

Monitoring Reflectance & Scattering of INT Primary Mirror

Neil O'Mahony performed cleaning, processed data and wrote this report.
 Dome Humidity 30-35%. Flakes did not stick much. Mirror very dusty.
 One pass with fast CO2 flow, second pass was deliberately low flow rate.
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SMS μ Scan Measurements from BEFORE CO2 cleaning of INT primary

		BDSF (Scattering)		REFLECTANCE	Couplet averages (%R)	Surface Roughness RMS (Å)	TIME	DATE
		Pos 1: Zenith 0° Azim. 0°	Pos 2: Zenith 50° Azim. 180°					
INT primary		1.06E-002	5.84E-003	0.807		76.4	12:10:05	07-15-1910
	2	1.05E-002	5.80E-003	0.816		75.8	12:10:10	07-15-1910
	3	1.05E-002	5.79E-003	0.816	81.6	75.8	12:10:14	07-15-1910
	4	1.28E-002	9.69E-003	0.787		84.6	12:10:25	07-15-1910
	5	1.28E-002	9.65E-003	0.788		84.6	12:10:30	07-15-1910
	6	1.28E-002	9.62E-003	0.787	78.7	84.5	12:10:36	07-15-1910
	7	1.08E-002	6.63E-003	0.809		77	12:10:48	07-15-1910
	8	1.09E-002	6.62E-003	0.812		77	12:10:53	07-15-1910
	9	1.09E-002	6.61E-003	0.809	80	77.3	12:10:58	07-15-1910
	10	1.11E-002	6.97E-003	0.830		76.8	12:11:10	07-15-1910
	11	9.78E-003	5.80E-003	0.832		72.2	12:11:15	07-15-1910
	12	9.96E-003	5.77E-003	0.837	83.1	72.7	12:11:21	07-15-1910
	13	1.52E-002	8.64E-003	0.771		93.7	12:11:33	07-15-1910
	14	1.53E-002	8.66E-003	0.774	77.3	93.8	12:11:38	07-15-1910
	15	1.52E-002	8.64E-003	0.812		91.4	12:11:43	07-15-1910
	16	9.92E-003	5.23E-003	0.812		74	12:11:57	07-15-1910
	17	9.93E-003	5.25E-003	0.811	81.2	74	12:12:02	07-15-1910
Averages		0.0117	0.0071		80.32	80.09		
std error		6.8	9.37	%	0.86	2.96	Measurement units	

variability large

Reference Mirror:

18	3.18E-002	1.03E-002	0.923		129.6	12:13:55	07-15-1910
19	3.19E-002	1.03E-002	0.922		129.7	12:14:00	07-15-1910
20	3.19E-002	1.03E-002	0.923	92.3	129.6	12:14:05	07-15-1910
21	2.93E-003	1.87E-003	0.925		37.4	12:14:13	07-15-1910
22	2.93E-003	1.87E-003	0.926		37.4	12:14:17	07-15-1910
23	2.93E-003	1.87E-003	0.926	92.6	37.4	12:14:22	07-15-1910
24	2.41E-003	1.23E-003	0.923		34.3	12:14:28	07-15-1910
25	2.42E-003	1.23E-003	0.923	92.3	34.3	12:14:33	07-15-1910
26	1.02E-002	4.26E-003	0.922		71.2	12:14:41	07-15-1910
27	1.02E-002	4.25E-003	0.921	92.2	71.3	12:14:46	07-15-1910
28	2.18E-002	4.27E-003	0.912	skip	119.8	12:14:52	07-15-1910

Ref mirror consistency check 0.923 **92.3** all meas.ts consistent, except last

Measurements from AFTER CO2 cleaning of INT primary

INT primary measurements at 4 points, 3 close locations each.

Ref Mirror	6.39E-003	3.39E-003	0.907		56.2	13:49:30	07-15-1910
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2	6.42E-003	3.40E-003	0.906		56.3	13:49:37	07-15-1910
3	6.44E-003	3.41E-003	0.906		56.4	13:49:42	07-15-1910
4	2.77E-003	2.47E-003	0.901		36.8	13:49:50	07-15-1910
5	2.72E-003	2.48E-003	0.900		36.5	13:49:55	07-15-1910
6	6.73E-003	2.33E-003	0.910		59.5	13:50:06	07-15-1910
7	6.74E-003	2.33E-003	0.909		59.6	13:50:11	07-15-1910
8	4.12E-003	2.17E-003	0.909		45.1	13:50:19	07-15-1910
9	4.87E-003	1.80E-003	0.908		50.3	14:07:05	07-15-1910
10	4.88E-003	1.80E-003	0.908		50.4	14:07:11	07-15-1910
11	2.64E-003	1.77E-003	0.907		35.8	14:07:18	07-15-1910
12	2.64E-003	1.78E-003	0.906		35.9	14:07:24	07-15-1910
more air blowing			0.906				
13	5.04E-003	3.64E-003	0.924		49.1	14:08:17	07-15-1910
14	5.06E-003	3.65E-003	0.924		49.1	14:08:22	07-15-1910
15	2.74E-003	1.16E-003	0.912		37.1	14:08:31	07-15-1910
16	2.74E-003	1.16E-003	0.912		37.2	14:08:36	07-15-1910
17	4.50E-003	2.40E-003	0.918		46.8	14:08:54	07-15-1910
18	4.51E-003	2.41E-003	0.918		46.9	14:08:59	07-15-1910
19	1.63E-003	1.05E-003	0.912		28.1	14:09:07	07-15-1910
20	1.63E-003	1.05E-003	0.912		28.1	14:09:12	07-15-1910
21	4.52E-003	2.64E-003	0.912		46.9	14:09:20	07-15-1910
22	4.53E-003	2.65E-003	0.912		47	14:09:25	07-15-1910
23	4.24E-003	2.14E-003	0.907		45.8	14:09:33	07-15-1910
24	4.25E-003	2.14E-003	0.908		45.9	14:09:38	07-15-1910
more air blowing			0.914				
25	2.37E-003	1.41E-003	0.903		34.1	14:11:36	07-15-1910
26	2.37E-003	1.41E-003	0.904		34.1	14:11:41	07-15-1910
27	3.60E-003	2.90E-003	0.906		41.9	14:12:28	07-15-1910
28	3.61E-003	2.90E-003	0.905		42	14:12:33	07-15-1910
29	1.04E-002	5.12E-003	0.916		71.5	14:12:41	07-15-1910
30	1.04E-002	5.12E-003	0.917		71.5	14:12:46	07-15-1910
31	1.27E-002	2.03E-003	0.907		98.3	14:12:55	07-15-1910
			0.910	unusually low, directly after measuring dirty mirror			
32	9.02E-003	2.37E-003	0.905		72.1	10:32:57	07-16-1910
33	9.07E-003	2.37E-003	0.905		72.3	10:33:04	07-16-1910
34	1.43E-002	6.53E-003	0.915		84.2	10:33:10	07-16-1910
35	1.43E-002	6.55E-003	0.914		84.3	10:33:15	07-16-1910
36	9.15E-003	6.98E-003	0.918		66.3	10:33:23	07-16-1910
37	9.19E-003	6.99E-003	0.918		66.4	10:33:28	07-16-1910
38	8.12E-003	3.03E-003	0.898		65.2	10:33:34	07-16-1910
39	8.13E-003	3.03E-003	0.899		65.2	10:33:40	07-16-1910
40	2.17E-003	1.45E-003	0.918		32.3	10:33:46	07-16-1910
41	2.17E-003	1.46E-003	0.917		32.3	10:33:51	07-16-1910
42	4.54E-003	1.93E-003	0.926		47.5	10:33:58	07-16-1910
43	4.55E-003	1.93E-003	0.926		47.5	10:34:03	07-16-1910
44	8.91E-003	4.62E-003	0.919		65.9	10:34:10	07-16-1910
			0.914	still low on following day			
45	9.04E-003	4.60E-003	0.920		66.4	10:51:45	07-16-1910
46	9.06E-003	4.59E-003	0.920		66.5	10:51:53	07-16-1910
47	4.16E-003	1.97E-003	0.908		45.6	10:52:00	07-16-1910
48	4.17E-003	1.97E-003	0.907		45.6	10:52:05	07-16-1910
49	5.79E-003	2.16E-003	0.909		54.7	10:52:12	07-16-1910
50	5.80E-003	2.16E-003	0.909		54.8	10:52:17	07-16-1910

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51	4.10E-003	2.30E-003	0.908		44.9	10:52:23	07-16-1910
52	4.10E-003	2.30E-003	0.909		44.9	10:52:29	07-16-1910
53	5.17E-003	2.78E-003	0.916		50.2	10:52:35	07-16-1910
54	5.19E-003	2.78E-003	0.915		50.3	10:52:40	07-16-1910
55	4.98E-003	2.15E-003	0.917		49.9	10:52:47	07-16-1910
56	4.99E-003	2.15E-003	0.918		49.9	10:52:51	07-16-1910
57	3.75E-003	2.01E-003	0.909		42.9	10:52:57	07-16-1910
58	3.75E-003	2.01E-003	0.910		42.9	10:53:01	07-16-1910
59	6.09E-003	3.94E-003	0.913		54.3	10:53:08	07-16-1910
60	6.09E-003	3.94E-003	0.915		54.3	10:53:13	07-16-1910
61	4.95E-003	2.20E-003	0.907		49.9	10:53:22	07-16-1910
62	4.96E-003	2.20E-003	0.909		49.9	10:53:26	07-16-1910

0.912 average is still low but similar to yesterday

INT primary

64	1.14E-002	2.24E-003	0.832		90.9	10:55:09	07-16-1910
64	1.14E-002	2.24E-003	0.834	83.3	90.5	10:55:14	07-16-1910
65	8.89E-003	1.75E-003	0.828		80.1	10:55:22	07-16-1910
66	8.89E-003	1.74E-003	0.825	82.7	80.4	10:55:27	07-16-1910
67	3.28E-003	5.76E-004	0.848		49.9	10:55:34	07-16-1910
68	3.28E-003	5.79E-004	0.847	84.7	49.9	10:55:39	07-16-1910
69	8.30E-003	1.54E-003	0.828		78.9	10:55:57	07-16-1910
70	8.29E-003	1.55E-003	0.830	82.9	78.6	10:56:02	07-16-1910
71	8.31E-003	1.55E-003	0.825		78.9	10:56:09	07-16-1910
72	6.94E-003	1.68E-003	0.827		67.2	10:56:20	07-16-1910
73	6.94E-003	1.68E-003	0.826	82.6	67.3	10:56:25	07-16-1910
74	4.91E-003	1.01E-003	0.834		58.7	10:56:34	07-16-1910
75	4.91E-003	1.01E-003	0.835	83.4	58.7	10:56:39	07-16-1910
76	3.21E-003	7.19E-004	0.841		46.1	10:57:03	07-16-1910
77	3.21E-003	7.22E-004	0.843	84.2	46	10:57:08	07-16-1910
78	6.39E-003	1.41E-003	0.830		65.8	10:57:18	07-16-1910
79	6.39E-003	1.41E-003	0.830	83	65.7	10:57:23	07-16-1910
80	5.01E-003	9.08E-004	0.834		61.5	10:57:31	07-16-1910
81	5.02E-003	9.08E-004	0.834	83.4	61.6	10:57:36	07-16-1910
82	4.88E-003	1.09E-003	0.833		57.2	10:58:11	07-16-1910
83	4.88E-003	1.09E-003	0.834	83.4	57.2	10:58:16	07-16-1910
84	3.95E-003	8.47E-004	0.842		51.7	10:58:24	07-16-1910
85	3.93E-003	8.47E-004	0.839	84.1	51.6	10:58:29	07-16-1910
86	4.42E-003	1.16E-003	0.833		52.6	10:58:38	07-16-1910

Averages	0.0062	0.0013	0.834	83.43	64.97		
std error	12.1833	11.7165	%	0.199	4.11	Measurement units	
Improvement	1.8863	5.6377	factor	3.111	15.12	difference	
Ref Mirror	5.34E-003	3.11E-003	0.922		50.7	11:00:17	07-16-1910
88	5.36E-003	3.11E-003	0.924		50.8	11:00:21	07-16-1910
89	2.65E-003	1.41E-003	0.909		36.1	11:00:28	07-16-1910
90	2.65E-003	1.41E-003	0.911		36.1	11:00:33	07-16-1910
91	5.47E-003	2.23E-003	0.927		52.3	11:00:40	07-16-1910

0.919 closer to recent maximum levels

Conclusions: scattering and roughness improved by amounts typical to CO2 cleaning experience
 Reflectivity increased by over 3 percentage points, but with large uncertainty of ~1%
 Improvement is significant but not well estimated. Pre-cleaning measurements were sparse.