



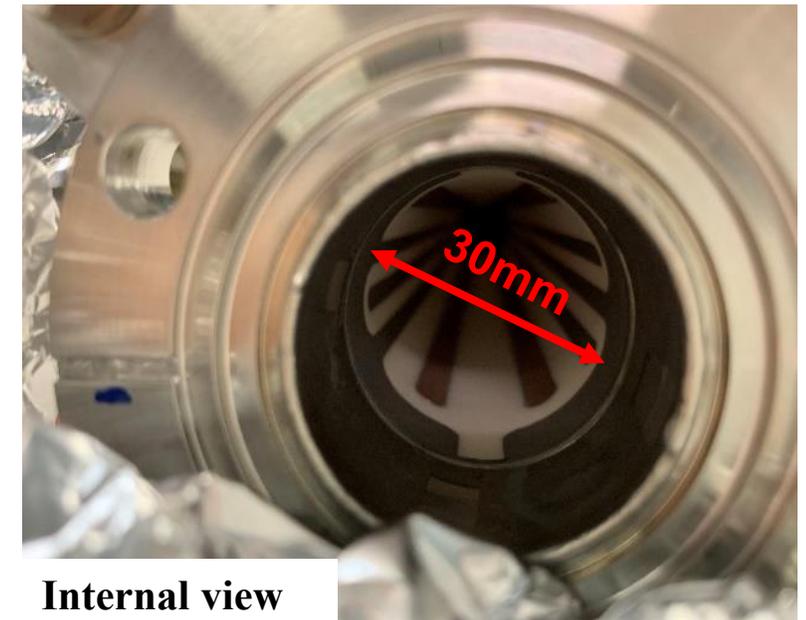
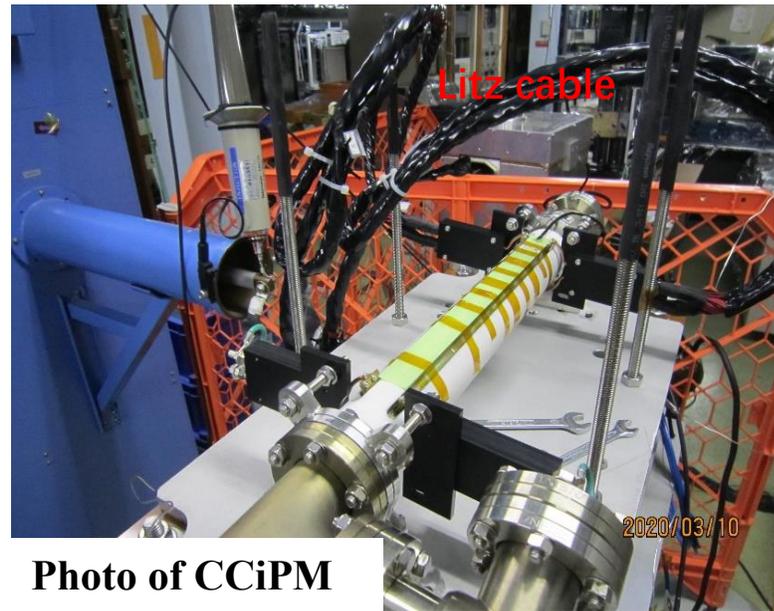
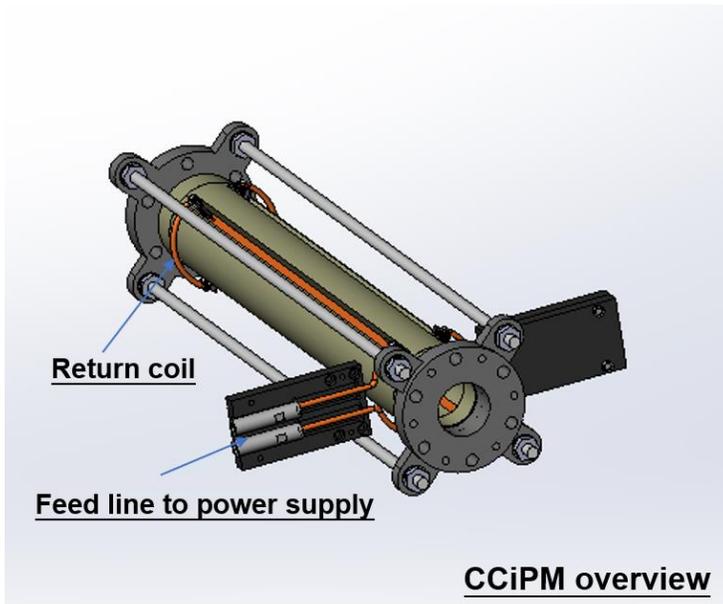
# Magnetic Field Measurement and Beam Performance Test of Ceramics Chamber with Integrated Pulsed Magnet at KEK~PF

Y. Lu(SOKENDAI), C. Mitsuda, H. Takaki, T. Obina, K. Harada, R. Takai,  
Y. Kobayashi, T. Nogami, T. Uchiyama, S. Nagahashi, A. Ueda(KEK)

[yaolu@post.kek.jp](mailto:yaolu@post.kek.jp)

2021/05/25

# Brief introduction about CCIpM-D30



**Ceramics Chamber with integrated Pulsed magnet(CCIpM) is an air-core type magnet. We expect that it could have strong magnetic field and high repetition rate. And some advantages are listed as follows:**

- Low impedance
- Compact and Light
- Eddy current effects are suppressed

**To examine whether it could be installed in a future light source, some offline experiments were performed. And later it's installed at the BT-line to have a beam test to evaluate the kick effect.**

# Offline experiments before beam test

## ① Baking(heat cycle) and vacuum extraction

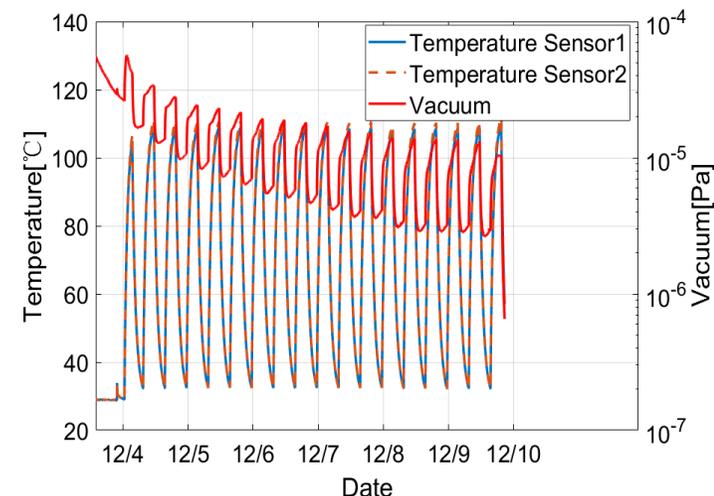
- There is no leakage during baking which continued for 1 month.
- Vacuum reached  $3 \cdot 10^{-8}$ [Pa] in the end.

## ② excitation experiment to test the endurance of high voltage

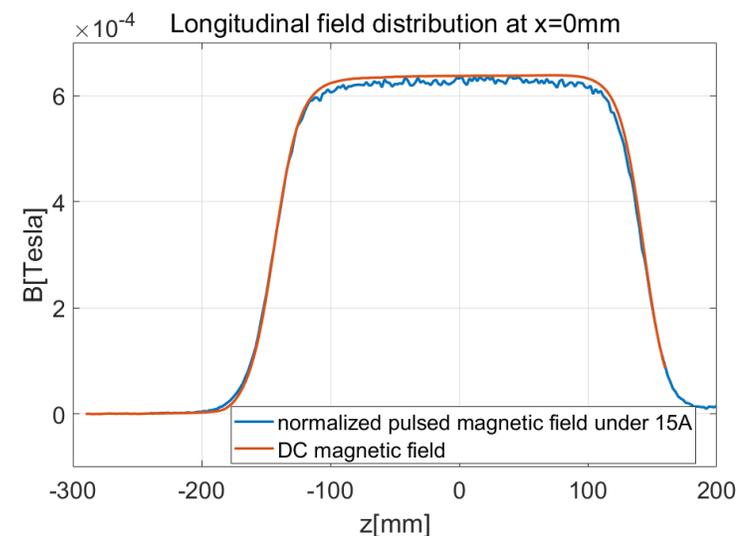
- Current could reach more than 3000A with a  $3\mu\text{s}$  pulse width.
- No electric discharge.

## ③ Magnetic field measurement

- Both DC and pulsed magnetic field are measured.
- Eddy current is negligible because the maximum difference between normalized pulsed magnetic field and DC magnetic field is less than 4%.
- The kick effect calculated from offline measurement will be compared with that in beam test.

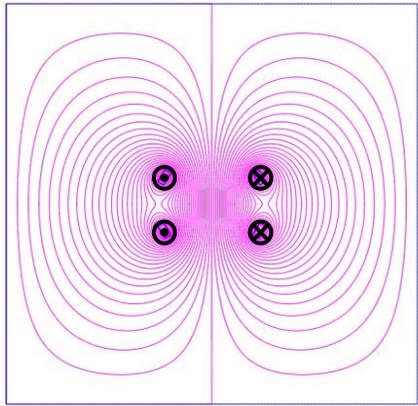


Curve of baking condition(Record for one period)

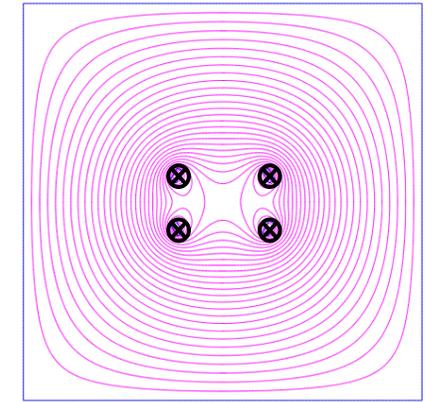
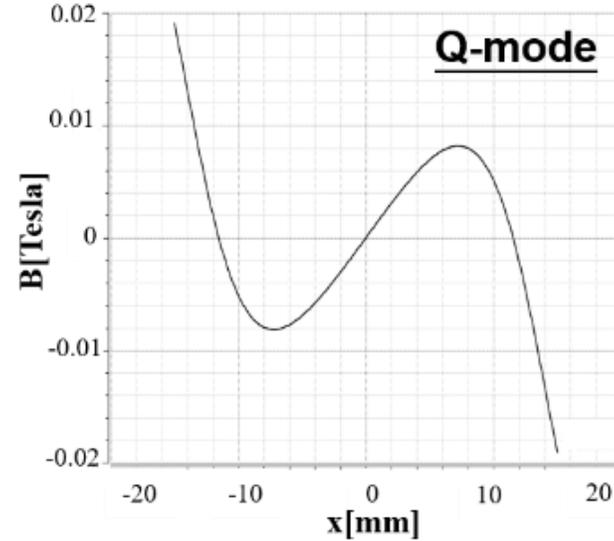
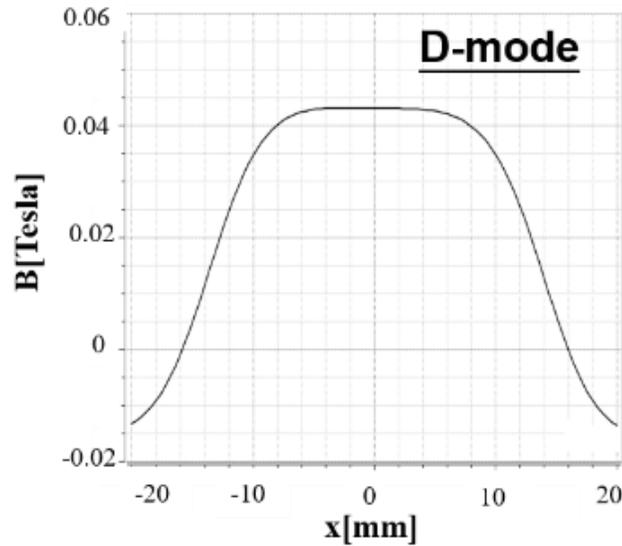


Magnetic field distribution along longitudinal axis

# Introduction about the beam test



Magnetic flux of D-mode



Magnetic flux of Q-mode

**Two modes are measured in the beam test.**

## Motivation:

- Compare with offline measurement results and examine the performance for the application in the future.
- Examine the nonlinear field distribution.

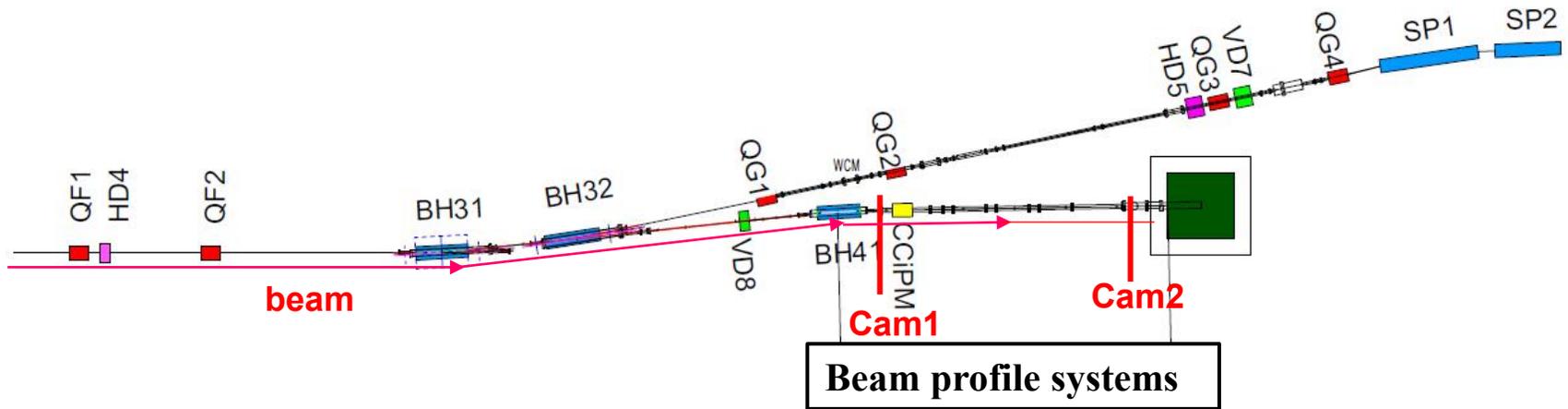
## Measurement contents:

- Excitation test to examine the linearity of the kick effects.
- Horizontal survey to check the flatness and gradient.

## Measurement method:

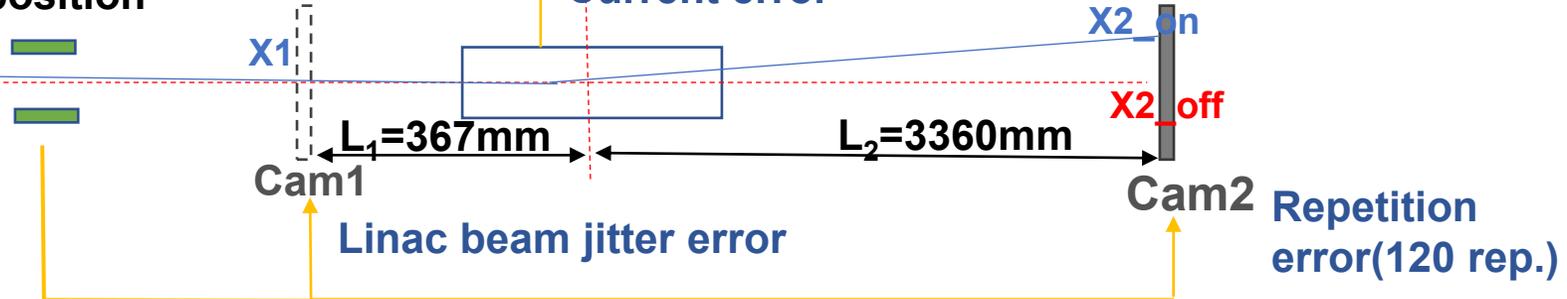
Generate a parallel beam at the dump line and kick the beam. The kick angle will be measured by the monitor system.

# Measurement system for beam test



**BPM: Observe Linac beam position**

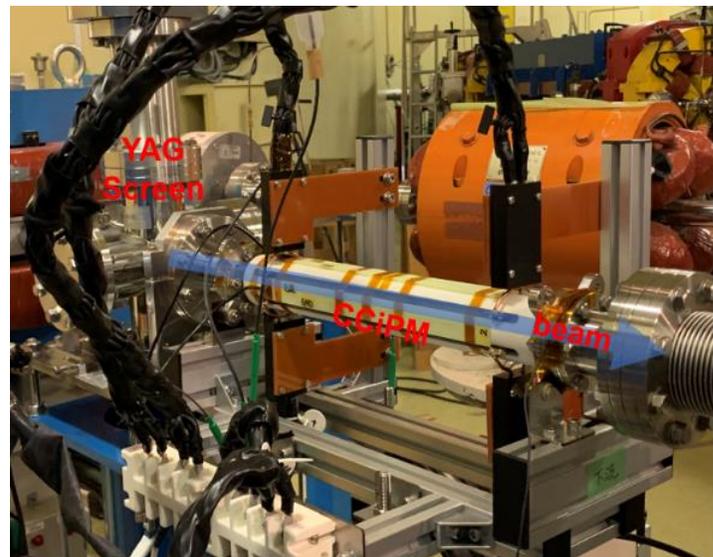
**CT: current measurement**  
**Current error**



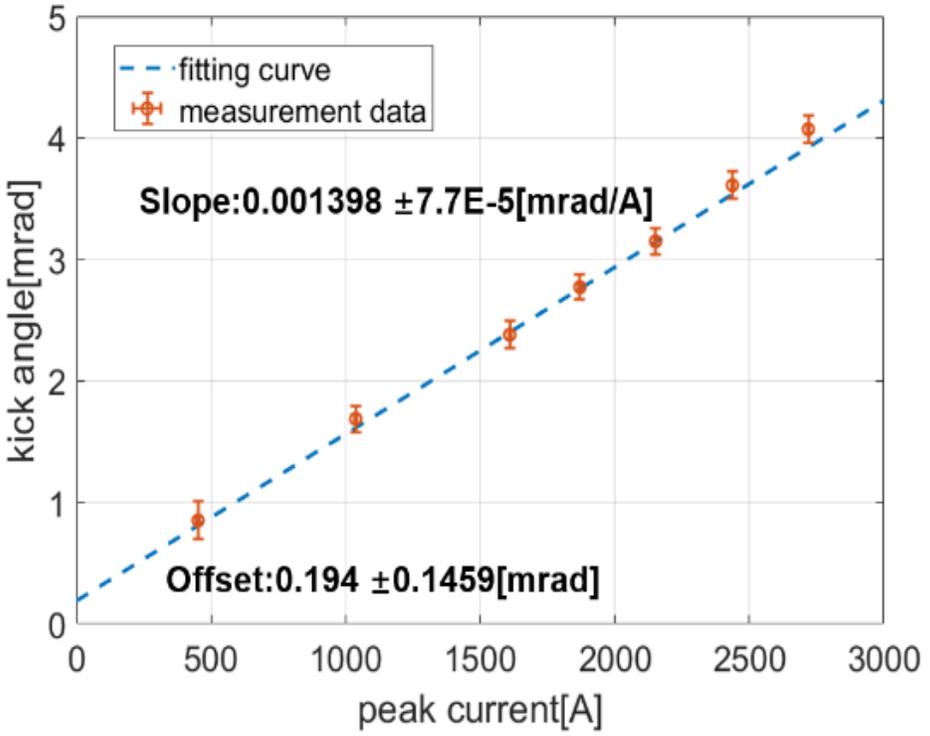
$$\theta_1 = (X2\_off - X1) / (L1 + L2)$$

$$\theta_2 = (X2\_on - X\_ccipm) / L2$$

$$\text{Kick angle} = \theta_1 - \theta_2$$



# Result of current excitation test

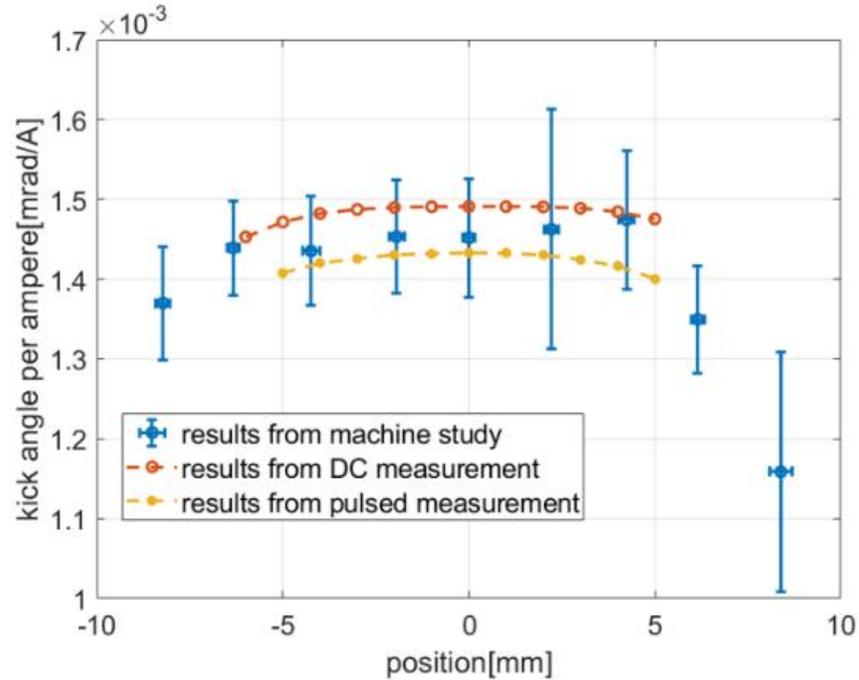


- A parallel beam is adjusted to pass through the center of CCI<sub>PM</sub> and current is gradually increased in the experiment.
- Difference of the coefficient [mrad/A] is slightly smaller than DC offline measurement within error, which is less than 3%.

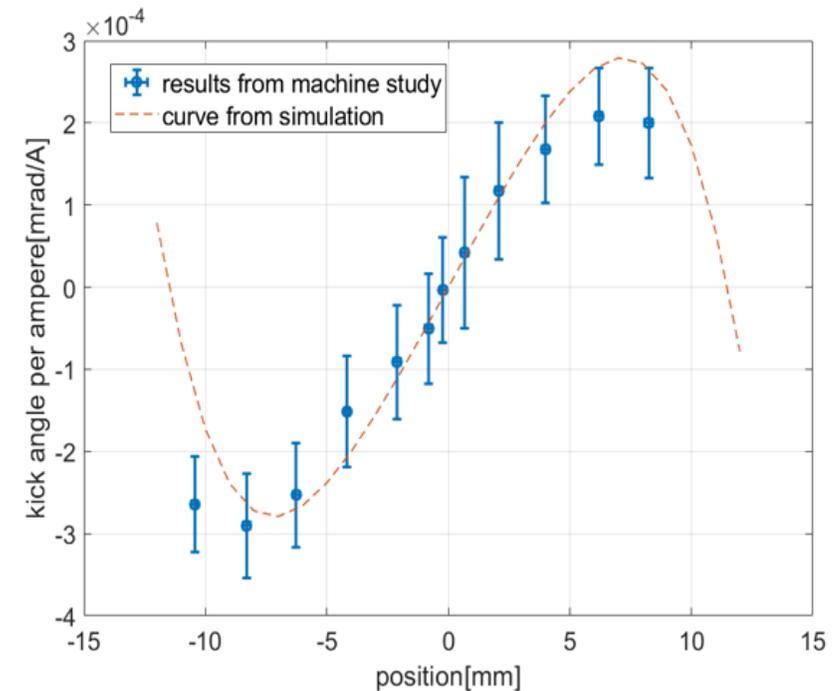
	DC measurement	Beam test
Kick effect [mrad/A]	0.001491	0.001398 ± 7.5E-5

# Result of horizontal survey

## Horizontal survey of D-mode



## Horizontal survey of Q-mode



**Horizontal distribution could match the offline results.**

Summary:

- The CCI<sub>PM</sub>-D30 has been developed at KEK-PF and mechanical performance is reliable based on offline measurement results.
- The beam test is carried out at the BT line. The kick effect could match the magnetic field measurement results.
- Further research will be conducted in the future.