PXD efficiency and impact parameter resolution in Phase 3 data

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Outline

Data samples

- Phase 3, experiment 7, runs 3356, 3370, 3372, 3374, 3375.
  - LER beam injection at $\sim 5 - 6.25\,\mathrm{Hz}$.
- Phase 3, experiment 8, runs 367, 1037.
  - Continuous LER injection.
  - Integrated efficiency drop for run 367 (Jira ticket).

Reconstruction

- Release 03-01-02 of basf2.
- Recommended global tags for SVD reconstruction (often updated).
  - basf2.use_central_database("data_reprocessing_prompt")
  - basf2.use_central_database("svd_basic")
  - basf2.use_central_database("svd_loadedOnFADC")
  - basf2.use_central_database("svd_offlineCalibrations")
- Output: tracking validation ntuples (1 row = 1 track).

Outline

Estimate of the PXD efficiency

- Select tracks coming from the IP and detected by the outer detectors (SVD and CDC).
- Efficiency estimate $= \frac{\#\,\text{selected tracks with}\ \#\,\text{PXD hits}\geq 1}{\text{total}\ \#\,\text{selected tracks}}$.
- This estimate is a function of the intrinsic PXD efficiency and the matching efficiency.
- Projection on the ϕ_0-tan(λ) plane.
- $\lambda \equiv \frac{\pi}{2} - \theta$: angle between a track and the plan $\perp$ to the beam.

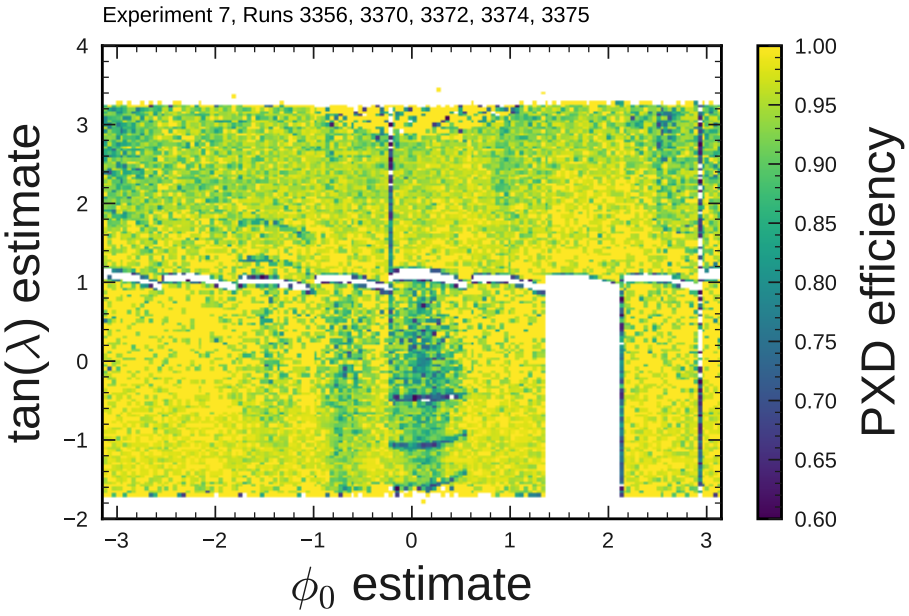
Track-based selection for PXD efficiency study

- Look for tracks detected in the SVD coming from Bhabha events.

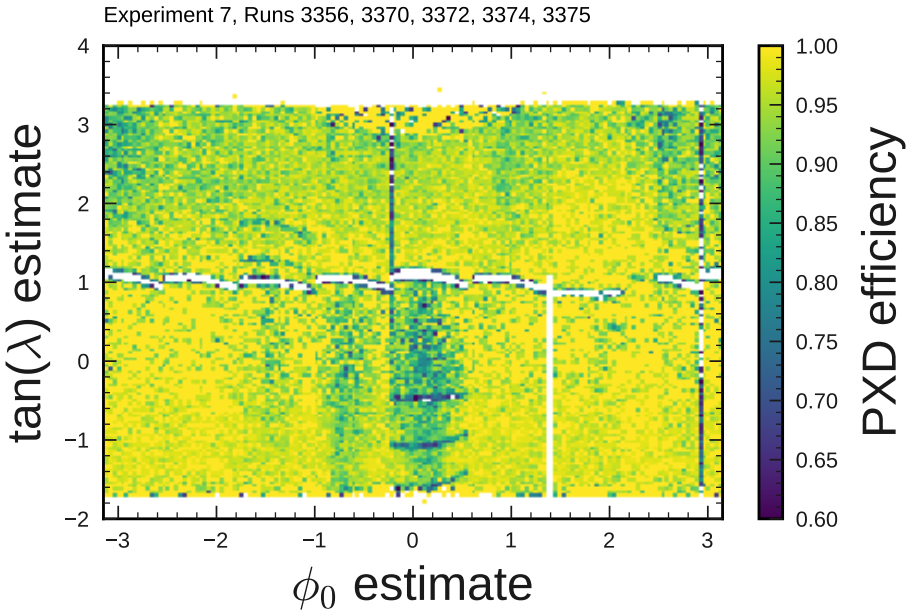
Variable	Requirement	Unit
$\lvert d_0 \rvert$	< 3	mm
$\lvert z_0 \rvert$	< 1	cm
# selected tracks in the event	$= 2$	
p_{T}	> 0.6	GeV/c
# selected tracks in the event	$= 2$	
# CDC hits	≥ 10	
# SVD hits	≥ 6	

PXD efficiency (experiment 7, runs 3356-3375)

- First PXD hit in L1

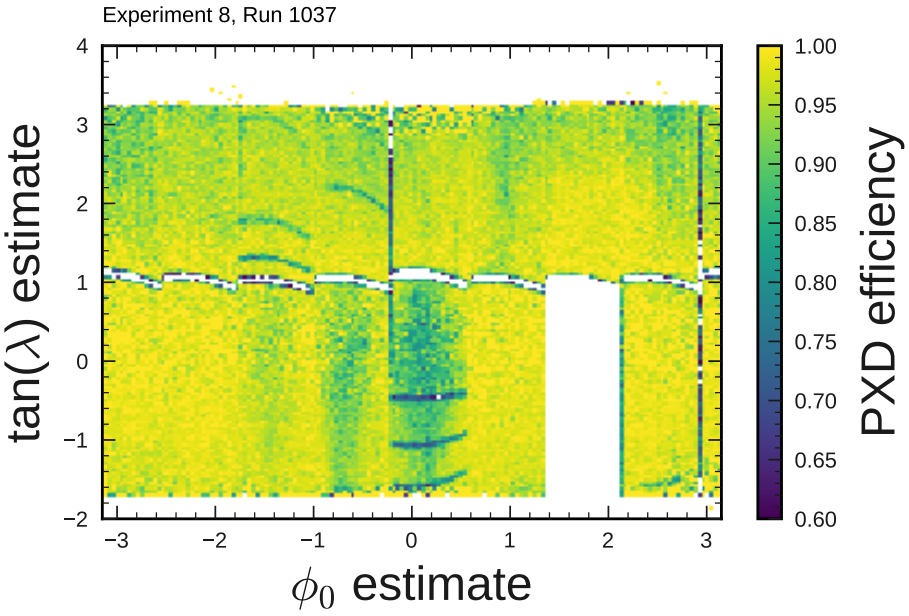


First PXD hit in L1 or L2.

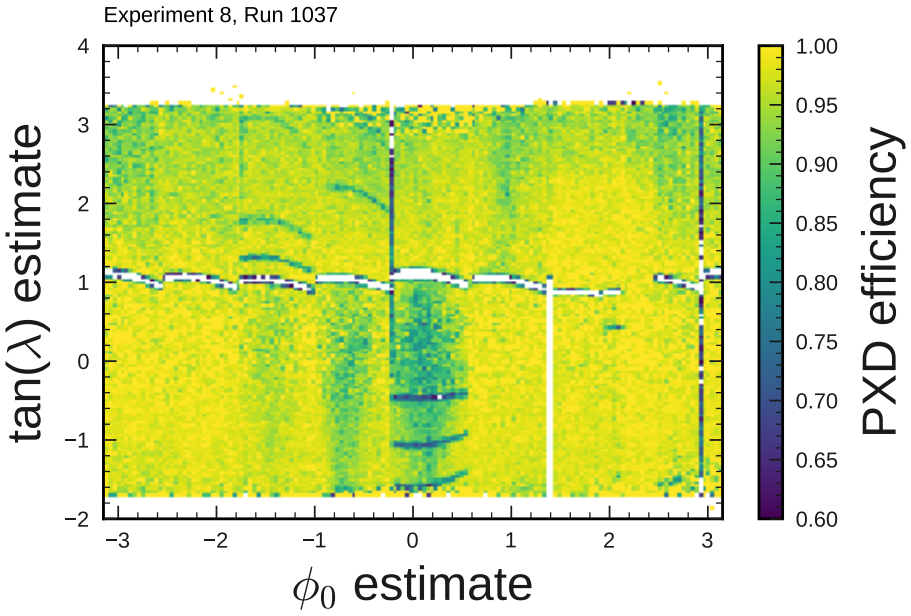


PXD efficiency (experiment 8, run 1037)

- First PXD hit in L1

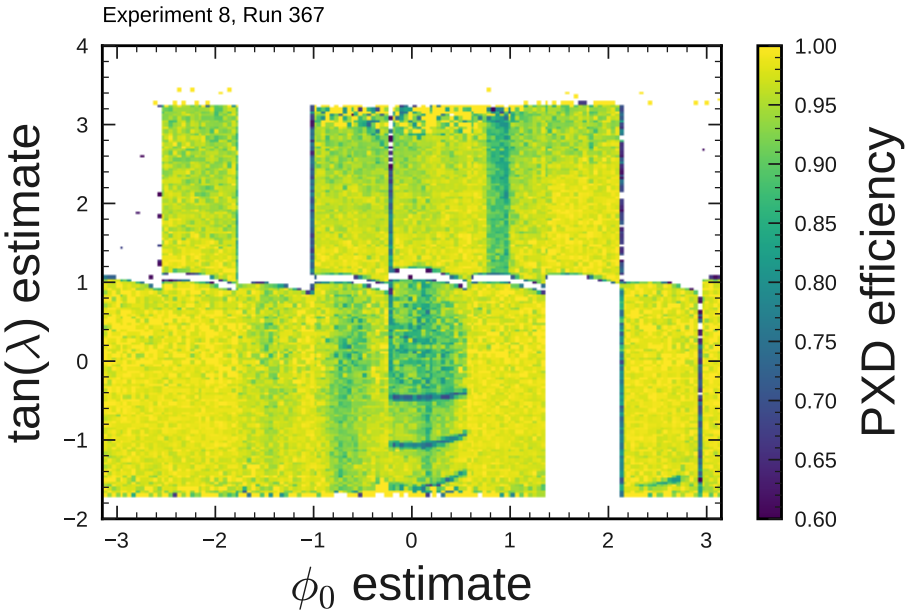


First PXD hit in L1 or L2.

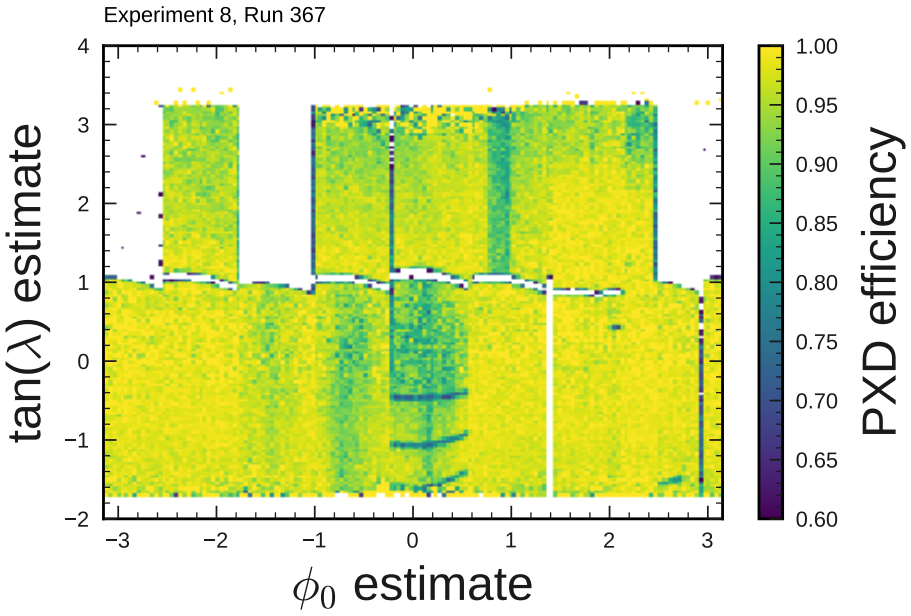


PXD efficiency (experiment 8, run 367)

- First PXD hit in L1

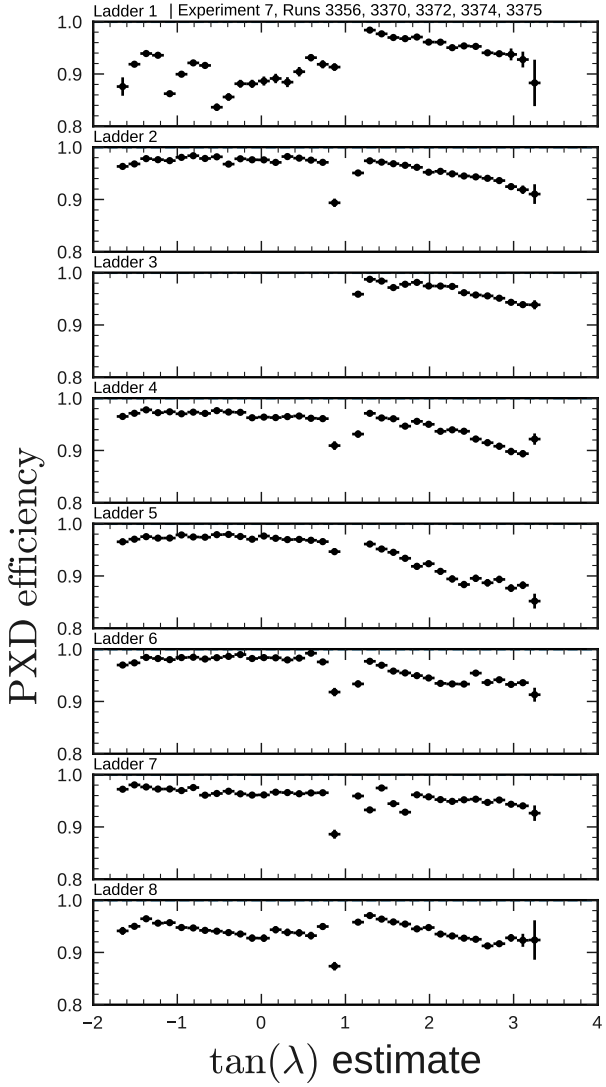


First PXD hit in L1 or L2.

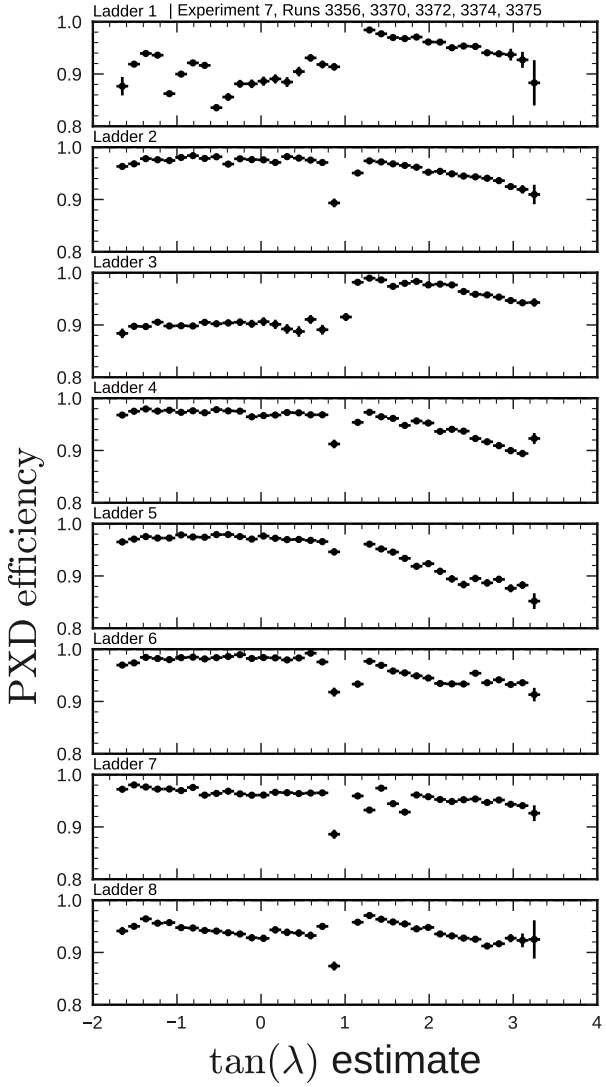


PXD efficiency vs tan(λ) (experiment 7, runs 3356-3375)

- First PXD hit in L1

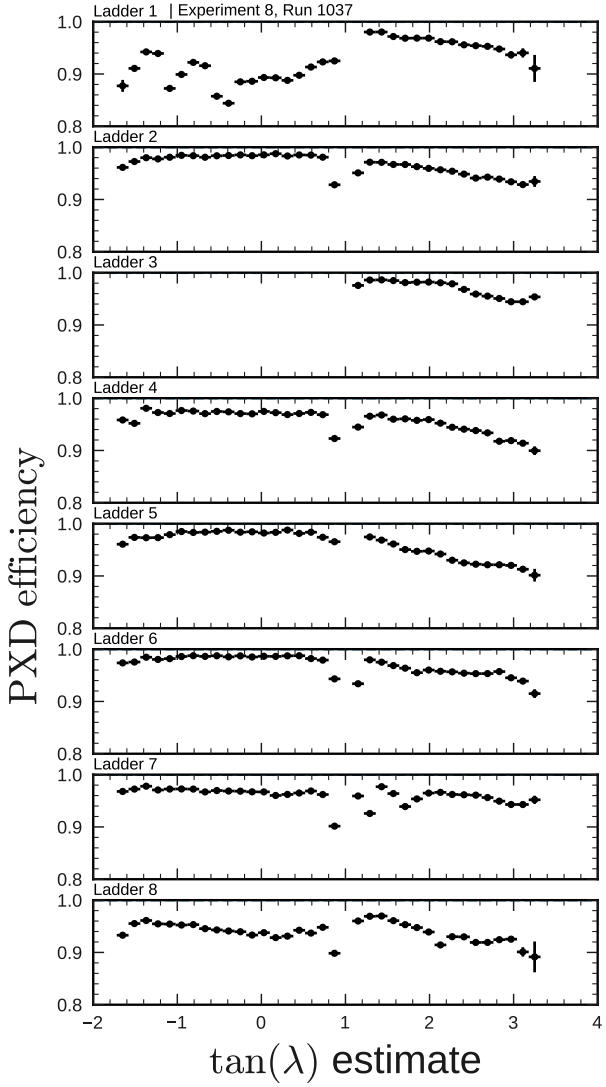


First PXD hit in L1 or L2.

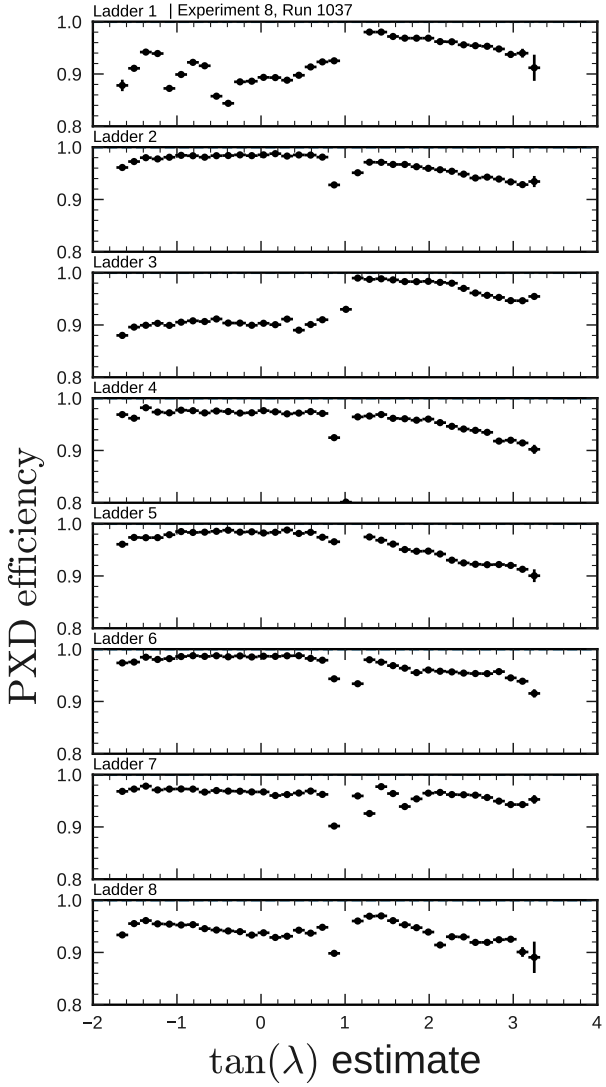


PXD efficiency vs tan(λ) (experiment 8, run 1037)

- First PXD hit in L1



First PXD hit in L1 or L2.



Outline

Estimate of the d_0 resolution

- Goal: estimation of the transverse impact parameter (d_0) resolution.
- Select tracks coming from the IP and detected by PXD and SVD.
- width of the d_0 distribution = estimate of the d_0 resolution.
  - (valid if beam size $\ll$ d_0 resolution).
- 68% coverage (σ_{68}): σ chosen so that the interval $[\mathrm{Median}(d_0) - \sigma, \mathrm{Median}(d_0) + \sigma]$ contains 68% of the distribution.

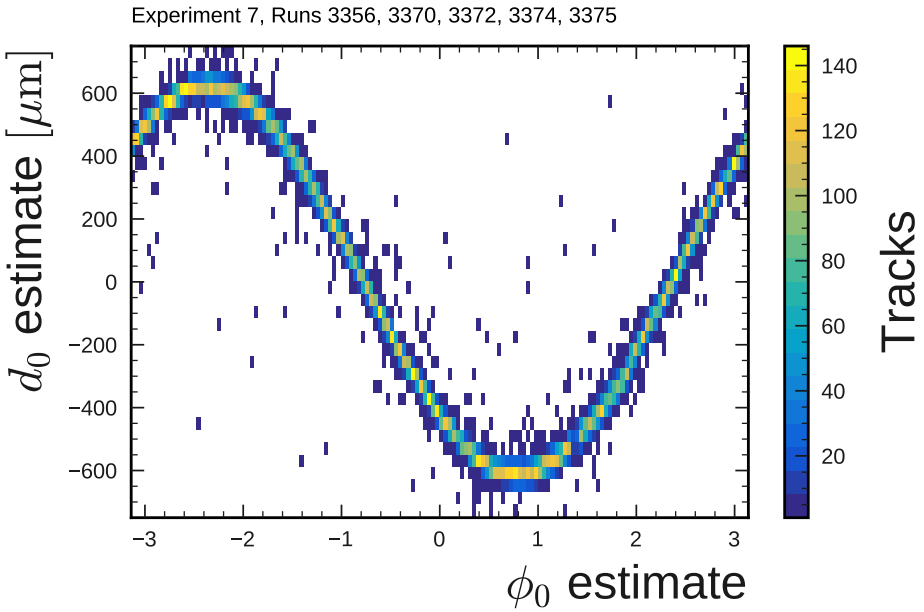
Track-based selection for d_0 resolution study

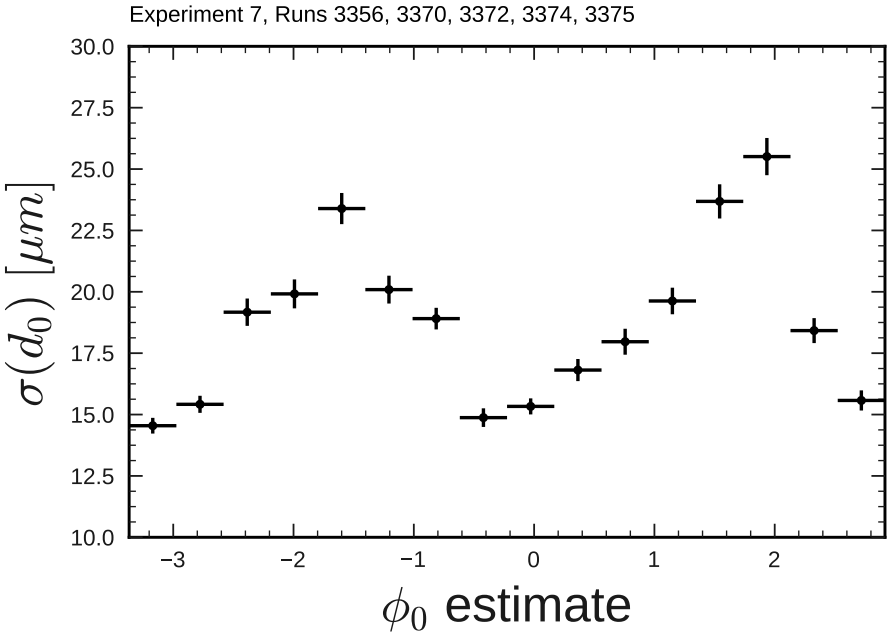
- Look for tracks detected in the VXD coming from Bhabha events.

Variable	Requirement	Unit
$\lvert d_0 \rvert$	< 3	mm
$\lvert z_0 \rvert$	< 1	cm
# selected tracks in the event	$= 2$	
p_{T}	> 1	GeV/c
$\lvert \theta - \pi/2 \rvert$	< 0.5	
$p\beta \sin(\theta)^{3/2}$	> 2	GeV/c
# selected tracks in the event	$= 2$	
# CDC hits	> 20	
# SVD hits	≥ 6	
# PXD hits	≥ 1	

d_0 and $\sigma(d_0)$ against ϕ_0

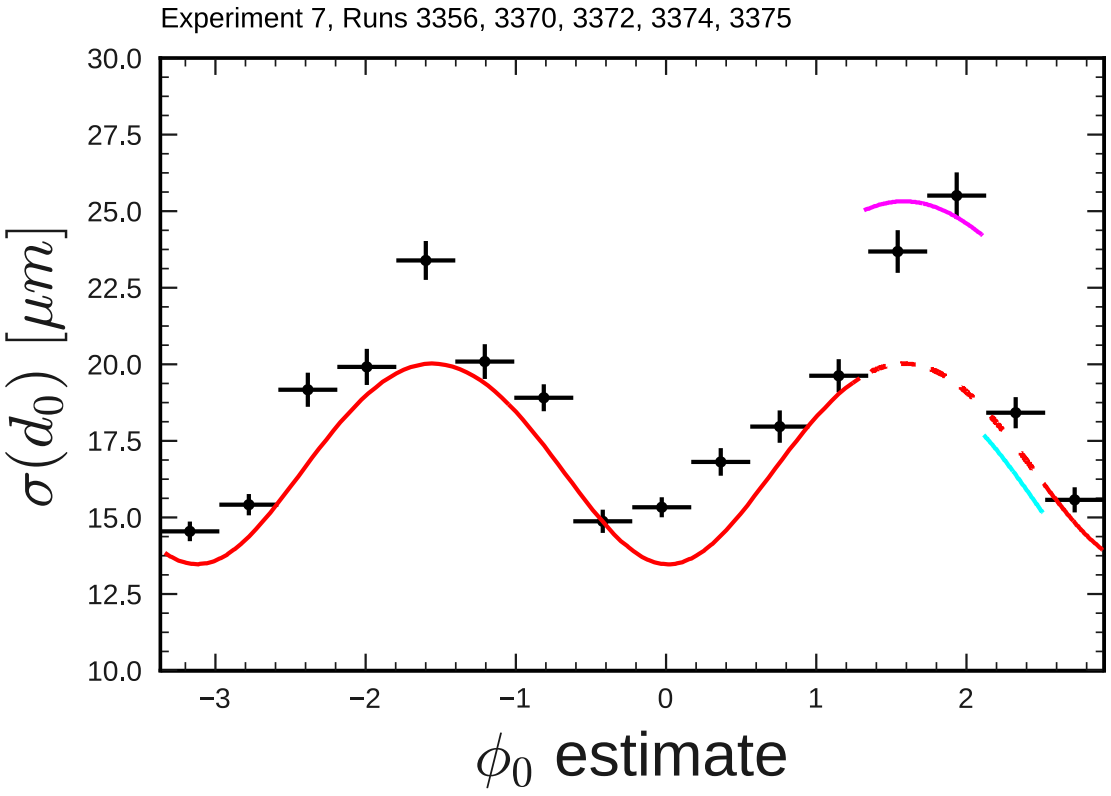
- In data, d_0 depends on ϕ_0, because the center of the beam is not exactly located at the origin.
- Fit $d_0(\phi_0)$ with $A\cos(\phi_0) + B\sin(\phi_0) + C$.
- Correction of the d_0-offset for each run individually.
- $\sigma(d_0)$ as a function of ϕ_0 exhibits the horizontal beam size.





Comparison with simple model [C. Niebuhr]

- The resolution estimate depends on the intrinsic resolution (σ_i) and the horizontal beam size at the IP (σ_x^*).
- Simple model: $\sigma(d_0)(\phi_0) = \sqrt{\sigma_i^2 + (\sin(\phi_0) \cdot \sigma_x^*)^2}$.



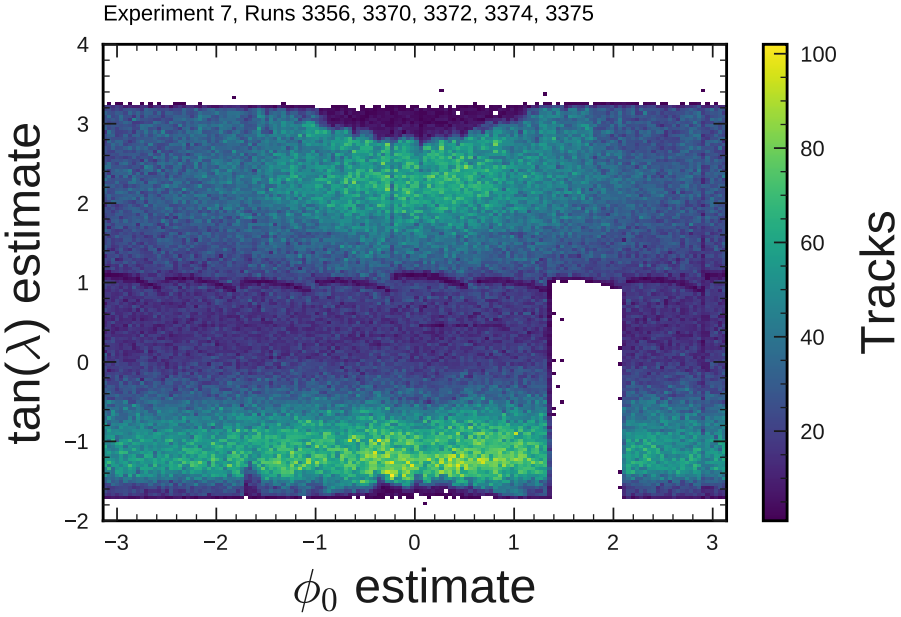
Status and outlook

- Many improvements since the very early phase 3 data.
- Calibration constants have not yet fully converged.
- An internal note will be written to present the d_0 resolution study.
  - Comparison with simulation.
  - Goal: public plot by the end of the next B2GM.

Thank you for your attention.

PXD efficiency (experiment 7, runs 3356-3375)

- Numerator



Denominator.