B field impact on forward RICH performance

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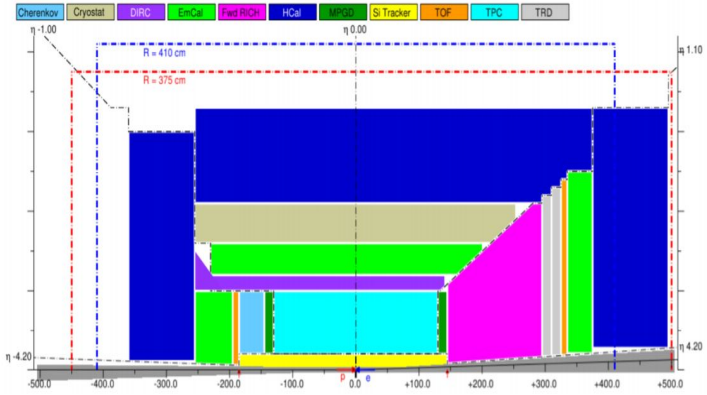
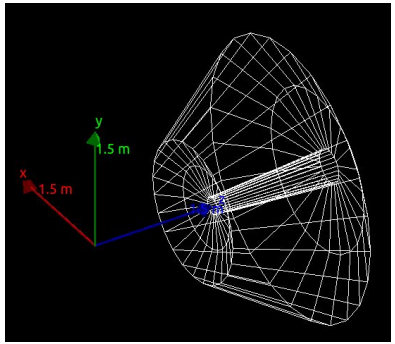
Can we give an upper limit to what is tolerable?

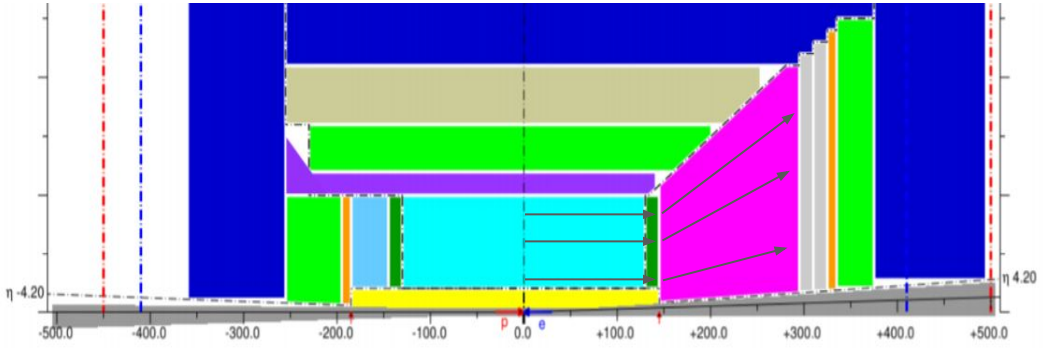
- **stick to the simple ideal RICH model**
  - extract B field contribution to 1pe angular resolution
  - the radiator has been put where the full RICH should be
    - overestimated radiator length → overestimated bending / angular smearing
- **use 1pe angular resolution in the dRICH analytical model**
  - replace old B field contribution to new estimate
  - look at how the separation power changes → is it tolerable?





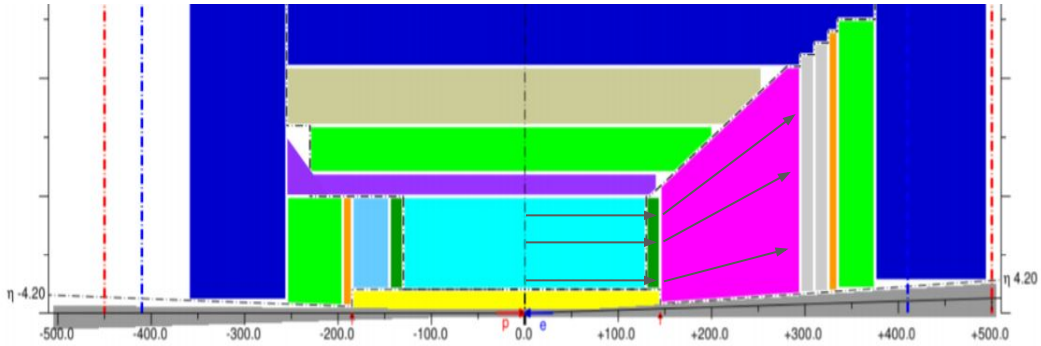
Intermezzo

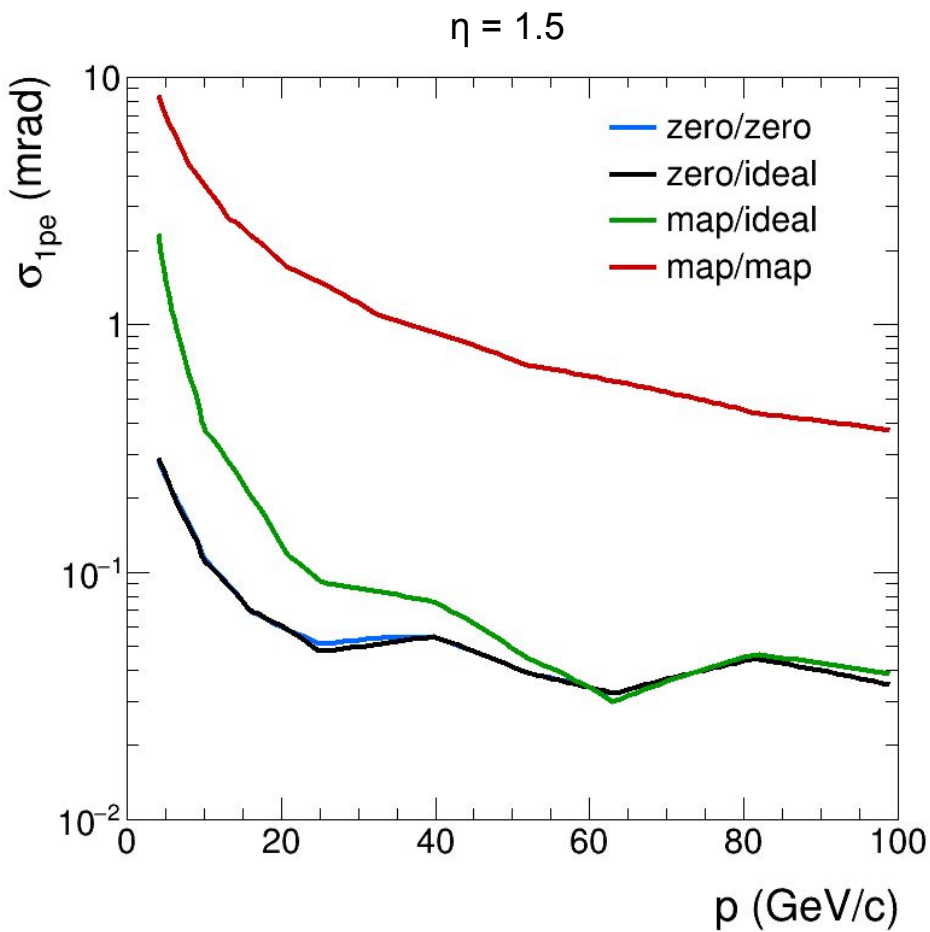
- **even an ideal projective B field in the radiator has some bending**
  - tracks curl in the solenoid and reach radiator with some azimuthal spinning component
  - trajectory of low p_T particles entering the radiator DO NOT point to IP
    - some spin clockwise, some anticlockwise...
    - somewhat that is a lower limit that cannot be eliminated even by perfect B design
- **look at how much worse the 1pe angular spread is**
  - in the actual B field map
  - with respect to an ideal projective field in the radiator volume

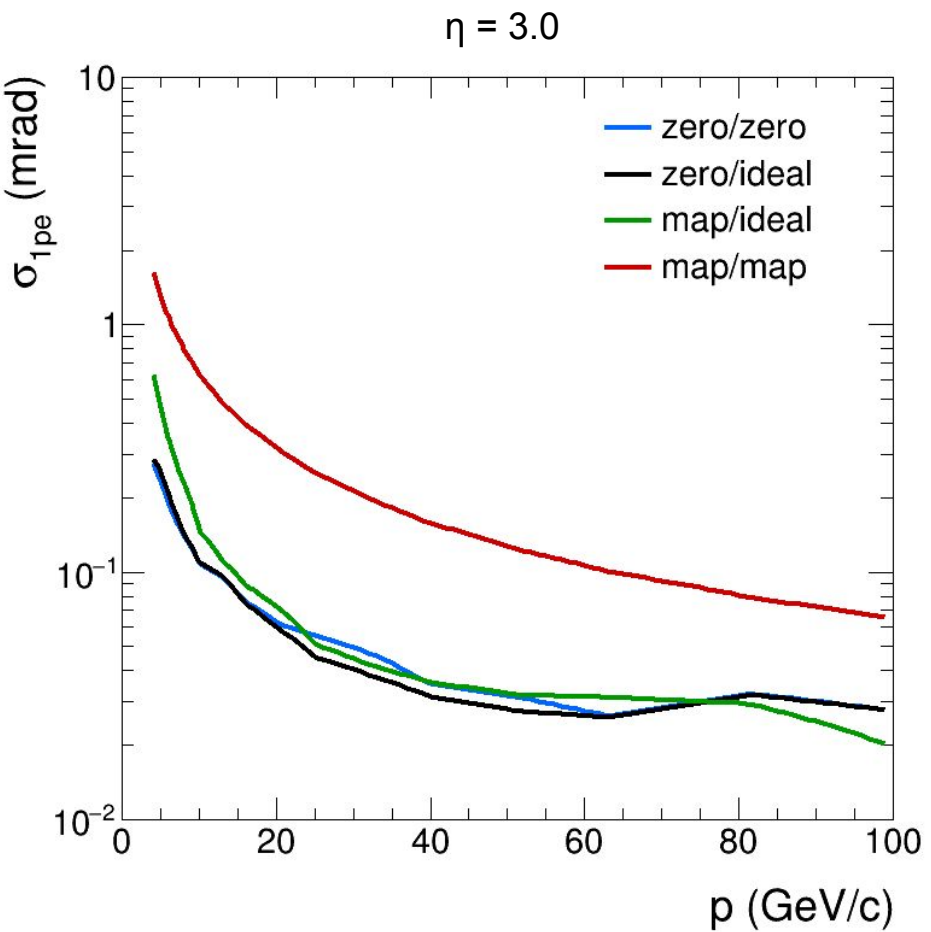


the ideal projective field in the radiator is constructed starting from the field map
the magnitude of the B vector is preserved for each (x,y,z) space point the B vector is rotated such that it points to the IP

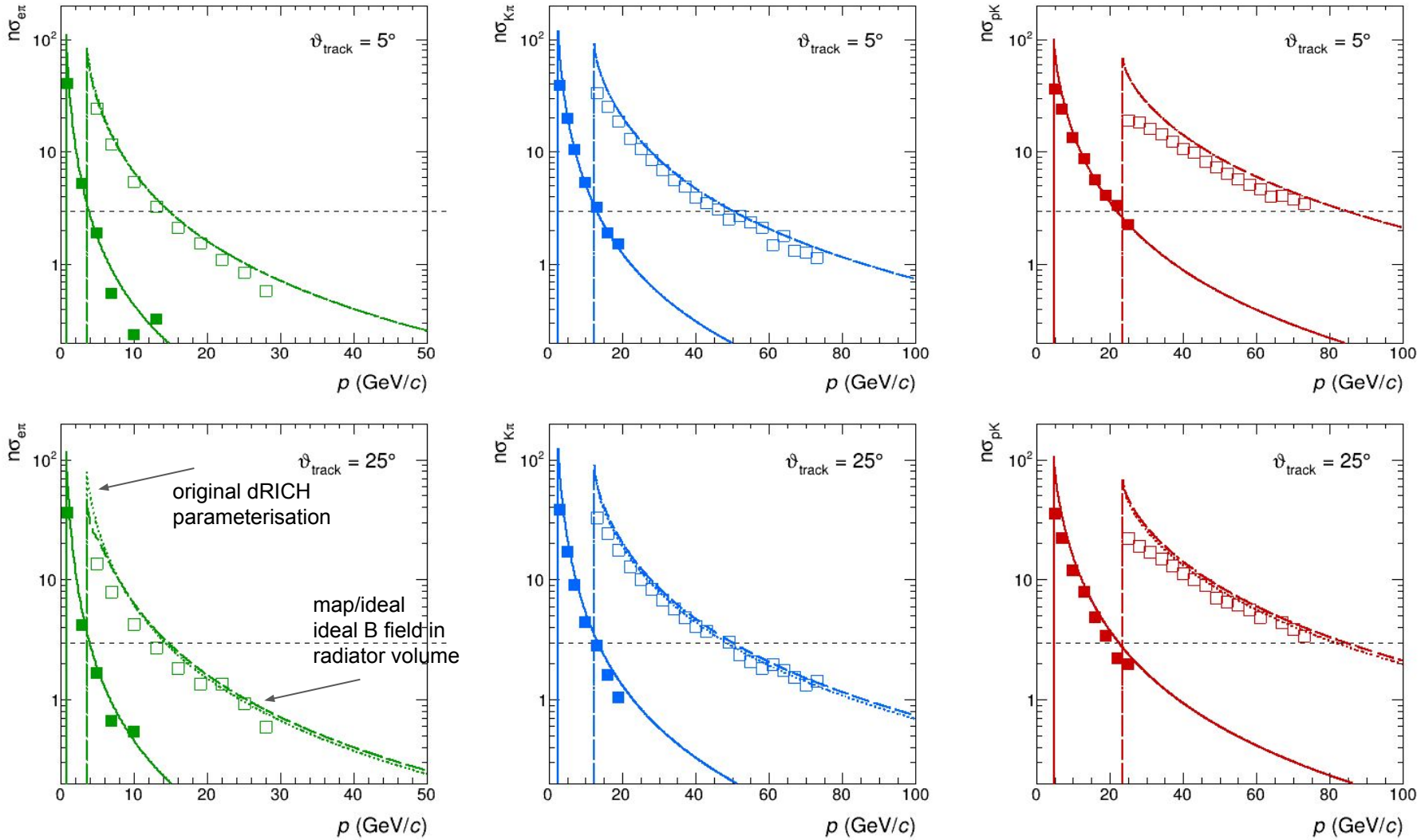
- **for that we define two regions**
  - magnet region, everywhere but the radiator volume
  - radiator region, only in the radiator volume
- **and we do these test runs**
  - magnet = zero, radiator = zero
    - nothing happens, only multiple scattering
  - magnet = zero, radiator = ideal
    - no curling in barrel, projective in radiator… nothing should happen
  - magnet = map, radiator = ideal
    - curling in barrel according to map, projective radiator… we see the effect of the solenoid
  - magnet = map, radiator = map
    - everything

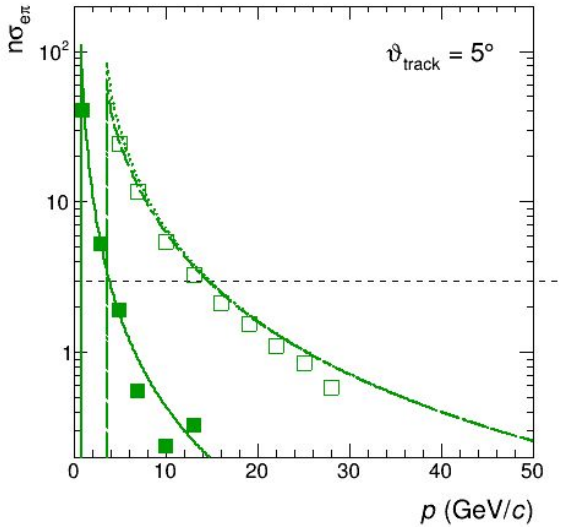


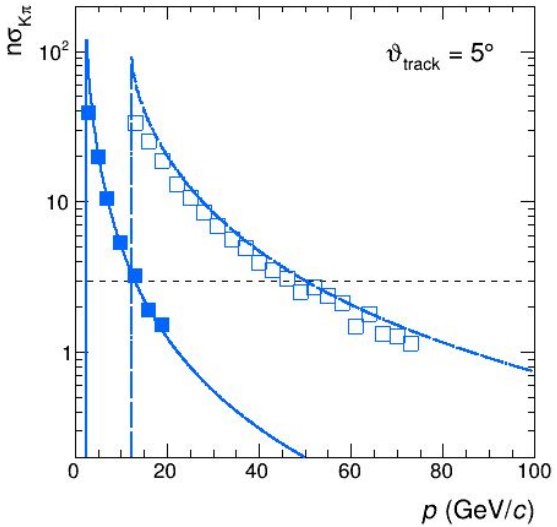


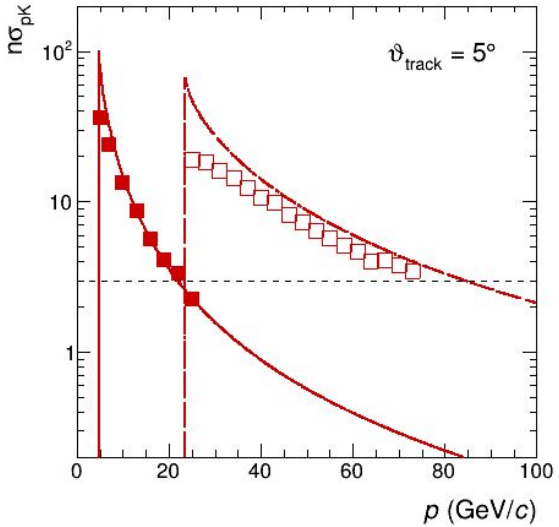


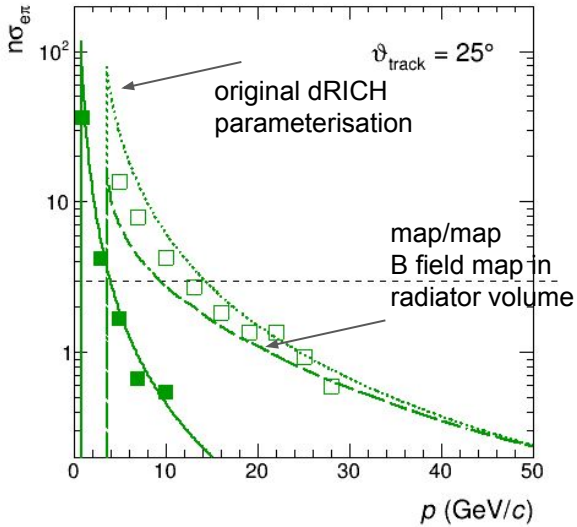
no difference between **zero/zero** and **zero/ideal** (as expected) and no η dependence (expected if multiple scattering)
map/ideal shows the effect of tracks entering the ideal projective radiator field **after curling in the barrel**
map/map shows the effect of tracks **bending in the non projective radiator field** on top of the curling in the barrel


nσ_eπ
nσ_Kπ
nσ_pK
ϑ_track = 5°
ϑ_track = 25°
p (GeV/c)
original dRICH
parameterisation
map/ideal
ideal B field in
radiator volume


nσeπ
ϑtrack = 5°
p (GeV/c)


nσKπ
ϑtrack = 5°
p (GeV/c)


nσpK
ϑtrack = 5°
p (GeV/c)


nσeπ
ϑtrack = 25°
original dRICH
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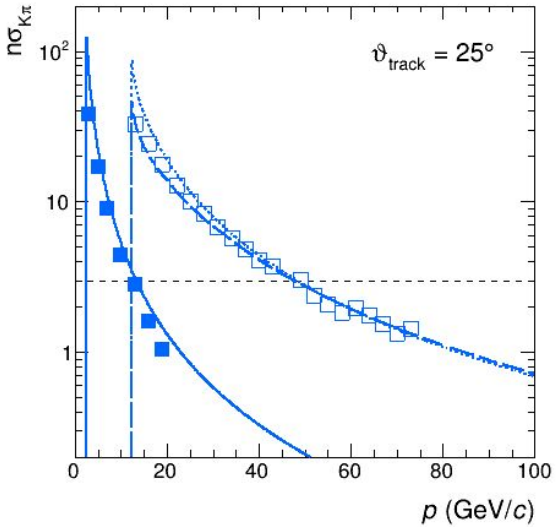
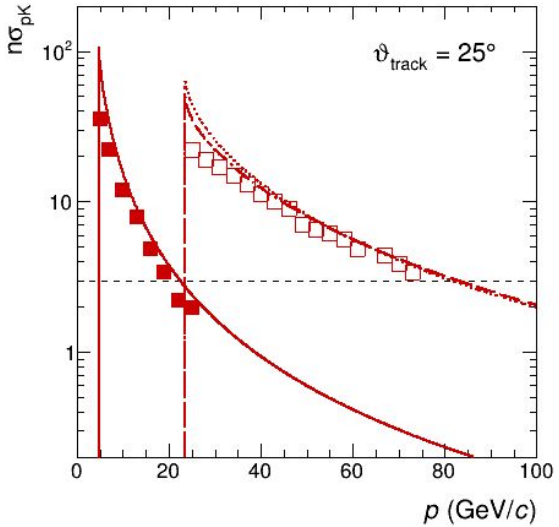
map/map
B field map in
radiator volume
p (GeV/c)


nσKπ
ϑtrack = 25°
p (GeV/c)


nσpK
ϑtrack = 25°
p (GeV/c)

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

current B field maps do not seem to significantly impact hadron identification performance of dRICH
on the other hand, limits e/π separation up to ~ 10 GeV/c

beware these test are using ideal track-photon association
broader rings means larger probability of background associations