

Reflectivity Report for Aluminization of the INT primary mirror, 2012 Sept 26

by Neil O'Mahony, March 2017. Note, report was not published on time due to uncertainty about data from CT7, which was then new.

Measurements of INT Primary mirror 5 and again 9 days after 26 Sept realuminizing (reinstalled).

SMS micro-Scan reflectometer, at AP3. Page 6 has the first ever CT7 measurements on a freshly aluminized mirror.

A new battery was installed into SMS between the 2 dates of measurements.

SMS measurements are in pairs at same location. Datum skipped if repeatability of 0.5% is exceeded.

Note INT M2 (secondary) was aluminised on 9th October 2012

Lambda	0.67 micron	<--SMS Summary characteristics
Incident Angle	25 deg	
BW Limits	1 0.01	

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datum #	Scattering at angles Θ, Φ			Reflectivity	user comment	Roughness RMS(Å)	TIME	DATE
	Θ s->		Φ s->					
1	Ref mirror	7.13E-03	2.05E-03	0.939		61.9	13:50:48	01/10/2012
2		7.15E-03	2.05E-03	0.939		61.9	13:50:54	01/10/2012
3		8.21E-03	9.09E-03	0.903		63.7	13:51:01	01/10/2012
4		8.27E-03	9.08E-03	0.904		63.9	13:51:05	01/10/2012
5		4.28E-03	1.92E-03	0.93		45.8	13:51:14	01/10/2012
6	position 1	9.81E-05	5.07E-05	0.862		7.1	13:52:49	01/10/2012
7		9.66E-05	5.11E-05	0.853		7.1	13:52:53	01/10/2012
8		1.01E-04	5.42E-05	0.864		7.2	13:52:59	01/10/2012
9	2	6.65E-05	1.28E-05	0.863		6.8	13:53:08	01/10/2012
10		7.17E-05	1.37E-05	0.855	skip	7.1	13:53:12	01/10/2012
11		6.46E-05	1.25E-05	0.859		6.7	13:53:17	01/10/2012
12	3	7.03E-05	9.56E-06	0.863		8.1	13:53:37	01/10/2012
13		7.03E-05	9.42E-06	0.861		8.1	13:53:40	01/10/2012
14		7.13E-05	1.47E-05	0.874	skip	6.9	13:54:02	01/10/2012
15	4	1.07E-04	1.74E-05	0.862		9.2	13:56:10	01/10/2012
16		1.07E-04	1.71E-05	0.861		9.2	13:56:14	01/10/2012

17		1.14E-04	1.91E-05	0.875 skip	9.3	13:56:35	01/10/2012
18	5	9.83E-05	1.75E-05	0.869	8.5	13:56:40	01/10/2012
19		9.87E-05	1.82E-05	0.865	8.4	13:56:45	01/10/2012
20	6	1.02E-04	3.28E-05	0.858 skip	7.6	13:57:03	01/10/2012
21		9.14E-05	3.11E-05	0.874 skip	7.1	13:57:08	01/10/2012
22	7	4.21E-05	8.86E-06	0.874	5.3	13:57:24	01/10/2012
23		4.22E-05	8.51E-06	0.873	5.3	13:57:28	01/10/2012
24	8	5.04E-05	1.45E-05	0.871 skip	5.4	13:57:41	01/10/2012
25		6.02E-05	1.63E-05	0.863	6	13:57:46	01/10/2012
26		4.90E-05	1.47E-05	0.862	5.3	13:57:51	01/10/2012
27	9	1.24E-04	2.38E-05	0.86	9.3	13:58:07	01/10/2012
28		1.23E-04	2.37E-05	0.859	9.3	13:58:11	01/10/2012
29	10	9.45E-05	1.43E-05	0.869	8.9	13:58:22	01/10/2012
30		9.49E-05	1.38E-05	0.87	9	13:58:26	01/10/2012
31	11	5.90E-05	9.52E-06	0.868	6.8	13:59:05	01/10/2012
32		5.88E-05	9.70E-06	0.866	6.8	13:59:09	01/10/2012
33		6.70E-05	9.91E-06	0.862 skip	7.6	13:59:21	01/10/2012
Averages		8.22E-05	1.97E-05	0.864	7.5		

Reference mirror measurements follow

34	Ref mirror	2.97E-03	1.03E-03	0.942	38.8	14:02:27	01/10/2012
35		2.98E-03	1.03E-03	0.942	38.9	14:02:33	01/10/2012
36		2.80E-03	1.79E-03	0.934	36.4	14:02:41	01/10/2012

All above 93% - SMS is not contaminated.

More on INT primary

37	12	6.06E-05	3.31E-05	0.855	5.6	14:04:18	01/10/2012
38		5.94E-05	3.31E-05	0.853	5.6	14:04:22	01/10/2012
39	13	5.54E-04	1.60E-04	0.87	17.9	14:04:32	01/10/2012
40		5.53E-04	1.59E-04	0.87	17.9	14:04:36	01/10/2012
41	14	1.89E-03	5.93E-04	0.855	32.9	14:04:46	01/10/2012
42		1.88E-03	5.98E-04	0.853	32.9	14:04:51	01/10/2012
43	15	1.32E-04	3.23E-05	0.86 skip	9.1	14:05:01	01/10/2012

44		1.32E-04	3.30E-05	0.853 skip	9.1	14:05:05	01/10/2012
45	16	6.75E-05	3.96E-05	0.86	5.9	14:05:24	01/10/2012
46		6.75E-05	3.96E-05	0.859	5.9	14:05:28	01/10/2012
47	17	8.19E-05	2.57E-05	0.863	6.8	14:05:36	01/10/2012
48		8.24E-05	2.44E-05	0.863	6.9	14:05:41	01/10/2012
49	18	1.35E-04	6.97E-05	0.866	8.4	14:06:12	01/10/2012
50		1.35E-04	6.96E-05	0.866	8.4	14:06:16	01/10/2012
51	19	9.70E-05	1.04E-05	0.864	10.9	14:06:27	01/10/2012
52		9.74E-05	1.06E-05	0.863	10.8	14:06:32	01/10/2012
53	20	1.17E-04	2.02E-05	0.862	9.4	14:06:39	01/10/2012
54		1.18E-04	2.12E-05	0.86	9.3	14:06:44	01/10/2012
Averages		2.09E-04	6.27E-05	0.863	9.6		
std deviation				0.005			
std error				0.001			

measurements after changing battery. Intervening data numbers were duplicates of above.

Reference mirror follow

109		1.23E-02	5.94E-03	0.942	76.9	15:46:28	10/04/2012
110		1.24E-02	5.96E-03	0.943	77	15:46:33	10/04/2012
111		2.68E-03	1.17E-03	0.94	36.1	15:46:40	10/04/2012
112		2.68E-03	1.18E-03	0.939	36.2	15:46:45	10/04/2012
113		2.64E-03	1.16E-03	0.943	35.8	15:47:24	10/04/2012
114		2.65E-03	1.16E-03	0.942	35.9	15:47:28	10/04/2012

All 94% - consistent and no contamination of SMS head.

INT primary mirror measurements:

115 null		1.97E-08	2.25E-08	0.001	3	15:48:04	10/04/2012
116 position 1		7.96E-05	1.05E-05	0.868	8.7	15:48:17	10/04/2012
117		8.05E-05	1.08E-05	0.867	8.7	15:48:21	10/04/2012
118	2	3.69E-04	1.35E-04	0.866	14.2	15:48:28	10/04/2012
119		3.62E-04	1.33E-04	0.87	14	15:48:32	10/04/2012
120	3	8.34E-05	3.31E-05	0.868	6.7	15:48:40	10/04/2012
121		8.36E-05	3.27E-05	0.864	6.7	15:48:43	10/04/2012

122	4	4.35E-04	2.38E-04	0.868	15	15:48:59	10/04/2012
123		4.34E-04	2.41E-04	0.869	14.9	15:49:04	10/04/2012
124	5	7.65E-05	9.14E-06	0.871	9	15:49:19	10/04/2012
125		7.50E-05	9.45E-06	0.867	8.7	15:49:24	10/04/2012
126		6.75E-05	7.84E-06	0.864	8.6	15:49:31	10/04/2012
127	6	9.71E-05	2.80E-05	0.873	7.5	15:49:42	10/04/2012
128		9.98E-05	2.84E-05	0.873	7.6	15:49:46	10/04/2012
129	7	9.25E-05	1.60E-05	0.87	8.3	15:49:55	10/04/2012
130		9.51E-05	1.64E-05	0.87	8.5	15:50:00	10/04/2012
131	8	3.78E-04	9.72E-05	0.873	15.1	15:50:07	10/04/2012
132		3.81E-04	9.63E-05	0.873	15.2	15:50:13	10/04/2012
133	9	1.20E-04	3.48E-05	0.866	8.3	15:50:29	10/04/2012
134		1.21E-04	3.17E-05	0.86	8.6	15:50:33	10/04/2012
135	10	1.36E-04	4.79E-05	0.854	8.7	15:50:43	10/04/2012
136		1.36E-04	4.80E-05	0.855	8.7	15:50:47	10/04/2012
137	11	1.94E-04	1.93E-05	0.867	16.1	15:50:56	10/04/2012
138		1.92E-04	2.02E-05	0.868	15.5	15:51:01	10/04/2012
139	12	1.17E-04	2.53E-05	0.867	8.8	15:51:15	10/04/2012
140		1.17E-04	2.57E-05	0.866	8.7	15:51:19	10/04/2012
141	13	4.71E-04	2.31E-04	0.864	15.7	15:51:34	10/04/2012
142		4.69E-04	2.33E-04	0.864	15.6	15:51:38	10/04/2012
143	14	2.53E-04	7.08E-05	0.866	12.2	15:51:49	10/04/2012
144		2.76E-04	7.98E-05	0.866	12.7	15:51:53	10/04/2012
145	15	1.52E-04	2.29E-05	0.868	11.3	15:52:09	10/04/2012
146		1.76E-04	1.65E-05	0.87 skip	16.1	15:52:13	10/04/2012
147		1.43E-04	1.95E-05	0.869	11.5	15:52:20	10/04/2012
148		1.13E-04	2.63E-05	0.868	8.4	15:52:32	10/04/2012

Averages **1.98E-04** **6.63E-05** **0.867** **10.9**
std deviation **0.004**

Discussion and Conclusions overleaf:

Discussion: no significant difference between the two sets of measurements made 5 days apart, because $\sim <1\sigma$ difference between the means. The average is similar to that measured on WHT M1 in 2012/03-04 shortly after Aluminising and CO₂, but that is almost 2% lower than in 2009. Comment in 2017: It appears the SMS had been measuring aluminium > 1.5% lower since 2010 than before. On the other hand, measurements on the reference mirror are maintained at 93-94%. BDSF measurements are also consistent with previous aluminisations. Scattered light sensor is separate from reflected. BDSF data show an increase in scattered light, particularly a 2x increase at 0,0 angle, over the 2 week period since aluminization. We can also say the mirror %R is very uniform 9 days after Alum. This is because it was still very clean.

%R and dust measurements from CT7 Nr 10002 (old model- was calibrated and updated in 2015).

These are corrected retrospectively using 2015 V-W measurements from the updated CT7.

reference mirror measurements:

datum	wavelength of band (nm)							"Dust Indices"						
	365	404	464	522	624	760	970	365	404	464	522	624	760	970
1	88.2	86.9	90.5	86.4	86.2	75.6	81	7.9	4	3.3	3.2	3	2.9	2.2
2	87.9	86.9	90.5	86.6	86.3	75.7	81.1	7.8	4	3.3	3.2	3	2.9	2.2
3	87.7	86.9	90.4	86.5	86.3	76.3	81.6	8.5	5	3.4	3.3	3.6	3.4	2.3
4	87.7	86.9	90.5	86.6	86.3	76.3	81.6	8.5	5	3.4	3.2	3.6	3.4	2.3

Later reference measurements

24/6/15	84.5	83.5	88.4	90.6	89.6	83.3	86.5	
factor	1.04	1.04	1.02	0.96	0.96	0.91	0.94	(use these to correct Aluminium meas.)

Aluminium measurements

5	95.2	97.3	93.4	85.3	85.0	80.4	85.7	6.8	2.3	3.2	2.9	2.1	2.4	1.8
6	94.9	96.8	93.3	85.3	85.0	80.2	85.7	6.5	2.2	3.2	3.0	2.0	2.4	1.8
7	95.2	97.3	93.4	85.5	84.9	80.6	85.9	6.6	2.3	3.3	2.9	2.0	2.4	1.8
8	94.9	96.9	93.2	85.5	85.0	80.3	85.7	6.7	2.3	3.3	3.0	2.1	2.5	1.9
9	94.9	97.3	93.3	85.5	85.0	80.4	85.8	6.5	2.2	3.3	3.0	2.1	2.4	1.8
10	94.8	97.1	93.2	85.5	85.0	80.4	85.6	6.7	2.3	3.3	3.0	2.1	2.4	1.9
11	94.7	96.8	93.1	85.5	85.0	80.3	85.6	6.4	2.2	3.2	3.0	2.0	2.4	1.9
Averages	94.9	97.1	93.3	85.4	85.0	80.4	85.7	6.6	2.3	3.3	3.0	2.1	2.4	1.8

corrected 91.3 93.3 91.1 89.5 88.3 88.1 91.2 (averages corrected by factor form above)

Haas 1961 92.4 92.6 92.3 91.7 90.7 n/a n/a (Literature values)

Alum2015 93.4 91.7 91.2 91.2 90.2 87.5 93.5 (Liverpool finder meas. by new CT7)

discrep.% 1.1 0.7 0.1 1.7 1.9 0.6 2.3 minimum discrepancy of corrected CT7

omitted measurements (12 = Gauge, 13=?)														
12	87.3	86.6	90.2	86.6	86.3	75.6	81.0	8.0	4.1	3.3	3.0	3.0	3.1	2.1
13	92.0	93.1	89.2	82.1	80.9	77.3	82.7	12.3	7.5	8.7	10.0	7.0	7.2	7.9