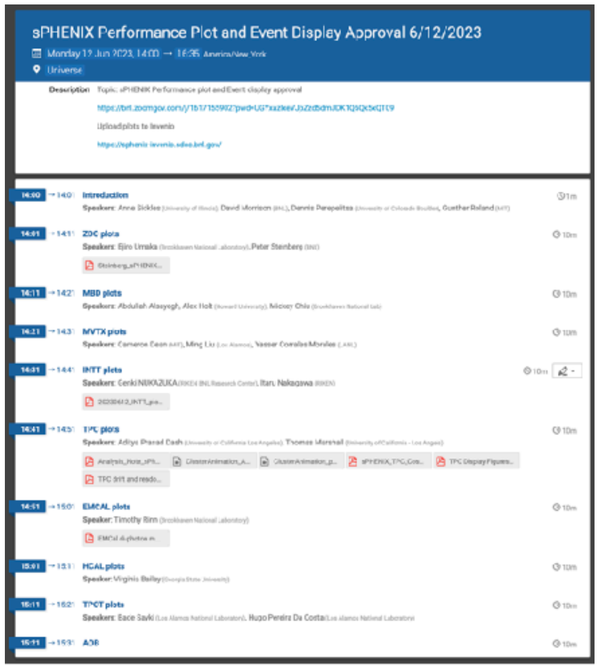
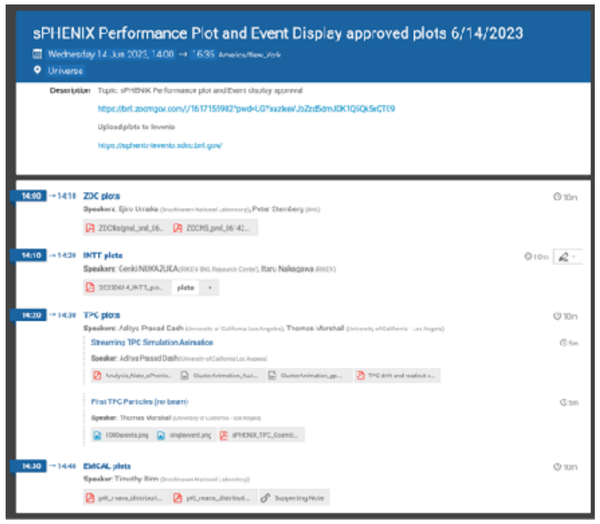
A Report of sPHENIX Performance Plot and Event Display approved plots

Genki Nukazuka (RIKEN/RBRC),
Maya Shimomura (NWU),
Mai Kano (NWU),
Takashi Hachiya (NWU)
on behalf of the INTT collaboration

Meeting for Plot Approval

The meeting was held in June/12. I gave a presentation and had some comments/ homework. Those were shared by e-mail. After correcting the plots, I upload them here.





Genki Nukazuka <nukadukagenki@gmail.com>
To Itaru, sphenix-intt-l

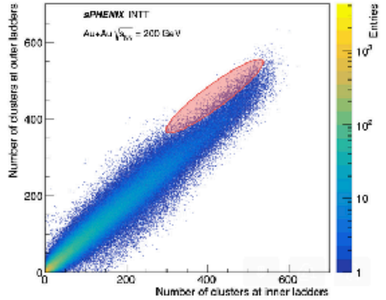
Dear all,

I briefly summarize the discussion/comments/homework in the meeting.

General Comments
- Add "Internal" next to the letter "sPHENIX" to all plots.
  -> Genki, Mai, and Maya will add it.
- Add the date of approval to all plots. (or the date when the plot is made but not the date of data taking)
  -> Genki, Mai, and Maya will add it.
- Add words to indicate that a part of INTT was used in this analysis.
  -> Genki, Mai, and Maya will add it.
- Don't use jargon (e.g. INTT2 and INTT3).
  -> We will follow the suggestion. We need to come up with nice words.

time-in plot
- What is the small mountain at x=
  -> Answer by Rachid: Debunching of the beam
  -> Suggestion to us: Take another data (or scan again) in the same condition
- The unit for the y-axis
  -> Genki will change it to "[arbitral unit]"
- (cosmetics) Suggestion of changing the plotting style from dots to dots with connecting lines or histogram
  -> Genki will do it

Multiplicity of the inner vs outer
- What is the asymmetric shape of the distribution (the red circle in the figure below)?
  -> We don't have any clear interpretation of the shape. Since the analysis was done without data cuts, some more studies with cuts may give a hint.



- (cosmetics) The sPHENIX standard style seemed not to be used.
  -> Genki disagreed with the comment, but Mai confirmed after the meeting that it was not used... She will make the plot using the style.

Hits (cluster) correlation between intt2 nad intt3
- Why are the statistics quite low than the plot of the inner vs the outer?
  -> Because only a part of the data was analyzed.
  -> Maya will analyze again using full data taken in the run.

We will follow the suggestions and make plots as soon as possible.
If you have any comments, please let me know.

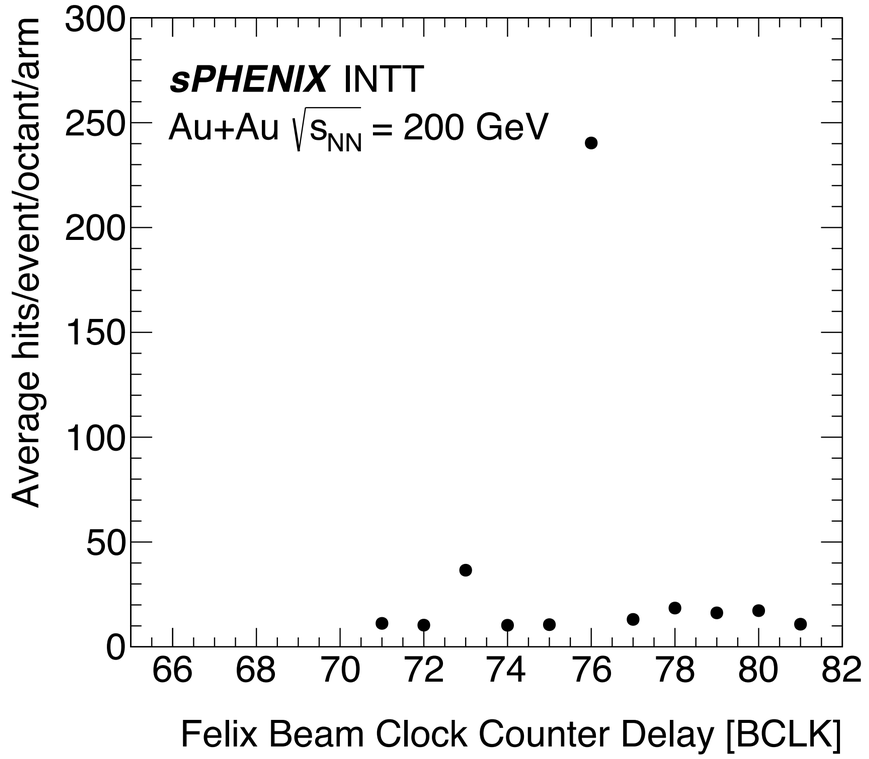
Dear Maya and Mai,

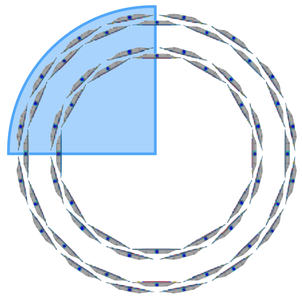
Let's have a discussion and make new plots!

Best regards,
Genki

Hit Rate as a Function of Beam Clock Delay in FELIX

— Evidence of Time-in —





The cross-section seen from the south side.

List of half-ladders used in this analysis

B0L006S	B0L106S	B1L008S	B1L108S
B0L007S	B0L107S	B1L009S	B1L109S
B0L008S	B0L108S	B1L010S	B1L110S
		B1L011S	B1L111S

Note: 1/8 of all ladders analyzed.

Condition

- Date: May/30/2023
- Run: 8116 - 8125
- Beam: √s = 200 GeV, 56 × 56 bunches
- DAQ: GL1 trigger
- Parameters
  - Number of BCLK tags to be recorded: 1 [BCLK]
  - L1 Delay: 25 [BCLK]
  - DAC0 threshold: 23 [ch]

Axes

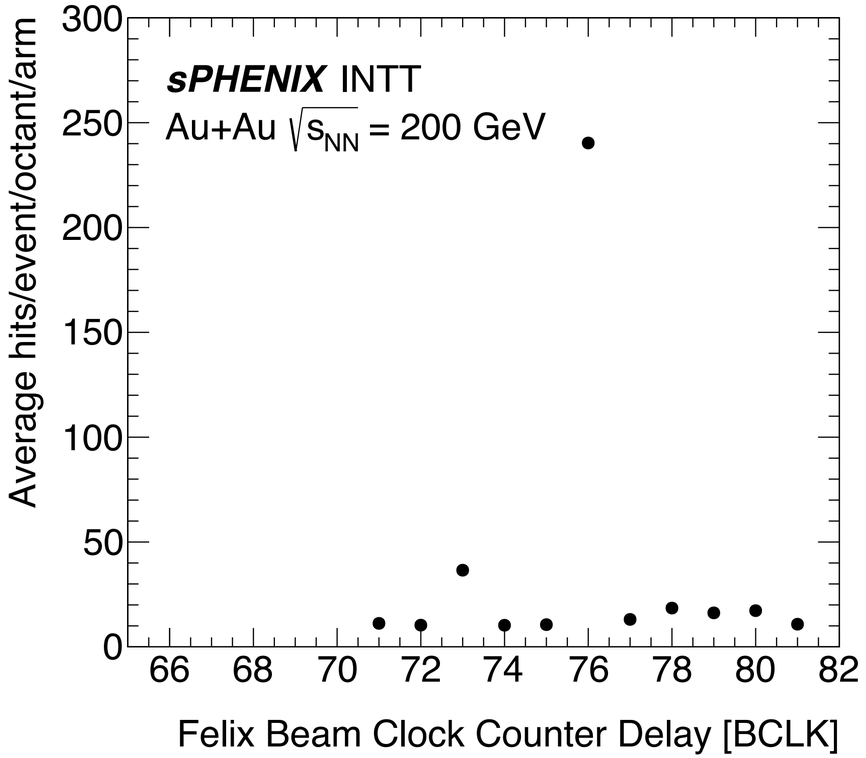
- x: Delay of the beam clock counter in the FELIX
- y: Hit rate
  - The number of hits on chip1-13 of all 14 ladders connected to INTT FELIX Server 2 per event

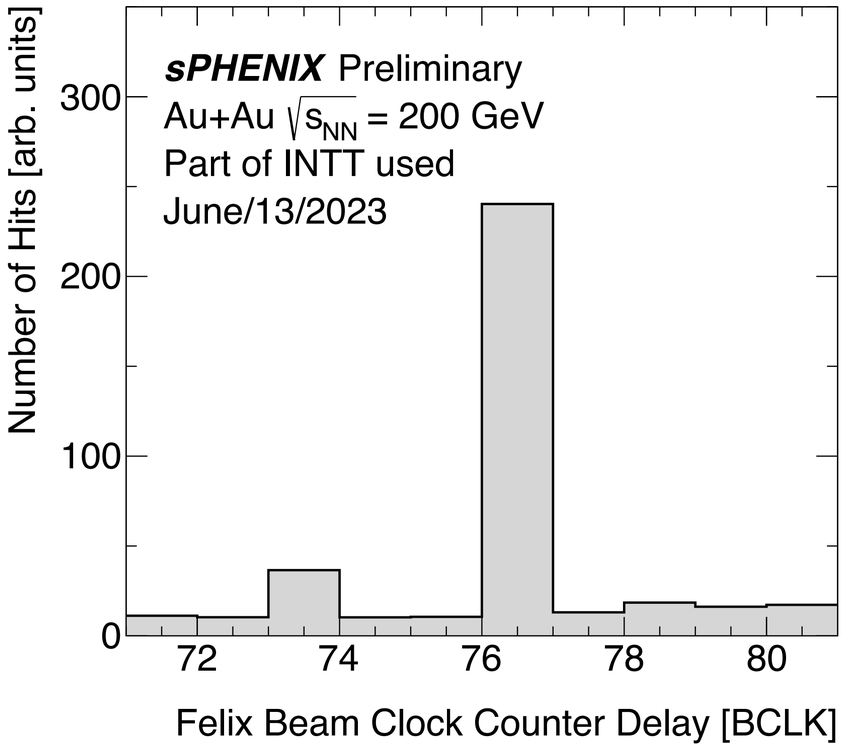
Explanation

Hit rate measurements with various values of the delay shows a hot spot at 76 BCLK. The hits originate from the beam. Timing resolution was confirmed to be less than 1 BCLK as designed.

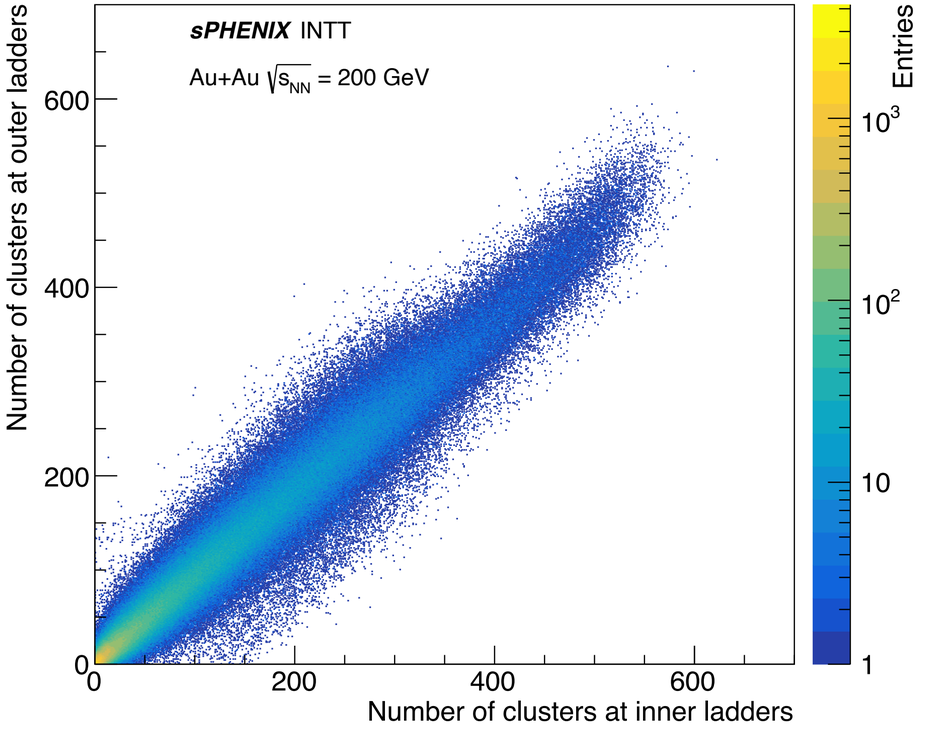
Hit Rate as a Function of Beam Clock Delay in FELIX

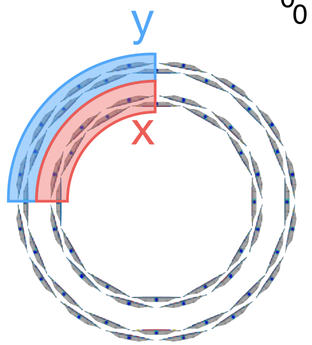
— Evidence of Time-in —





Multiplicity Correlation Between the Inner and the Outer Ladders





The cross-section seen from the south side.

List of half-ladders used in this analysis

B0L006S	B0L106S	B1L008S	B1L108S
B0L007S	B0L107S	B1L009S	B1L109S
B0L008S	B0L108S	B1L010S	B1L110S
		B1L011S	B1L111S

Note: 1/8 of all ladders analyzed.

Condition

- Date: June/05/2023
- Run: 9328
- Beam: $\sqrt{s}$ = 200 GeV, 56 × 56 bunches
- No magnetic field
- DAQ: GL1 trigger
- Parameters
  - Number of BCLK tags to be recorded: 5 [BCLK]
  - L1 Delay: 25 [BCLK]
  - Delay of the beam clock counter in the FELIX: 78 [BCLK]
  - DAC0 threshold: 15 [ch]

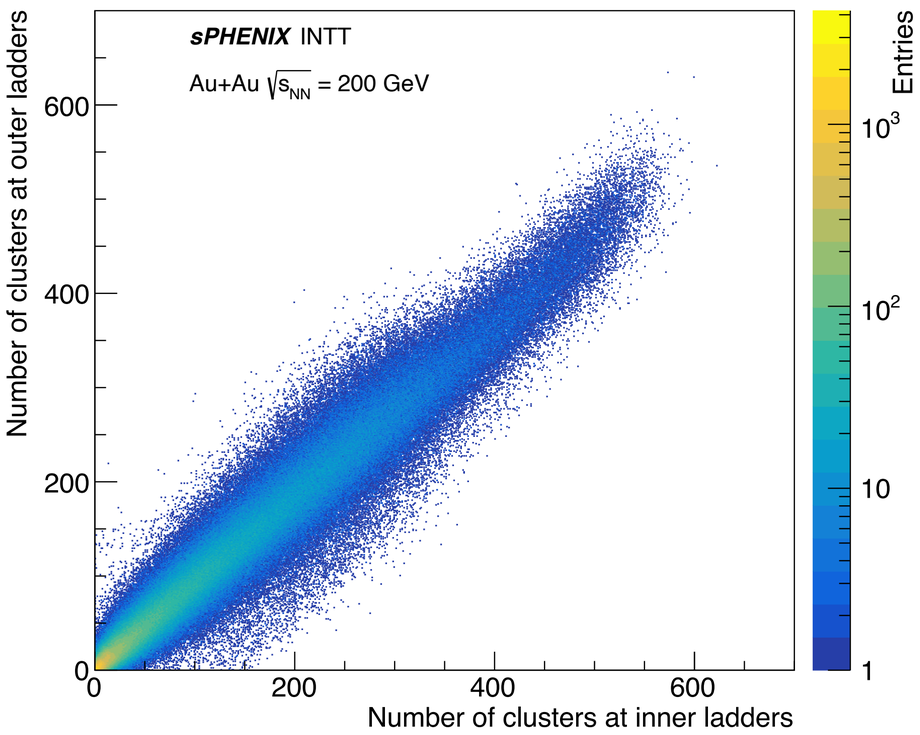
Axes

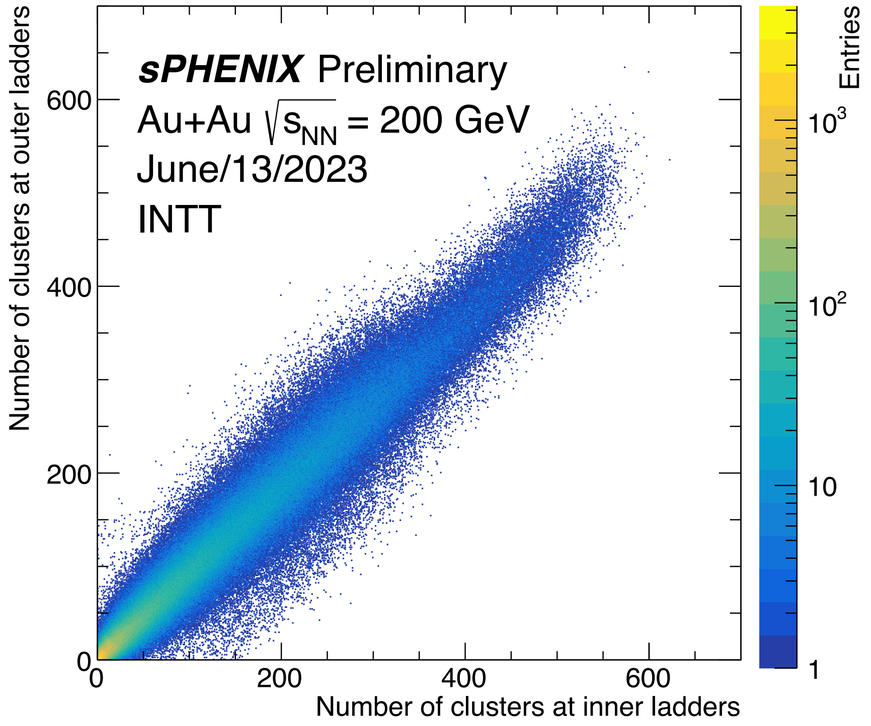
- x: Multiplicity of 6 inner half-ladders connected to a FELIX
- y: Multiplicity of 8 outer half-ladders connected to the FELIX
- here, multiplicity is the number of hit clusters per event.

Explanation

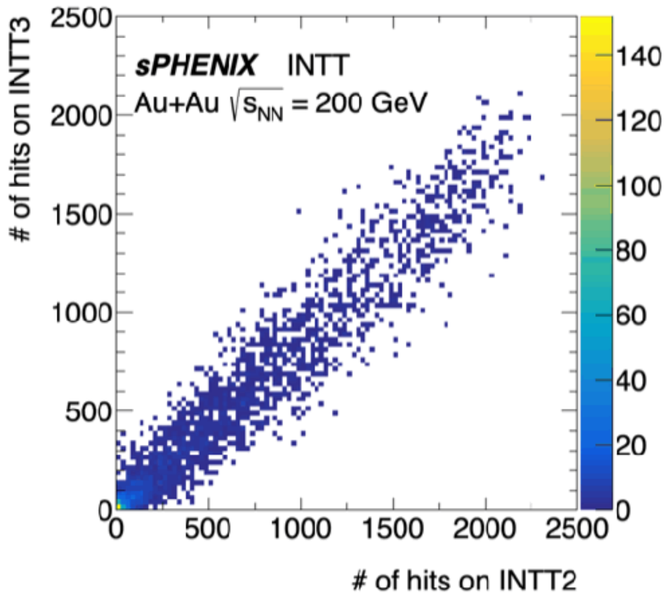
A multiplicity of the inner correlates to that of the outer barrel. It agrees with a naive physics picture: if a particle penetrates the inner barrel, it also goes through the outer barrel. It proves that hits are correlated and not random within a FELIX server.

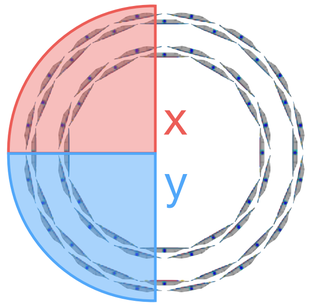
Multiplicity Correlation Between the Inner and the Outer Ladders





Number of Hits Correlation Between Two FELIXs
— Confirmation of Event Synchronization —





The cross-section seen from the south side.

List of half-ladders used in this analysis

intt2		intt3	
B0L006S	B1L009S	B0L009S	B1L013S
B0L007S	B1L010S	B0L010S	B1L014S
B0L008S	B1L011S	B0L011S	B1L015S
B0L106S	B1L108S	B0L109S	B1L112S
B0L107S	B1L109S	B0L110S	B1L113S
B0L108S	B1L110S	B0L111S	B1L114S
B1L008S	B1L111S	B1L012S	B1L115S

Note: 1/4 of all ladders analyzed.

Condition

- Date: June/05/2023
- Run: 9328
- Beam: $\sqrt{s}$ = 200 GeV, 56 × 56 bunches
- No magnetic field
- DAQ: GL1 trigger
- Parameters
  - Number of BCLK tags to be recorded: 5 [BCLK]
  - L1 Delay: 25 [BCLK]
  - Delay of the beam clock counter in the FELIX: 78 [BCLK]
  - DAC0 threshold: 15 [ch]

Axes

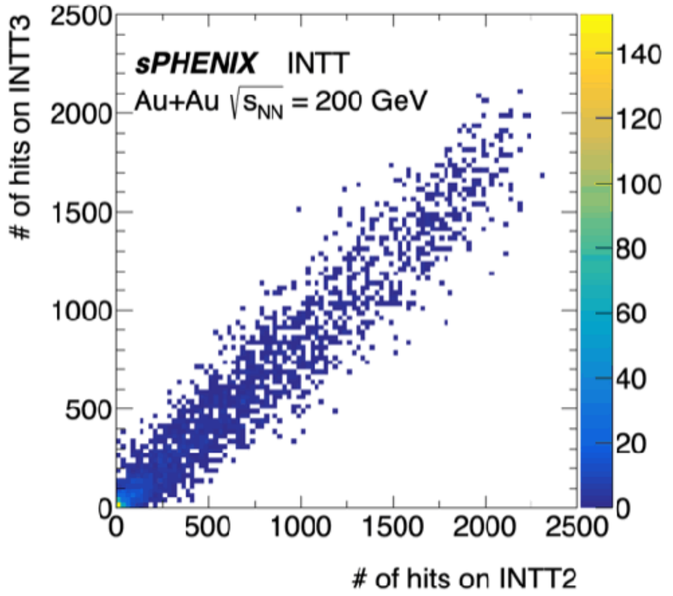
- x: The number of hits of 14 half-ladders connected to INTT2
- y: The number of hits of 14 half-ladders connected to INTT3

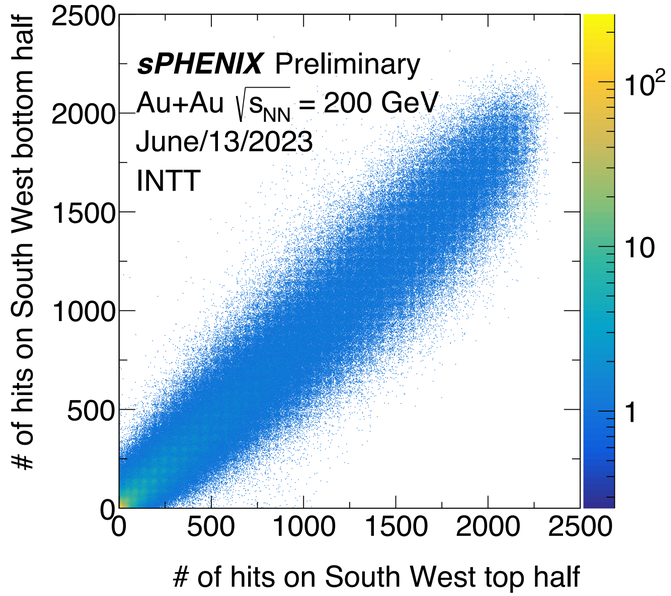
Explanation

Timing synchronization among FELIX servers is crucial for the best timing resolution over the whole acceptance. By selecting events with the same beam clock count, The plot shows the clear multiplicity correlation between the clusters of one Felix(INTT2) and that of another (INTT3). This means we see the signal from collisions.

Number of Hits Correlation Between Two FELIXs

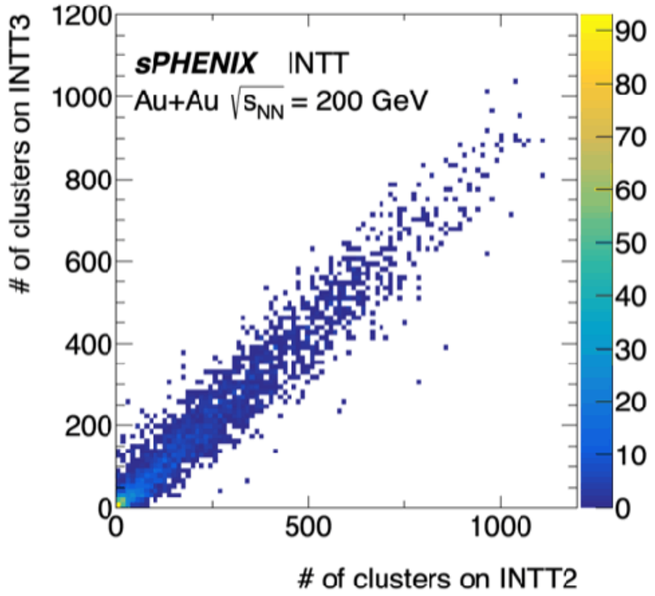
— Confirmation of Event Synchronization —

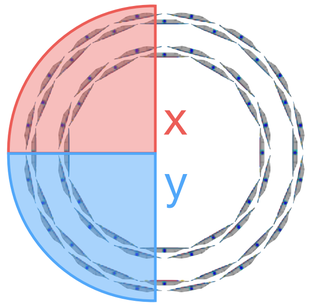




Number of Clusters Correlation Between Two FELIXs

— Confirmation of Event Synchronization —





The cross-section seen from the south side.

List of half-ladders used in this analysis

intt2		intt3	
B0L006S	B1L009S	B0L009S	B1L013S
B0L007S	B1L010S	B0L010S	B1L014S
B0L008S	B1L011S	B0L011S	B1L015S
B0L106S	B1L108S	B0L109S	B1L112S
B0L107S	B1L109S	B0L110S	B1L113S
B0L108S	B1L110S	B0L111S	B1L114S
B1L008S	B1L111S	B1L012S	B1L115S

Note: 1/4 of all ladders analyzed.

Condition

- Date: June/05/2023
- Run: 9328
- Beam: $\sqrt{s}$ = 200 GeV, 56 × 56 bunches
- No magnetic field
- DAQ: GL1 trigger
- Parameters
  - Number of BCLK tags to be recorded: 5 [BCLK]
  - L1 Delay: 25 [BCLK]
  - Delay of the beam clock counter in the FELIX: 78 [BCLK]
  - DAC0 threshold: 15 [ch]

Axes

- x: The number of hit clusters of 14 half-ladders connected to INTT2
- y: The number of hit clusters of 14 half-ladders connected to INTT3

Explanation

Timing synchronization among FELIX servers is crucial for the best timing resolution over the whole acceptance. By selecting events with the same beam clock count, The plot shows the clear multiplicity correlation between the clusters of one Felix(INTT2) and that of another (INTT3). This means we see the signal from collisions.

Number of Clusters Correlation Between Two FELIXs

— Confirmation of Event Synchronization —