



MICE Dipole Current-Field Relationship



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Background

Fields in dipoles determine momentum selection - if not as expected, will get poor performance from muon beamline (quads and DS) and of course a mismatch between D1 and D2 will give poor transmission.

The formula labelled "MMS-3" is that used in the Magic Spreadsheets and appears to be a fit to the original datasheet from 1968.

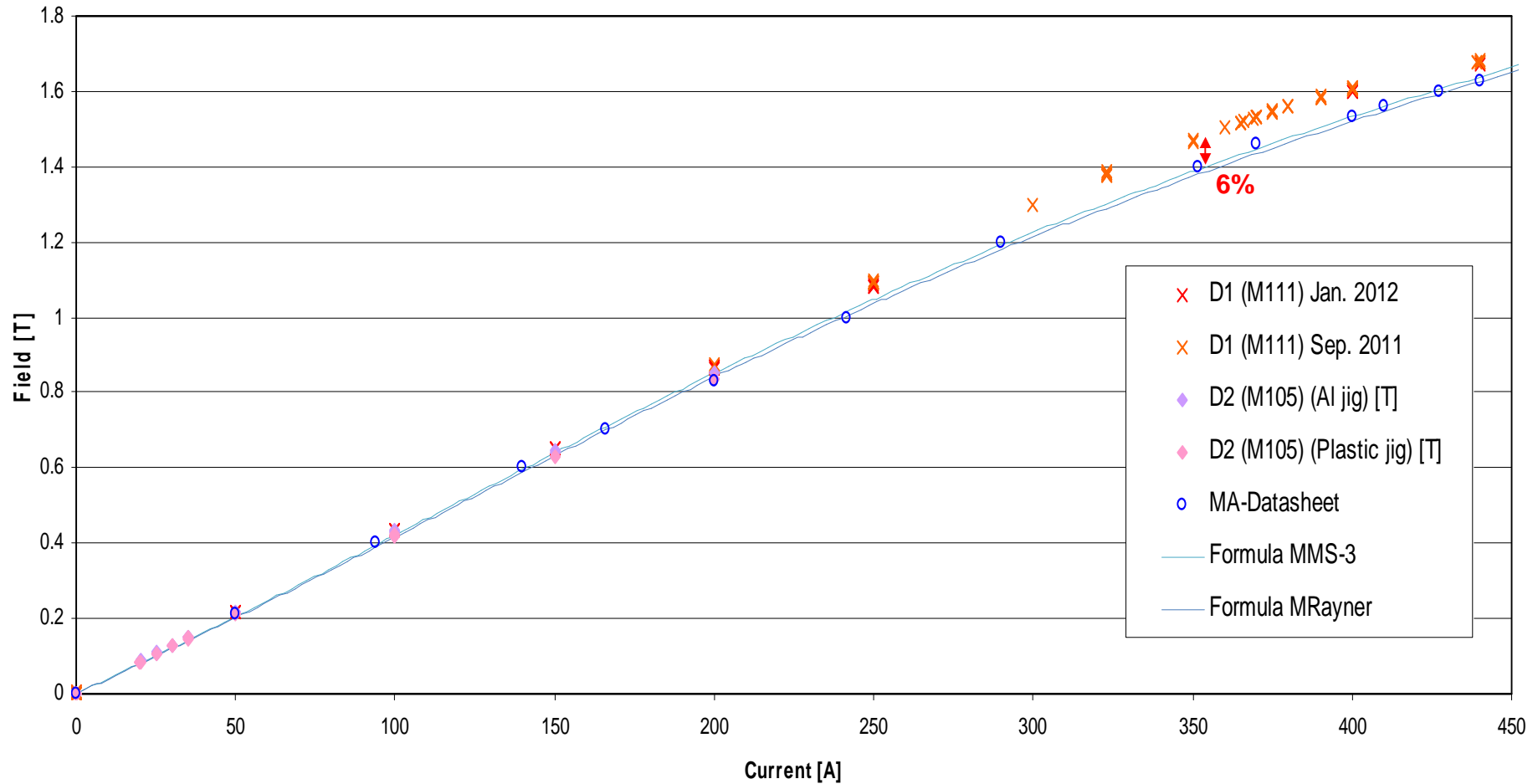
$$I=39.59*B^3-55.998*B^2+253.91*B$$

Measurements with an (uncalibrated) gaussmeter show significantly higher fields at high current (6% at 360A)



Measurements and Formulae

Field-Current Relationship for Nimrod Type 1 Dipole (6" Tapered)





Formulae

Mark Rayner's MICE Note 325 and his thesis both give a subtly different relationship, also cited as coming from Marco:

$$I=39.59*B^3-55.998*B^2+256.914*B$$

instead of

$$I=39.59*B^3-55.998*B^2+253.91*B$$

The extra decimal place is puzzling, otherwise it looks like a typo. No (visual) reason on the graph to prefer either.

MMS-3 is used in the Magic Spreadsheets (and thus implicitly in the M0 beamline solutions at least), and is cited there as from the "D1-2+Q1-3+Q4-9_conv_table" on the Beamline website, which looks like the place Marco meant to define them.

http://www.isis.rl.ac.uk/accelerator/MICE/Task%20Notes%20and%20Specifications/beamline%20-%20optics/Data/D1-2+Q1-3+Q4-9_conv_table2.xls

Note this website no longer exists.



Measurements

I've no idea if the measured values are right, but I don't believe the discrepancy between the measurements and MMS-3 is solely due to miscalibration of the gaussmeter - note the difference between D1 and D2 at 200A, and that the discrepancy goes away at the highest currents.

If meaningful measurements are needed, they need to be made before the gaussmeter calibrations expire (end November) and will need manpower to help.

Hence my question has been whether a discrepancy of 6% is significant for physics with MICE (given the D1 scan was +/- 10%), and thus taking reliable measurements is something that **MUST** happen.



Analysis

Date: Mon, 19 Aug 2013 01:10:13 +0100

From: John Nugent

Subject: RE: D1/D2 Measurements

Hi Henry,

I compared the values in the spreadsheet that you forward to me to the values given by the equations in appendix A of Mark Rayner's thesis and there was a negligibly small difference between the two values. As far as I was aware there was no issue of compatibility between the values used in G4beamline vs. the actual experiment and the conversion currents to fields was as expected.



Future

Based on above, more measurements are not a sufficiently high priority and it's thus *unlikely they will ever get done.*

As MMS-3 has already been used to decide the currents for some of our experimental runs, I should have thought it better to stick with it for consistency. I certainly don't see any reason to believe either formula is more "correct" than the other!