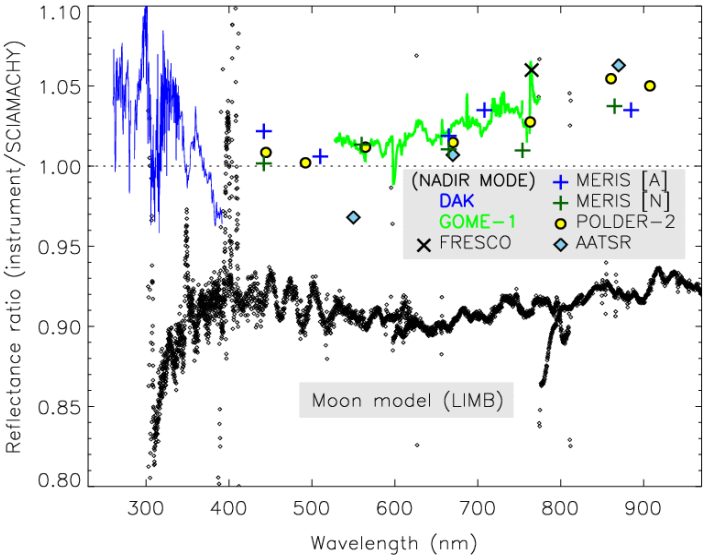
SCIAMACHY	Operation Change Request	OCR No: 045 Issue:

Title: Extended Moon observations (repeat)

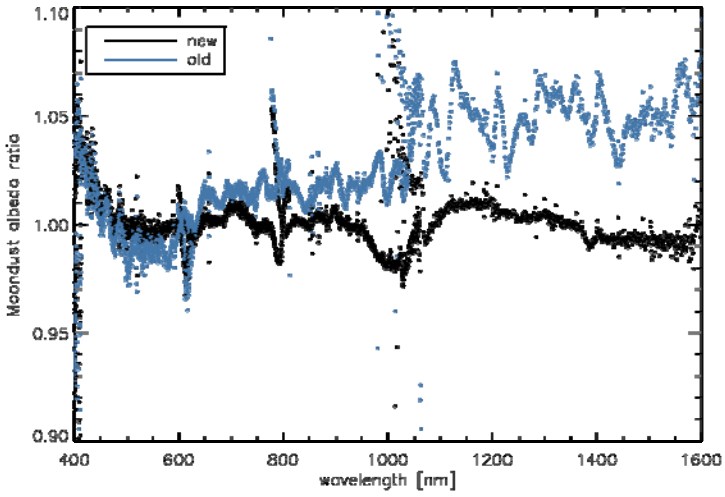
Description of Request:

Repeat of OCR 25 (Extended Moon observations) in order to characterise ongoing ASM and ESM mirror degradation.

OCR 25 was extremely helpful in determining the baseline limb radiometric calibration, which revealed both an offset with respect to nadir reflectance calibration, and confirmed many of the spectral features already observed in nadir radiometric validation (see figure below).



The lunar calibration results were essential in providing direction for further investigations into calibration key data improvement. The figure below shows preliminary results for the new radiometric calibration, where the ratio with a scaled lunar spectrum is shown for the old (blue) and the new (black) key data. The reduction in spectral features is obvious, and is visible due to the fact that the spectral features of the Moon are smooth, typically several hundreds of nm wide.



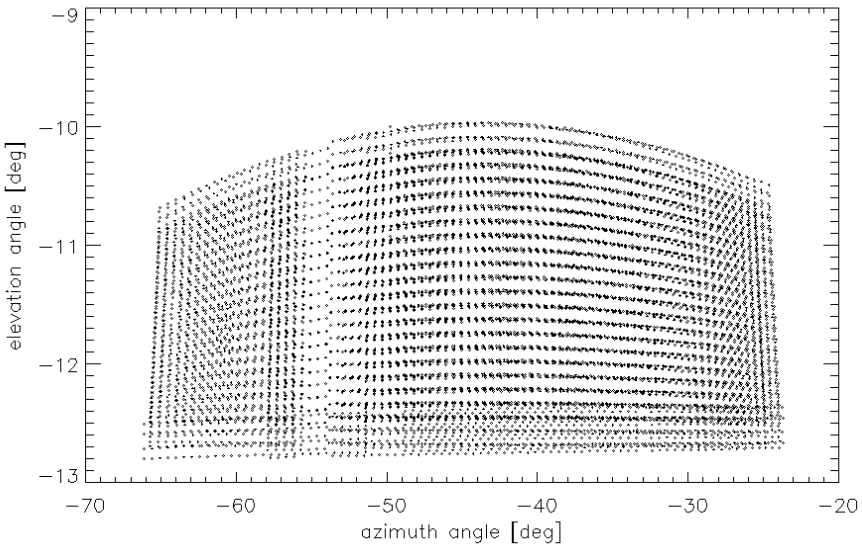
There are many additional uses for the lunar observations, among which a means to validate aspects of the new scanner model used in the new calibration key data. The new scanner model allows contamination of the mirror and diffuser surfaces, an aspect which has not yet been investigated in detail.

The proposed repeat of the OCR 25 measurements serves the following purposes:

- Allow investigation of in particular ASM mirror degradation (as observed in the UV after the most recent decontamination). The lunar measurements cover the full azimuth field of view and should be able to distinguish ASM scan angle dependent degradation.
- Serve as an additional well-defined point in time for radiometric calibration, in combination with the on-ground calibration and OCR 25.
- In combination with OCR 25, serve as a basis for radiometric degradation over time, in particular for the limb viewing geometry.
- In contrast to solar and WLS monitoring, the lunar measurements can be used to determine reflectance degradation of the instrument.

The OCR could be implemented similar to OCR 25, with possible modification that the scan range in elevation direction could be optimised to cover more of the elevation range in the top part of the limb total clear field of view. The azimuth range should cover the limb total clear field of view, the elevation range from approximately the top of atmosphere to the maximum elevation allowed by the limb total clear field of view. Additional coverage of the lower elevation ranges are not necessary, but are not a problem either.

The OCR shall not affect nominal lunar occultation measurements. Note that for this OCR only the part above the atmosphere is of interest.



The figure above shows the coverage as obtained by OCR 25.

Originator: Ralph Snel	Date of Issue: 2010-05-19	Signature: RS

Assessment of SSAG (necessary for requests by scientists):
As explained in the justification above, the proposed lunar measurements are of great value to constrain SCIAMACHY radiometric calibration and degradation correction, both relevant for a mission in its best age. Implementation is therefore recommended. Ideally the OCR will be executed before the orbit change.

SSAG: H. Bovensmann	Date: 19.5.2010	Signature: e-mail 19.5.2010

Classification of OCR:

OCR Analysis (incl. Implementation Option):
OCR_045 is implemented as a test campaign similarly to the original implementation of OCR_025. The only difference is that the measurement duration is extended by 28 sec giving an additional coverage of 1.25° in elevation.

The implementation requires definition of a test state and of a test timeline.

State:
It is planned to modify state 54 such that it can start as early as possible and end as late as possible in the MO&C window. Currently state 54 has a duration of 15.57 sec with a SDPU duration (measurement phase) of 12 sec. The nominal scan width amounts to ±0.33° with a scan duration of 2 sec.
The modified state 54 begins to scan the lunar disk at an altitude of 100 km and ends scanning 120 sec later close to the upper edge of the limb TCFoV. Scanning parameters are as in the OCR_025 measurements. Only scanner state table no. 54 and state duration table need modifications
The 2 CTI-tables are shown below:

Timeline:
In timeline set 9 a timeline 13 is defined which executes state 54 modified as described above. Timeline header information (moon fixed event) will be defined accordingly. In order not to produce an idle gap before moon scanning, another test timeline 42 is implemented executing a single nadir state.

Envisaged execution of the measurements is in the monthly visibility period between 18th-23rd August (orbit 44273-44339). After orbit 44339 moon occultations on the nightside are scheduled. A second period with extended moon observations is possible between 17th-22nd September provided it does not hamper preparations for the ENVISAT orbit modifications.

SOST: M. Gottwald, E. Krieg (ESA, Industry if necessary)	Date: 01-06-2010	Signature: via e-mail 01-06-2010

Approval of Proposed Implementation:

Originator Approval: Ralph Snel, SRON	Date: 07-06-2010	Signature: via e-mail 07-06-2010
SSAG Approval: H. Bovensmann, IUP-IFE	Date: 07-06-2010	Signature: via e-mail 07-06-2010

Decision / Approval:
Shall be implemented as proposed. ESA confirmed (T. Fehr, e-mail 09-06-2010) that this OCR does not interfere with preparations for ENVISAT orbit manoeuvre in October.

DLR Approval: A. Friker, DLR (if necessary NIVR, SPEC)	Date: 09-06-2010	Signature: via e-mail 09-06-2010

Implementation by SOST:
OCR_045 will be executed in a first observation window starting 19th August from orbit 44273 to 44340. Moon occultations on nightside observations follow from orbit 44341 incl. 44357 with configuring SCIAMACHY back to nominal (state ID 54 and timeline 13 of set 35). On 24th August in orbit 44358 the modified parameters (state ID 54) and timelines (13 and 42 of set 09) for OCR_045 are loaded again for the second observation window extending to orbit 44368 included.

SOST: M. Gottwald, E. Krieg	Date: 25-06-2010	Signature: via e-mail 25-06-2010

Annex: Modified parameter tables and timelines

Scanner State Parameter #54	54	Moon_Cal_Scan				new due to OCR_045			
	Common	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
STATE ID	54								
spare									
Relative Scan Profile 1 Factor	000								
Relative Scan Profile 2 Factor	000								
Relative Scan Profile 3 Factor	000								
Relative Scan Profile 4 Factor	002								
Relative Scan Profile 5 Factor	000								
Relative Scan Profile 6 Factor	000								
Number of Scan Phases	4								
Duration of Phase [msec]		1300,0	2000,0	118000,0	1020,0	0,0	0,0	0,0	0,0
Phase Type		0	1	1	0	0	0	0	0
Azimuth Centering of Relative Scan Profile		0	0	0	0	0	0	0	0
Azimuth Filtering		0	0	0	0	0	0	0	0
Az. Inverse Rel. Scan Profile for Even Scan		0	0	0	0	0	0	0	0
Azimuth Correction of nominal Scan Profile		5	5	7	0	0	0	0	0
Azimuth Relative Scan Profile Identifier		5	5	5	0	0	0	0	0
H/W constellation		3	3	3	3	0	0	0	0
Azimuth Basic Scan Profile Identifier		5	5	5	0	0	0	0	0
Azimuth Number of Repetition of Rel. Scan		0	0	4	0	0	0	0	0
spare									
Elevation Centering of Relative Scan Profile		0	0	0	0	0	0	0	0
Elevation Filtering		0	0	0	0	0	0	0	0
El. Inverse Rel. Scan Profile for Even Scan		0	0	1	0	0	0	0	0
Elevation Correction of nominal Scan Profile		5	5	9	0	0	0	0	0
Elevation Relative Scan Profile Identifier		5	5	4	0	0	0	0	0
spare									
Elevation Basic Scan Profile Identifier		3	3	3	0	0	0	0	0
Elevation Number of Repetition of Rel. Scan		0	0	58	0	0	0	0	0

Table 1: Scanner State table

CTI State Name	Output 2 CTI			Configuration 1				
	State ID	Restart Time	(SDPU) Mode	SDPU Duration (Number of BCPS)	Wait Measurement Execution	State Duration	Scanner Reset Wait	
Moon_Cal_scan_extented-duration	54	255	STANDARD	1920	30696	31637	179	changed duration (new state design) due to OCR_045

Table 2: State Duration table

Moon extended observation (ID 54) timing inputs for timeline generation

```
RTCS                        STT_01
RTCS set-up                 636 cts
RTCS cleanup (inc. WSR)     281 cts (762-636-24 +179)
                                    (see rts-state-duration_01_03_06.xls)
total RTCS-duration         762 cts
WME                       30696 cts (120×16×16-24)
                                    (see rts-state-duration_01_03_06.xls)
WSR                         179 cts
total state duration      31637 cts (762+30696+179)

set-up                      636 cts
cleanup                     281 cts
measurement               30720 cts (120×16×16)
total state duration      31637 cts
SDPU duration              1920 bcps

phase 1                    1300 msec
phase 2                    2000 msec
phase 3                  118000 msec
phase 4                    1020 msec
```

TL-Timing for Moon extended observation (ID 54)

TL 13

```
TL set_up                   709 cts
Total state 54 duration   31637 cts
TL_close_up                  24 cts
total TL_duration         32370 cts

TL padding = 1s            256 cts
planning gap= 0,1s          26 cts
```

next TL START

H:\scia\timing\timeline_set_09\tl_09_13_02.xls		MOC_100_MOC_end_moon_ns		Table start ID =	769	Event_type =	m_06
DURATION <s>=	127,44531250	DTX0 <s>=	5,25390625	DTX1 <s>=	0,00000000	DTX2 <s>=	121,02000000
SCHED_TYPE =	MF_FI	GEO_TYPE =	tangent_height	GEO_NUM <km>=	100,00	FOV_CHECK =	YES
RATE_TYPE =	LOW	DTX3 <s>=	n/a	DTX4 <s>=	n/a	TL_PAD <s>=	1,00000000

State Running Index	State ID	State Description	State TT (relative, ct)	State TT (relative, sec)	Start Time (absolute, sec) T1 +	State Duration (sec)	End Time (absolute, sec) T1 +
		T/L setup			0	2,77	
1	54	mos01	709	2,77	2,77	123,58	126,35
2	End of Timeline	End of Timeline	31637	123,58			
3	End of Timeline	End of Timeline	0				
4	End of Timeline	End of Timeline	0				
5	End of Timeline	End of Timeline	0				
6	End of Timeline	End of Timeline	0				
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8	End of Timeline	End of Timeline	0				
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11	End of Timeline	End of Timeline	0				
12	End of Timeline	End of Timeline	0				
13	End of Timeline	End of Timeline	0				
14	End of Timeline	End of Timeline	0				
15	End of Timeline	End of Timeline	0				
16	End of Timeline	End of Timeline	0				
17	End of Timeline	End of Timeline	0				
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26	End of Timeline	End of Timeline	0				
27	End of Timeline	End of Timeline	0				
28	End of Timeline	End of Timeline	0				
29	End of Timeline	End of Timeline	0				
30	End of Timeline	End of Timeline	0				
31	End of Timeline	End of Timeline	0				
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33	End of Timeline	End of Timeline	0				
34	End of Timeline	End of Timeline	0				
35	End of Timeline	End of Timeline	0				
36	End of Timeline	End of Timeline	0				
37	End of Timeline	End of Timeline	0				
38	End of Timeline	End of Timeline	0				
39	End of Timeline	End of Timeline	0				
40	End of Timeline	End of Timeline	0				
41	End of Timeline	End of Timeline	0				
42	End of Timeline	End of Timeline	0				
43	End of Timeline	End of Timeline	0				
44	End of Timeline	End of Timeline	0				
45	End of Timeline	End of Timeline	0				
46	End of Timeline	End of Timeline	0				
47	End of Timeline	End of Timeline	0				
48	End of Timeline	End of Timeline	0				
49	End of Timeline	End of Timeline	0				
50	End of Timeline	End of Timeline	0				
51	End of Timeline	End of Timeline	0				
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63	End of Timeline	End of Timeline	0				
64	End of Timeline	End of Timeline	0				
		T/L Cleanup	32346		126,35	0,09	126,45

Table 3: Timeline 13 (t/l set 09, sub_ID 02)

H:\scia\timing\timeline_set_09\tl_09_42_02.xls		MOC_start_MOC_100_nadir		Table start ID =	2625	Event_type =	n/a
DURATION <s>=	72,42187500	DTX0 <s>=	n/a	DTX1 <s>=	n/a	DTX2 <s>=	n/a
SCHED_TYPE =	NF_FB	GEO_TYPE =	n/a	GEO_NUM <>=	n/a	FOV_CHECK =	NO
RATE_TYPE =	LOW	DTX3 <s>=	n/a	DTX4 <s>=	n/a	TL_PAD <s>=	1,00000000

State Running Index	State ID	State Description	State TT (relative, ct)	State TT (relative, sec)	Start Time (absolute, sec) T1 +	State Duration (sec)	End Time (absolute, sec) T1 +
		T/L setup			0	2,77	
1	6	nad06	709	2,77	2,77	68,56	71,33
2	End of Timeline	End of Timeline	17551	68,56			
3	End of Timeline	End of Timeline	0				
4	End of Timeline	End of Timeline	0				
5	End of Timeline	End of Timeline	0				
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63	End of Timeline	End of Timeline	0				
64	End of Timeline	End of Timeline	0				
		T/L Cleanup	18260		71,33	0,09	71,42

Table 4: Timeline 42 (t/l set 09, sub_ID 02)