# Developments in the ray-tracing code Zgoubi for 6-D multturn tracking in FFAG rings

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### 1 Introduction

- 1.1 Original lattice
- 1.2 Lower tunes lattice

### 2 Transmission simulations : 5-10 GeV

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1 Introduction

- The Zgoubi method is based on stewise ray-tracing, and uses an integrator of 6th order in $\Delta s$. Hence very good symplecticity.
  Hence interest in developing further the Zgoubi optics library, for FFAG 6-D tracking simulations.

- FFAG simulations need special elements, like
  - sector dipoles with “arbitrary” radial (e.g., non-linear) and axial (e.g., Fringe Fields) dependence of field
    \[
    B_{zi}(r, \theta) = B_{z0,i} F_i(r, \theta) R_i(r)
    \]
    - Scaling FFAG, NC magnets ("FFAG" procedure):
      \[
      R_i(r) = (r/R_{0,i})^{K_i}
      \]
    - Scaling FFAG, SC magnets ("Dipoles" procedure):
      \[
      R_i(r) = b_0 + b_1 (r - R_{0,i})/R_{0,i} + b_2 (r - R_{0,i})^2/R_{0,i}^2 + ...
      \]
    - accounting for possible overlapping of fringe fields

- Linear FFAG use the "MULTIPOLE"
  Did not necessitate any special development.

- Isochronous FFAG also uses "MULTIPOLE", together with "Dipoles"
During this week transmission simulations have been done in the 5-10 GeV to check the longitudinal emittance growth dependence with the transverse dimensions of the beam.

\[
\frac{dT}{dJ} = -2\pi p \frac{d\nu}{dE}
\]

1.1 Original lattice

1.2 Lower tunes lattice
2 Transmission simulations : 5-10 GeV

2.1 Original Lattice

30mm / 0.05 eV.s  
15mm / 0.05 eV.s

2.2 Lower tunes lattices

30mm / 0.05 eV.s  
15mm / 0.05 eV.s