Requirements for Hall D Tagger Dipole Field Map

Daniel Sober
The Catholic University of America
8 August 2013

As a result of my ray-tracing exercises using the Tosca field map, I have come up with the following suggestions for the field regions needed. The attached figure indicates the desired rectangular "field boxes" by solid black outlines. For some boxes, as discussed below, it will not be possible to measure the field map directly, but the field can be calculated using a more limited set of measurements.

Since I am still uncertain about the dimensions and the coordinate system, I will refer my boxes to what I call the "field edges." These are probably close (within 5mm) to the "boxed" dimensions given by the projection of the second chamfer on Technical Drawing D00000-19-00-0102, which lead to overall pole dimensions of 16.138" by 245.325", or 40.991 by 623.126 cm. Because I am constantly switching between coordinate systems, I will always refer to the "entry edge", "long edge" and "short exit edge". (Negative distances = toward the uniform field, positive distances = away from the uniform field.)

Box 1 – Entry region

In magnet coordinates, this should extend approximately from

(Normal to entry edge)	50 cm outside to -10 cm[(1)] inside	1 cm steps
(Normal to long edge)	-5 cm inside to 20 cm inside	2.5 cm steps

Note (1): or far enough to assure at least 5 cm overlap with Box 2

Because of the vacuum chamber, it will be impossible to measure this box directly. An alternative procedure is to measure the field accurately in 1 cm steps along the incident beam axis, from 50 cm outside to 20 cm[(1)] inside, and construct the necessary box by calculation.

Box 2 – Main field region

(Normal to entry edge)
-50 cm[(2)] inside entry edge to -50 cm[(2)] inside exit edge 2.5 cm steps
(Normal to long edge)
-35 cm[(3)] inside to 35 cm outside 1 cm[(4)] steps

Notes: (2) or as close as possible to vacuum chamber wall
(3) or as close as possible to the back wall. The full-energy trajectory is at ≈-32.5 cm by my estimate.
(4) 1 cm steps necessary near exit edge (from -10 cm to 10 cm). Could take coarser steps outside this region.

Box 3 – High-energy exit region

For electron energies above ≈6 GeV, the electron leaves the main field box by crossing the plane of the short exit edge. This is a complicated region, in which there is fringe field variation in two directions.

(Normal to short exit edge)	20 cm inside to 50 cm outside	2.5 cm[(5)] steps
(Normal to long edge)	10 cm outside to 20 cm inside	1 cm[(5)] steps

Note (5): This is the spacing of the main field box, which will have to be used as a basis for calculating this field.

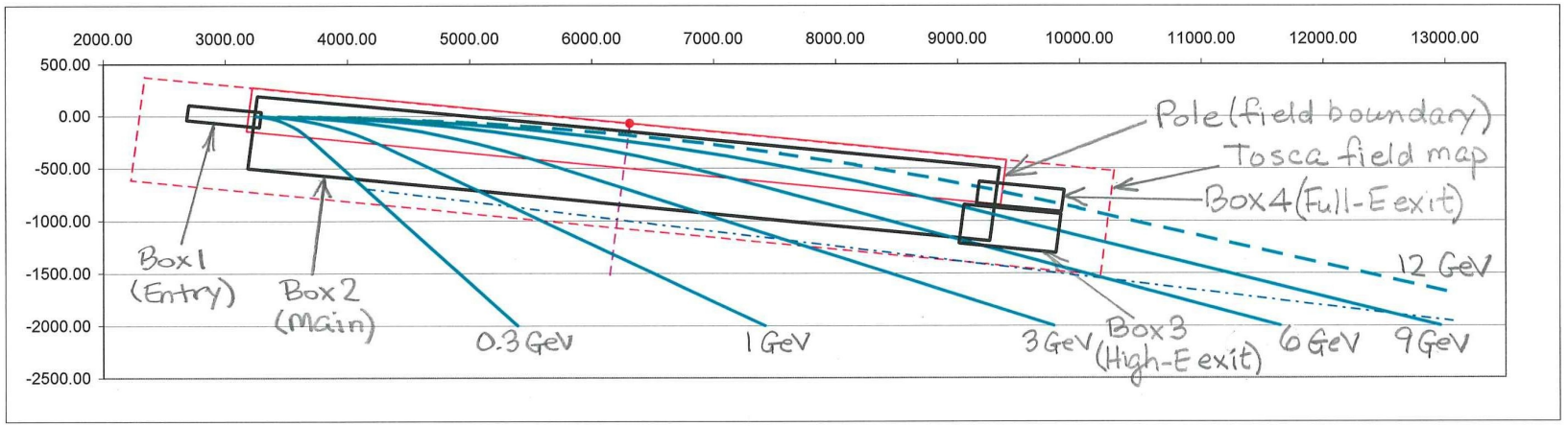
Because of the vacuum box, it will not be possible to measure all of this region directly. Some limited measurements outside the vacuum box will be useful in constraining calculations.

Box 4 – Full-energy exit region

(Normal to short exit edge)	-10 cm[(1)] inside to 50 cm outside	1 cm steps
(Normal to long edge)	-1 cm inside to -20 cm inside	2.5 cm steps

Note (1): or far enough to assure at least 5 cm overlap with Box 2

This is almost a mirror image of Box 1 – not quite, because the exit angle is 6.9° instead of 6.5°. As with Box 1, it will be impossible to measure this box directly. An alternative procedure is to measure the field accurately in 1 cm steps along the incident beam axis, from -20 cm[(1)] inside to 50 cm outside, and construct the necessary box by calculation.


2000.00
3000.00
4000.00
5000.00
6000.00
7000.00
8000.00
9000.00
10000.00
11000.00
12000.00
13000.00
500.00
0.00
-500.00
-1000.00
-1500.00
-2000.00
-2500.00
Pole(field boundary)
Tosca field map
Box4(Full-E exit)
12 GeV
Box1
(Entry)
Box2
(Main)
0.3 GeV
1 GeV
3 GeV
Box3
(High-E exit)
6 GeV
9 GeV