J-PARC E16実験における GEM飛跡検出器の建設及び実機の性能評価

Performance and construction of GEM Tracker for the J-PARC E16 experiment

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for the J-PARC E16 collaboration.

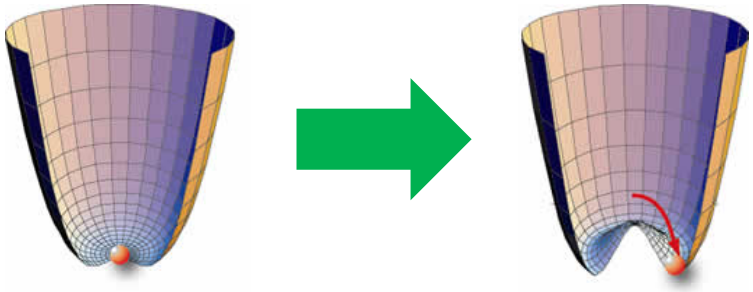
Outline and related talks

1. The J-PARC E16 Experiment,
   motivation method, and features.
2. GEM Tracker itself and construction.
3. Tracking without a magnetic field.
4. Summary

Related talks
-13pV3-07 T. K. Kondo : Discharge protection of GEM Tracker trigger electronics
-13pV3-08 H. Sako : Development of MRPC

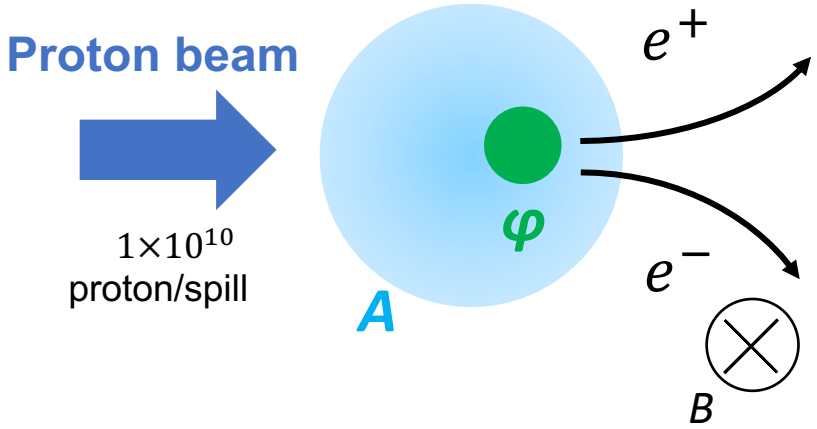
Motivation and Method (J-PARC E16)

Spontaneous chiral symmetry breaking



Potential changes

Measures φ mass in nuclei

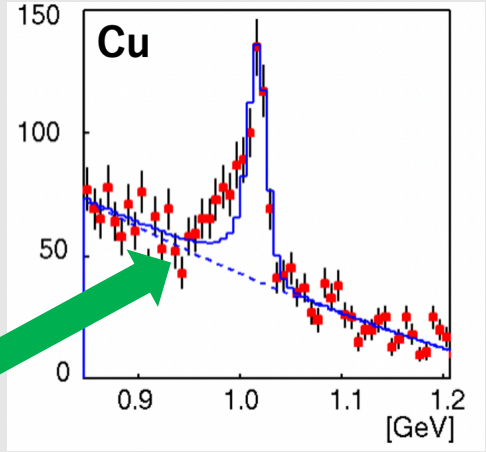


- Is spontaneous chiral symmetry breaking ?
  - If so, hadron mass in finite-density would decrease.
- φ meson mass in nuclei will be measured using $\phi \rightarrow e^+e^-$.
  - The mass spectrum of the φ meson is sharp.
  - No final state interaction.

Features of the experiment

Prior experiment @ KEK-PS

E325



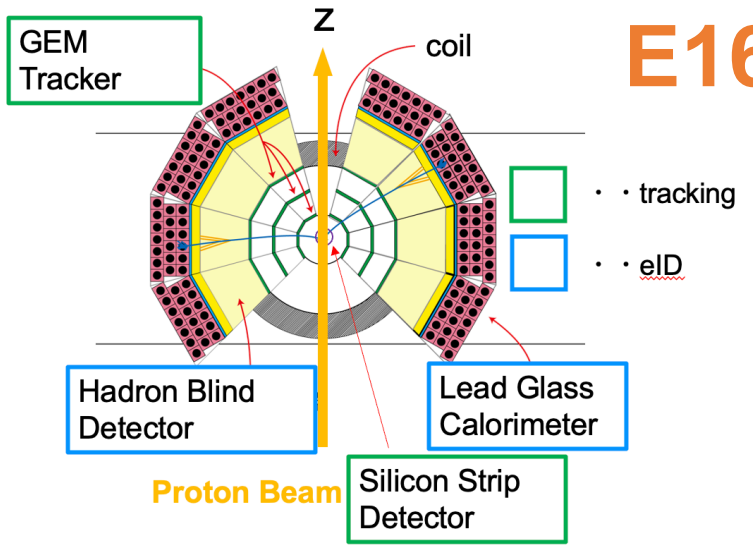
Observed excess

Bγ < 1.25

R. Muto *et al.*, Phys. Rev. Lett. 98(2007) 042581

New spectrometer

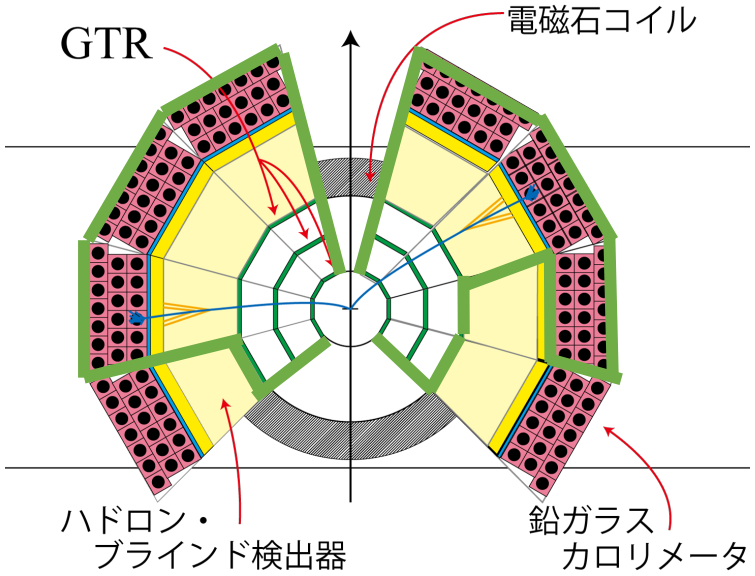
E16



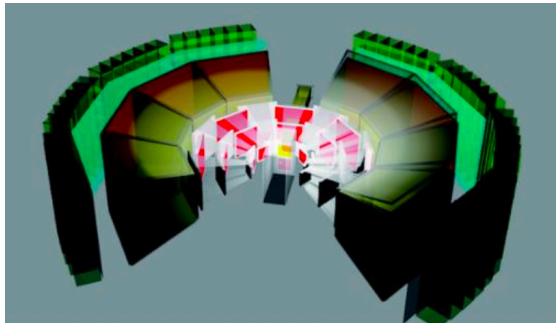
- The decrease of mass of φ mesons (3%) are observed.
  - However, excess is not so clear.
- To obtain statistics…
  - High Intensity beam (J-PARC high-p beamline)
  - Large acceptance spectrometer.

Staging strategy

Run0 spectrometer



Run1 & Run2 spectrometer



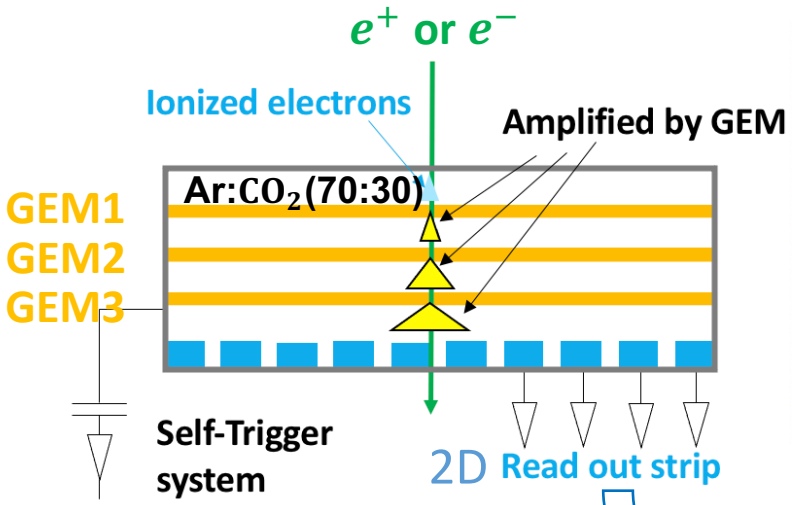
8 modules and more over

- Run0 : Detectors' commissioning (320h).
  - 8 modules of GEM Tracker were installed and operated.
  - 75% done (June 2020 & February 2021 & June 2021)
- Run1 & Run2 : Physics run.
  - Planed in after 2022.

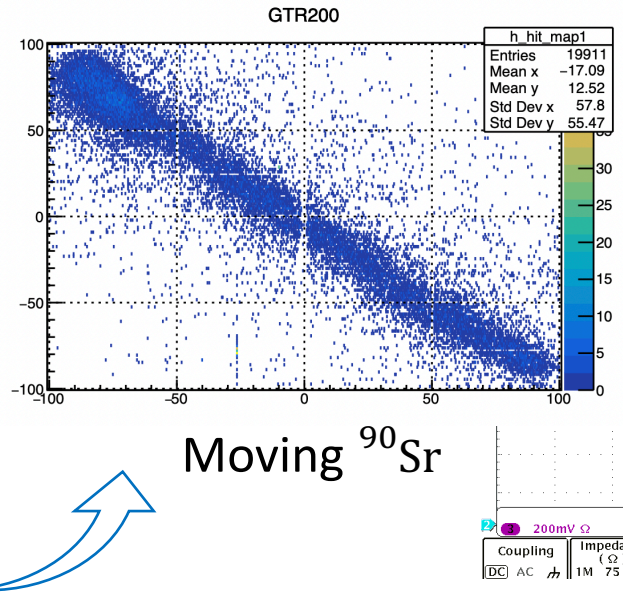
Today's topic

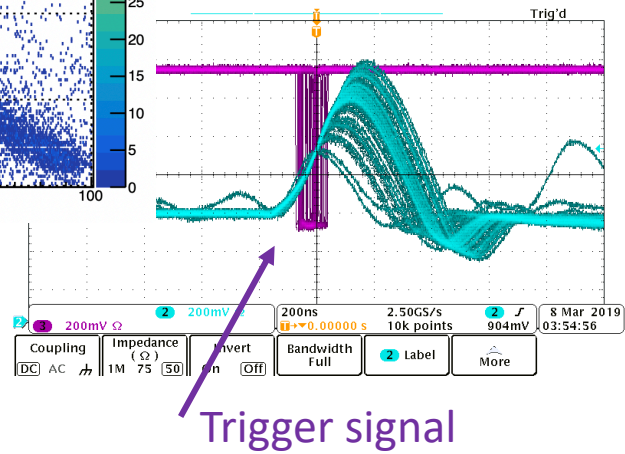
GEM Tracker

Operating principle



Two types of readout Signals and trigger

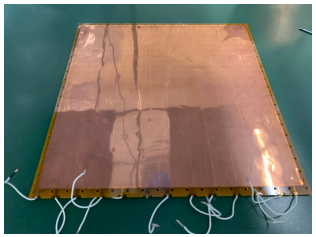




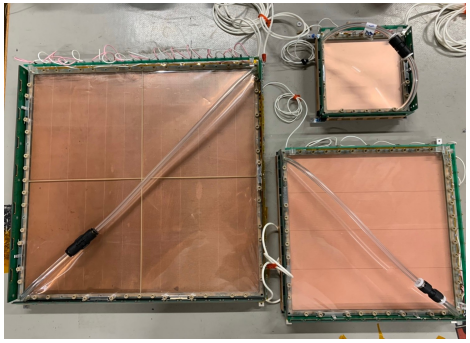
- GEM Tracker consists of three GEM foils.
  - *Amplification gain (6000)* is needed for the resolution (100 μm).
- For a commissioning run in last February.
  - Eighteen GEM Trackers were necessary.

For mass production, quality control methods should be established.

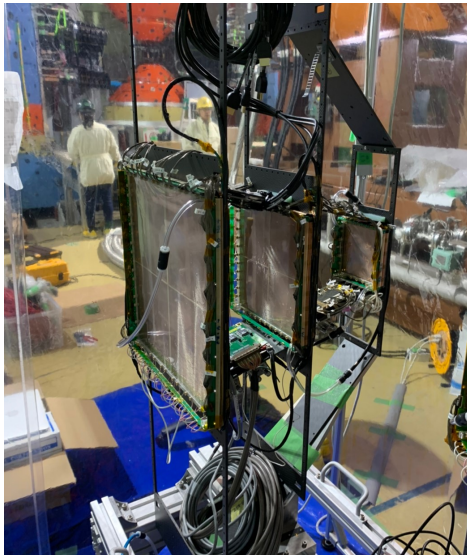
Construction



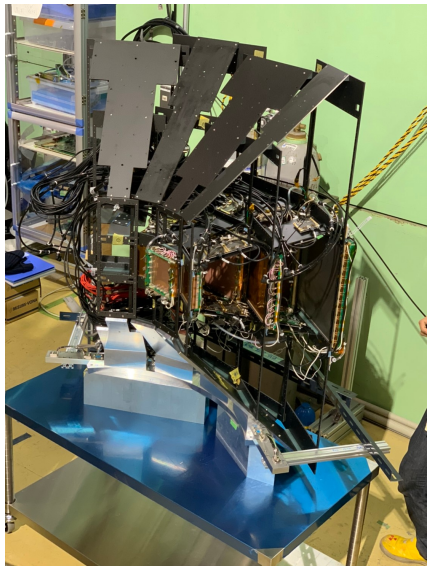
GEM foil
×~100



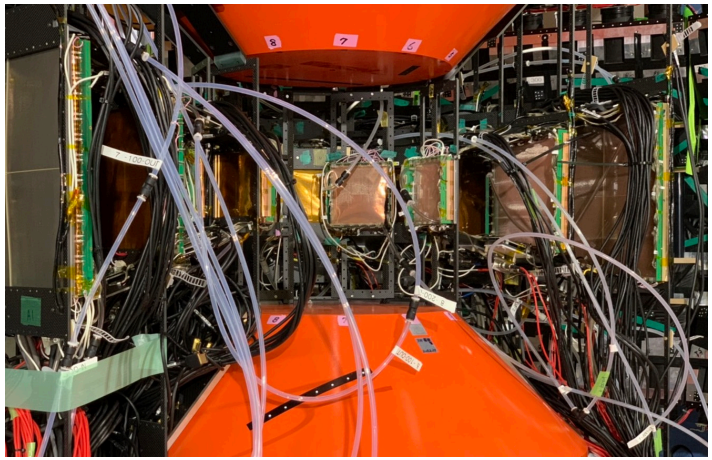
GEM Tracker
(1 module)×8



×8
Frame mounted module



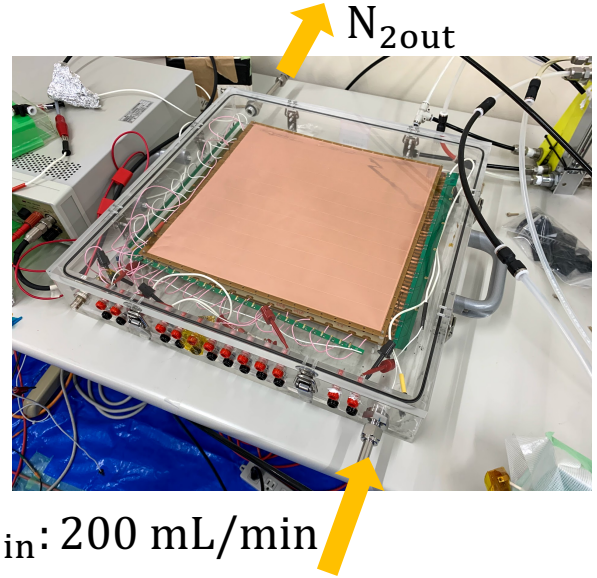
Right-half



GEM Tracker
(8 modules)

Selection of GEM foils

Test setup



Results

	Good	Bad	sum (yield)
100	31	17	48 (0.64)
200	25	14	39 (0.64)
300	30	11	41 (0.73)
sum	86	42	128

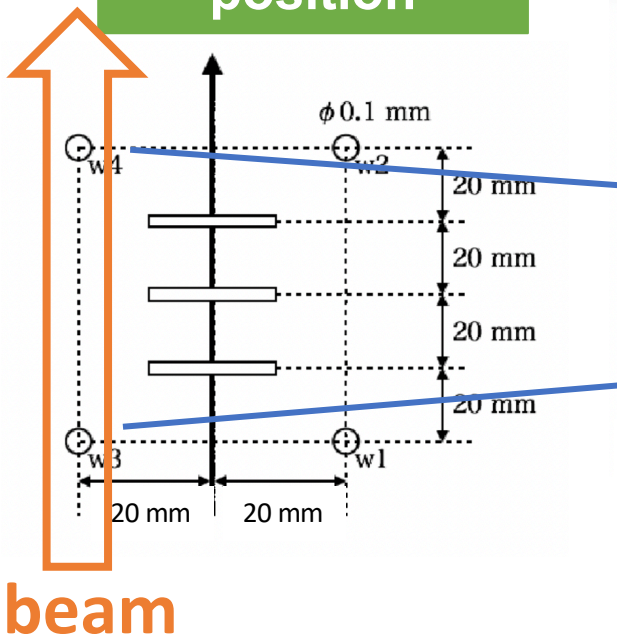
The biggest number in Japan

- Leak current between top and bottom electrodes is measured.
  - ✓ less than 10 nA / 100 cm^2 while applying 500 V in N_2 gas.
  - ✓ less than 10 times / hour discharges. →Stable operation
- ***Over hundred GEM*** foils were checked over three months.

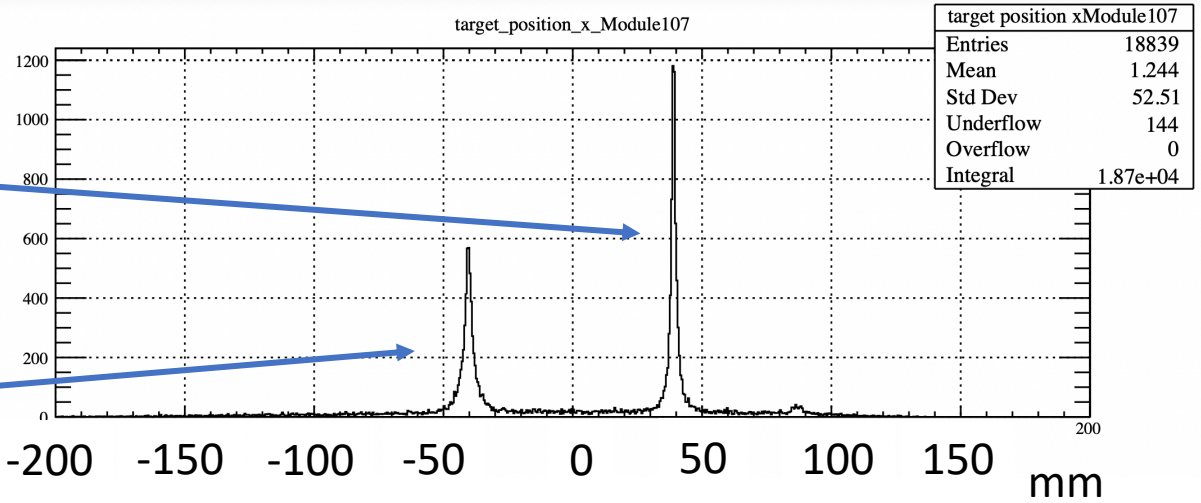
High-quality GEM foils are selected out.

Tracking without magnetic field

Wire targets position



wire target positions on beam axis

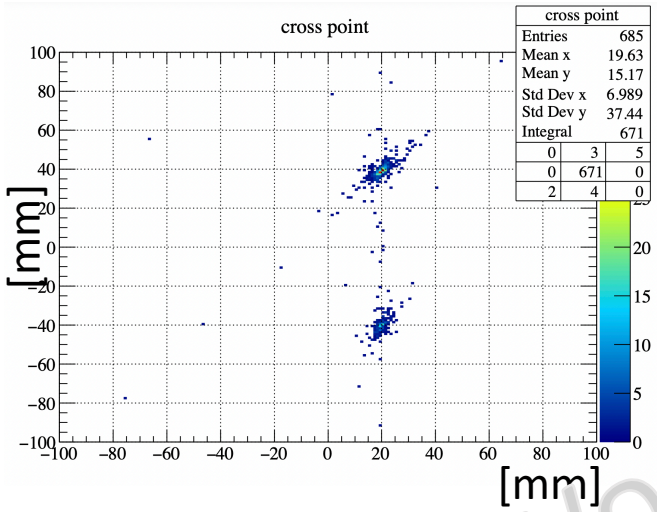


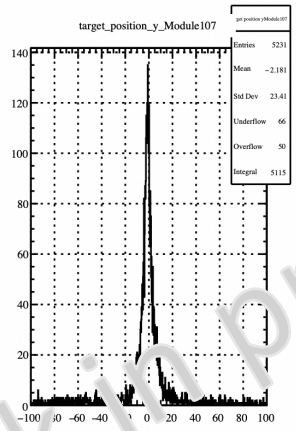
- Besides targets, wire targets are installed for a calibration.
  - There are four tungsten wire targets (φ = 100 μm).
- Wires are detected clearly.

→precondition for calibration

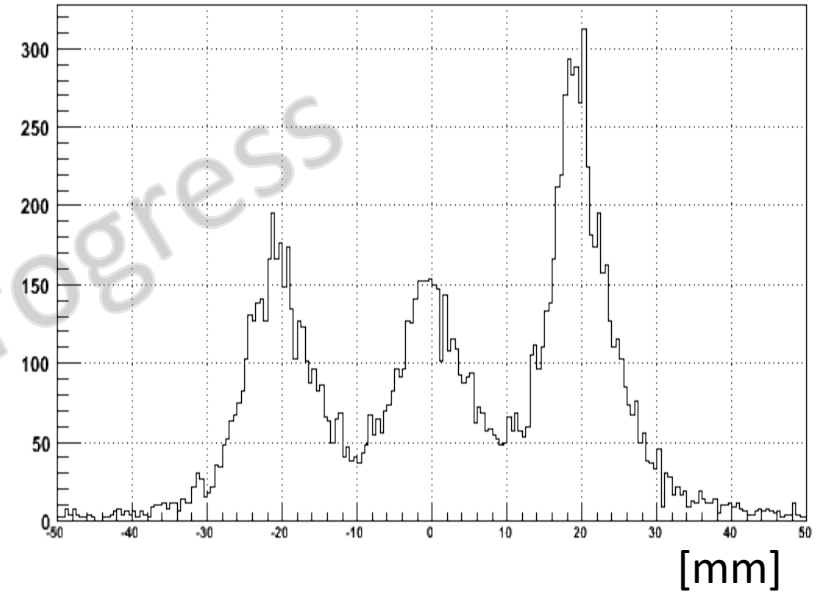
Tracking withhout magnetic field

Cross points on XZ plane & projection on YR plane (wire)





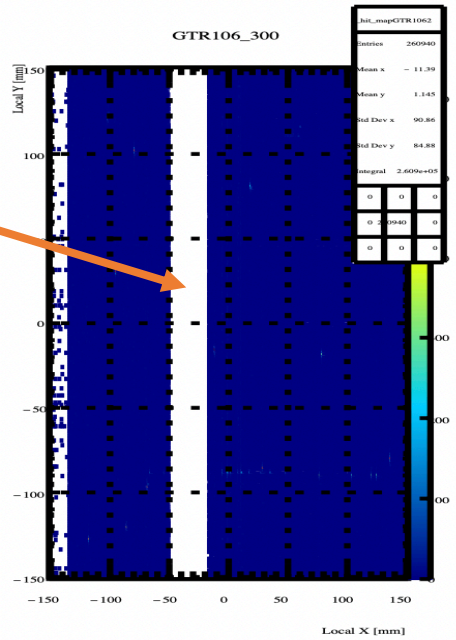
Three targets



- Cross points on XZ plane, projection on YR plane was reconstructed
- Three targets are seen even in higher intensity beam

Some problems and future prospects

❑ Parts of GEM foils had conduction.



❑ Large discharge causes latch-up of GTR-ASD (for trigger signal)→ Next talk, by K.T Kondo

❑ Analysis including SSD is ongoing

→ position resolution evaluation & calibrations will be done.

❑ tracking in a magnetic field is also ongoing.

Summary

- J-PARC E16 experiment is ongoing to reveal
  if spontaneous chiral symmetry breaking is occurring.
- Mass production of GEM Tracker was performed.
- In the commissioning run, wire targets were detected.
- Targets in a high intensity beam were also seen.
- Position evaluation with SSD will be performed.
- Tracking in the magnetic field is still ongoing.