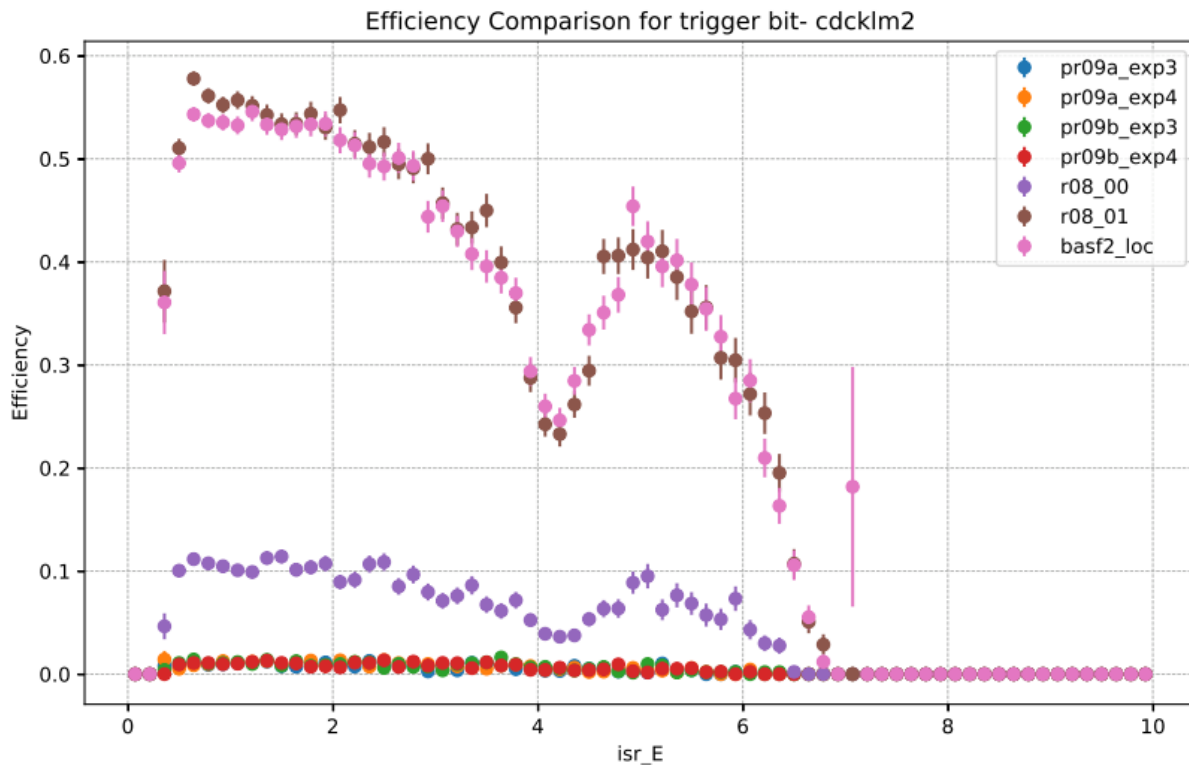


KLMTRG

2025-02-21 B2GM Peschke

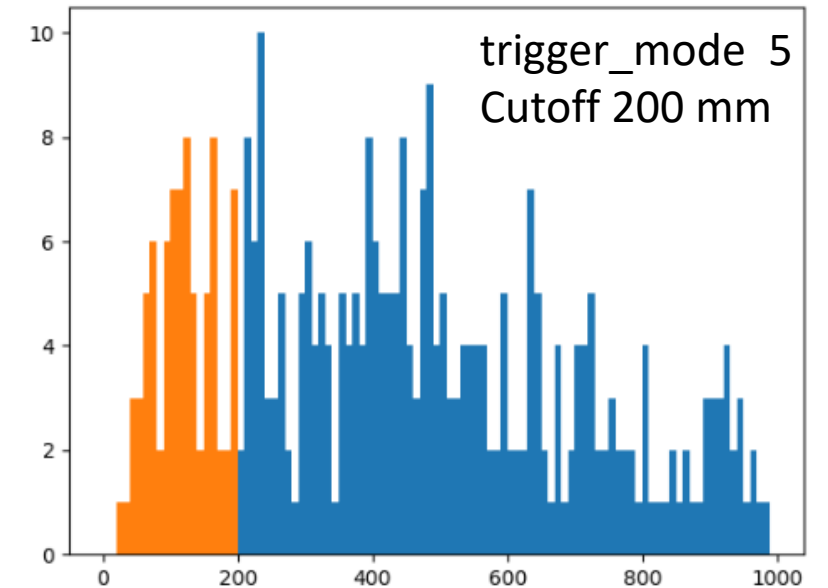
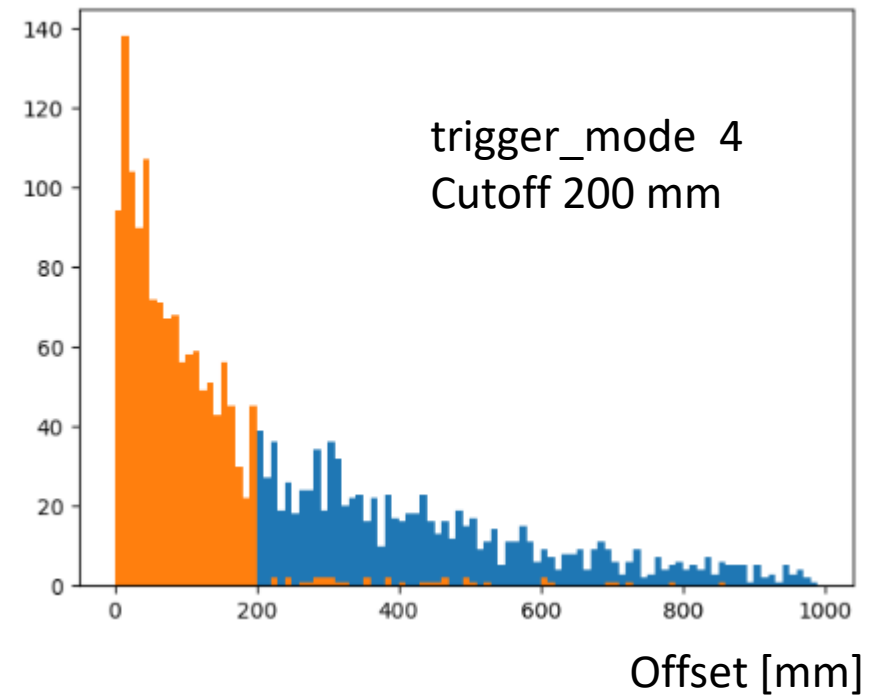
TSIM



- Issue with TSIM in KLMTRG: The efficiency results were incorrect.
- Root Cause:
 - The labeling scheme was inconsistent between different modules.
 - KLM Digits use sector numbers starting from 1, while all downstream modules expect them to start from 0.
- Fix Status:
 - The issue was already addressed and implemented some time ago.
 - However, there was some miscommunication regarding which branch contained the fix and how to properly use it with the simulation software

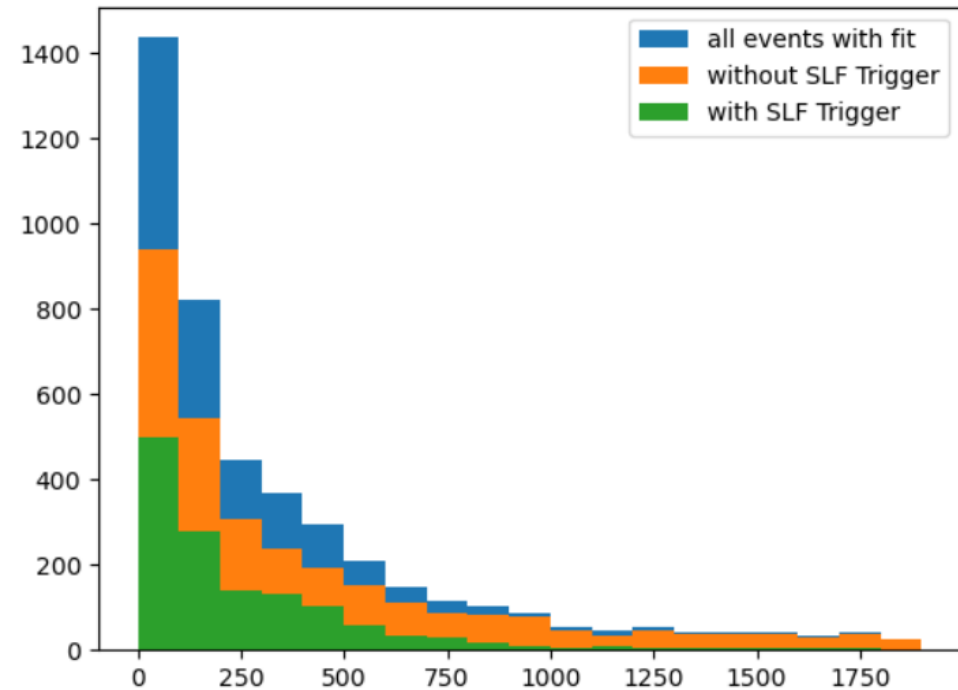
ISIM Simulation

- The plots display simulation results using ISIM.
- Actual physics data files serve as input for the simulation.
- The top plot shows the distribution of events based on their offset from the origin (y [mm]).
- In trigger mode 4, the offset is determined by taking the minimum offset of any track in the event.
- The bottom plot presents a similar distribution for trigger mode 5.
- In trigger mode 5, both the z and phi planes must contain a track, and the maximum distance of either is used.
- As a result, the distribution in trigger mode 5 skews toward larger offset values.
- In both trigger modes, applying the SLF trigger ensures only events within the cutoff parameter remain.



Physics Run exp35run2725

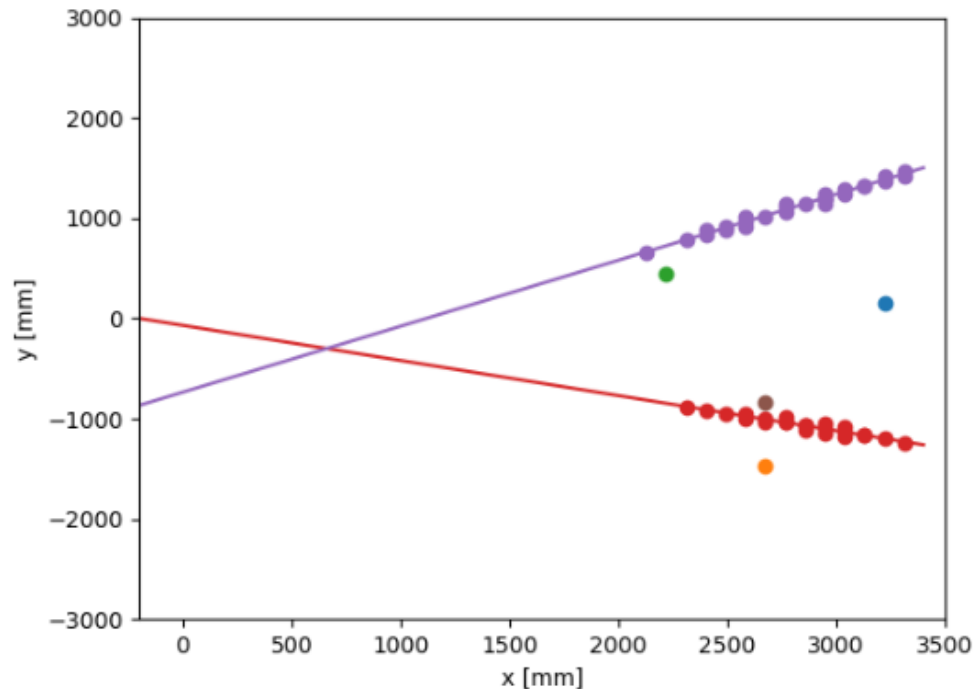
- physics.0035.02725.HLT02.m01.f00000.root
- During "exp35run2725," the SLF trigger bit was switched on.
- The main trigger used for Belle2 remained the legacy trigger.
- The data stream included an additional bit (Trigger bit 137) encoding the SLF trigger information.
- The results are shown in the attached picture.
- TB137 appears to reject 50% of events regardless of their distance from the origin (SLF trigger criteria).
- The current working hypothesis is that TB137 is not correctly connected to the SLF trigger.



Results From Cosmic Run on 2025-02-18

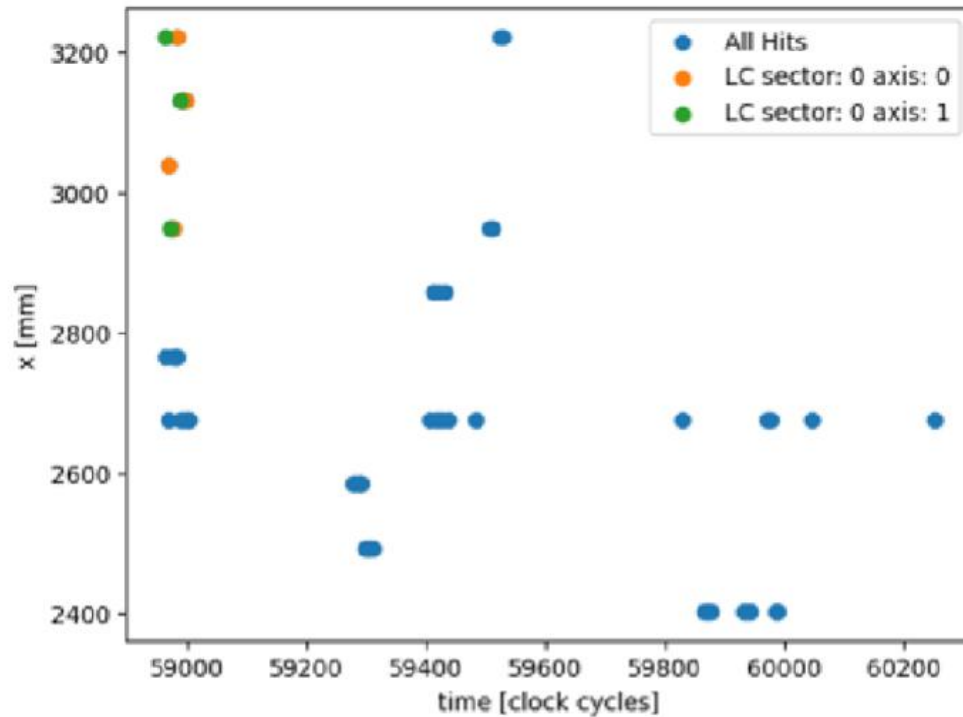
- Exp 36 run 78 - run 92
- Cosmic Run on Tuesday:
 - A cosmic run was performed to test new firmware updates.
- Firmware Updates: Several new firmware versions were produced in preparation for the run.
- Final Firmware Used: Included improvements to the track maker, making track finding more robust.
- Test Objectives:
 - Verify if the SLF trigger bit is transmitted correctly.
 - Investigate whether different trigger modes affect the results.
- Results:
- The SLF trigger bit was transmitted correctly.
- The firmware still struggles to correctly identify tracks close to the interaction point.

Investigating Individual Events



- Issue Identified in Individual Events: The problem is clearly related to the algorithm.
- Incorrect Flagging:
 - The event shown in the slide was incorrectly flagged as negative, despite it being obviously positive.
- Simulation vs. UT3:
 - When reprocessing these events in simulation, they are correctly flagged.
- Missing Information in Data Files:
 - This suggests that some information is not being stored in the data files

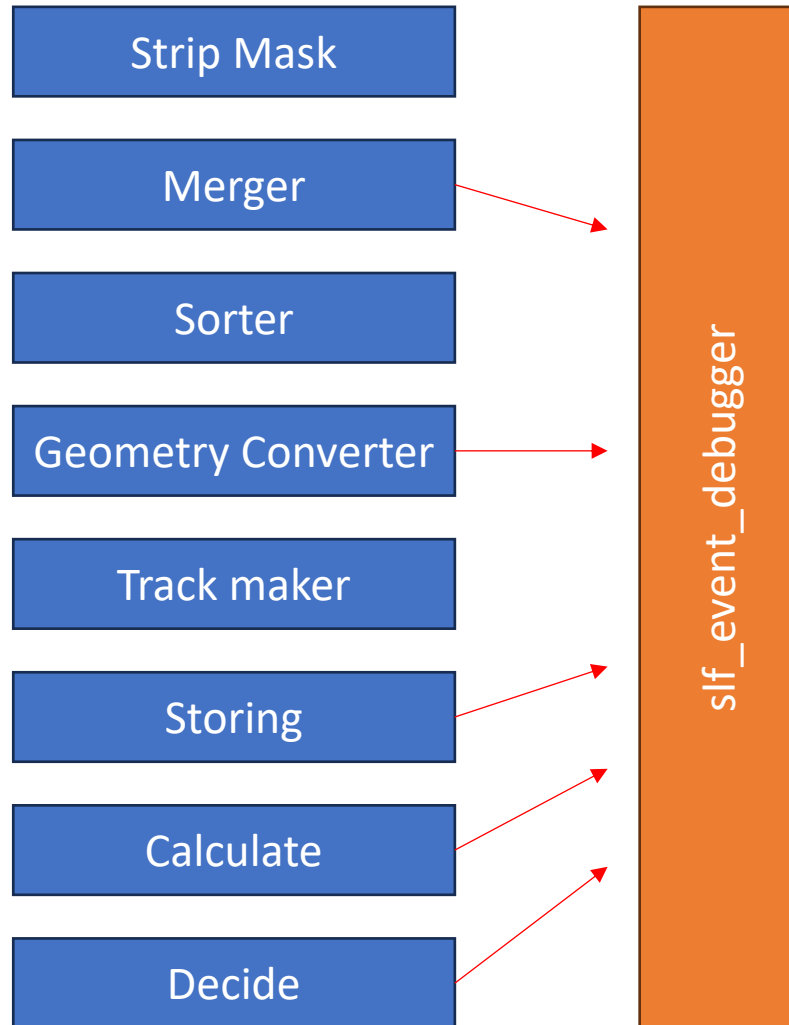
Simulations



- Figure Analysis: Displays hits received over time.
- Hit Rate Observation: Sparse hits with gaps of hundreds of events.
- Simulation Setup:
 - In previous simulations, the gap between events was set to ~ 100 clock cycles.
 - Based on cosmic run results, this gap was removed.
- Impact of Higher Hit Rate:
 - A component, "track maker," could not handle the increased hit rate.
 - It entered an overflow state, causing all hits from one sector to merge into the same track.
- New Version of the Firmware has an improved version of the track maker that cannot overflow anymore

Next Step

Components of the SFL



- **Simulation Validation:**
 - Simulation has shown that with high hit rates the track maker can be overwhelmed and stop working
- **Need for a Dedicated KLM Cosmic Run:**
 - A new KLM-only cosmic run is required to record all signals from these components.
 - No other detectors need to be active during this test.
- **Firmware Requirements:**
 - The test might require several dedicated firmware versions.
 - The current firmware can record data and send it out via the register interface. (`slf_event_debugger`)

VME Module and Register interface

- SLF Event Debugger Readout:
 - Accessed via the register interface on the VME computer.
- Identified Issue (Summer 2024):
 - VME computer crashes when reading large amounts of data from the register interface.
 - Workaround: Stopped recording data using the register interface.
- Need for a KLM-Only Cosmic Run:
 - The issue cannot be reproduced by simulating data files.
 - A dedicated KLM-only run is needed to test the register interface without interfering with other sub-detectors.

Current Tasks And Outlook

- Simulating the events from "exp36run78" to "exp36run91"
- Prepare new Firmware for upcoming Cosmic run
- Plan a new KLM only cosmic run
- Finish KLMTRG paper
- Upgrade from UT3 to UT4