Backup Beam Test Option

RIKEN/RBRC

Itaru Nakagawa

Open Issues planned to be addressed in the next beam test

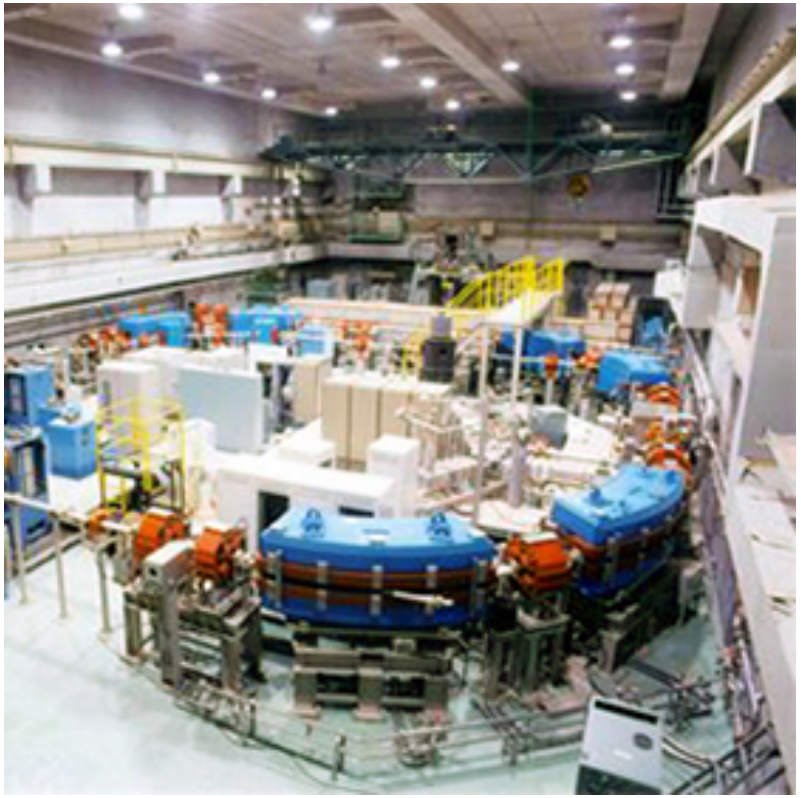
1. Prove ~100% detection efficiency of the silicon sensors by inclusion of TDC in data (~97% in the last two beam tests)
2. Time in with respect to the trigger timing. (Taken accidentals in the last two beam tests).
3. Smooth DAQ commissioning
4. Test production full ladders
5. Inefficiency between silicons/cell borders
6. Successful HV operation
7. Satisfactory data taking with a (pre-)production bus extender
8. Play with grounding conditions
9. Fine threshold scan to measure fake hit rates and calculate S/N
10. Monitor ROC power consumption during the beam data taking
11. Etc.

Research Center for Electron-Photon Science at Tohoku University (Japan)

https://www.lns.tohoku.ac.jp/en/

Facility

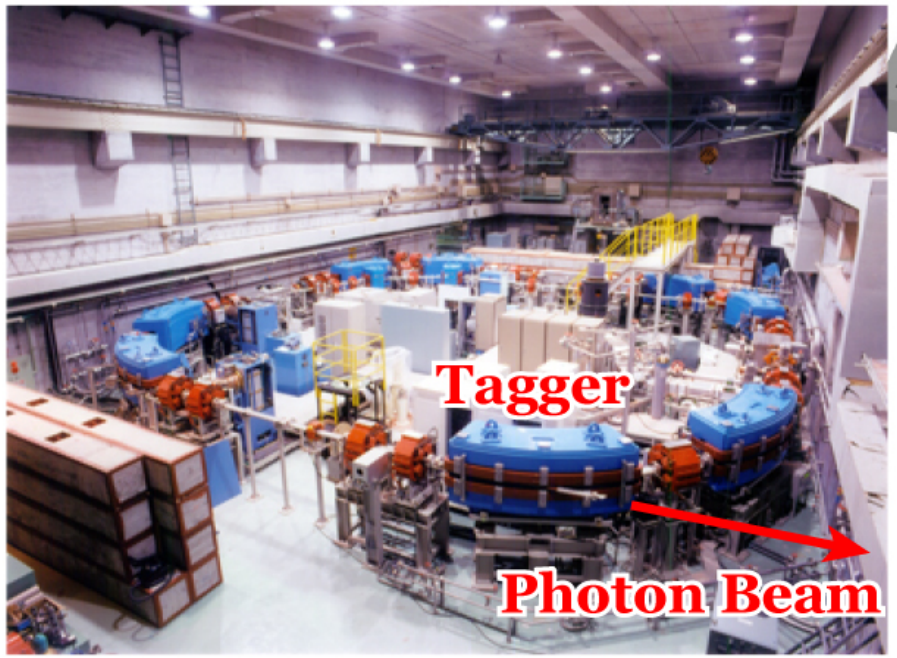
300 MeV Electron Linac

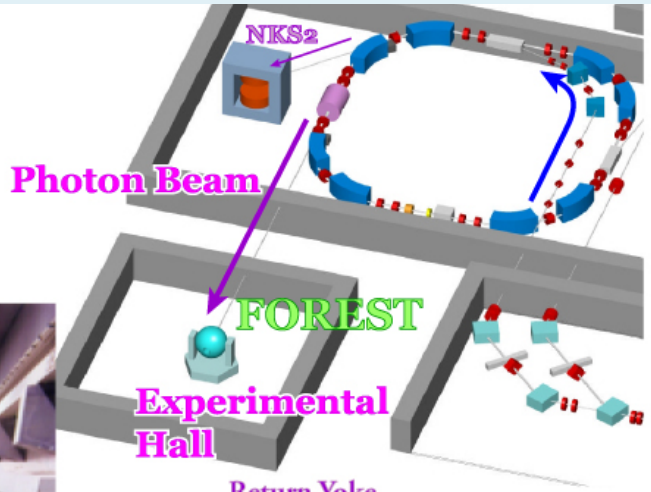


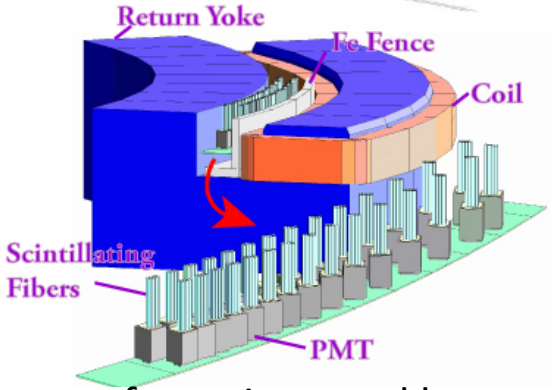
1.3GeV Booster Storage Ring

GeV-γ Beam Line

GeV-class Bremmstrahlung γ ray
from Internal Target Wire

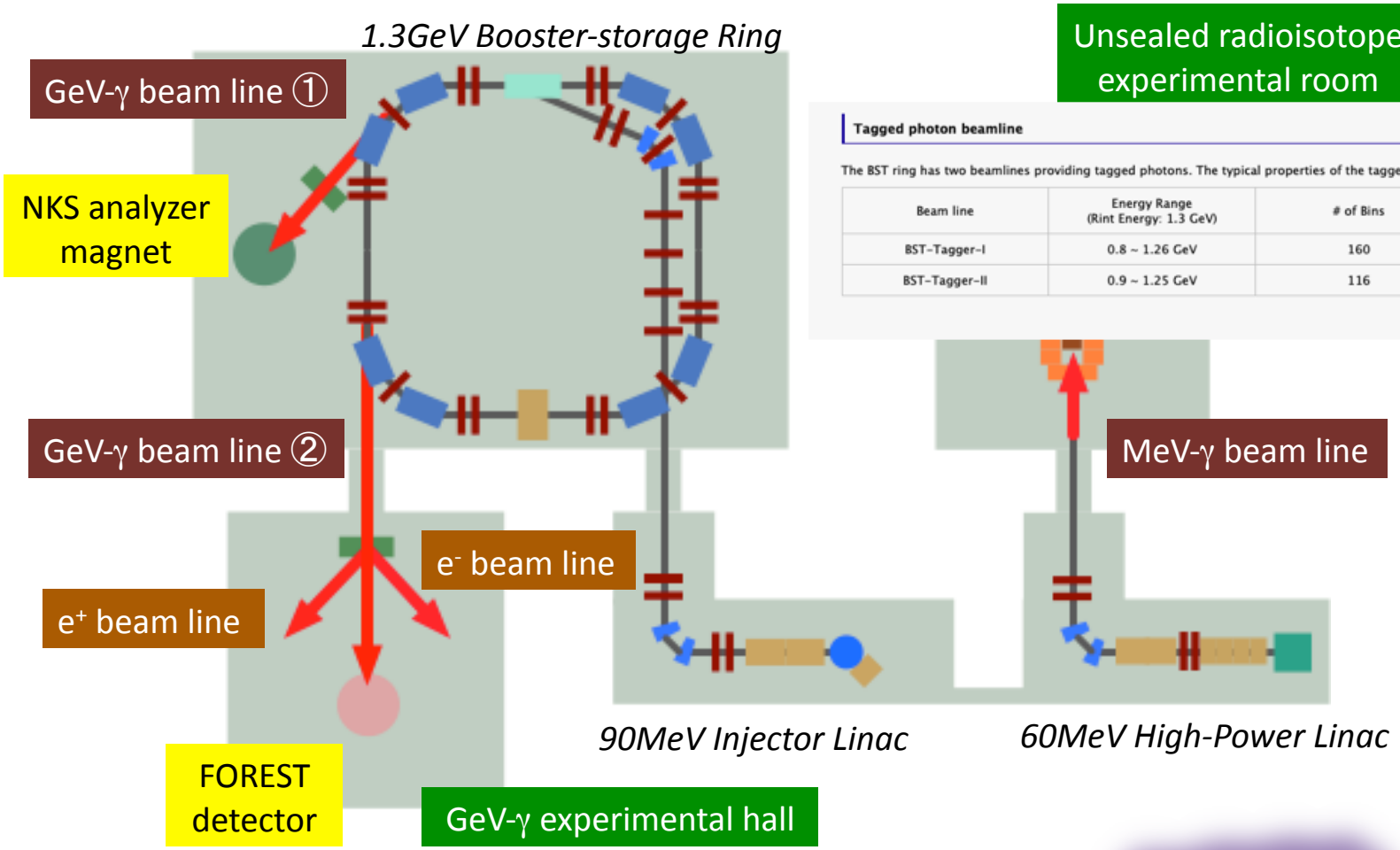






Energy of γ ray is tagged by
recoiled electron

Beam Lines



Tagged photon beamline

The BST ring has two beamlines providing tagged photons. The typical properties of the tagged photon beams are summarized in the table:

Beam line	Energy Range (Rint Energy: 1.3 GeV)	# of Bins	Intensity	Duty
BST-Tagger-I	0.8 ~ 1.26 GeV	160	TBC	~60% (NKS2)
BST-Tagger-II	0.9 ~ 1.25 GeV	116	TBC	~50% (FOREST)

Test Beam Parameters @ Tohoku University

The positrons and electrons, which are produced at a metal plate in front of the bending magnet RTAGX by the photon beam, are provided at three beamlines in the GeV-γ experimental hall. The positrons and electrons are momentum-analyzed with RTAGX, and the energy spread of them is approximately 0.5% . The beam profile and intensity depend on the beam energy, and **the diameter of the beam is roughly 20 mm**, the intensity is roughly a few kHz. The positrons (or electrons) at the -30 deg beamline can be focused with a triplet quadrupole magnets thanks to a KEK cooperation. The polarity of the magnets can be changed. The details of the photon beam properties after the earthquake are under investigation. Information before can be obtained in a reference "A detailed test of a BSO calorimeter with 100-800 MeV positrons",

Reference: T. Ishikawa et al., Nucl. Instr. and Meth. A 694, 348 (2012).

Beam	Beam line	Maximum beam energy
Positron / Electron	± 30 deg	~840 MeV
Positron	-23 deg	~1000 MeV

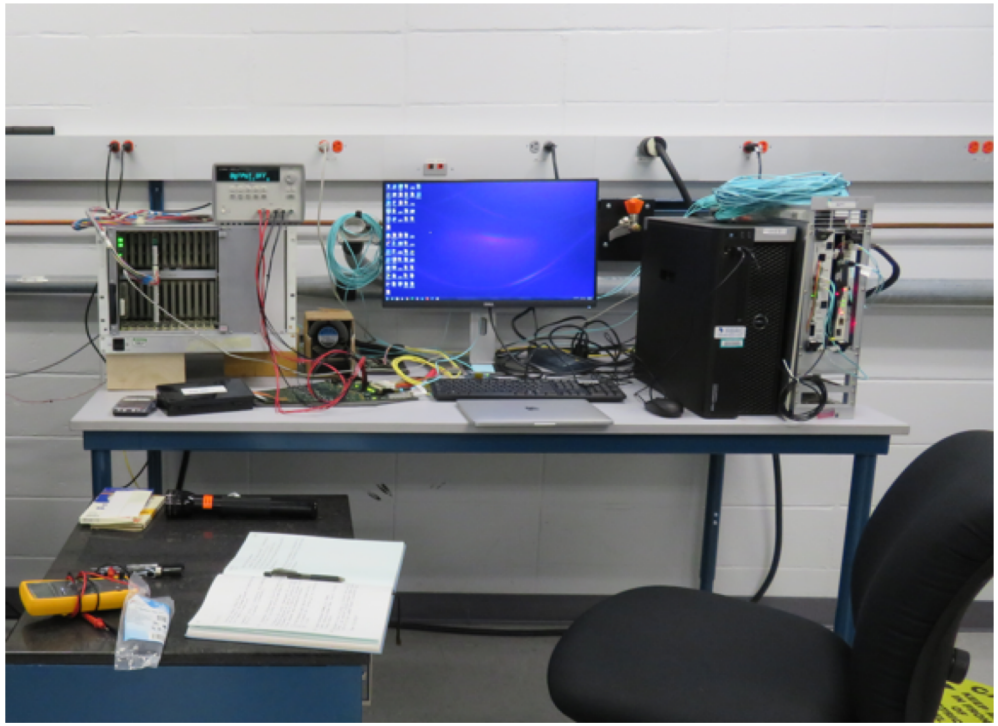
Need to accumulate RTAGX information into data to tag the energy of electron/positron

INTT Data Acquisition Systems

GTM-BASE DAQ

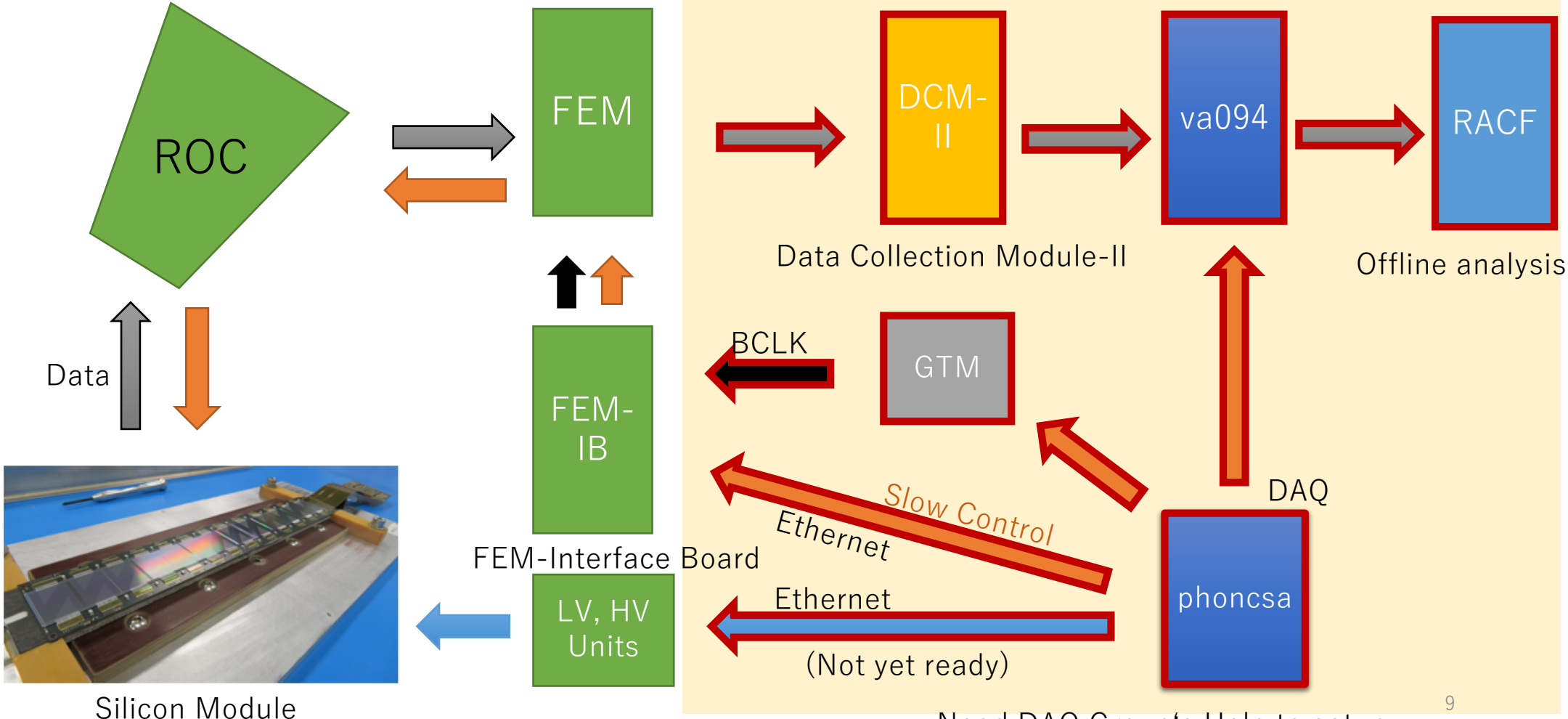
Setup in BNL

STAND ALONE

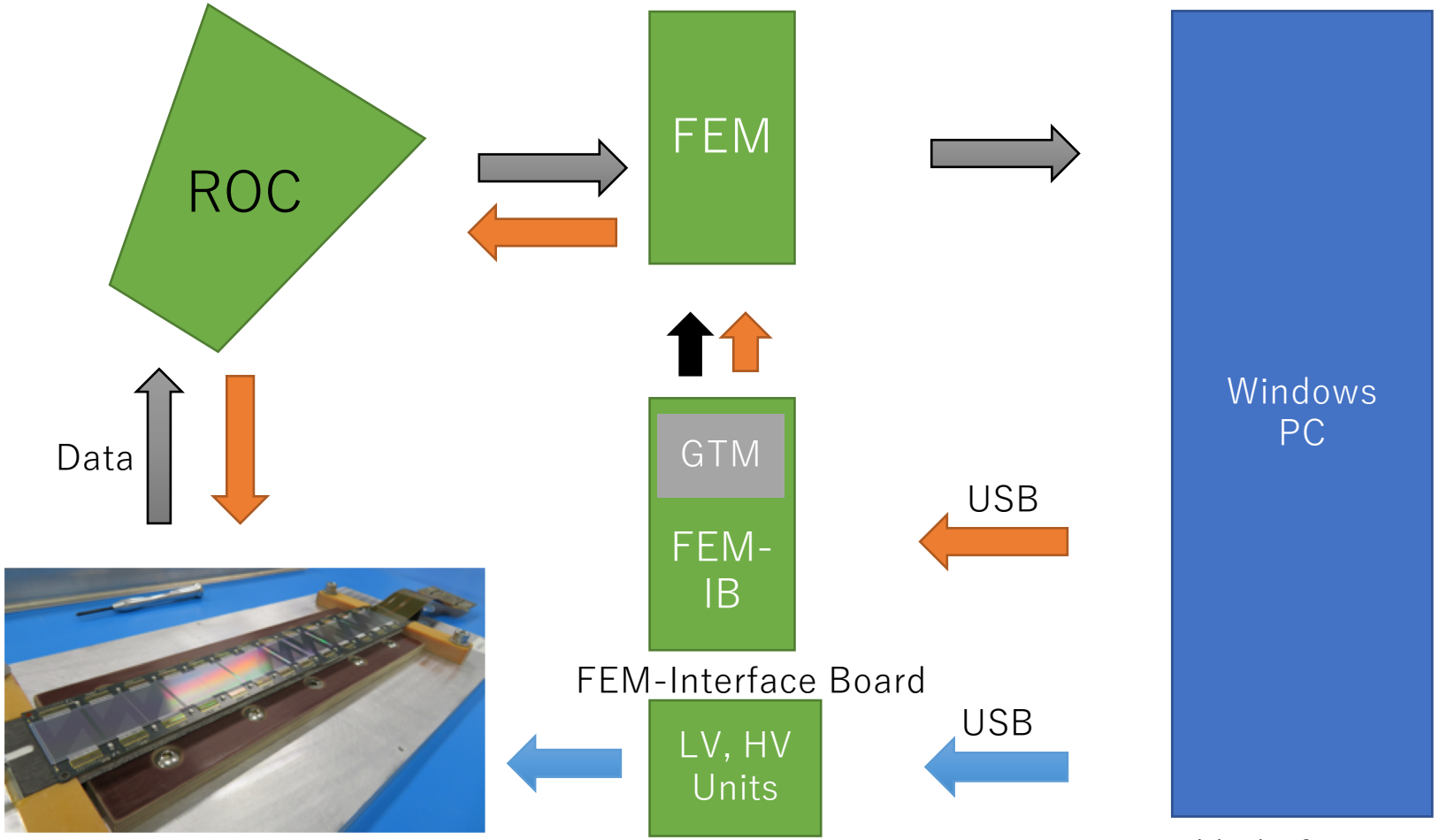


Setup in BNL, NWU, Taiwan

INTT GTM Based Full Readout Chain Schematic



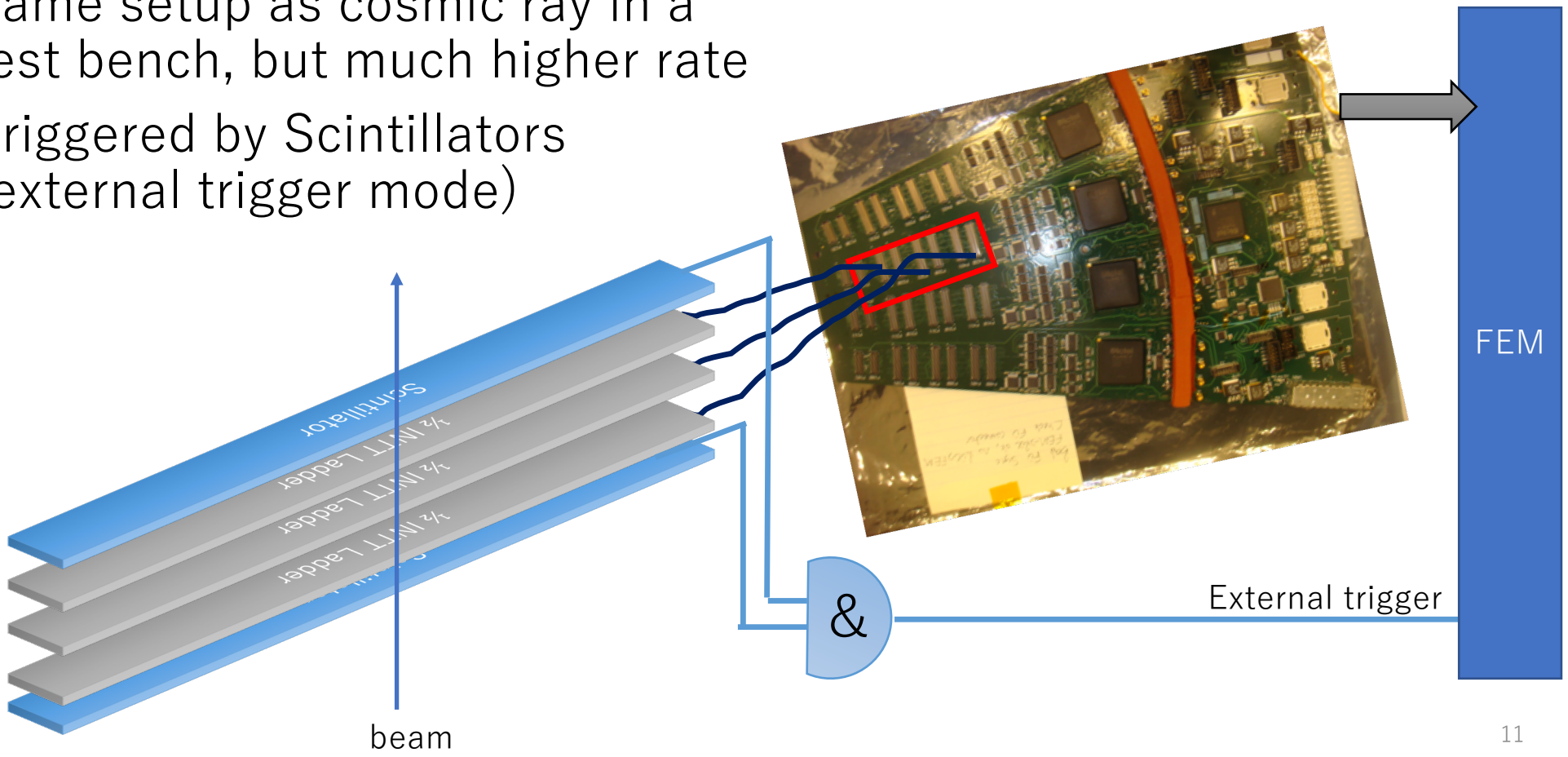
INTT Standalone DAQ Setup



- Never tried to accumulate large event.
- Worry in long time operation without hung

Running Standalone DAQ in Beam Test

- Same setup as cosmic ray in a test bench, but much higher rate
- Triggered by Scintillators (external trigger mode)



What we can/cannot do by standalone

	GTM	Standalone
Data Rate	~10kHz	< 1kHz? Need to test PCIe-6536B
FPHX Communication	Expert GUI	Nevis GUI
Disk Space	6G Raw data + 20GB rootfile	1TB Disk Sufficient

What can we do in the beam test @ Tohoku U.

1. Prove ~100% detection efficiency of the silicon sensors by inclusion of TDC in data. (~97% in the last two beam tests)
2. Time in with respect to the trigger timing. (Taken accidentals in the last two beam tests). -> same as cosmic in standalone
3. Smooth DAQ commissioning
4. Test production full ladders
5. Inefficiency between silicons/cell borders -> ϕ20mm is too large
6. Successful HV operation
7. Satisfactory data taking with a (pre-)production bus extender
8. Play with grounding conditions
9. Fine threshold scan to measure fake hit rates and calculate S/N
10. Monitor ROC power consumption during the beam data taking
11. Etc.

Some important items have to be removed from the scope. However, I think it is better than no 3rd beam test.

Accounted experts to run the FNAL2020 beam test

Role	Experts	Assistant
DAQ	Itaru* (RIKEN) Takashi* (NWU) John Kuczewski (BNL)	
Detector	Itaru* (RIKEN) Rachid* (BNL) Takashi* (NWU) Kai-Yu* (Taiwan) ChengWei (Taiwan) Mika (NWU) Miu (NWU)	Yasuyuki (RIKEN), Shoichi* (JAERI) Xie Wei(Purdue) Chia-Ming* (Taiwan)
Analysis	Milan (Perdue) Kai-Yu* (Taiwan) ChengWei (Taiwan) Miu (NWU) Mika (NWU)	Rui* (Perdue)

Student 2019 beam test participant*

Do we have sufficient domestic man power for Tohoku?

- Itaru* (DAQ, Detector, Analysis)
- Takashi* (DAQ, Detector, Analysis)
- Genki (DAQ, Detector, Analysis)
- Yasuyuki (Detector)
- Shoichi* (Detector)
- Miu (DAQ, Detector, Analysis)
- Mika (DAQ, Detector, Analysis)
- ＋NWU/Rikkyo Undergraduates for assistant
- ＋Remote offline analysis by international members

Student　　2019 beam test participant*

Tight, but may not be impossible.

When?

- The call for the proposal of the term Oct, 2020 ~ March, 2021 was closed on July 20th, 2020.
- The call for the next term April 2021 ~ Oct. 2021 may be announced in January 2021 (deadline around January 20th).
- Will investigate if there is possibility to parasite to other experiment if we eager to run earlier.

Summary

- Feasibility of the beam test in Tohoku University in Japan is investigated as a back of 3rd FNAL beam test assuming no international travel for a while.
- The DAQ suppose to be down graded to standalone because setting up the full DAQ system without sPHENIX DAQ group locally is not feasible.
- Even with the standalone DAQ, some crucial tests can be made such as
  1. Prove ~100% detection efficiency
  2. Test production full ladder
  3. Test (pre-)production bus extender
  4. Etc.
- It is likely not impossible in domestic man power wise
- My opinion is it is worthy to put effort rather than giving up 3rd beam test (if there is no possibility to run in FNAL)