Homework from Operation Board

INTT Group

List of Homework

Assume (correct if wrong):

- Analog readout? Yes
- zero suppressed? Yes

1) Pedestal processing? Offline or online? Does fun4all analysis code exist?
2) Gain calibration? Offline or online? Does fun4all analysis code exist?
3) Common mode noise analysis/subtraction?
3) Timing studies? Bunch crossing association?
4) Hit finding efficiencies?
5) Dead/noisy channel analysis.
6) Data base storage of detector performance parameters?
7) Feedback of detector performance parameters to simulation?
8) Who will work on the analysis?
9) Does the analysis code exist in fun4all?
10) Do we have maps connecting detector channels to trkrhitmap positions for rawdata unpacker?

1) Pedestal processing? Offline or online? Does fun4all analysis code exist?

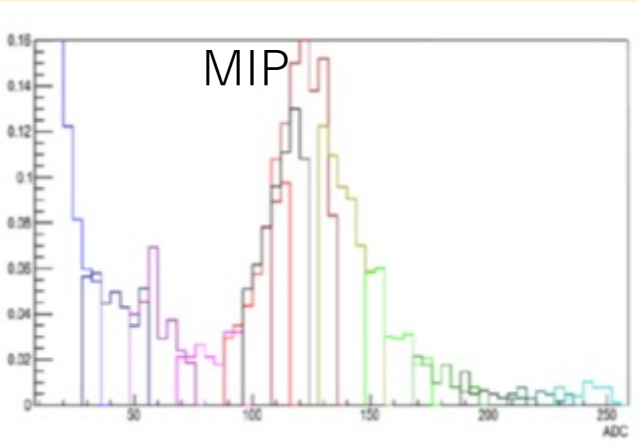
- Pedestal is to be measured by the noise/random trigger periodically during physics run.
- Pedestal won't be subtracted in online.
- INTT is basically designed to deal with only hits and not to measure ADC values in high resolution. The 3 bit ADC is to be utilized to distinguish either noise or true hit in offline. The lowest ADC bit, i.e. ADC=0 may be treated as thhee noise bin and be excluded from a good hit in offline analysis.
- There is no dedicated software needed to handle pedestals for INTT. No plan to develop fun4all analysis code for pedestals.

2) Gain calibration? Offline or online? Does fun4all analysis code exist?

- The gain tuning and matching will be carried out intensely during the commissioning period. No periodical calibration run is planned during a physics run.
- Fine resolution gain matching can be done by scanning through entire DAC range (0~255:8-bit) with series of runs covering different DAC range per run.

The offline analysis code has been developed for the beam test analysis. The code will be further developed in fun4all framework for the commissioning.

DAC Scan result from 2021 Beam Test

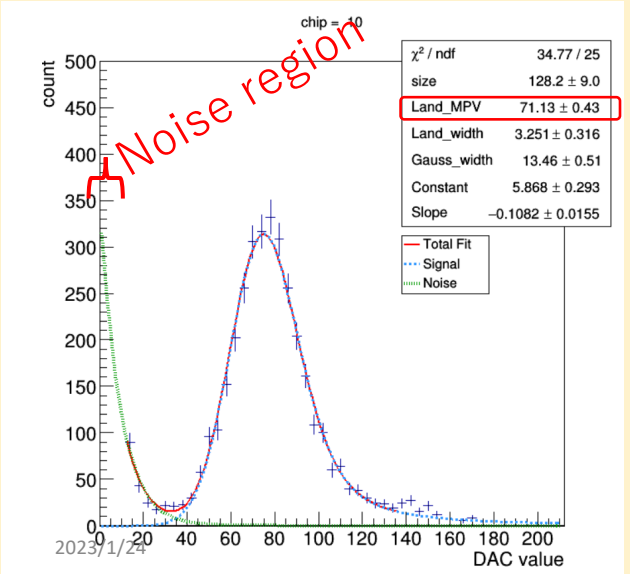


Courtesy of Yuka Sugiyama

3) Common mode noise analysis/subtraction?

- No plan to subtract noise neither in online nor offline in INTT regardless of common or random mode.
- The mode of the noise will be studied during the commissioning through the measurement of the DAC0 threshold scan.

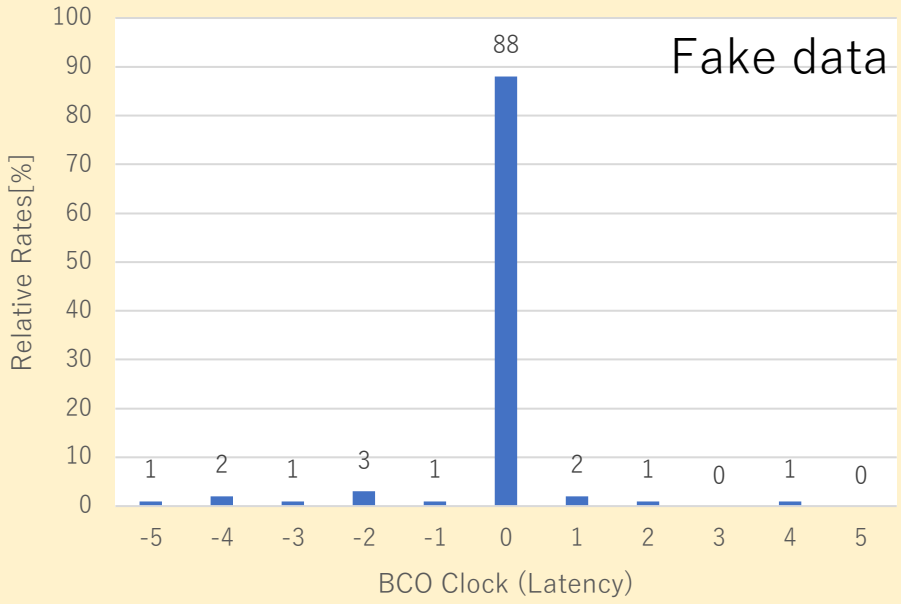
The DAC0 scan will explore the noise region intensely.



3) Timing studies? Bunch crossing association?

- Coarse and fine timing scans are planned in the very early stage of commissioning with the beam.

The coarse scan is done in the unit of a beam clock. A sharp peak within one BCLK in the hit rate is expected as the image below.



The fine scan is done by tuning the relative phase w.r.t. the beam clock. Below is the fine scan result of the FVTX.

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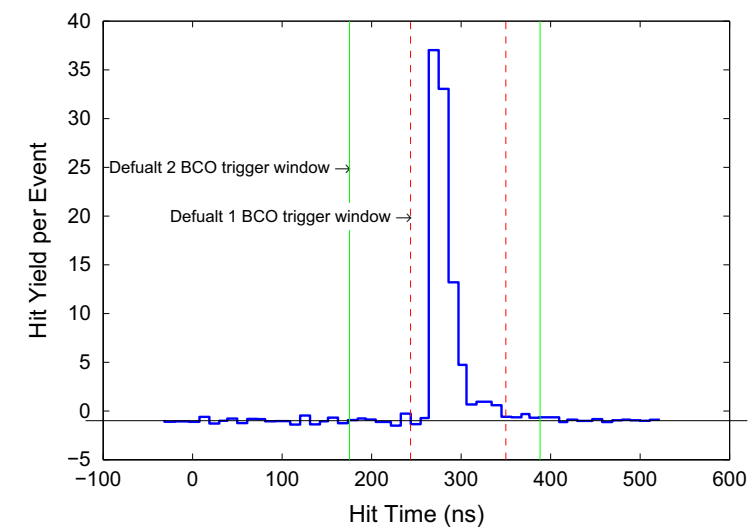


Fig. 32. Timing distribution of the FVTX hits relative to the RHIC beam clock.

4) Hit finding efficiencies?

- The INTT efficiency has been proven to be > 99% as the result of 3rd beam test in Japan.
- No acceptance dependency has been observed yet so far within a ladder.

Based on the past beam tests analysis, we expect > 99% efficiency throughout entire barrel. The efficiency may be lost 0.5% or so if we apply ADC>0 cut.

G. Nukazuka, C.W. Shih, Y. Sugiyama, et al.: ELPH annual report 1 (2023).

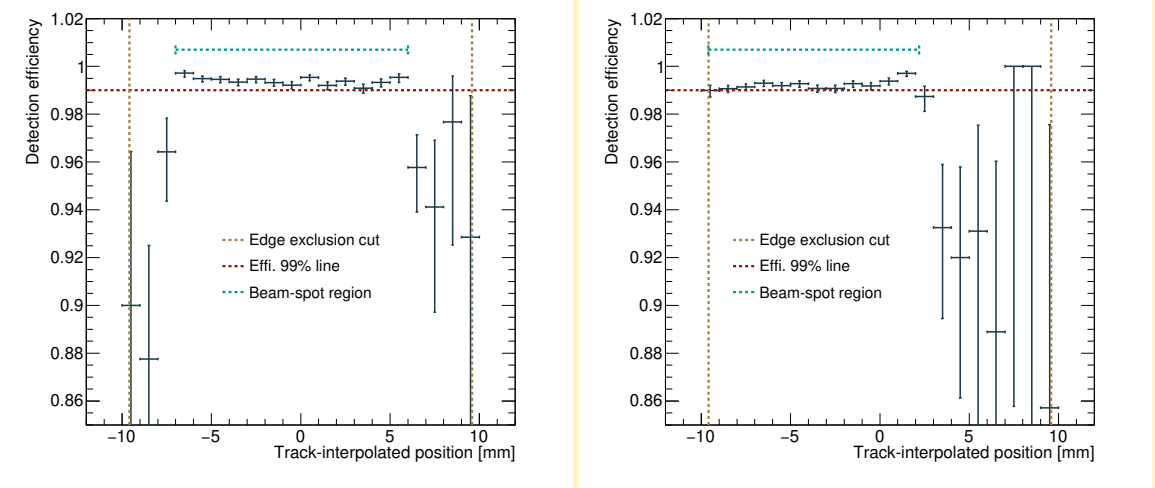
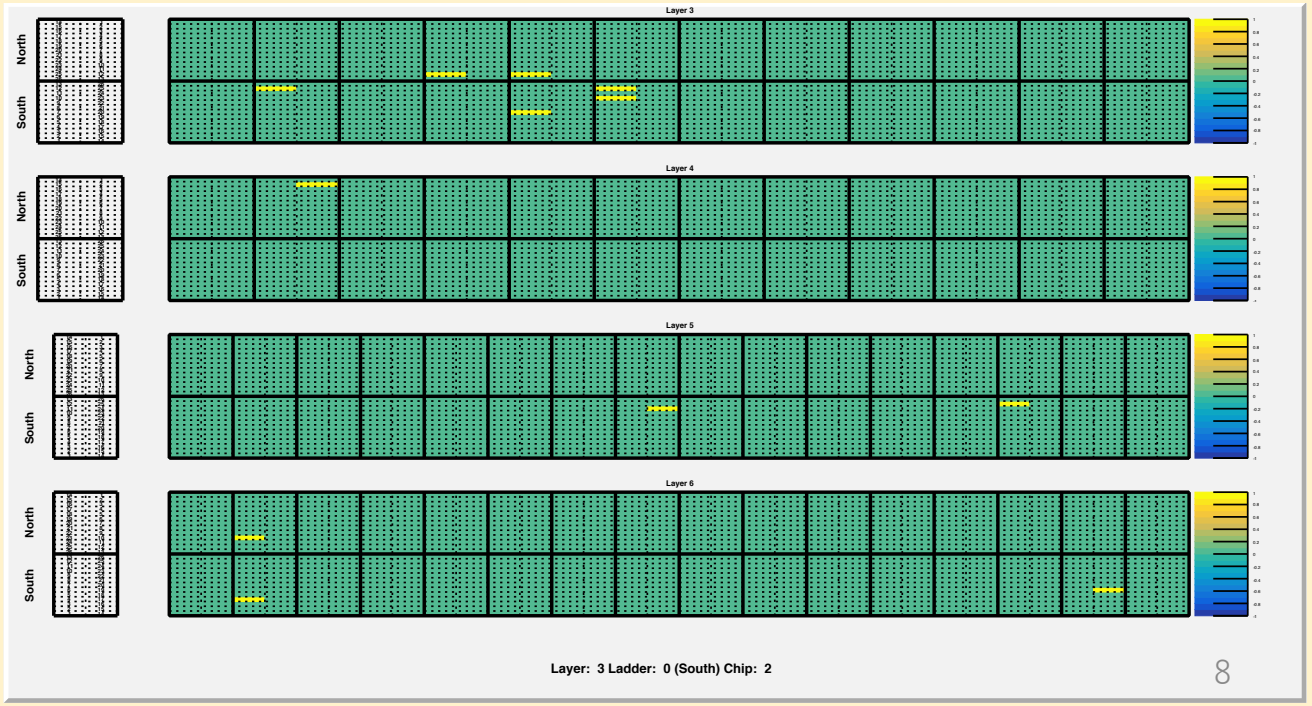


Fig.10. The detection efficiency as a function of the track position. (Left) The beam spot is in the middle. (Right) The beam spot aligns with the edge. The error bars indicate the statistic uncertainties.

5) Dead/noisy channel analysis.

- The dead/noise channels are to be kept in the database.
- The dead/noise channels are to be detected by the Online Monitor automatically. A semi-automated software may be developed to update the database.

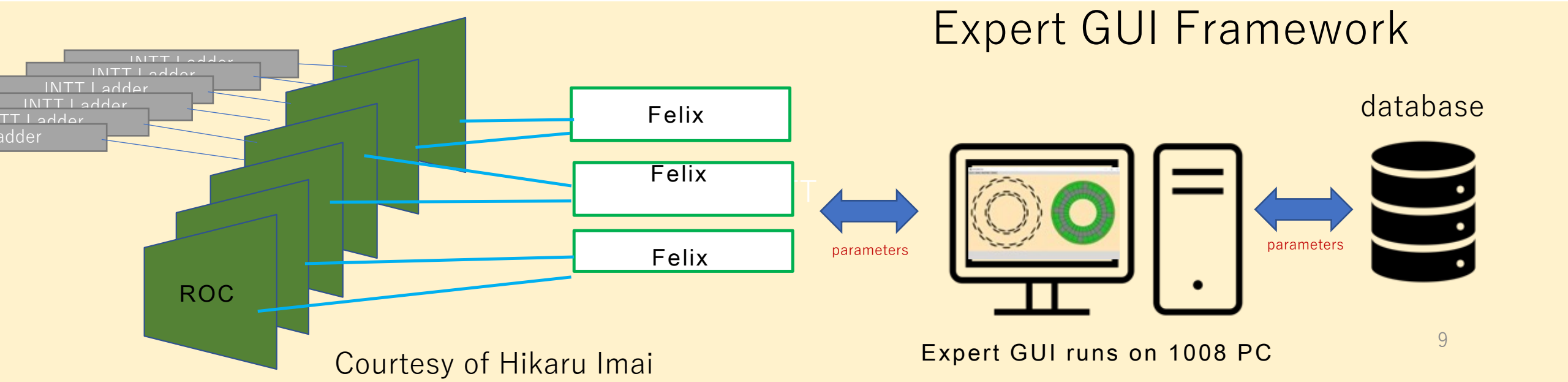
The INTT Online Monitor hit map display. Any hot/cold channels compared to the reference are highlighted by different colors than normal one.



Courtesy of Joseph Bertaux

6) Data base storage of detector performance parameters?

- The detector performance parameters are controlled by the expert-GUI (same philosophy with the FVTX one).
- The PostgreSQL database is under development in a local PC at the silicon lab to store these parameters. The expert GUI communicates with the database. The database will be exported to sPHENIX database server.

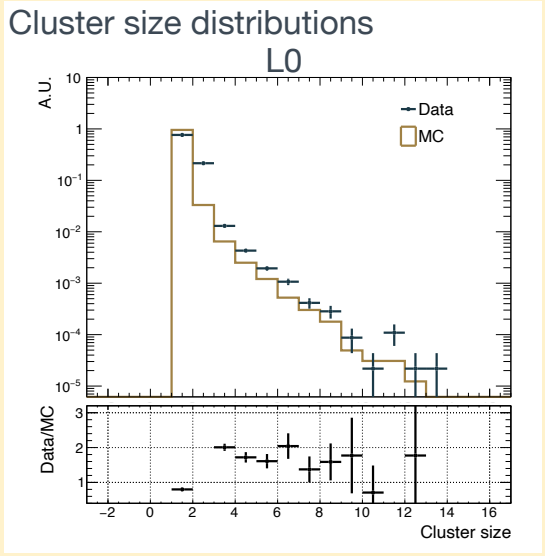


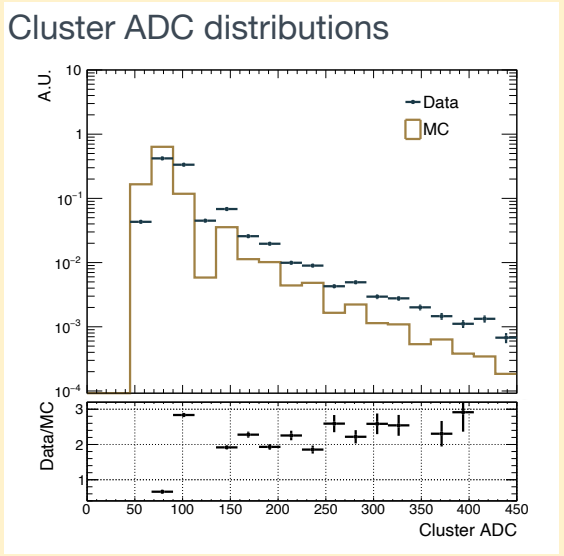
Courtesy of Hikaru Imai

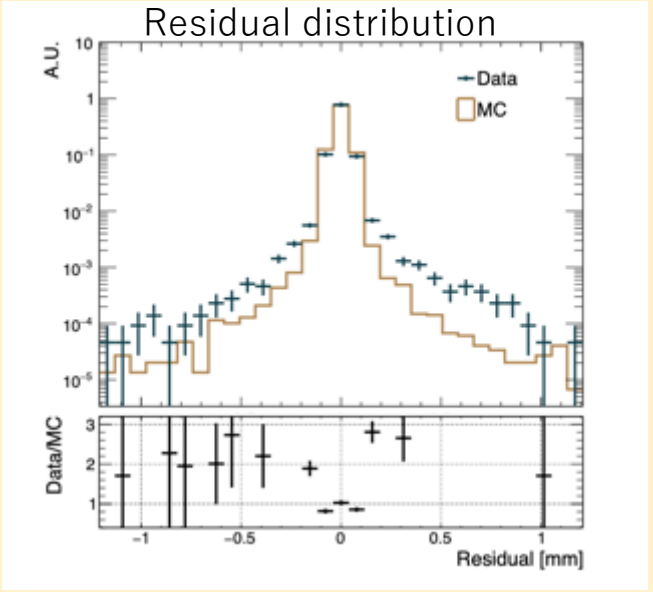
7) Feedback of detector performance parameters to simulation?

- The INTT GEANT model has been developed through past 3 beam tests.
- The model reproduces experimental data reasonably well, but still some room to be improved.

These parameters are to be optimized during the commissioning and we will feedback to the simulation.







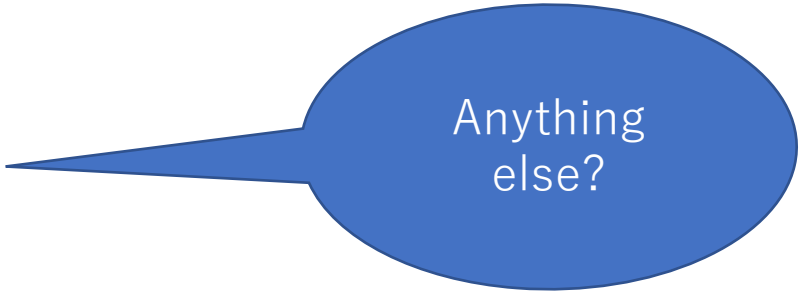
Courtesy of Cheng-Wei Shih

8) Who will work on the analysis?

- One ~ two dedicated Postdoc
  - Genki Nukazuka (RBRC)
  - One new opening this Spring (RBRC)
- 3 dedicated Ph.D students who will write their thesis with INTT/sPHENIX.
  - Cheng-Wei Shih (National Central University, Taiwan)
  - Joseph Bertaux (Purdue University, USA)
  - Jaein Hwang (Korea University, South Korea)
- Dedicated master's students
  - 6 (Nara Women's University), 3 (Rikkyo Univ.), 1 (NCU)
  - + undergrads
- Senior Scientists
  - Takashi, Maya, Rachid, Itaru, Yasuyuki, Chia-Ming, Wei, …

9) Does the analysis code exist in fun4all?

- Yes:
  - Online Monitor, GEANT Simulation
- To be committed:
  - DAC scan codes, and other commissioning codes.
- Not yet developed:
  - Gain matching analysis code, etc…



10) Do we have maps connecting detector channels to trkrhitmap positions for rawdata unpacker?

- The rawdata format is under development by Raul Guidolini (Instrumentation group) and so as a decorder by Martin.
- The ladder channel map is also under optimization now.
- Once they are settled, we are planning to establish the connection map and saved in the PostgresSQL database. This scheme is the part of the expert GUI development.