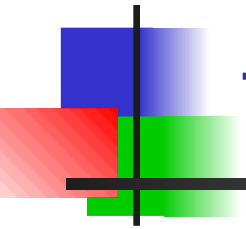

Tracking ERIT-FFAG in OPAL

Chris Rogers,
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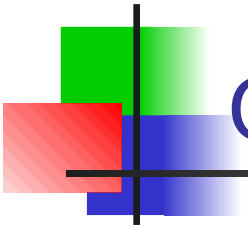


Overview

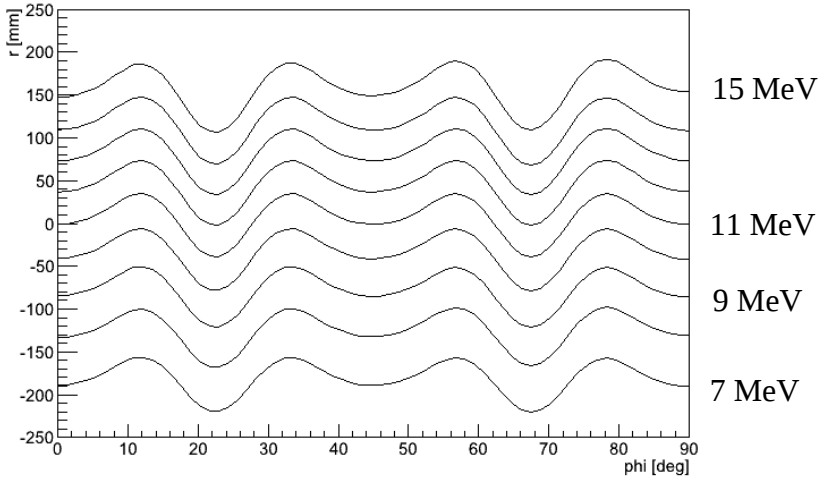
- Previously I tracked ERIT ring using Geant4 based code
- Would like to simulate collective effects
  - e.g. cross check S-Code
- Not possible in Geant4 code
  - G4 tracking loop tracks particle-by-particle
  - Requires aggressive intervention to change this to step-by-step
- Look to OPAL as an alternative
  - Developed by Andreas Adelmann et al (PSI)
- Some potentially very nice features
  - Multibunch space charge solver
  - Reasonable foil model

Overview (cont.)

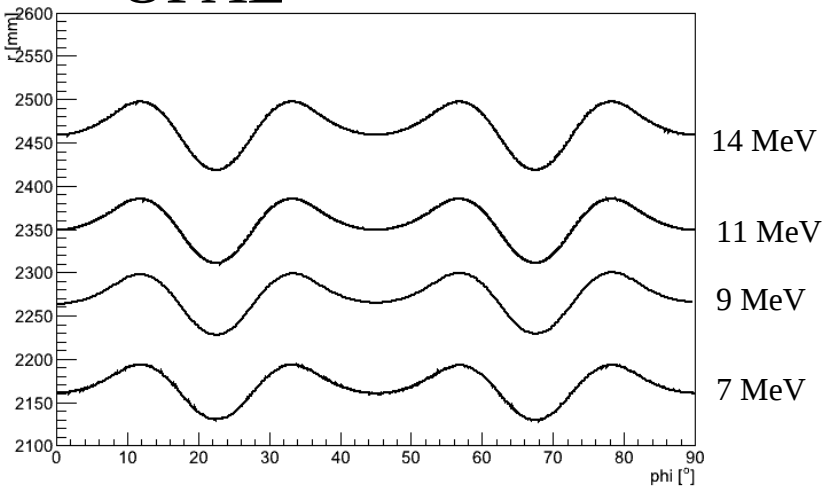
- OPAL requires modification to adequately track FFAG field maps
  - OPAL-T allows tracking through a set of beam elements in linac-type geometry
  - OPAL-Cycl currently hard coded to use 2D midplane field map + single RF cavity
  - Aim to introduce the capability to track through a set of “arbitrary” beam elements in ring-type geometry
    - I have now mostly finished this phase of coding
    - Still some hard coded elements
    - All bugs/problems should be considered my fault!
- Here I present few checks on tracking stability, closed orbit etc

Closed Orbits

Geant4



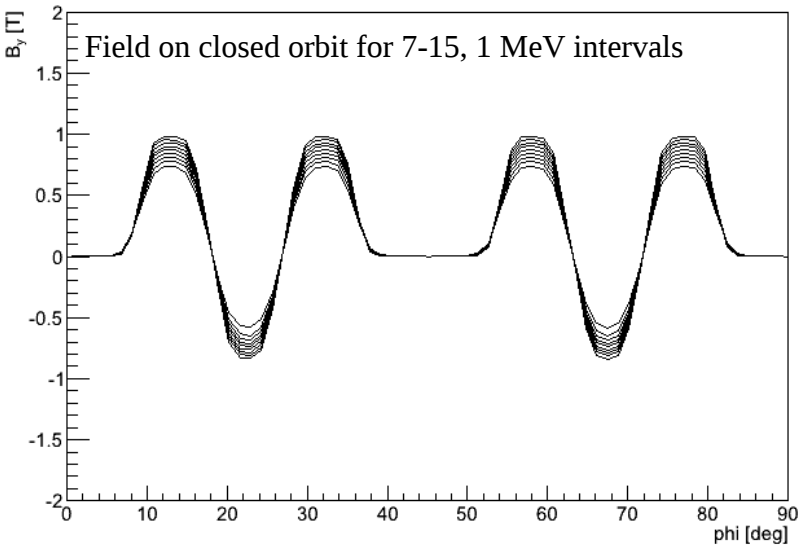
OPAL



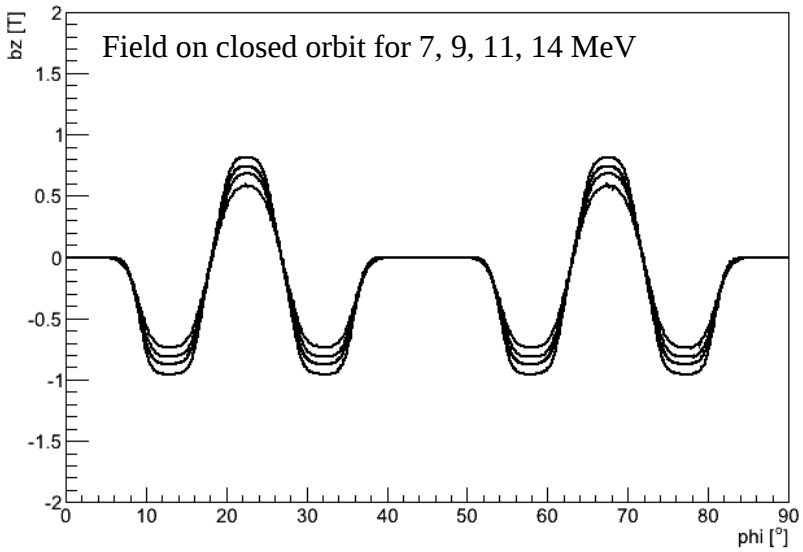
- Getting closed orbit through OPAL
  - Failed to find closed orbit at 15 MeV
  - Potentially bounding box issue?

Field on Closed Orbits

Geant4



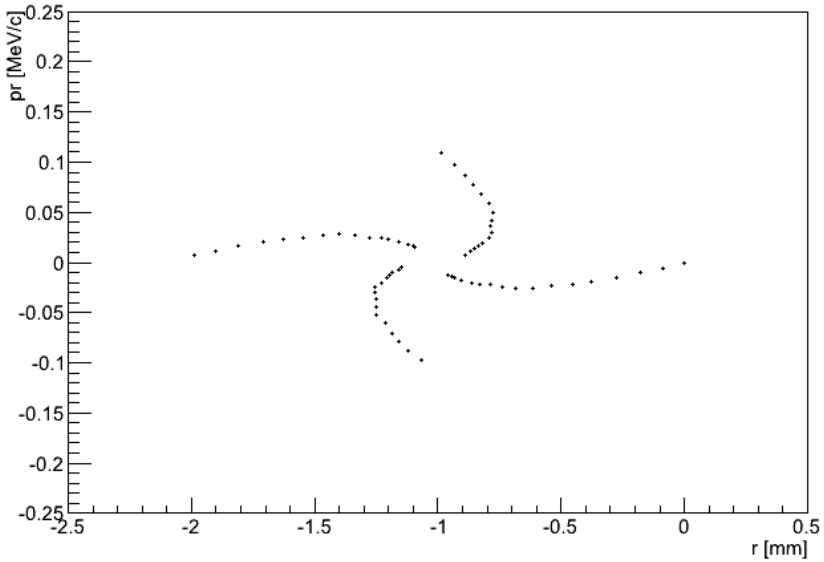
OPAL



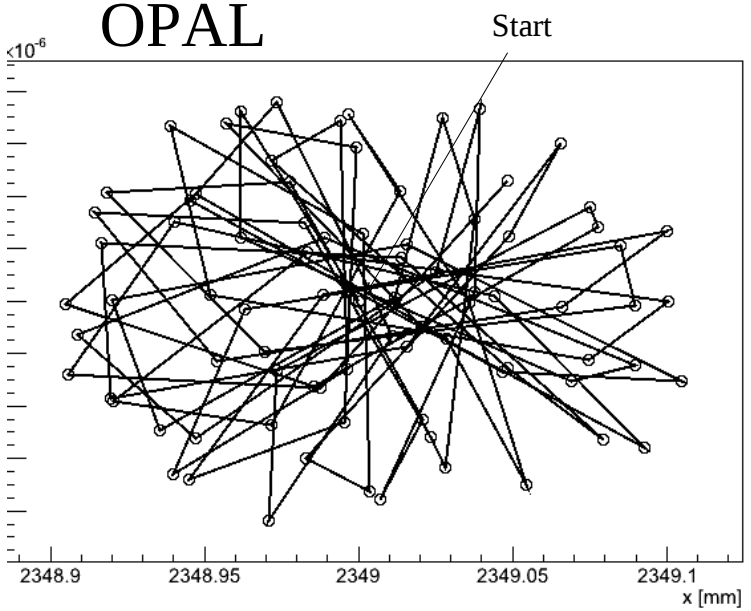
- Field on closed orbit looks okay

Tracking Stability

Geant4



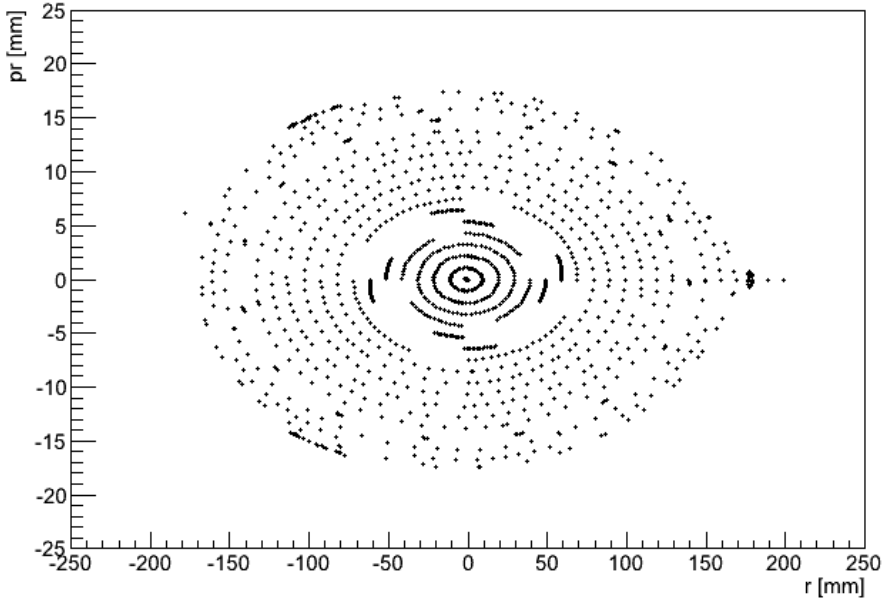
OPAL



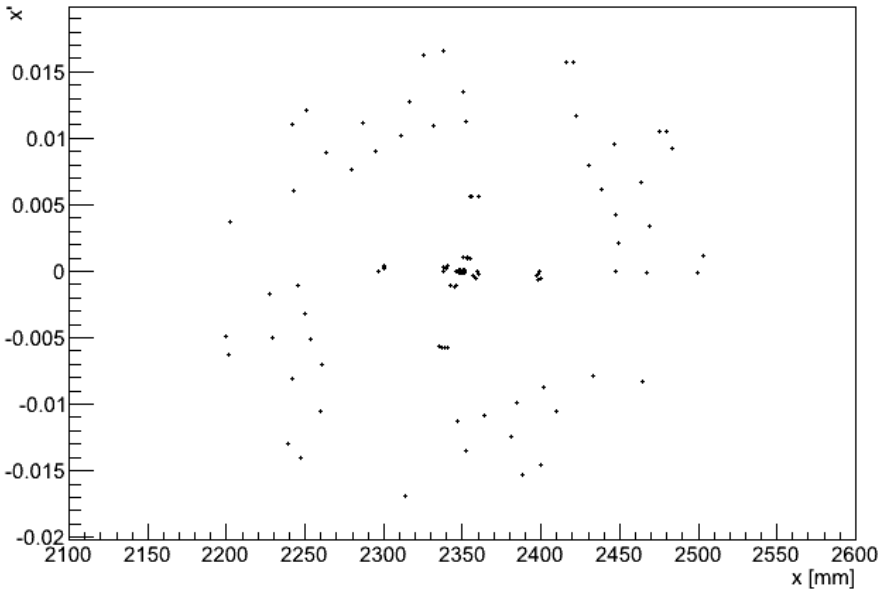
- Closed orbit stability in OPAL is much better than G4
  - Both nominally RK4
  - Both 100 mm step size
  - Closed orbit distortion (tracking error) ~ 0.1 mm and looks incoherent in OPAL
    - 84 turns @ 11 MeV
  - Closed orbit distortion ~ 1 mm and coherent in G4
    - 66 turns @ 11 MeV

“Dynamic” Aperture - Horizontal

Geant4



OPAL



- After 18 turns aperture looks okay in OPAL
  - Needs a bit more processing time here
  - Some question as to whether this is dynamic aperture or field map aperture

Summary

- Introduce the ability to load arbitrary beam elements into OPAL cyclotron code
  - Some tidying to do here
  - Some more validation to do e.g. vertical aperture
- Now go on to look at foil scattering and space charge models
  - Comparison with Geant4 is again useful for foil models