Blanco Shutdown
April-May 2009

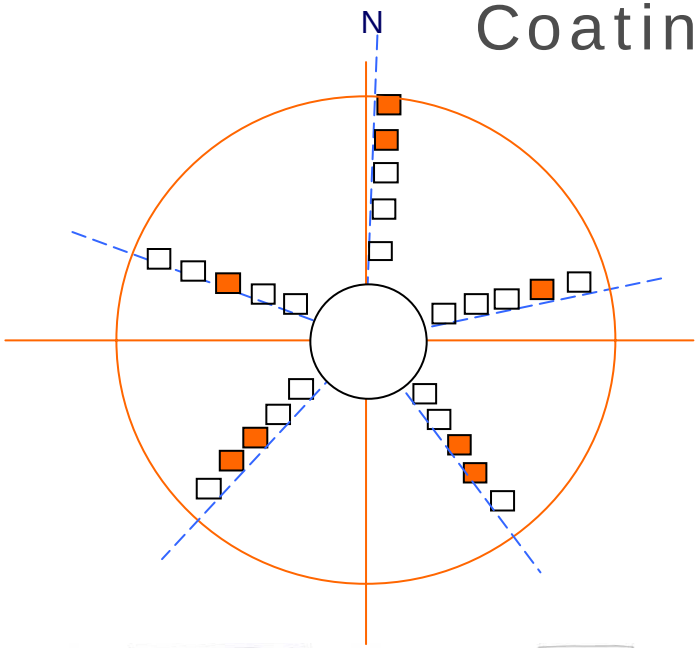
Optics and Opto-mechanics

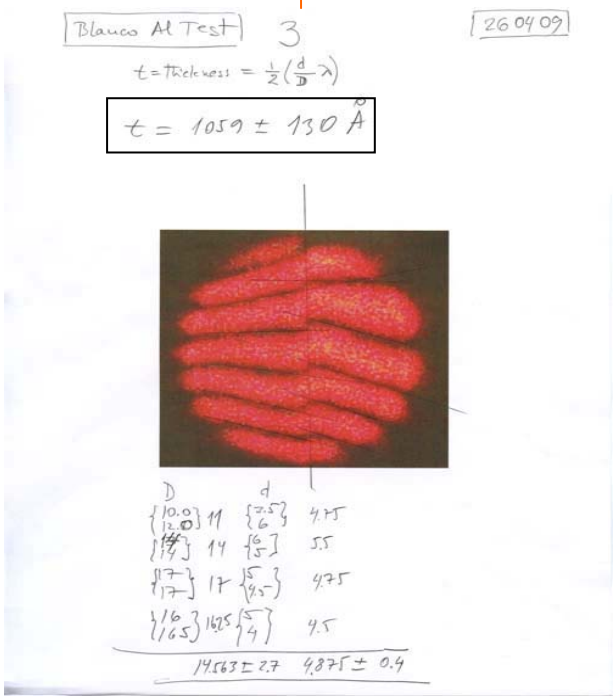
R.Tighe

List of Works Done

- **Coating Chamber Testing:** Results show the Al coating obtained has some contamination (a ring of low reflectance). Decided to not re-coat M1 now.
- **Pasivation of Mirror Cracks:** Fabian Collao and I, with the knowledgeable support of Doug Neill and Gary Poczulp, ground out the volume of glass containing the dangerous cracks and Tim, Gale and I finished etching the hole with HF acid.
- **Mirror to Counterweights balance:** The M1-to-CW balance was measured using the load cells on the radial defining points, as sensors. An unbalance of ~30Kg was measured. Friction forces can deal with that!. We doubt it is real unbalance though!!.
- **Axial hard points Load Cells:** Measured w/r to Zd give info on M1 attitude.
- **Displacement measurements of Mirror w/r to Cell:** Done with linear gauges called Mitutoyos (schematics shown ahead). Permanent logging system is working.
- **IQ measurements:** Hartmann testing at PF with radial defining points pressed against mirror edges with average force of ~80kg per load cell. Results: strong astigmatic features, decided to remove the radial defining points.
- **Active Optics Corrections:** Applied PF baseline corrections from measured values near Zenith (similar to ones before shutdown). In F/8 an educated guess is that most of the aberrations are due to M2, so shouldn't have changed, therefore we applied the same F/8 baseline corrections used before shutdown.
- **Coma Corrections:** With M1 centered in and parallel to the cell base, Blanco is aligned.

Coating Chamber Testing





Possible Reflectometer Measurement Error = ~±0.5%

1 : Measured Apr 28

2 : Measured Apr 29

Thickness monitor final reading = 580A

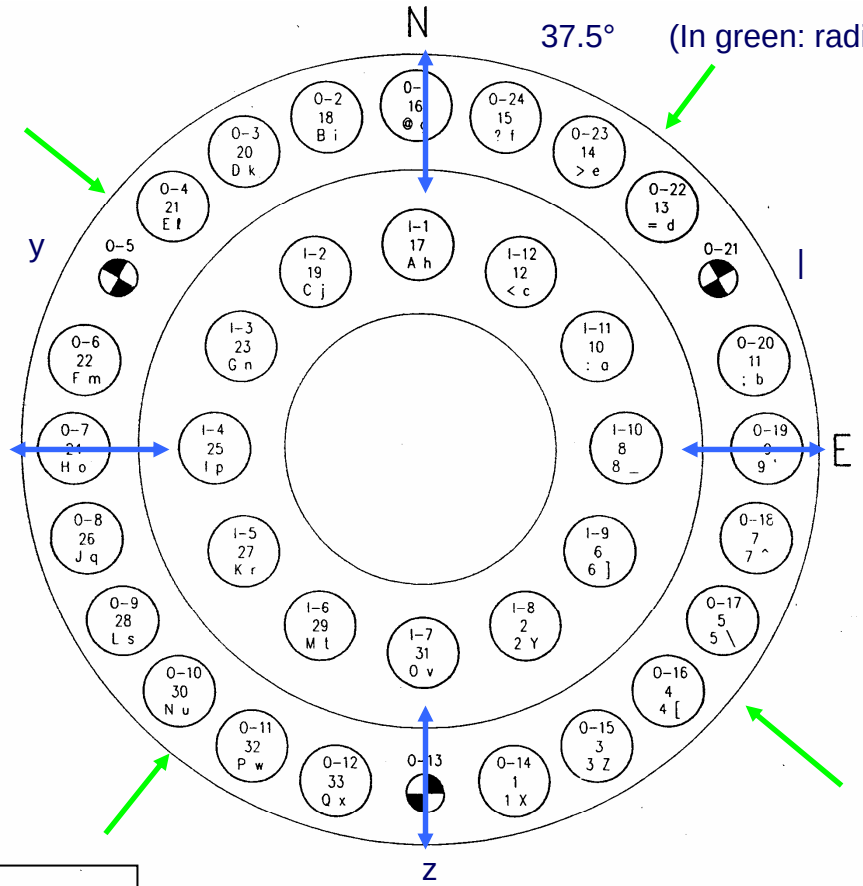
Sample	<R_1>(%)	<R_2>(%)	ND	measured thick. (A)	+/- σ
1		87.08%	4.55	698	120
2	83.44%	83.70%	3.75	857	200
3		89.01%	4.02	1059	130
4	89.62%	88.94%	3.22	1419	160
5		89.71%	3.57	1066	160
6	89.62%	89.76%	3.67		
7		88.11%	4.07	1248	500
8	82.05%	82.58%	3.24	can't measure	
9		88.95%	2.92	can't measure	
10	89.97%	90.03%	3.12	820	160
11		88.77%	4.10	1332	260
12	87.39%	87.16%	4.09		
13		83.63%	4.09		
14	88.91%	89.00%	3.06		
15		89.75%	3.28	757	215
16	89.75%	89.41%	3.97	963	158
17		87.69%	4.29		
18	85.47%	86.05%	4.01		
19		89.55%	3.54		
20	89.39%	89.75%	3.29		
21		89.03%	4.33		
22	84.95%	85.35%	4.18		
23		89.47%	4.41		
24	90.09%	90.22%	3.81		
25		89.99%	3.82		
Average all		88.1%	3.8	**1021.9**	**206.3**
Average R	Goal		90%-91%	900-1000A	
Coating	Oct02		88.81%		
Coating	July04		89.60%		

The low reflectance must be due to contamination because the ND, the Coating Thickness Monitor and the Film Thickness Interferogram measurements say the layer thickness is OK.

Decided not to re-coat the Blanco main mirror and wash it instead given that the coating is in good condition:

Av.R=88.3%,TIS=0.85% (new Aluminium coating: R= 89.6%,TIS=0.35%).-

The Blanco Main mirror Cell



Axial Hard Points Load Cells:

y: NW

z: S

|: NE

(note: we have a discrepancy in the naming, to be checked !!)

Linear Gauges (blue arrows; and from here on called Mitutoyos), measure the E-W and the N-S displacement of the mirror w/r to the Cell.

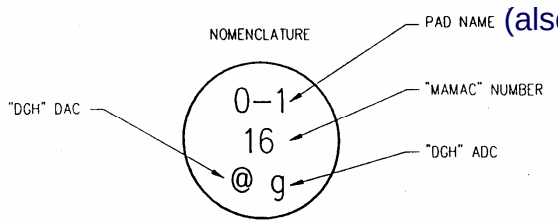
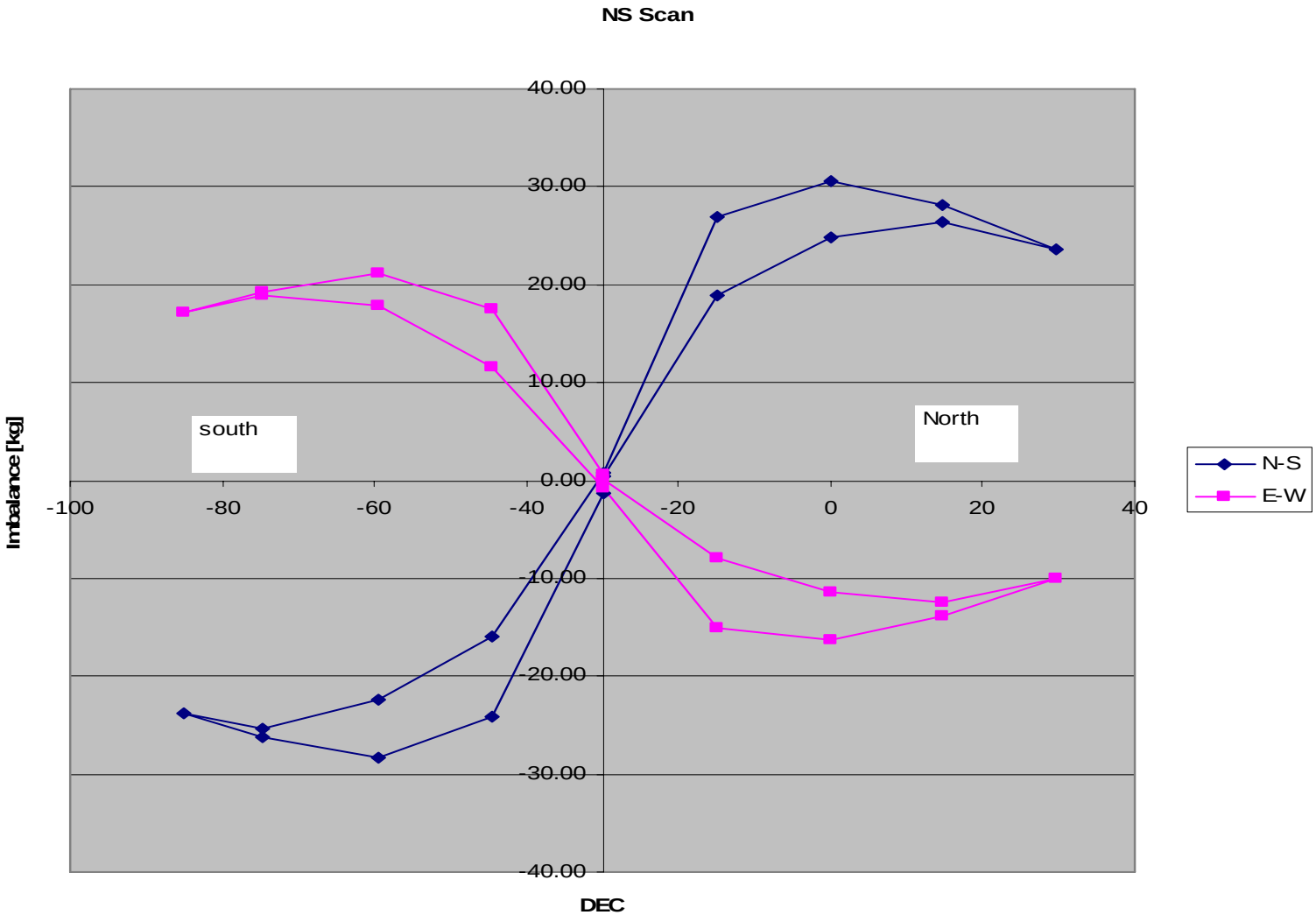


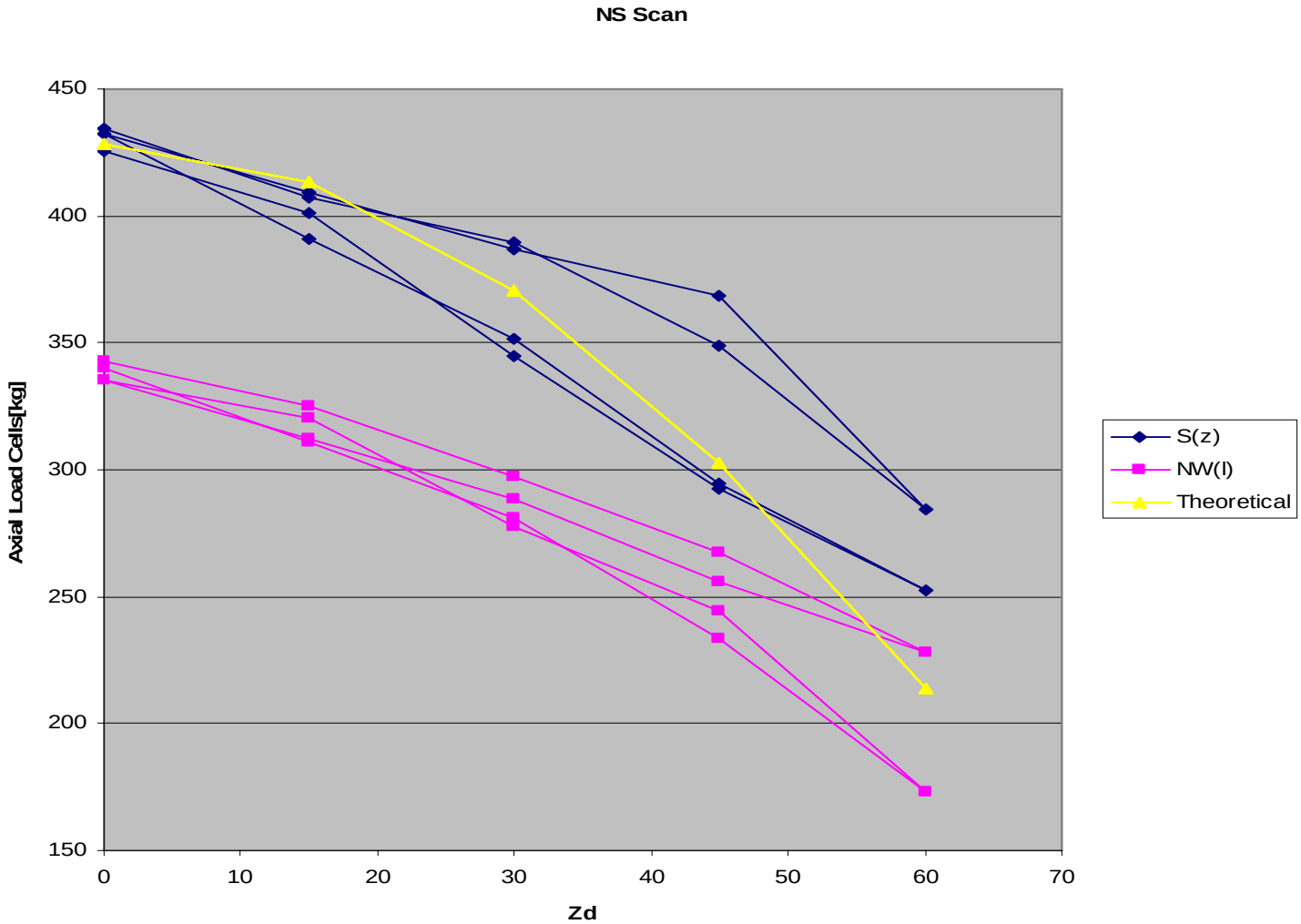
FIGURE 3.1.1: NOMENCLATURE DIAGRAM

Balance: Mirror to Counterweights



Imbalance of ~30Kg means the M1 is “heavier” than the counterweights by that amount. But adding the missing mass to the counterweights made no significant difference. Moreover the max. amplitude happens at Zd~30°. To be studied.

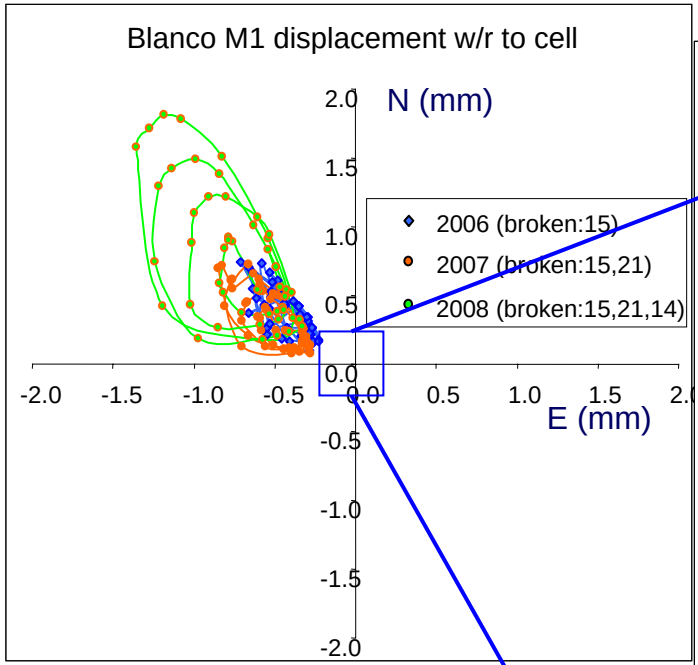
The Axial Load Cells



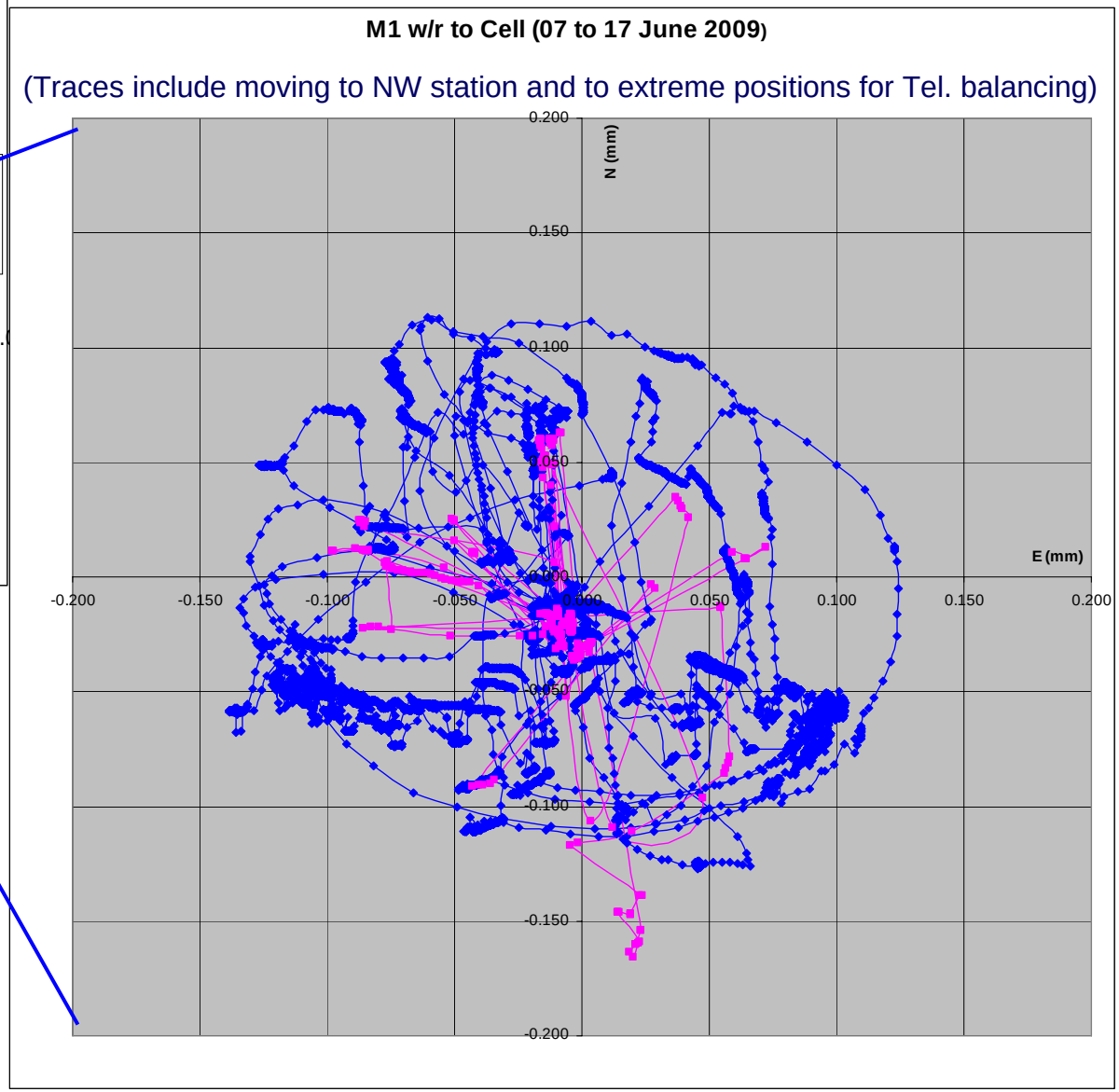
Results not too different from measurements done in the past but: i) load cells had been re-calibrated so why the discrepancy?...and ii) Is the missing load cell taking a higher load?. Measurements should be done again. Now that all 3 load cells are working and M1 is free from the radial defining points.

M1 displacement w/r to M1 Cell

Before shutdown (Oct2005-April2009)

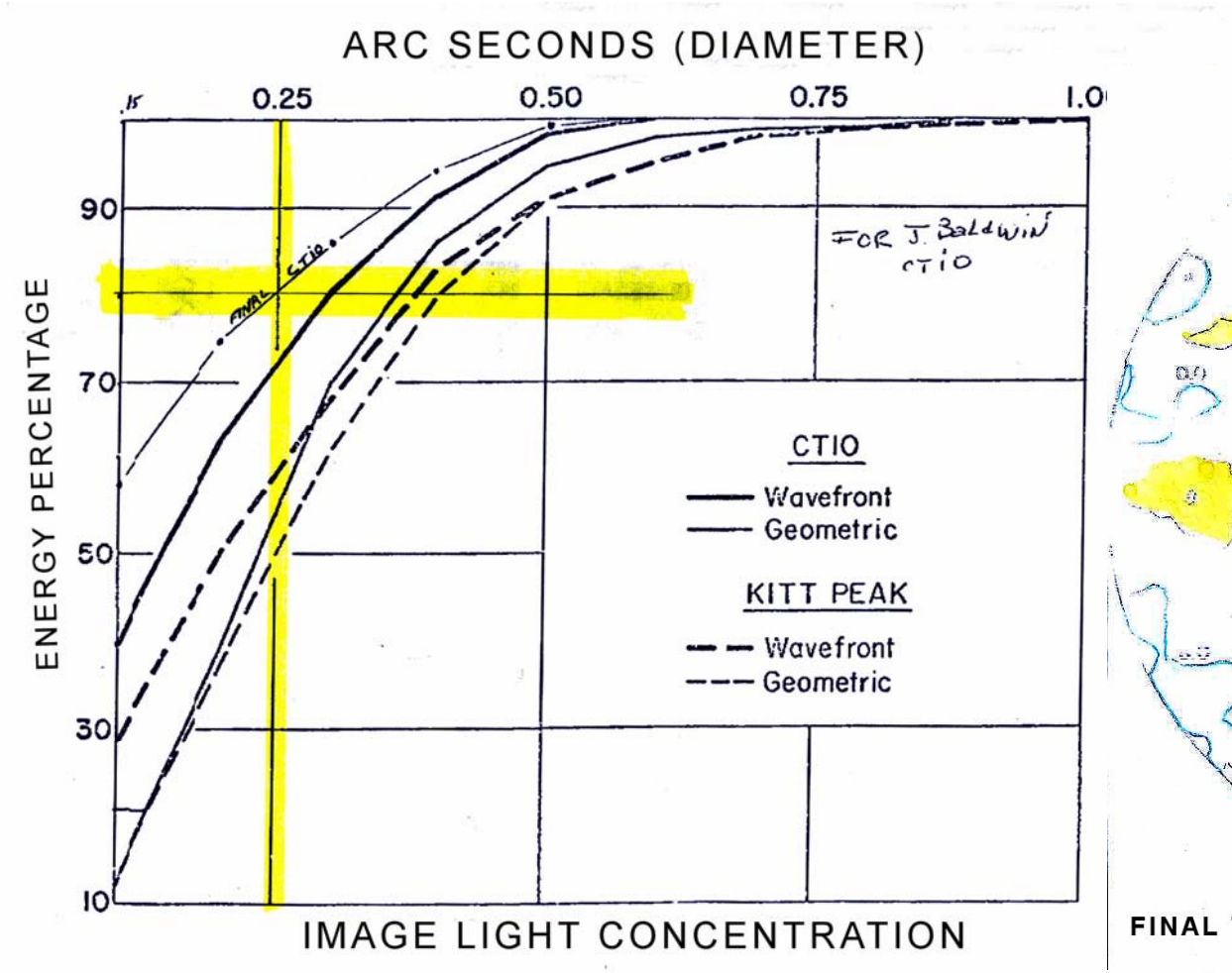


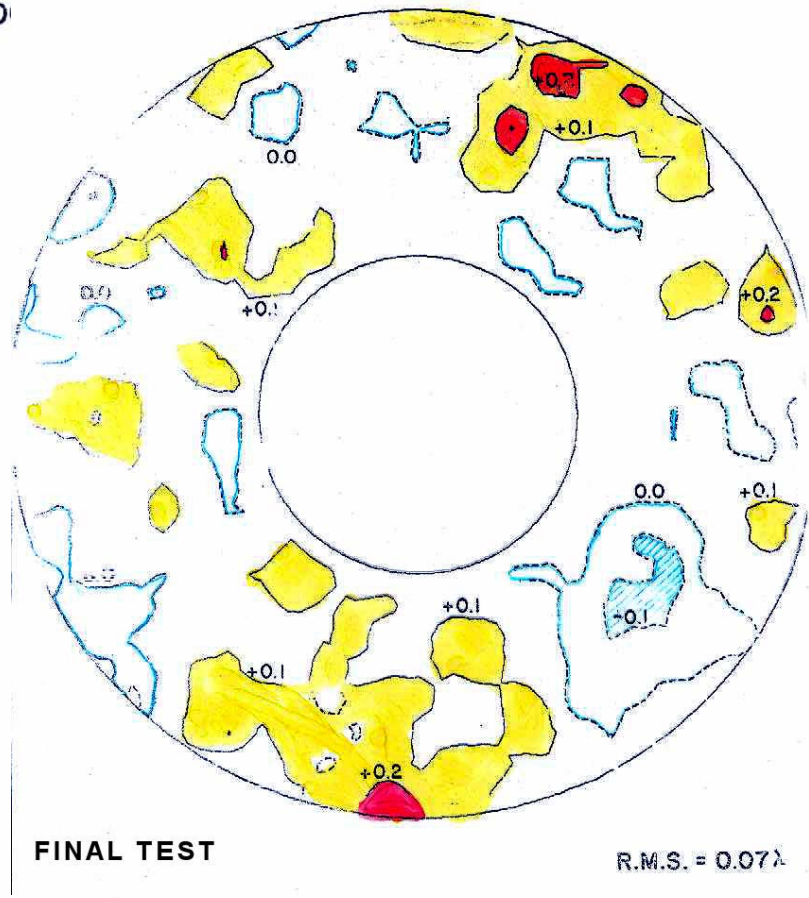
With New Radial Supports after shutdown, data: 07-17 June 2009



Results: The M1 walk w/r to cell is within a circle of maximum radius ~100um centered in the center of the mirror cell to within ~50um.

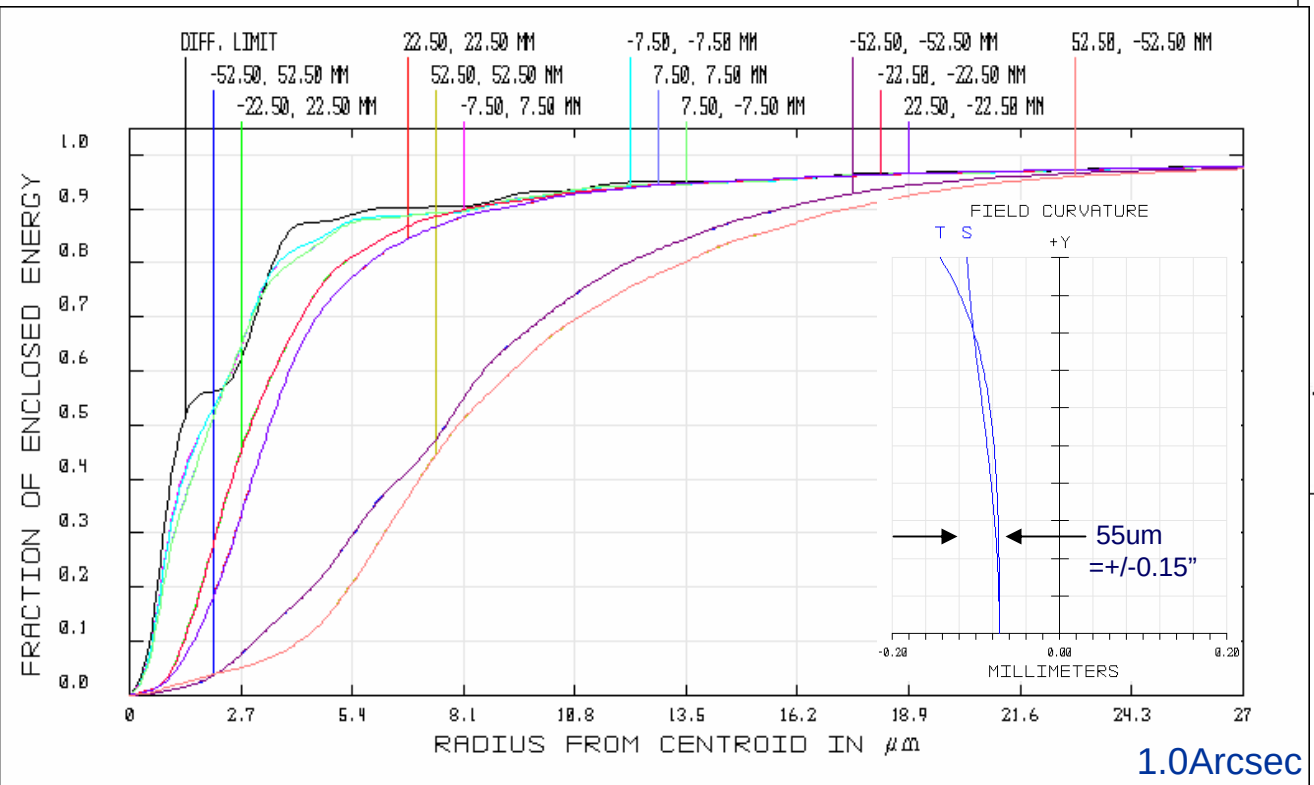
The Blanco PF IQ

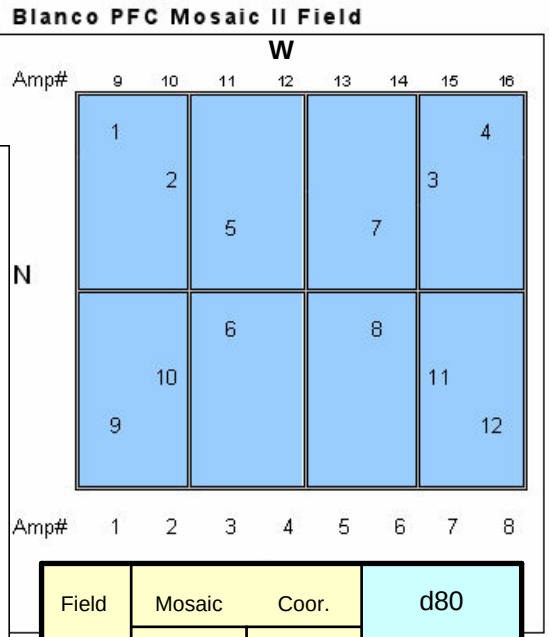




d80= 0.25Arcsec= 13.86um at the prime focus

Zemax Model of Blanco+PFCorrector





Field Pos.	Mosaic x (mm)	Coor. y (mm)	d80 (Arcsec)
1	-52.50	52.50	0.44
2	-22.50	22.50	0.19
3	22.50	22.50	0.21
4	52.50	52.50	0.49
5	-7.50	7.50	0.13
6	-7.50	-7.50	0.13
7	7.50	7.50	0.14
8	7.50	-7.50	0.14
9	-52.50	-52.50	0.44
10	-22.50	-22.50	0.19
11	22.50	-22.50	0.21
12	52.50	-52.50	0.49

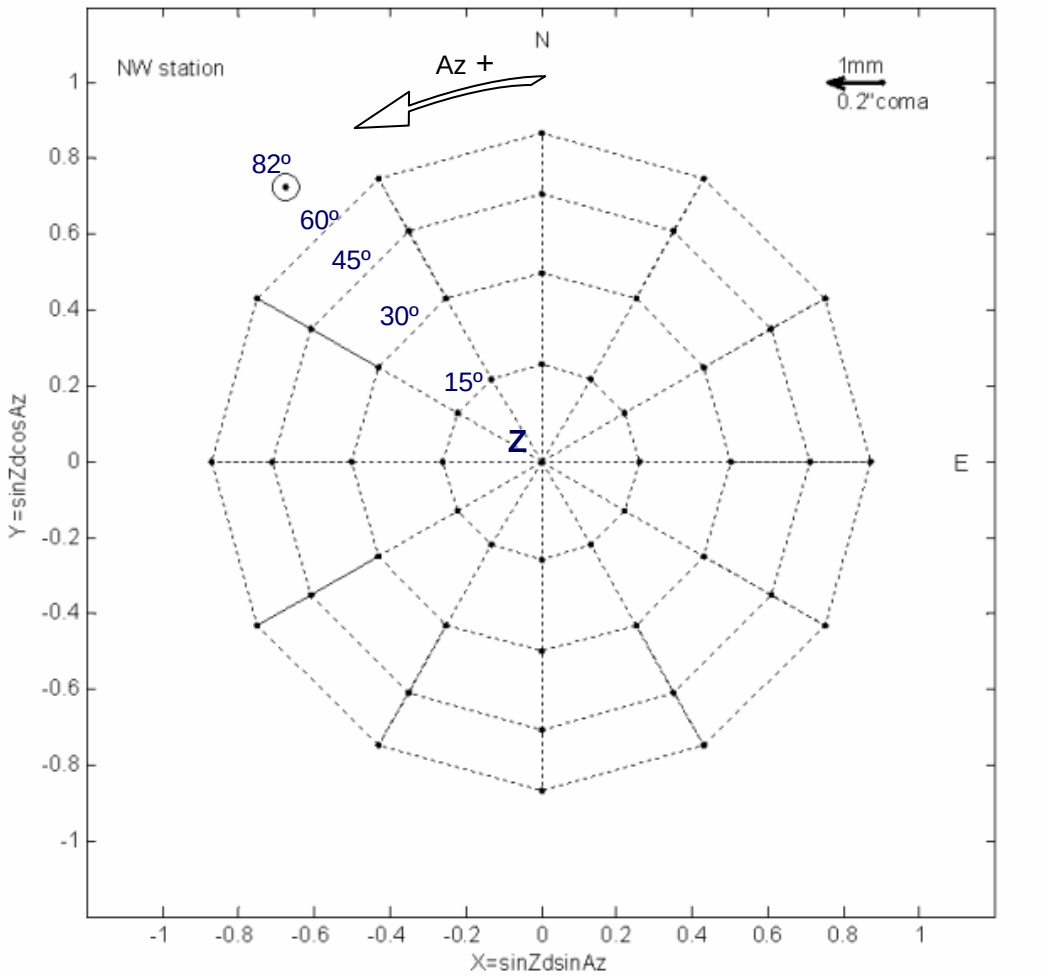
(MOSAIC Display SKY Orientation: North- right, East-up)

Expected d80 = ~ 0.3 - 0.4 (Arcsec)

Measured IQ at PF (2006-2007; red: May 2009 before correction)

Aberration	sph(0,4)	coma(1,3)	astig(2,2)	trian(3,3)	quad(4,4)	d80w/o def.	**d80**
Average all-sky (Arcsec)	-0.27	0.12	0.10	0.06	0.02	0.33	**0.36**
Stdev (Arcsec)	0.06	0.06	0.06	0.03	0.02	0.07	**0.07**
Average all-sky (Arcsec)	-049	0.19	0.25	0.11	0.08	0.60	**0.62**

Where all-sky means over the Telescope Pointing Position Sky-Map shown here:

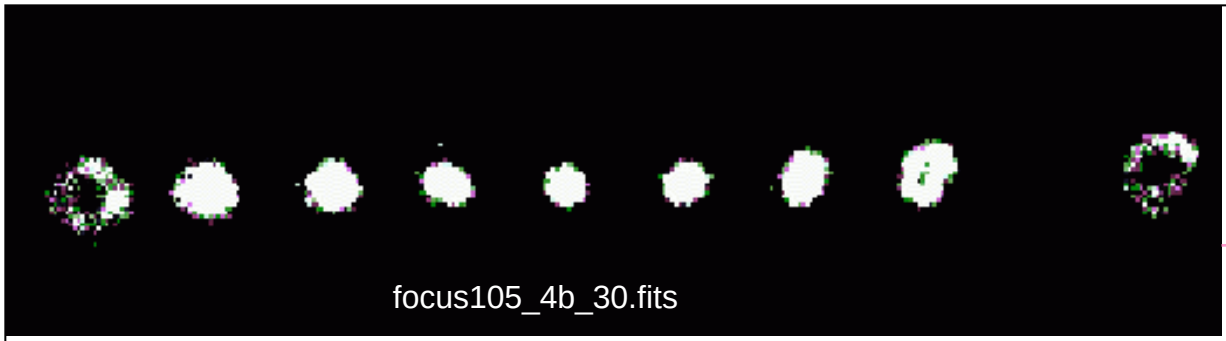


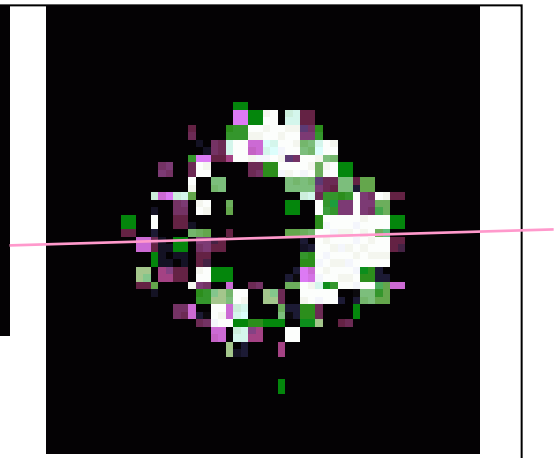
Measurement Tools:

Hartmann Test at PF
Shack-Hartmann at F/8

Aberration Term	Conversion factor (Arcsec/umWF)
Defocus	0.84
Spherical	0.11
Coma	0.14
Astigmatism	0.33
Trefoil	0.39
Quadratic	0.42

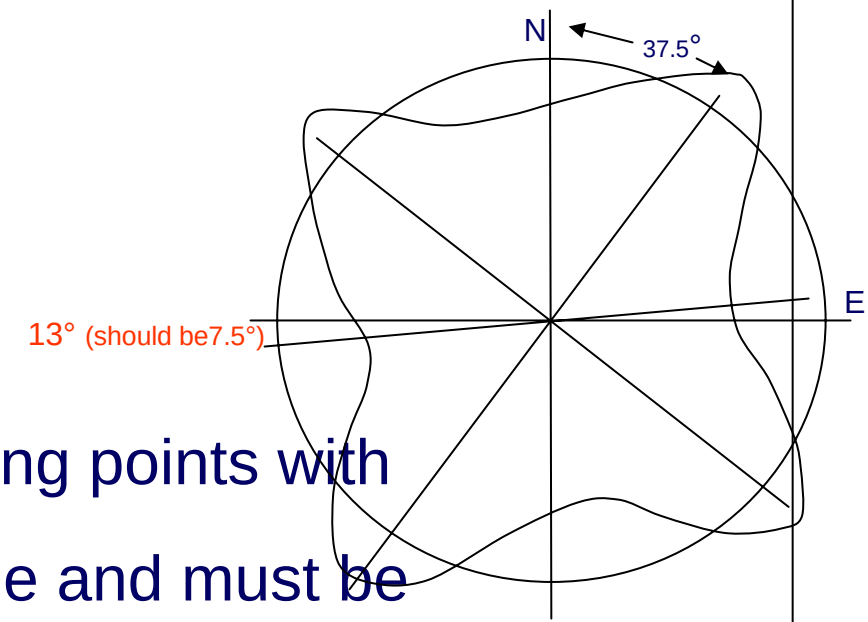
IQ measurements: analysis and action taken





IQ data from Hartmann tests 26-27-28-30 May2009.

- Spherical: 1.8 times the normal value.
- Coma: 1.6 times
- Astigmatism: 2.5 times
- Trefoil: 1.8 times
- Quadrafoil: 4 to 5 times **(0.1” angle=13°)**



Conclusion: the four radial defining points with load cells are distorting the image and must be backed away from the mirror edge, (done! 0.7mm).

4map Baseline Corrections

- PF:

new			old	
b0=0			b0=0	
b2=500	70	(should be put back to old)	b2=400	15
b3=0	0		b3=0	0
b4=0	0		b4=0	0

- F/8:

new		old	
b0=0		b0=0	
b2=940	340	b2=940	340
b3=270	349	b3=270	349
b4=100	180	b4=100	180

The Coma at Blanco

The M1 was put parallel to the cell base (NW hard-point lowered ~300um) and moved towards the center of the cell by ~1.5mm.

Both movements combined maintained the telescope alignment.

- Coma fine adjustment at PF will be done always by Translation of the PF Pedestal.
- Coma fine adjustment in F/8 will be done as always by Tip-Tilting M2.

Height (in Inches) of the Blanco M1 Axial Hard-points w/r to the Cell Base Plate:

Date	NW (y)	S (z)	NE (|)	Average
July 2004	4.442 (+190um)	4.432	4.437	4.437
17/09/04	4.452 (+480um)	4.431	4.435	4.439
24/05/09	**4.449** (-300um approx.)	**4.452**	**4.451**	**4.451** (+300um)

Comments and To Do List

Comments:

- M1 displacement w/r to cell is ~ 1/4 the max. tolerance for coma (~500um).

To Do short term:

- Re-measure the aberration skymaps at PF and F/8.
- Re-adjust Baseline corrections and LUTs for PF and F/8.
- Check the counterweights behavior (how close to cell?)

To Do long term:

- Re-measure the PFC unit w/r to M1 using the laser projector and Mitutoyos.
- Finish upgrading the Coating chamber and produce a reliable Al coating recipe before next shutdown.