Changes in Rosie field and Geometry

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30-Dec-2006

This note describes the changes made to the ROSIE fieldmap and geometry in 2006. The changes are due several reasons.

- Rosie field components did not have the correct polarity. Rosie was ziptracked from the downstream end and this caused an inversion in the Z co-ordinate when translated into the MIPP coordinate system. This error was corrected in the map.
- The divergence of the Rosie field was calculated at all the grid points. Some anomalous divergences were seen and these were tracked down to a set of min-zips which were done in a slightly rotated co-ordinate system. The boundary between the main ziptrack grid and this min-grid produced anomalous divergences. This was solved by rotating the mini-grid counter clockwise along the beam axis by 10 mrads.
- The center of the ROSIE mother volume is not the center of the Rosie field, since this is located at the center of the iron core. This is because the coil package in the downstream end of Rosie is longer than that at the upstream end. The halfway point between the mirror plates that terminate the coil package is the center of the mother volume. The surveyors also identified this as the center of Rosie but due to a mis-communication, it was thought that they had surveyed the center of the iron core as the center of Rosie. The center of the mother volume should have been at z =-121.96cm in the CAVE co-ordinate system. Instead it was put downstream by 4.909cm so that the center of the iron core would be at –121.96cm. This mistake has been corrected and the magnet moved upstream by 4.909cm.
- The scaling of the field algorithm has been changed. Now the magnetic field will be scaled by the ratio of the average reading of the hall probes during the run to that of the ziptrack average reading.

We now give details of each of these steps.

Rosie B_z Problem

Figure 1 shows the B_z component of Rosie as a function of z, the co-ordinate along the beam for the field map as obtained by Donut and also for the MIPP map (as it was then). There is clearly a problem. Both B_x and B_y components behave canonically. This was tracked down to the orientation of the ziptrack for Rosie (the equipment was facing upstream and mounted from the downstream end of Rosie). This error was corrected on 31-Dec-2005.

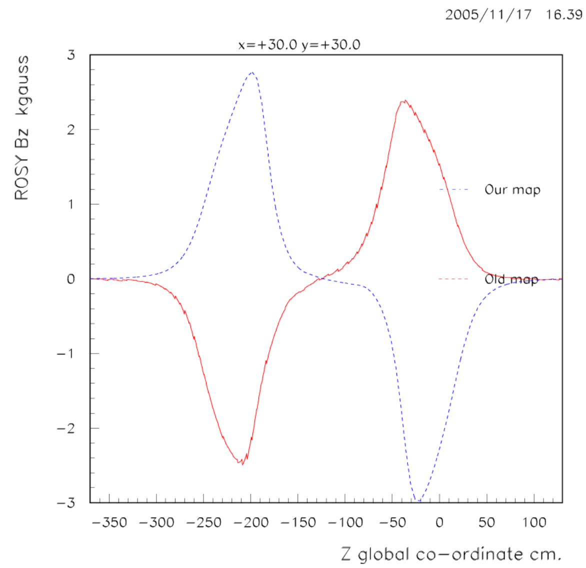

Figure 1 Bz vs z at (x,y) = (30cm,30cm) for the Donut map (denoted old map) and the incorrect MIPP field map.

Figure 2 shows B_z for the present map.

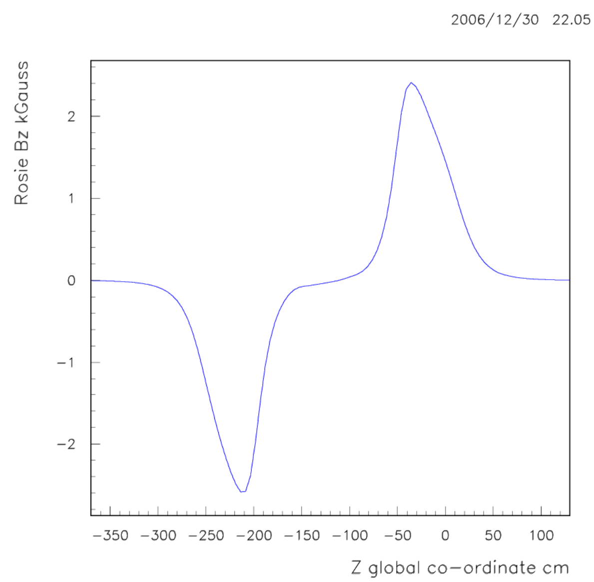

Figure 2 Bz vs z at (x,y) = (30cm,30cm) for the correct MIPP field map.

Divergence of the field

A good test of the Maxwellian nature of the field (as well as the relative calibration of the ziptrack Hall probes, each of which measure one component of the field) is to test for the divergence and curl of the field. The derivatives of the field component were calculated at each ziptrack grid point. We have done this for both the Jolly Green Giant and Rosie. The JGG passed the tests, where as Rosie showed some problems. Figure 3 shows the scatter plot of the divergence at each grid point as a function of the z component of the grid point. The rectangular box around the problem divergence defines a graphic paw Ntuple cut to select out the problem grid points.

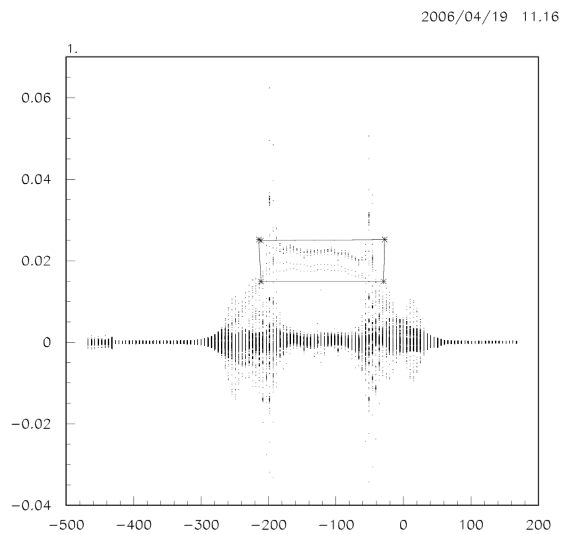

Figure 3 Divergence (kGauss/cm) vs z of grid point for Rosie. The rectangular box selects the problem divergences.

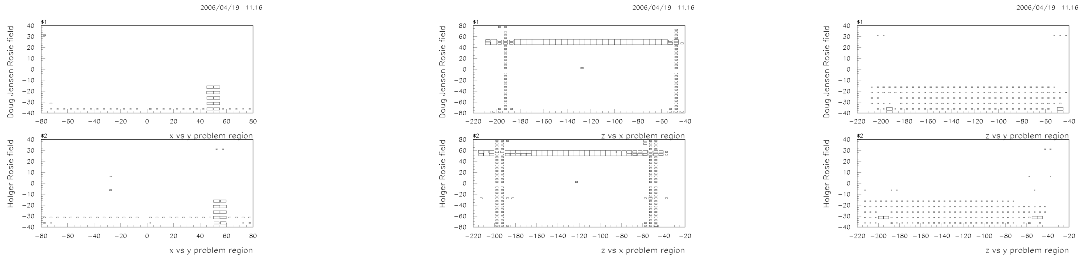

Figure 4 (x vs y) (z vs x) and (z vs y) of the problem divergence grid points

Figure 4 shows the xy, zx and zy scatter plot of the grid points of the problem divergence. The xy plot shows a clear excess at the boundary between the mini-zip and the main ziptrack grid. We deduce from this that the mini-zip was misaligned wrt to the main grid. The divergence excess will only show up at the boundary as we jump across co-ordinate systems. *It is also evident that the interpolation routine used in the field map needs to improve at the boundary of the ziptrack grid where we see an excess in divergence as well.*

The min-grid was rotated by a series of angles ranging from –18mrad to +15mrad about the z axis. A rotation of 10mrads (counter clockwise) was shown to reduce the divergence problem the most. Figure 5 shows the histograms of the unrotated and rotated divergences.

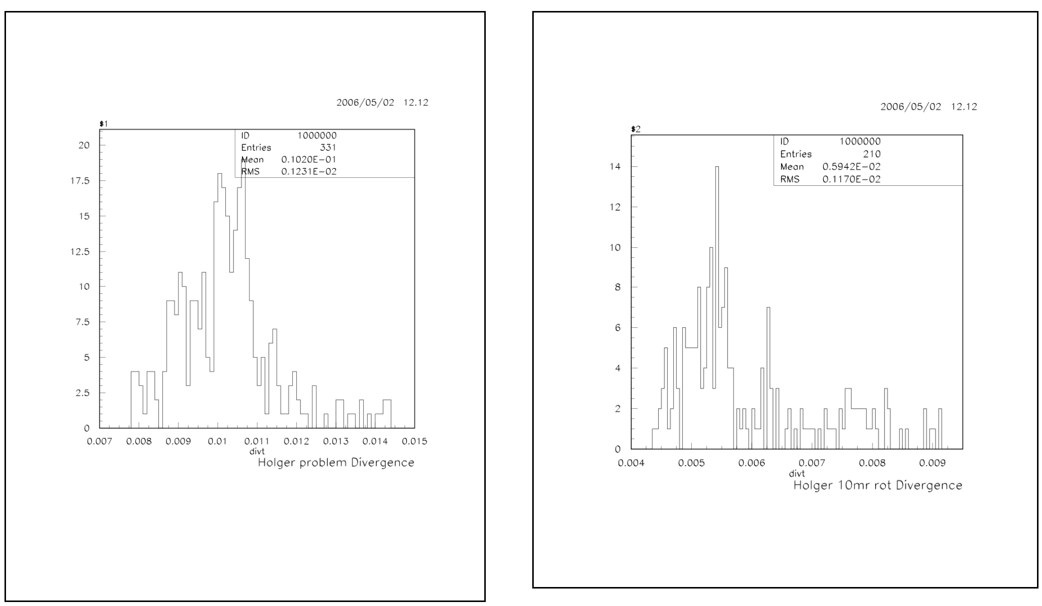

Figure 5 Problem divergences without rotatig the minigrid(left) and with a 10mrad rotation.

Position of Rosie Center

This was due to a miscommunication between the surveyor and one of us (RR). The problem has now been corrected. Figure 6 shows the ziptrack B_y as a function of z in CAVE co-ordinates at (x,y) = (0,0)cm vs the field map as implemented on 28-Dec-2006. The two curves are indistinguishable. The third curve (labeled Raja) is for the Donut field.

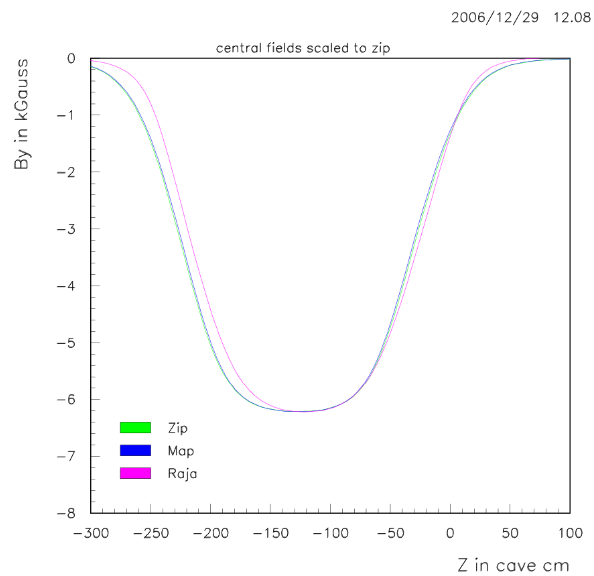

Figure 6 Rosie By vs z at (x,y)=(0,0) compared to ziptrack. The magenta curve labelled Raja is for the donut field and should be ignored.

Algorithm to Scale the field using Hall probe info

Both MIPP analysis magnets are equipped with two Hall probes each. These probes have been tracking small fluctuations in the magnetic field through the runs. The field map determined from the Ziptrack needs to be scaled to the field strength observed in the magnet Hall probes during a run.

In the past the average Hall probe readback during a run has been compared to the field read out of the ziptrack map at the approximate location of the Hall probes. This assumes knowledge of the position of the Hall probes. The positions have not been precisely surveyed.

Now instead the average Hall probe readback during a run is compared to the known average readback during Ziptrack. This assumes that the position of the Hall probes is unchanged (which it is), but does not require the absolute position of the Hall probes.

The changes in scaling are small. The new JGG scaling is 0.34% lower than before. Rosie is 0.38% higher. The following table shows the old and new scaling values for two randomly selected runs and the scaling when no Hall probe data is available (run 0).

Run	JGG old scaling	JGG new scaling	JGG new/old	Rosie old scaling	Rosie new scaling	Rosie new/old
16666	0.927563	0.924404	.9966	0.855393	0.858651	1.0038
17443	0.928072	0.924901	.9966	0.854788	0.858045	1.0038
0	0.92666	0.923523	.9966	0.842597	0.845803	1.0038

Table 1: Comparison of B-field scaling.

The following plots illustrate how the magnetic fields drifted between January 2005 and February 2006 and how read-back currents and Hall probe readings correlate. The discontinuities resulting from coil failures show in the JGG plots. In Rosie the current read-back is noisy, resulting in weak correlation between current and Hall probes. However, the two Hall probes track each other closely, so they both represent the true field in the magnet.

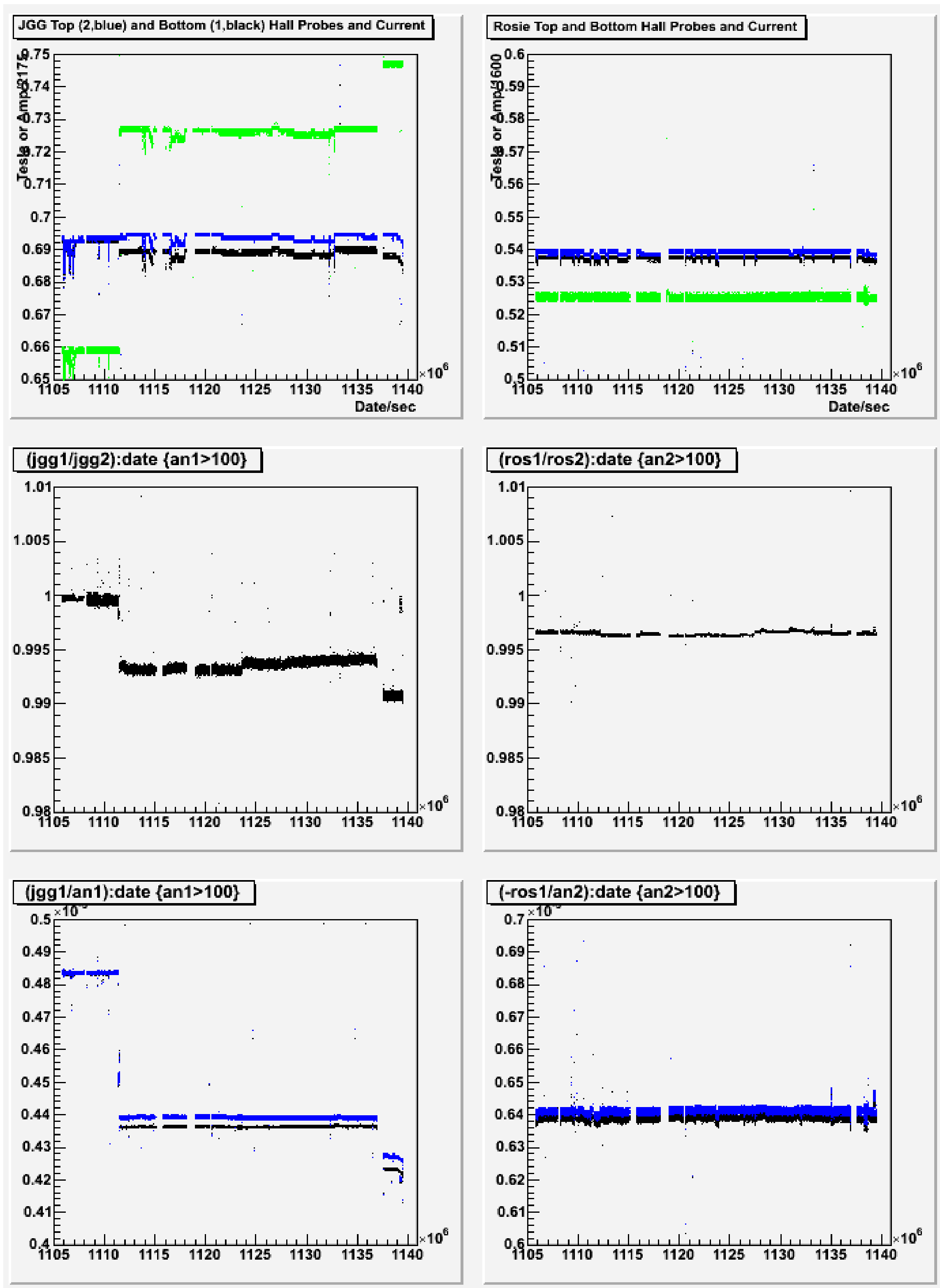

Figure 7 Plots of JGG (left plots) and Rosie (right plots). The x axis is time in epoch and covers the 14 months of the MIPP1 run. The top plots show Hall probe and current readbacks. The middle two plots show the ratio of the bottom (1) to the top (2) Hall probe. The bottom plots show ratios of bottom (black) and top (blue) Hall probes to current readback.

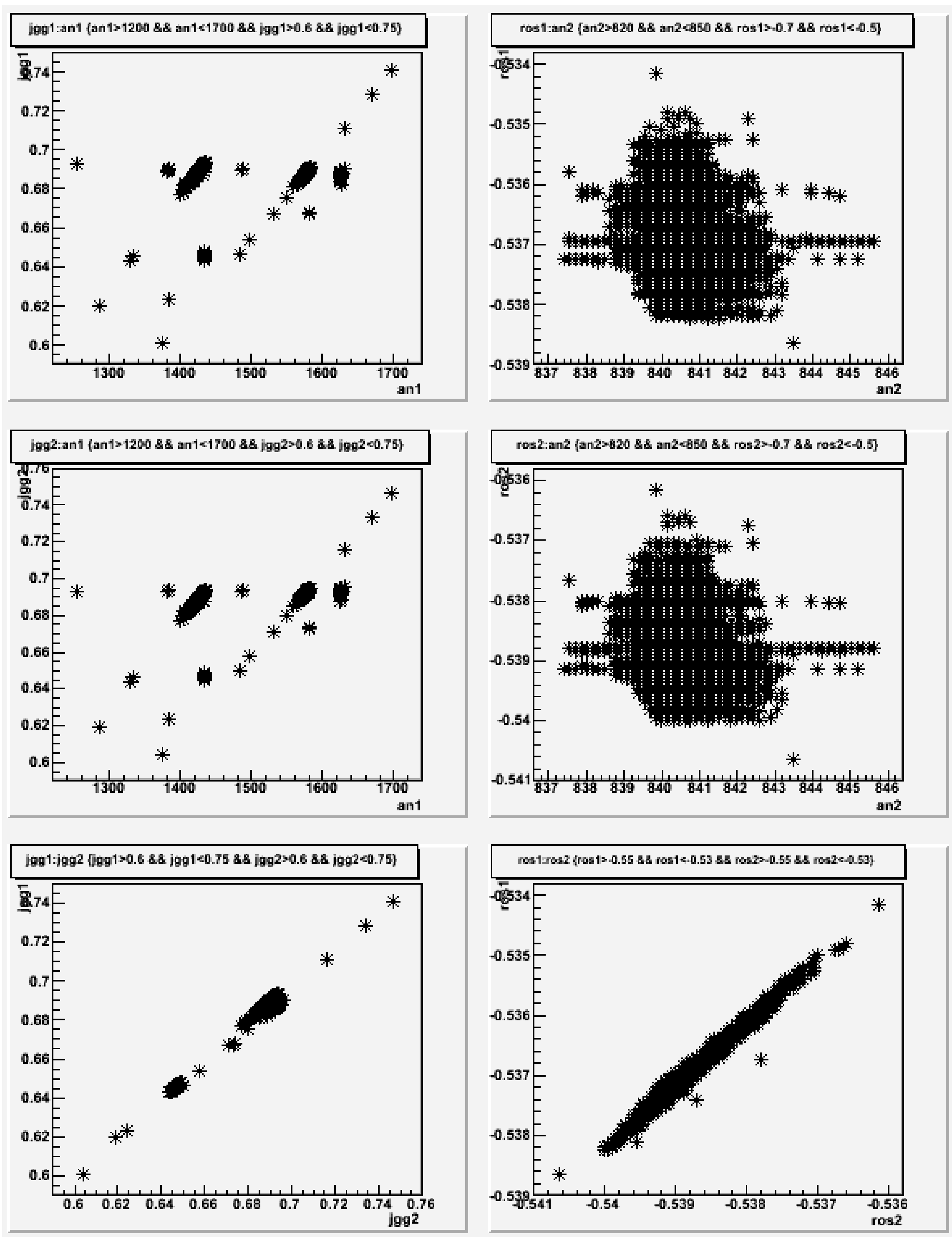

Figure 8: Scatter plots of JGG (left) and Rosie (right) Hall probes and currents. The top and middle plots show the bottom (1) and top (2) Hall probes in Tesla vs. read-back current in amps. The bottom plots show top vs. bottom Hall probes.