technische universität dortmund

FSP LHCb
Erforschung von Universum und Materie

Bundesministerium für Bildung und Forschung

# SciFi reconstruction and alignment

**Nils Breer** + SciFi alignment + calibration team

**2. Juni 2023**

SciFi general at 108th LHCb week - 5th june 2023

# Reconstruction and alignment overview

- SciFi simulation and reconstruction
  - Weekly group meetings: Monday, 13:00h
  - Mailing list: lhcb-upgrade-ft-software
  - Twiki
- Updates since last LHCb week
  - Alignment:
    - published Alignment v10
    - new and improved photogrammetry taken
    - readout map improved
    -

**People working with SciFi align and calibration**

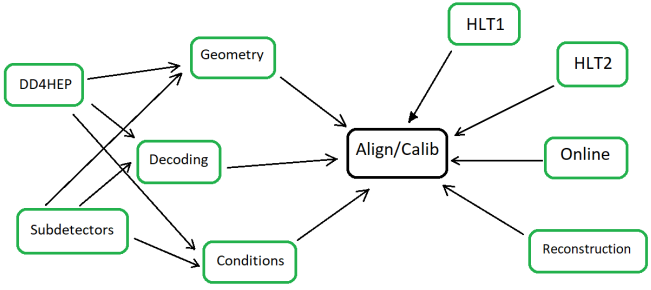
- Blake Leverington
- Fred Blanc
- Izaac Sanderswood
- Maria Vieites Diaz
- Zehua Xu
- Jessy Daniel
- Louis Henry
- Emmy Gabriel
- Sophie Hollitt
- Biljana Mitreska
- Miguel Ruiz Diaz
- Giulia Tuci

**People from different projects**

- Laurent Dufour

**…ral, RTA alignment and … on helped a lot during**

# Overview of the topics



## Readoup Map adaptations

Readout map →Cabling Map

automatic fetching of deactivated links

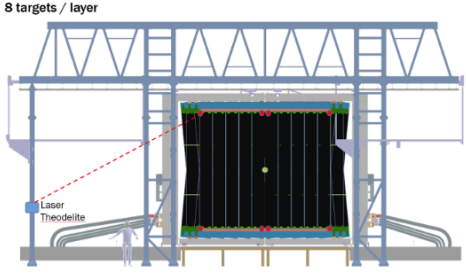
→deactivate links without changing readout map!

2022: no active link map →empty events

LHCb!4129 improved flexibility

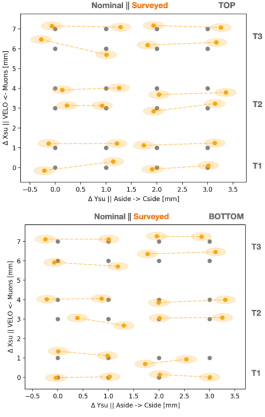
2023: allows to ignore dynamic link deactivation if no active link found

# Survey and Photogrammetry



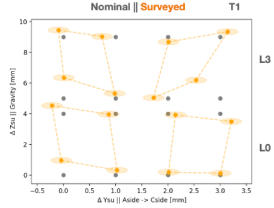

- photogrammetry taken: feb 20th - march 9th
- 4 measurement points per C-frame at corners
- target: keep inner modules as close to nominal as possible, outer edges can move as needed
- summary: 450 microns in z, most frames within 200 microns from nominal
- 400 microns in x, 1.5 mm in y
- on average 400 - 600 microns in y, 50 - 200 microns in the center

# Photogrammetry

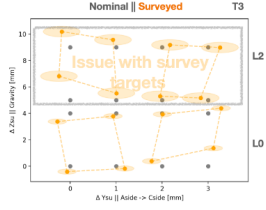



- top/bottom view of the respective edges **±2.5*m*** above/below beam pipe
- 200 ***μm*** survey uncertainty
- A-side →+x, C-side →-x
- T1, T2: outer layers surveyed →L0 and L3

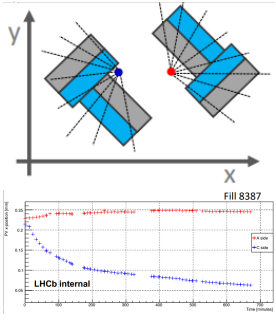
# Survey and Photogrammetry




- T3: L0 and L2 surveyed (L3 targets in RICH volume)
- T3L2 measured between L1 and L2 with smaller targets
- possible movement during measurement



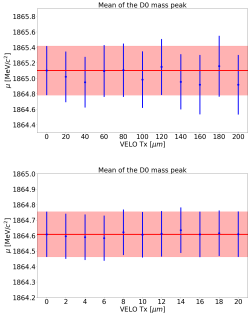
# VELO drift situation



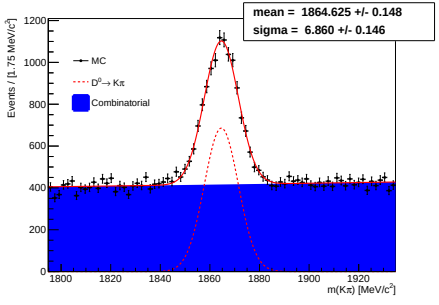

- The situation:
- Monitoring, alignment and material scan are consistent
- During closing, C-side starts rotating around y with pivot point at around 850 mm
- →upstream region lacks behind
- complications:
  - start of drift unpredictable
  - drift amount differs over time

# VELO drift impact for SciFi alignment

- Goal: estimate impact of VELO movement on reconstructed mass
- DoFs: Tx, Rz long modules aligned, GoodLongTracks
- data set: $B_0 \rightarrow D^*\pi$ and $D_0 \rightarrow K\pi$

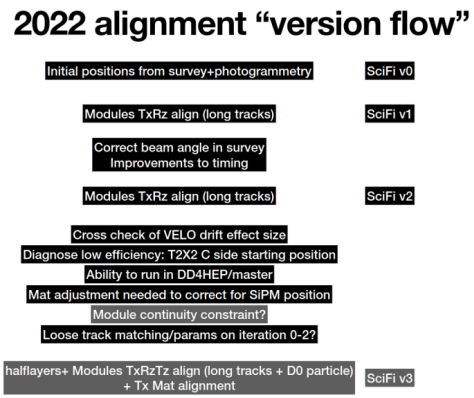


# VELO drift impact for SciFi alignment




- **Ry** shows no impact on SciFi alignment and mass distribution
- mass peak slightly affected for drifts below $20\mu m$
- large movements impact on mass resolution visibly
- alignment with VELO drift also negatively impacts resolution slightly

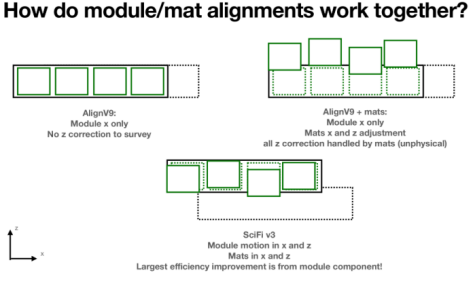
# SciFi alignment with 2022 data




- half modules yield better performance than long modules
- why? becasue if starting conditions not quite correct, half modules can correct it better
- beam angle fix + better fine timing
- VELO z-drift studies (later in the talk)
- discovered low efficiency C-side →improved starting conditions
- mats need to correct for SiPM positions
- loose track matching/params in first

ıance boost

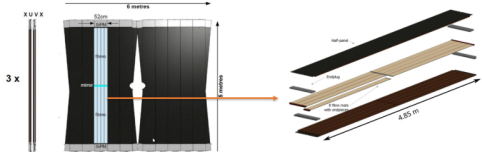
# SciFi Mats: from v9 to v10




- v9 featured no z correction in survey and shifting of whole module in x
- v9 + mats: SiPMs being aligned and not glued mats
- →still unphysical movement out of the module
- v10: modules movement in x and z allows for physical 'mat movement'
- yield: largest efficiency improvement from module alignment but mats needed

# Mat alignment

from Zehua's slides




- real mats glued together with fine tolerance
- but preliminary mat alignment sees movement up to 1.5mm
- Mat alignment: moving mats in software to match best hit position in tracking
  - depends on module alignment quality
  - depends on relative position of glued SiPM readout relativ to mats

## Summary

→Goal:

- correct for hit positions in readout without moving mat material in simulation
- understand rotations in survey positions that may produce z movement in reco
- understand true variations in SiPM positions

# Monitoring

# Cluster bias