

## Measurements on INT Primary and Secondary mirrors, July 2021.

Results of CO2 cleaning of M1 are analysed, as is a repeat cleaning on 1 August.

Found problems with the CT7 Reflectometer: Data from 2020 is missing from CT7 memory and cannot be recovered from archive. Meas file dated 2019.

The Refl calibration parameters are different now than in 2018, the last time they were exported.

The effects on reference surface (Gauge) are examined and are shown to be small.

				T <sup>o</sup> C	%R per waveband (nm)							Dust Index						
					365	404	464	522	624	760	970	365	404	464	522	624	760	970
14	19/07/2021	11:53	8 INTM2 all	22.7	90.0	89.1	89.2	89.6	89.0	86.1	91.7	5.5	4.5	3.9	2.3	2.2	1.3	1.4
15	19/07/2021	11:54	8 INTM2 all	23.0	90.6	89.5	89.6	89.8	89.3	86.2	91.8	4.5	3.6	3.0	1.9	1.5	1.0	1.4
New Aluminisation measured 3/2020					92.9	91.3	90.9	90.9	89.9	86.9	92.6	2.5	2.3	2.2	1.6	1.6	1.2	1.1
Difference - degradation in surface cond.					-2.6	-2.0	-1.4	-1.2	-0.7	-0.7	-0.8	2.5	1.8	1.3	0.5	0.3	0.0	0.3

### Conclusion:

INT Secondary mirror condition is very close to newly aluminised surface, with more degradation in blue bands than in red, a trend observed in aged surfaces.

### Primary mirror measurements:

16	19/07/2021	12:08	3 INTM1 all	24.5	73.9	73.0	72.9	73.0	72.6	69.9	73.9	23.6	25.2	28.0	24.2	26.1	22.1	29.8
17	19/07/2021	12:08	3 INTM1 all	24.6	75.9	75.1	74.9	75.3	73.7	71.6	75.3	21.1	20.9	24.1	20.8	25.6	21.8	27.5
18	19/07/2021	12:09	3 INTM1 all	24.8	75.9	76.4	77.0	76.8	75.3	73.4	75.8	20.9	20.6	22.0	19.1	24.6	21.3	25.7
19	19/07/2021	12:10	3 INTM1 all	25.0	75.2	74.6	74.7	75.8	74.7	72.7	77.1	21.4	21.5	24.3	19.2	24.1	21.4	23.2

### Mirror cleaned with dry air hose, only. Results of this cleaning below:

20	19/07/2021	12:17	3 INTM1 all	25.7	79.9	78.7	78.6	78.7	78.4	75.6	80.5	20.1	20.7	22.9	19.5	22.9	21.0	22.4
21	19/07/2021	12:18	3 INTM1 all	25.8	79.8	79.2	79.2	79.6	78.8	76.4	81.5	22.2	21.1	22.9	18.9	22.9	20.5	21.5
22	19/07/2021	12:19	3 INTM1 all	26.0	78.6	78.2	78.7	79.2	79.3	76.6	81.9	19.8	19.5	21.0	17.3	19.9	18.4	18.9
Result of dry air cleaning					4.2	3.9	4.0	3.9	4.8	4.3	5.8	-1.1	-1.6	-2.3	-2.3	-3.2	-1.7	-5.6

### A rapid and superficial CO2 cleaning in this interval

23	19/07/2021	14:33	3 INTM1 all	24.1	79.6	78.6	78.7	79.1	78.8	75.9	81.4	20.1	20.3	22.0	18.5	21.8	20.5	21.1
24	19/07/2021	14:34	3 INTM1 all	24.1	78.5	78.5	78.2	79.6	75.8	76.5	81.5	23.0	22.4	23.9	19.1	24.0	20.4	21.1
25	19/07/2021	14:34	3 INTM1 all	24.3	85.0	84.0	84.1	84.9	84.3	81.9	87.7	14.8	14.3	14.8	10.8	11.9	10.0	9.6
Result of CO2 cleaning					1.6	1.7	1.5	2.0	0.8	1.9	2.2	-1.4	-1.4	-2.0	-2.4	-2.7	-3.0	-3.7

Datum 25 is much different. This is probably a sampling problem on a very inhomogeneous mirror, as corroborated by Datum 28 < 29 or 30 on 1 Aug.

### Calibration data and second cleaning results on next page

26	20/07/2021 12:13	3 Gauge	21.2	84.5	83.6	88.3	90.4	89.3	82.8	86.0	2.5	3.1	2.6	1.5	1.1	0.9	1.1
27	20/07/2021 12:17	# Gauge	21.8	84.4	83.7	88.4	90.5	89.2	82.8	86.0	2.6	3.1	2.5	1.4	1.1	0.8	1.1
average from 2/2019 Gauge			84.7	83.9	88.5	90.6	89.5	83.4	87.2	2.6	3.1	2.6	1.6	1.2	0.9	1.2	
<b>change since 2019 (due to Fault)</b>			-0.2	-0.3	-0.2	-0.2	-0.1	-0.6	-1.2	-0.1	0.0	0.0	-0.1	-0.1	0.0	-0.1	

The largest effect of the loss of calibration parameters is greatest in 970 nm, but still less than 1.5%.

**A second and more thorough CO2 cleaning was carried out on 1 August on INT Primary mirror, using the same Rcals as described above**

Repeat measurements before this second cleaning

28	01/08/2021 09:40	3 INTM1 all	21.8	79.0	77.2	77.0	77.8	78.6	75.5	82.2	24.4	25.8	28.8	22.2	23.4	21.0	18.4
29	01/08/2021 09:41	3 INTM1 all	21.9	83.1	82.1	82.0	81.7	81.8	79.4	83.9	16.7	16.6	18.0	15.2	17.0	14.7	16.1
30	01/08/2021 09:42	3 INTM1 all	22.1	82.2	81.1	80.1	81.9	79.9	78.2	84.1	16.3	16.3	20.0	13.9	20.7	17.0	14.9
difference from 20th July			0.4	-0.2	-0.6	-0.7	0.5	-0.4	-0.1	-0.2	0.6	2.0	1.0	1.1	0.6	-0.8	
global average of very variable mirror			81.2	80.3	80.0	80.8	79.9	77.9	83.5	19.2	19.3	21.3	16.6	19.8	17.3	16.9	

measurements after cleaning. No.33 special care taken to measure on an area that looked cleaner than the average. No.35 chosen as a stained area.

31	01/08/2021 10:12	3 INTM1 all	22.4	82.9	82.5	83.0	83.6	83.4	81.2	86.5	18.0	16.4	16.0	12.7	13.4	11.1	11.6
32	01/08/2021 10:13	3 INTM1 all	22.4	83.2	82.4	82.9	83.1	82.9	80.5	86.0	17.5	16.9	16.6	13.2	14.4	12.4	12.2
33	01/08/2021 10:14	3 INTM1 all	22.7	82.8	82.5	82.9	83.7	83.2	81.0	86.6	18.8	17.1	16.9	12.6	13.7	11.0	10.6
34	01/08/2021 10:15	3 INTM1 all	22.9	84.4	83.4	84.0	82.4	84.1	81.3	84.4	15.0	14.6	14.3	14.3	12.0	10.6	14.2
35	01/08/2021 10:15	3 INTM1 all	23.2	81.4	80.2	80.5	79.8	80.7	77.1	82.3	19.4	19.0	20.0	18.0	18.8	18.6	19.0

average Improvement from 2nd CO2	1.7	2.2	2.9	2.6	3.3	3.0	2.9	-1.1	-2.5	-4.8	-3.8	-6.0	-5.8	-5.4
Max. Improvement from 2 cleanings	8.1	7.9	8.3	8.0	9.3	9.1	10.4	-4.4	-5.8	-8.7	-7.6	-11.7	-10.4	-14.4

<b>average Reflectivity Result from cleaning</b>	83.3	82.7	83.2	83.2	83.4	81.0	85.9	17.3	16.3	16.0	13.2	13.4	11.3	12.2
--	------	------	------	------	------	------	------	------	------	------	------	------	------	------

**Conclusion:**

Fault in CT7 memory has affected calibration minimally in all bands except 970 nm, where it reaches about 1.2% underestimate.

Taking this into account, the result for INT Primary is an overall increase in reflectivity of 9% and a similar reduction in scattering.

The 2nd CO2 cleaning, more thorough, had greater effect than the first. The initial dry air cleaning of a very dusty mirror was equally effective as the CO2.

M1 condition remains very variable due to many persistent stains over the entire surface. Water washing recommended.