

22 April 2024, First cleaning of the INT Primary mirror since its aluminisation last September. 3 pages.

One week after calima finished and a week later than an unsatisfactory CO2 cleaning of WHT. Unlike the 4.2 m, the INT Primary mirror has not yet been washed, and the coating of dust was pretty uniform, unaffected by condensation. A couple of spots had a scattering of grit, of unknown origin. This advised using compressed air (pistol) before CO2. There are also 3-4 long streaks of liquid staining on the right and apparent drops of oil. Compressed air removed a lot of dust and grit, also cleaning the surrounding area, channels, petals. CT7 data show a significant improvement. Following this, the change measured by CO2 cleaning was relatively small. Overall a 3 - 5% improvement in %R and 3 - 7% in Scattering. This returns the mirror surface to within 2-3 % of the reflectivity and scattering values measured after aluminisation. However stains remain. A drift in Reference mirror values of up to 0.6% in 2 channels, both during the process and w.r.t proximal dates, was tracked and adjusted for.

Reference measurement			Temp /°C	%R per waveband (nm)					Dust Index % per waveband (nm)								
				365	404	464	522	624	760	970	365	404	464	522	624	760	970
175	22/04/2024 10:03	Gauge %R change in gauge since Friday	18.4	86.09	85.16	89.25	90.85	90.29	83.95	87.11							
				0.01	-0.03	0.08	-0.09	-0.07	-0.22	-0.10							
Reflectivity Measurements before cleaning																	
180	22/04/2024 10:06	INT Primary	19.7	90.06	87.93	86.72	86.46	85.98	83.07	87.94	5	5.5	6.5	7.4	7.3	9.7	9.6
181	22/04/2024 10:06	INT Primary	20	89.78	87.63	86.42	86.10	85.69	82.80	87.66	5.2	5.6	7	7.7	7.4	9.8	9.7
182	22/04/2024 10:07	INT Primary	20.2	89.56	87.55	86.31	86.05	85.55	82.81	87.43	5.8	6.2	7.5	8.6	8.2	10.8	11.2
183	22/04/2024 10:07	INT Primary	20.4	89.08	87.11	85.93	85.71	85.10	82.45	86.98	5.7	6.3	7.6	8.5	8.3	10.9	10.9
184	22/04/2024 10:08	INT Primary	20.5	87.75	85.61	84.34	84.18	83.68	80.87	85.28	7.8	8.2	9.6	11	10.7	13.8	13.7
185	22/04/2024 10:08	INT Primary	20.8	88.37	86.14	84.86	84.60	84.22	81.38	85.78	7.1	7.8	9.4	10.7	10.1	13.4	13.3
186	22/04/2024 10:09	INT Primary	20.8	89.80	87.78	86.45	86.32	85.81	83.04	87.81	5.3	5.7	7	7.8	7.6	10	9.8
187	22/04/2024 10:09	INT Primary	21	89.31	87.21	86.05	85.76	85.37	82.52	87.23	5.8	6.2	7.3	8.5	8.5	10.8	10.5
Averages before cleaning				89.21	87.12	85.89	85.65	85.18	82.37	87.01	6.0	6.4	7.7	8.8	8.5	11.2	11.1
Std deviations				0.79	0.83	0.84	0.82	0.81	0.81	0.98	1.0	1.0	1.1	1.4	1.3	1.6	1.6
188	22/04/2024 10:19	Gauge %R change in gauge since start of day	18.6	85.8	85.18	88.93	90.86	90.32	83.96	87.25							
				-0.29	0.02	-0.32	0.01	0.03	0.01	0.14							

This change in reference values occurred in 20 minutes., thus datum #180 may be overestimated, but the amount is less than the variance. Also this variance is much smaller than measured on WHT M1, indicating a much more uniform surface condition.

Reflectivity measurements after compressed air cleaning

	Temp /°C	%R per waveband (nm)							Dust Index % per waveband (nm)							
		365	404	464	522	624	760	970	365	404	464	522	624	760	970	
190	22/04/2024 10:22 INT Primary	20.1	92.28	90.40	89.11	89.09	88.73	86.00	91.21	3.5	3.6	4.1	4.4	4.4	5.4	5.6
191	22/04/2024 10:22 INT Primary	20.4	91.52	89.55	88.25	88.15	87.80	84.98	90.11	4.5	4.7	5.4	6.3	5.9	7.9	7.6
192	22/04/2024 10:22 INT Primary	20.6	92.01	90.00	88.63	88.68	88.37	85.54	90.85	3.8	4.2	4.9	5.4	5	6.8	6.3
193	22/04/2024 10:23 INT Primary	20.8	92.02	90.04	88.75	88.68	88.38	85.58	90.77	3.8	4.0	4.8	5.4	5	6.8	6.5
194	22/04/2024 10:23 INT Primary	21.1	92.04	90.08	88.85	88.82	88.48	85.78	90.78	3.8	4.0	4.6	5.2	4.9	6.4	6.4
195	22/04/2024 10:24 INT Primary	20.9	91.96	90.07	88.79	88.78	88.45	85.75	90.90	3.9	4.1	4.7	5.2	4.9	6.4	6.1
196	22/04/2024 10:25 INT Primary	21.3	91.89	89.94	88.63	88.69	88.28	85.59	90.71	4.1	4.3	4.9	5.3	5.2	6.6	6.3
197	22/04/2024 10:25 INT Primary	21.5	89.74	87.80	86.43	86.49	86.13	83.35	88.21	6.6	7.0	8.3	9.1	8.4	11.1	10.6
198	22/04/2024 10:26 INT Primary	21.7	89.92	87.91	86.43	86.54	86.12	83.23	88.18	6.2	6.9	8.1	8.8	8.5	11.2	10.6
Averages after Air cleaning			91.49	89.53	88.21	88.21	87.86	85.09	90.19	4.5	4.8	5.5	6.1	5.8	7.6	7.3
Std deviations			0.96	0.98	1.03	0.99	1.01	1.06	1.17	1.1	1.3	1.6	1.7	1.6	2.1	1.9
<b>Change from air cleaning</b>			2.27	2.41	2.32	2.57	2.69	2.72	3.18	-1.5	-1.7	-2.2	-2.7	-2.7	-3.5	-3.8

199	22/04/2024 10:28 Gauge %R	20.9	85.71	85.09	88.84	90.89	90.32	84.07	87.13
	change in gauge since previous		-0.09	-0.09	-0.09	0.03	0	0.11	-0.12
	change in gauge since start of day		-0.38	-0.07	-0.41	0.04	0.03	0.12	0.02
	Note: smaller drift than previously								

Reflectivity measurements after CO2 cleaning

200	22/04/2024 11:34 bottom 1	16.2	92.58	91.18	89.52	89.67	89.35	86.40	92.21	2.8	3	3.7	3.7	3.3	4.4	3.8
201	22/04/2024 11:34 bottom 2	16.9	92.68	91.34	89.90	90.11	89.60	87.01	92.50	2.8	2.7	2.8	2.8	2.7	3.1	2.9
202	22/04/2024 11:35 right 1	17.4	91.95	90.59	89.29	89.20	88.87	86.20	91.30	3.5	3.6	3.9	4.4	4.2	5.1	5.3
203	22/04/2024 11:35 right 2	17.9	92.82	91.37	89.94	90.19	89.74	87.07	92.55	2.6	2.4	2.6	2.5	2.3	2.8	2.6
204	22/04/2024 11:36 top	18.3	92.44	90.97	89.82	89.89	89.71	87.08	92.42	3.3	3.1	3.3	3.2	3	3	2.8
205	22/04/2024 11:36 top	18.7	92.29	90.85	89.59	89.76	89.39	86.83	91.96	3.3	3.1	3.2	3.3	3	3.3	3.5
206	22/04/2024 11:37 left	18.9	92.10	90.57	89.14	89.34	88.98	86.32	91.40	3.5	3.7	4.1	4.3	3.9	5	4.9
207	22/04/2024 11:37 left	19.4	92.56	90.95	89.65	89.84	89.59	86.97	92.08	3.1	6.3	4.8	3.4	3.9	4	3.4
208	22/04/2024 11:38 left, stain?	19.6	83.06	90.38	76.55	90.04	65.97	86.57	92.31	2.5	2.4	2.6	2.8	2.5	2.9	2.7
209	22/04/2024 11:40 left repeat	20.1	92.37	90.58	89.13	89.36	89.15	86.28	91.66	3.3	3.5	4.1	4.2	3.5	5	4.4

## Results of Cleaning

	%R per waveband (nm)							Dust Index % per waveband (nm)						
	365	404	464	522	624	760	970	365	404	464	522	624	760	970
Averages after CO2 cleaning	92.42	90.93	89.55	89.71	89.38	86.68	92.01	3.1	3.5	3.6	3.5	3.3	4.0	3.7
std deviations	0.28	0.32	0.31	0.35	0.32	0.38	0.47	0.3	1.1	0.7	0.7	0.6	0.9	1.0
<b>Change in average from CO2 cleaning</b>	0.93	1.40	1.35	1.49	1.52	1.60	1.82	-1.3	-1.3	-1.9	-2.6	-2.5	-3.7	-3.6
Change in maxima from CO2 cleaning	0.54	0.97	0.83	1.10	1.01	1.08	1.34							
<b>Change in average from all cleaning</b>	3.21	3.81	3.67	4.06	4.20	4.32	5.00	-2.8	-2.9	-4.1	-5.2	-5.2	-7.2	-7.4
Adjusted for drift in gauge reference	3.83	4.05	4.20	3.96	4.27	4.09	5.17							
Change in maxima from all cleaning	2.76	3.44	3.22	3.73	3.76	4.01	4.61	-2.4	-3.1	-3.9	-4.9	-5	-6.9	-7

Note: data with red highlight was omitted from statistics; probably corresponds to a stain.

Brown highlight draws attention to the wavelength channel most affected by drift measured in reference values, which was adjusted for.

### Calibration/Reference Data:

22/11/2023 15:54 average Gauge %R	84.86	83.43	87.56	89.72	89.91	83.62	86.36	
19/04/2024 11:45 average Gauge %R	86.08	85.19	89.17	90.94	90.36	84.17	87.21	
change in gauge in 5 months	1.22	1.76	1.61	1.22	0.45	0.56	0.85	
211 22/04/2024 11:42 Gauge %R 20.6	85.45	85.02	88.77	90.94	90.2	84.12	86.94	final reference checks of the day
212 22/04/2024 11:43 Gauge %R 21.0	85.48	84.83	88.66	90.95	90.25	84.24	86.94	
change in gauge since previous meas.	-0.24	-0.17	-0.13	0.05	-0.09	0.11	-0.19	
change in gauge since start of day	-0.63	-0.23	-0.53	0.09	-0.07	0.23	-0.17	This is used to adjust Change from cleaning, above
Note: 2 blue channels continued drift, while the 760 nm channel returned to yesterday's value								
213 23/04/2024 12:26 Gauge %R	85.66	85.13	88.89	90.95	90.22	84.22	87.16	
change in gauge <b>next day</b>	0.19	0.20	0.17	0.01	0.00	0.04	0.22	Suggests yesterday's drift recovered a little
=> total drift since 11/2023	0.61	1.49	1.16	1.22	0.31	0.57	0.58	This is used to adjust Loss in quality, below
Average for Fresh Aluminisation 9/2023	93.89	91.80	90.34	90.92	90.20	87.88	93.24	
Loss in quality, adjusted, wrt 9/2023	2.08	2.36	1.94	2.44	1.14	1.76	1.82	
=> adjusted %R changes are consistent among themselves and with scattering increases, so the adjustment looks correct								