First elements towards a two dimensional model of field quality in MCBXF

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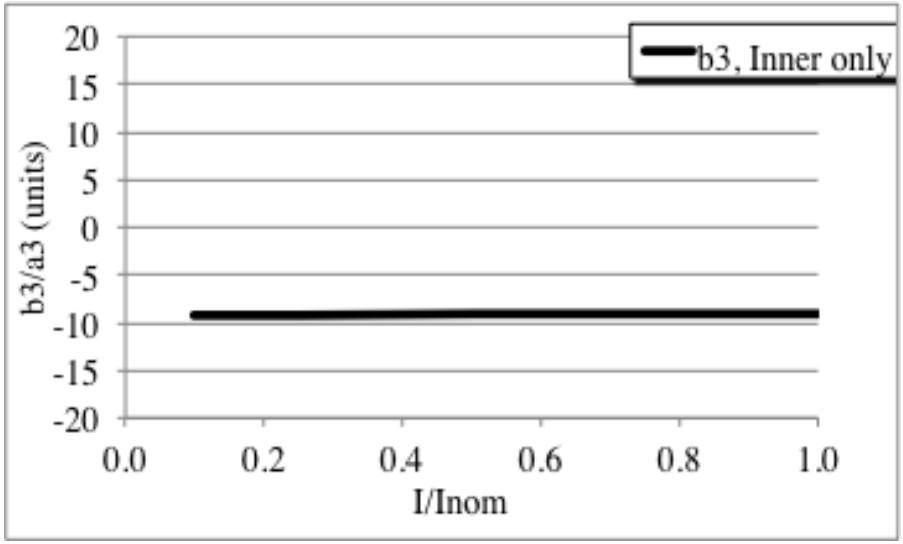
SIMULATION RESULTS

- The main critical nonlinear components in MCBXF are b_3 and a_3
  - Normalization is done with respect to (x,y) coordinate system, first allowed given by inner dipole is b3, and of the outer dipole is a3
  - MCBXFA and MCBXFB have similar field quality features
- For the inner dipole the iron is quite far and therefore saturation is negligible in single powering mode
  - The geometric can change as an offset according to the shimming

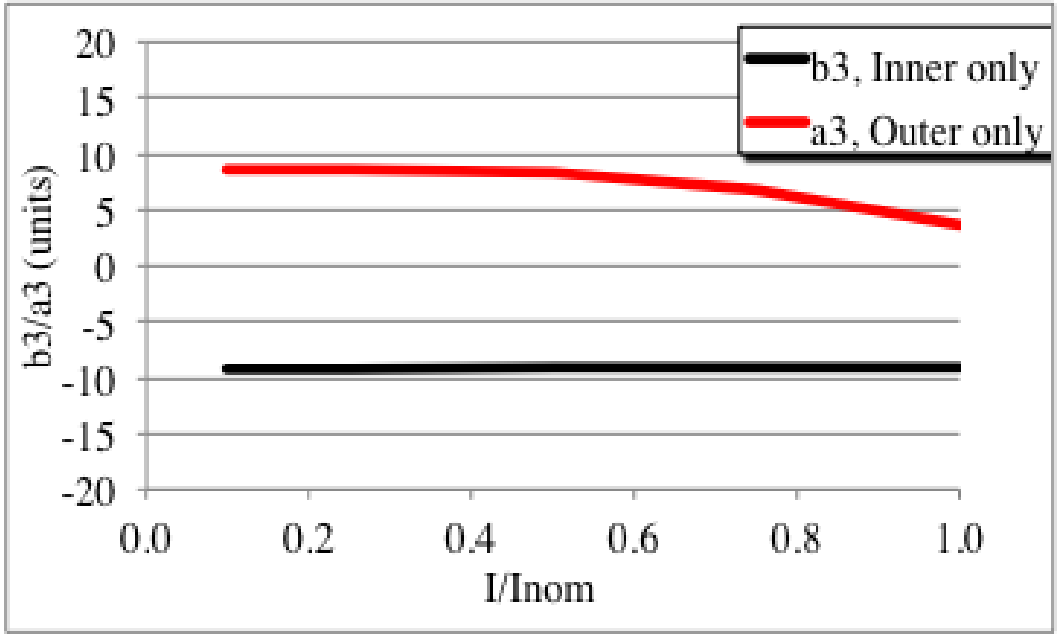
	Inner only
I/I_nom	b3
0.10	-9.2
0.25	-9.2
0.50	-9.2
0.75	-9.1
1.00	-9.0



SIMULATION RESULTS

- For the outer dipole the iron is closer and therefore saturation induces a change of a_3 of -5 units
  - The geometric can change as an offset according to the shimming

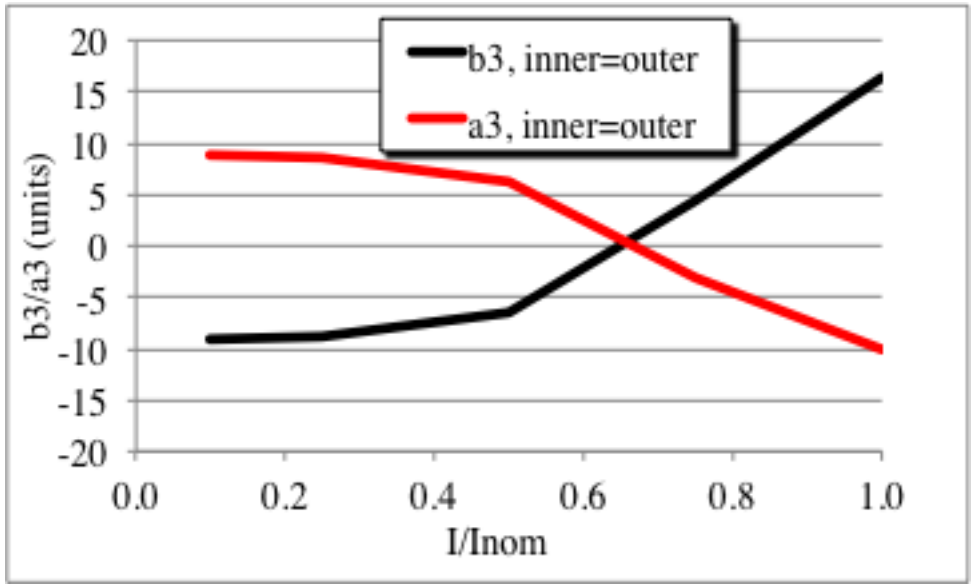
	Outer only
I/I_nom	a3
0.10	8.5
0.25	8.5
0.50	8.3
0.75	6.8
1.00	3.6



SIMULATION RESULTS

- In combined powering saturation strongly affects both b_3 (+25 units) and a_3 (-20 units)
  - The geometric can change as an offset according to the shimming
  - The change due to saturation begins at 50% of nominal current

	Combined	
	b3	a3
0.10	-9.1	8.8
0.25	-8.9	8.7
0.50	-6.4	6.2
0.75	4.5	-3.0
1.00	16.5	-10.1



- We are planning to have simulations also on the loadlines with ratio 0.5 and 2 between inner dipole and outer dipole integrated field

TUNING POSSIBILITIES

- The geometric in the nominal design is placed at -10 units (b_3) and +10 units (a_3) to minimize the impact of saturation
  - Our initial specification were a window of ±20 units – recent work by Frederick and Massimo shows that 20 units could affect dynamic aperture
- We can change the geometric b_3 and a_3 by changing the midplane/pole shim of inner and outer
  - Two free parameters for optimizing preload and a3 or b3 – but also the shimming in the heads is essential, so there is not a total freedom

A POSSIBLE MODEL

- One should find suitable forms for the functions
  - $a_3=a_3(f;\alpha)$
  - $b_3=b_3(f;\alpha)$
  - The functional fit should use the *erf* as done in Fidel (but this is a three parameter fit …)
  - A simple $a_3=a_{3geo}+a_{3sat}*f^n$ could also be a good approximation, but it is not clear how a_{3sat} depends on α
- Where f is the ratio current/nominal current and r is the angle of the loadline
  - α=0 for inner only
  - α=90 for outer only
  - α=45 for inner dipole intergrated field=outer dipole integrated field

A POSSIBLE MODEL

- Another option could be have a table of values and interpolate linearly in between
- A feedback is needed on the best way to proceed

- It would be interesting to run a sensitivity analysis on b_3/a_3 versus dynamic aperture (maybe with nominal field and half field), so that we know what are the limits