

$\mu^+ \rightarrow e^+ \gamma$ 探索実験 MEG II の準備状況

(Status of the MEG II experiment
searching for $\mu^+ \rightarrow e^+ \gamma$)

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他 MEG II collaboration

Abstract

1. **MEG II** is upgrade of MEG experiment, searching for $\mu \rightarrow e\gamma$
2. All the detectors are now under construction
3. To carry out a **'pre'-engineering run in 2015**
4. Toward start of data taking in 2016

Next $\mu \rightarrow e\gamma$ Experiment

- **Aim at sensitivity of $O(10^{-14})$**
 - x10 improvement from MEG
- **By exploiting the full beam power available today,**
 - $\sim 10^8 \mu^+/\text{s}$ at PSI $\pi E5$
- **By upgrading the MEG detector**
 - Keep experimental concept
 - in short (~ 5 years), at low cost

MEG II Experiment

MEG II

Keep 3 keys of MEG

1. World's most intense DC μ beam @ PSI
2. Innovative liquid xenon γ -ray detector
3. Gradient B-field e^+ -spectrometer

Double beam intensity,
Double efficiency,
Suppress BG factor ~ 30
● Halve every resolution,
● Add new detector to
identify BG

Where We Will Be

4×10^{-14} 500

2012	Start the project. Conceptual designing. Submit the proposal to PSI
2013	Proposal approval.
2014	R&D Construction partially start.
2015	Detector construction. Detector commissioning. Pre-engineering run.
2016	Full engineering run. Data taking.
2017,2018	

$\times 10^5$ sensitivity
MEG1
DAQ

Upgraded MEG

2008

2010

2012+2013

2017

2.4×10^{-12}

375

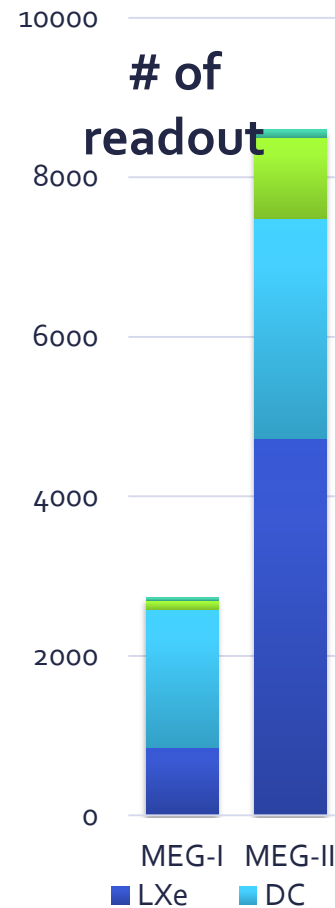
250

125

k factor
($\times 10^{11}$)

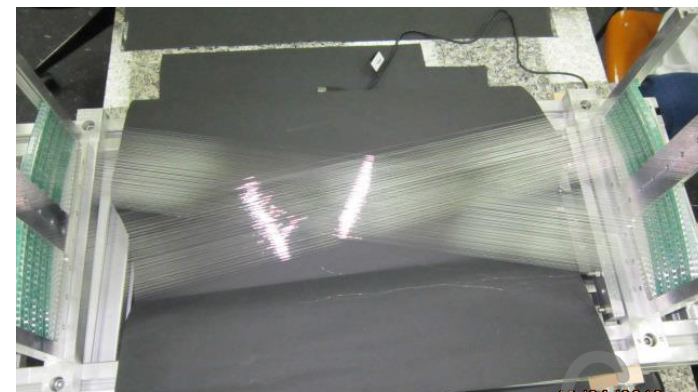
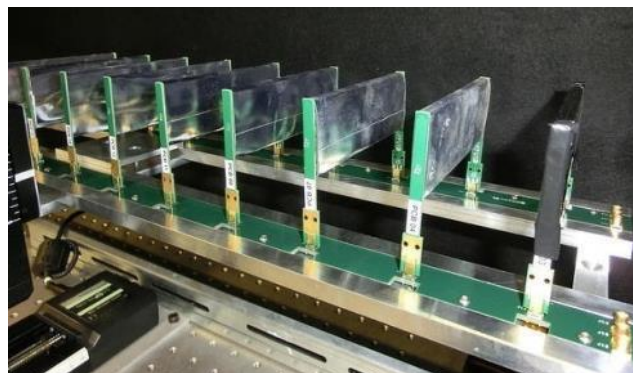
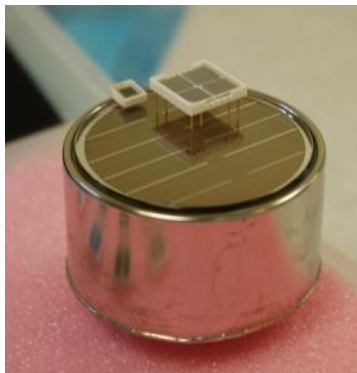
0 5

Detector technologies



- **Large-area VUV sensitive SiPM**
 - for the world's largest LXe detector. (wavelength 175 nm)
- **30 ps precision time measurement**
 - with fast plastic scinti. & SiPMs
- **Low mass long stereo-wire drift chamber**
 - $0.0017 X_0$ for a particle
- **Compact, dense DAQ system**
 - To deal with increased channels
 - Waveform digitizer & first trigger step in a same board

Prototypes

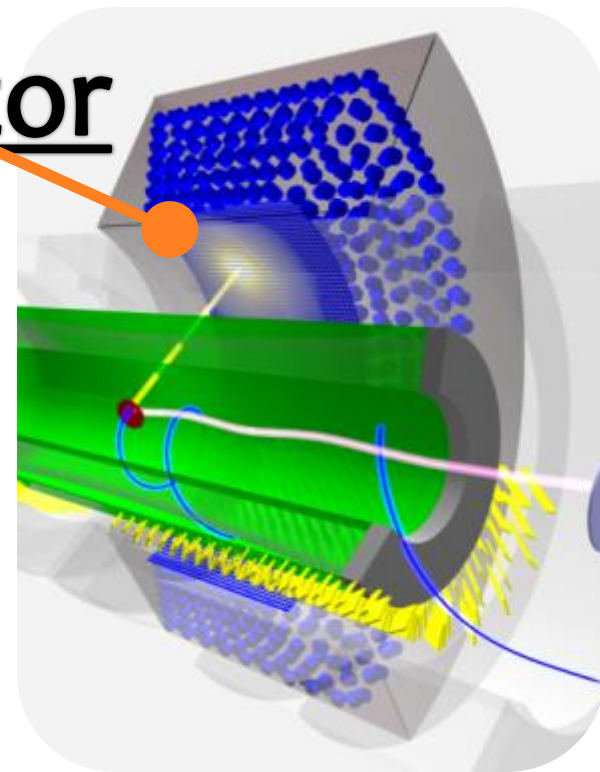


LXe γ -ray detector

- Large area VUV-MPPC development completed

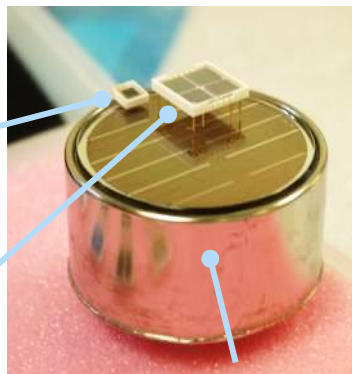
- >15% PDE achieved
- 600 prototypes test in LXe performed
- Final model (w/ cross-talk suppression) successfully tested.

- Final MPPCs (>4000) are about to be delivered.

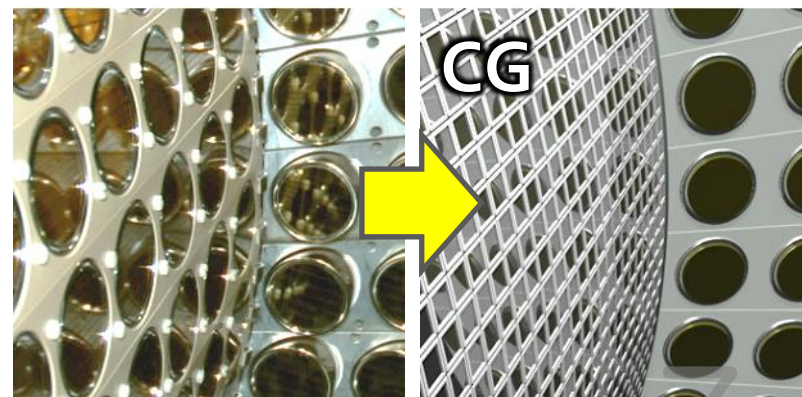


Normal MPPC
(3×3 mm²)

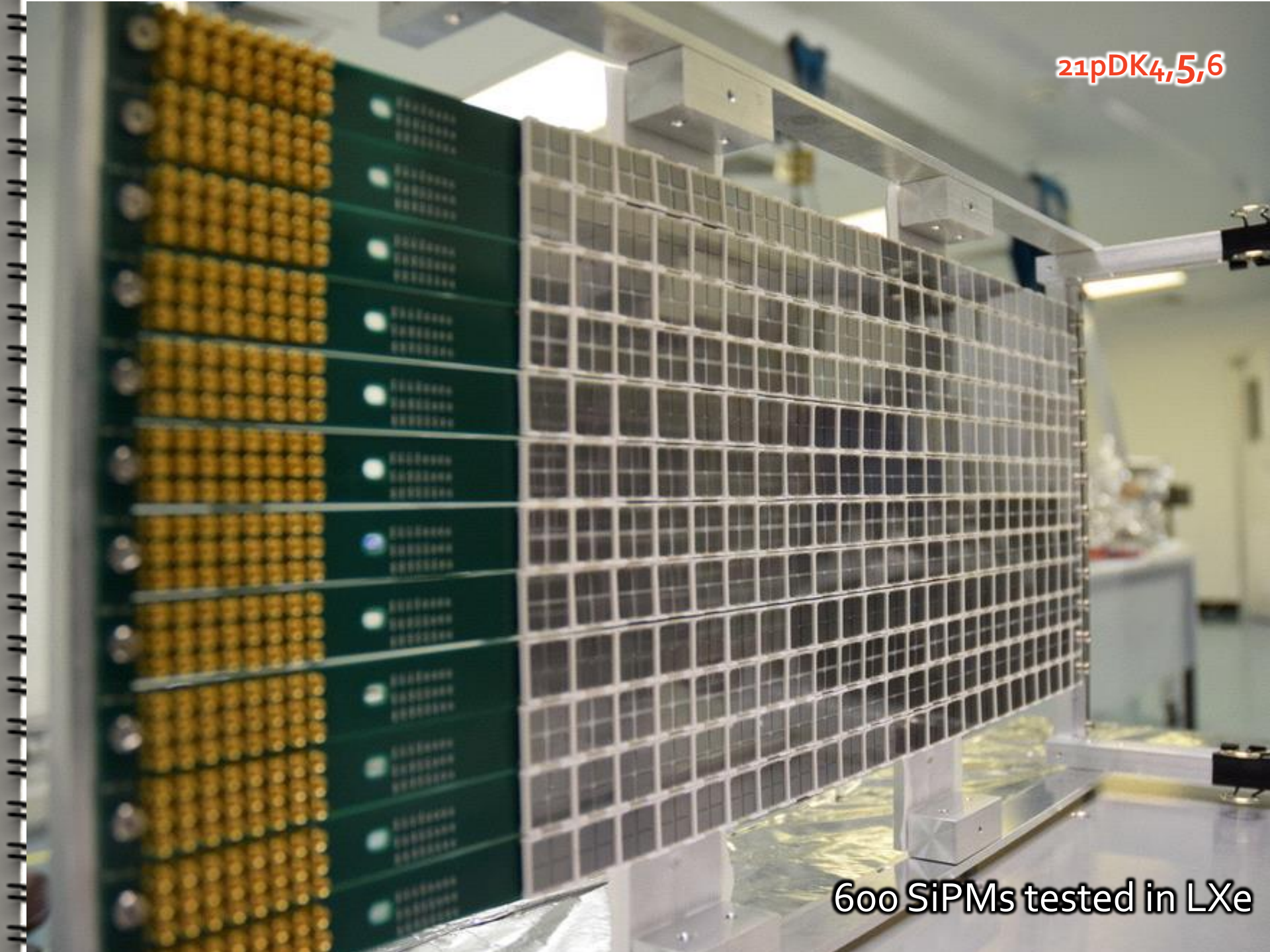
VUV MPPC
(12×12 mm²)



2" LXe PMT



21pDK4,5,6



600 SiPMs tested in LXe

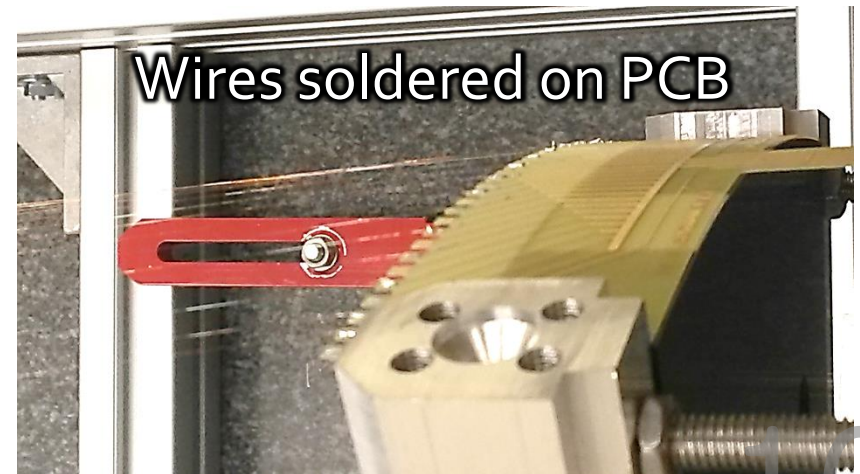
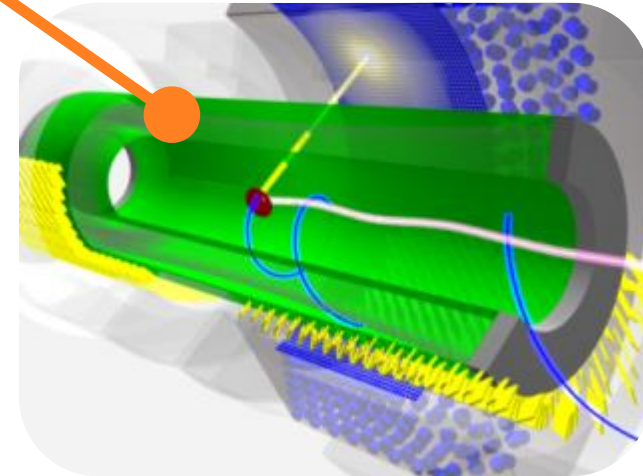
- This year, concentrate on the construction
- Assembled detector will move to the experiment site in Sep.
- Installation & commissioning in Sep-Dec.
 - Liquefaction
 - Signal test with limited readout channels
- Purification, calibration continued until summer 2016

Present detector status



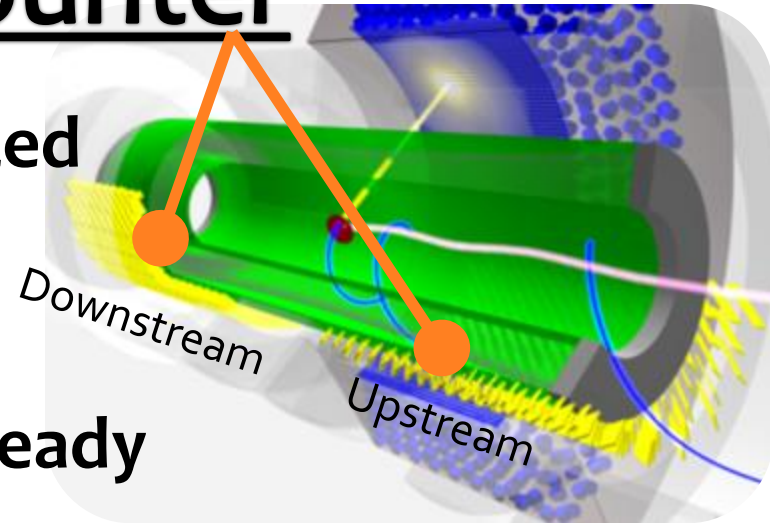
New drift chamber

- All material procurement done.
- Wiring will be started soon.
- Full chamber will be delivered to PSI by March 2016.
- Partially wired **'mock-up chamber'** will be delivered to PSI by July this year
 - with HV & gas system
 - for mechanical integration & operation test



Pixelated timing counter

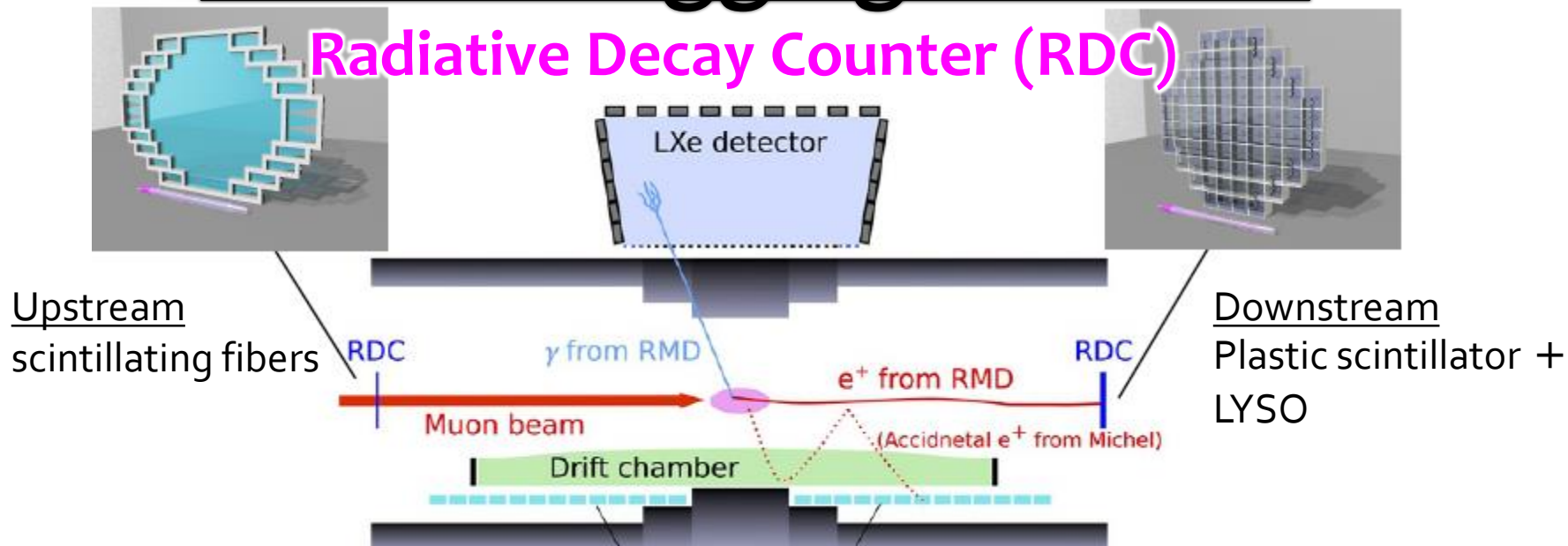
- **~30 ps** resolution demonstrated under MEG-II condition.
- 6000 SiPMs were delivered.
- Downstream system will be ready by Sep. this year.



Structure under construction



New BG tagging detector

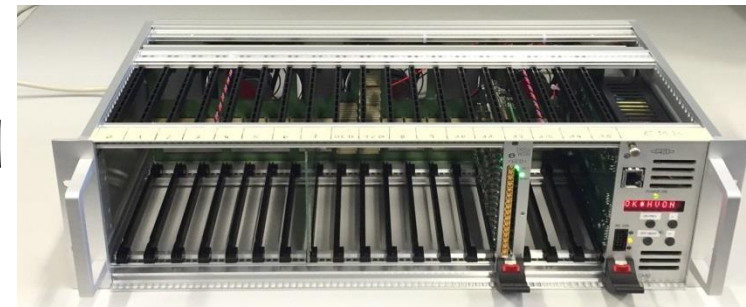
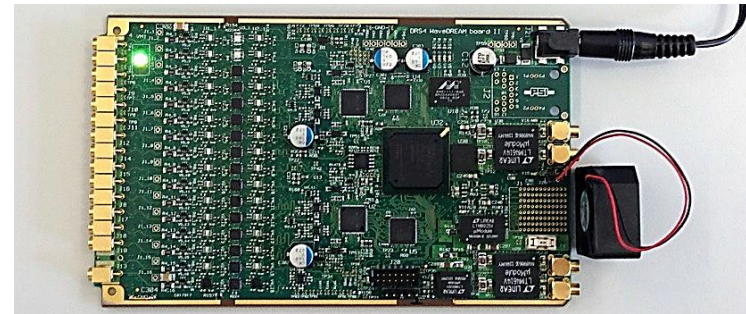


- **Optional detector, new for MEG II**
 - To actively tag BG from $\mu \rightarrow e\nu\bar{\nu}\gamma$
- **Downstream detector was approved by the collaboration, giving 16% higher sensitivity**
 - Construct by this summer. Production has been started.
- **Need more study for the upstream detector**
 - effect on the beam transportation
 - Test it in this year's beam commissioning.



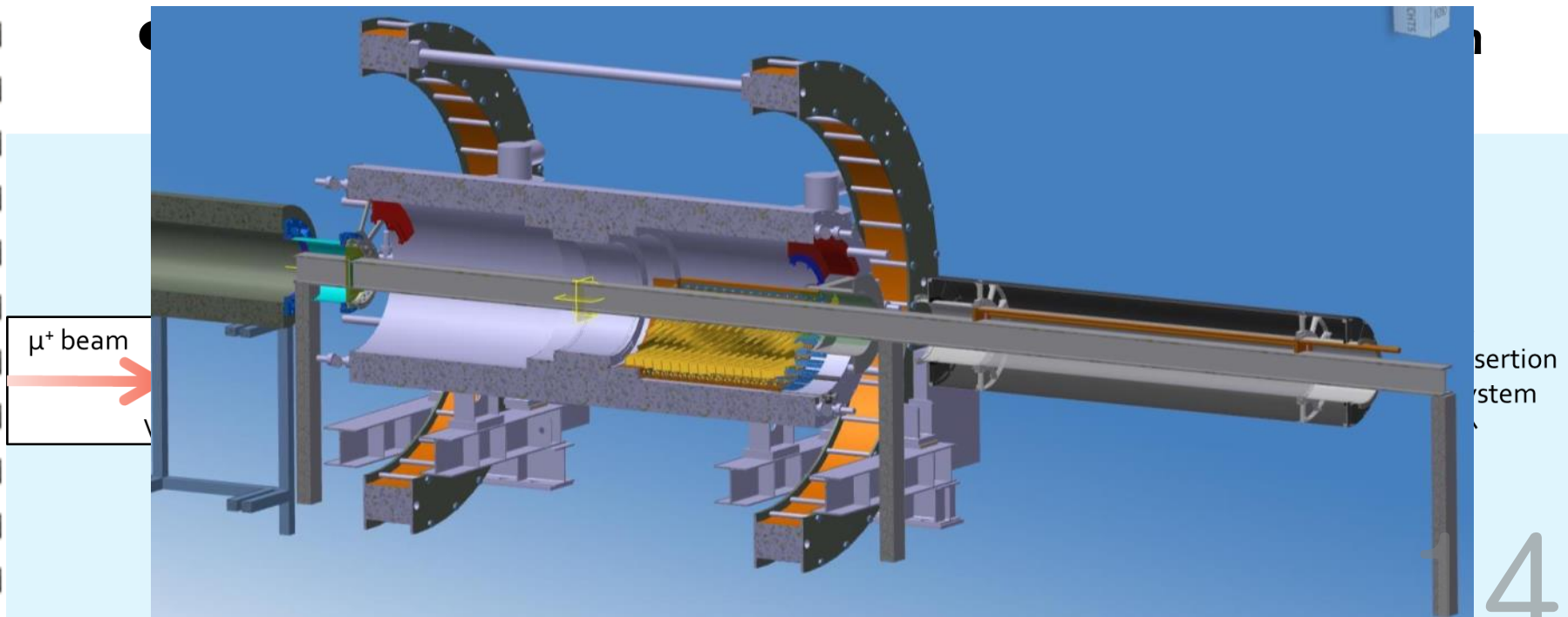
Electronics, DAQ

- **Innovative solution for Trigger & DAQ**
 - Waveform digitizer, frontend circuit, HV supply, 1st level trigger on a board
- **Prototype board under test**
 - Frontend circuit was tested with detector signal
- **First full crate (256 ch) available by Oct. this year**
 - tested in the pre-engineering run
- **Mass production will be started after the test**
- **Complete system ready by spring 2016**



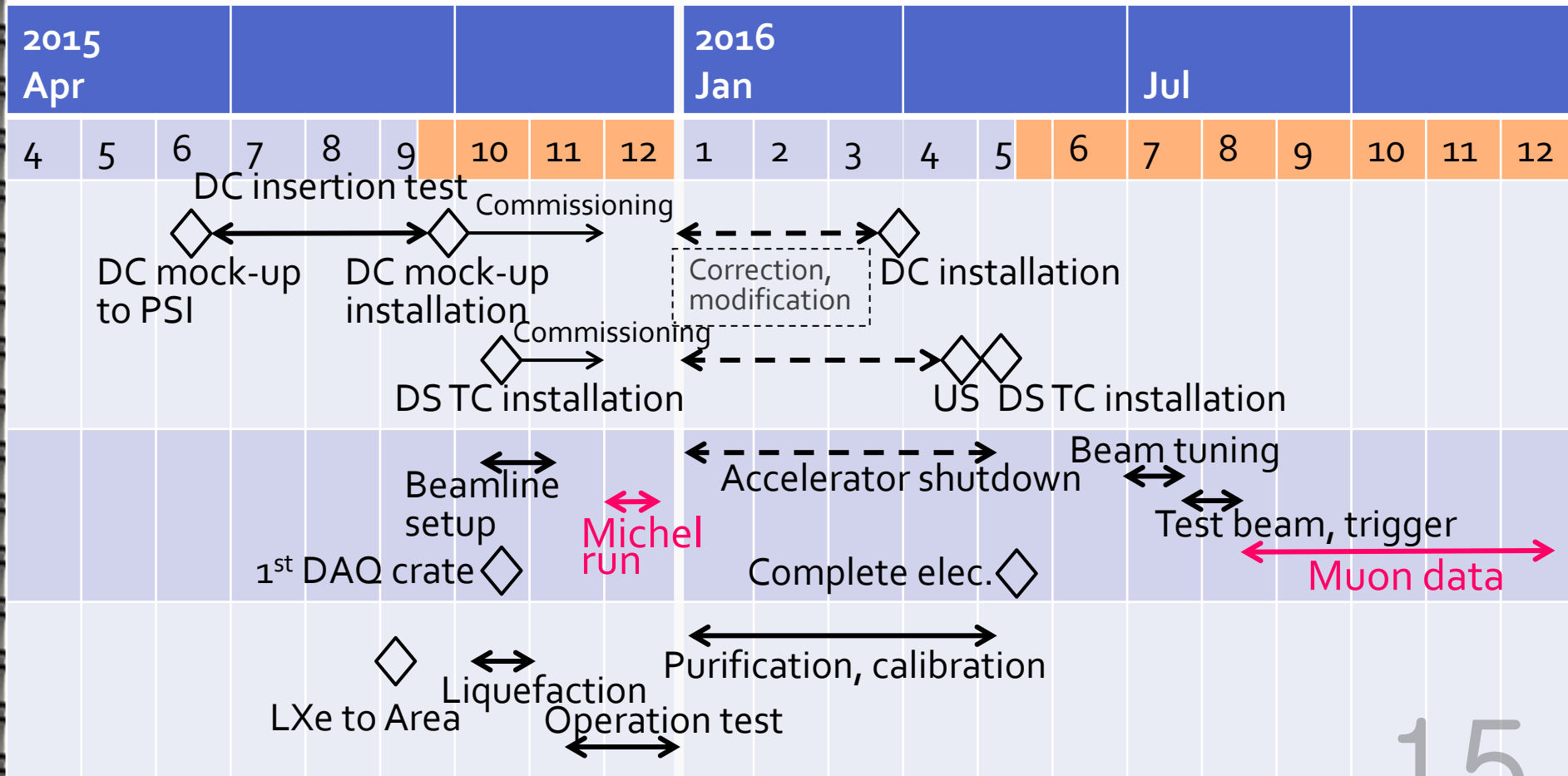
Goal of 2015

- Check the **mechanical integrity & functionality** of the MEG II upgrade design
- Enable design corrections & modifications well before Engineering run in 2016
- Enable beam optimization & setup of new target & test of US RDC principle



Schedule

- 2015 Beam time granted : 12.5 (+1.5 provisional) weeks
 - from mid. or end of Sep.

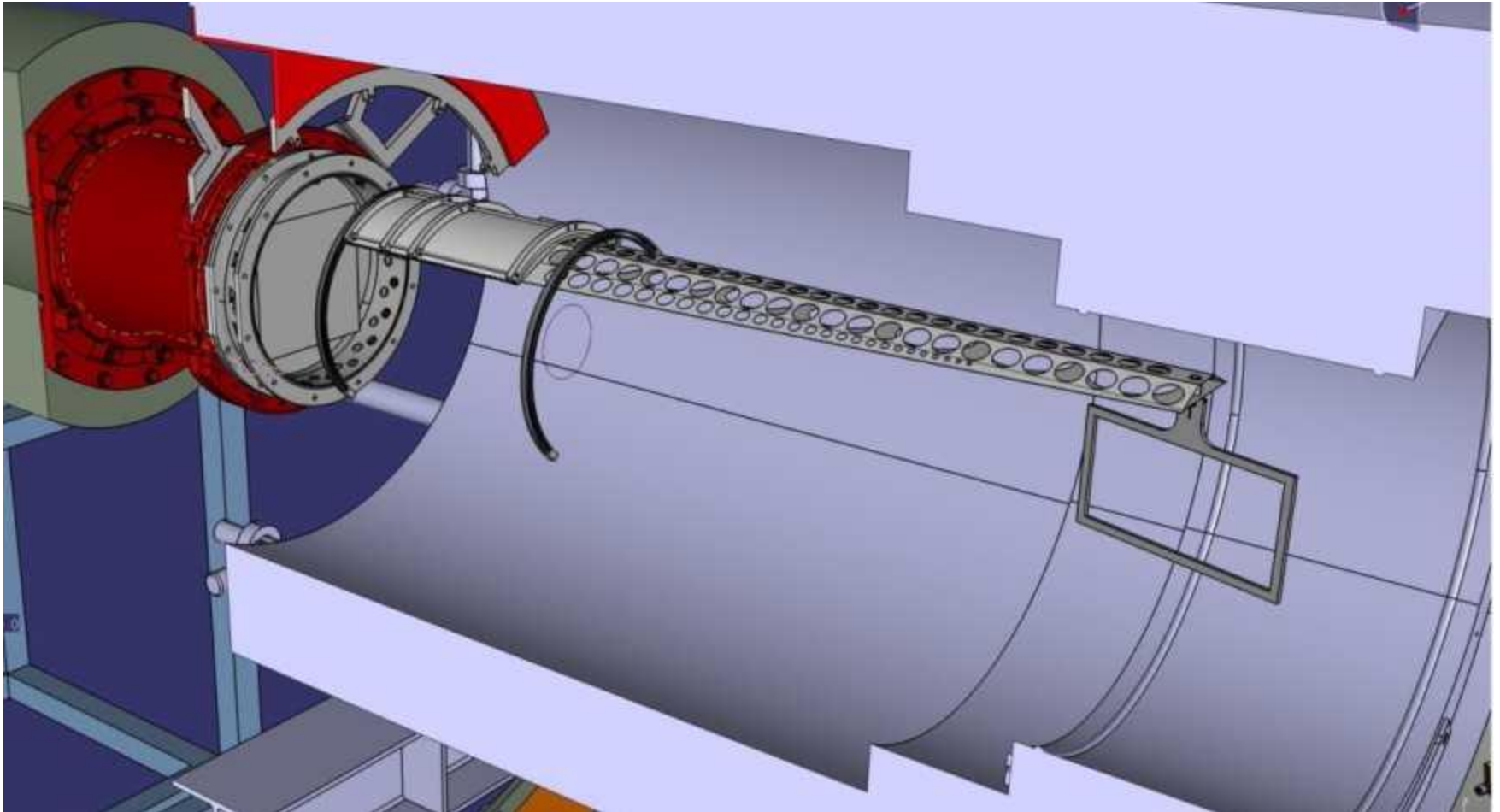


Conclusion

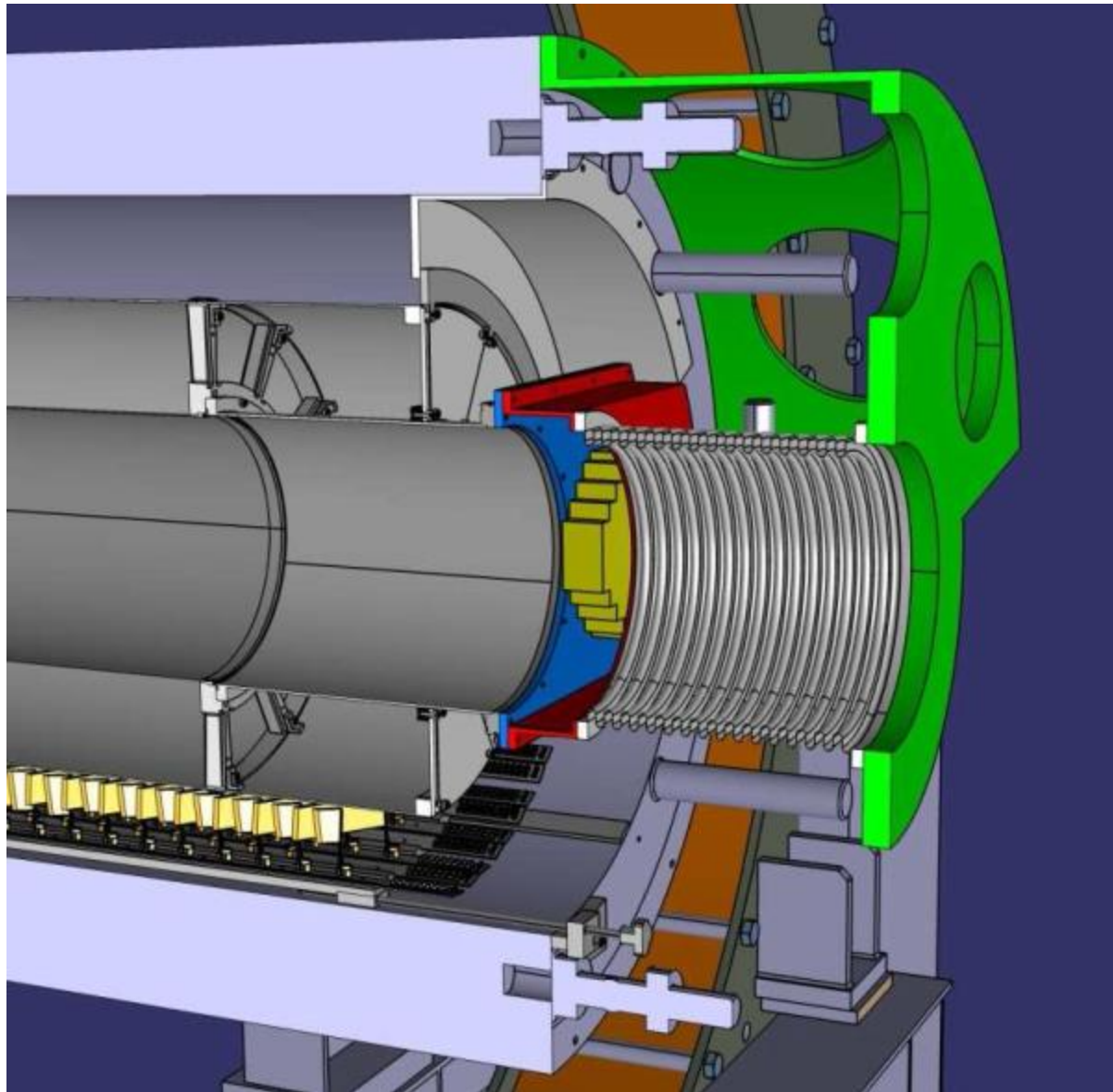
- **A very important step for MEG II realization foreseen this year**
 - All the detectors are now under construction
 - We plan to carry out a ‘pre’-engineering run in autumn–winter
 - ✓ Test mechanical integrity
 - ✓ Test all the detector signal with limited electronics
 - ✓ Carry out Michel run with a Timing Counter

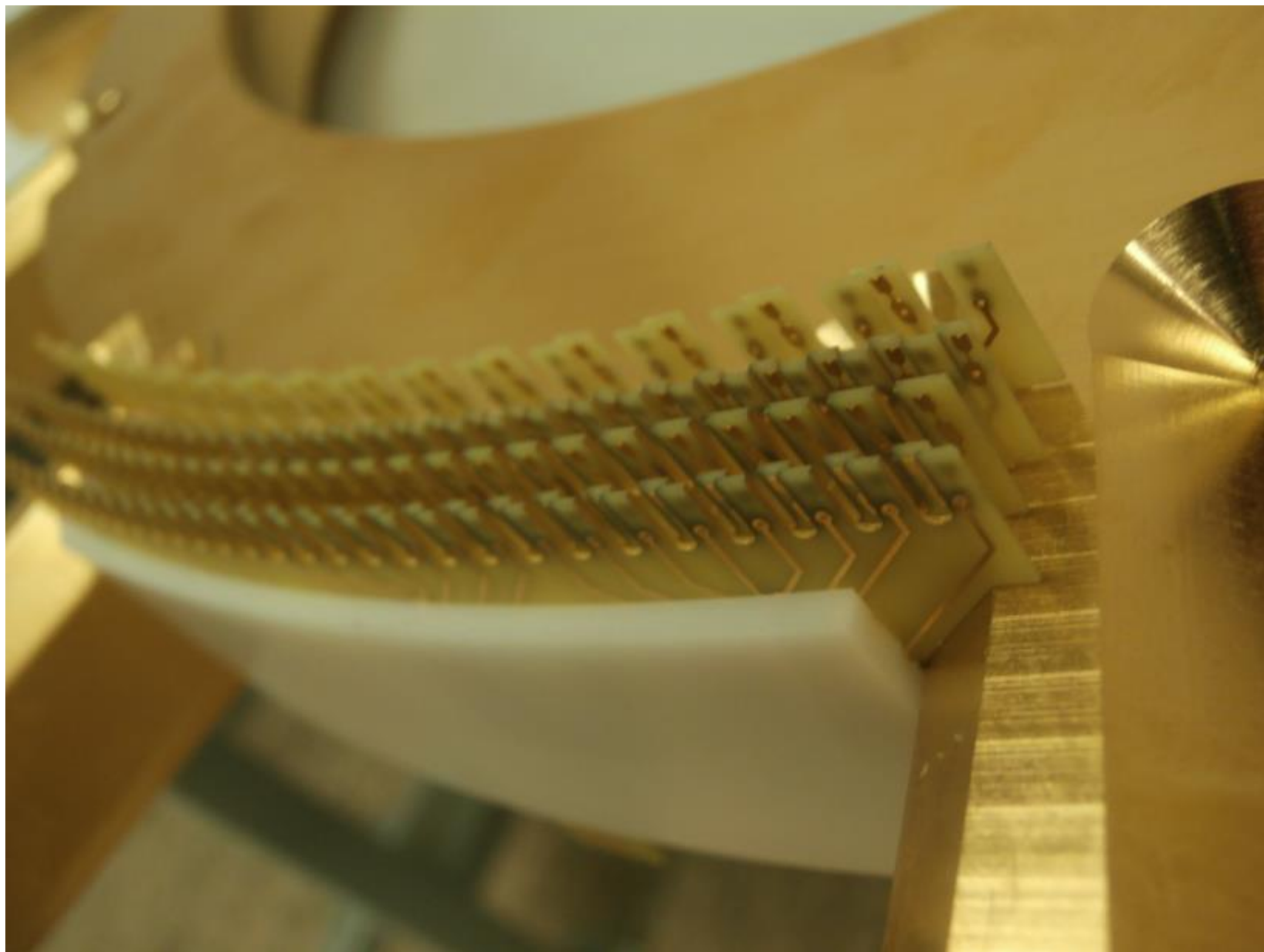
- **Toward data-taking started in 2016**

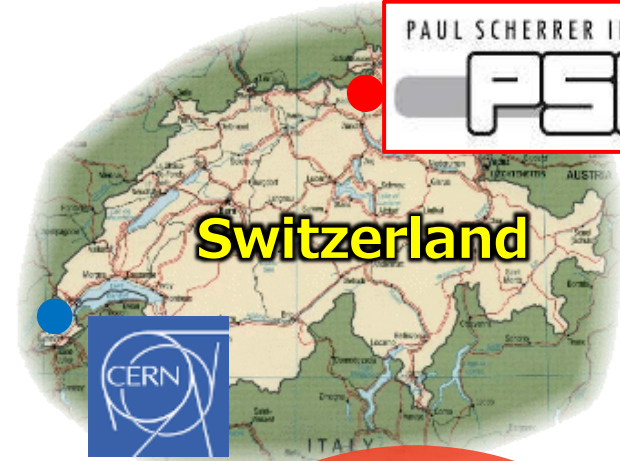
Target system



Downstream end-cap







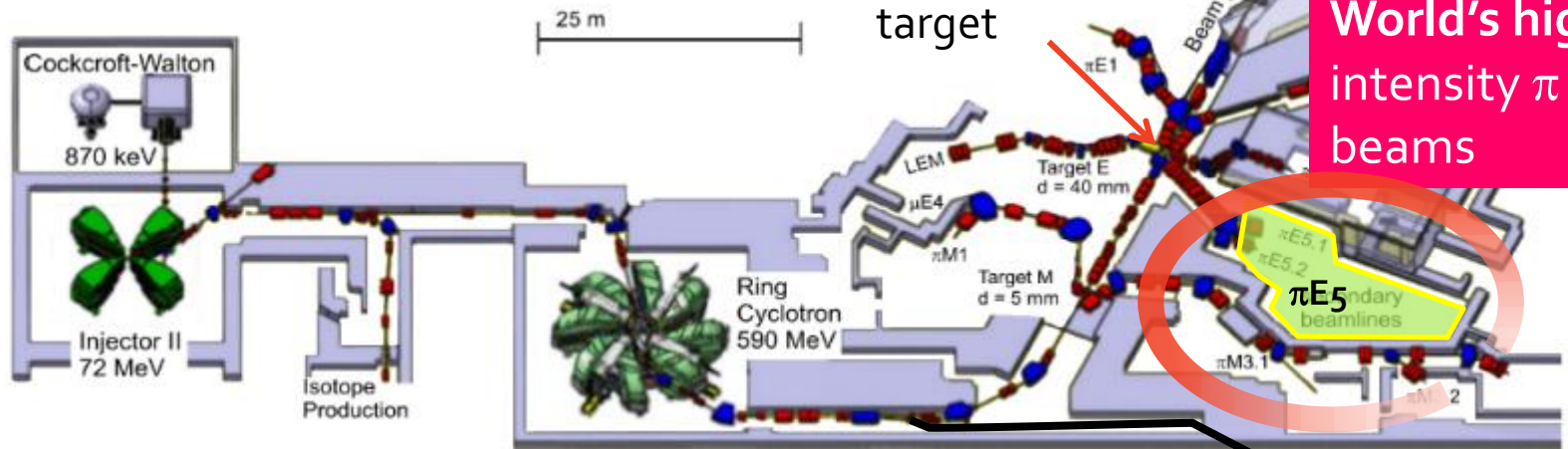
Switzerland

- Paul Scherrer Institut

World's most powerful proton beam to targets:

$$590 \text{ MeV} \times 2.4 \text{ mA} = 1.4 \text{ MW}$$

Proton accelerator complex



World's highest intensity π & μ beams

To UCN source