A snapshot of ongoing studies in Parmela for AMD simulation

Coils Based Magnetic field in Parmela

- For magnetic fields in Parmela we can use coils which are defined by:
  - Their radius r_i
  - Their location z_i
  - Their intensity I_i
- From these coils a longitudinal field B_z is built up (and also a radial field)

For 1 coil:

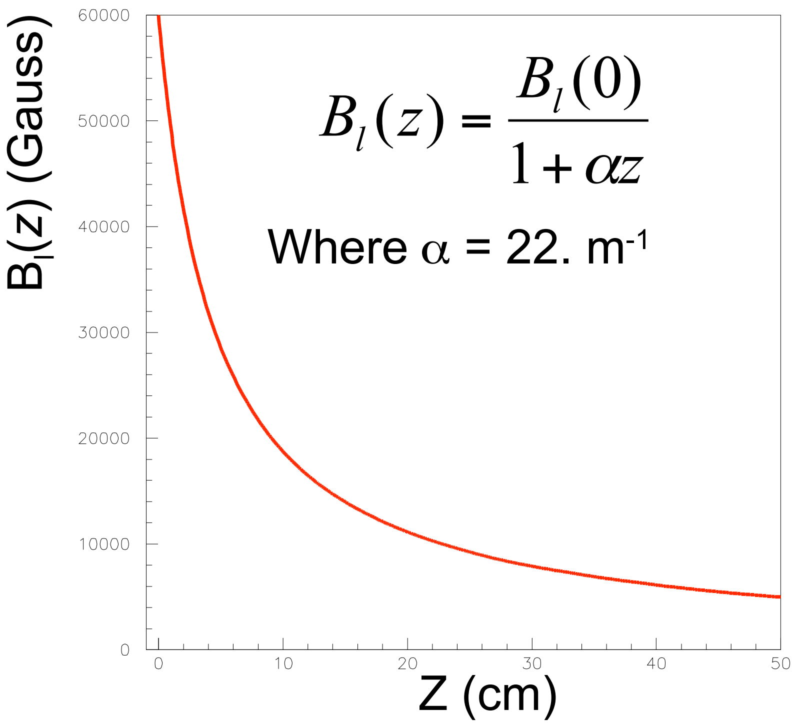
$$B(z, r = 0) = \frac{\mu I r_i^2}{2(r_i^2 + \delta z_i^2)^{1.5}}$$

For several coil (equa.2):

$$B(z, r) = \sum_{i=1}^{n} \frac{\mu I_i r_i^2}{2(r_i^2 + \delta z_i^2)^{1.5}}$$

An AMD in Parmela

- An AMD is usually defined by a slowly decreasing longitudinal field from B_{max} to B_{min}



Here $B_{max}=B_l(0)=6$ T

$B_{min}=B_l(50\text{ cm})=0.5$ T

AMD length=50 cm

- In the past, we had an empirical solution which was provided to us.
  - Not flexible enough
  - As What should we do in Parmela if we want to provide a different AMD (various length, B_{max},)?
  - Is this empirical solution describing well enough an AMD? What should describe an AMD?
- Can we build up an automatic algorithm to provide us with the right coils?
- A solution which we had a look at is the inversion matrix

The matrix

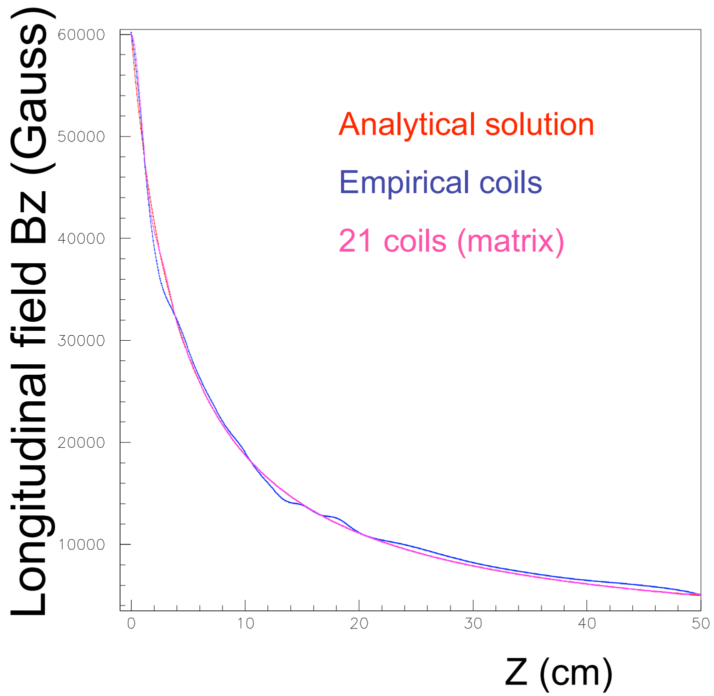
- The transformation of I to B_z can be described as:

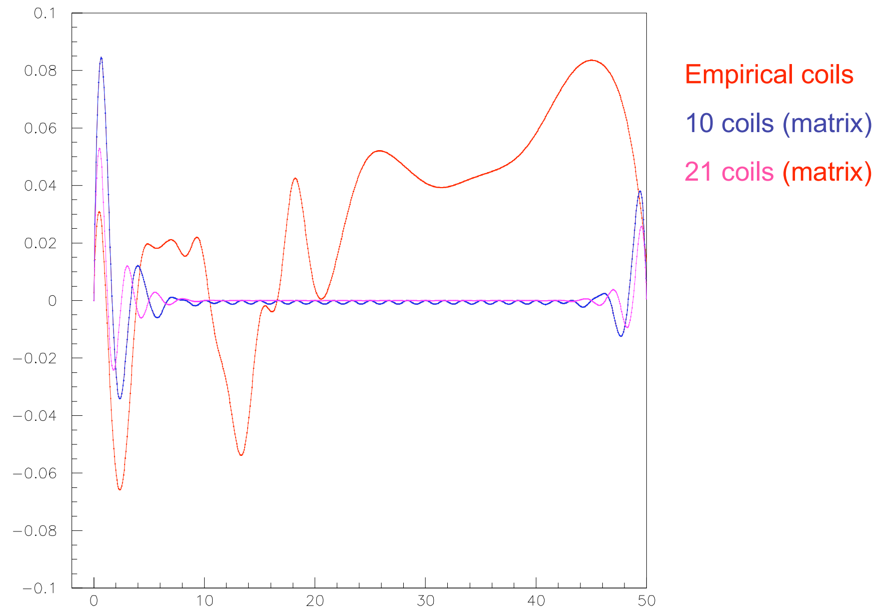
  $B_z = IM$ (if r_i=cste, z=known)

  - where M is the matrix transformation of the intensity of the coil into the longitudinal field as given in equation 2.
  - In this case, if the matrix can be inversed,

    $I = B_z M^{-1}$

    i.e. we can define a longitudinal field and then obtain a set of intensity for the coils





Relative Difference with the analytical form of the longitudinal field Bz

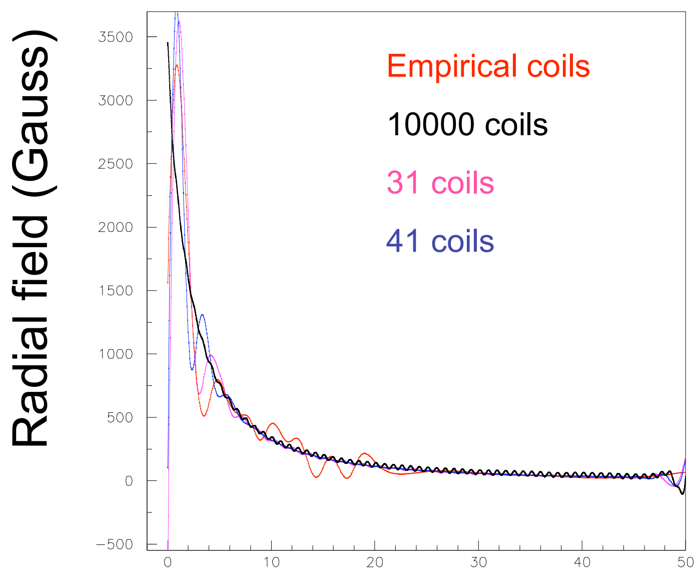
With this matrix inversion solution only, to describe accurately the longitudinal field "the more coils the better it is".

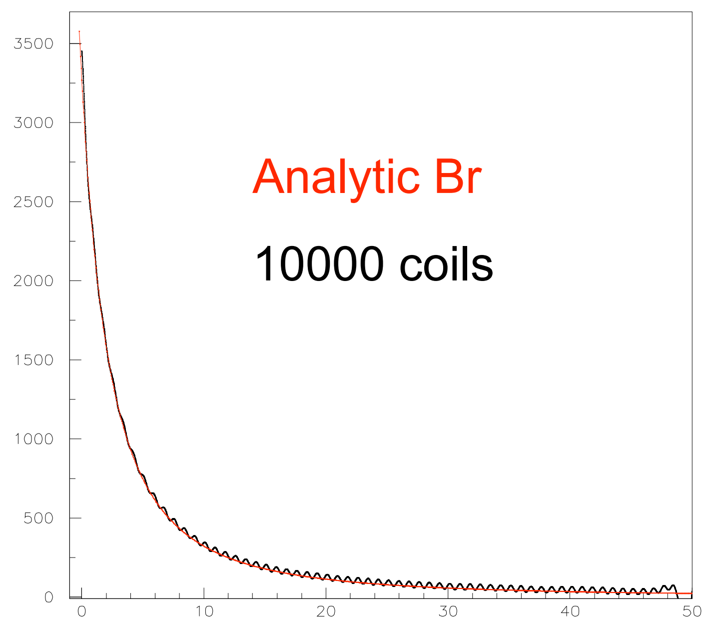
- Though it is not a criteria for the choice of the method it has been looked at the number of particles at the end of the AMD when tracked in Parmela
  - With 1000 coils: acceptance 19.8%
  - With empirical coils: acceptance 20.6%

  } With Bz only (Br is 0)
- If only the longitudinal field is introduced, the method (empirical and matrix inversion based) are rather equivalent (and if number of coils is well chosen)

Radial Field

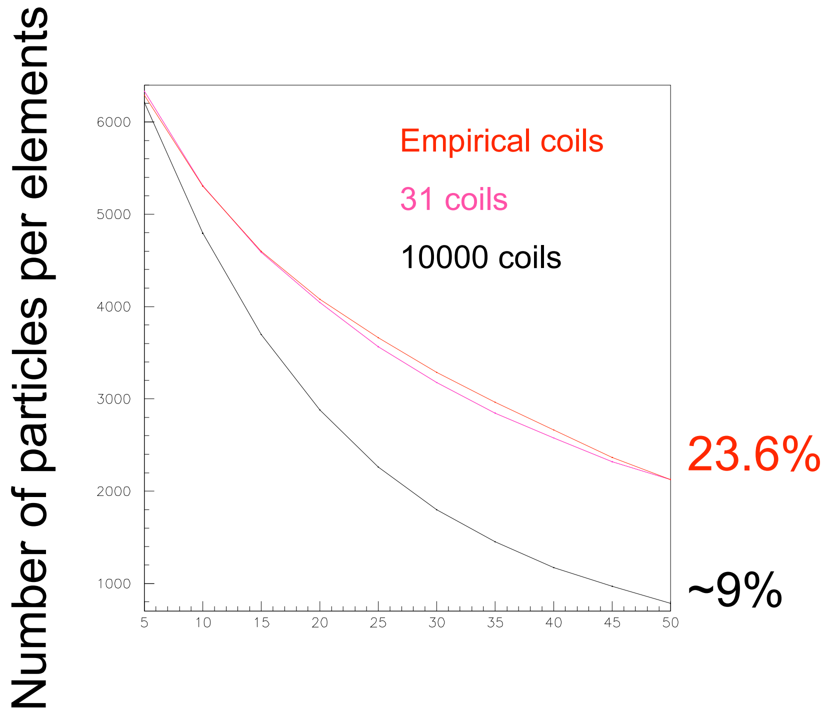
When the radial field Br is switched on:





From the Br field, we could think that the black curves (10000 coils here) describe pretty well the AMD → But there are all this tiny fluctuations

Field applied in Parmela and study with a CLIC positron distribution:



Here 10000 coils is not the right choice when Br is on

- Importance of the definition of the radial field
  - Importance of a smoothed solution for the coils (?)

Conclusion

- Several solution are also being studied:
  - Extension of the coil definition (which allow to get rid of limit effects)
  - Smoothing of the intensity coils solution with Tikhonov regularisation
  - See Julien Brossard
- A temporary solution:
  - Application of the analytic radial field
- A more physical possible solution:
  - Use of Poisson as input for the various fields (if Bz and Br are provided)