

ATHENA PID

24 June 2021

B field impact on forward RICH performance

so far

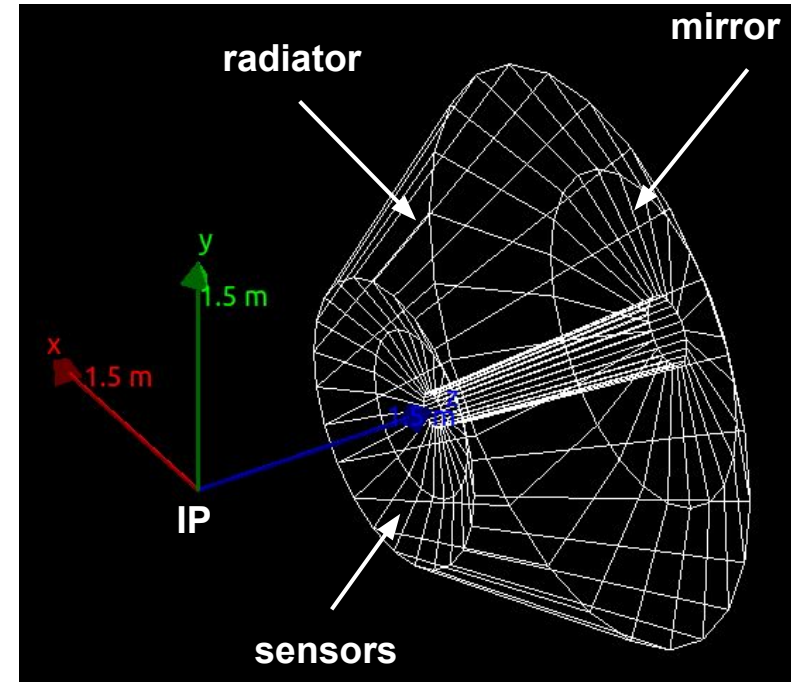
- std.alone study based on an ideal-RICH detector geometry
- assess the effect of particle bending in the B field within the gas radiator
- quantify B field contribution to single-photon angular resolution
- apply to dRICH fast-analytical model to estimate impact on PID

ideal-RICH model

- with ~ realistic dimension/position in ATHENA
- spherical mirror with $R = 300$ cm
- spherical sensor surface with $R = 150$ cm
- 150 cm gas radiator
- rings reconstructed with inverse ray-tracing

note

this is not the dual-RICH, but at 1st approximation the B field bending effect on the photon distribution should be the same



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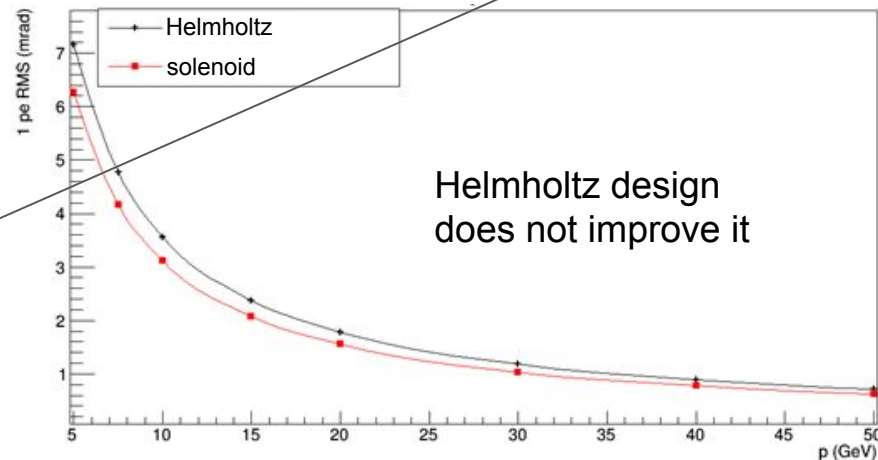
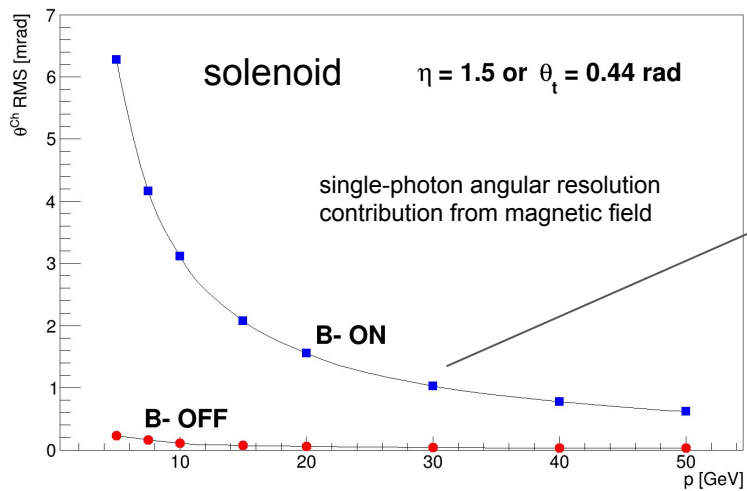
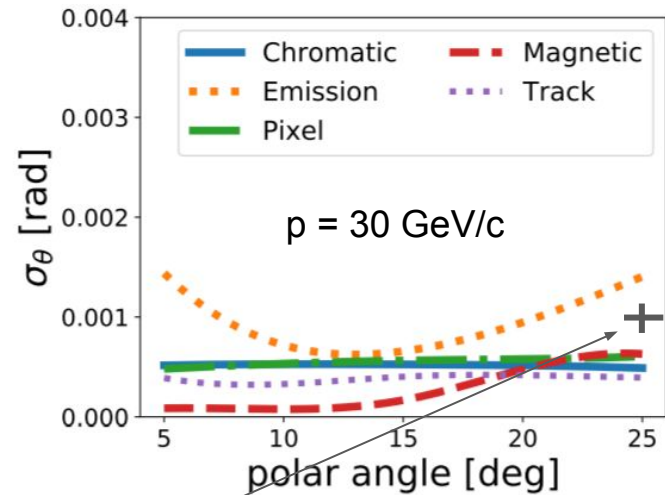
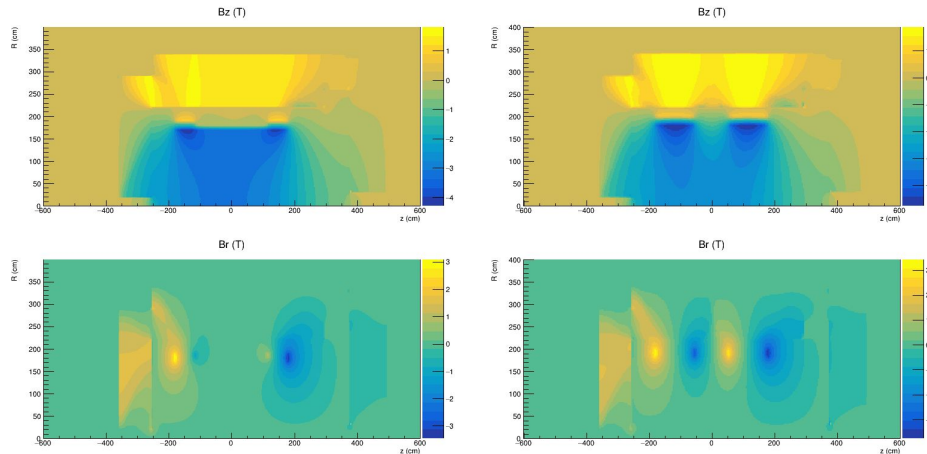
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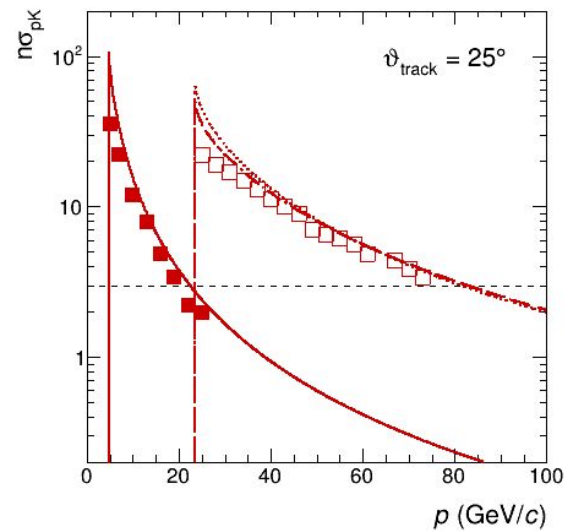
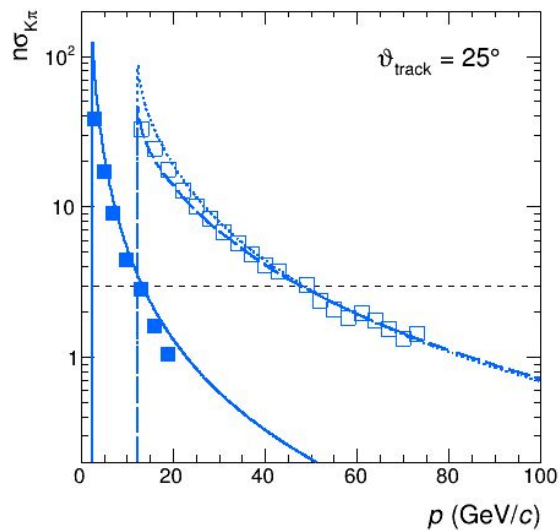
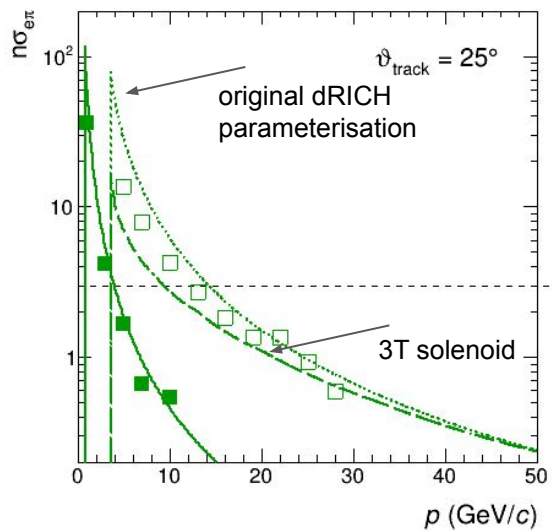
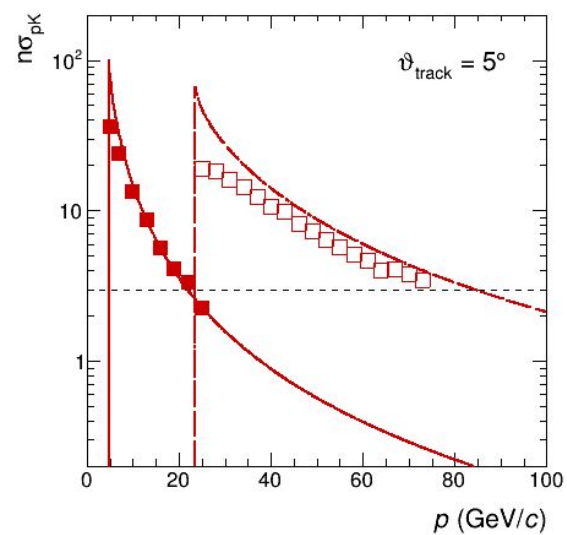
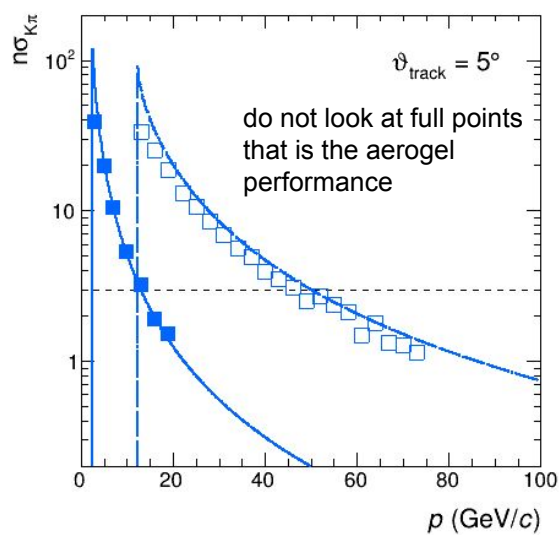
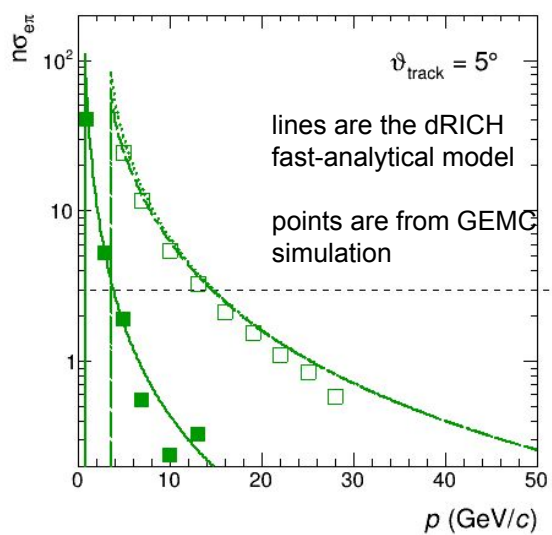
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3T solenoid

3T Helmholtz coils

GEMC studies of dRICH in JLEIC



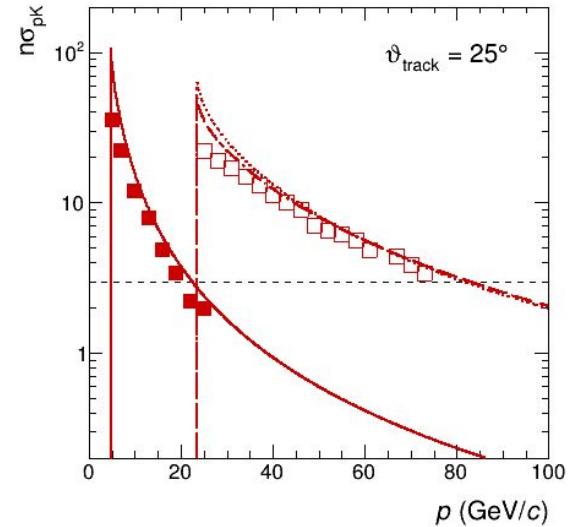
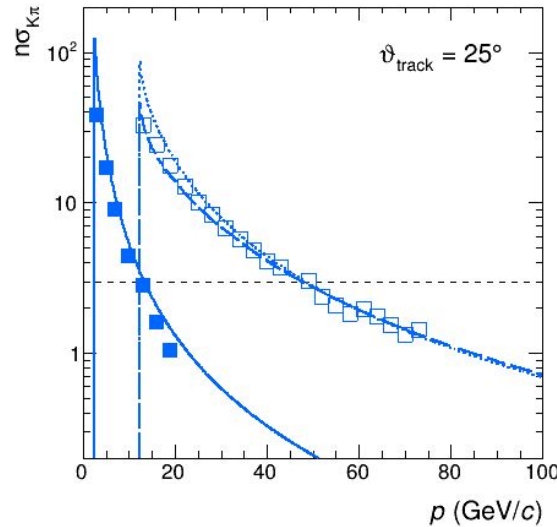
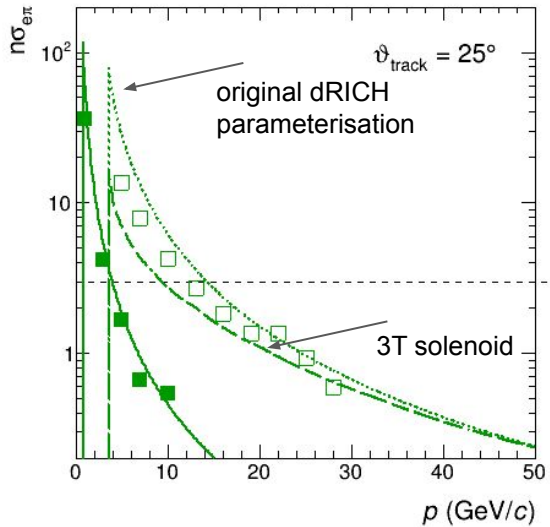


current study indicates that

- the largest effect is for small η (large ϑ)
- the largest effect is for small p
- no significant separation-power loss for hadrons at high p
- significantly lower e/π separation power

beware these tests may show optimistic estimates

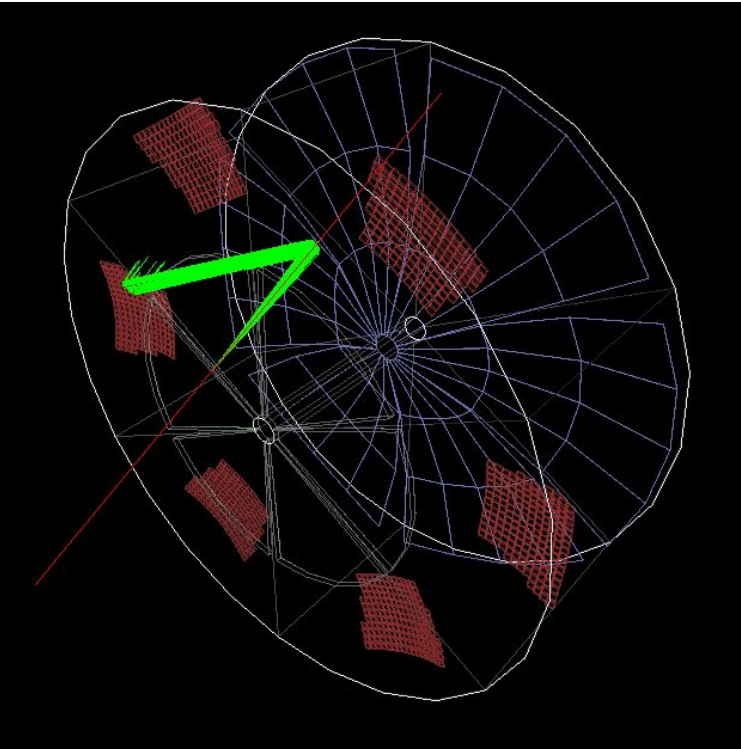
- using ideal track-photon association (broader rings mean larger probability of background associations)
- fast-analytical calculations not doing a Poisson sampling of the number of photons, the average is used
- not obvious (likely yes, but to be checked) that the B field contribution scales as $\sigma_{1pe} / \sqrt{N_{\text{photons}}}$



import dRICH geometry and optical properties in std.alone simulation with B field maps and repeat the study
abandon fast-analytical model, estimate PID performance with complete Geant4 simulation of dRICH

→ **possible timeline for these studies: ~ 10 days... but**

the studies in std.alone simulation would eventually still yield an incomplete assessment of the impact of the B field on the RICH performance



RICH performance also depends on tracking

- track information (position and direction) in the radiator is needed to define Cherenkov angle
- resolution on track direction contributes directly (no $1/\sqrt{N_{\text{photons}}}$ factor) to the reconstructed angle resolution

need to estimate B field impact on reconstructed trajectory resolution within the RICH gas radiator volume

final assessment would need integration of dRICH geometry within the ATHENA SW framework (DD4hep) and running of the reconstruction chain. SWG already contacted for that

→ **possible timeline depends on DD4hep developments: 2 weeks from when geometry and reconstruction in place**