

*SciFi performance: efficiency*

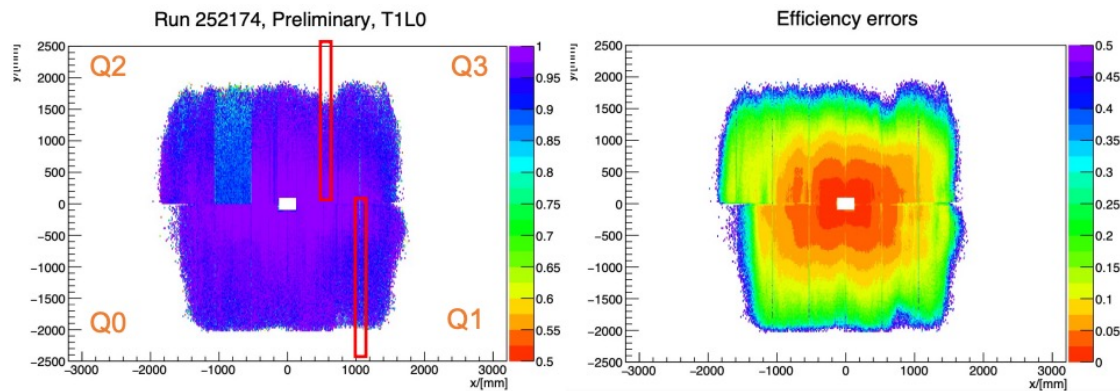
# Update on SciFi hit efficiency

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RTA WP4  
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# Introduction

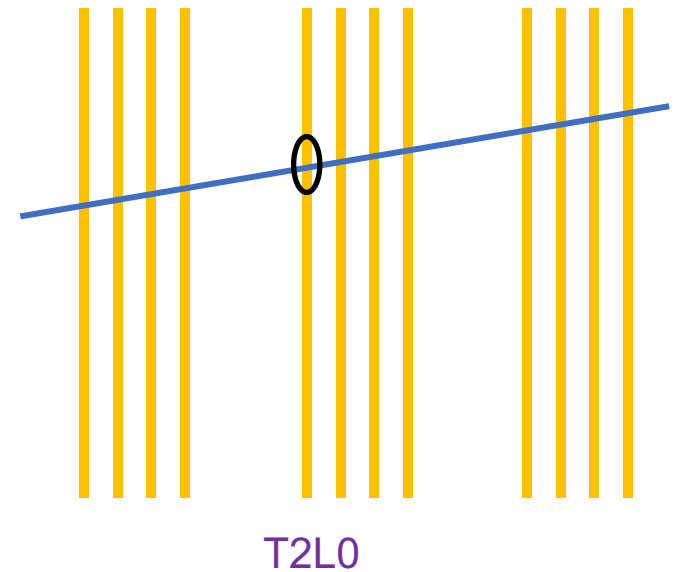
- Hit efficiency is a key indicator of tracker detector
- SciFi hit efficiency monitor (online/offline) to check the performance of time alignment and position alignment
- First SciFi hit efficiency algorithm implemented last year:  
Talks in [SciFi meeting](#) & [RTA meeting](#) in 2022



- Updates of SciFi hit efficiency estimations:
    - ✓ Channel-hit distance calculation
      - Track extrapolating to mat plane (mat alignment)
    - ✓ Efficiency per SiPM
    - ✓ Biased and unbiased estimations
- ([LHCb!4058](#), [Moore!2204](#), [Rec!3371](#))

# Hits efficiency study method

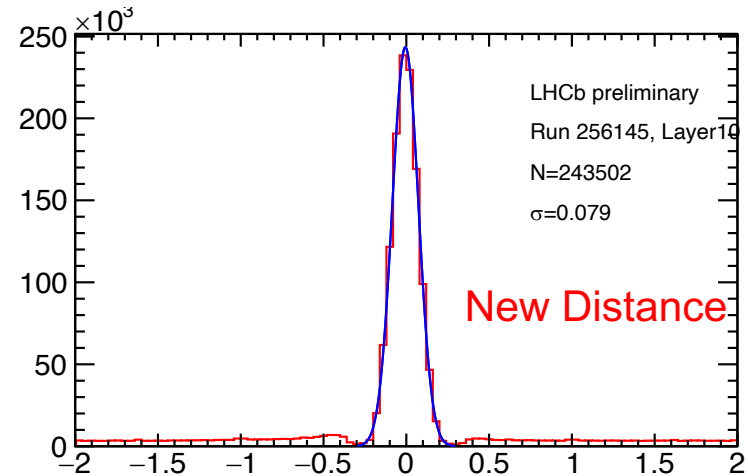
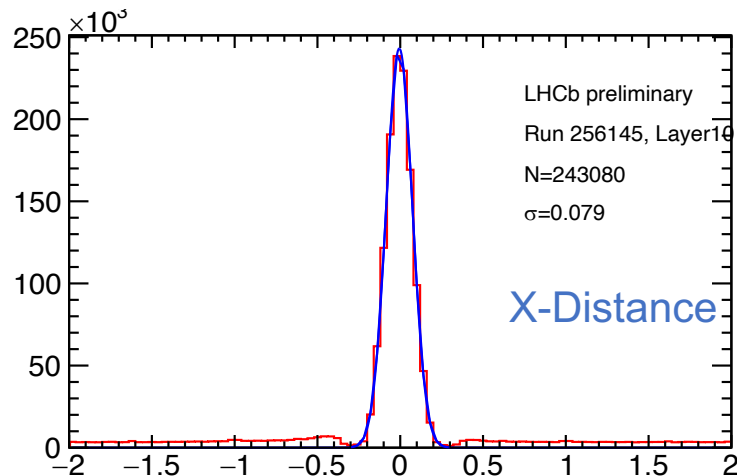
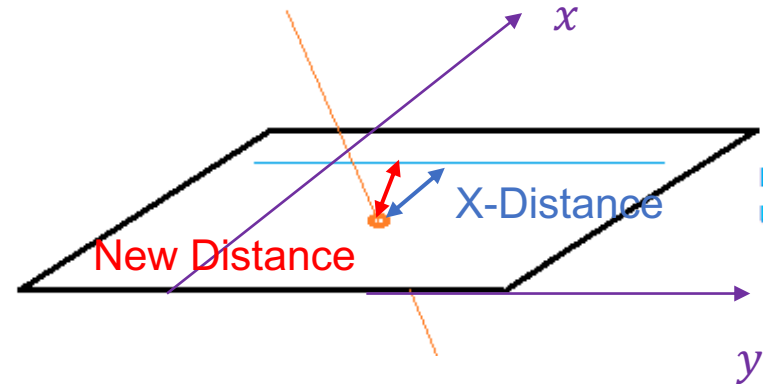
- Re-reconstruct tracks **with** or **without** the hits in the studied layer (**T2L0**)
- (**biased** or **unbiased** estimation)
- Good tracks used for hit efficiency determination:
  - Num hit  $> 8$
  - $p > 5 \text{ GeV}$ ,  $p_T > 0.4 \text{ GeV}$
  - Track interpolating error  $< 0.2$
- Search for the possible matched hit/cluster around the meeting point between track and the plane
- Tag as hit found if distance  $< 1 \text{ mm}$



$$\epsilon = \frac{\text{\#hits found}}{\text{\#hits expected}}$$

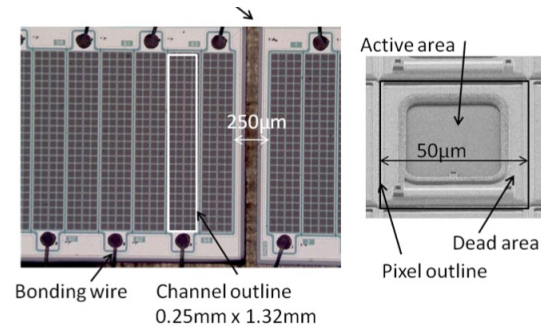
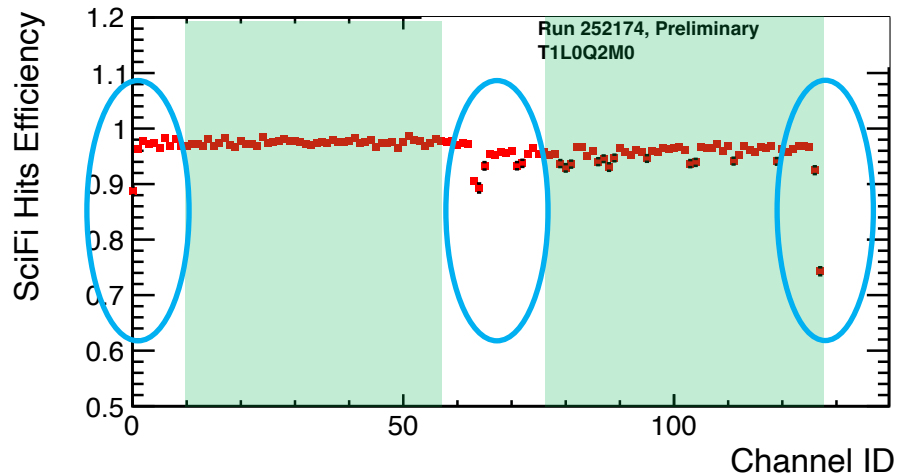
# Update on hit-channel distance estimation

- Search for the possible matched hit/cluster around the meeting point between track and the plane  
(distance alone x-direction in previous algorithm)

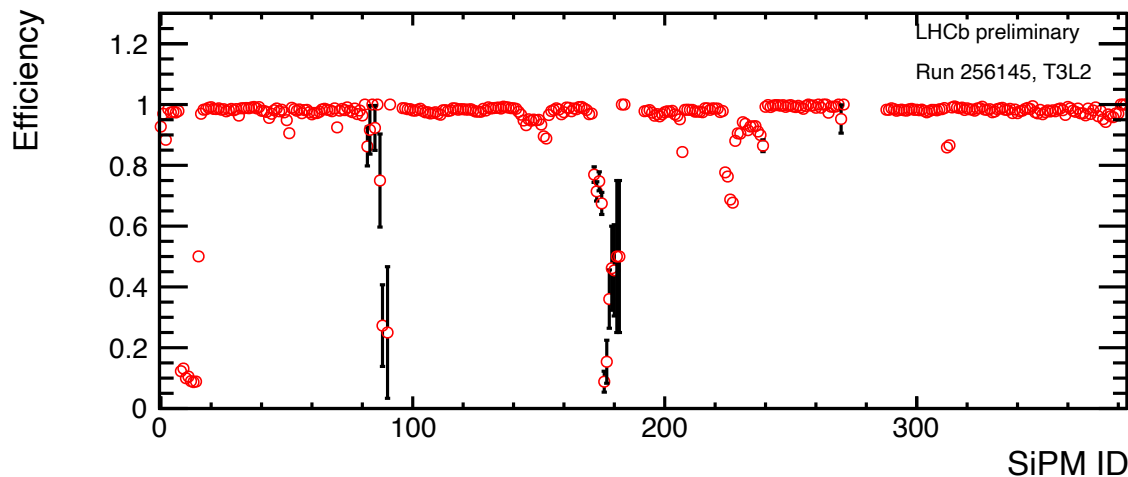


- Better in theory, more possible matched channels

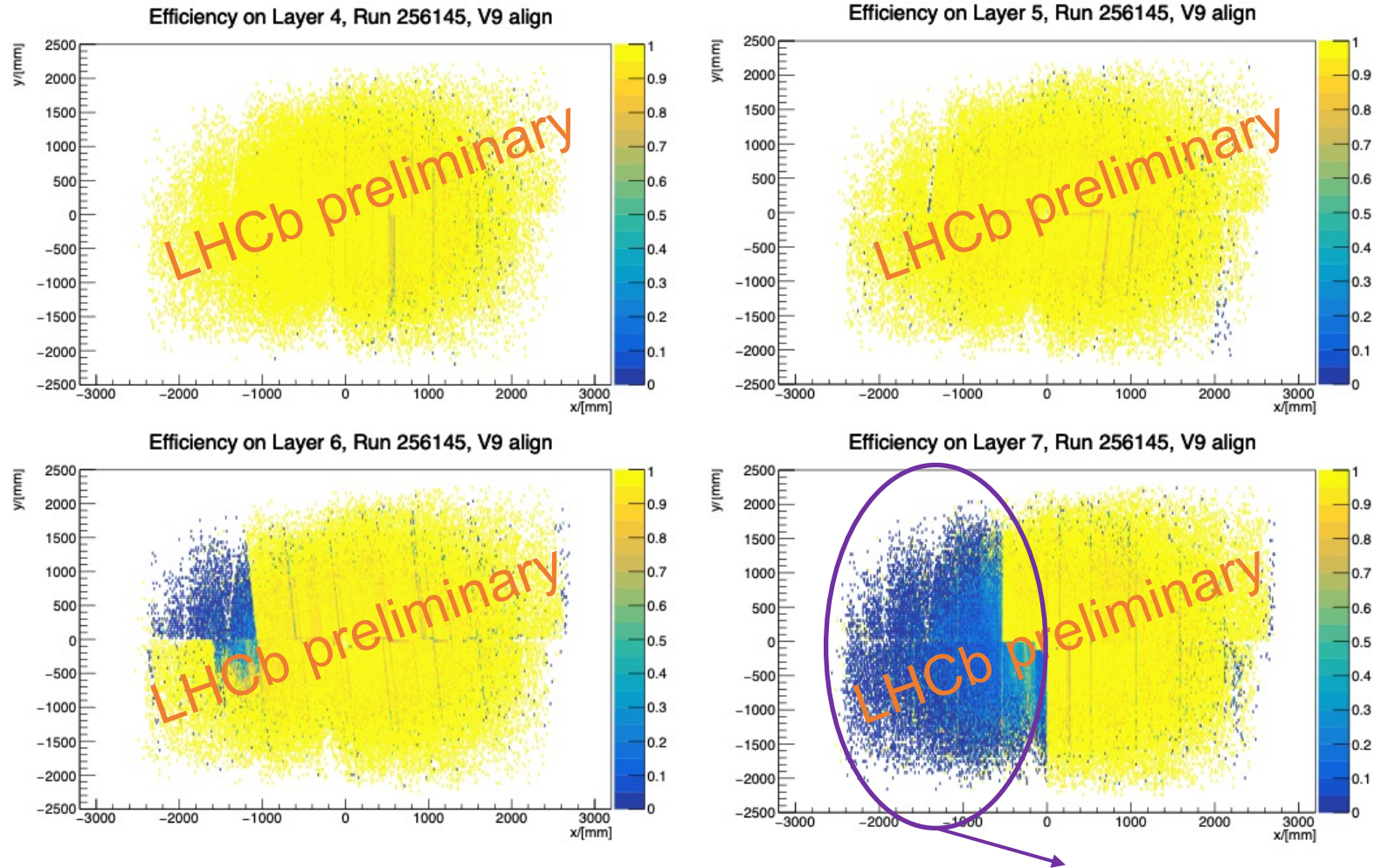
# Efficiency per SiPM



- **Signal hit efficiency:** dead/gap area in one SiPM masked in efficiency estimation
- Using single hit efficiency to define SiPM efficiency, e.g.



# Pseudo(biased) efficiencies for online monitor

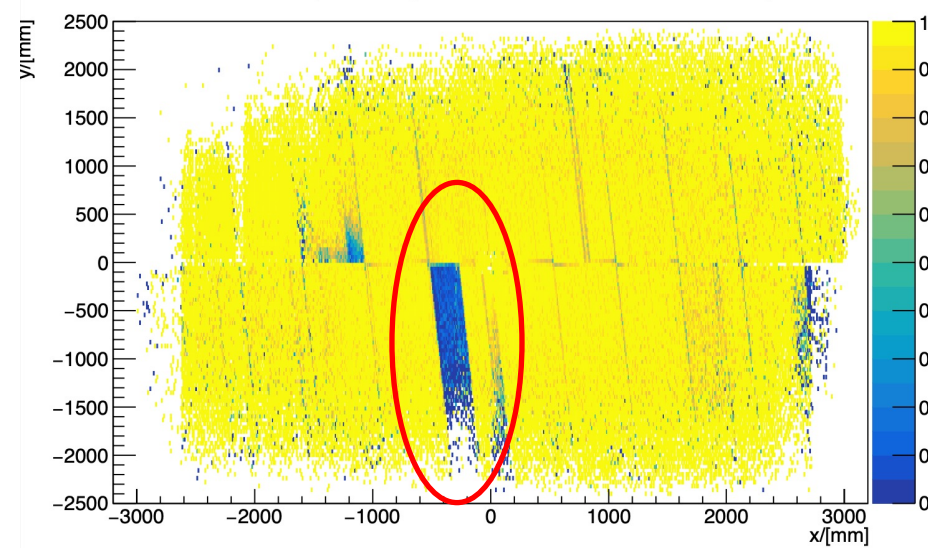


- Some low efficiency modules, might due to position mis-alignment or time mis-alignment

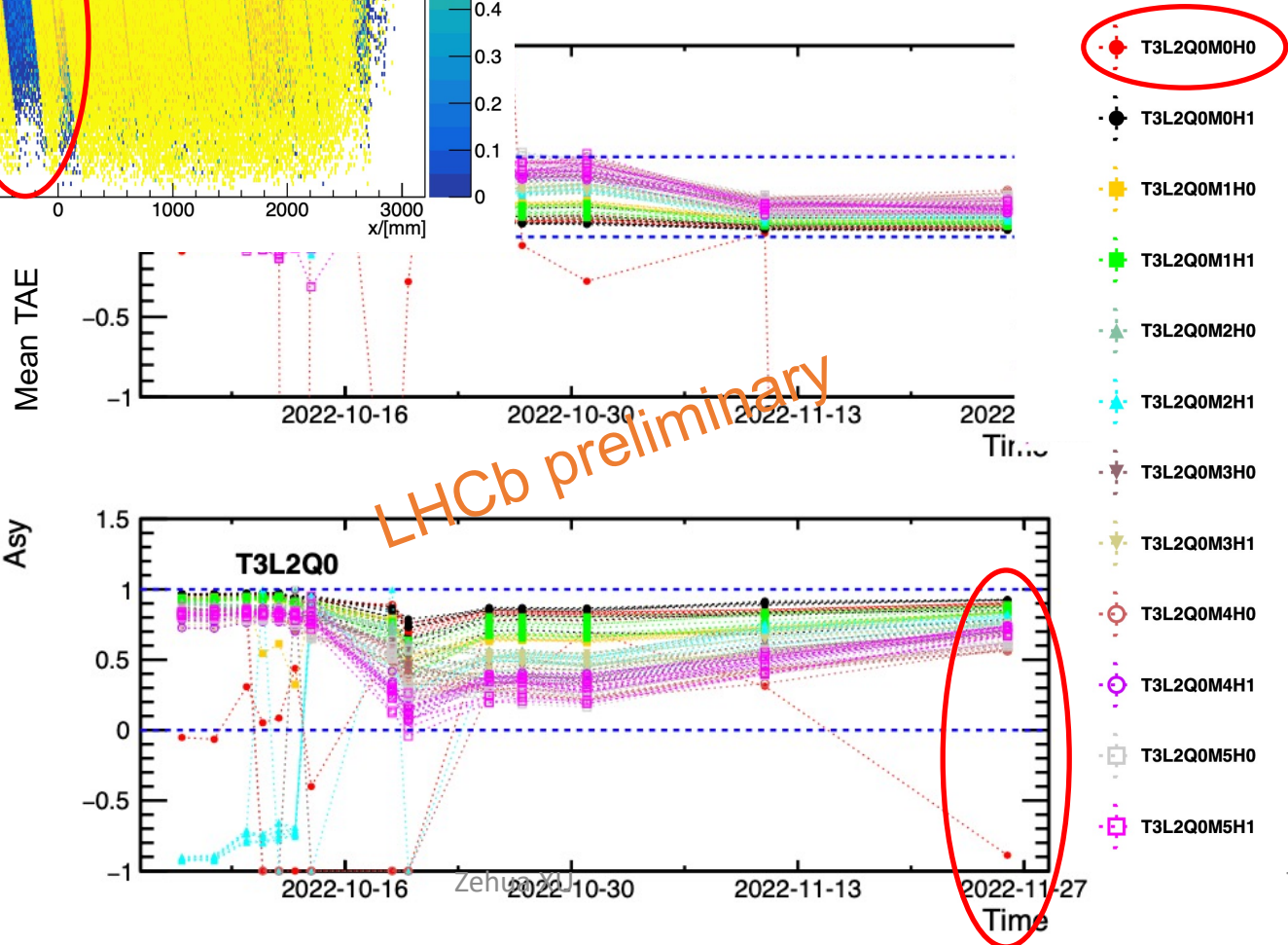


# Inefficient (half)module – imperfect time align

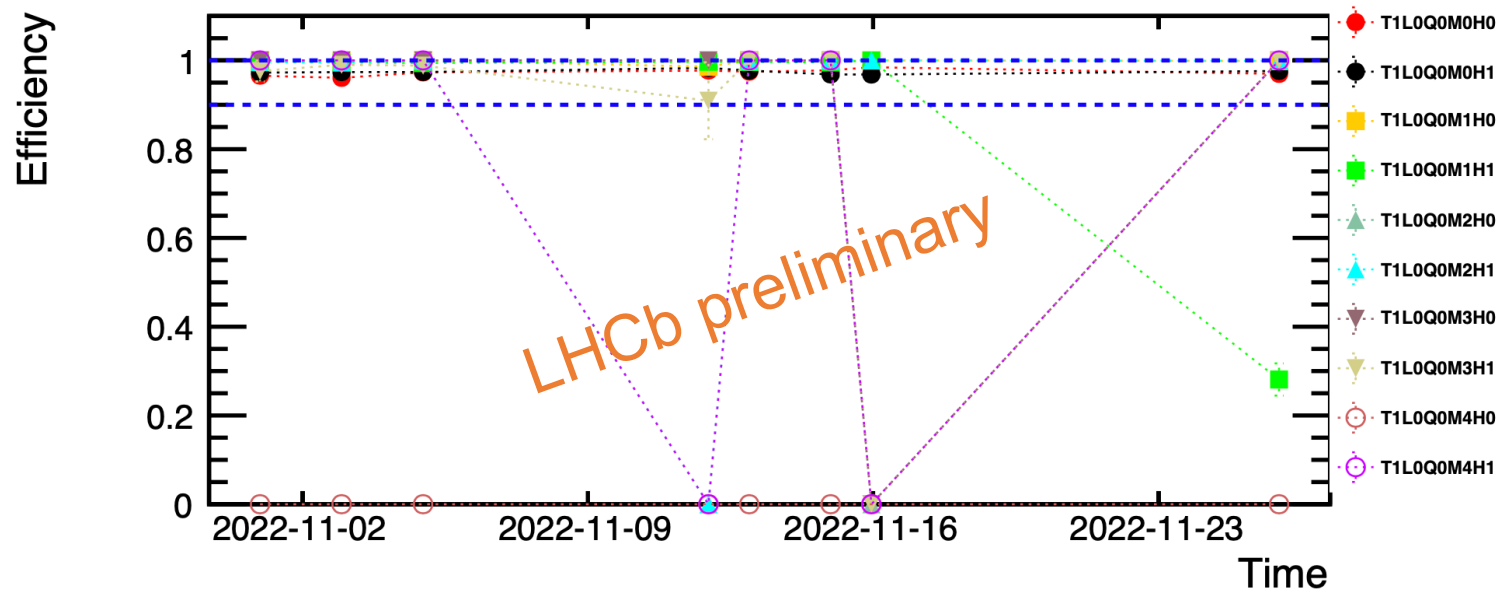
Efficiency on Layer 10, Run 256145, V9 align



Imperfect time lead to low efficiency in **T3L2Q0M0H0**



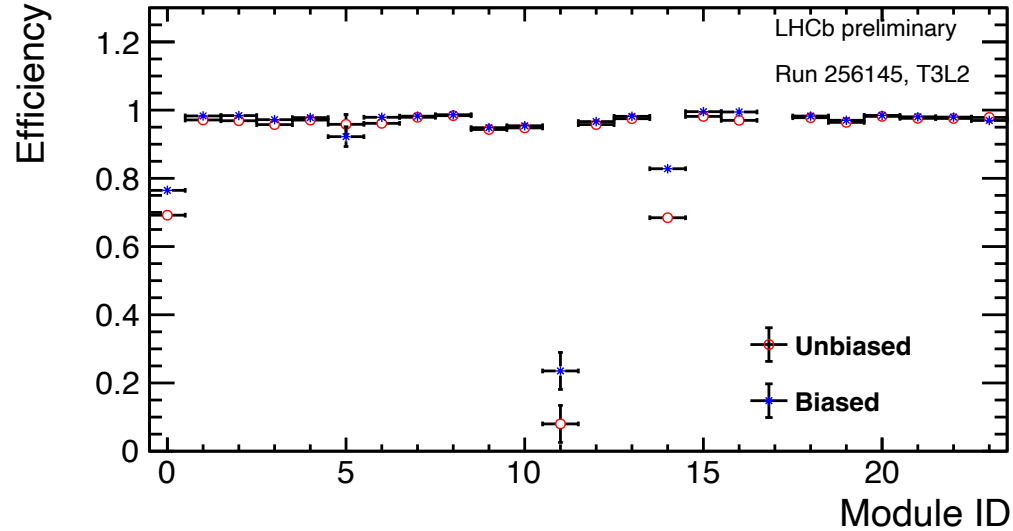
# SciFi hit efficiency over time – future operation



- Efficiency over time to check SciFi stability
- Maybe piquet responsible to this plot in future



# Biased-unbiased comparison



➤ Biased efficiency bigger than unbiased one

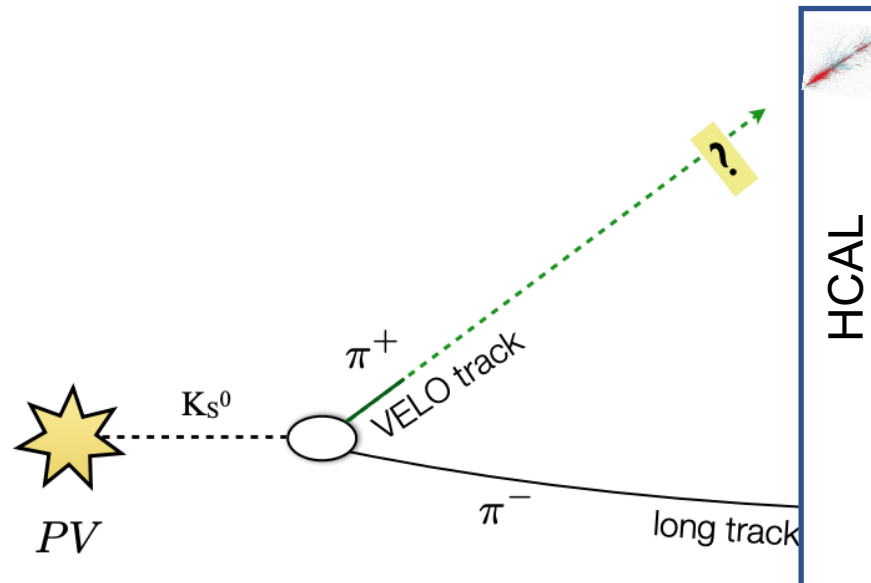
# Summary and plans

## Summary:

- SciFi hit (un)biased efficiency monitor updated
- Efficiencies monitor used to check position alignment and time alignment performance
- Biased one for online; unbiased one for detailed study

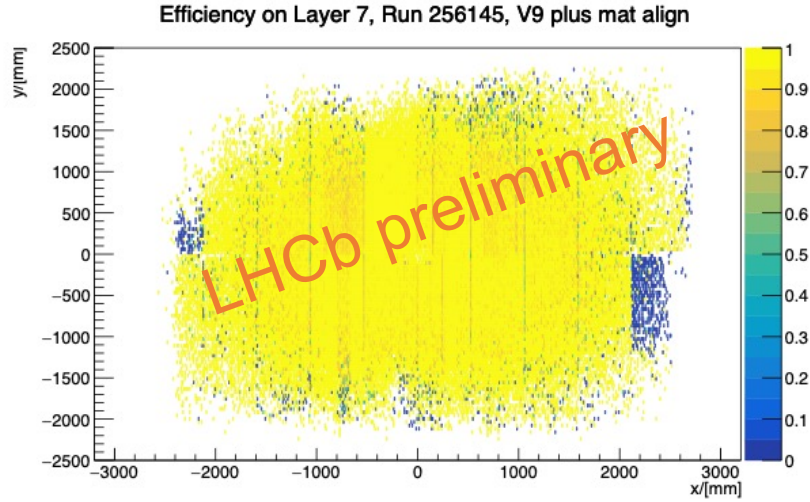
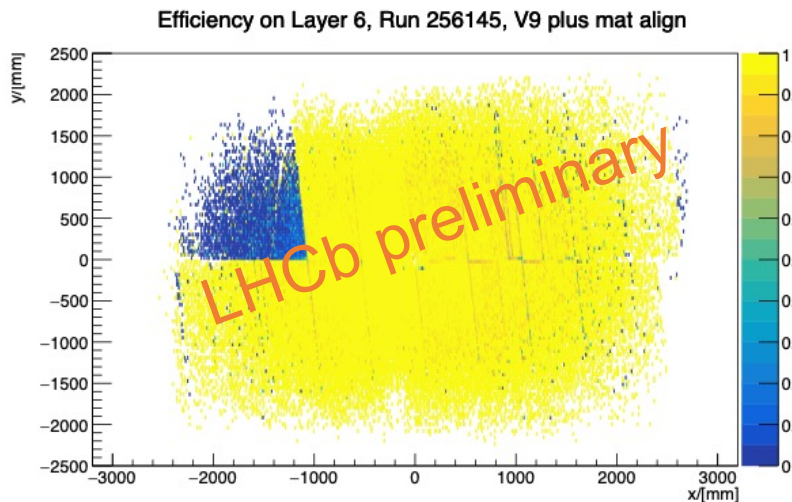
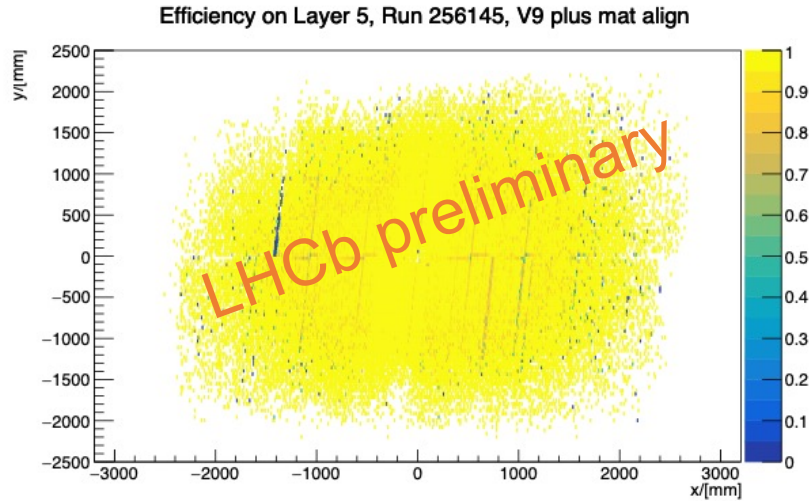
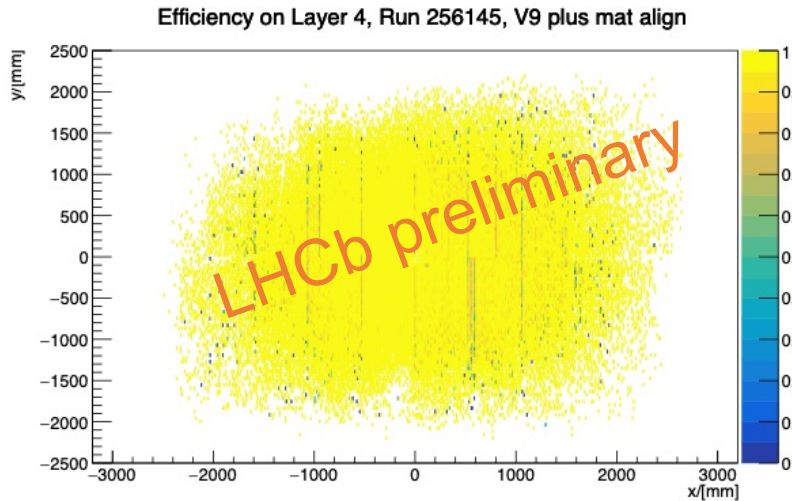
## Plans:

- SciFi hit efficiencies with different momentum for  $p/K/e^\pm$
- Probe-and-tag to study SciFi tracking find efficiency



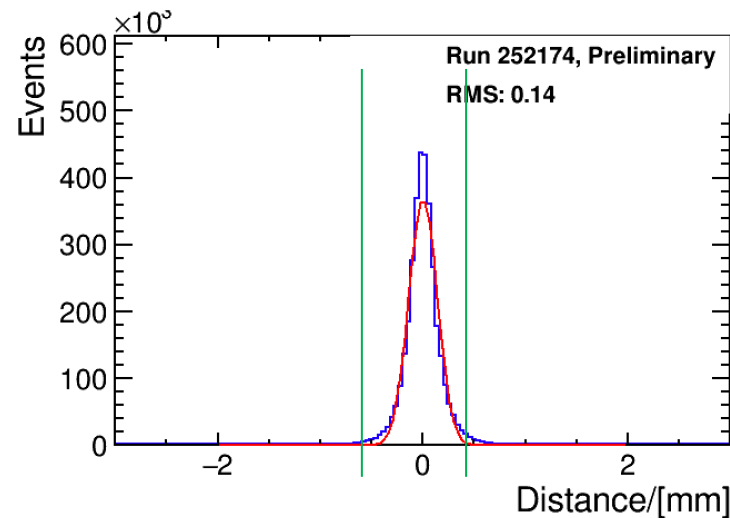
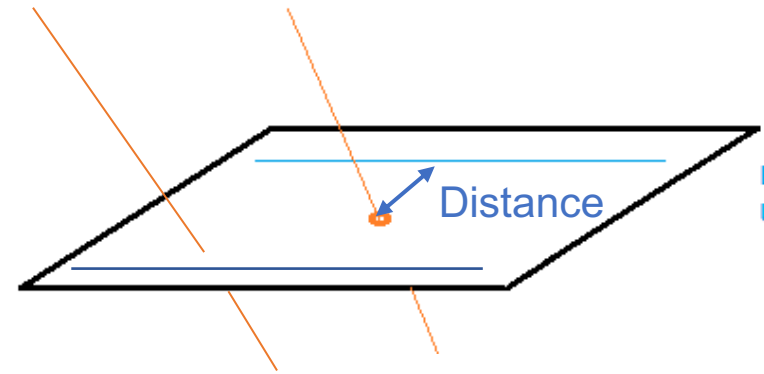
# Backup

# Pseudo(biased) efficiencies with mat algin



➤ Efficiency could be improve after fine alignment

- If the search area (distance tolerance) is too small: lost some real signals, underestimate the efficiency
- If the search area is too large: some signal from other tracks enter search area, overestimate the efficiency



- Distribution of distance fitted using Gauss, the probability outside  $[-0.5, +0.5]$  smaller than 0.1%