

Tracking Projections/ Resolution at hpDIRC

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and
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Workshop Motivation

❑ PID performance

- PID performance is dependent on the angular resolution of tracks that enter the PID detectors.
- hpDIRC performance ability to meet ePIC detector physics requirements is most sensitive to the tracking performance.

Cherenkov Angle Resolution

hpDIRC PID Goals

- π/K separation up to at least 6 GeV $\rightarrow \Delta\theta \approx 3$ mrad
 - 3 s.d. requires $\sigma_c(\text{particle}) \leq 1$ mrad @ 6 GeV
- e/π separation up to 1-1.2 GeV $\rightarrow \Delta\theta \approx 6 - 9$ mrad
 - 3 s.d. requires $\sigma_c(\text{particle}) \leq 3$ mrad @ 1 GeV

Cherenkov Angular Resolution

- $$\sigma_c(\text{particle}) \approx \sqrt{\left(\frac{\sigma_c(\text{photon})}{\sqrt{N_\gamma}}\right)^2 + \sigma_{\text{correlated}}^2}$$

- ePIC hpDIRC

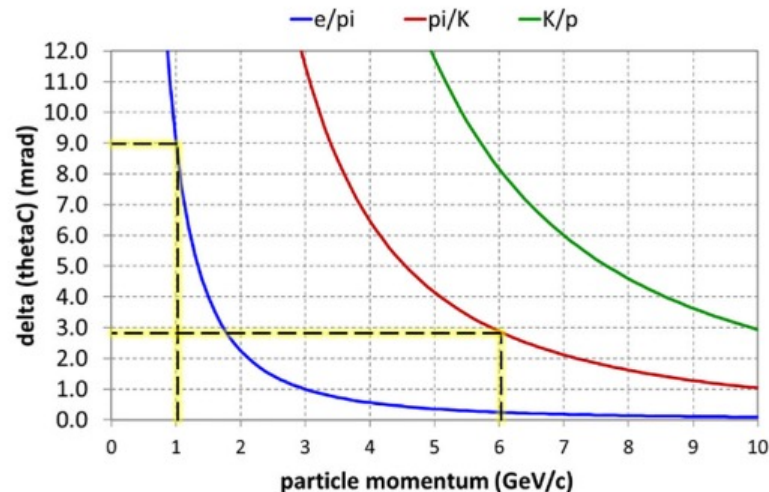
- $\sigma_{\theta_c}(\text{particle}) = 3 - 5$ mrad,
- $N_\gamma = 30 - 170$

$$\sigma_{\text{correlated}} = \sqrt{\sigma_{\text{tracking}}^2 + \sigma_{\text{ms}}^2}$$

Angular resolution from tracking system

Multiple scattering inside DIRC bar

Cherenkov angle difference in fused silica



Sensitivity of Tracking Resolution on Performance

➤ [Slide from Aug. 19 2024 TIC Meeting \(Jochen Schwiening\)](#)

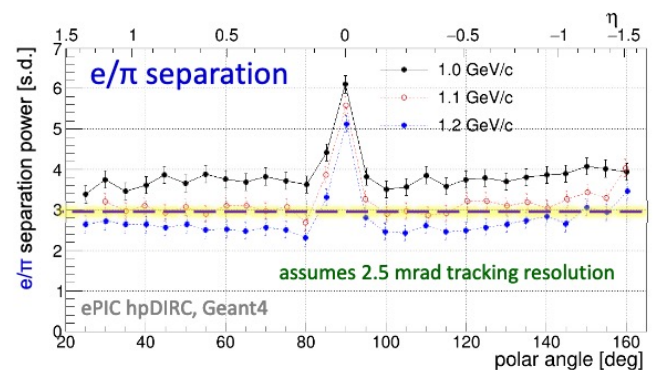
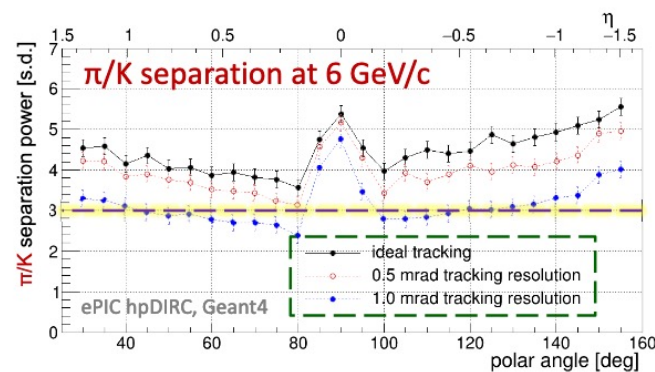
During YR/DPAP times, tracking experts suggested expected tracking angular precision values of 0.5 mrad at 6 GeV/c and 2.5 mrad at 1.2 GeV/c

Implemented these resolutions in hpDIRC standalone simulation

π/K separation at 6 GeV/c reaches 3 s.d. goal for 0.5 mrad tracking resolution

e/π separation with 3 s.d. in reach at 1.1 GeV/c for 2.5 mrad tracking resolution

(Caveat: non-Gaussian tails from multiple scattering, 3 s.d. value for core of log-likelihood difference distribution)



Caveat for all shown results: standalone Geant4, particle gun, no magnetic field, track hits center of bar, no backgrounds, 100 ps photon timing

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❑ Guide ePIC detector design

- Final placement of imaging layers in Barrel Imaging Calorimeter will be determined based on its impact on the angular resolution of tracks entering hpDIRC.

❑ Workshop Goals

- Develop a work plan to
 - Converge on a common approach for estimating angular resolutions
 - Layout tasks needed to optimize angular resolutions

Workshop Agenda

14:00	Introduction <i>Sala degli Svizzeri, Villa Mondragone, Monte Porzio Catone (RM), Italy</i>	<i>Matt Posik</i> 14:00 - 14:05	
	Fitting and Propagation in ACTS <i>Sala degli Svizzeri, Villa Mondragone, Monte Porzio Catone (RM), Italy</i>	<i>Andreas Stefl</i> 14:05 - 14:35	⇒ ACTS Details
	Angular Resolutions via Trajectory Propagations <i>Sala degli Svizzeri, Villa Mondragone, Monte Porzio Catone (RM), Italy</i>	<i>Matt Posik</i> 14:35 - 15:05	Summary of what has been done
15:00	Angular Resolutions via Hit Extrapolation <i>Sala degli Svizzeri, Villa Mondragone, Monte Porzio Catone (RM), Italy</i>	<i>Kentaro Kawade</i> 15:05 - 15:35	
	Discussion Session 1 <i>Sala degli Svizzeri, Villa Mondragone, Monte Porzio Catone (RM), Italy</i>	15:35 - 15:55	
16:00	Coffee Break <i>Sala degli Svizzeri, Villa Mondragone, Monte Porzio Catone (RM), Italy</i>	15:55 - 16:30	
	Open Tasks <i>Sala degli Svizzeri, Villa Mondragone, Monte Porzio Catone (RM), Italy</i>	<i>Matt Posik</i> 16:30 - 16:50	Develop plan to converge on final angular resolution performance
17:00	Discussion Session 2 and Planning <i>Sala degli Svizzeri, Villa Mondragone, Monte Porzio Catone (RM), Italy</i>	16:50 - 17:50	