



A Magnet Field Model for a FFAG Accelerator

Steve Kahn

9 March 2004

FFAG Video Conference



Purpose of Study

- We would like to provide a model of a FFAG Triplet that could be used for muon acceleration in a neutrino factory.
- We would like to generate a realistic field for this system that would include ends.
 - No hard-edge or other approximations that violate Maxwell's equations.
- We would like to be able to use this realistic field map for tracking.
 - Specifically we would like to provide the field description for tracking with ICOOL. ICOOL only knows about a local coordinate system about some reference path.

Specifications of Triplet Parameters

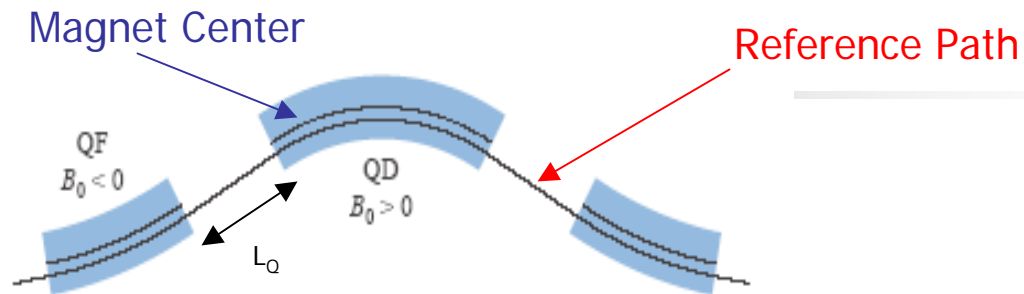
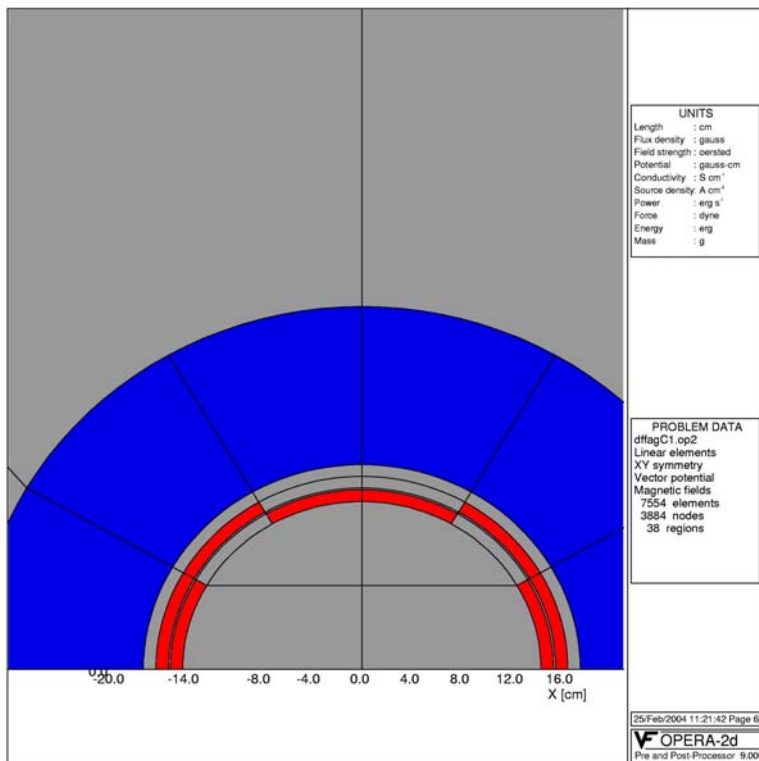


Figure 1: Geometry of the triplet. The displacements of the magnet centers for all magnets are positive. The solid line is the reference orbit, the dot-dashed line goes through the center of the magnet aperture.

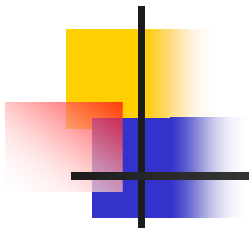
E_{\min} (GeV)	5		10	
E_{\max} (GeV)	10		20	
L_0 (cm)	2			
L_Q (cm)	0.5			
r	90		105	
	QD	QF	QD	QF
L (m)	1.612338	1.065600	1.762347	1.275747
ρ (m)	15.2740	-59.6174	18.4002	-70.9958
x_0 (mm)	-1.573	7.667	1.148	8.745
r (cm)	14.0916	15.2628	10.3756	12.6256
B_0 (T)	1.63774	-0.41959	2.71917	-0.70474
B_1 (T/m)	-9.1883	8.1768	-15.4948	12.5874

meters

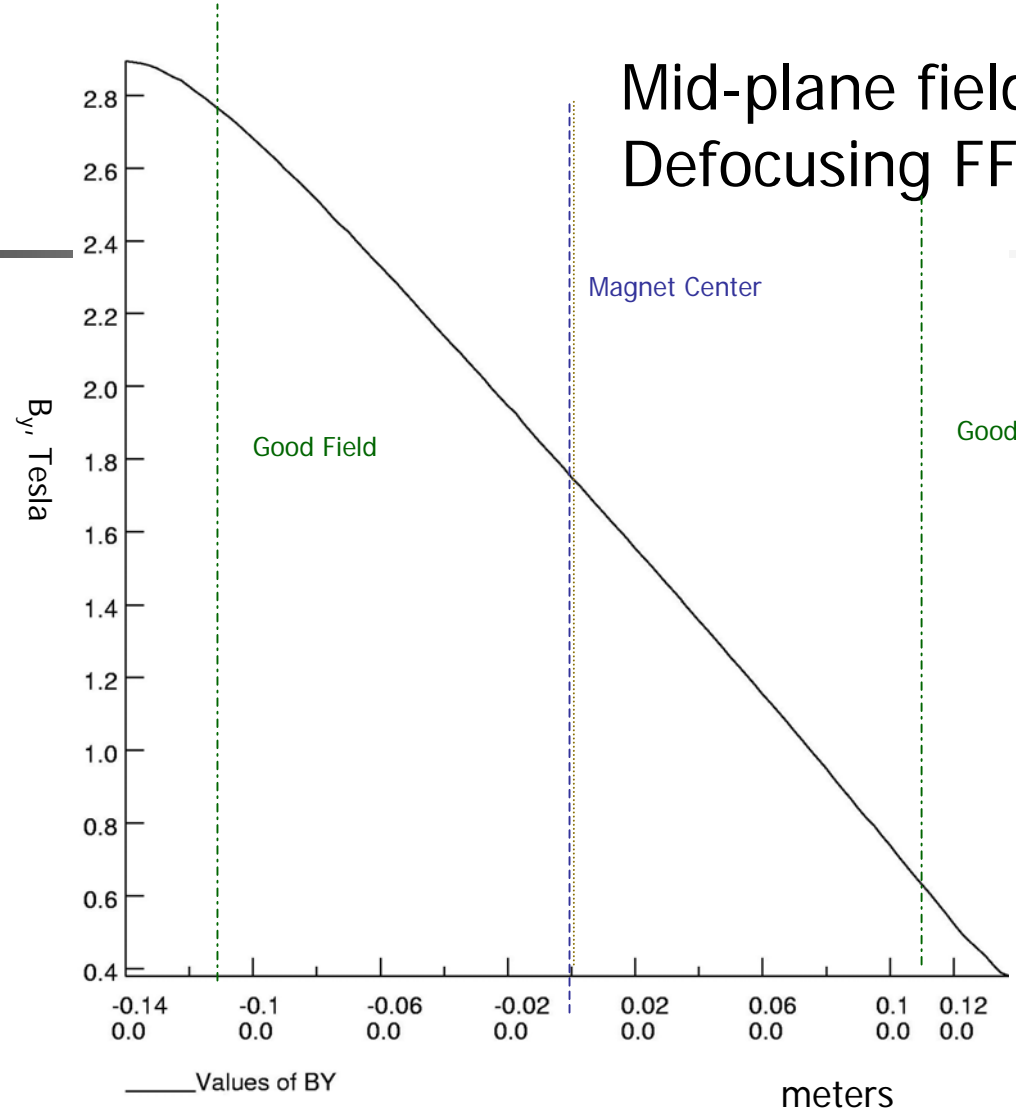
2D Cross Section of Magnet Model

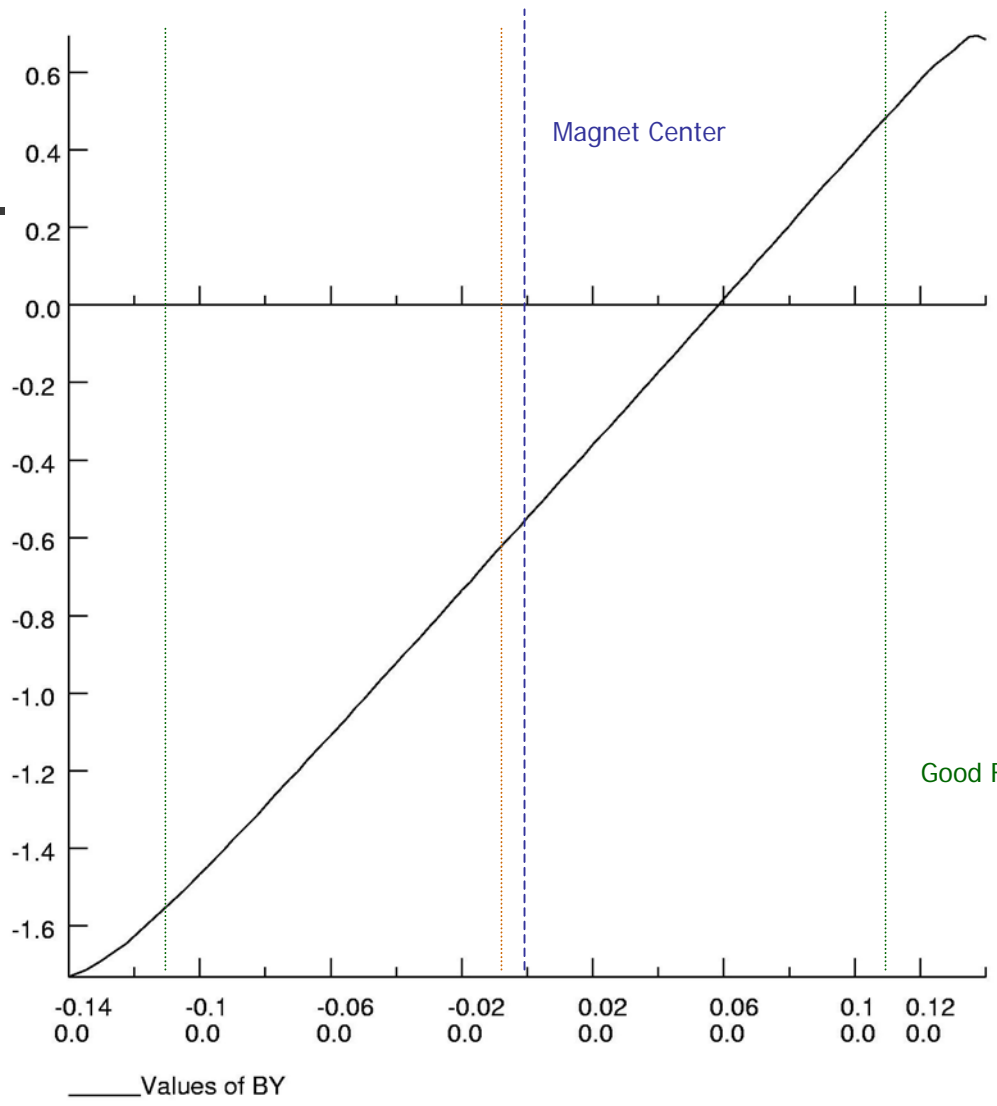
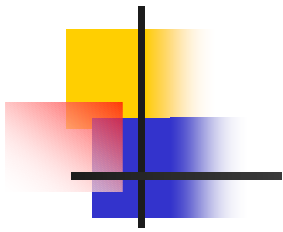


- The figure shows the 2D cross section of a magnet that has both dipole and quadrupole coils.
- The yoke is just a simple iron annulus. In construction it would look more like the KEK FFAG cross section



Mid-plane field for Defocusing FFAG





Mid-Plane Field
for the Focusing
FFAG



Where are we going?

- The 2D study gives us the current densities for the conductors.
- I am in the process of setting up a 3D analysis to use Tosca.
 - The sagitta does complicate the design since Tosca has no standard coil type for this.
 - The sagitta is 2.1 cm for the D_ffag in the 5-10 GeV case.
 - Thus the coil has to be built from small “bricks”. I am currently writing a program to do this.



Future Plans

- Tosca will provide us with the following:
 - It will give us a field map.
 - We will use a 2D map of the field in the mid-plane of the entire triplet.
 - It will allow us to track through the magnet field
 - We will use that to find the closed orbit reference path through the cell.
- Given the field map and the closed orbit we can find the field and its derivatives along that path.
 - ICOOL can accept a Fourier decomposition of the field and its derivatives along that path as the field input.