

# Plots of hot/dead channel algorithm to show in JPS meeting

2024/3/13

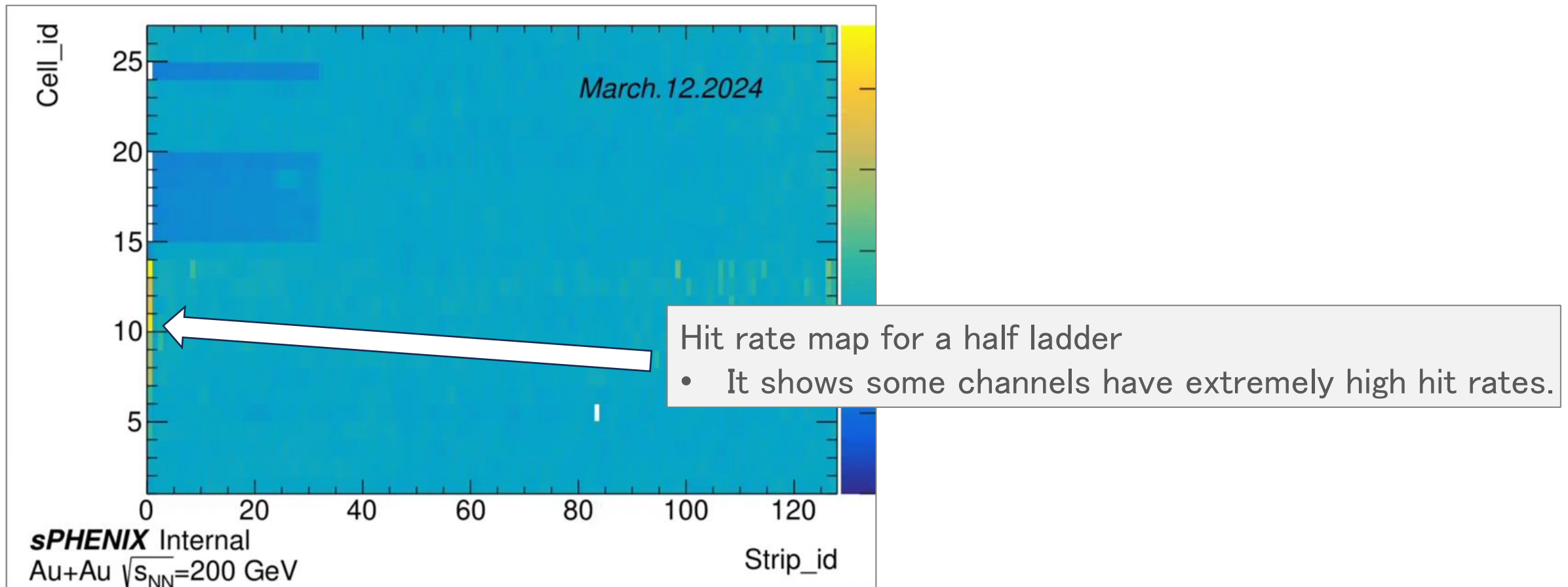
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# Hot/Dead channel algorithm

I developed the hot/dead channel algorithm with Jaein in November and December last year, and finished cross-checking.

I'll report this result at the JPS(Physical Society of Japan) meeting, and today I'll show you the plots.



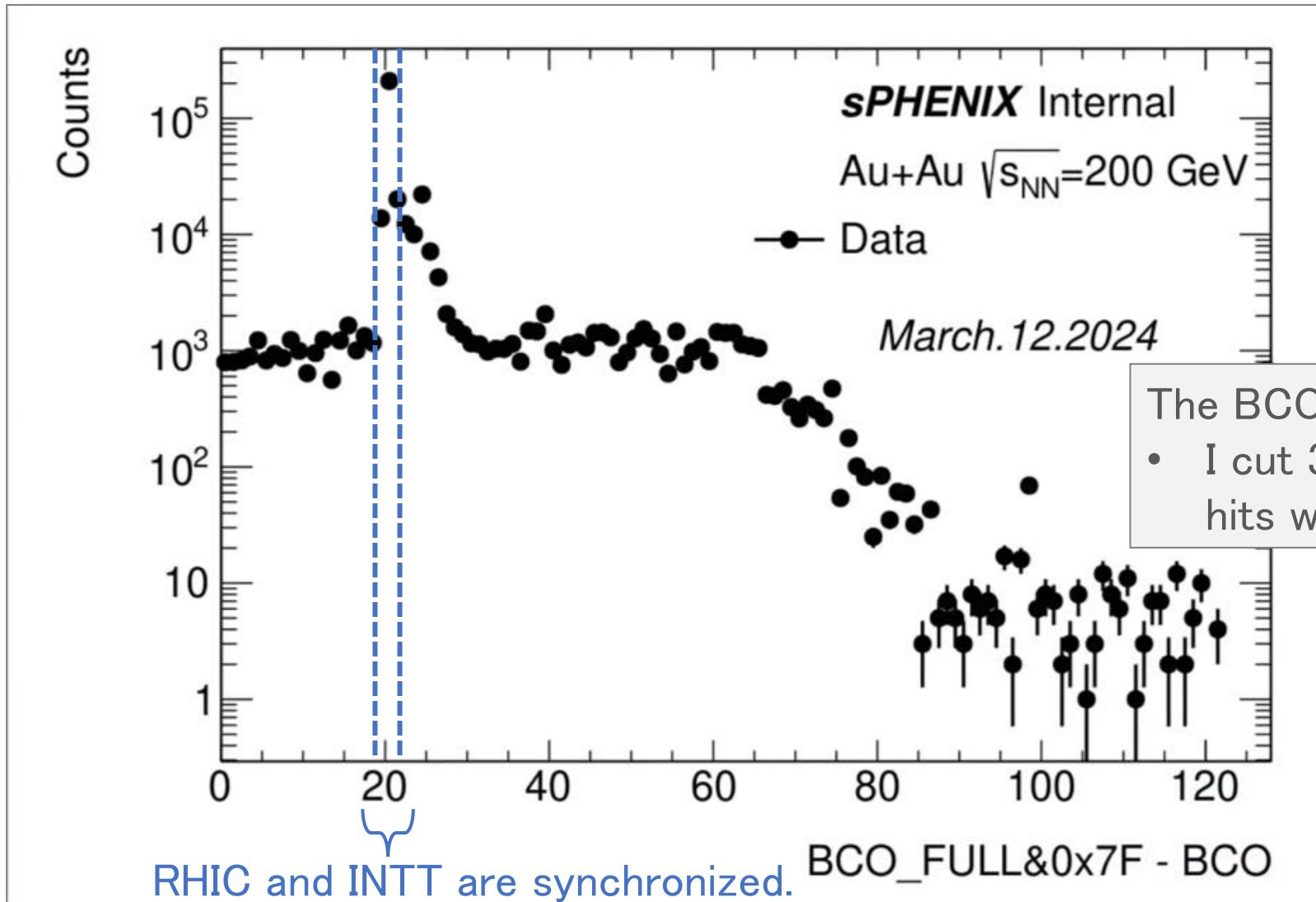
# Algorithm

After I removed noise, I defined bad channels based on hit rate variation.

1. Noise cut
  - Clone hit cut
  - BCO cut
2. Making a hit rate distribution and Gaussian fitting
3. Channel classification

I analyzed 10,000 events with Run 20869 performed in 2023.

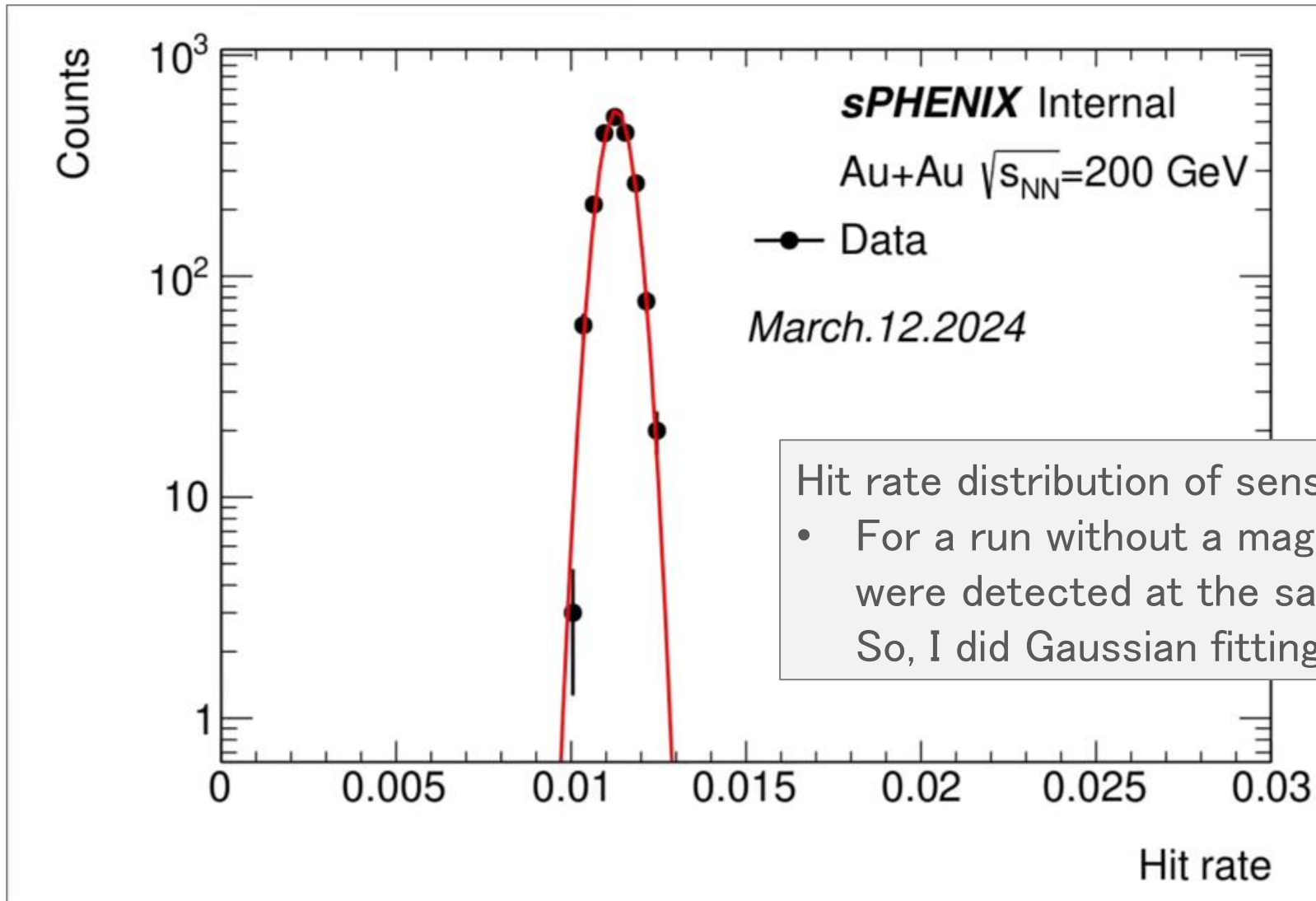
# BCO cut



The BCO distribution for a half ladder

- I cut 3 bins around the peak in this plot as hits which RHIC and INTT are synchronized.

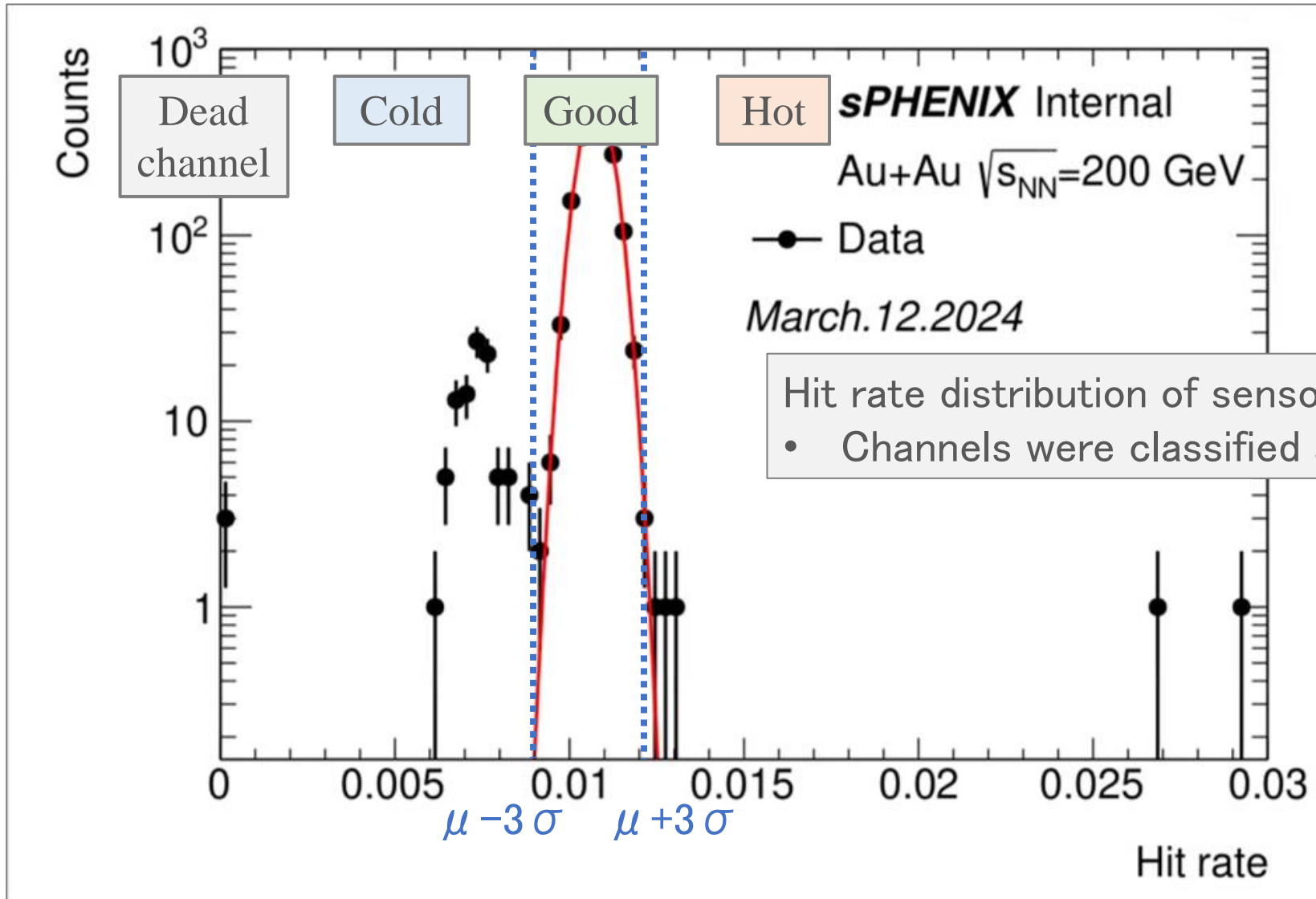
# Gaussian fitting to hit rate distribution



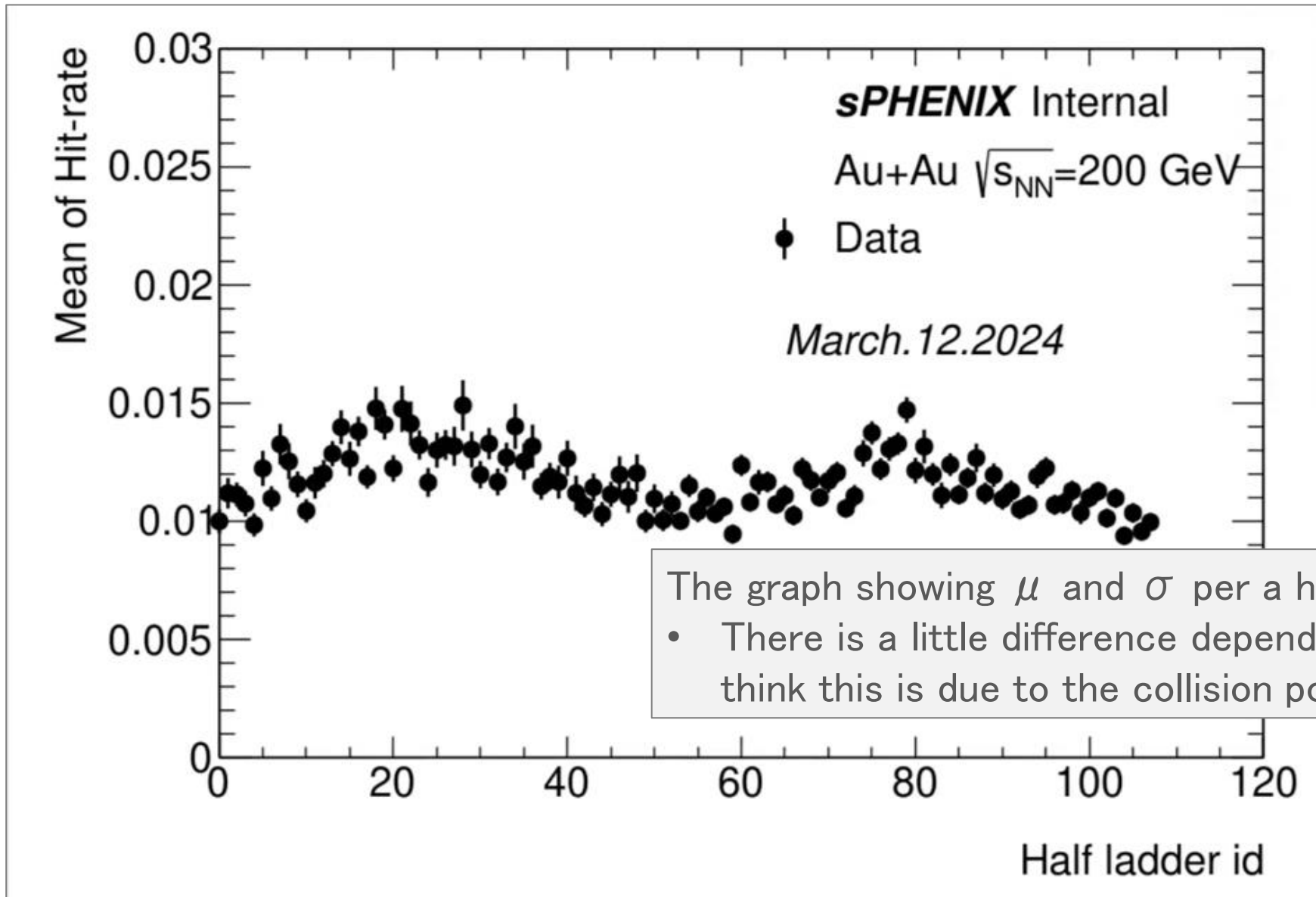
Hit rate distribution of sensor Type-A for a half ladder

- For a run without a magnetic field, I assumed that particles were detected at the same rate in all directions of the INTT. So, I did Gaussian fitting.

# Channel classification



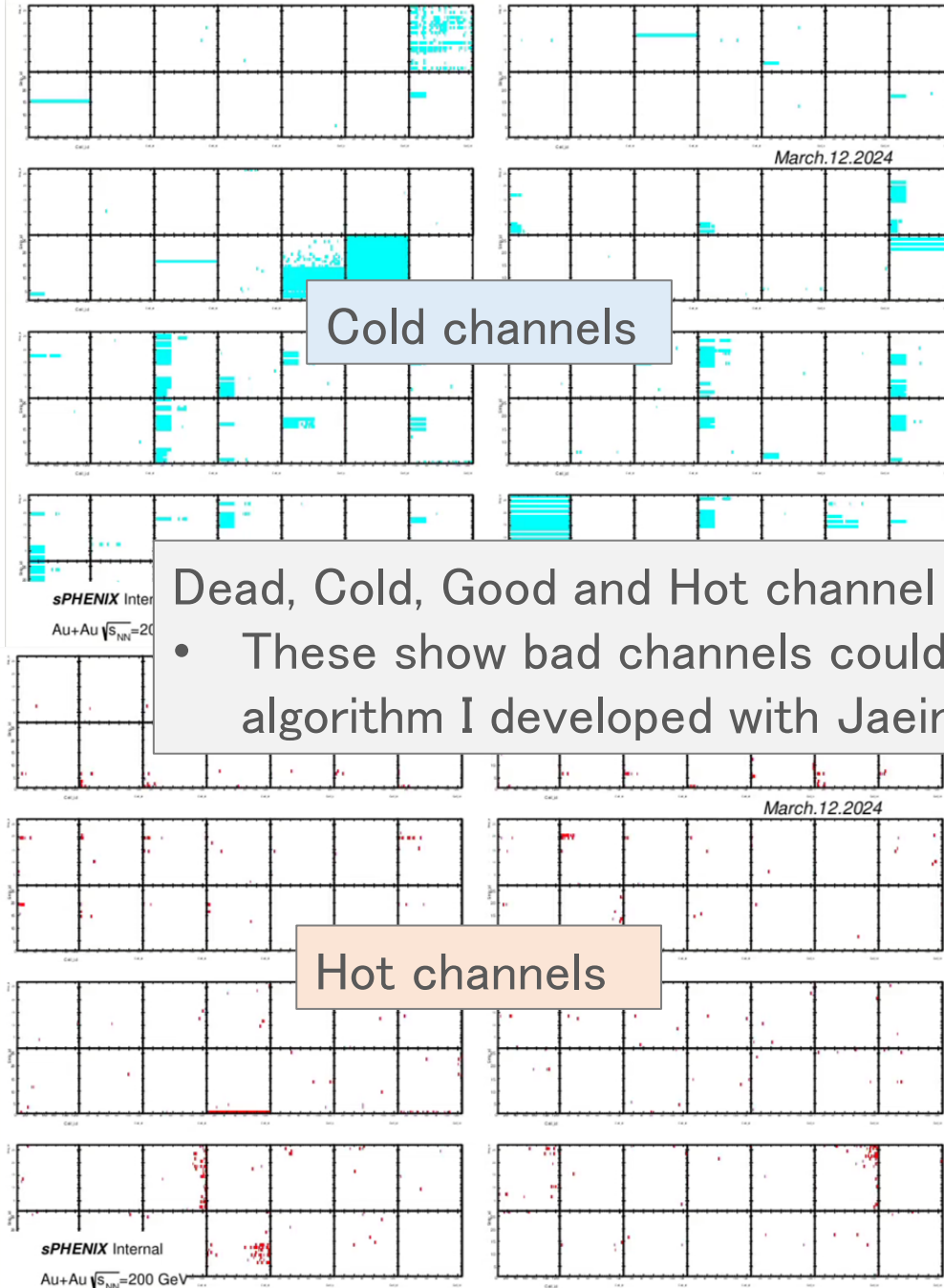
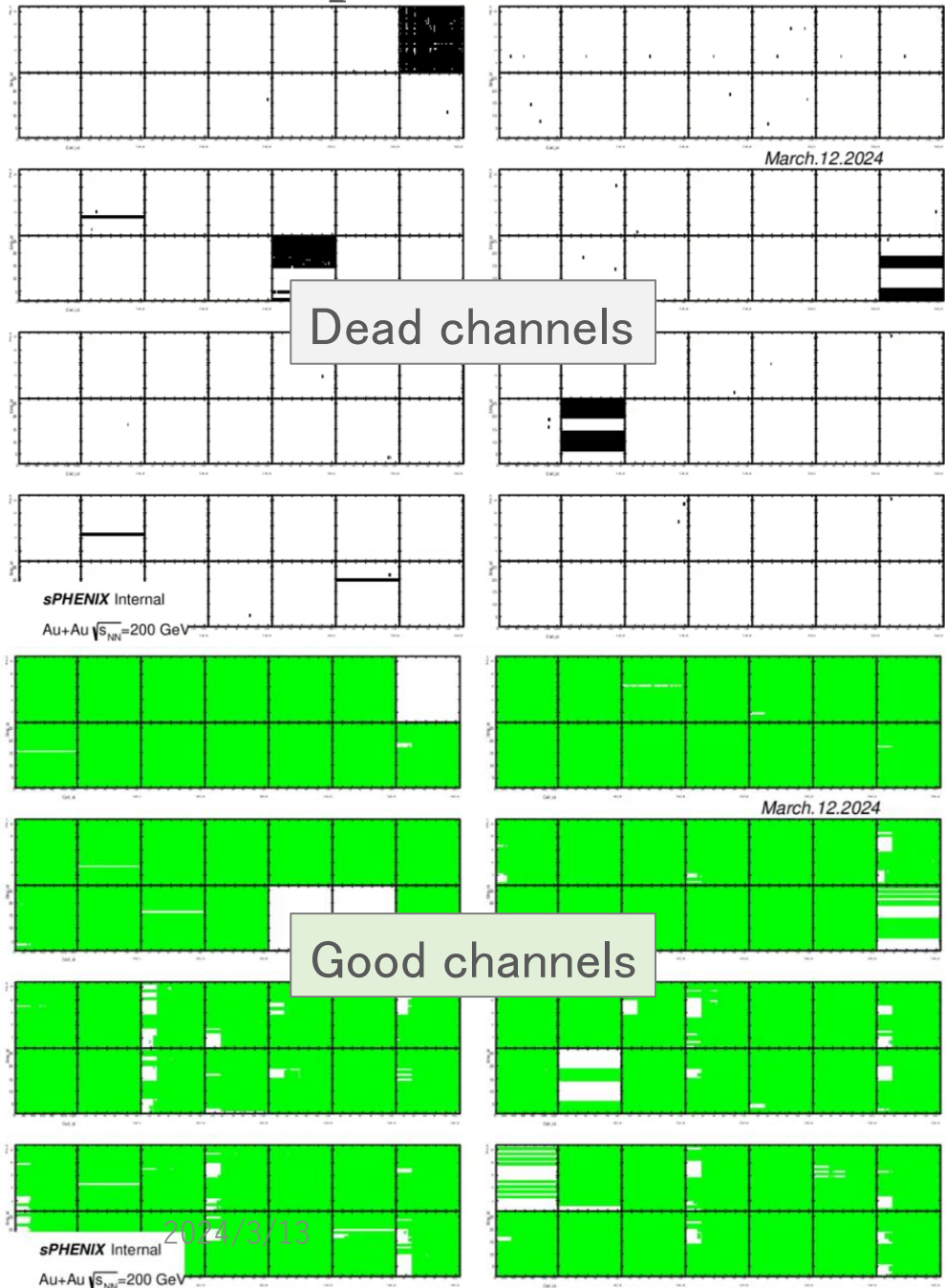
# Fitting parameter per a half ladder



The graph showing  $\mu$  and  $\sigma$  per a half ladder

- There is a little difference depending on the half ladder, but I think this is due to the collision point being shifted in XY plane.

# Channel map



Dead, Cold, Good and Hot channel maps for all ladders

- These show bad channels could be detected with algorithm I developed with Jaein.



# Summary

- I analyzed Au-Au collision data from the sPHENIX experiment in 2023, and verified the operation of INTT.
- In order to remove bad (hot, cold and dead) channels from the analysis, I developed hot/dead channel algorithm with Jaein and finished cross-checking.

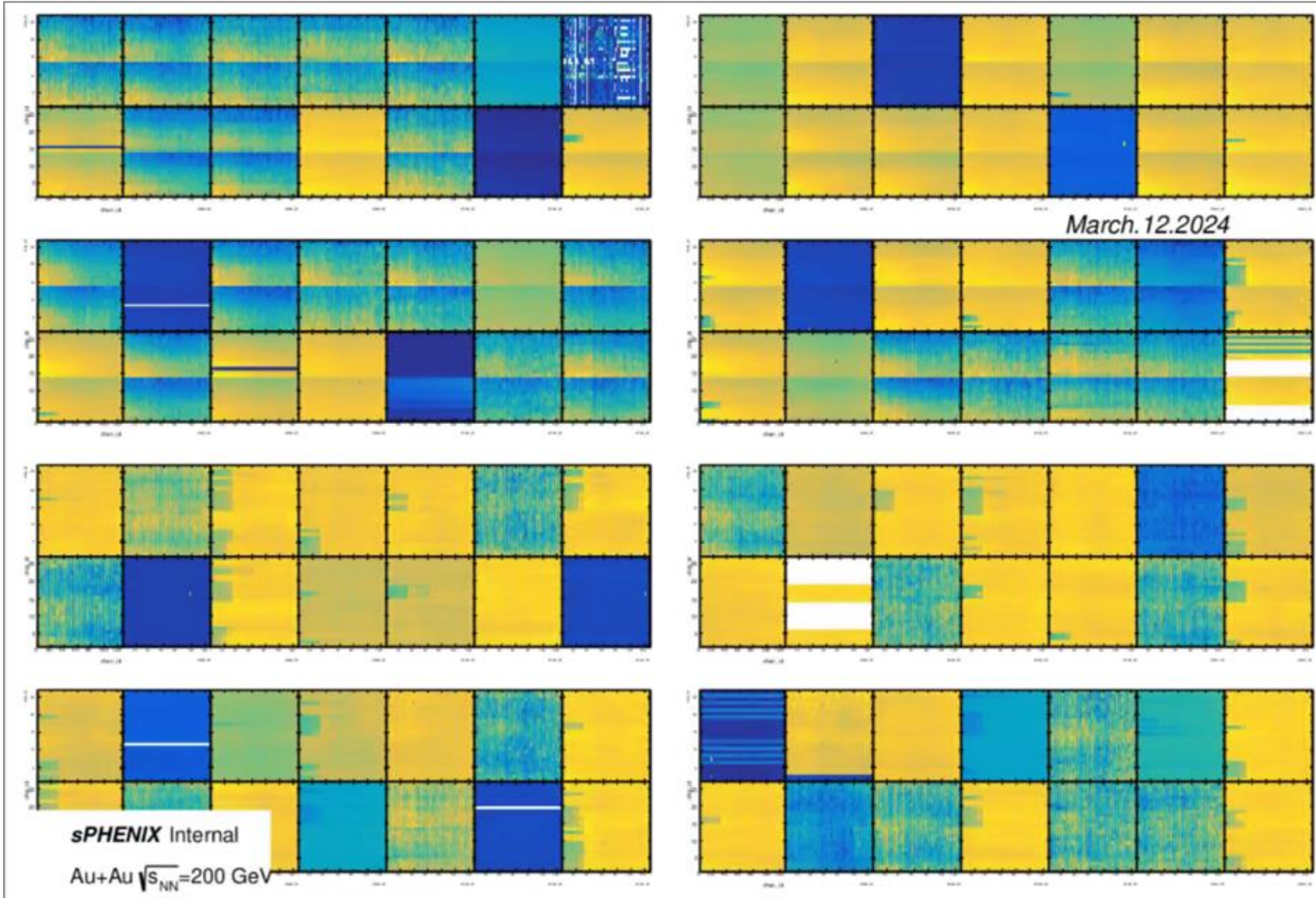
```
all Felix  
bad channel by Yuka: 0  
bad channel by Jaein: 1  
bad channel by both: 11455  
mismatched ratio: 8.72905e-05
```

We confirmed that it was consistent with Jaein's and my code in December last year.

- I'll report this results and show some plots in JPS meeting.

# Back up

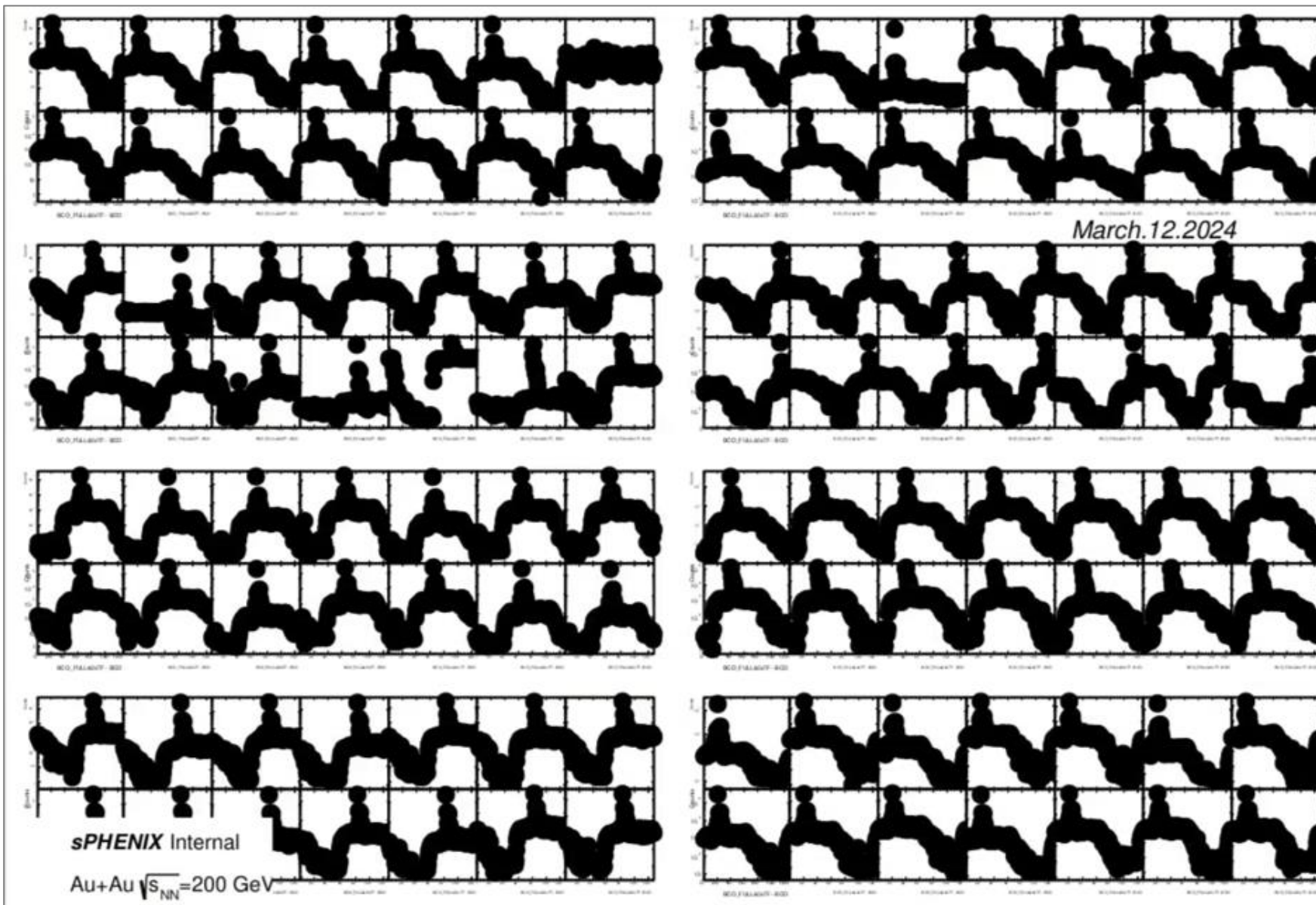
# Hit rate map for all ladders



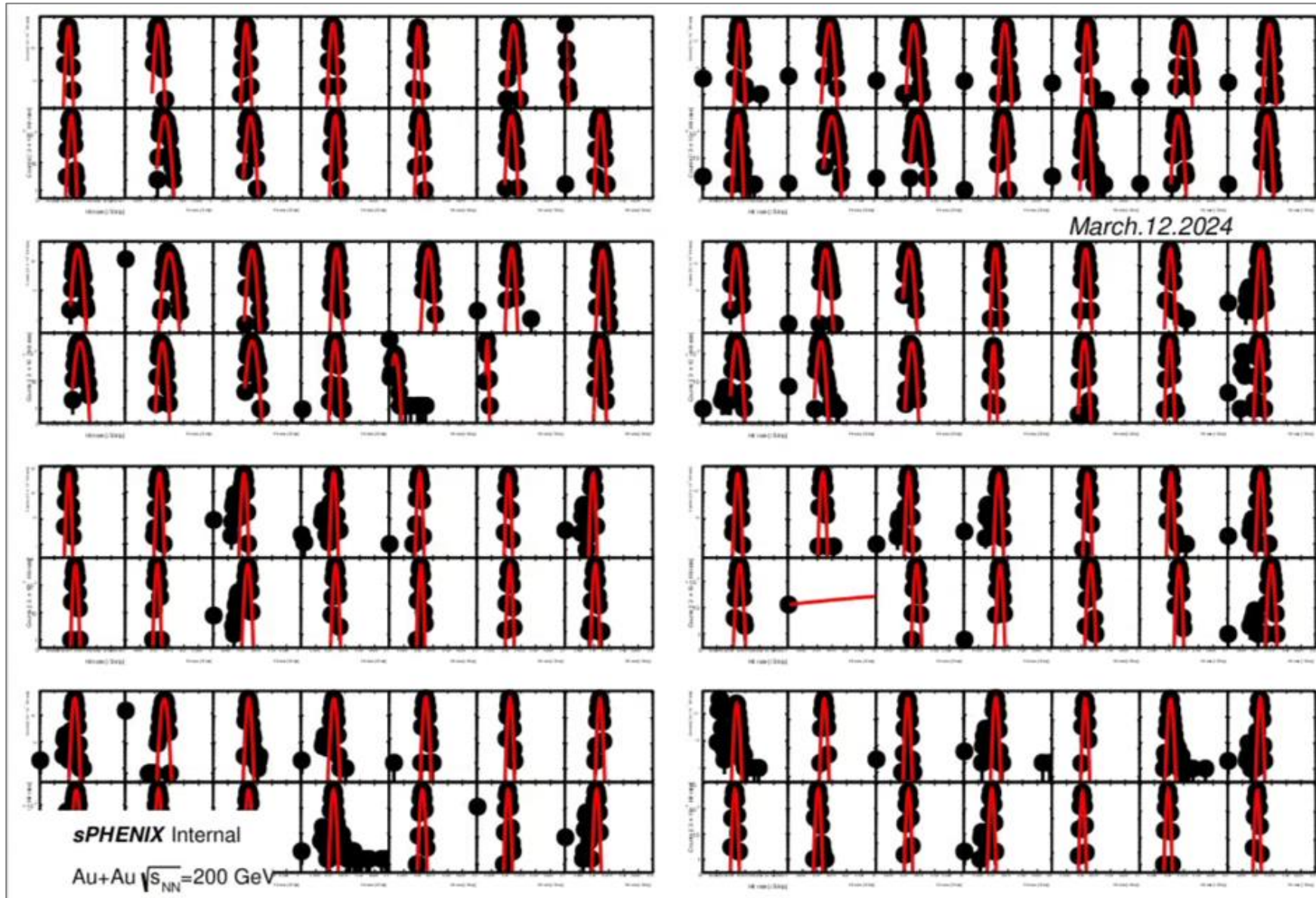
2024/3/13

INTT meeting

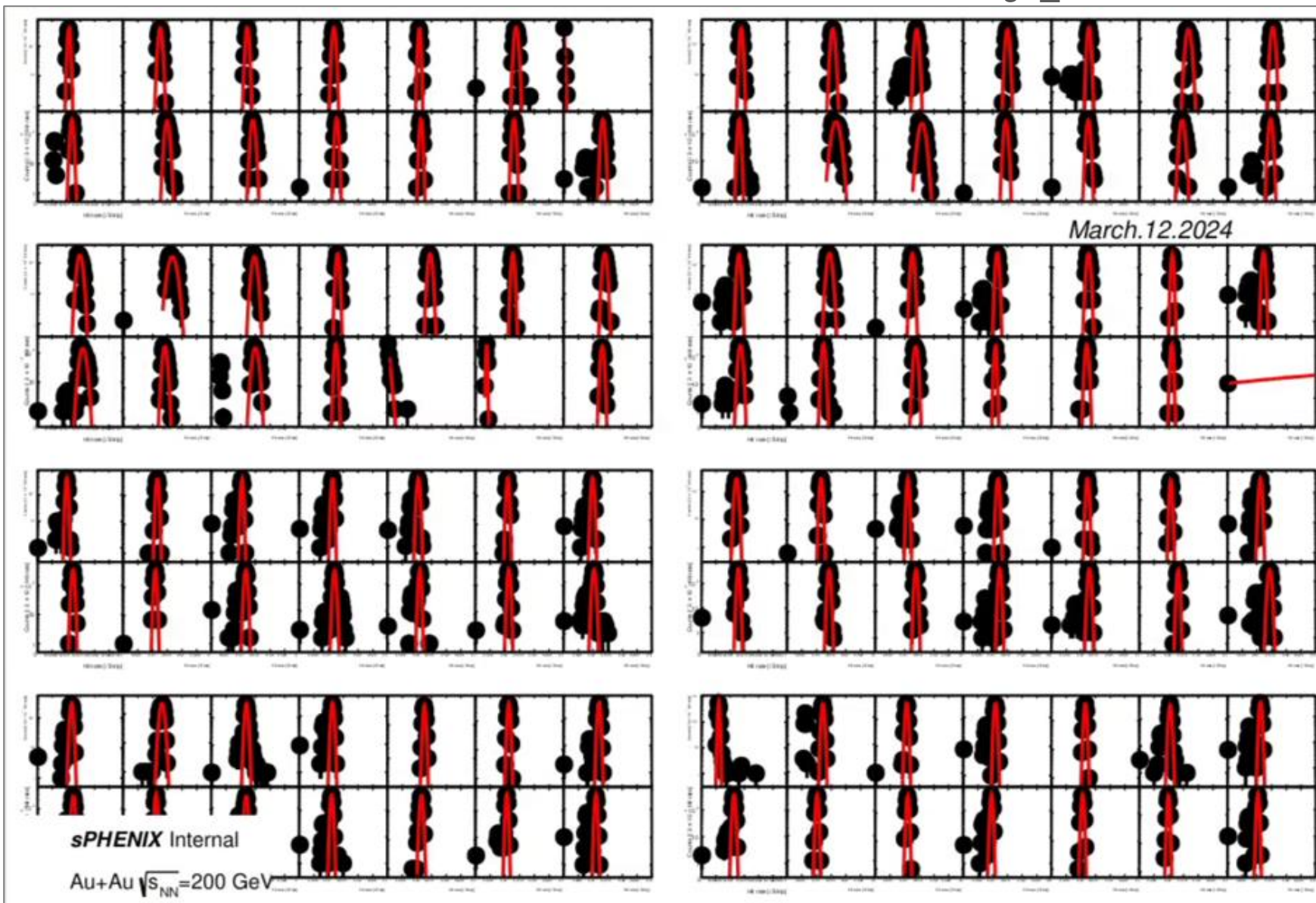
# BCO distribution for all ladders



# Hit rate distribution of sensor Type-A for all ladders

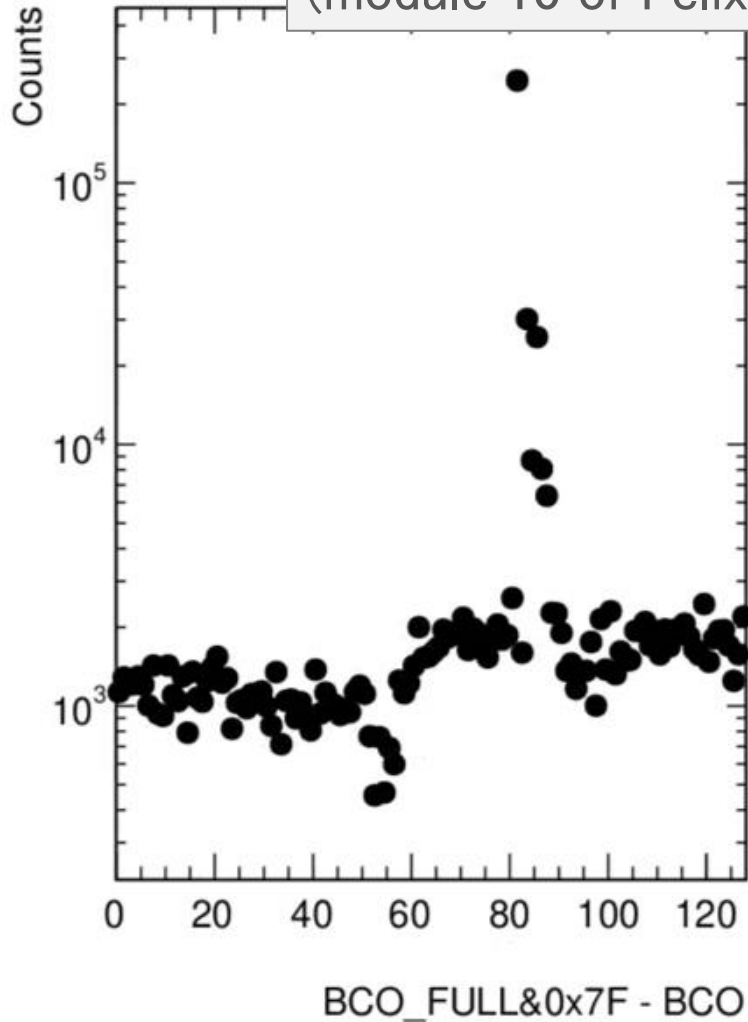


# Hit rate distribution of sensor Type-B for all ladders

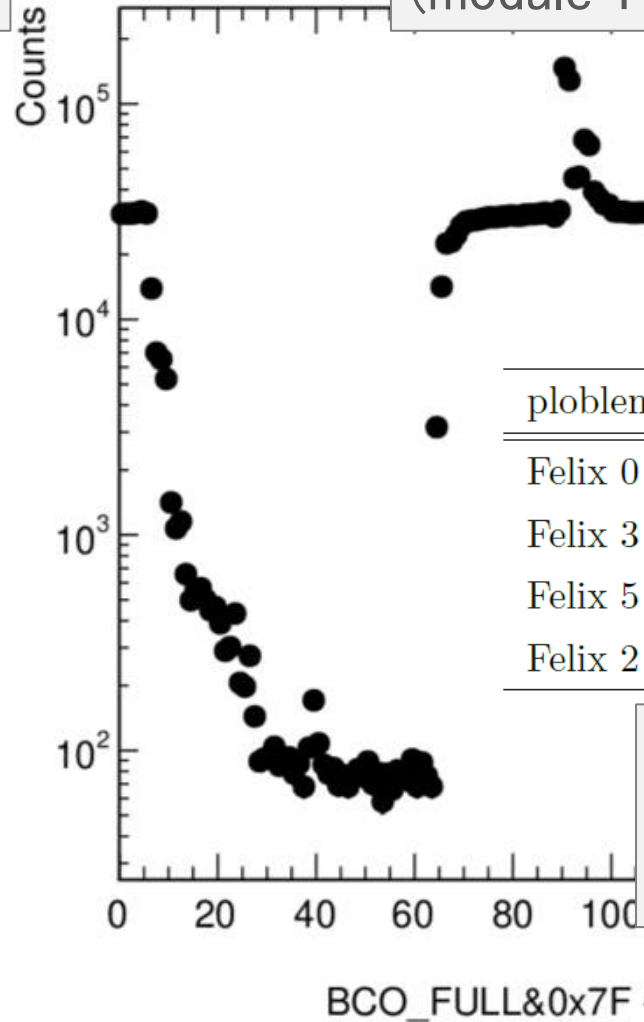


# The problematic ladders

A good ladder  
(module 10 of Felix 2)



A problematic ladder  
(module 11 of Felix 2)



In module 11 and 12 of Felix 2, it was confirmed that the shape of the BCO distribution is strange.

problematic sensor	原因
Felix 0 Ladder 6 Type A,B	due to the no-timed in
Felix 3 Ladder 13 Type B	Masked due to no bias
Felix 5 Ladder 8 Type A	Masked due to no bias
Felix 2 Ladder 11,12 Type A,B	due to the BCO distribution

⇒ When the cause is already revealed, these ladders are defined as problematic ladders.

# The result to detect each channel

The ratio of each channel to the entire INTT was calculated using Run 20869.

Channel	The ratio to entire the INTT
Good	93.1 %
Dead	0.2 %
Cold	2.9 %
Hot	0.3 %
Problematic ladder	3.6 %

} Bad channel

→The ratio of good channel which can be used is about 93.1 % in Run 20869.

→The bad channels can be detected according to this algorithm.



## Comparison Jaein's and my hot channel list

Felix0

```
hot channel by Yuka: 0  
hot channel by Jaein: 0  
hot channel by both: 75  
mismatched ratio: 0
```

Felix4

```
hot channel by Yuka: 0  
hot channel by Jaein: 0  
hot channel by both: 193  
mismatched ratio: 0
```

Felix1

```
hot channel by Yuka: 0  
hot channel by Jaein: 0  
hot channel by both: 176  
mismatched ratio: 0
```

Felix5

```
hot channel by Yuka: 0  
hot channel by Jaein: 0  
hot channel by both: 64  
mismatched ratio: 0
```

Felix2

```
hot channel by Yuka: 0  
hot channel by Jaein: 0  
hot channel by both: 89  
mismatched ratio: 0
```

Felix6

```
hot channel by Yuka: 0  
hot channel by Jaein: 0  
hot channel by both: 201  
mismatched ratio: 0
```

Felix3

```
hot channel by Yuka: 1  
hot channel by Jaein: 0  
hot channel by both: 93  
mismatched ratio: 0.0106383
```

Felix7

```
hot channel by Yuka: 0  
hot channel by Jaein: 0  
hot channel by both: 137  
mismatched ratio: 0
```

Run 20869,

I removed problematic ladders

- Felix 0 Ladder 6 Type A,B (due to the no-timed in)
- Felix 3 Ladder 13 Type B / Felix 5 Ladder 8 Type A (Masked due to no bias)
- Felix 2 Ladder 11,12 Type A,B (due to the BCO distribution)

```
all Felix  
hot channel by Yuka: 1  
hot channel by Jaein: 0  
hot channel by both: 1028  
mismatched ratio: 0.000971817
```

When I used the analysis method same as Jaein, the mismatched ratio was close to 0. (About 40% before unification)

I compared hot channel lists after confirming that the BCO distribution and a hit map were the same as Jaein.

## Comparison Jaein's and my bad channel list

<code>Felix0 bad channel by Yuka: 0 bad channel by Jaein: 0 bad channel by both: 201 mismatched ratio: 0</code>	<code>Felix4 bad channel by Yuka: 0 bad channel by Jaein: 0 bad channel by both: 2107 mismatched ratio: 0</code>
<code>Felix1 bad channel by Yuka: 0 bad channel by Jaein: 0 bad channel by both: 223 mismatched ratio: 0</code>	<code>Felix5 bad channel by Yuka: 0 bad channel by Jaein: 0 bad channel by both: 1371 mismatched ratio: 0</code>
<code>Felix2 bad channel by Yuka: 0 bad channel by Jaein: 0 bad channel by both: 300 mismatched ratio: 0</code>	<code>Felix6 bad channel by Yuka: 0 bad channel by Jaein: 0 bad channel by both: 2442 mismatched ratio: 0</code>
<code>Felix3 bad channel by Yuka: 0 bad channel by Jaein: 0 bad channel by both: 1008 mismatched ratio: 0</code>	<code>Felix7 bad channel by Yuka: 0 bad channel by Jaein: 1 bad channel by both: 3803 mismatched ratio: 0.000262881</code>

Run 20869,

remove problematic ladders

- Felix 0 Ladder 6 Type A,B (due to the no-timed in)
- Felix 3 Ladder 13 Type B / Felix 5 Ladder 8 Type A (Masked due to no bias)
- Felix 2 Ladder 11,12 Type A,B (due to the BCO distribution)

```
all Felix  
bad channel by Yuka: 0  
bad channel by Jaein: 1  
bad channel by both: 11455  
mismatched ratio: 8.72905e-05
```

Similarly the mismatched ratio was almost 0.

→ I think we finished cross-checking. Next steps need to be discussed.

I compared bad channel lists after confirming that the BCO distribution and a hit map were the same as Jaein.

# Hit rate

粒子を検出したヒットの総数は、衝突事象数や検出感度によって異なるため、規格化する必要がある。

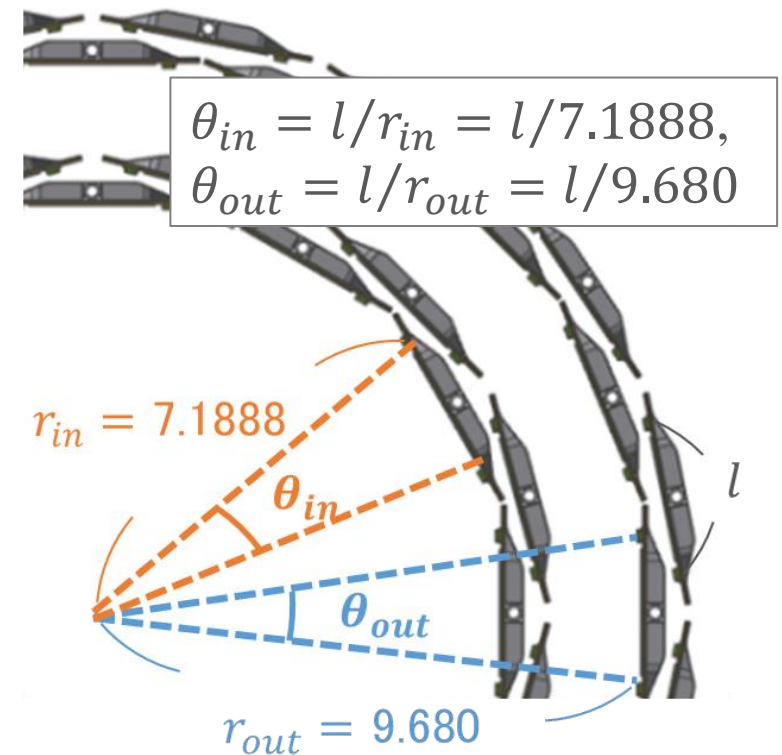
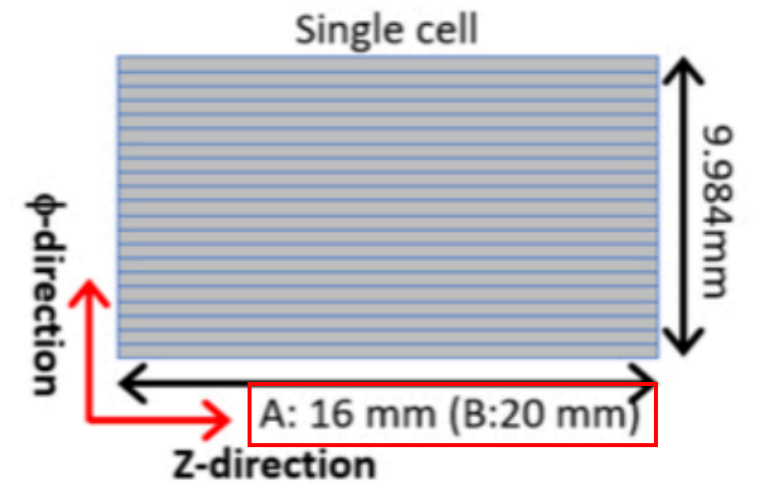
$$\text{ヒットレート } R_{hit} = \frac{1}{\epsilon_{acc} N_{evt}} N_{hit}$$

- $N_{hit}$ : あるChannelでのヒット数
- $N_{evt}$ : 解析したAu-Au衝突事象数
- $\epsilon_{acc}$ : 検出感度の違いを補正する係数

$$\left\{ \begin{array}{l} size = \frac{20mm}{16mm} \end{array} \right. \quad (∵ \text{センサーサイズの違い})$$

$$\left\{ \begin{array}{l} theta = \frac{\theta_{in}}{\theta_{out}} \end{array} \right. \quad (∵ \text{検出角度の違い})$$

$$\epsilon_{acc} = size * theta$$



# Clone hit cut

## 1. データ収集によるノイズ (クローンヒット)

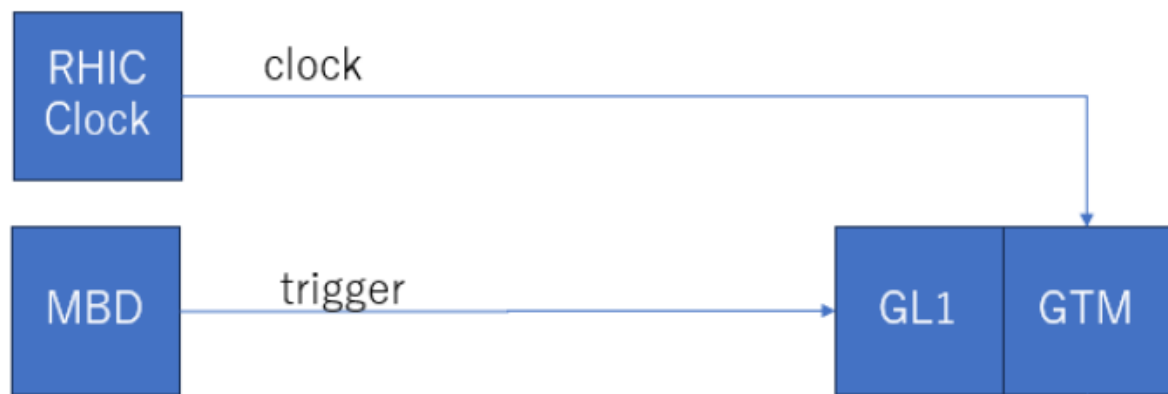
検出されたヒット情報 (Chip, Channel番号など) が同一であるクローンヒットが確認された。実際は1ヒットだが、データ収集系の問題で同じヒットが読み出されたと考えられる。

	ラダー番号	Chip番号	Channel番号
Hit 1	1	10	68
Hit 2	1	10	68
Hit 3	1	10	68

同一のヒットのうち  
2番目以降のヒット(偽ヒット)を除去した。

# BCO cut

## 2. センサーのランダムノイズの除去



ビーム衝突時刻=信号測定時刻のとき  
Au-Au衝突を測定する。

⇒一致しないときの信号はノイズ

ただし、

- 実際はBCO\_FULL ≠ BCO  
(測定開始時刻が異なるため)  
差分 BCO\_FULL - BCO は一定の値

