New features in guineapig++ (automatic grid sizing…)

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The grid in guineapig

- Computation of the electric field (Poisson equation)
- in transverse dimensions : x and y
- the total size of the grid : ±cut_x, ±cut_y
- Number of cells : n_x, n_y

« miss » parameters

- Output :
  - maximum relative amount of interacting particles that were outside the grid during one time step :
    - miss.1 : beam1 ; miss.2 : beam2
  - Maximum number of interacting part. that were outside the grid during one time step :
    - out.1 : beam1 ; out.2 : beam2

Standard user's data :

- beta (_x, _y), emitt (_x, _y), sigma (_x, _y)
  - 2 of these 3 parameters must be given by users :
    - If beta given :
      - if emitt given : sigma = f(beta, emitt)
      - if sigma given : emitt = f(sigma, beta)
      - else error
    - else :
      - if emitt and sigma given : beta = f(emitt, sigma)
      - else error
- Cut (_x, _y)
  - if given : this will be the grid size
  - else : default value : 3*sigma

new keyword :

- automatic_grid_sizing :
  - = 0 : as in guineapig « standard »
  - = 1 : automatic determination of cut_x, cut_y, and of n_x, n_y……

automatic grid sizing

- Cut = mp + delta + deflection + 4*sigma

- Both beams are taken into account :
  - mp = (mp1 + mp2) / 2
  - delta = |mp1 - mp2| / 2

    - mp1 mean position of beam1
    - mp2 mean position of beam2

deflection ??

cdm deflection : empirical formula

(Yokoya, Chen : beam-beam phenomena in linear colliders)

$$\Theta = \frac{1}{2}\theta_0 F(\delta)$$

$\delta = \dfrac{2 * delta}{\sigma}$ offset between beams

$\theta_0 = \dfrac{2Nr_e}{\gamma(\sigma_x + \sigma_y)}$ disruption angle

$D_{x,y} = \theta_0 \dfrac{\sigma_z}{\sigma_{x,y}}$ disruption parameter

$A_{x,y} = \dfrac{\sigma_z}{\beta_{x,y}}$

Form factor :

$$F(\delta) = \delta\left[C_1 + C_2\delta^2 + \frac{1}{\pi^2}\delta^4\right]^{-1/4}$$

$$C_1 = \left(1 + A^2\right)\left[1 + \frac{0{,}5}{0{,}6 + \left(\sqrt{D} - 2{,}5\right)^2}\right]^2$$

$$C_2 = \left[\frac{1{,}2D^2}{D + 10}\right]^2$$

Numbers of cells

- Power of 2 which is nearest from :

4*cut/sigma

(for both n_x and n_y)

About load_beam

- If load_beam = 3 (except 0, other values are not available)
  - if cuts_from_loaded_beam = 0 : nothing is changed
  - else (cuts_from_loaded_beam = 1) :
    - The cuts are computed from sigma's of actually from files loaded beams, assuming gaussian distribution
      - cut_x = cut_x_factor*sigma_x
      - cut_y = cut_y_factor*sigma_y
      - cut_z = cut_z_factor*sigma_z
    - cut_x_factor, cut_y_factor, cut_z_factor are 3 new keywords with default value 3.

Others :

- A general cleaning and restrucration of the code has been made (much yet remains to make)
- No more results on the « output screen »
- All results on output file : with units and little explanations.