LG 2005/09/27

Alignment and surface profile of 50 µm MIMOSA5 detectors on a prototype mechanical ladder.

We have constructed a mechanical prototype ladder to test the mechanical, thermal and vibrational properties of the assembled prototype as well as to test construction techniques and alignment accuracy. This report will focus on our construction techniques and placement / alignment accuracy.

The construction sequence was;

1. Fabricate the carrier.
2. Place the carrier in the Optical Measurement Machine at B77 and measure a pattern of z-elevation points over the top surface.
3. Glue the heater cable to the carrier with thin film acrylic adhesive.
4. Place the carrier / cable in the OMM at B77 and measure the same pattern of z-elevation points over the top surface of the cable.
5. Glue the available thinned 50 µm MIMOSA5 detectors to the surface using the vacuum chuck fixturing to the top of the cable / carrier assembly.
6. Place the prototype ladder in the OMM at B77 and measure the same pattern of z-elevation points over the top surface of the detectors / cable. Then measure the positions of the corners of the MIMOSA5 detectors. Then do a line of points along the undeflected ladder (one end held securely). Put a 10 g weight on the unsupported end and repeat the measurement f the same line of points to get the deflection.

We used 8 chips on this mechanical prototype (these were all of the appropriate chips that we have currently thinned). The MIMOSA5 detectors used as mass dummies were all red coded chips thinned to 50 µm. The chips used are shown schematically below;

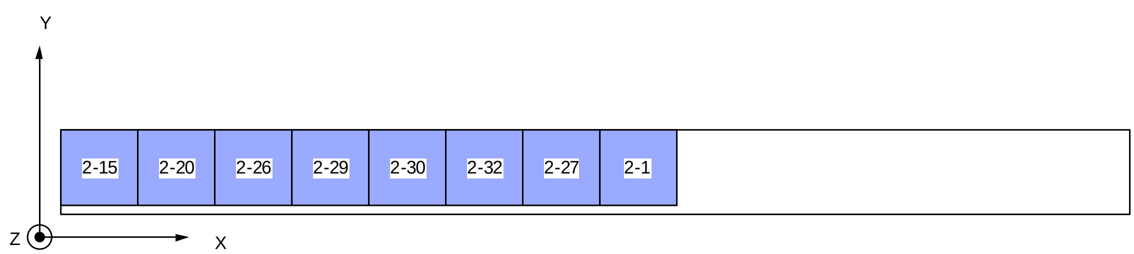

Figure 1: Top view of mechanical prototype ladder. Axes used in measurements are labeled.

The results of these measurements are shown below;

<u>Positioning the Detectors.</u>
The thinned MIMOSA5 detectors are positioned using a vacuum chuck with an alignment bump edge and individual vacuum chuck valves for each detector position.. The detectors themselves are positioned individually by placing the detectors along the

long axis bump edge of the chuck and subsequent detectors are bumped to the edge of the adjacent detector.
The alignment of the detectors along the as demonstrated by the corner measurements are shown below.

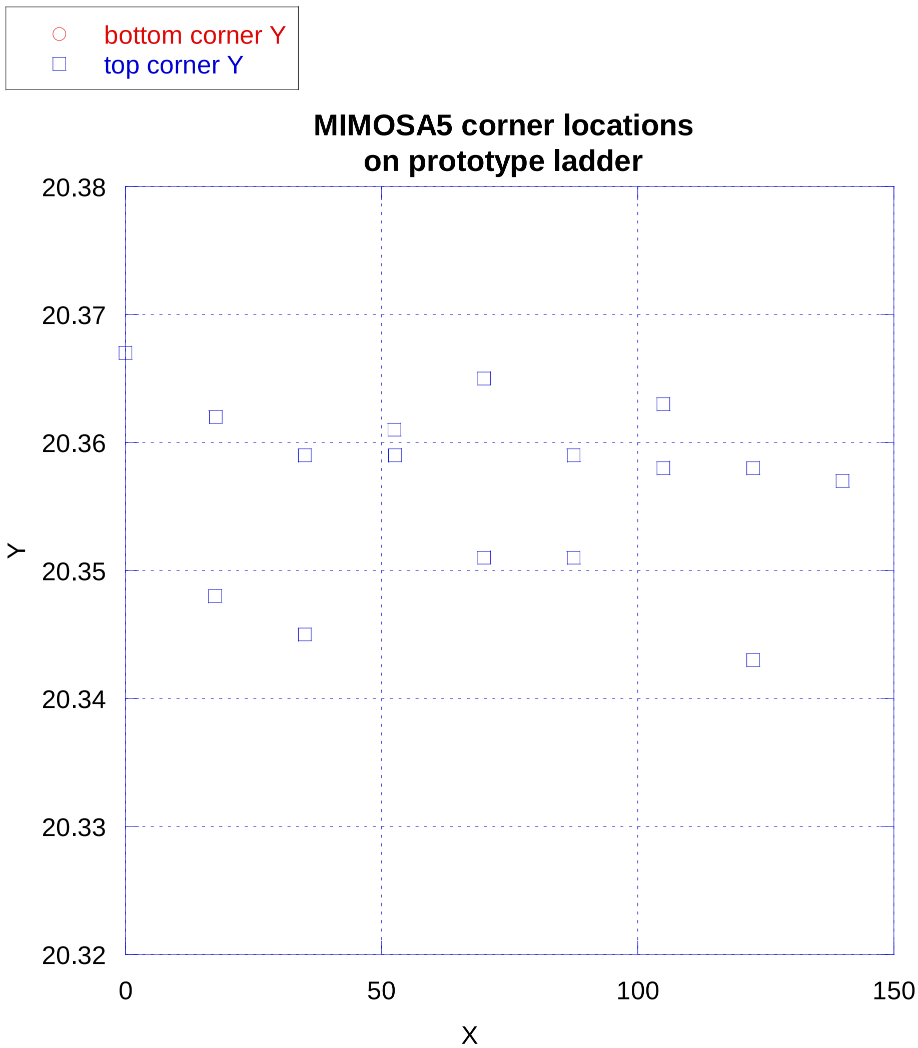

Figure 2: Top corner Y for 8 MIMOSA5 detectors. Dimensions are in mm.

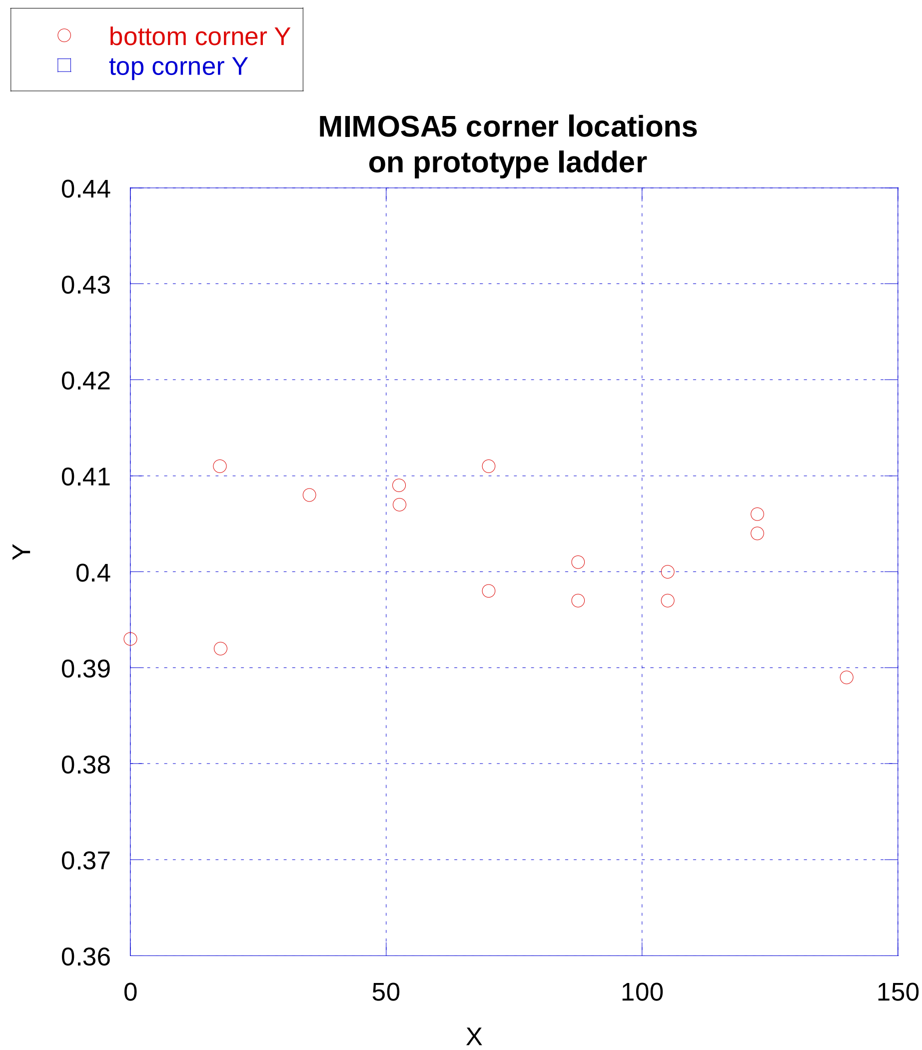

Figure 3: Bottom corner Y for 8 MIMOSA5 detectors. Dimensions are in mm.

As one can see, the alignment along the edge of the ladder is quite good.

A Note on the Accuracy of the Measurements:

Consistency checking revealed an interesting discrepancy in the above corner measurements. The OMM should be reliable and repeatable to within 1-2 µm over ~300 mm. The dicing house that diced our MIMOSA5 wafers told us that the dicing would result in the dimensions of the MIMOSA5 chips being the same to within 1 µm. Doing a simple subtraction of the data for the corners gave discrepancies in the measured dimensions of the MIMOSA5 detectors (these detectors were all taken from wafer #2 which was diced in 1 operation). To account for the possible slight rotation in the chip to chip positioning one can do an individual subtraction [(top left – top right) – (bottom left – bottom right)] and histogram the differences. This is shown below;

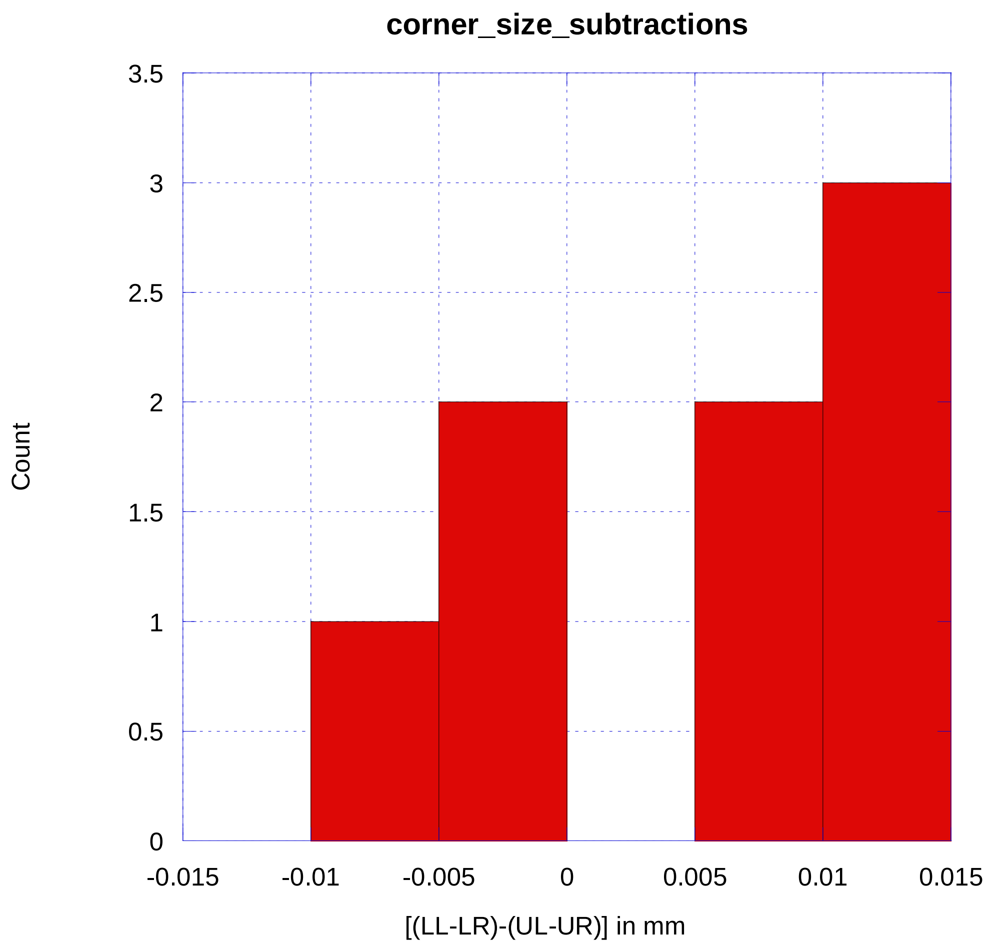

Figure 4: ((LL-LR)-(UL-UR)) from the corner data in mm.

To check if this discrepancy was the result of measurement error, we re-measured the corners of the detectors on the ladder. The new measurements agreed to within 1-2 µm with the measurements taken 4 days previously. In addition, we measured the corners of a non-thinned (thinned detectors are not flat) MIMOSA5 detector 10 times. The data agreed to less than 1 µm.

It appears that the OMM is quite repeatable and accurate (it is calibrated). The dicing house tolerances result in detectors that vary in size and are not rectangular by ~ +/- 15 µm.

<u>Surface Measurements:</u>

Surface measurements were done along a regular grid of x,y,z points in a 50 x 5 grid spanning 1-200 in X and 1-19.4 in Y. The plots are shown below;

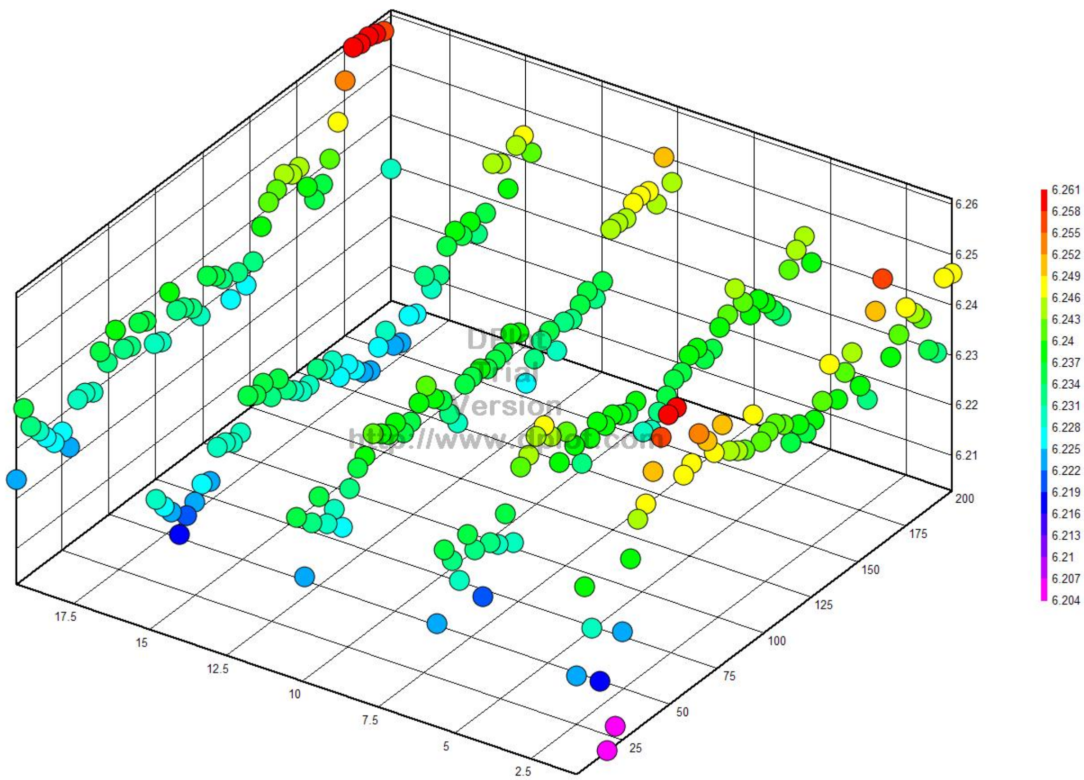

Figure 5: Surface of bare beam

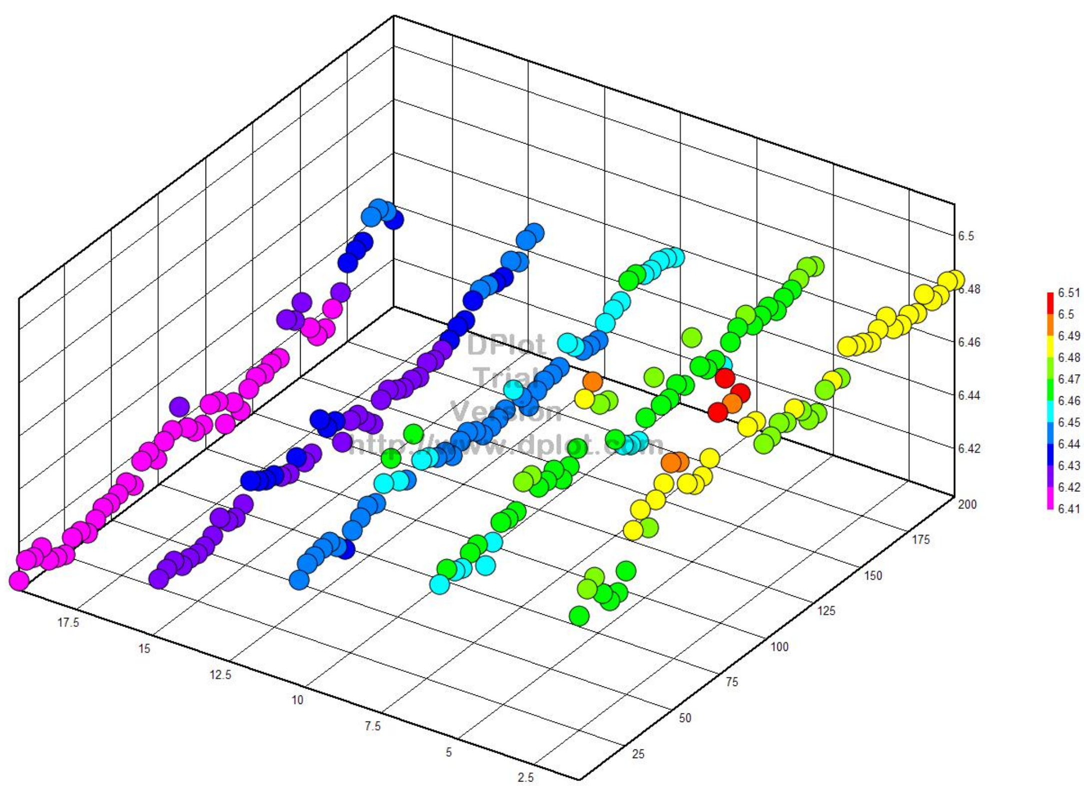

Figure 6: Surface plot of cable profile on beam

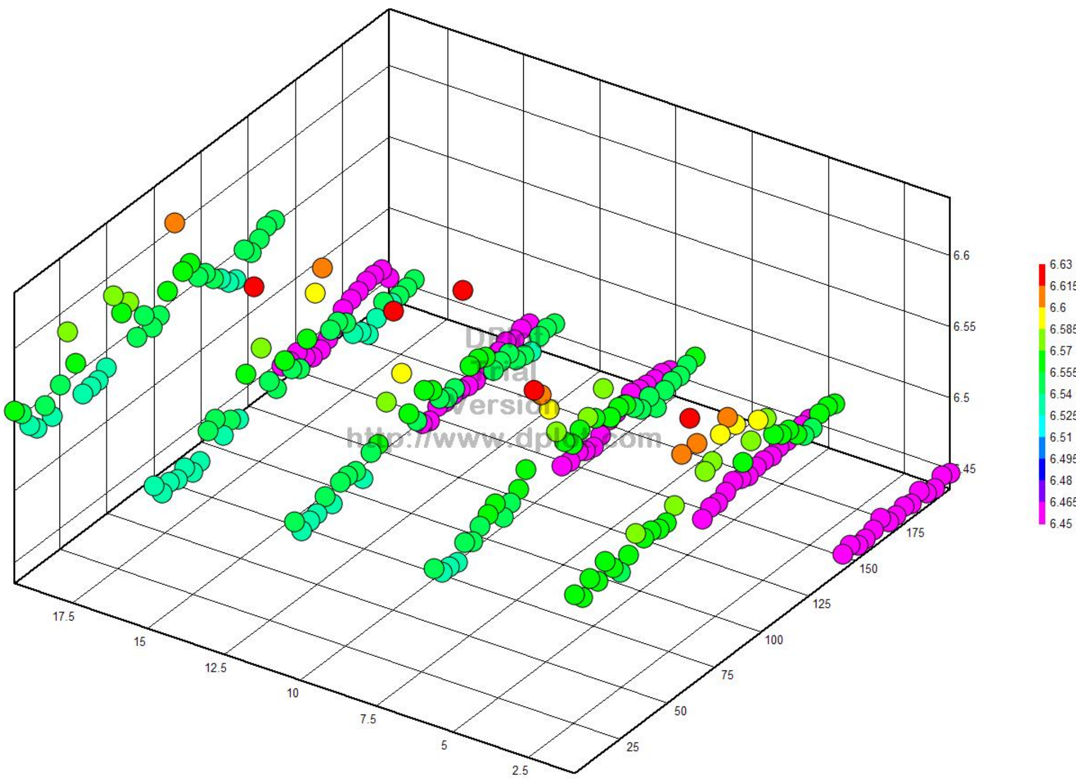

Figure 7: Surface plot of detector profile on cable

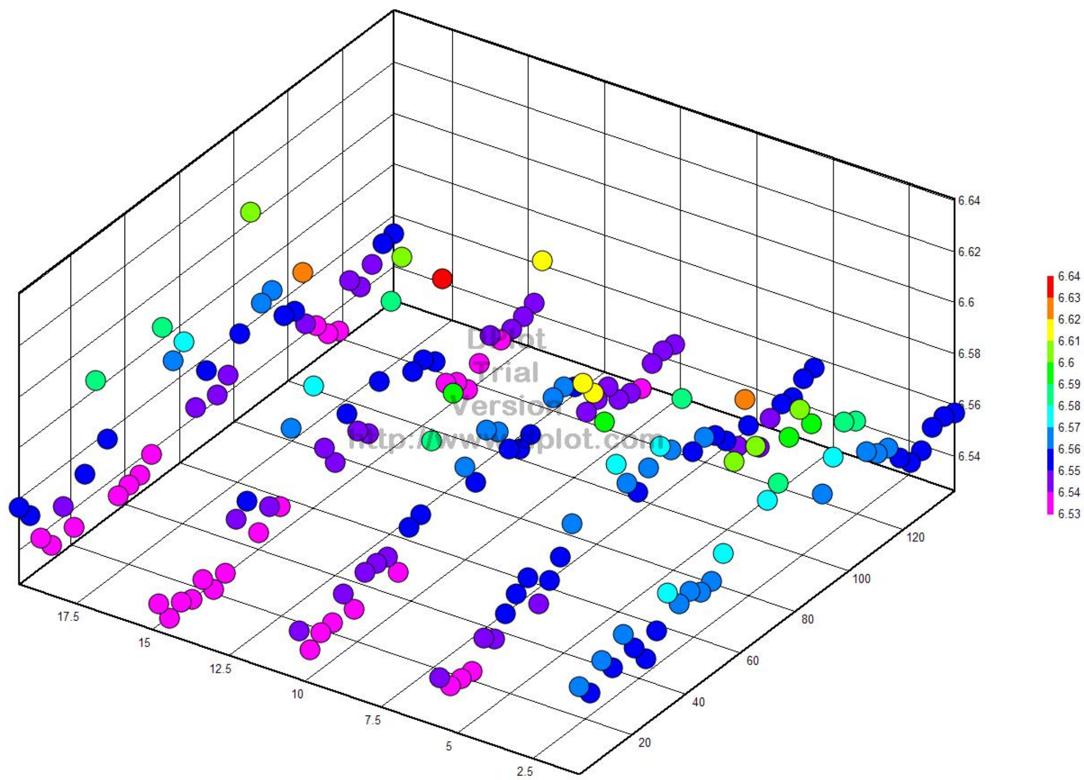

Figure 8: Surface plot of detector profile on cable with x < 140

We can see that the surface of the raw beam in figure 5 shows some irregularity but is reasonably flat to ~ 30 µm over most of the surface. Surface quality and edge effects are pronounced here. In figure 6, the surface traces of the heater cable show themselves in the measurement. Some points are on the conductor, some are on the kapton and the full width is ~ 100 µm.