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03/12/07

Surveying –Z1 Physics Run Half Disk with OGP CMM.

First measurements was on 3/8/07 – 3/9/07
Start about 9.30 a.m. on 03/08/07
Start about 7.15 a.m. on 03/09/07
Finished 3-side by 4.30 p.m. on 03/09/07.
Decided to start 3-side since 4-side position do not fit machine yet.
Adjusted later using three rods of proper height made by G. Derylo.
The half disk photo is presented on Fig.1 with the main measured points shown.

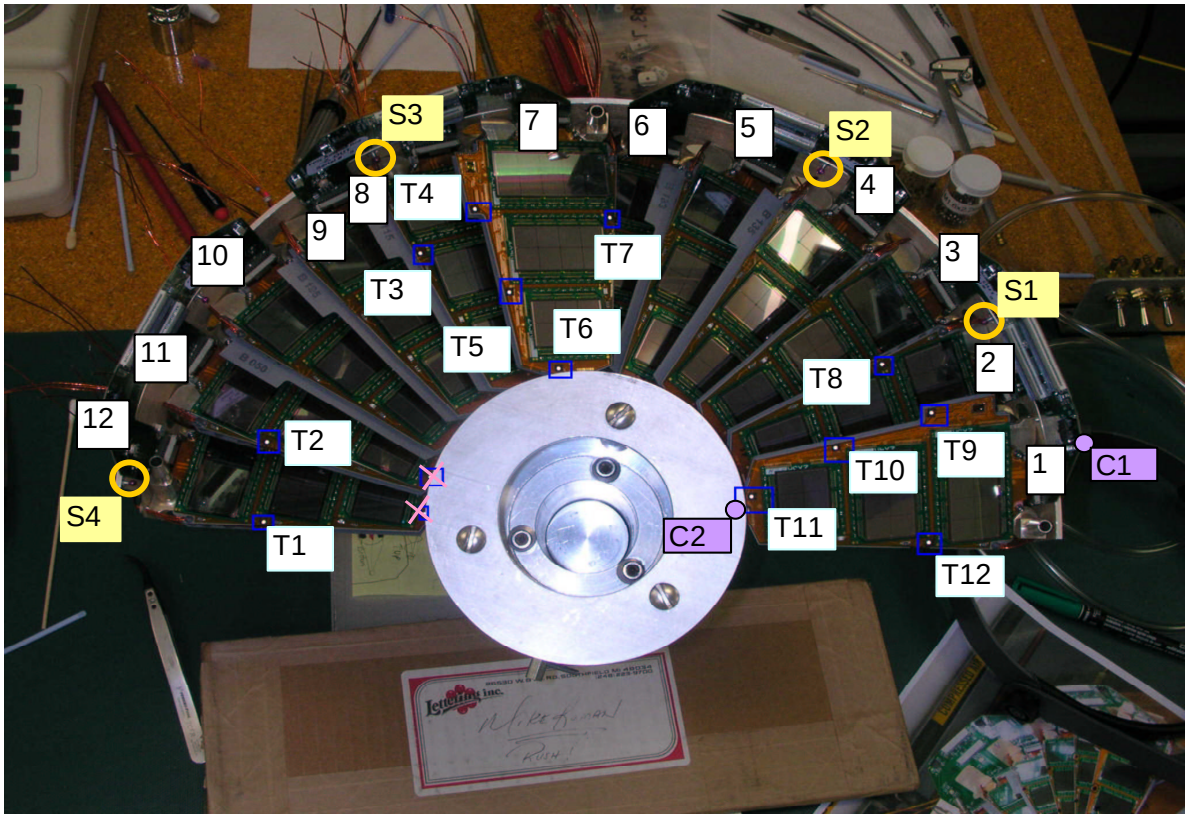

Fig. 1. 3-plaquette side of the half disk with panel numbers (1-12), survey starting points (C1,C2), survey balls (S1-S4) and photogrammetry targets (T1-T12)

A list of the panels installed on the disk is presented in the Table 1.

Table 1

`-Z1 disk panels list in survey panel order			
3-plaquette side		4-plaquette side	
#	ID	#	ID
1	P3L-010	1	P4L-010
2	P3R-017	2	P4L-011
3	P3R-073	3	P4R-033
4	P3R-005	4	P4R-052
5	P3R-045	5	P4R-059
6	P3R-048	6	P4R-011
7	P3L-019	7	P4L-014
8	P3R-014	8	P4R-043
9	P3R-042	9	P4R-066
10	P3R-012	10	P4L-012
11	P3R-021	11	P4L-007
12	P3R-074	12	P4R-028

The 4-side of the half disk will be surveyed after the electrical test of the disk will be finished and it will take about two days to finish.
Additional half day is needed for photogrammetry session.

Measurements and observations.

1. Inter-calibration touch and optical probes
2. Establish initial points on the half disk optically using two points on the outer and inner rings (C1 and C2 on Fig. 1) - not reported
3. Measure 4 out of 5 survey spheres on the outer half ring (S1- S4 on Fig. 1). The margins of 1-2 mm between the adapter board and touch probe as the spheres was measured. One board (at panels 10-12) tilted inside so the probe shaft touches it on the way to measure the sphere so it was skipped
4. Measure 4 out of 5 support plate stainless spheres (SS1-SS4). The sphere at the inner ring plate side cannot be reached. Need to be re-located.
5. Switch to optical probe lens 5x. Remove the touch probe stylus.
6. Measure the panel fidicials following pattern closed to one used for individual panel survey. The differences are due to space limitations:
   the safety margins between the lens and outer ring of 2-3 mm, so on the 2x5 sensor only one row of the fiducials was measured;
   panels are overlapped in two ways: if the upper panel has no a TBM wing over the lower neighbor we measure 4 fiducials on the panel visible side; if the upper panel has the TBM wing above we change pattern measuring a different fiducial closer to the open edge.
7. The data are available on the PPD server directory on Monday 3/12/03:
   \\Ppdserver\tc.ppd\Projects\SiDet\CMM\OGP_machine\CMS\Pixels\Half Disk\Physics Run

Details of panel measurements.

1. Panels # 1 and #7 are open and standard fiducials are measured except 4 on the 2x5 plaquette closest to the outer ring.
2. Panels #3 and 4 are measured with standard fiducials skipping inner invisible ones: 4 fiducials on the 2x3 and 2x4 plaquettes and 2 fiducials on the 2x5 plaquette.
3. Panels #2,8,9,10,11 are overlapped by TBM wing and measured with changed pattern of 4 fiducials on the 2x3 and 2x4 plaquettes and 2 fiducials on the 2x5 plaquette (see Fig. 2).
4. Panel 5 has additional limitations on 2x3 plaquette due to inner ring space limitation and only 3 fiducials were measured.
5. Panel 6 has severe space limitations and was measured according special pattern of 7 points to be presented on Fig.3.
6. Panel 12 has space limitations by the inner ring and only 2 fiducials were measured on the 2x3 panel.
7. 12 (T1-T12) out of 14 photogrammetry targets were measured with automatic pattern recognition. Two targets on panels 11 and 12 were skipped due to the inner ring space limitation.
8. The program was run in semi-automatic mode twice on Friday 03/09/07 afternoon twice. It takes one and half-hour to make one measurement.
9. First measurement run was concluded by re-attachment of the touch probe stylus and re-measurement of one of the survey balls. The repeatability was in X and Y about 2-3 microns and in Z was 8-9 microns, which is acceptable.

Panel position measurement results.

1. We compare measured positions of sensor fiducials. It shows difference between two measurements of 1-2 microns in X and Y and 3-4 microns in Z (Table 2).

Table 2

Difference, mm	Dx	Dy	Dz
Average	-0.002	-0.003	0.001
StDev	0.001	0.001	0.003
Max	0.003	0.002	0.010
Min	-0.006	-0.006	-0.024

2. Panel 1 (P3L-010) half disk measurement data were compared with an individual panel measurement. Comparison of results of two measurements is shown in the Table 3.

Table 3. Residuals (mm) between Panel #1 (ID= P3R-010) individual measurements and measurements on the assembled half disk –Z1.

Fiducial Label	Fit residuals between two measurements			
	DX	DY	DZ	
2X3_1	-0.002	0.002	0.010	
2X3_2	-0.002	0.003	0.011	
2X3_3	0.001	0.003	0.011	
2X3_4	0.001	0.002	0.010	
2X3_5	-0.004	0.002	-0.003	
2X3_6	-0.002	0.003	-0.006	
2X3_7	-0.001	0.003	-0.004	
2X3_8	0.000	0.004	-0.009	
2X4_1	-0.002	-0.008	-0.010	
2X4_2	0.001	-0.005	-0.012	
2X4_3	0.003	-0.003	-0.009	
2X4_4	0.003	-0.002	-0.010	
2X4_5	-0.002	-0.005	-0.005	
2X4_6	0.001	-0.003	-0.004	
2X4_7	0.001	-0.003	-0.006	
2X4_8	0.003	0.001	-0.007	
2X5_1	-0.004	0.001	0.011	
2X5_2	0.000	0.001	0.007	
2X5_3	0.001	0.002	0.008	
2X5_4	0.004	0.002	0.015	
	Dx	Dy	Dz	Dall
RMS:	0.002	0.003	0.009	0.010

3. Panel 6 (P3R-048) half-disk measurements pattern is shown in Fig. 3 and in Table 4 where corresponding 2x4 plaquette fiducial labels and nominal positions are compared with measured ones. The 2x3 5-04 sensor fiducial position is not corrected for real 2x3 plaquette placement position and need to be compared with the corresponding individual panel measurement position.

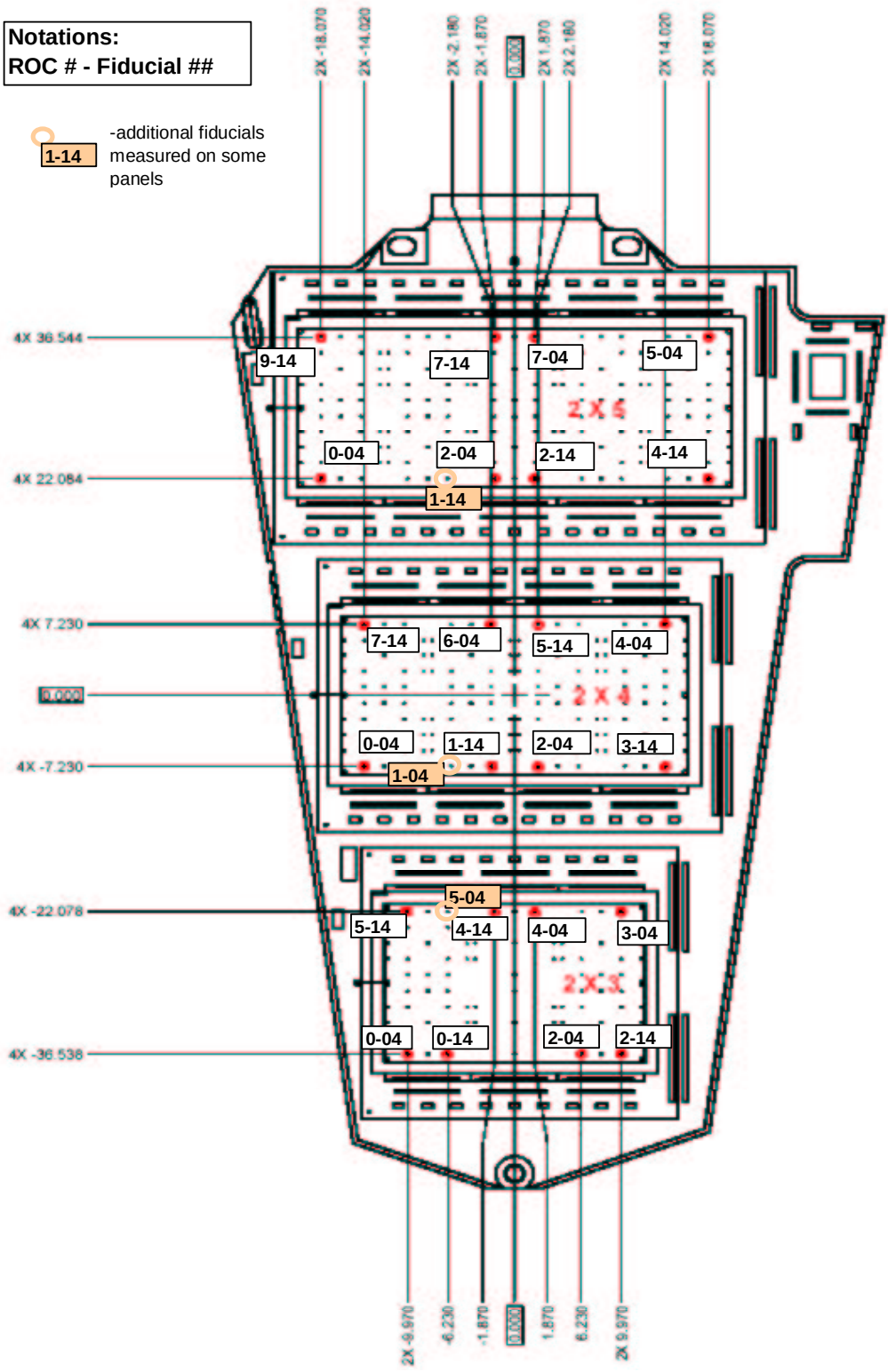

Fig. 2 Pattern of measured fiducials on the panels (except Panel #6). Additional fiducials measured on the half-disk are shown

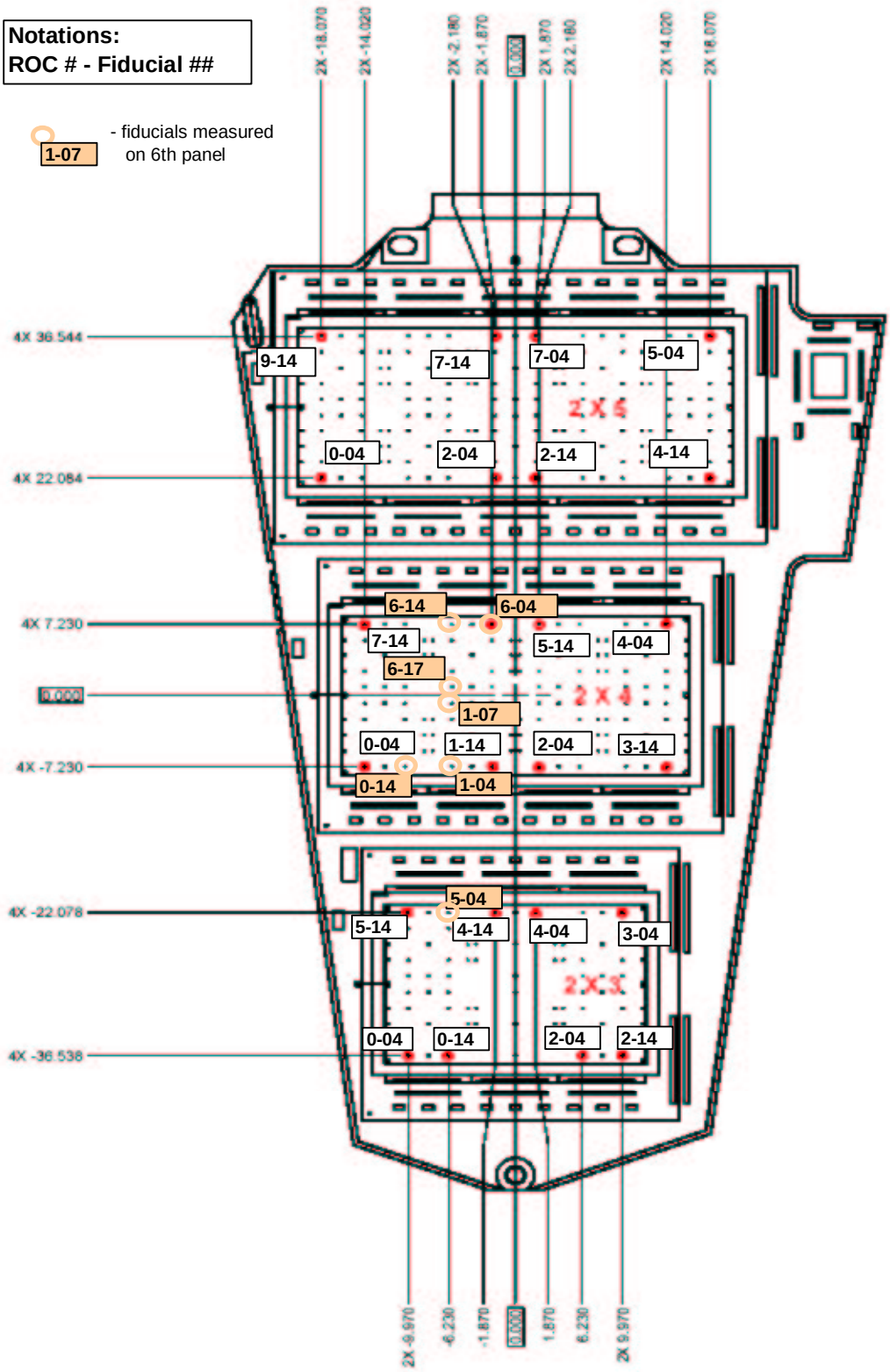

Fig. 3 Fiducials measured on the panel 6.

Table 4. Panel 6 measured fiducial nominal positions (the panel coordinate system) and 2x4 plaquette with X-Y measurement fit residuals

	Nominal fiducial positions			2x4 X-Y fit residuals	
Fiducial	Xnom	Ynom	Znom	Dx	Dy
2x4 1-04	-7.230	-5.920	0.000	0.000	0.000
2x4 0-14	-7.230	-10.280	0.000	0.001	0.002
2x4 6-04	7.230	-2.180	0.000	-0.001	0.000
2x4 6-14	7.230	-5.920	0.000	0.000	0.000
2x4 1-07	-0.830	-5.920	0.000	0.000	-0.001
2x4 6-17	0.830	-5.920	0.000	0.000	0.000
2x3 5-04	-22.078	-6.230	0.000	0.116	-0.033