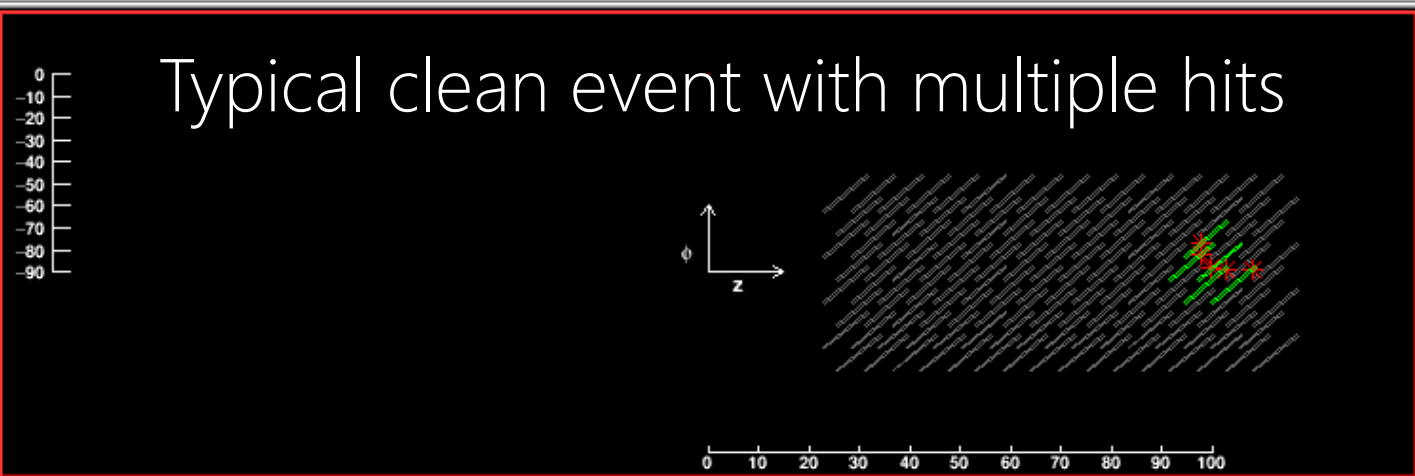
A 3U crate manages 256 channels

File



Run : 300327
 Event : 43
 Event step : 1
 Update period : 100
 Date : 2015-Dec-23
 Time : 02:05:03

- Monitor for trigger hit register
- SPX
 - SPX2D
 - SPX Waveform Monitor
 - OneDHit
 - SPXHitMonitor



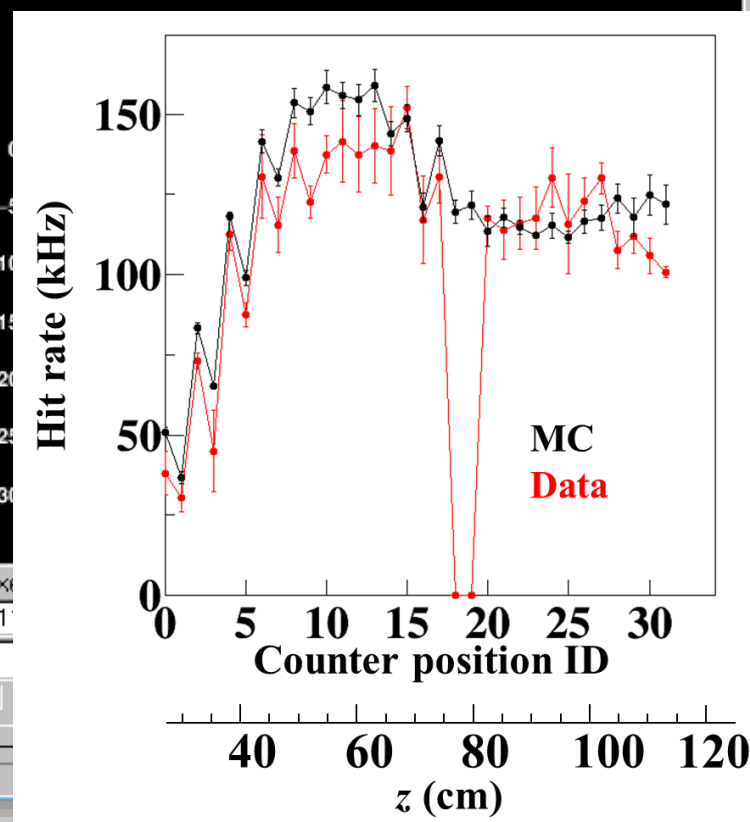
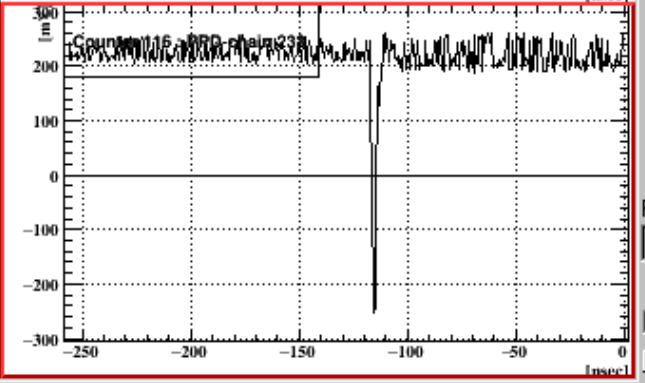
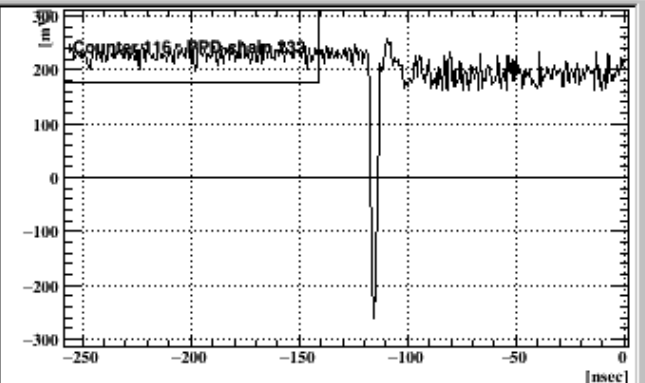
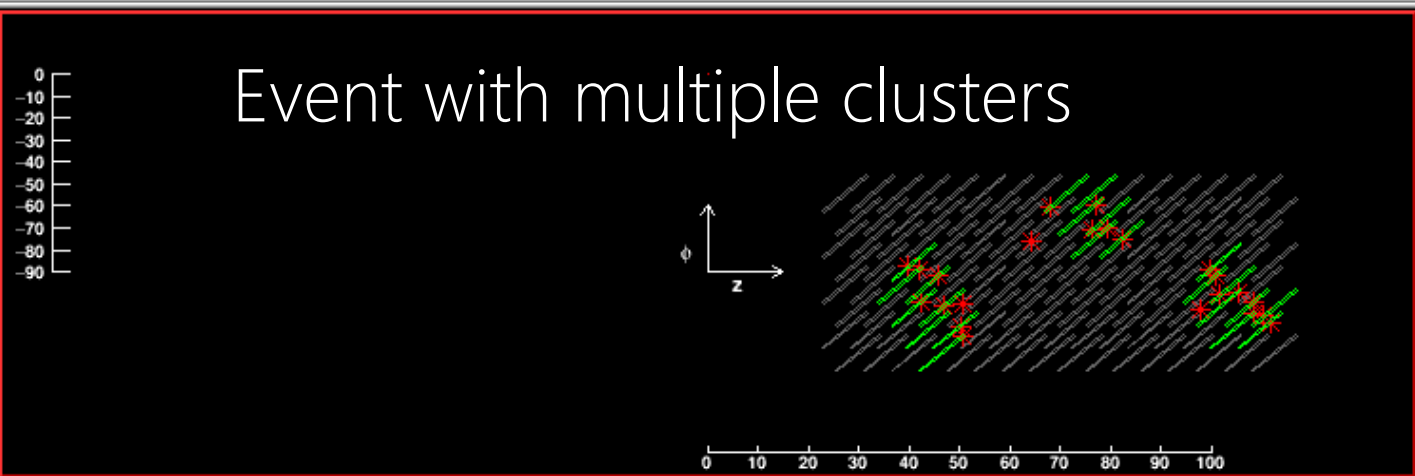
Pixel number with hit
 #116, 99, 108, 106, 107,

 Rec track MC hit MC track only e+



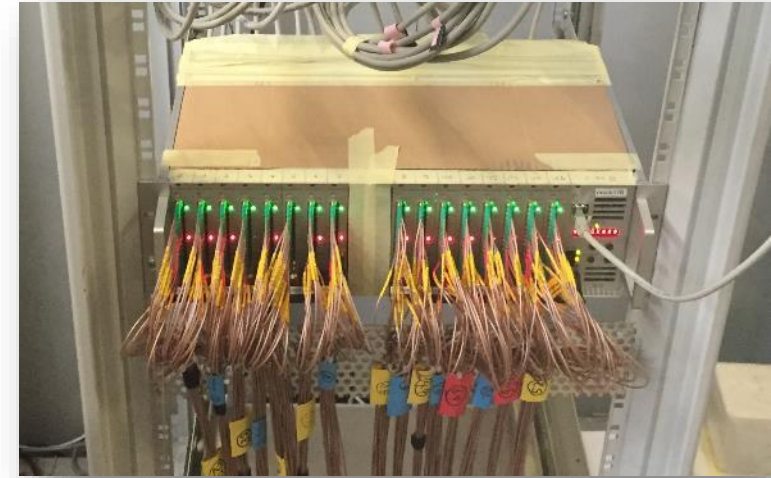
Run : 300327
 Event : 23
 Event step : 1
 Update period : 100
 Date : 2015-Dec-23
 Time : 02:05:01

- Monitor for trigger hit register
- SPX
 - SPX2D
 - SPX Waveform Monitor
 - OneDHit
 - SPXHitMonitor



Electronics problems

- WaveDAQ system
 - ▣ Multi-functional board
Amplifier, shaper, waveform digitizing, first level trigger & SiPM biasing.
 - ▣ First test in the pilot run.
- Confirmed several functionalities
 - ▣ Biasing & triggering works well
 - ▣ Basic waveform sampling succeeded.
- Figure out several problems
 - ▣ FPGA programming bug, mis cabling on board, lack of synchronization, missing calibration, and noise.
- → consequences
 - ▣ Data quality of the pilot run is not good.
 - ▣ Need intensive work to solve these problems before mass production
- Carry out another pilot run with modified electronics in June

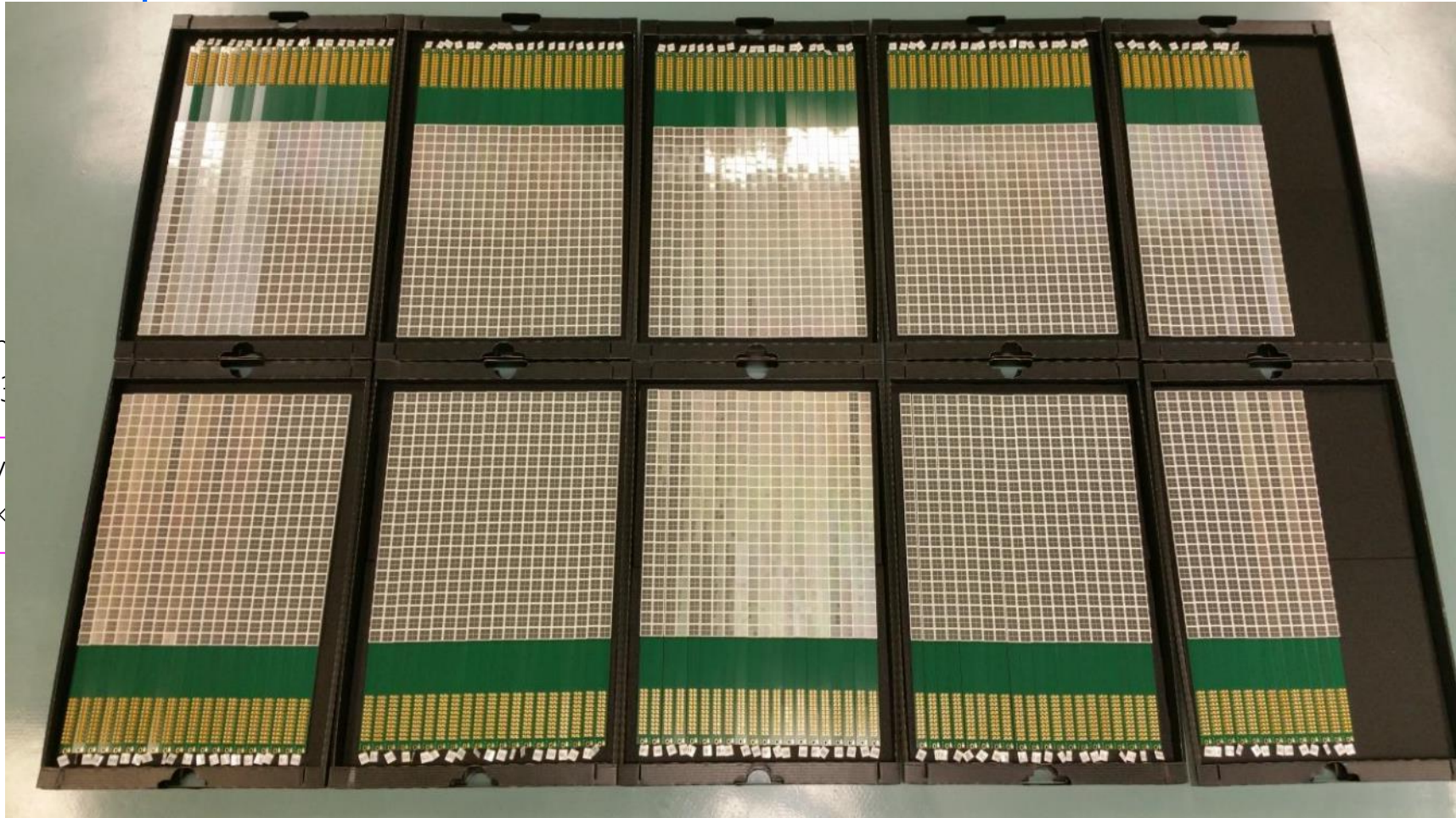


A 3U crate manages 256 channels

- Electronics development takes more than expected
- Before confirmation of all functionality, never order mass production.

Status of detector construction

LXe photon detector



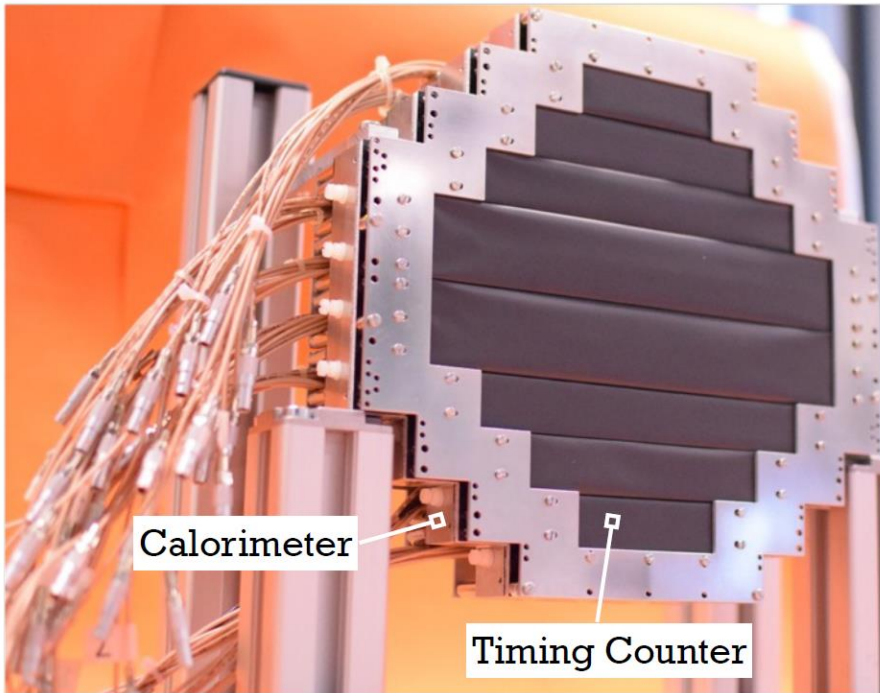
Norm
(3 × 3)

VUV
(12 × 12)

- 4092 MPPCs on 186 PCBs, ready for assembly.
- Assembled detector will be installed in the area in Jul.
- Test performance with 18-MeV γ line from $\text{Li}(p,\gamma)\text{Be}$ (C–W accel.)

22pAN-3-4

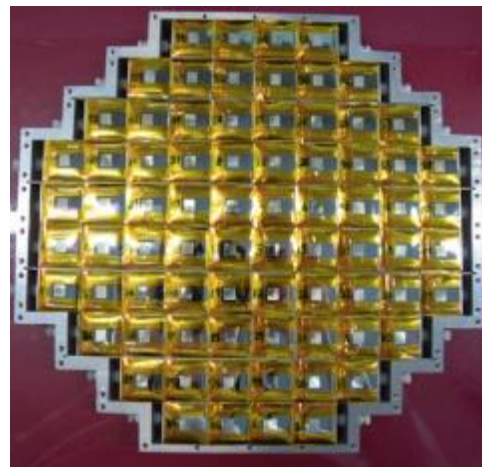
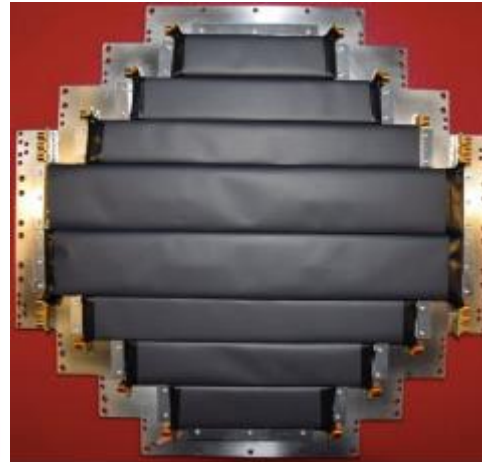
New BG-tagging detector (RDC)



Put on the beam axis to detect low-momentum e^+ from $\mu \rightarrow e \nu \nu \gamma$ to tag high-energy γ

Low momentum

High energy \rightarrow BG



- Downstream detector was constructed
- The functionality was tested with γ source (^{88}Y)
- Upstream detector (scintillating fiber) study pushed forward
 - ▣ Influence on beam was directly tested in the beam study period
 - ▣ Small impact \rightarrow positive for the adoption
- 19aAH-10-11

Target

- In pilot run 2015
 - ▣ 120- μm thick polyethylene target was used
 - ▣ with new target system implemented inside the DC inner wall

- ▣ The new target system impact on beam will be carefully checked this May

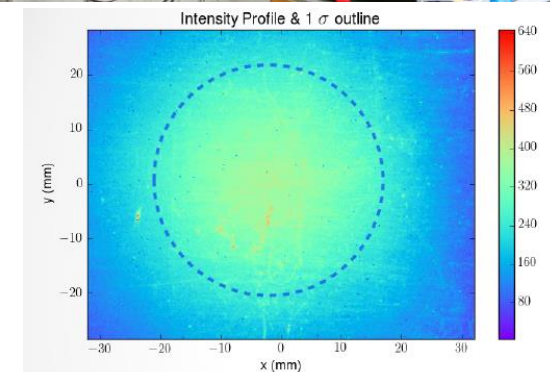
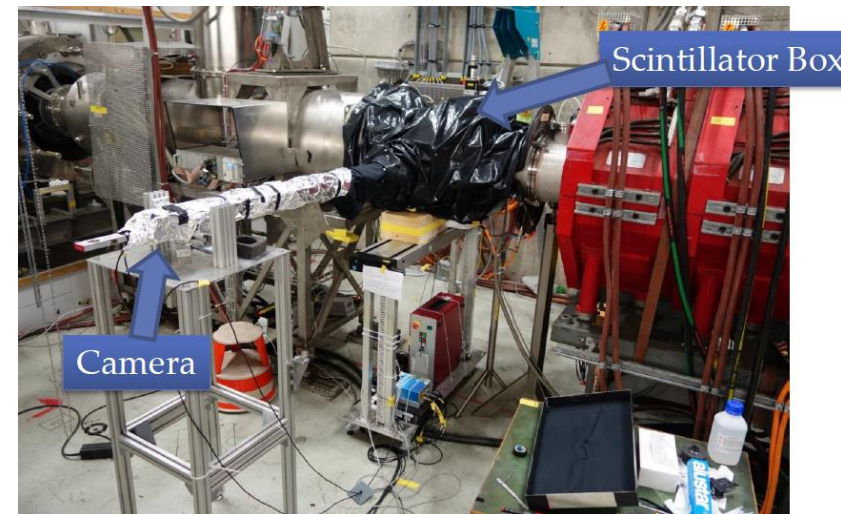
*Some beam transmittance loss observed last year.
Due to the target system, too close to beam axis?*

- In pilot run 2016
 - ▣ Scintillating sheet target* will be used (130- μm thick BC-400)

An alternative candidate as target

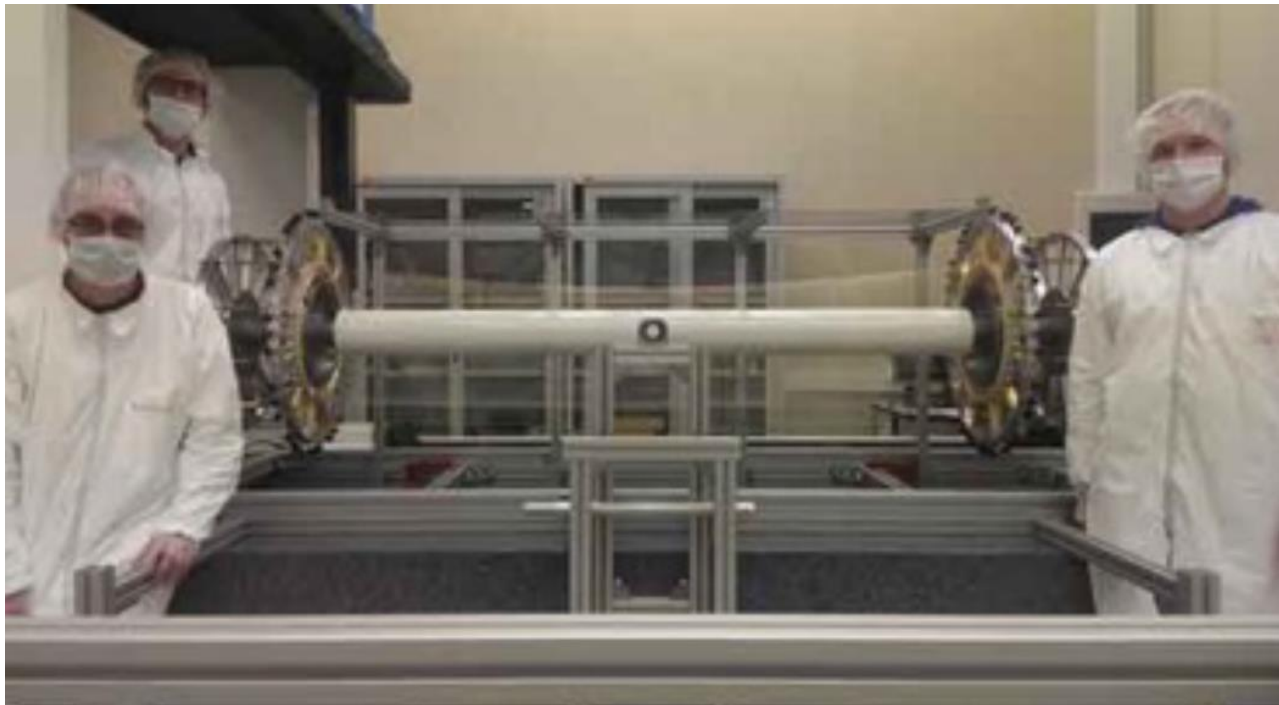
 - Mechanically more rigid
 - Allow online monitoring of beam center/profile and intensity
 - ▣ Preliminary study done in 2015 shows a good result

* This is not an “Active target” with event-by-event reconstructing power



Drift chamber

- 2-m long stereo-wire drift chamber
 - ▣ completely new system for MEG II
- Wiring on going
 - ▣ 4 frames / day. 468 frames necessary.
 - ▣ To be continued till Aug.
- However, an incident happened.

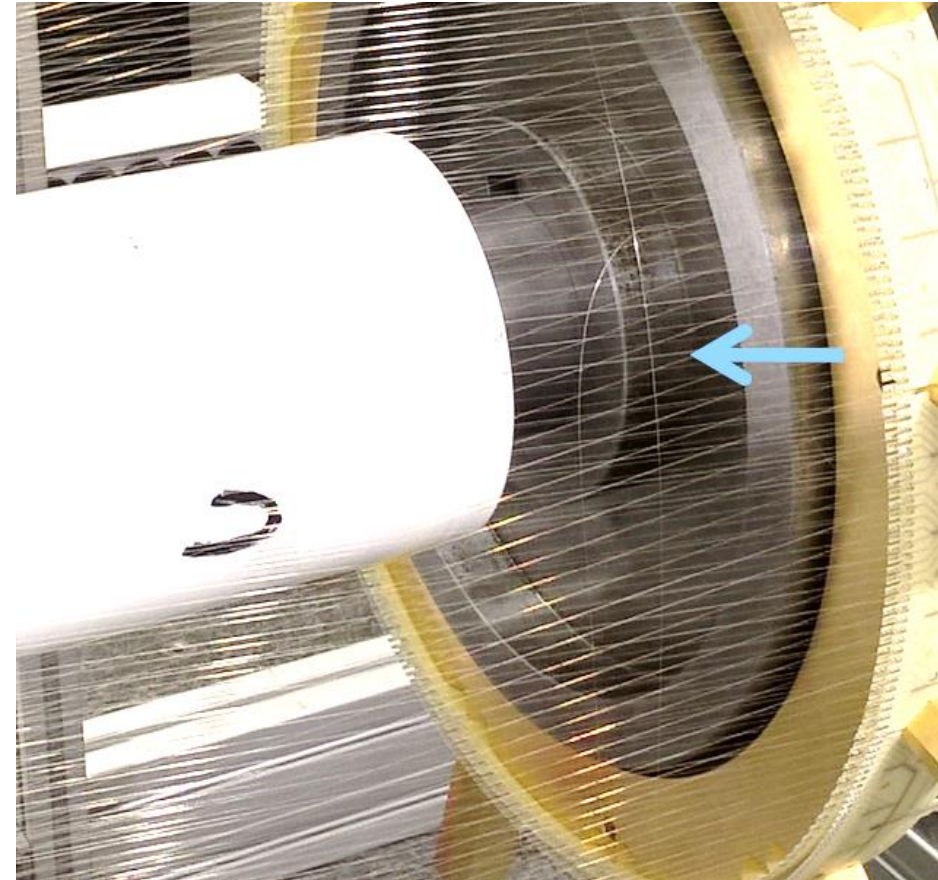


YUSUKE UCHIYAMA

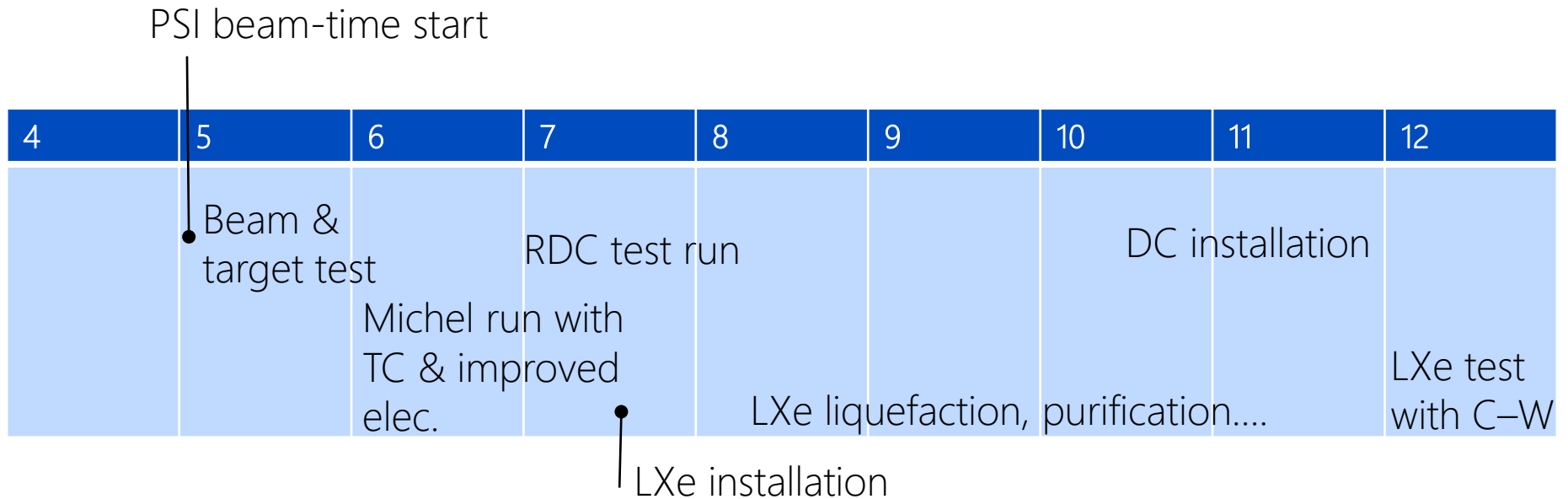


Wire break

- On 8/Mar, during an elongation test (to nominal length)
- 13 50 μ m guard wires broke.
 - ▣ Later, other 4 guard wires + 1 cathode wire broke
- Deep investigation is on going
 - ▣ So far, no clear reasons found
 - ▣ From the geometrical viewpoint, it is not possible.
- Due to this incident, wiring is now stopped.

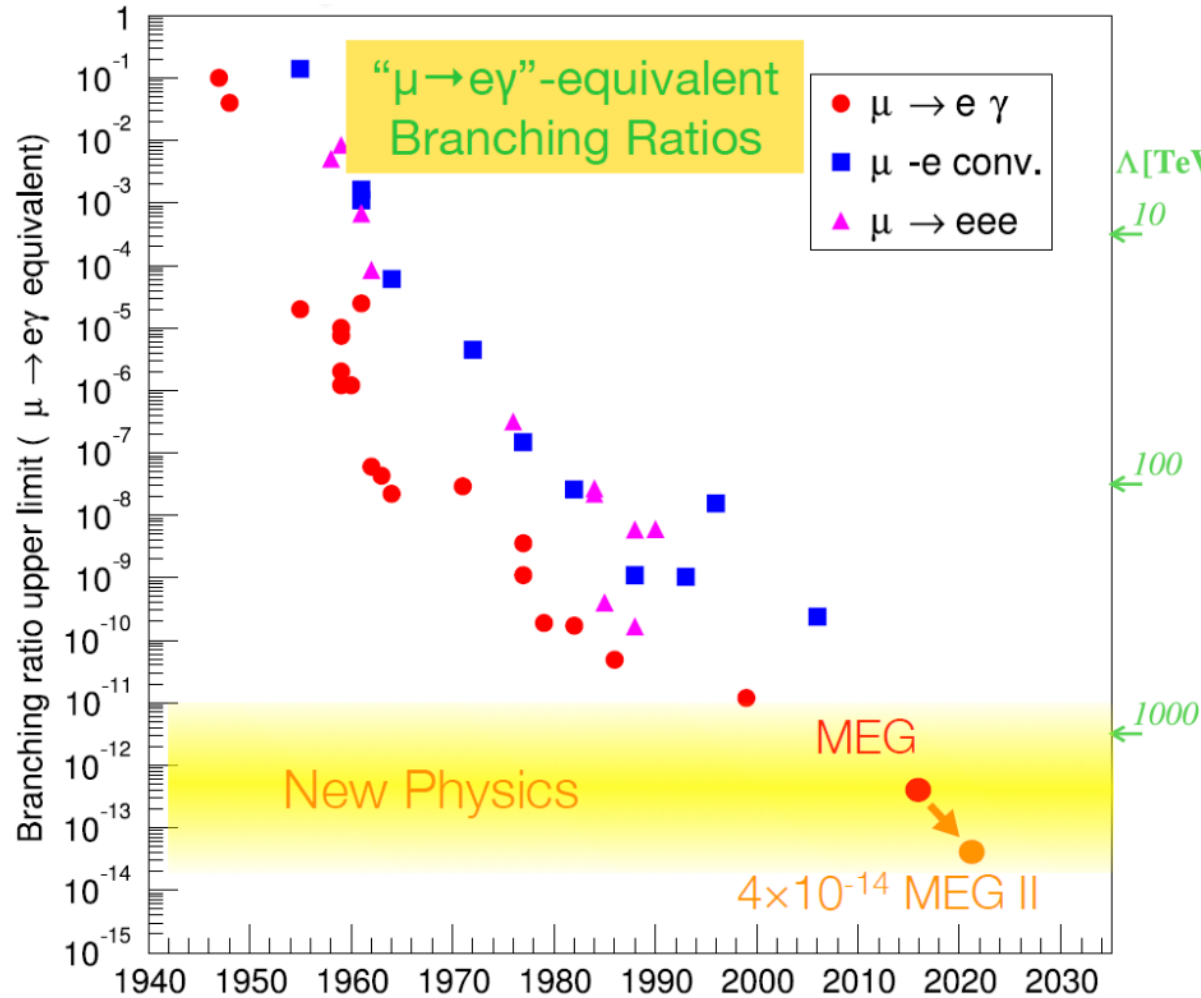


Schedule



- Another pilot run (with TC, RDC, & modified elec.) is planned in Jun–Jul
- Full detector system will be ready in the end of this year.
- Engineering run in 2017 with full elec. → physics run

Summary



- An important step was made in 2015
- First pilot run with beam – TC – elec – Trigger/DAQ of MEG II
- Detector construction progresses
- Important issues were figured out to be addressed before the full MEG II run in 2017

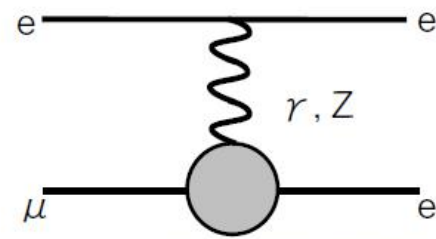
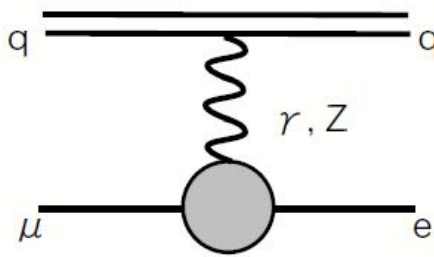
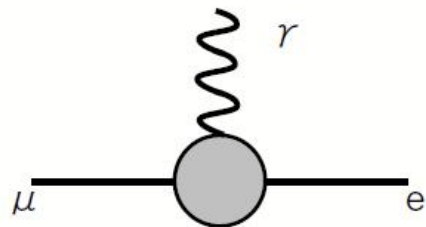
Muon cLFV Sensitivity Comparisons

$$\mu \rightarrow e\gamma$$

$$\mu N \rightarrow eN$$

$$\mu \rightarrow 3e$$

“dipole”
dominant
(SUSY etc)



$$1 \quad : \quad 1/390 \quad : \quad 1/170$$

$$\text{BR} = 4 \times 10^{-14} \quad : \quad 1 \times 10^{-16} \quad : \quad 2 \times 10^{-16}$$

~MEG II goal

for Al target