“Simulations of the KURRI FFAG

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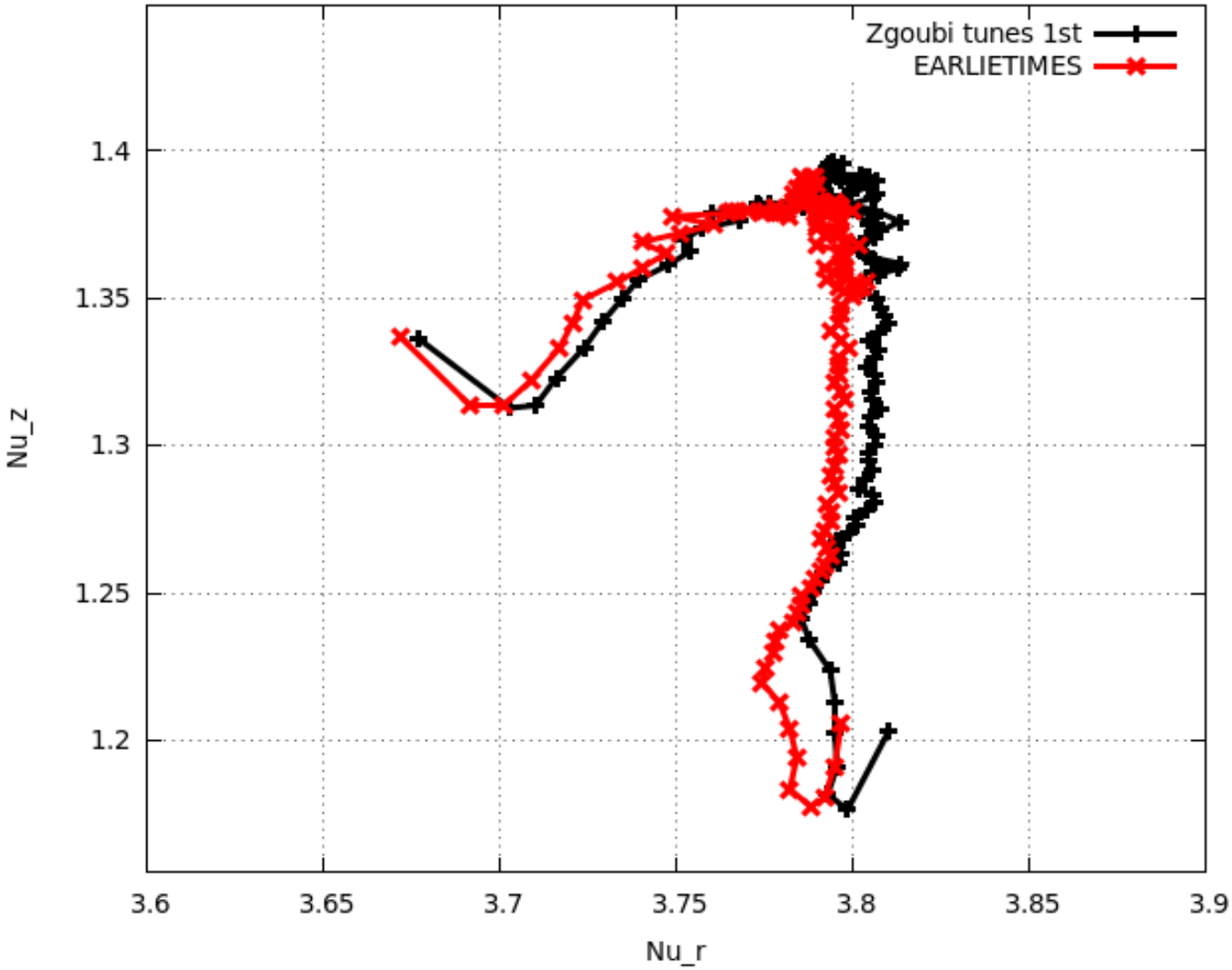
Tune results with ZGOUBI

The results obtained by the two codes differ by:

~ 0.2 % for the horizontal tune

~ 2 % for the vertical one

Origin of the discrepancy?



- The tune is computed from multi-turn tracking and a Discrete Fourier Transform.
- Varying the initial conditions would change the final tune results.
- 4 parameters to vary:

  - 2 in the horizontal plane: radius and angle (projection of the velocity)

  - 2 in the vertical plane: vertical coordinate and angle

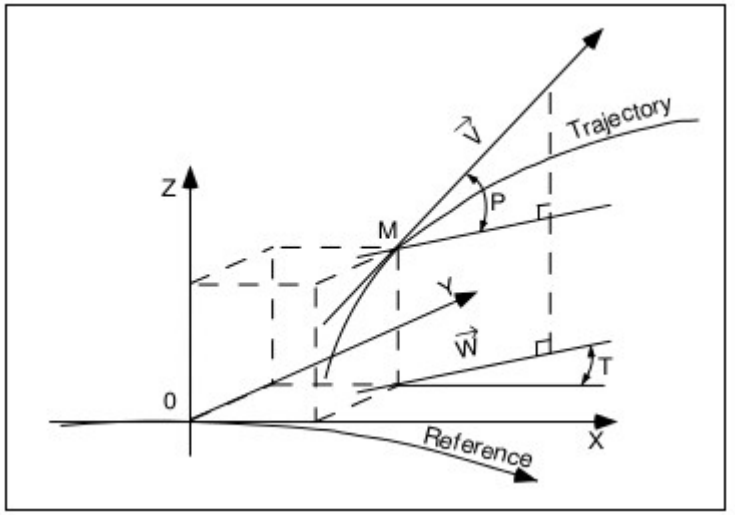
- Assuming that the actual orbit has some errors, this could explain the discrepancy between the tune measurement and the expected (ideal) values.

Reference frame and coordinates (Y,T,Z,P) in zgoubi:

W= projection of the velocity v in the (X,Y) plane

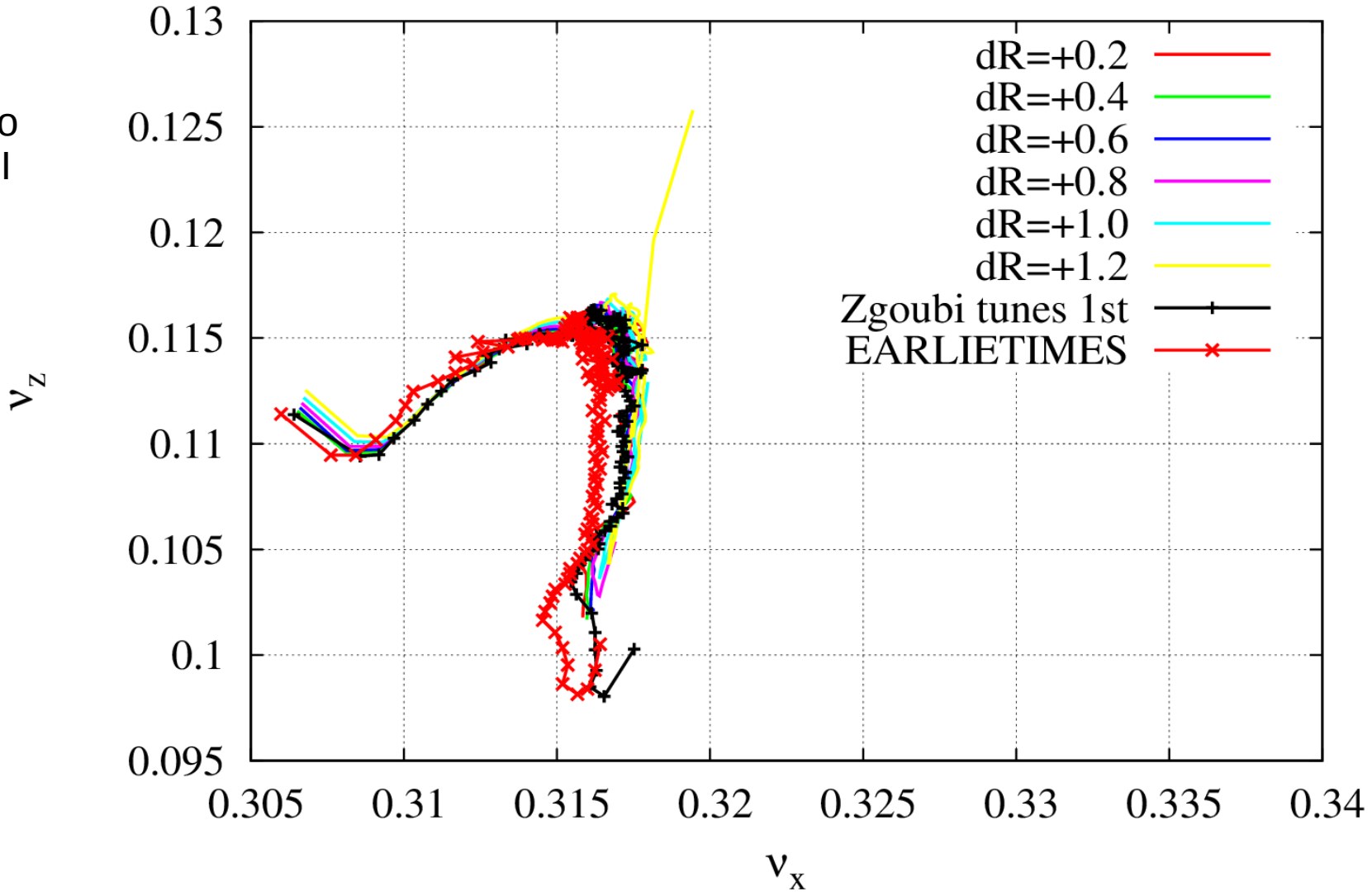
T=(W,X)

P=(W,v)

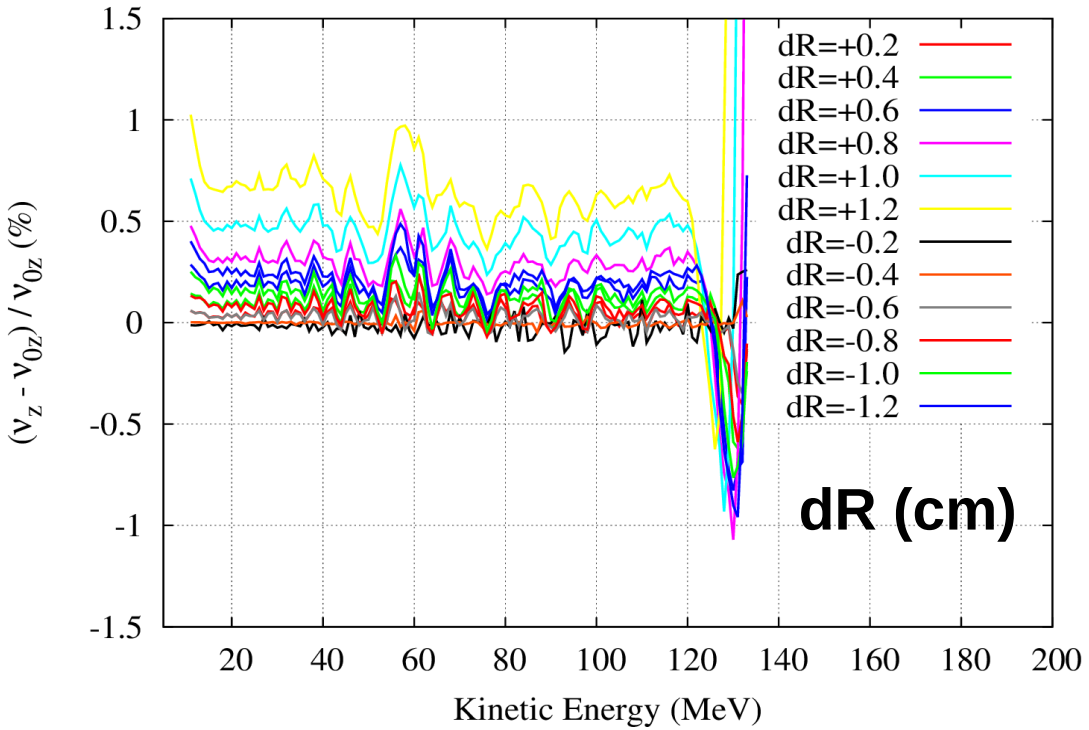


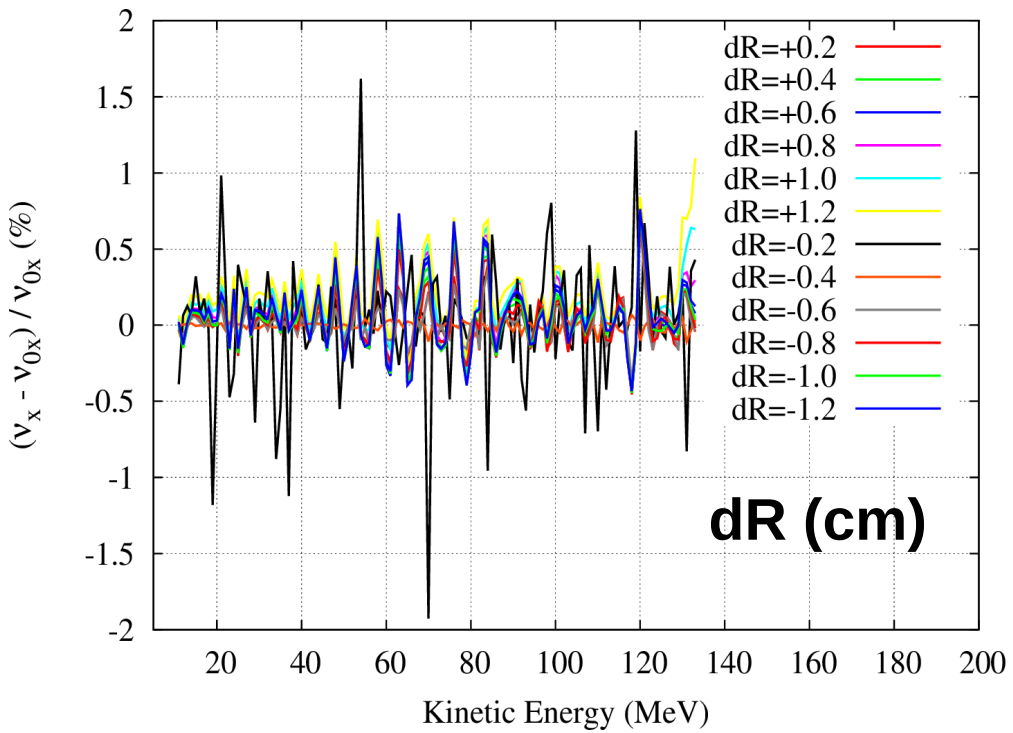
1st parameter: the radius R

R is equivalent to Y in the ZGOUBI notation.



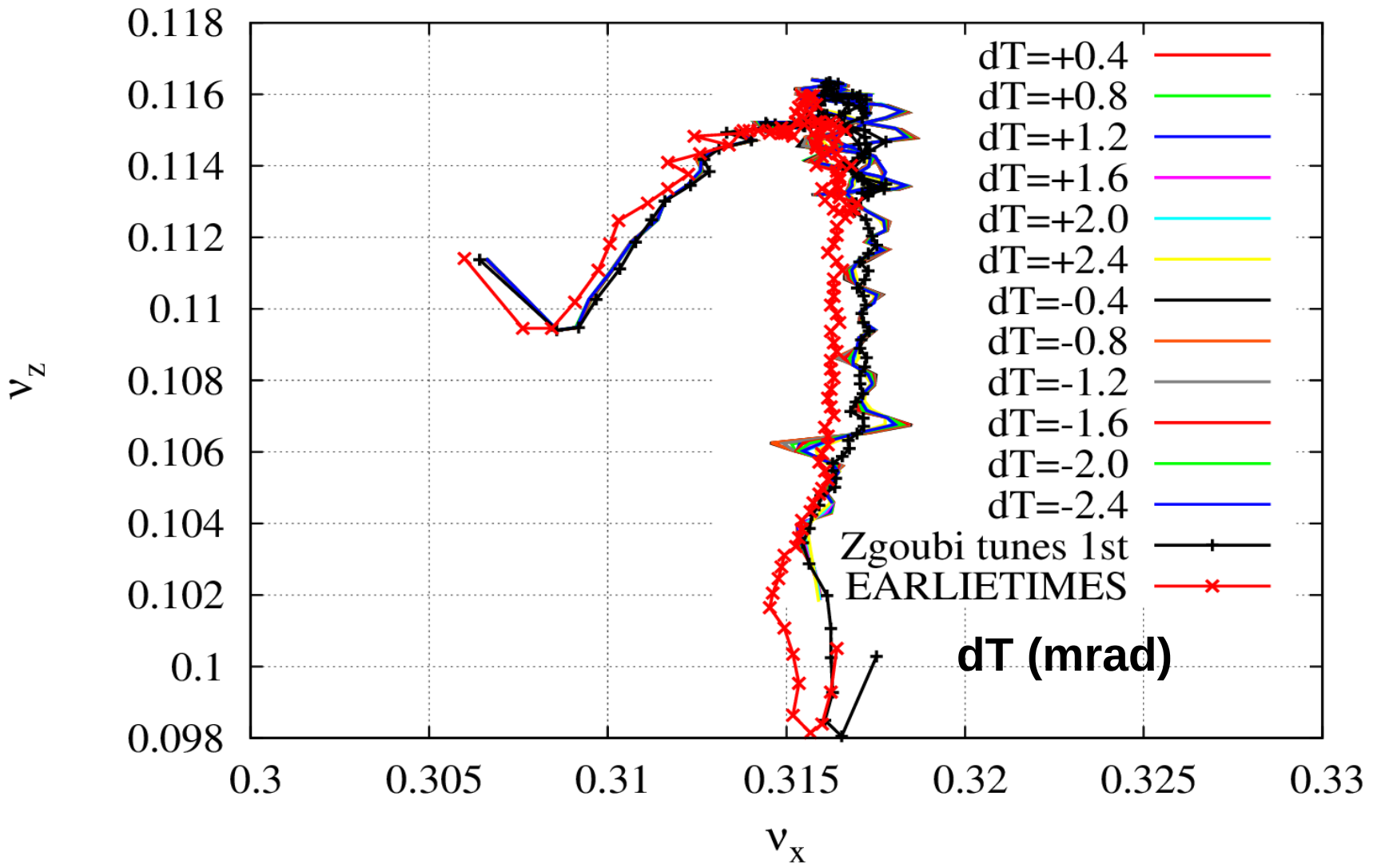
1st parameter: the radius R





A relative error of less than 1.5% is achieved in both planes with small increments in R (dR less than 1cm)

2nd parameter: the angle T

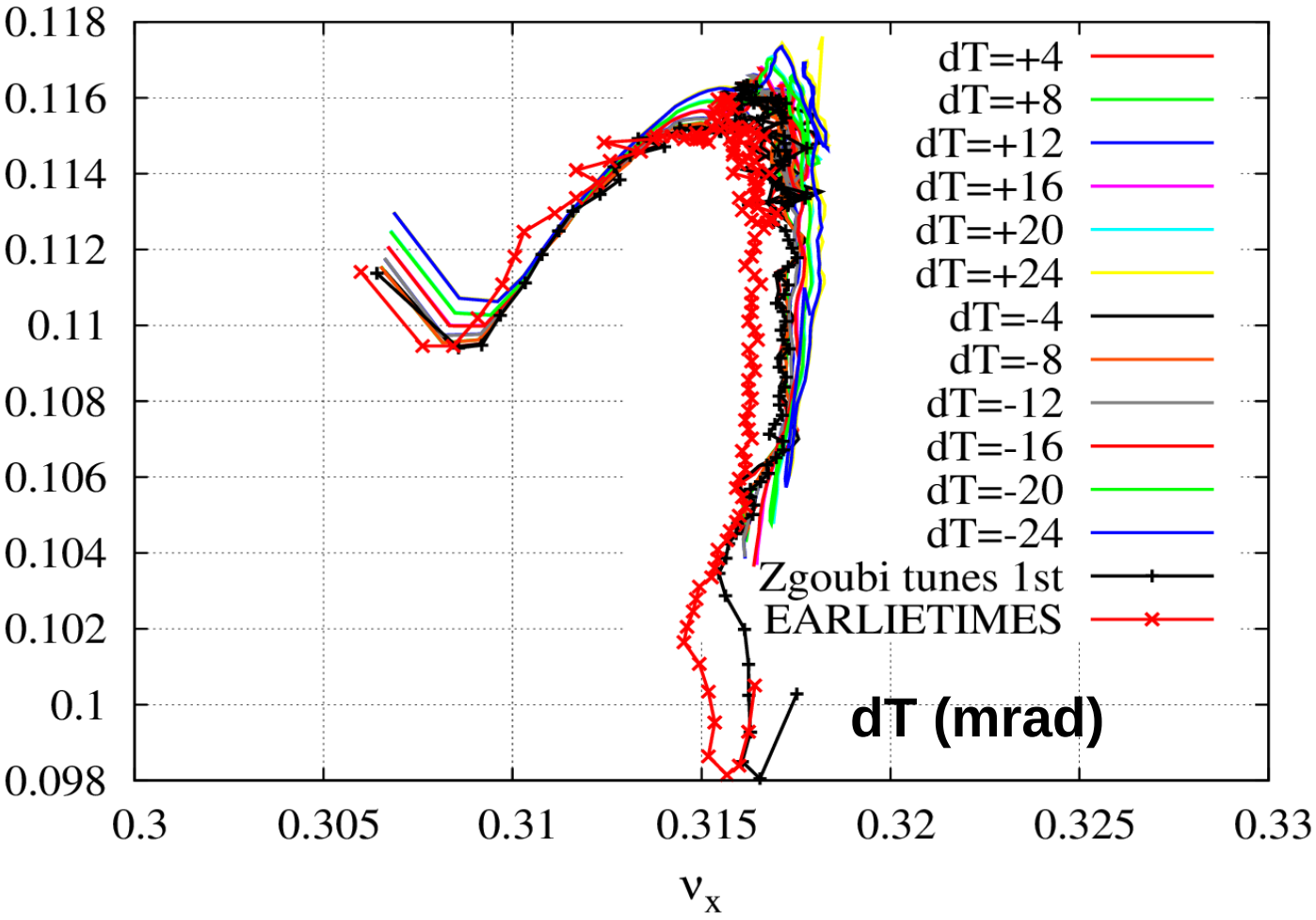


2nd parameter: the angle T

Tune calculation fails above 130 MeV: Particles lost

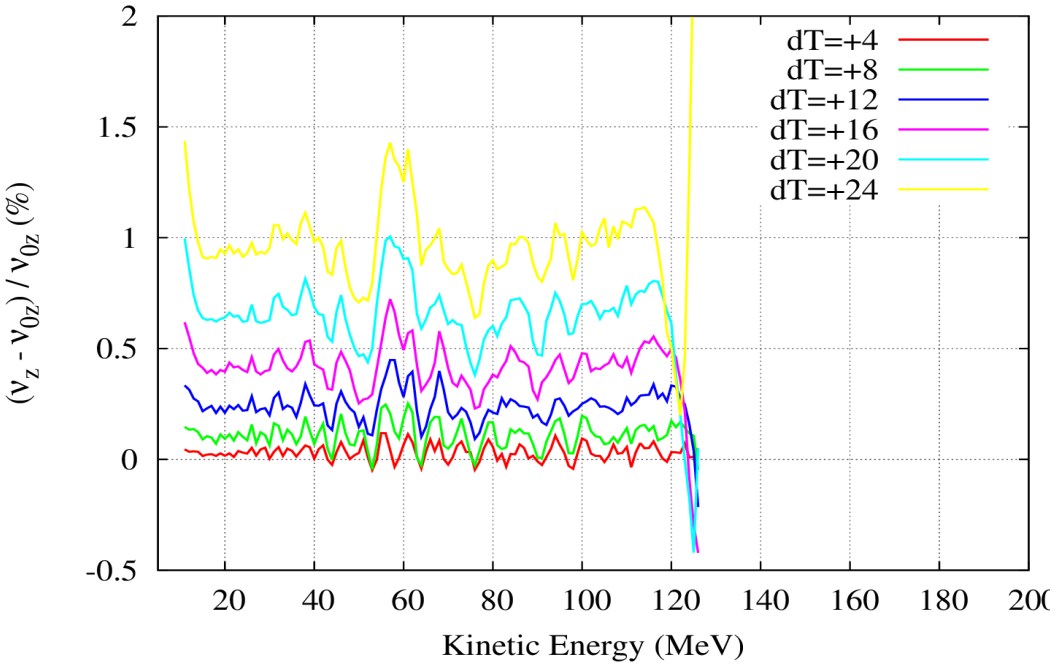
What's the error committed on this parameter from the experimental measurement of the tune?

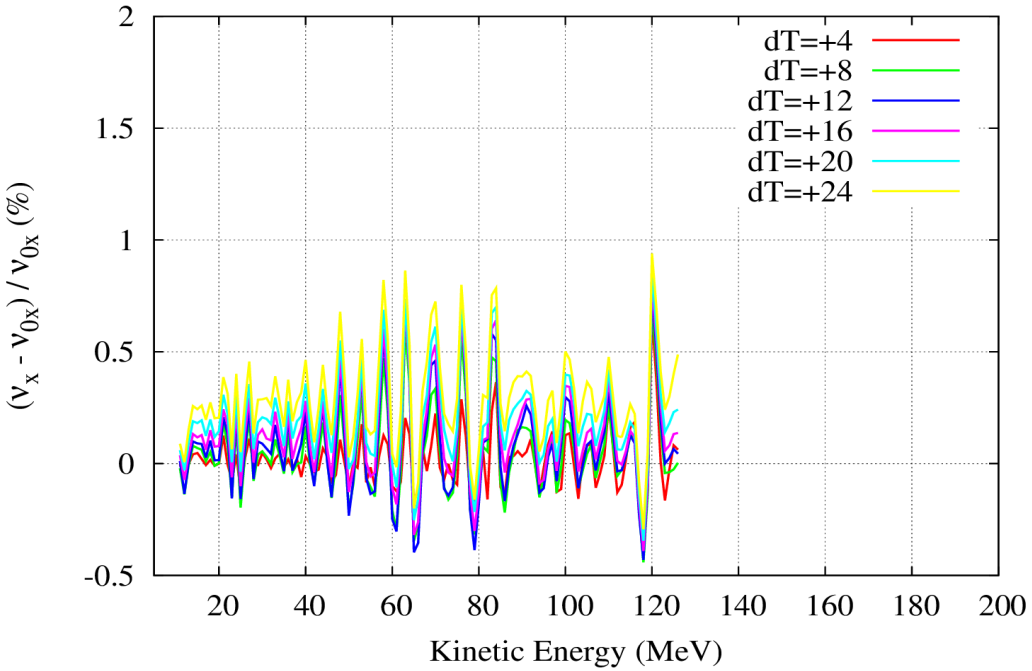
How accurate are the orbits known inside the FFAG ring?



PS: 4 mrad ~ 0.23 deg

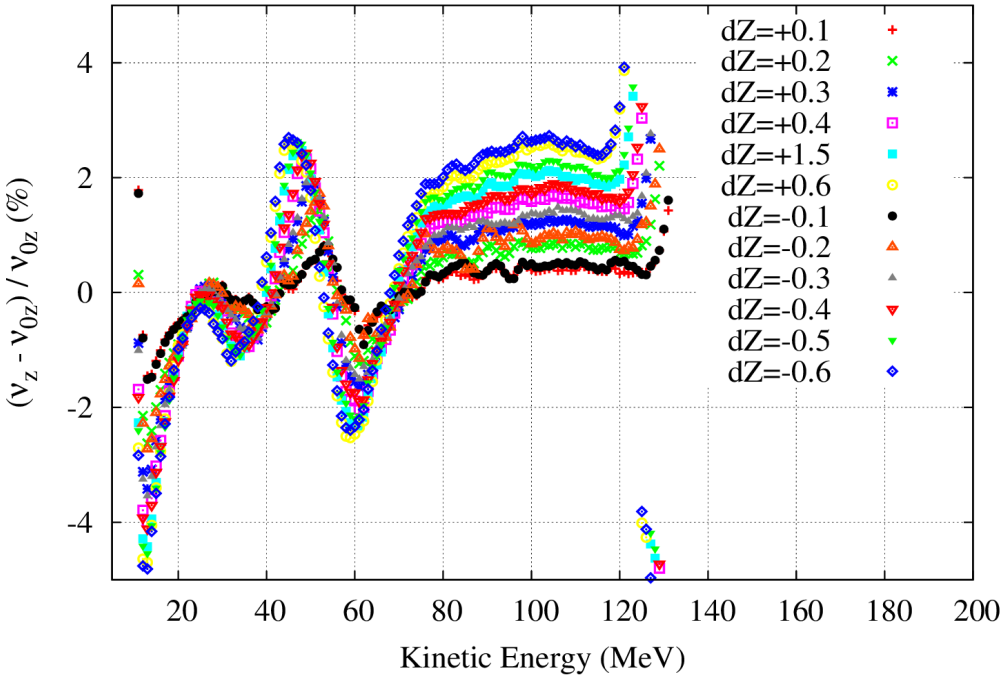
2nd parameter: the angle T

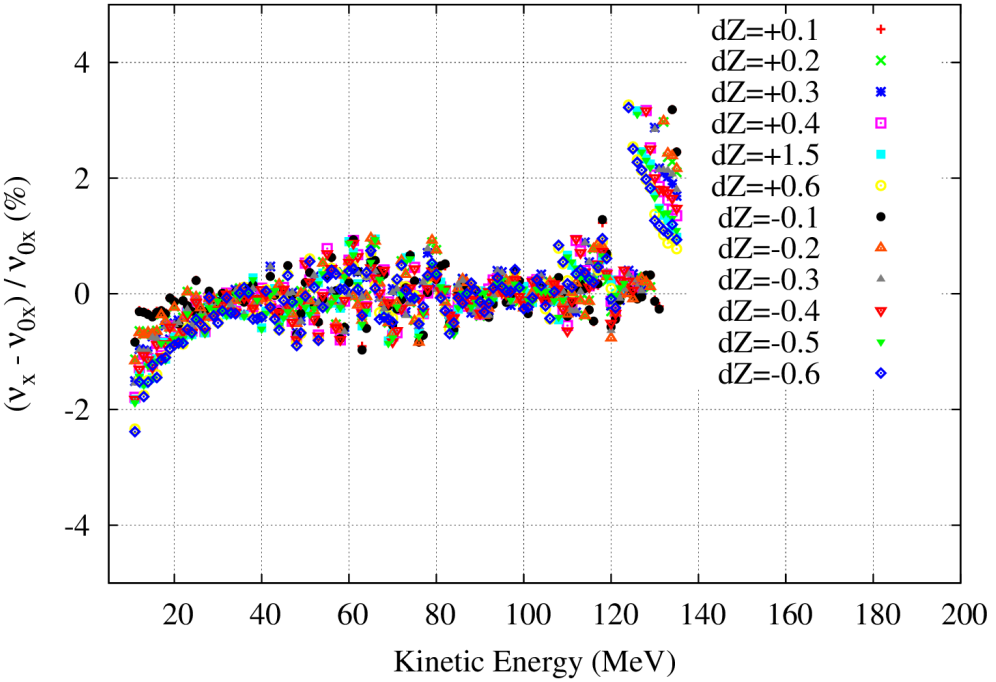




A relative error of less than 1.5% is achieved in both planes with small increments in R (dR less than 1cm)

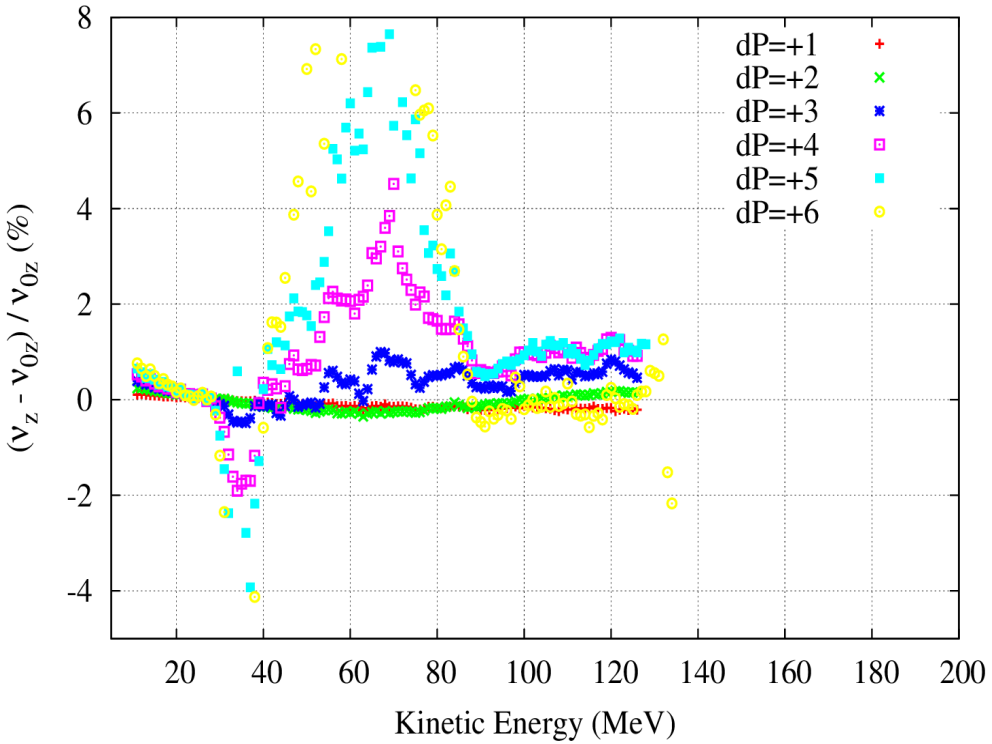
3rd parameter: the vertical coordinate Z

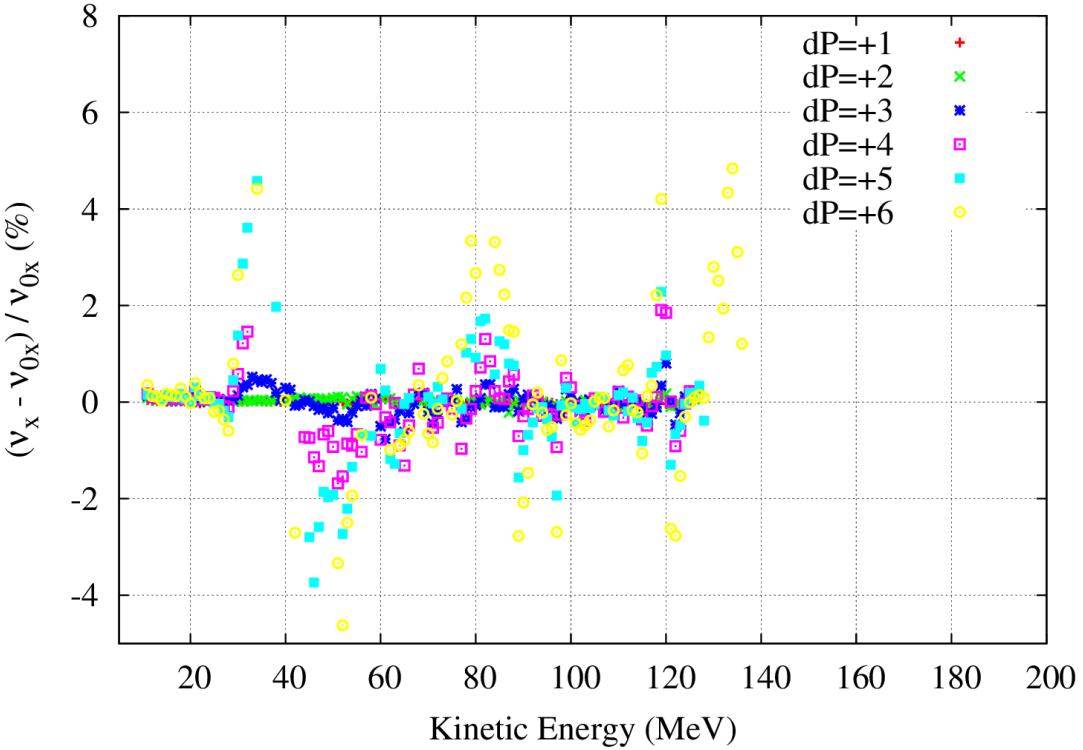




A relative error of less than 4% is obtained in both planes with small increments in Z (dZ less than 0.6 cm)

4th parameter: the angle P

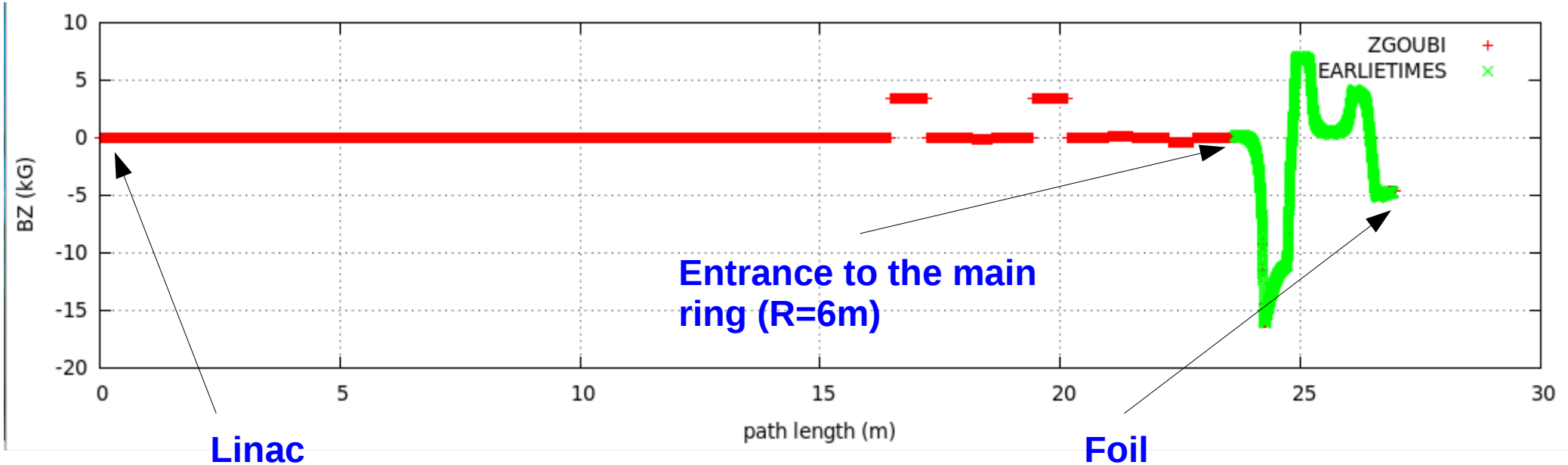


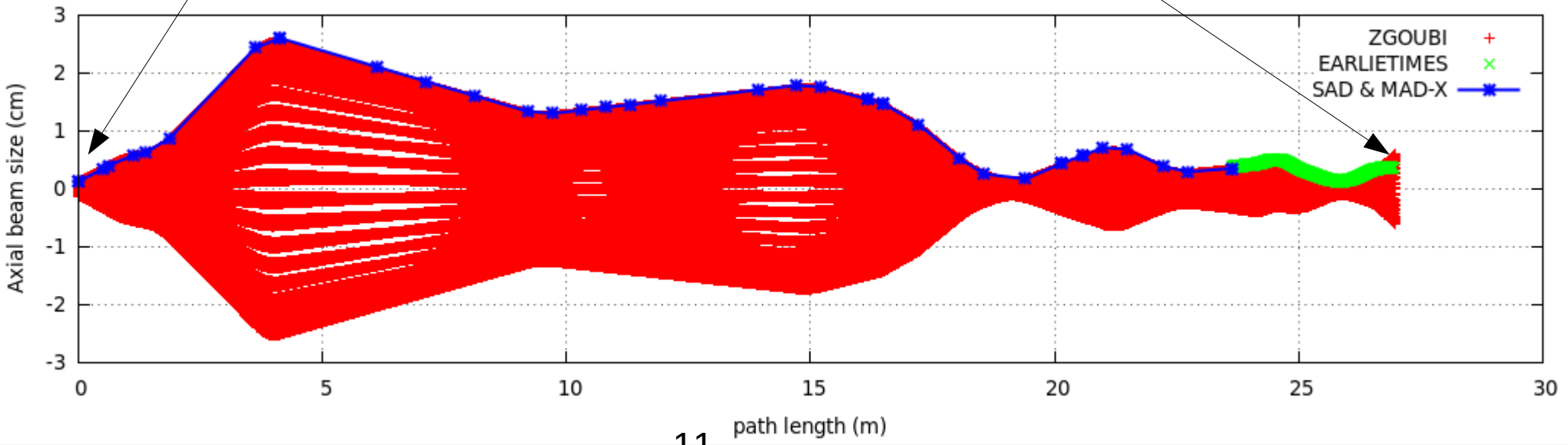


A relative error of less than 8% is obtained in both planes with small increments in P (dP less than 6 mrad)

The vertical plane errors (initial coordinates) may cause strong tune variations.

Linac to foil beamline





- The orbit errors should be taken into account in the simulation?
- A combined effect of all the above parameters would be very difficult to predict.
- Re-do the tracking with +- ΔR, Δz, etc and make sure that the experimental results fit into these domains.

- This will be added soon to the

  https://github.com/fixed-field-accelerator-simulation