SVT Hit Smearing for 2021

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Introduction

- Track parameter distributions differ significantly between MC and data.
 - Examples: track time, d0/z0, χ^2 , etc.
- This talk: Preliminary results from applying SVT cluster/hit level smearing to reproduce distributions observed in 2021 data
 - Initial work by Matt Graham at analysis workshop last year.



Overview

- **Data Samples**: /sdf/data/hps/physics2021/data/hpstr/prod_v7_pass0/
 - Detector(s): HPS_Run2021Pass1_v7beta
- MC Samples: /sdf/data/hps/physics2021/mc/recon/tritrig_pulser/pass_v6b/
 - Detector: HPS_Run2021Pass1_template_v6
- **Disclaimer**: The MC samples use in these plots include pulser overlay, and smearing was applied to all hits.
 - Overlay hits can be excluded from smearing in future iterations.

Position Smearing SVT Clusters

- SVT cluster positions are smeared by 0-15 um (using StripHitSmearer.java).
- Data/MC comparison quantified through fit to Gaussian core.
 - Does not capture behavior in tails.



Position Smearing SVT Clusters

- Smearing between 5-10 um reproduces residuals in data for most sensors.
- Generally more smearing needed in layers 1-4 than 5-7.



Impact on Track Parameters

- χ^2 , impact parameter distributions reproduced for similar levels of smearing (~10-12 um)
- Some distributions show worse resolution in MC than data
 - Potentially a result of misalignment in pulser overlay?



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Smearing Hit Times

- SVT fitted hit times are smeared by 0-6 ns (using RawHitTimeSmearer.java).
- Smearing is performed on t0 fit parameter.
- In early layers, data has much wider tails in t0.



Smearing Hit Times

- Smearing between 2-4 ns reproduces sensor hit times.
- Level of smearing required increases for closer layers.
- Estimates are consistent between top/bottom.



Impact on Track Times

• Smearing raw hit time t0 does not reproduce track time widths observed in data, even for 6 ns smearing.



Directly Smearing Track Times

- Implemented new driver to directly smear track times: TrackTimeSmearer.java
- Can reproduce data with < 4 ns smearing.



Summary

- Able to reproduce most track parameter distributions observed in data with reasonable levels of smearing on SVT clusters/hits.
 - Track time distributions remain too narrow after smearing raw hit time fits.
 - Track time smearer implemented as potential approach.
- Next steps:
 - Data/MC comparisons and smearing values will be finalized with v8 alignment samples.
 - Requires small number of files with hit collections saved.