SCIAMACHY	Operation Change Request	OCR No: 031 Issue: A

Title: Characterisation of the spatial straylight in Limb measurement mode

Description of Request:

The spatial straylight in Limb has a measurable influence on Limb measurements, and an unknown but probably significant impact on trace-gas or pointing retrievals. Attempts to characterise the straylight using available SODAP measurements yielded insufficient quantitative information. The SODAP measurements indicate that the spatial straylight is due to scattering off the ASM mirror, but a contribution from baffle scattering can not be excluded.

Therefore it is requested to perform a limited number of special state measurements for spatial straylight characterisation. The special states are slightly modified Limb scanning or pointing states, which are executed with the Sun in the TCFOV to characterise mirror straylight, and with the Sun outside the TCFOV to check for baffle straylight. Each state needs to be executed only once. In particular, the following measurements are proposed:

1) One Limb scanning state which has the Sun inside the TCFOV at the start of the measurement, the Sun outside the TCFOV at the end of the measurement. At the beginning of the state, the tangent height shall be above the atmosphere. The “Limb dark” pointing shall be outside the TCFOV. The preferred integration time of channels 2-6 is 0.375 seconds.

2) Several Limb pointing states, which differ only in ASM azimuth pointing. The most important measurement shall have the same azimuth as the Sun (within the length of the slit), and the Sun shall be measured at different elevation distances from the IFOV. At the beginning of the state, the IFOV shall be located just under the Sun, the tangent height shall be above the atmosphere, and the tangent height step shall be less than the solar elevation rate. Other azimuths are, in order of importance, 8 degree East of flight direction, 8 degree West of flight direction, 10 degree West of Sun, exactly in flight direction. The preferred integration time of all channels is 1.5 seconds.

Originator: S. Slijkhuis, DLR-IMF	Date of Issue: 25-Jan-2007	Signature: e-mail Sander.Slijkhuis 25.01.2007

Assessment of SSAG (necessary for requests by scientists):

As stated above there are several indications that external straylight in limb measurement mode is affecting the data quality significantly. The characterisation of the straylight in flight is therefore recommended.

SSAG: H. Bovensmann	Date: 17.4.2007	Signature: e-mail, 17.4.2007

Classification of OCR: D

OCR Analysis (incl. Implementation Option):

This OCR requires to define 7 states and 2 timelines. We suggest that safety issues are considered because we point the IFoV close to the Sun. Although the statement exists that the detectors can cope with direct Sun illumination with **APSM large** and **NDFM out** (RTCS 1), we recommend to follow a very safe approach. This includes potential impacts onto the thermal state of detectors 7 & 8 with direct Sun illumination in the above configuration. Therefore we propose here to implement the initial straylight test states with **APSM small** and **NDFM in** (RTCS 2). If only RTCS 1 can ensure successful measurements, it has to be verified that this configuration does not harm the detectors. This will be done by executing the measurement close to the Sun of 2) with **APSM small** and **NDFM in** first. After analysis of the acquired data a decision has to be made whether the remaining measurements of 2) and 1) can be safely executed with **APSM large** and **NDFM out** . The analysis of the first part is presented in annexed at the end of this OCR.

States: In total 7 different states have to be implemented to fulfil the requirements of OCR31. For the measurements of 1) two states require the nominal limb scan strategy. These states are labelled 1_1 and 1_2., The measurements of 2) need 5 states in limb pointing geometry (labelled states 2_1 to 2_5). All 7 states have to be executed during the SO&C-window and above the atmosphere. Note that all states are executed with nominal platform and instrument yaw steering, i.e. the -Y axis is always slightly off flight direction. Furthermore all states will be built with the isimilar state duration, number of scan phases and scans (30).
The implementation proposed below implies the identical general design for the states 1_1 and 2_1 to 2_5:

- Start of the state when the Sun has reached an altitude of 150 km. Since all states shall start with the same position for the ESM, the ESM begins scanning/pointing at a lower altitude (state 2-1 requires to point close to the lower edge of the solar disk).
- Execute limb scans resp. limb pointing until the Sun has proceeded 1 deg above the upper edge of the TCFoV. The time until the Sun leaves the upper edge of the TCFoV is for August approx. 92 sec. The additional 1 deg rise takes about 20 sec. In total 60 scans are needed.
- Execution of limb scan profile (ASM – relative profile 3, factor 4 or 0; ESM – relative profile 1, factor 3! to produce larger angular distances between sun and slit) with vertical steps of 1.5 km each.
- At end of the limb scans execute a jump to an elevation position above the upper edge of the limb TCFoV, i.e. looking into the baffle and continue measurements in pointing mode at a constant altitude for 3 sec.
- Execution shall take place, when no moon observations or monthly calibration activities are planned so that basic profiles from calibration states may be overwritten to produce the 2 different ESM positions and the 1 ASM position.

State 1_2 differs slightly as after 30 limb scans the ESM jumps to a fixed position in the baffle where the ASM then continues with the remaining 30 scans. While states 1_1 and 2_1 to 2_5 allow to determine the straylight in the TCFoV when the Sun is in and out of the TCFoV, state 1_2 helps to quantify the baffle straylight.

Based on the results from OCR_29 (special state ID55 in orbit range 26812 to 26833, e-mail S. Slijkhuis, dated 14/5/2007) for state 2_1 (to be executed first) a T_{int} = PET of 0.5 sec is required. The settings for the other 6 states will be defined after evaluation of state 2_1. More detailed description of special state design is given in the annex including the modified parameter tables. For implementation the state ID55 (moon_troposphere) will be overwritten and altered sequentially as required.

Timelines: Because the state duration differs slightly between states 2_1 and 1_1, 1_2 and 2_2-2_5 two timelines are needed to implement OCR_031. They will be defined in t/l set 09. These test timeline include only the one test state, which shall be performed with data rate set to HIGH since it is executed within the SO&C-window.

After completion of each test timeline the nominal timelines 47 or 50 are scheduled. Note that due to the requirement to continue measurements in states 1_1 to 2_5 for another 20 sec after the Sun has reached the upper edge of the limb TCFoV, timelines 47 and 50 (note: they run front-to-back) are slightly delayed as compared to routine operations. However the shift is less than half a limb/nadir state duration such that the nominal t/l 47 and 50 can still be used. In all orbits where OCR_031 is scheduled the nominal t/l 02 (SO&C-state ID47) will be executed beforehand.

Each test state shall be performed twice, i.e. OCR_031 requires 14 orbits. Depending on the approval of the implementation approach the measurements can be planned in the August timeframe.

SOST: M. Gottwald, E.Krieg; DLR-IMF	Date: 21.5.2007	Signature: via e-mail, 21.5.2007

Approval of Proposed Implementation:		
Originator Approval: S. Slijkhuis, DLR-IMF	Date: 21.6.2007	Signature: e-mail 21.6.2007
SSAG Approval: H. Bovensmann	Date: 05.6.2007	Signature: Via e-mail, 5.6.2007

Decision / Approval:

The OCR shall be implemented as proposed by SOST considering the integration times proposed by Sander Slijkhuis:

- 0.375 sec for scanning and 0.5 sec for pointing
- settings for the other 6 states will be defined after evaluation of state 2_1

DLR Approval: Ch. Chlebek	Date: 25.6.07	Signature: e-mail, 25.06.2007

Implementation by SOST:

Implementation for the first test executing state 2_1 will take place 11th September in orbits 28917 incl. 28920 (4 orbits have been scheduled instead of 2 to ensure that NRT products are immediately available). Parameter setting are given in annex 2.

The remaining measurements are scheduled in orbits 30836-30849 (January 23rd/24th 2008). The sequence of states (2 orbits each) is 2_2, 2_3, 2_4, 2_5, 1_1 and 1_2. Between execution of 2_4 and 2_5 the 2 nominal daily calibration orbits are executed.
Parameter settings are given in annex 3.

Timelines will be 14_02 (state 2_1) and 14_03 (all other states) in timeline set 09.

Note:
State 2_1 will be executed using correction 8 – sun/moon tracking using SC_AOCS – to provide optimum alignment of ASM to sun disk. All other states, which will be performed with different ASM offsets, will be executed using correction 2 – correct with earth model without instrument yaw-steering – implementing Sun ASM-position, Sun ASM-rate and offset via basic profile.

SOST: M. Gottwald, DLR-IMF E. Krieg, DLR-IMF	Date: 03.08.2007 / 07.12.2007	Signature: e-mail, 03.08.2007 / 07.12.2007

Annex 1: Detailed State Design

State 1_1:
This modified limb state shall be executed in the nominal limb observation direction, while the Sun is within the limb TCFoV i.e. the Sun has a azimuthal LoS distance to the slit of approx. 27deg. The starting height for the ESM will be defined by basic profile 5, ASM position will be flight direction. The ASM scan motion will be as in a nominal limb state. The ESM steps will be reduced by a factor of 2 to increase the vertical distance between Sun centre and the IFoV to about 190 km at the end of the limb scan sequence. At the end of the 60 horizontal scans a step upwards of the ESM to a position 2 deg outside the TCFoV takes place – ESM basic profile 13. This position will be maintained for a total duration of 2*1.6875 sec to produce dark signals in pointing mode (no horizontal scans). PET and Coadding table will be finally chosen after execution and analysis of state 2_1. If possible the integration times for channels 2-6 shall be equivalent to 0.375 sec.
State 1_2:
This state shall be executed similar to state 1_1 in the nominal limb observation direction, while the Sun is within the limb TCFoV. The starting altitude for the ESM is identical to state 1_1 as well as all other scanner settings. At the end of 30 horizontal scans a step upwards of the ESM to the position 2 deg outside the TCFoV takes place. This position will be maintained for the remaining 30 scans (duration = 30*1.6875 sec, pointing mode) to produce signals at decreasing Sun distances to the upper edge of the limb baffle. PET and Coadding table will be chosen as for state 1_1.

States 2_1 to 2_5 shall be executed without a horizontal scan, i.e. ASM relative profile 3 factor will be set to = 0. Except for the state 2_1 the PET and Coadding tables will be specified after evaluation of state 2_1. For state 2_1 the channel 2-6 integration times are set to 0.5 sec.

State 2_1:
The ASM direction shall be aligned with the Sun, the ESM shall be positioned 0.3 deg below the Sun. For a solar centre altitude of 150 km this is equivalent to an IFoV start altitude of 122 km (note that this start IFoV altitude is used in all state definitions of OCR_031 while the timeline definition has to use the solar altitude of 150 km). This requires basic profile 10 (ESM) to be set according to the Sun position at execution time. ASM position during state execution will be controlled by the MPS using the predicted sun position and rate in the START-TL-mcmd by defining correction 8 – Sun pointing using SC-AOCS. [For back-up reasons ASM position and rate in basic profile 13 will be set to sun azimuth and to coarsely compensate the azimuth rate of the Sun]. The vertical step sequence will be as in state 1_1, i.e. the jump to the specified position outside the TCFoV is included.
State 2_2:
The ASM direction shall be aligned with flight direction plus an offset of 8 deg LoS left. As in state 2_1 this requires basic profile 13 ASM to be set in flight direction (-45 deg) plus the additional ASM offset . The ASM rate in basic profile 13 will be set to coarsely compensate the azimuth rate of the Sun. ESM positions will be as in state 2_1.
State 2_3:
This state is like state 2_2 but the offset will be 8 deg right.
State 2_4:
The ASM shall be aligned with the Sun plus an offset of 10 deg LoS right of the Sun. This requires basic profile 13 (ASM) to be set according to the Sun position at execution time, ESM as in state 2_1.
State 2_5:
The ASM direction shall be aligned exactly with flight direction. This state resembles a nominal limb pointing state with ESM steps reduced to 1.5 km but executed with the Sun positioned within the limb TCFoV. The nominal limb basic profile 2 will be used.

State 1_1 and 2_1 to 2_5:

Time		Event	Sun		IFOV	
			altitude (km)	elevation (deg)	altitude (km)	elevation (deg)
T0	0 sec	Start of measurement	150	24.37	122	25.15
T1	T0 + 89.5 sec	Sun reaches end of TCFoV	378	19.50	202	23.36
T2	T0+101.25 sec	End 60 limb scans in TCFoV	401	18.94	212	23.15
T3	T0 + 101.25 sec	Start measurement in baffle (limb pointing at constant elevation)	401	18.94	458	17.50
T4	T0 + 104.5 sec	End measurement in baffle (limb pointing at constant elevation)	409	18.76	458	17.50
T5	T0 + 109.5 sec	Sun 1 deg above upper baffle	420	18.50	458	17.50

State 1_2:

Time		Event	Sun		IFOV	
			altitude (km)	elevation (deg)	altitude (km)	elevation (deg)
T0	0 sec	Start of measurement	150	24.37	122	25.15
T1	T0 + 50.5 sec	End 30 limb scans in TCFoV	283	21.67	167	24.05
T2	T0 + 50.5 sec	Start measurement in baffle (limb pointing at constant elevation)	283	21.67	458	17.50
T3	T0 + 89.5 sec	Sun reaches end of TCFoV	378	19.50	458	17.50
T4	T0 + 101.25 sec	End measurement in baffle (limb pointing at constant elevation)	401	18.76	458	17.50
T5	T0 + 109.5 sec	Sun 1 deg above upper baffle	420	18.50	458	17.50

Table 1: Illustration of Sun and IFoV LoS altitude and elevation for the different phases of the straylight states. Due to the seasonal variations all figures are accurate to within a few seconds only.

Details of the parameter settings follow on the next pages.

Annex 2: Parameter tables required for state 2_1

State RTCS index table:

	State ID	HEX	ALPHAN
Limb_straylight	55	0259	STT_02

State duration table:

	State ID	Restart Time	(SDPU) Mode	SDPU Duration (Number of BCPS)	Wait Measurement Execution	State Duration	Scanner Reset Wait			
Limb_straylight	55	27	Limb	1674	26760	28058	8	OCR31 - WSR for STT02		

NOTE 1:
WSR is set to value = 8 cts since this is the minimum time taken by the ICU to send a primitive cmd to the PMTC. The usual time needed for WSR for a limb-type measurement would be 174 cts, but since in this modified limb state ID55 the APSM and the NDFM are sequentially commanded to their home position each taking 132 cts, the return of the scanners to the Idle position taking 174cts can occur within these 2*132 cts and no longer ΔT than the 8 cts has to be accounted for WSR in the RTCS respectively the state duration table.

NOTE 2:
Just for reasons of margin in a discussion with EADS-ASTRIUM R. Mager proposed to make here a very safe approach and allow an additional gap of this 174 cts. This can be realised by adding at least 174 cts to the timeline duration e.g. at parameter TL-pad. In this case the state RTCS is executed as defined by STT_02 and the values specified in the state duration table for this state. The next timeline and its first state are started after an additional IDLE gap of the specified TL-pad.

State Index:

	State ID	Cluster Definition Index	Coadding Index High Data Rate	Coadding Index Low Data Rate	Measurement Category ID
Limb-straylight	55	1	10	5	31

Note:
Limb-straylight will be executed with data rate HIGH only since the execution will take place in the SO&C window with high data rate available. Insofar any conflicts in state parameter settings for data rate low can be neglected.

PET Table:

	State ID	Data Rate	Channel 1a	Channel 1b	Channel 2b	Channel 2a	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7	Channel 8	State ID	Data Rate	Channel 1a	Channel 1b	Channel 2b	Channel 2a	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7	Channel 8	
Limb straylight	55	Low	ک	ک	ک	ک	ک	ک	ک	ک	ک	ک	55	High	ک	ک	ک	ک	ک	ک	ک	ک	ک	ک	changed due to =OCR_31

Note:
High rate only is applicable. Coadding in all clusters is set to 1. T_INT will be 0.5 sec.

Scanner state parameter table:

Scanner State Parameter #55 55 Limb Straylight 2-n

	Common	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
STATE ID	55								
spare									
Relative Scan Profile 1 Factor	003								
Relative Scan Profile 2 Factor	000								
Relative Scan Profile 3 Factor	000								
Relative Scan Profile 4 Factor	000								
Relative Scan Profile 5 Factor	000								
Relative Scan Profile 6 Factor	000								
Number of Scan Phases	5								
Duration of Phase [msec]		1300,0	101250,0	250,0	3125,0	840,0	0,0	0,0	0,0
Phase Type		0	1	0	1	0	0	0	0
Azimuth Centering of Relative Scan Profile		1	1	1	1	0	0	0	0
Azimuth Filtering		0	0	0	0	0	0	0	0
Az. Inverse Rel. Scan Profile for Even Scan		1	1	1	1	0	0	0	0
Azimuth Correction of nominal Scan Profile		8	8	8	8	0	0	0	0
Azimuth Relative Scan Profile Identifier		3	3	0	0	0	0	0	0
H/W constellation		3	3	3	3	3	0	0	0
Azimuth Basic Scan Profile Identifier		13	13	13	13	0	0	0	0
Azimuth Number of Repetition of Rel. Scan		0	59	0	0	0	0	0	0
spare									
Elevation Centering of Relative Scan Profile		1	1	1	1	0	0	0	0
Elevation Filtering		0	0	0	0	0	0	0	0
El. Inverse Rel. Scan Profile for Even Scan		0	0	0	0	0	0	0	0
Elevation Correction of nominal Scan Profile		2	2	2	2	0	0	0	0
Elevation Relative Scan Profile Identifier		1	1	0	0	0	0	0	0
spare									
Elevation Basic Scan Profile Identifier		10	10	13	13	0	0	0	0
Elevation Number of Repetition of Rel. Scan		0	59	0	0	0	0	0	0

Here the times for limb-states are used in phase 3 and 4, whereby phase 4 is extended by 1.6875 sec. Phase 5 uses the nominal time for a Limb state.

Scanner basic profile table:

Since the standard moon basic ESM profile 5 is used for state 27 (Limb-Mesosphere) and the special states will be schedules outside any calibration activities it is proposed to overwrite temporarily some calibration specific basic profiles:

- *ESM basic profiles:*
  10 (SLS) -> to achieve approx. 120 km altitude
  13 (WLS) -> to achieve approx. 460 km altitude
- *ASM basic profile:*
  13 (Sun Diffuser 5) -> to produce the mean Sun azimuth and rate and including any offset to be accounted for (unused because of correction 8).

Scanner Basic Profile EU

Basic Scan Profile ID	Basic Scan Rate Azimuth [10-6 rad/sec]	Basic Scan Rate Elevation [10-6 rad/sec]	Basic Scan Position Azimuth [10-6 rad]	Basic Scan Position Elevation [10-6 rad]		
					Orbit 28917	
10	-008145	000000	0003263766	-217904	OCR_31	ESM position 120km (sun = 150km)
13	-000093	000000	-0000536252	-152716	OCR_31	ESM position 1.6 deg (CFI) above limb TCFoV; sun-az = 331,45deg (CFI)

State 2-1 (ID 55) timing inputs for timeline generation:

RTCS	STT_02
RTCS set-up	900 cts
RTCS cleanup	374 (1290-900-24+8)
total RTCS-duration	1290 cts
WME	26760 cts (62*27*16 - 24)
WSR	8 cts
SDPU duration	1674 cts
state duration	28058 cts (1290+26760+8)

set-up	900 cts
cleanup	374 cts
measurement	26784 cts (62*27*16)
total duration	28058 cts

phase 1	1300 msec
phase 2	101250 msec
phase 3	250 msec
phase 4	3125 msec
phase 5	840 msec

Annex 3: Parameter tables required for states 1_1, 1_2 and 2_2-2_5

In total 6 more states are executed. As described on page 4 they are of 2 different types

- type 1 is performing nominal limb azimuth scans and elevation steps, while the sun is within the FoV
- type 2 is performing elevation steps and pointing in azimuth to fixed positions

All 6 states are planned for sequential execution always for 2 orbits starting the 23rd of January 2008. The table below summarises the sequence, the key settings and the CTI-tables required:

State	Orbit range	ASM scan & viewing direction	ESM scan & viewing direction	CTI-type required
2-2	30836-37	point in flight dir + 8° left	60 steps, start at –25,04°	Scanner Basic Profile, Scanner State, State Index, State Duration, Pixel Exposure Time
2-3	30838-39	point in flight dir + 8° right	60 steps, start at –25,04°	Scanner Basic Profile
2-4	30840-41	point in sun dir at 150km + 10° right	60 steps, start at –25,04°	Scanner Basic Profile
2-5	30844-45	point in flight dir	60 steps, start at –25,04°	Scanner Basic Profile
1-1	30846-47	nominal Limb scan in flight dir (60)	60 steps, start at –25,04°	Scanner State
1-2	30848-49	nominal Limb scan in flight dir (30)	30 steps, start at –25,04°	Scanner State

The actual values to be implemented are shown in the following tables, whereby The first 3 parameter tables are those applicable for all 6 special states and the next ones are marked for the individual states.

State duration table:

	State ID	Restart Time	(SDPU) Mode	SDPU Duration (Number of BCPS)	Wait Measurement Execution	State Duration	Scanner Reset Wait	
Limb_straylight	55	27	Limb	1674	26760	27696	174	OCR31 - WSR for STT01

Note:
WSR is set to value = 174 cts since these states are executed with APSM_large and NDFM_Out based on the results gained during execution of state type 2-1. Due to this fact the nominally applicable RTCS STT01 to state ID55 can be used for these special states the setting of the state_RTCS-table can remain.

State Index:

	State ID	Cluster Definition Index	Coadding Index High Data Rate	Coadding Index Low Data Rate	Measurement Category ID
Limb-straylight	55	1	10	5	31

Note:
Limb-straylight will be executed with data rate HIGH only since the execution will take place in the SO&C window with high data rate available. Insofar any conflicts in state parameter settings for data rate low can be neglected.

PET Table:

	State ID	Data Rate	Channel 1a	Channel 1b	Channel 2b	Channel 2a	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7	Channel 8	State ID	Data Rate	Channel 1a	Channel 1b	Channel 2b	Channel 2a	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7	Channel 8	
Limb straylight	55	Low	,c	,c	,c	,c	,c	,c	,c	,c	,c	,c	55	High	,c	,c	,c	,c	,c	,c	,c	,c	,c	,c	changed due to =OCR_31

Note:
High rate only is applicable. Coadding in all clusters is set to 1. T_INT will be 0.5 sec.

Scanner state parameter table applicable for state 2-2 to 2-5:

Scanner State Parameter #55 55 Limb Straylight 2-n

	Common	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
STATE ID	55								
spare									
Relative Scan Profile 1 Factor	003								
Relative Scan Profile 2 Factor	000								
Relative Scan Profile 3 Factor	000								
Relative Scan Profile 4 Factor	000								
Relative Scan Profile 5 Factor	000								
Relative Scan Profile 6 Factor	000								
Number of Scan Phases	5								
Duration of Phase [msec]		1300,0	101250,0	250,0	3125,0	840,0	0,0	0,0	0,0
Phase Type		0	1	0	1	0	0	0	0
Azimuth Centering of Relative Scan Profile		1	1	0	0	0	0	0	0
Azimuth Filtering		0	0	0	0	0	0	0	0
Az. Inverse Rel. Scan Profile for Even Scan		1	1	0	0	0	0	0	0
Azimuth Correction of nominal Scan Profile		2	2	0	0	0	0	0	0
Azimuth Relative Scan Profile Identifier		3	3	0	0	0	0	0	0
H/W constellation		3	3	3	3	3	0	0	0
Azimuth Basic Scan Profile Identifier		13	13	13	13	0	0	0	0
Azimuth Number of Repetition of Rel. Scan		0	59	0	0	0	0	0	0
spare									
Elevation Centering of Relative Scan Profile		1	1	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	0	0	0	0	0	0
Elevation Correction of nominal Scan Profile		2	2	0	0	0	0	0	0
Elevation Relative Scan Profile Identifier		1	1	0	0	0	0	0	0
spare									
Elevation Basic Scan Profile Identifier		10	10	13	13	0	0	0	0
Elevation Number of Repetition of Rel. Scan		0	59	0	0	0	0	0	0

ASM is pointing in directions as described on p.8, ESM is stepping upwards.

Scanner basic profile table:

- *ESM basic profiles:*
  10 (SLS) -> to achieve approx. 120 km altitude
  13 (WLS) -> to achieve approx. 460 km altitude
- *ASM basic profile:*
  13 (Sun Diffuser 5) -> to produce the LoS direction as described on p.8, no compensation of the solar rate is implemented.

State 2_2:

Scanner Basic Profile EU

Basic Scan Profile ID	Basic Scan Rate Azimuth [10-6 rad/sec]	Basic Scan Rate Elevation [10-6 rad/sec]	Basic Scan Position Azimuth [10-6 rad]	Basic Scan Position Elevation [10-6 rad]		
10	-008145	000000	0003263766	-218515	OCR_31	ESM position 120km (sun = 150km)
13	000000	000000	-0000715585	-152716	OCR_31	ESM position 1.6 deg (CFI) above limb TCFoV; LoS_Az = - 82deg

State 2_3:

Scanner Basic Profile EU

Basic Scan Profile ID	Basic Scan Rate Azimuth [10-6 rad/sec]	Basic Scan Rate Elevation [10-6 rad/sec]	Basic Scan Position Azimuth [10-6 rad]	Basic Scan Position Elevation [10-6 rad]		
10	-008145	000000	0003263766	-218515	OCR_31	ESM position 120km (sun = 150km)
13	000000	000000	-0000855211	-152716	OCR_31	ESM position 1.6 deg (CFI) above limb TCFoV; LoS_az = - 98deg

State 2_4:

Scanner Basic Profile EU

Basic Scan Profile ID	Basic Scan Rate Azimuth [10-6 rad/sec]	Basic Scan Rate Elevation [10-6 rad/sec]	Basic Scan Position Azimuth [10-6 rad]	Basic Scan Position Elevation [10-6 rad]		
						orbit 30840
10	-008145	000000	0003263766	-218515	OCR_31	ESM position 120km (sun = 150km)
13	000000	000000	-0000558348	-152716	OCR_31	ESM position 1.6 deg (CFI) above limb TCFoV; sun-az - 10deg

State 2_5; 1_1; 1_2:

Scanner Basic Profile EU

Basic Scan Profile ID	Basic Scan Rate Azimuth [10-6 rad/sec]	Basic Scan Rate Elevation [10-6 rad/sec]	Basic Scan Position Azimuth [10-6 rad]	Basic Scan Position Elevation [10-6 rad]		
10	-008145	000000	0003263766	-218690	OCR_31	ESM position 120km (sun = 150km)
13	000000	000000	-0000785398	-152716	OCR_31	ESM position 1.6 deg (CFI) above limb TCFoV; LoS_az - 90deg

The basic profile remains for the execution of all 3 states in orbits 30844 incl. 30849

The special states in orbits 30846-30849 are executing actual limb-scans with the ASM and require therefore new settings for the scanning parameters.

Scanner state parameter table:

State 1_1:
This state performs in total 60 limb-scans before stepping up to the usual position outside the TCFoV.

Scanner State Parameter #55	55	Limb Straylight 1-1							
	Common	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
STATE ID	55								
spare									
Relative Scan Profile 1 Factor	003								
Relative Scan Profile 2 Factor	000								
Relative Scan Profile 3 Factor	004								
Relative Scan Profile 4 Factor	000								
Relative Scan Profile 5 Factor	000								
Relative Scan Profile 6 Factor	000								
Number of Scan Phases	5								
Duration of Phase [msec]		1300	101250	250	3125	840	0	0	0
Phase Type		0	1	0	1	0	0	0	0
Azimuth Centering of Relative Scan Profile		1	1	0	0	0	0	0	0
Azimuth Filtering		0	0	0	0	0	0	0	0
Az. Inverse Rel. Scan Profile for Even Scan		1	1	0	0	0	0	0	0
Azimuth Correction of nominal Scan Profile		2	2	0	0	0	0	0	0
Azimuth Relative Scan Profile Identifier		3	3	0	0	0	0	0	0
H/W constellation		3	3	3	3	3	0	0	0
Azimuth Basic Scan Profile Identifier		13	13	13	13	0	0	0	0
Azimuth Number of Repetition of Rel. Scan		0	59	0	0	0	0	0	0
spare									
Elevation Centering of Relative Scan Profile		1	1	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	0	0	0	0	0	0
Elevation Correction of nominal Scan Profile		2	2	0	0	0	0	0	0
Elevation Relative Scan Profile Identifier		1	1	0	0	0	0	0	0
spare									
Elevation Basic Scan Profile Identifier		10	10	13	13	0	0	0	0
Elevation Number of Repetition of Rel. Scan		0	59	0	0	0	0	0	0

State 1_2:
This state performs in total 30 limb-scans before stepping up to the usual position outside the TCFoV and waiting for the rest of the state duration while the Sun is approaching.

Scanner State Parameter #55	55	Limb Straylight 1-2							
	Common	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
STATE ID	55								
spare									
Relative Scan Profile 1 Factor	003								
Relative Scan Profile 2 Factor	000								
Relative Scan Profile 3 Factor	004								
Relative Scan Profile 4 Factor	000								
Relative Scan Profile 5 Factor	000								
Relative Scan Profile 6 Factor	000								
Number of Scan Phases	5								
Duration of Phase [msec]		1300	50625	250	53750	840	0,0	0,0	0,0
Phase Type		0	1	0	1	0	0	0	0
Azimuth Centering of Relative Scan Profile		1	1	0	0	0	0	0	0
Azimuth Filtering		0	0	0	0	0	0	0	0
Az. Inverse Rel. Scan Profile for Even Scan		1	1	0	0	0	0	0	0
Azimuth Correction of nominal Scan Profile		2	2	0	0	0	0	0	0
Azimuth Relative Scan Profile Identifier		3	3	0	5	0	0	0	0
H/W constellation		3	3	3	3	3	0	0	0
Azimuth Basic Scan Profile Identifier		13	13	13	13	0	0	0	0
Azimuth Number of Repetition of Rel. Scan		0	29	0	25	0	0	0	0
spare									
Elevation Centering of Relative Scan Profile		1	1	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	0	0	0	0	0	0
Elevation Correction of nominal Scan Profile		2	2	0	0	0	0	0	0
Elevation Relative Scan Profile Identifier		1	1	0	5	0	0	0	0
spare									
Elevation Basic Scan Profile Identifier		10	10	13	13	0	0	0	0
Elevation Number of Repetition of Rel. Scan		0	29	0	25	0	0	0	0

State 2-2 to 2-5 and 1-1 (ID 55) timing inputs for timeline generation:

RTCS	STT_01
RTCS set-up	636 cts
RTCS cleanup	374 (1290-900-24+8)
total RTCS-duration	762 cts
WME	26760 cts (62*27*16 - 2) –(6+8+8)
WSR	174 cts
SDPU duration	1674 cts
state duration	27696 cts (762+26760+174)

set-up	636 cts
cleanup	276 cts
measurement	26784 cts (62*27*16)
total duration	27696 cts

phase 1	1300 msec
phase 2	101250 msec resp.
phase 3	250 msec
phase 4	3125 msec
phase 5	840 msec

State 1-2 (ID 55) timing inputs for timeline generation:
Note: Only the duration of phase 2 and 4 has changed – all other values stay unchanged. No modification of the existing TL is required

phase 1	1300 msec
phase 2	50625 msec resp.
phase 3	250 msec
phase 4	53750 msec
phase 5	840 msec

SCIAMACHY

Level 0-1b Data Processing

Note on Spatial Straylight determined from OCR 31

ENV-TN-DLR-SCIA-00xx

Issue 0

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Change Record

Issue	Rev.	Date	Page	Description of Change
1			all	completely new

Overview

In the first part of OCR-31 the following measurement was carried out:

- "limb pointing" measurement with **NDFM-in** ands **APSM-small**,
  starting ~0.3 degree below the solar limb, with an increase in Tangent Height smaller than solar ascension rate (i.e. Sun-slit distance increases during measurement)
-

In the second part of OCR-31 similar measurements are planned with an azimuthal distance Sun-slit of at least 10 degree.
The nominal integration time is 0.5 seconds in channels 2-6
The nominal observation mode is **NDFM-out** and **APSM-large.**

In the following we analyse if these nominal measurements have any danger of saturation.

Measured intensity from part 1

Figure 1 shows the measured intensity:
- X-axis: detector pixels in the 8 channels
- Y-axis: measurement number, the scale at left shows an approximate distance of slit to solar centre (distance oscillates around mean difference of TH step size and solar ascension rate). The state starts at the bottom of the plot, not shown are the last 6 "dark" observations.
- Each row is a spectrum, intensity is colour-coded, scale is logarithmic

The spectra are corrected for memory effect and dark.
For channel 1-5 dark is taken from state 46 on the same orbit (neglecting less than 1 BU leakage current in 0.5 seconds), for channel 6-8 the median from the last 6 'dark' readouts in the state is used. For channel 6 it has been checked that this 'dark' is not significantly higher than the data on the level 0 product's "Leakage GADS" (and thus not contaminated by residual straylight).
Bad pixels have been replaced by interpolated values.

Result:
- the intensity falls approximately logarithmically with Sun-slit distance
- in channel 1-4 a diffraction pattern is visible (from distance 1degree in channel 1 to distance 2.5 degree in channel 4, distance linear with wavelength).
  Its relative intensity drops steeply with wavelength.
  In channel 1 and 2 also the 2nd order and 3rd order diffraction is faintly visible.

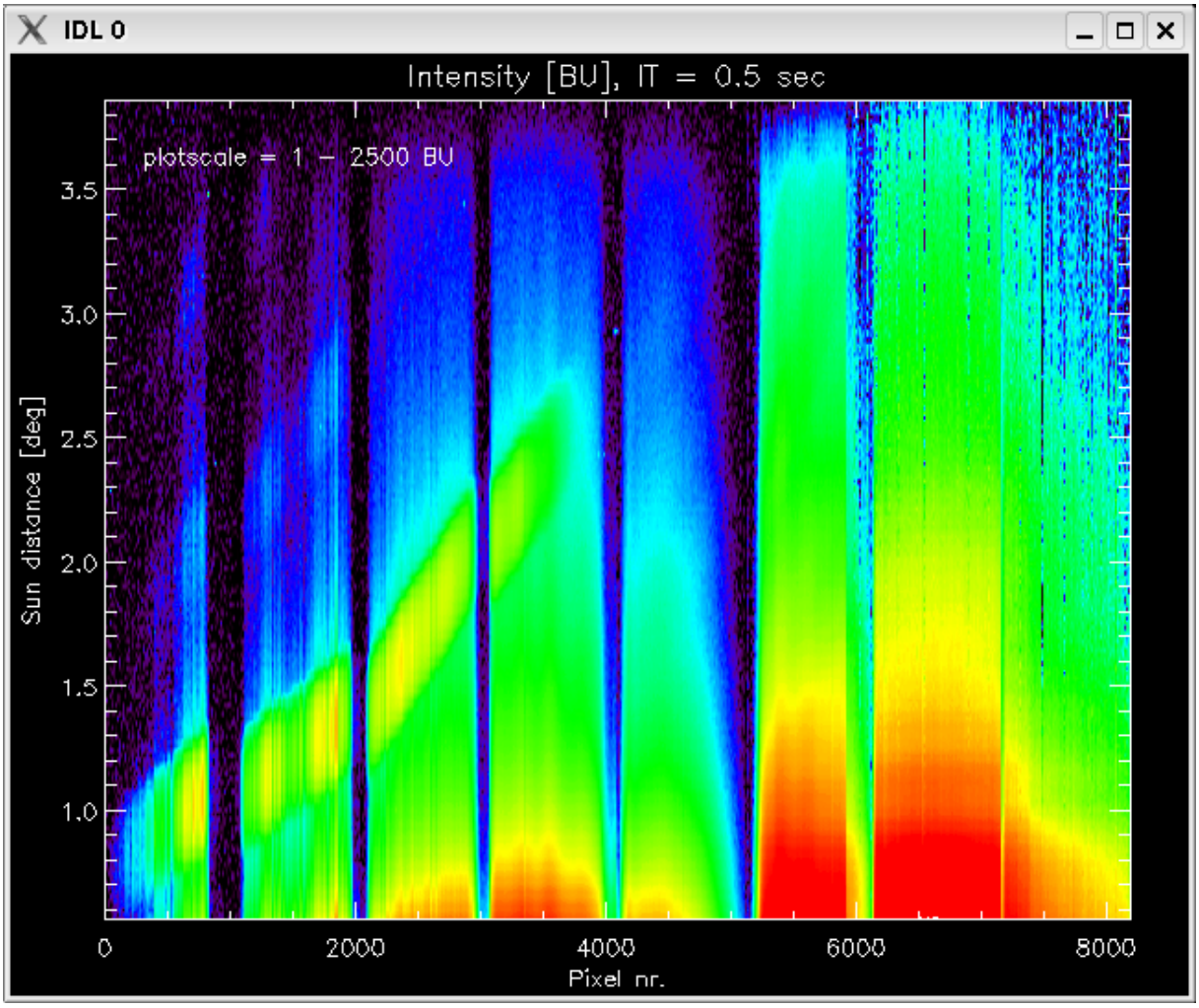


Figure 1: Measured intensity from OCR-31 part 1.

Predicted Intensity for Part 2

For measurements with **NDFM-out** and **APSM-large** we may predict the measured Intensities, to check for saturation.

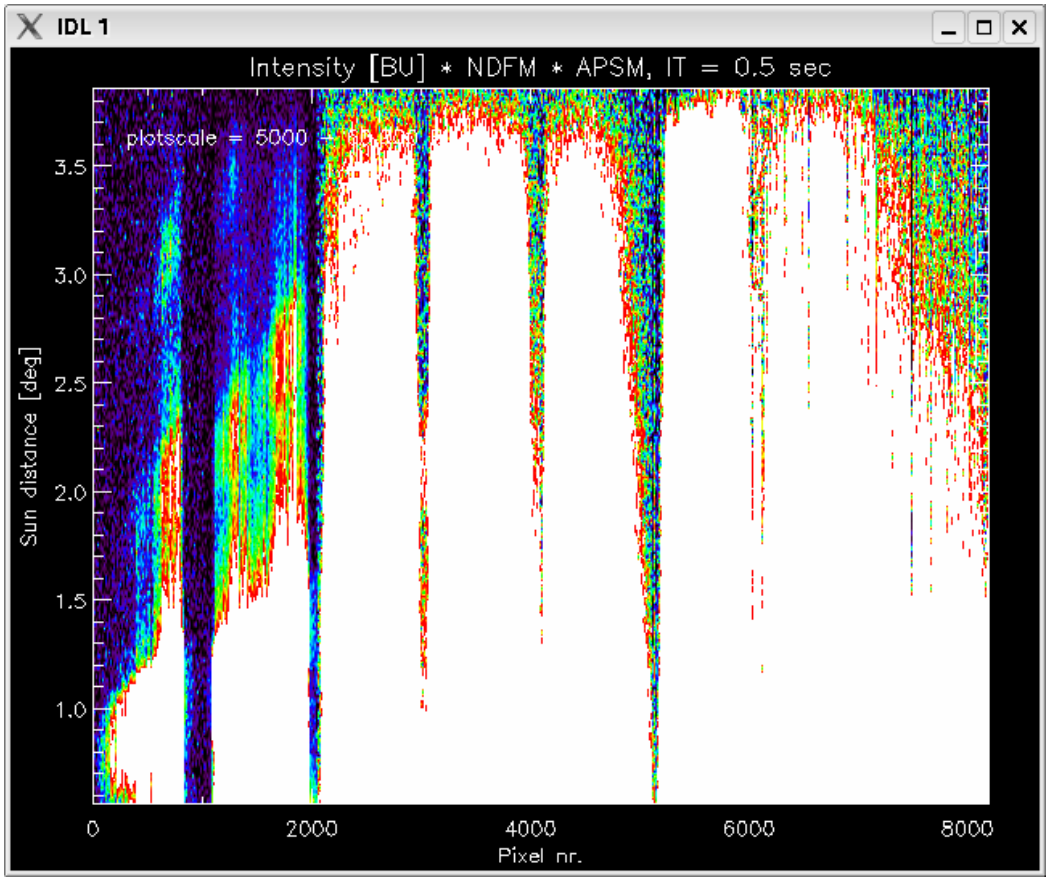
The following assumption is made:

- **APSM-small** reduces light by a factor of 2500 for channel 6-8 and a factor of 5000 for channels 1-5
- **NDFM-in** reduces light by a factor of 5 for channels 3-6

With these scaling factors, the measured intensity from part 1 would have been as shown in Fig.2 upper panel. Reducing the integration time by a factor of 4 (IT=0.125 sec) yields Fig.2 lower panel.

In all channels except Ch.6, the intensity for IT=0.125 is well below the saturation limit at a Sun-slit distance of more than 3.5 degrees. For channel 6 the saturation level is close to the scaled noise level, and therefore Fig.2 does not provide enough information.

Fig. 3 shows the scaled intensity for an IT = 1.5, which shows that for channel 1 there is no Saturation danger for Channel 1 with this IT.



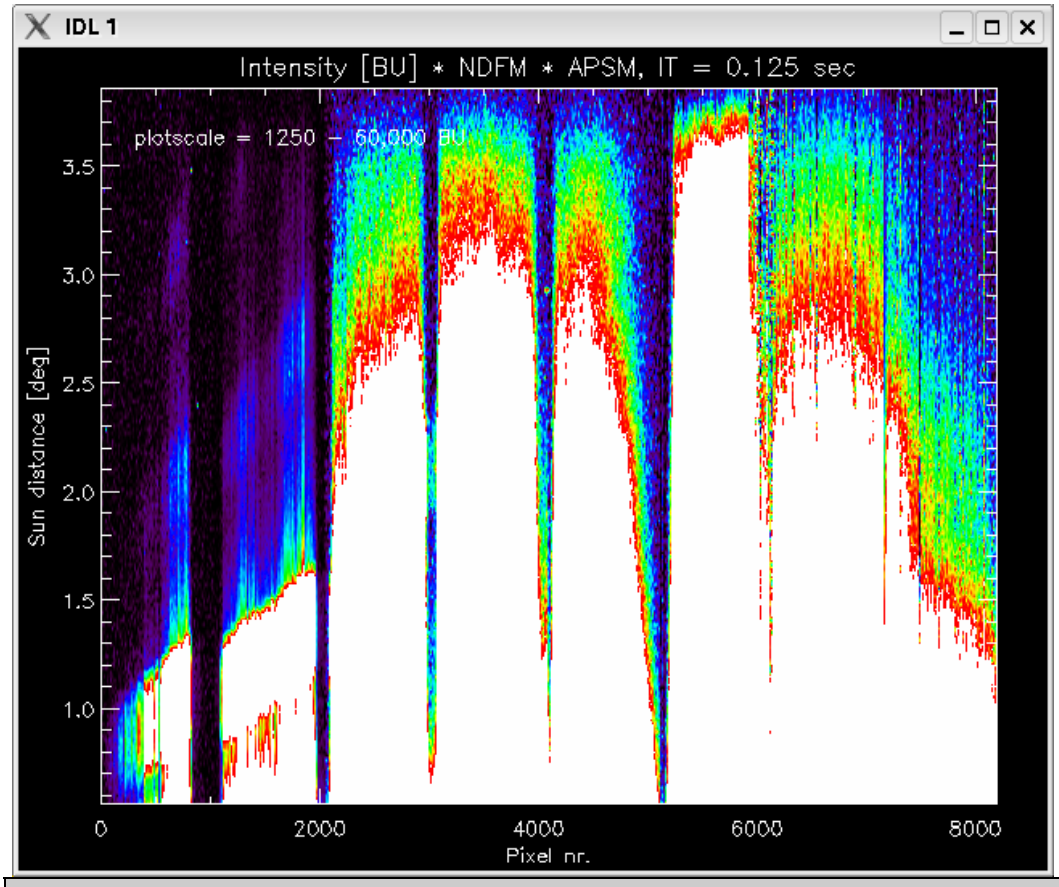


Figure 2: Intensity scaled to NDFM-out, APSM-large, for IT = 0.5 and IT = 0.125 sec

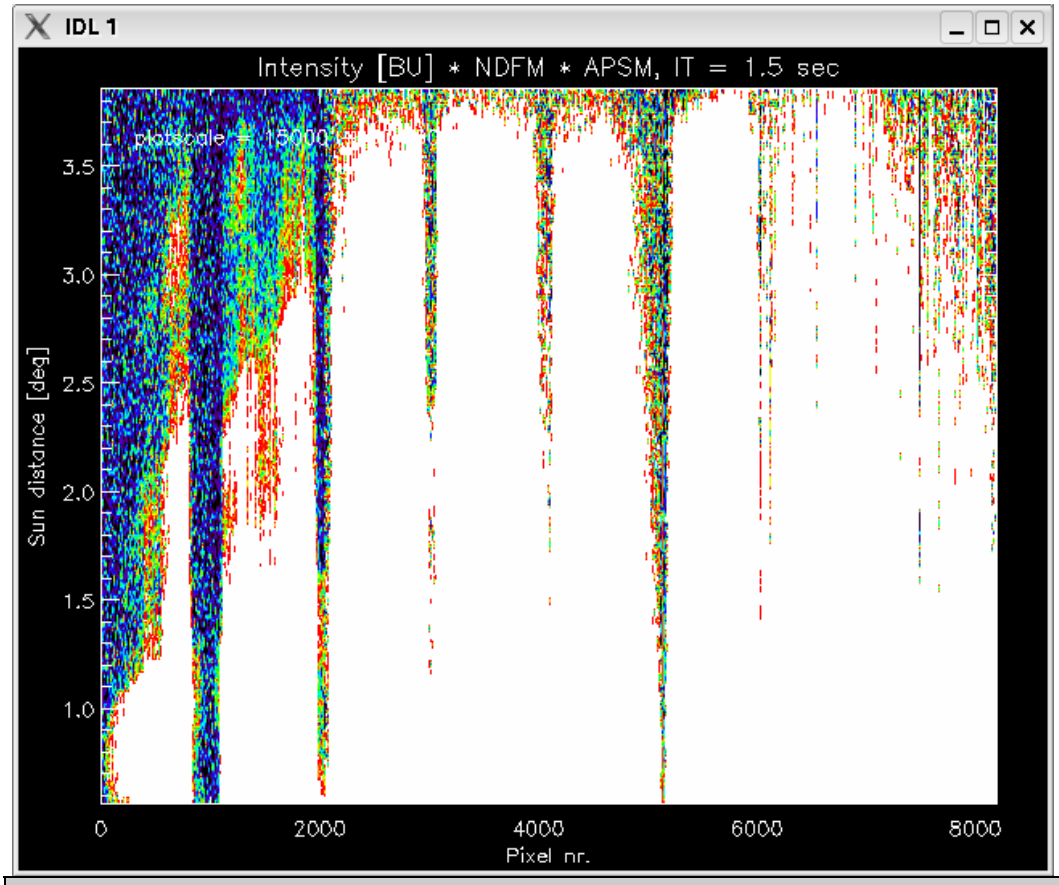


Figure 3: As Figure 2, for IT = 1.5 sec

Predicted Intensity for Part 2, Channel 6

This is the critical channel, where we need an extrapolation of Fig.2 to larger Sun-slit distances in order to come to a conclusion.

Fig.4 shows a plot of Log(Intensity) versus Sun-slit distance, for 3 pixels in channel 6 and for comparison one pixel each from channels 4 and 7.
Also plotted is the saturation level of 60,000 BU and a conservative extrapolation of the Channel 6 intensity to larger distances.

The straylight shows a logarithmic decay with distance. The upturn at the end of channel 6 is interpreted as the "grating" feature which is clearly visible in channel 4 (distance 2.4).
But even if we assume the upturn at the channel end as continuum straylight, and extrapolate logarithmically from there on (dotted line in Fig.4) we see that no saturation is expected for Sun-slit distances of more than 6 degrees.

Reducing the Channel 6 IT by a factor of 4 (IT=0.125, approx. 1.2 tickmarks intensity in Fig 4) would yield an absolutely safe irradiance level for distances above 6 degree.

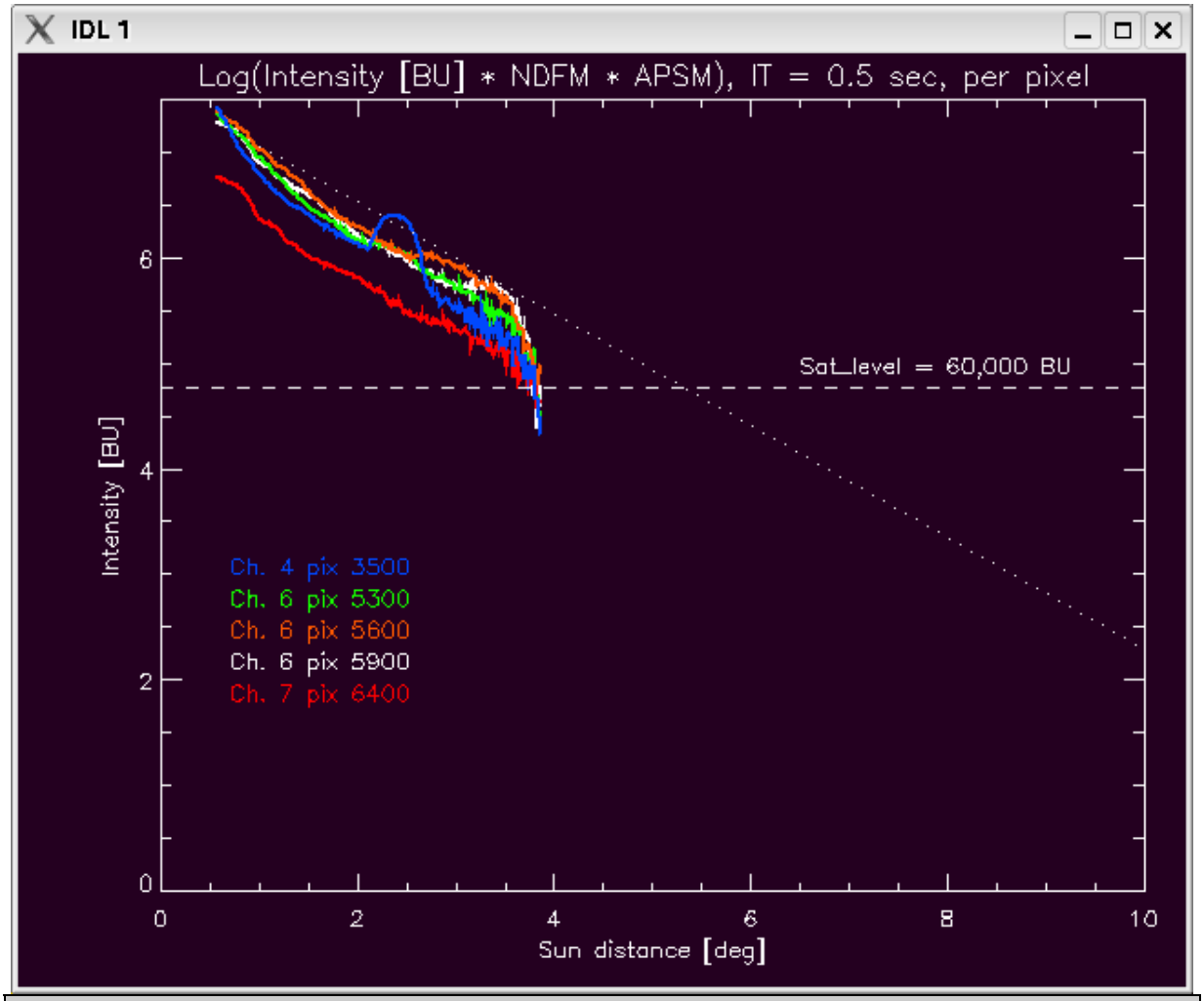


Figure 4: Log(Intensity) versus distance for several detector pixels

Conclusion

Saturation is not expected for the OCR-31 Part 2 measurements, having:

- **NDFM-out** and **APSM-large**
- **PET** = 1.5 for Channel 1
  PET = 0.5 for Ch. 2-8
  (**PET** = 0.125 for Ch. 6, conservative scenario)