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Fermilab

DCA311 Field Angle Change due to Cold Testing

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Colliding Dipole Magnet DCA311 is the first magnet to show major change in the field angle pattern upon cold testing. This change might be an artifact of the measuring conditions. We could not verify the reproducibility of the data taken after the cold test due to the urgency in having it shipped to SSCL. The two sets of data prior to cool-down shows this dipole with an average total twist of 10 milliradians. The set of data taken after cold testing shows an average twist reduction by a factor of 3, a significant change.

If the the change is real there is an occurrence during manufacture that might be related to it:

There was "chevronning" of the laminations during the manufacture of this magnet, as a consequence of which the laminations might be somewhat loose and the twist got straightened out by the Lorenz forces in the energyzed coil during the cold test.

If the change is not real one can think of following possible sources for the artifact:

1. Rush in getting it measured leading to the magnet not being completely warmed up and uneven speed in getting the data.

2. The magnet warming and rotating during the the data acquisition.

3. The temperature of the probe changing (cooling) and its calibration changing during the the data acquisition.

4. A combination of some or all of the above.

Figure 1 presents the set of data taken on Oct. 31, 1991 when the magnet in its cryostat was first surveyed for field angle in the Industrial Center Building (ICB). The two traces correspond to the two usual sweeps, with the probe pointing to opposite ends of the magnet, to eliminate zero offset and give an idea of the data reproducibility. The resulting "corrected" average of this dataset is presented in figure 2. Corrected here means substituting the bad (saturated) points by the average of its neighbors and deleting saturated extra points at the ends prior to carrying out the average of the sweeps.

A second set of data was taken on Nov. 4, 1991 with the magnet installed in one of the stands in the Magnet Test Facility (MTF) before the first cool-down. This is presented in figures 3 and its corrected average in figure 4. Because its installation in MTF was at 180 degrees with respect to the previous magnets (40 mm series) and the data acquisition procedure had not been updated for this change it presents itself up-side down and left-side right. Once these symmetry operations are carried out it matches very well the Oct. 31, 1991 data, indicating that this magnet has in average a pronounced twist.

Figures 5 and 6 present the set of data and its corrected average taken on Dec. 6, 1991 after the magnet was cold tested. It is a rather different pattern.

J. DiMarco in an analysis of the errors noticed not the expected scatter around a horizontal line but a scatter of the data around a slanted line (figures 7 and 8). This slant may be due to a process dependent on the passage of time or sequence of positions in the sweeps since both sweeps (corresponding to the probe pointing towards opposite ends) had the same sequence. One such process would be the cold mass rotating as its supports are still warming up. Another such process is the probe cooling down and having its calibration changing during the sweep.

The data acquisition rate on Dec. 6, 1991 shows higher speed and perhaps an acceleration towards the end of the measurement. In order to consider if this might have anything to do with the observation in question a new type of data on these measurements was extracted from the log files and is presented in figure 9, 10 and 11. They show the time for collection of a data-point.
For the data acquisition rate to have an influence in the observed change the cold mass of the magnet must be rotating. It is also possible that the higher rate used prevented checking for drift in the probe case orientation.

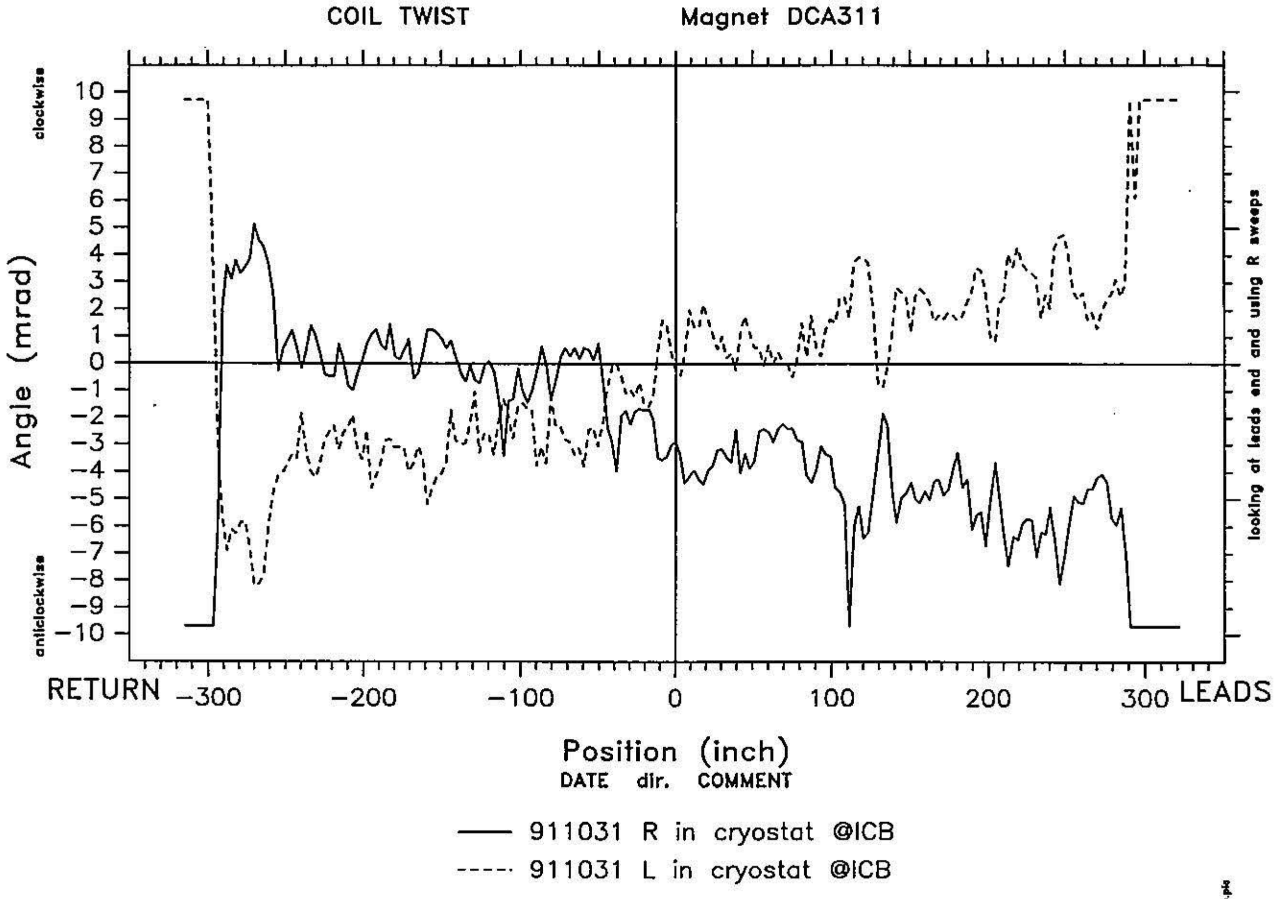

Figure 1.

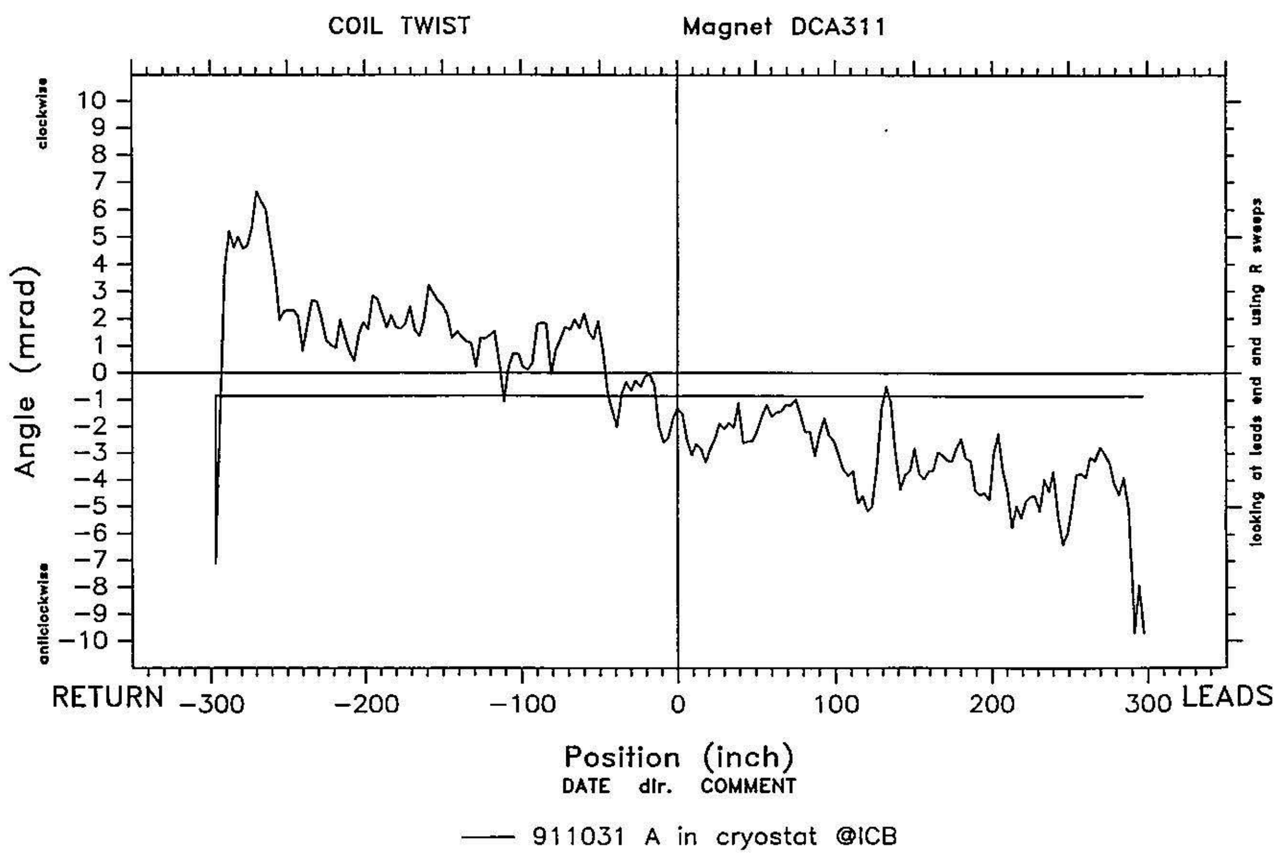

Figure 2.

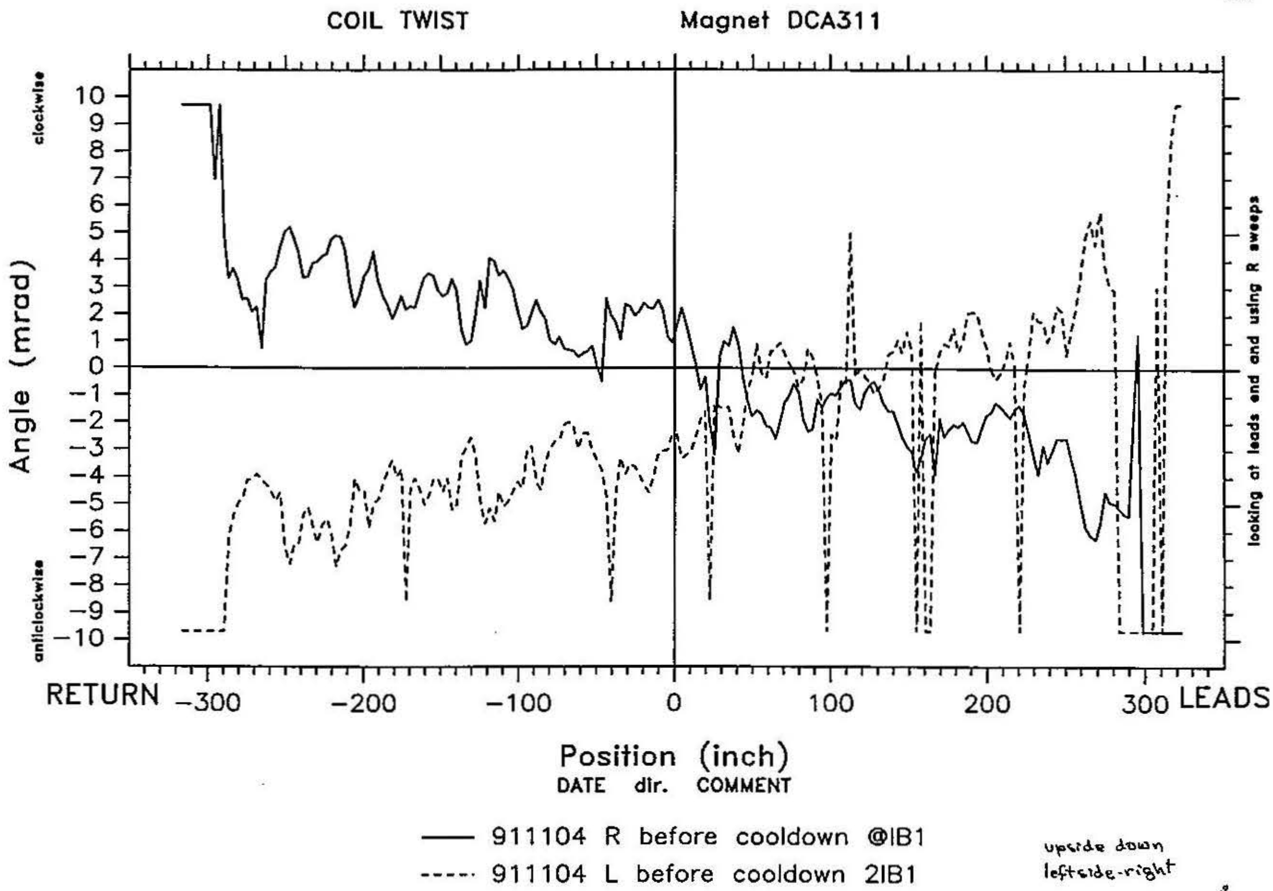

Figure 3.

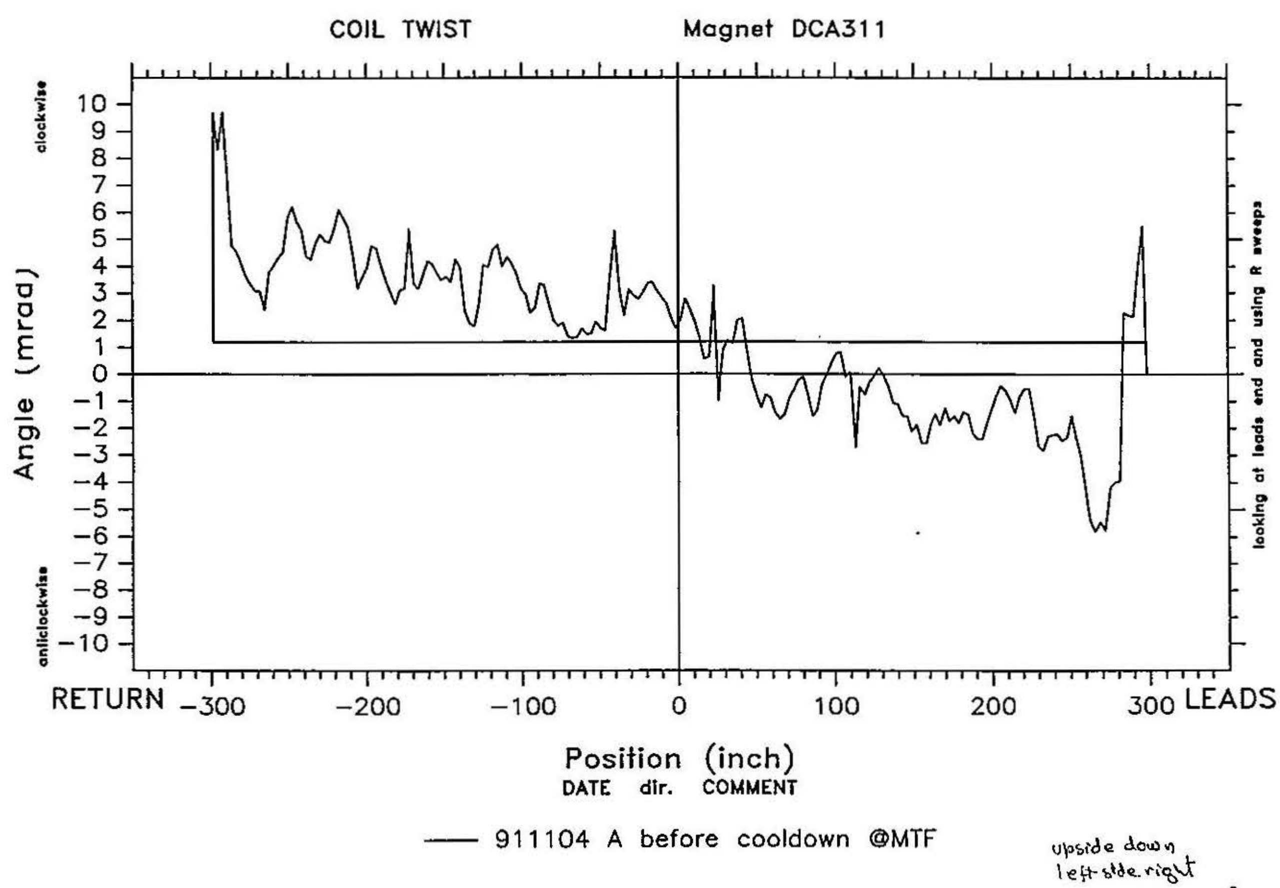

Figure 4.

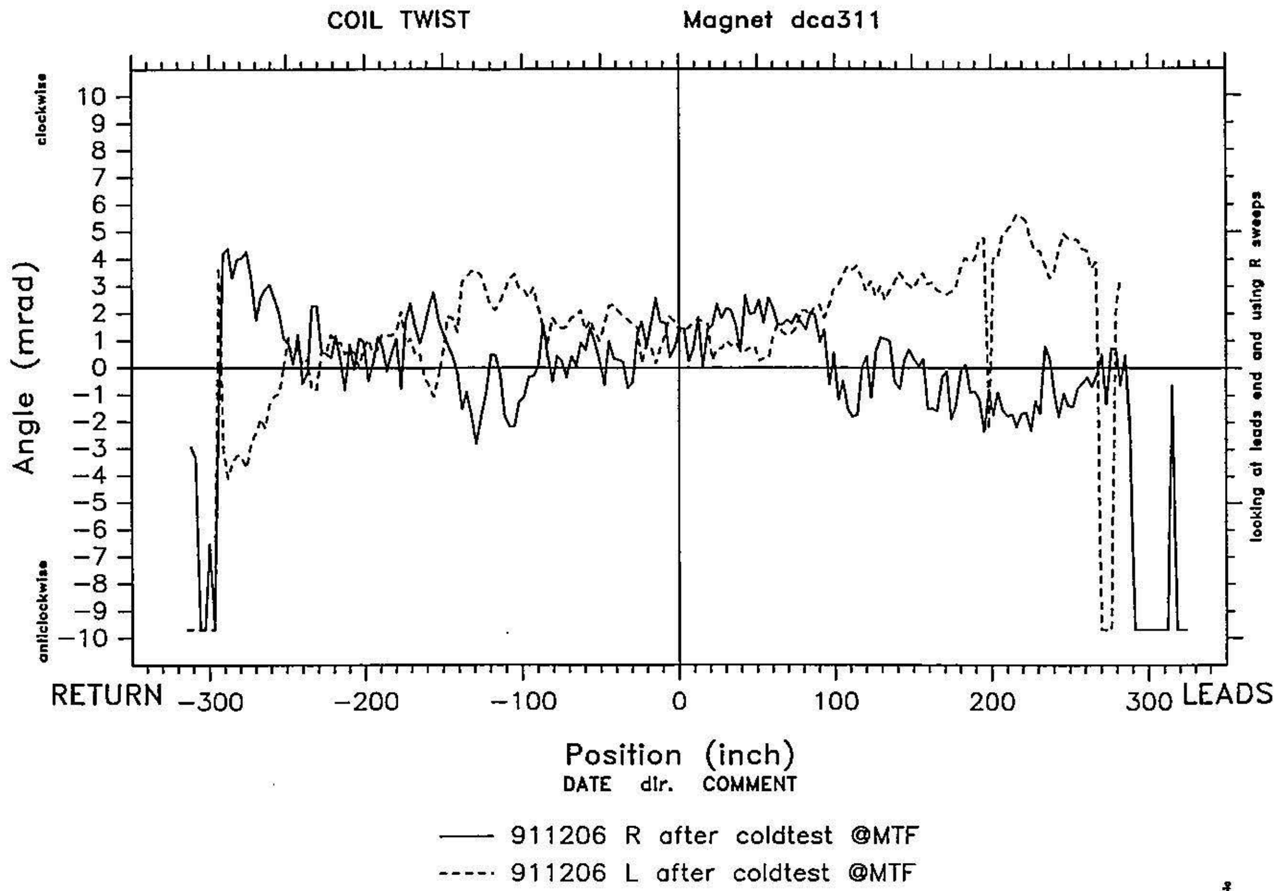

Figure 5.

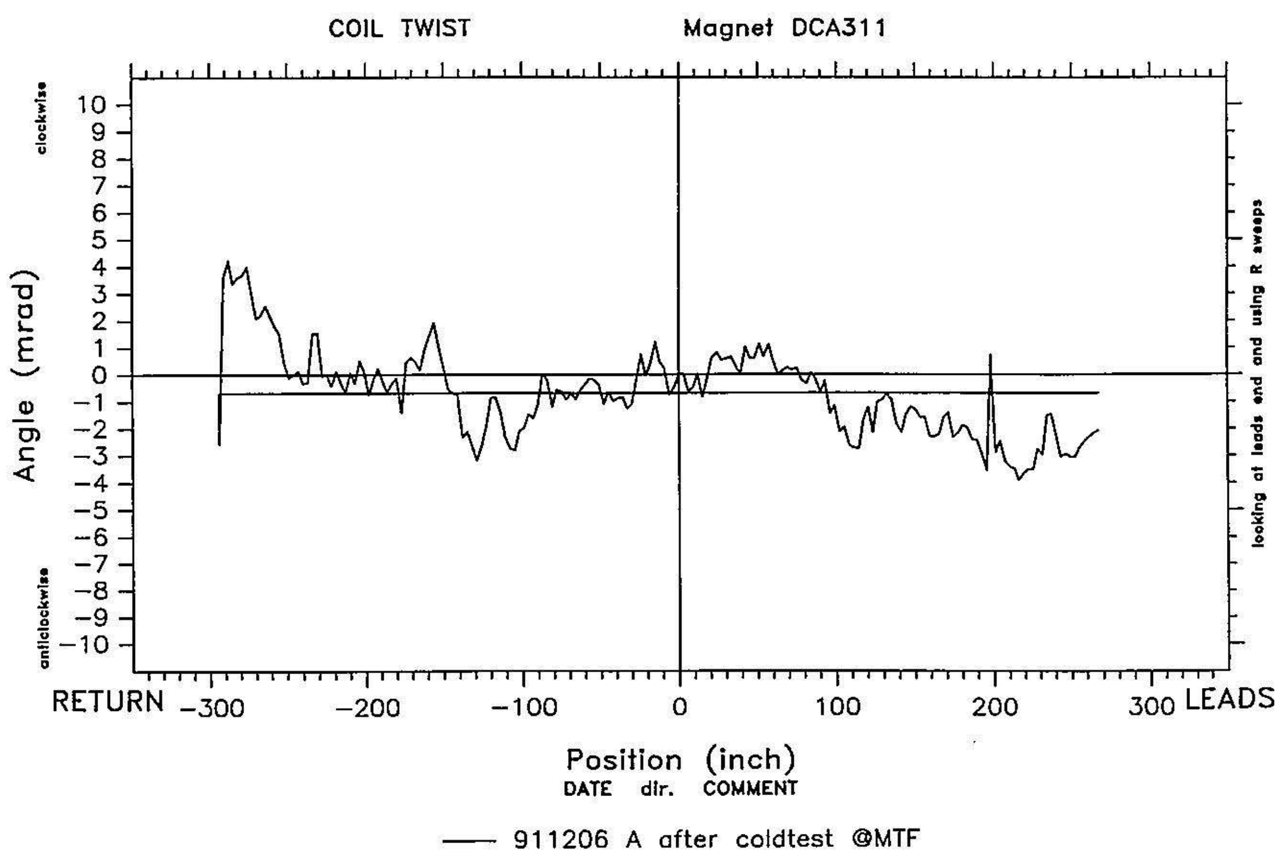

Figure 6.

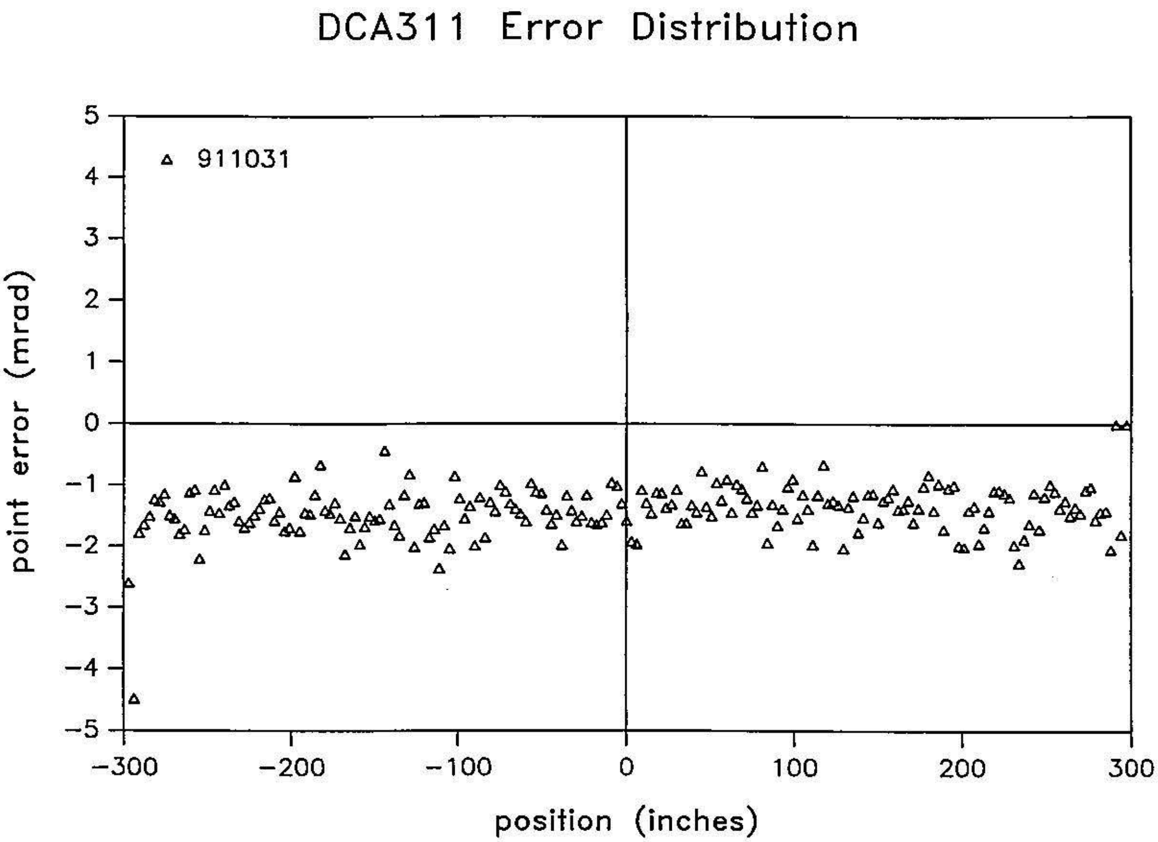

Figure 7.

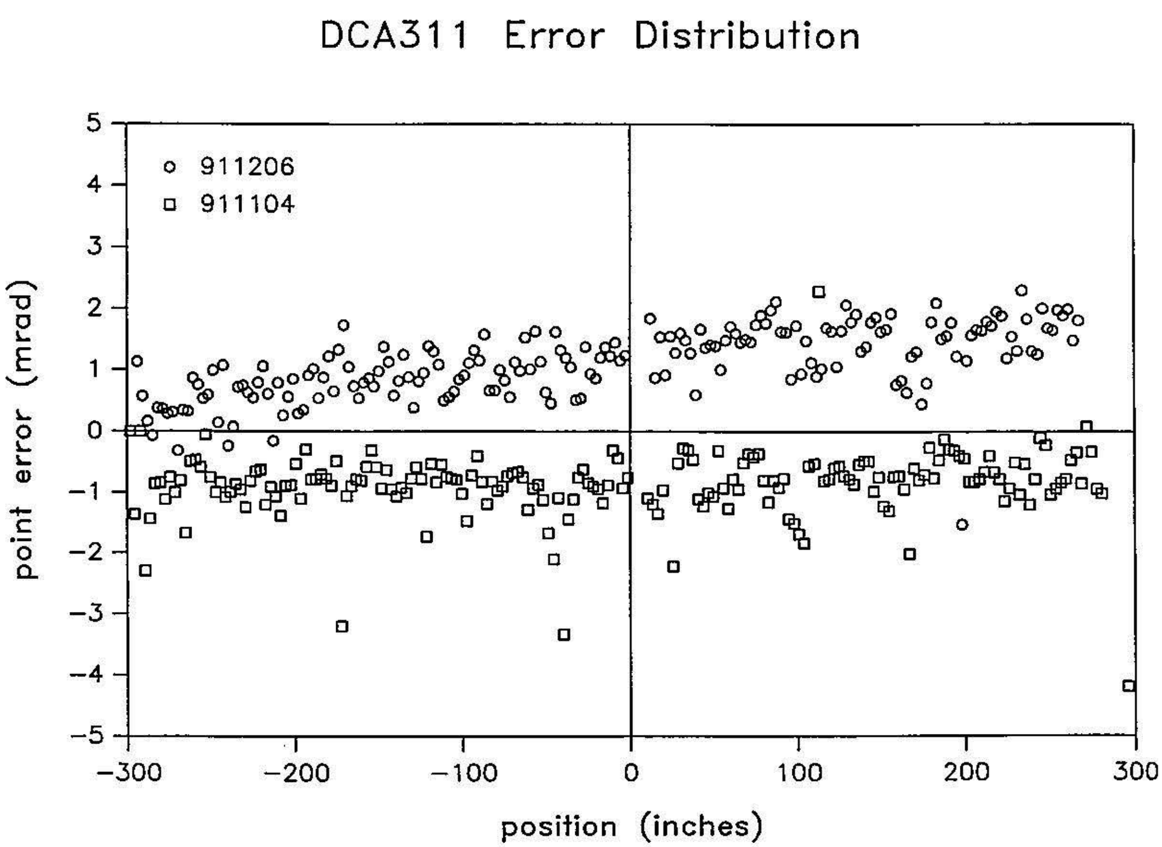

Figure 8.

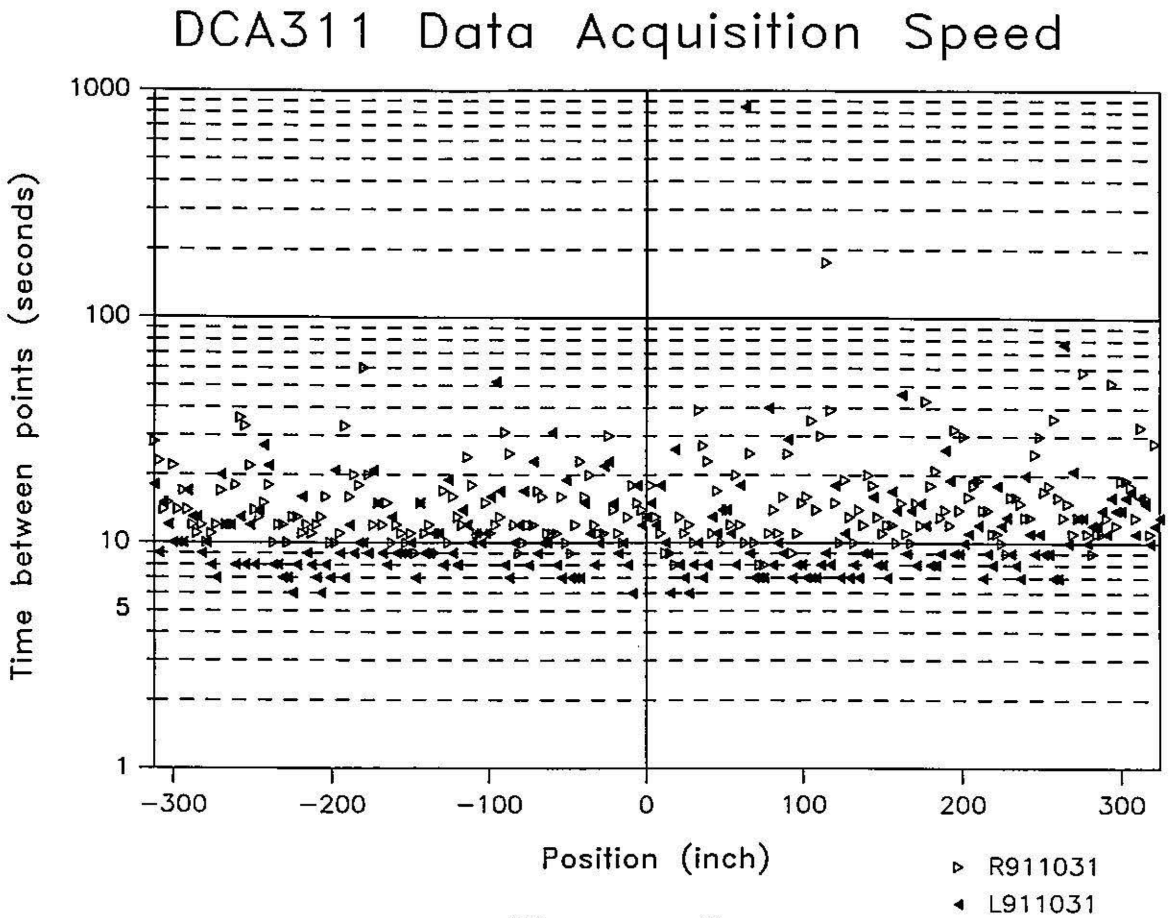

Figure 9

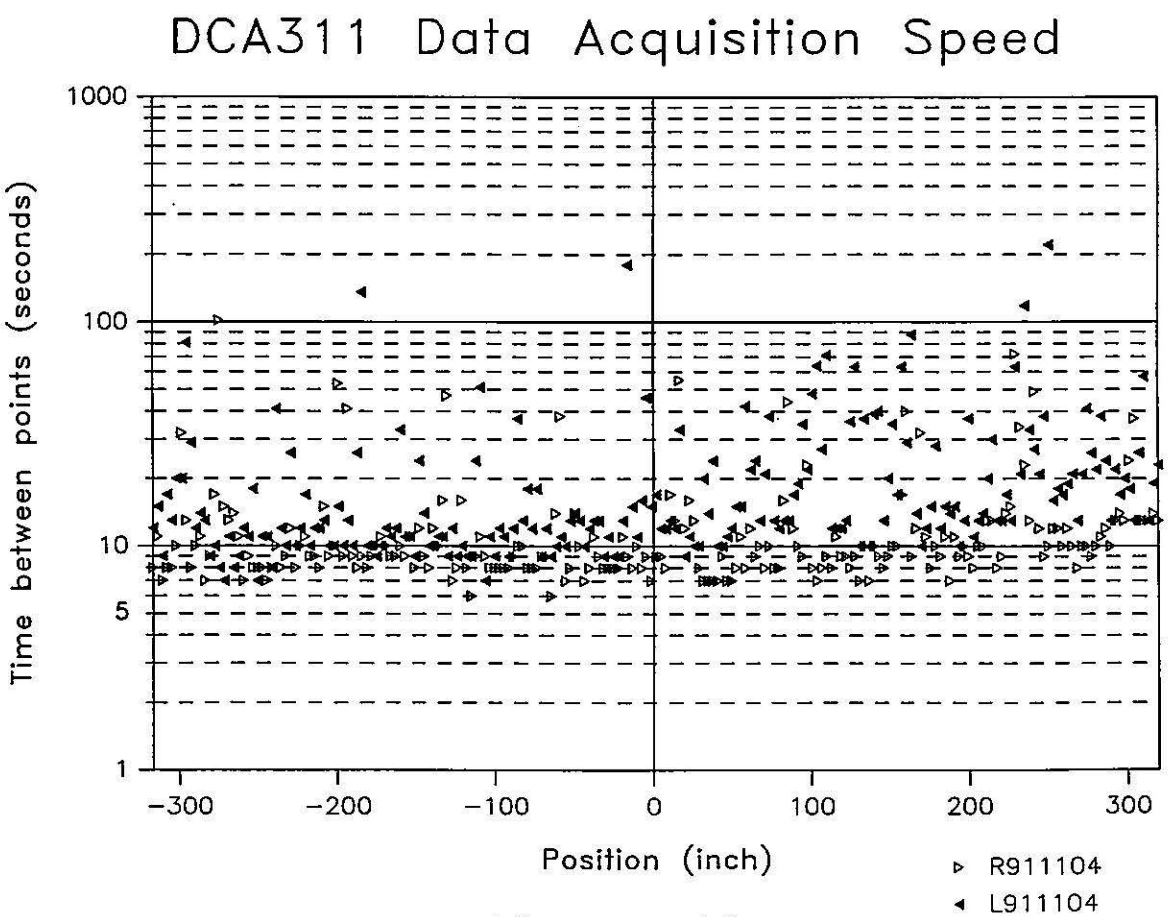

Figure 10

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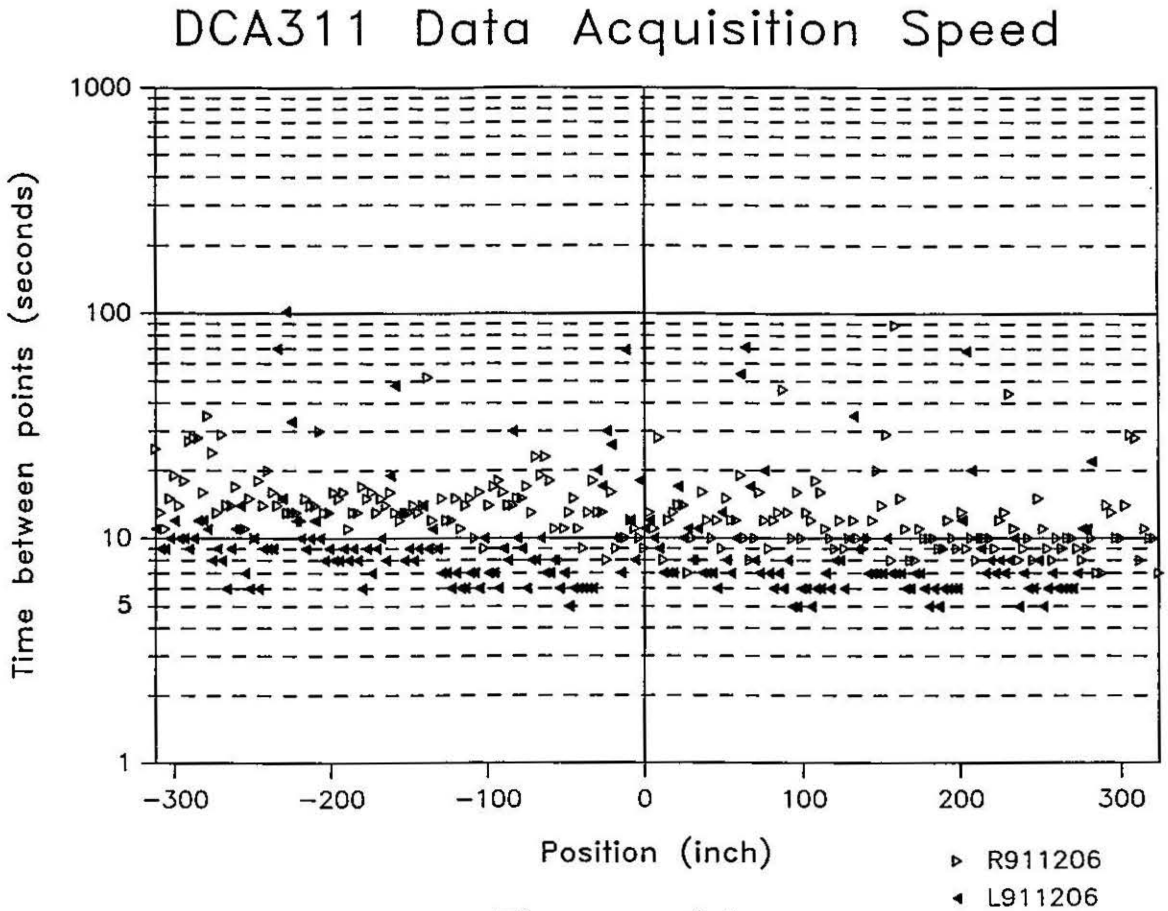
DCA311 Data Acquisition Speed
Time between points (seconds)
1000
100
10
5
1
-300
-200
-100
0
100
200
300
Position (inch)
R911206
L911206

Figure 11