Title: **Simulation of STM2 Straylight**

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Draft			Draft for Review	

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1 Introduction

Due to the discrepancies found between EQM stray light test results and the corresponding prediction [RD1] it has been decided to perform additional specific straylight testing on STM. These tests in the following are referred to as STM2 tests.

The STM2 tests were performed at the ESTEC test centre.[1] For the tests the Herschel flight cryostat was equipped with a mechanical thermal dummy of PACS FPU and the cryogenic qualification models of HIFI FPU and SPIRE FPU. Due to the absence of the PACS instrument the STM2 stray light measurement was performed with the SPIRE instrument only. Nevertheless, simulations were performed for both PACS and SPIRE stray light levels.

Compared to previous stray light predictions [RD2] for the ground case, the following changes are introduced to the current model:

- structural surfaces of the SPIRE entrance section are blackened,
- the cryocover mirror for STM is polished,
- design changes to the LOU TS2 baffle are modelled in a separate ASAP skript,
- the additional aperture in the entrance baffle (ENB) is added to the model.

The following Figure 1 shows the Herschel-STM2 stray light test.

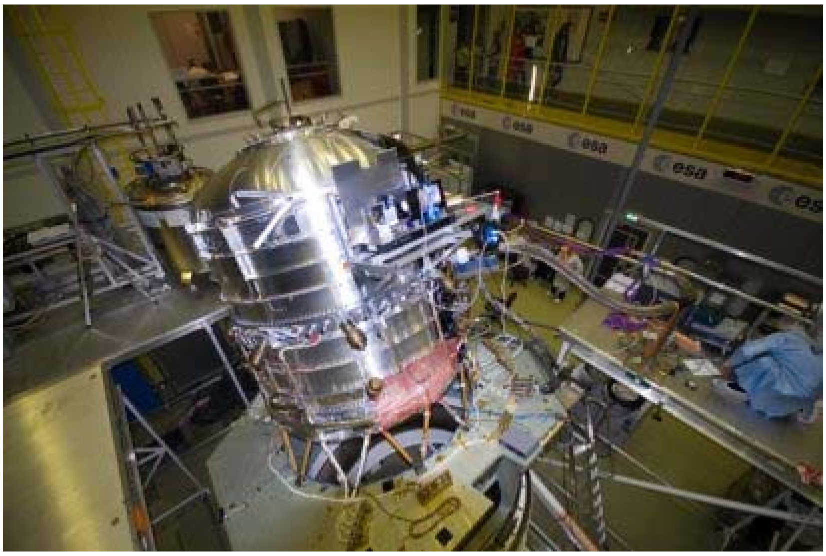

Figure 1 Herschel-STM2 stray light test[1]

[1] http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=40172

2 Documents

2.1 Applicable Document

AD1	H-EPLM Requirements Specification (HERS)	H-P-2-ASPI-SP-0250, issue 3/2

2.2 Reference Document

RD1	Explanations for excess EQM straylight	HP-2-ASED-AN-0020, 14.07.06
RD2	Optical Configuration and Straylight during Ground Testing	HP-2-ASED-TN-0076, issue 2, 30.03.04
RD3	H-PLM STM2 Straylight Test Procedure	HP-2-TP-0110 issue 1, 6.10.06
RD4	Herschel Straylight Calculation Results	HP-2-ASED-TN-0023, issue 4, 27.9.04
RD5	Optical configuration and Straylight during Ground Testing	HP-2-ASED-TN-0076, issue 2, 30.3.04

3 Abbreviations

ASAP	Advanced System Analysis Program
CATIA	Computer Aided Three-Dimensional Interactive Application
CCM	Crycover Mirror
CVV	Cryostat vacuum vessel
ENB	Entrance baffle
HBB	Hot black body
HIFI	Heterodyne Instrument for the Far-Infrared
IS	Instrument shield
K	Kelvin
LOU	Local oscillator unit
OB	Optical bench
PACS	Photodetector Array Camera and Spectromter
SPIRE	Spectral and Photometric Imaging Receiver
STM	Structural and thermal model
TS1	Thermal shield one
TS2	Thermal shield two
TS3	Thermal shield three
TSE	Thermal self-emission

4 Description of ASAP model configuration

The straylight test simulations cover the following test conditions as specified in RD 03:

- Band 3 LO window is illuminated with a specific heat source (1473 K hot black body (HBB) of 20 mm diameter).
- The temperature of the Cryocover Mirror is varied.
- The temperatures of the Thermal Shields are varied.

For the simulation the straylight model has been updated to reflect the STM2 configuration. The following changes were introduced:

- Structural surfaces of the SPIRE entrance section are blackened
- Polished cryocover mirror
- New TS1 baffle (modelled in a separate ASAP script).
- Design changes of the LOU TS2 baffle (modelled in a separate ASAP script).
- Additional aperture in the entrance baffle (ENB).
- Taping of 6 from 7 HIFI FPU channels (modelled in a separate ASAP script) [1]

These design changes and the corresponding assumptions made in the ASAP model are described in more detail in section 5 of this document.

The implemented model configuration is shown in the following pictures.

[1] On HIFI side, only band 3 was in flight configuration during the test. The other channels were taped and therefore the propagation of stray light through these channels was blocked.

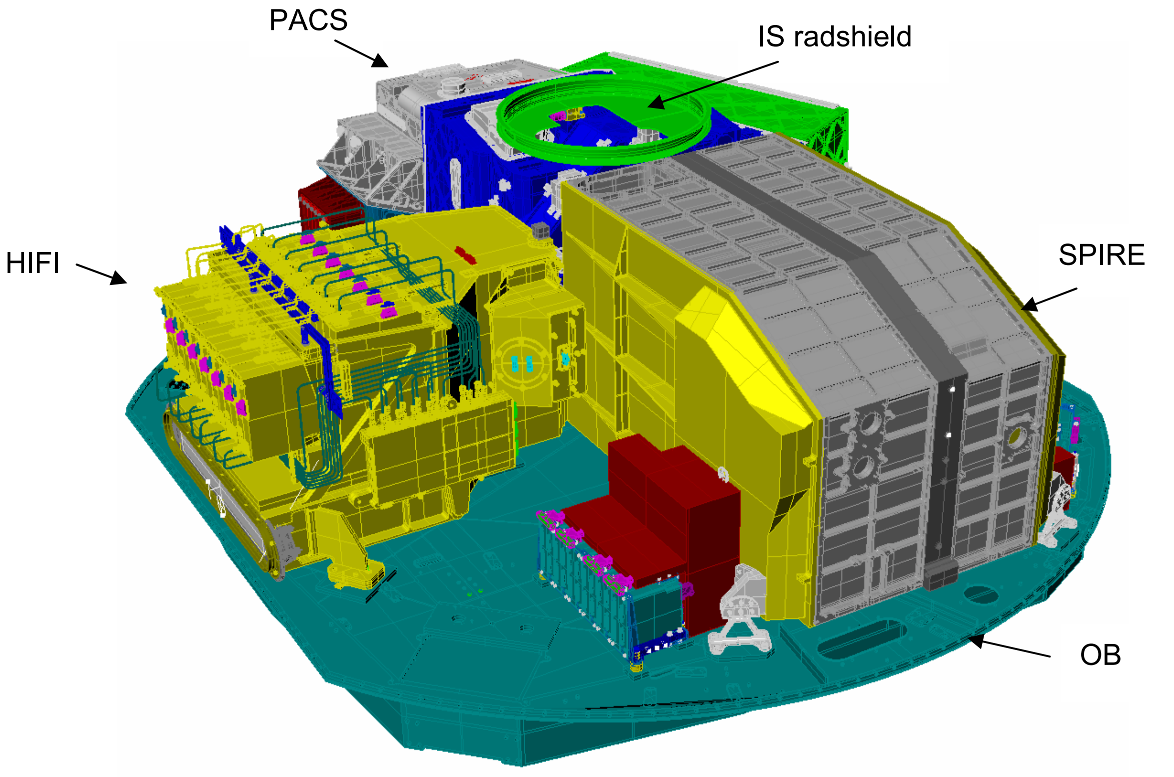

Figure 2 The instruments HIFI, PACS and SPIRE on the optical bench with the instrument shield (IS) radiation shield shown.

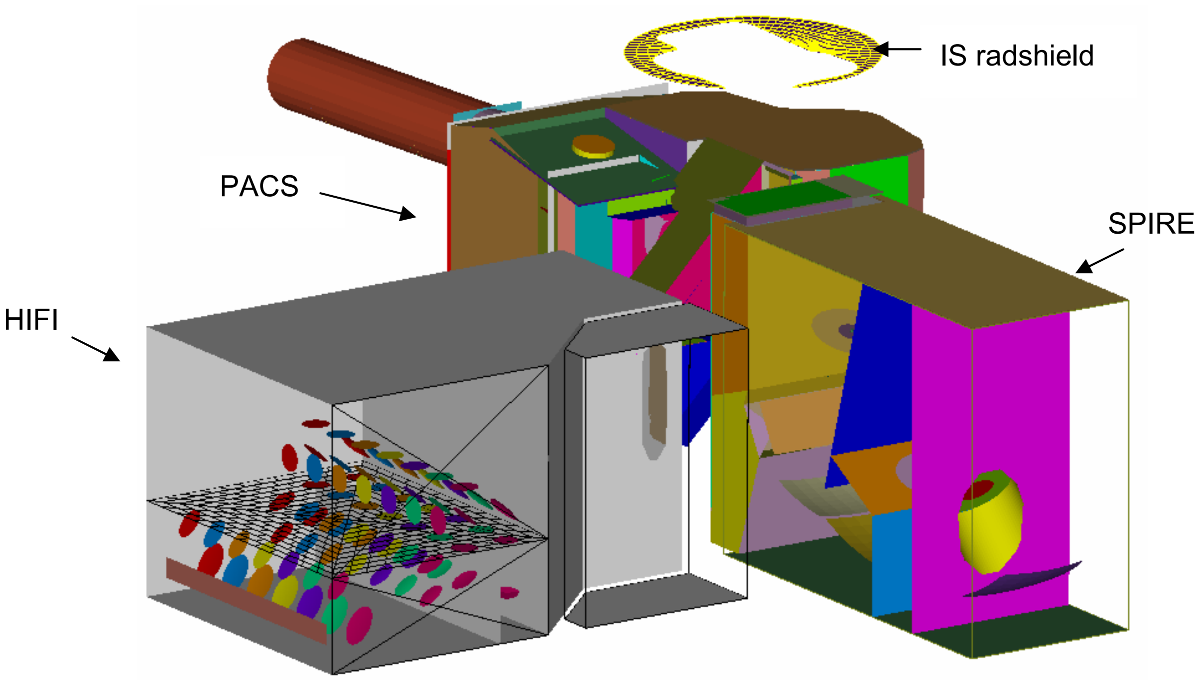

Figure 3 The instruments HIFI, PACS and SPIRE in the ASAP model with the instrument shield (IS) radiation shield shown.

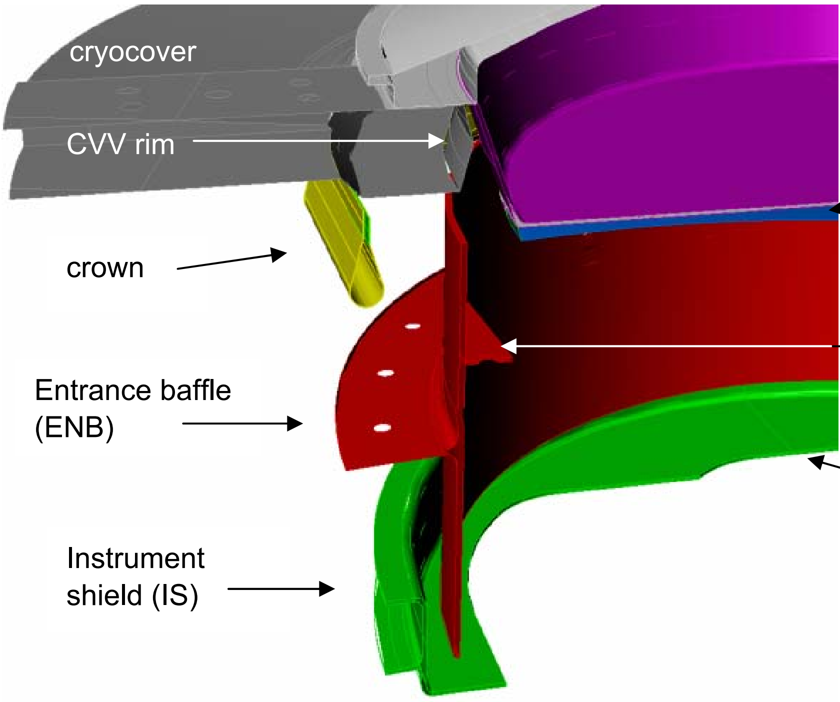

Figure 4 cross sectional view through the cryostat cavity with the cryocover mirror closed (CAD model).

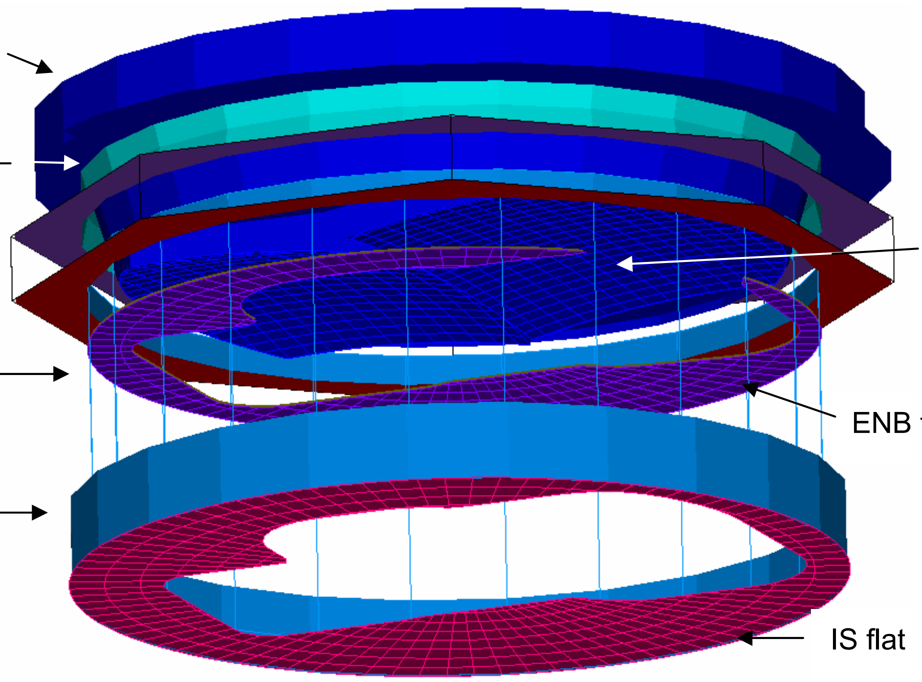

Figure 5 ASAP 3D plot of the cryostat cavity with closed cryocover mirror.

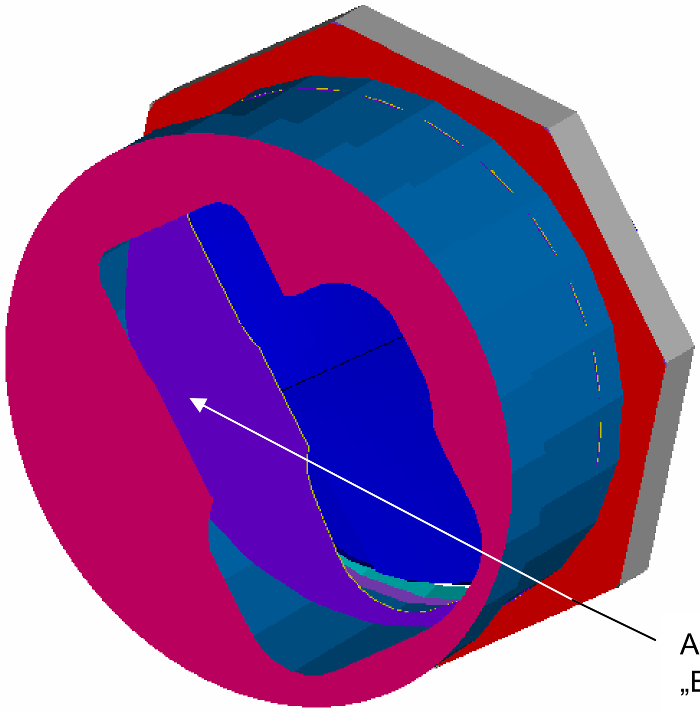

Figure 6 Detail of STM model configuration: Cryocover mirror, Crown, Entrance Baffle (tube and the newly added aperture) and Instrument Shield Baffle (tube and aperture) are shown.

For the design of the LOU TS2 and TS1 baffles and the position of the HBB source see Figure 7 and the following section 4.1.

4.1 LO baffle model description

The LO baffle ASAP model is implemented in a separate ASAP script. It can be used to calculate the power transfer from the LO windows as well as from an external hot blackbody source to the instrument shield (IS) openings.

In the model the geometry as taken from a simplified CAD file is implemented. This file was derived directly from the current CATIA model and contains only the interior and other surfaces relevant to the optical behaviour of the baffle. This geometry is shown in Figure 7.

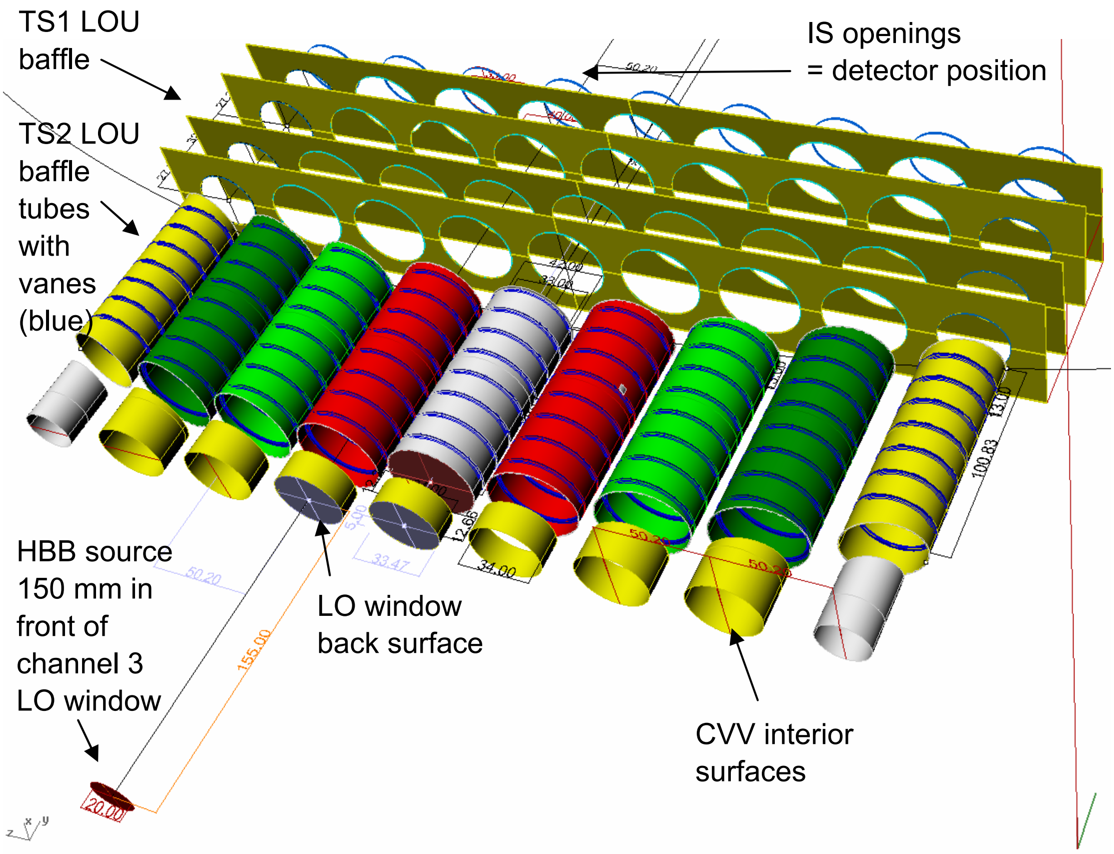

Figure 7 Simplified CAD model used to derive the geometry for the LOU ASAP model (HBB source shown in front of LO channel 3)

The ASAP model is fully parameterized so that changes to the geometry or any optical properties can be done through assignments to the corresponding input parameters. The following Table 1 summarises the most important input parameters to the model script.

Parameter and its value	comment
!! ray trace:	
LVL=3	number of times a scattered ray may be rescattered
LVLC=1.E-15	diffuse ray relative threshold, use LEVEL (LVL) (LVLC)
CTFF=1.E-12	absolute flux threshold, use CUTOFF (CTFF) (NCUT)
NCUT=100	maximum number of total object intersections for any ray
HLT=1000	maximum number of ray intersects on the same object, use HALT (HLT)
PTHFR=1E-5	flux sorting threshold, use PATHS TOTAL (PTHFR)
NRAY=500	source rays in one dimension
NSCAT=5	scattered rays per intersection
!! coatings:	
REFLECT=0.995	reflectivity ob metallic blank surfaces
R_BLACK=0.9	reflectivity of black anodyne surfaces
T_LOU_WIN=.96	transmission of LO windows
!! scatter models:	
HV_B=0.025	maximum BSDF (at specular), use HARVEY (HV_B) (HV_S) (HV_L)
HV_S=-0.5	asymptotic fall-off with angle
HV_L=0.01	A-Ao and B-Bo shoulder point in radians
!! geometry:	
!! TS1 baffle:	
A=70	half height on +/-Z side into Y
B=233	half length in Z
C=31	half length in X
D=55	half height on +/-X side into Y
E=-711.2	Y of outer horiz. surf.
F=30	distance between horiz. surfaces
!! TS2 baffle:	
TS2_AW_HW=33/2.	TS2 alignment window openings
TS2_LW_HW=40/2.	TS2 LO window openings
TS2_HOR_TILT=2	TS2 baffle surfaces tilt by 2 deg

!! CVV openings	
CVV_AW_HW=24/2	CVV alignment window openings
CVV_LW_HW=34/2	CVV LOU window openings
CVV_BT_Y1=-949.848	radius (around X) of CVV holes
CVV_BT_Y2=-962.511	Y min of CVV holes
RC=950	used for sources by H.H.
Y_DET_IS=-691.2	Y of DETector = Y of holes in IS
DHOLE=50.2	Z distance between tubes/channels
YHOLE5=-937.5	Y min of central (channel 4) TS2 baffle tube
DLY1=101.3	!! TS2 baffle vane Y positions
DLY2=106.8	…
DLY3=108.7	…
DLY4=111.3	…
DLY5=113.7	…
DLY6=DLY4	…
DLY5=113.7	…
RADHLL=21	TS2 LOU channel baffle tube inner radius
RADHLA=17.5	TS2 alignment channel baffle tube inner
VANE_D=2.	TS2 vane depths
HBB_HW=20/2	hot black body emitting radius

Table 1 Summary of input parameters

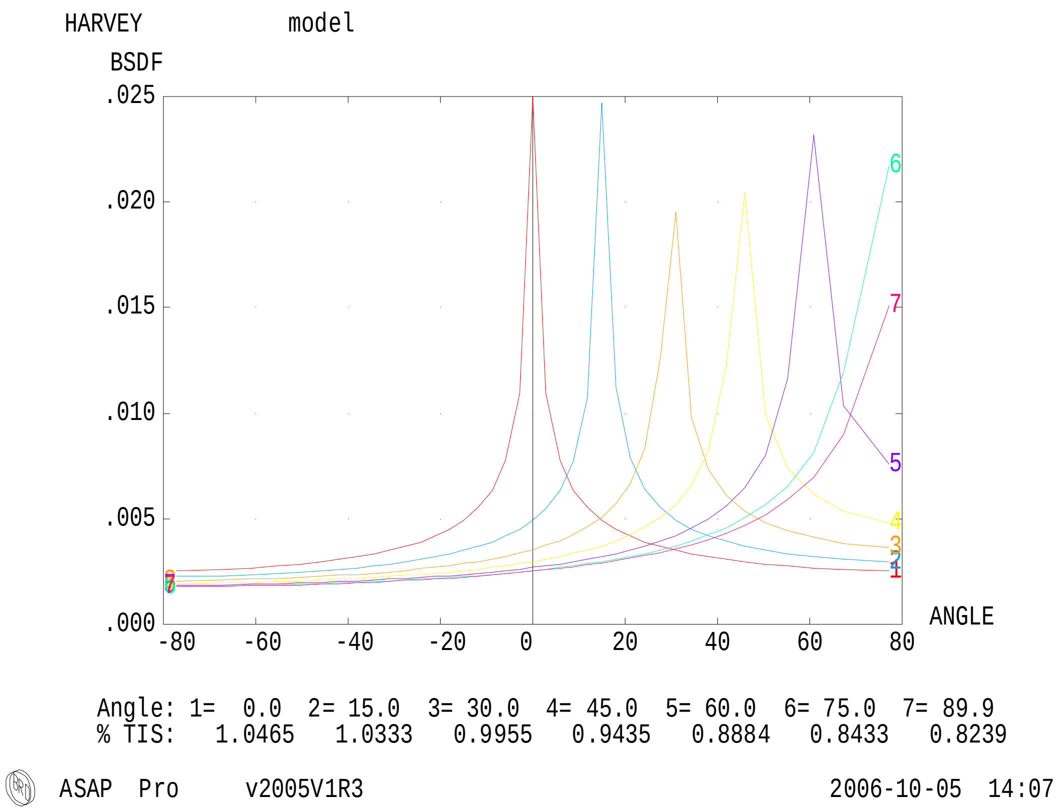

Figure 8 HARVEY 0.025 -0.5 0.01 BRDF model (TIS=1% at normal incidence)

The Figure 8 illustrates the scatter model used for the black anodised interior surfaces of TS1 and TS2 baffles. The reflectivity of these (in the VIS wavelength range) black surfaces are set to 90%. The CVV interior surfaces are left blank and therefore were assigned a reflectivity of 99.5%.

4.1.1 Simulation results for hot black body source on LOU band 3

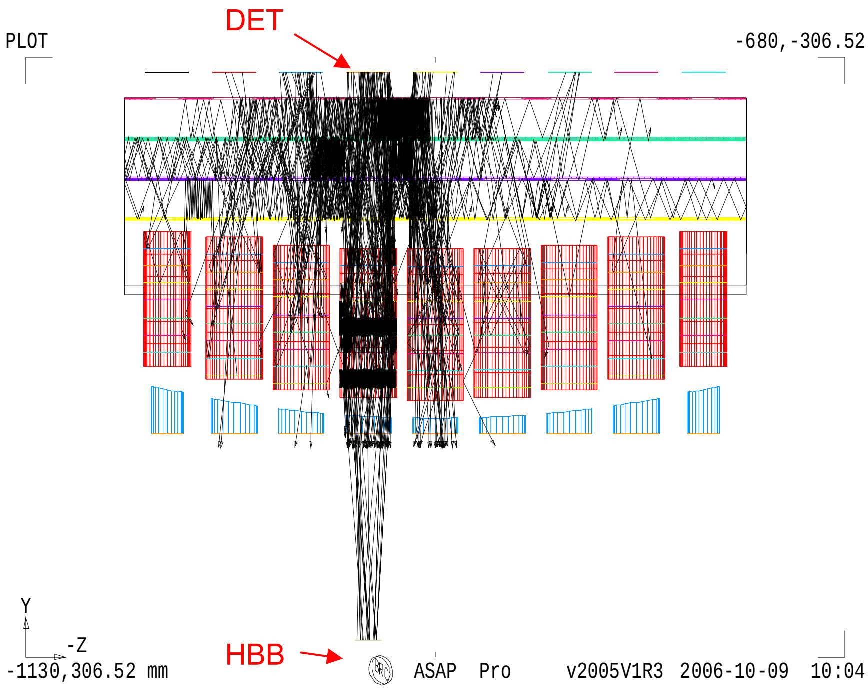

Figure 9 Ray trace from the HBB source (on LO and 3) through the LO baffle and to corresponding instrument shield openings (DET).

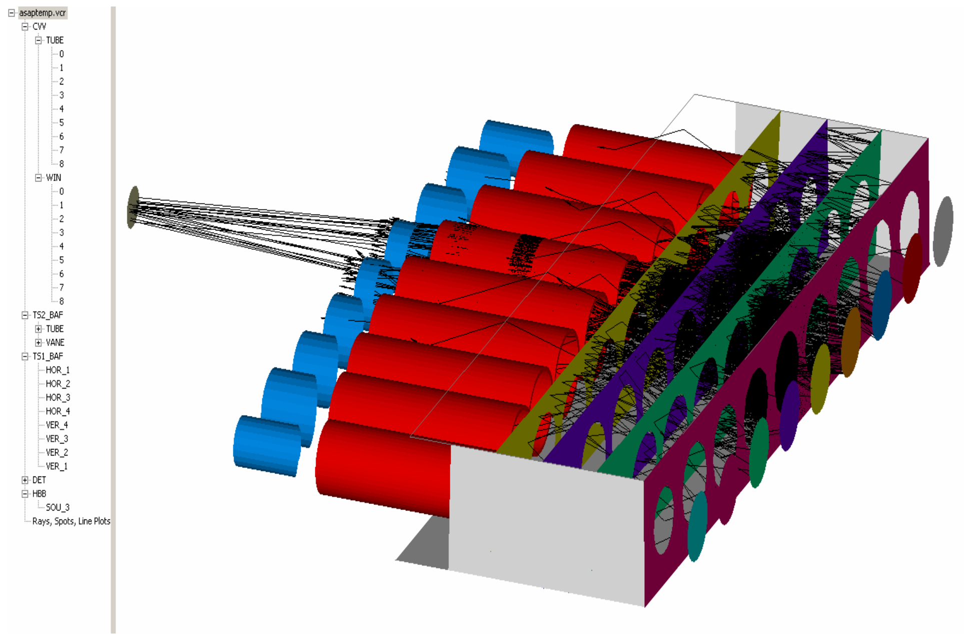

Figure 10 Ray trace through the LO baffle in 3D with object hierarchy shown.

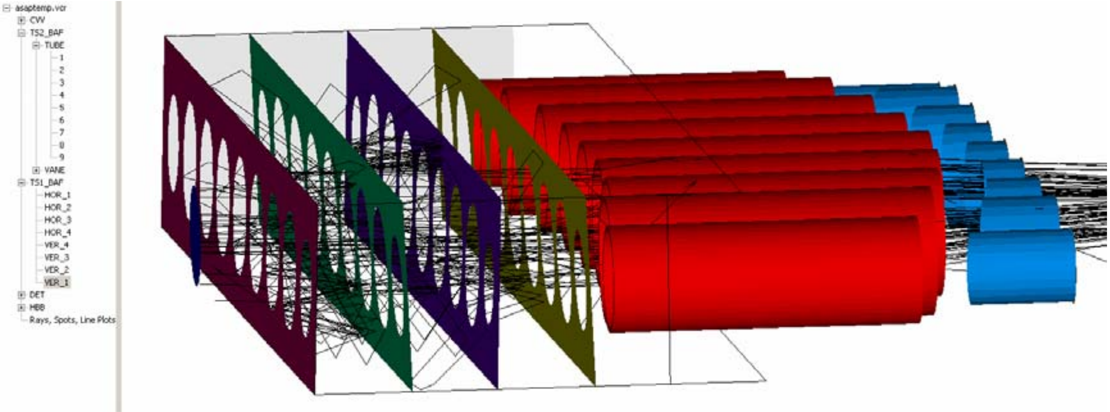

Figure 11 Ray trace in 3D with details of the TS1 LO baffle.

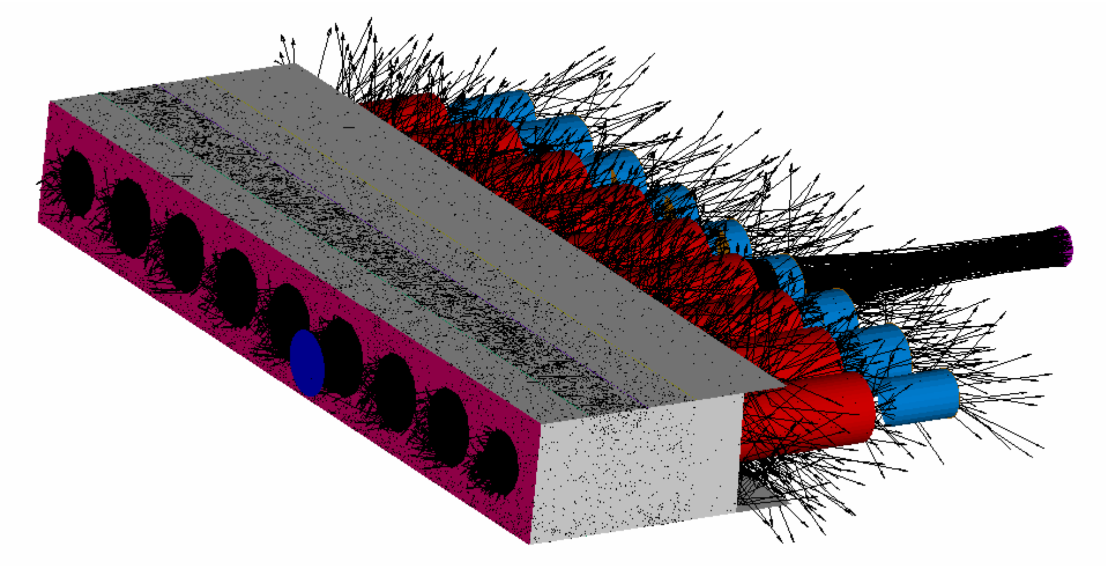

Figure 12 Ray trace in 3D with details of the TS1 LO baffle.

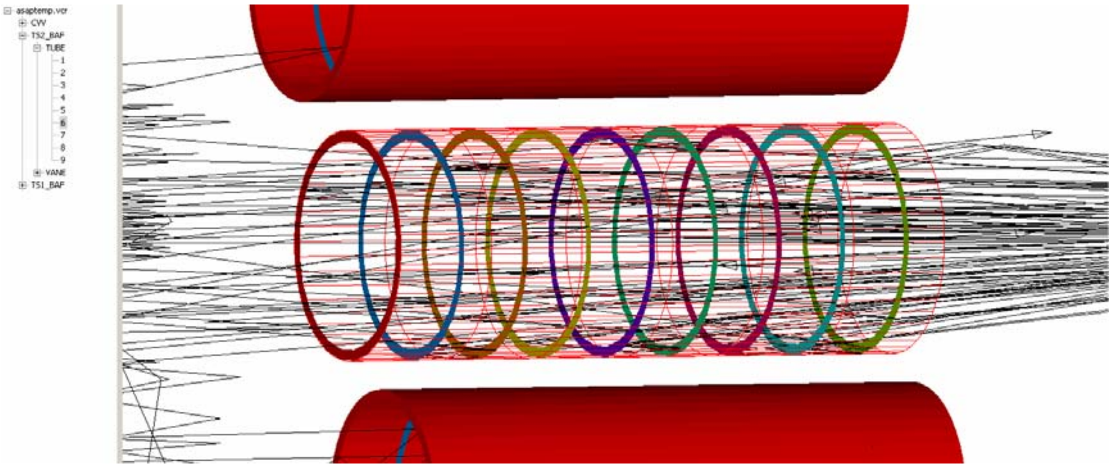

Figure 13 Ray trace in 3D with details of the TS2 LO baffle.

Object	Rays	Flux		
115	199340	0.8531 E-04	DET.LO_0	
116	694641	0.9212 E-03	DET.LO_1	
117	3759857	0.1695 E-01	DET.LO_2	
118	11150633	**1.114927**	DET.LO_3	(band 3)
119	3745329	0.1736 E-01	DET.LO_4	
120	650411	0.9162 E-03	DET.LO_5	
121	172933	0.7771 E-04	DET.LO_6	
122	62769	0.1333 E-04	DET.LO_7	
123	20445	0.1784 E-05	DET.LO_8	

TOTAL	20456358	1.1512		
FLI		314.16 (flux in)		
FLO		1.1512 (flux out)		
ATTENUATION		3.6645 E-3		

Table 2 Results of the HBB source on channel 3 through LOU baffle run.

Table 2 shows results obtained for the simulation of the radiation transfer from a hot black body (HBB) source through the LOU baffle. The input flux (FLI) equals the emitting area in system units (mm^2), FLO is the total flux on all detectors. The maximum occurs on channel 3 detector. Cross-talk to neighboring channels is attenuated by approximately a factor of 65. The attenuation of the HBB source within the baffle is 3.66 10^{-3}. The "effective source area" of 1.115 mm^2 from the HBB source is used for the calculation of results given in line 7b of Table 5 through Table 9.

4.1.2 Simulation results for thermal self emission from LOU windows

In another run the thermal self emission from the LOU windows and its surroundings in the CVV as well as its propagation through the LOU baffle was simulated. As the whole area around the LOU windows including mounts and CVV parts are at the same temperature (~293K) during STM2 tests this cavity is treated as a black body emitting into the TS2 baffle tubes. Therefore sources were created which fill the whole entrance area to the baffle tubes. Detectors (DET) have the size and are located at the position of holes in the instrument shield.

The following Figure 14 and Table 3 show this ray trace and the results.

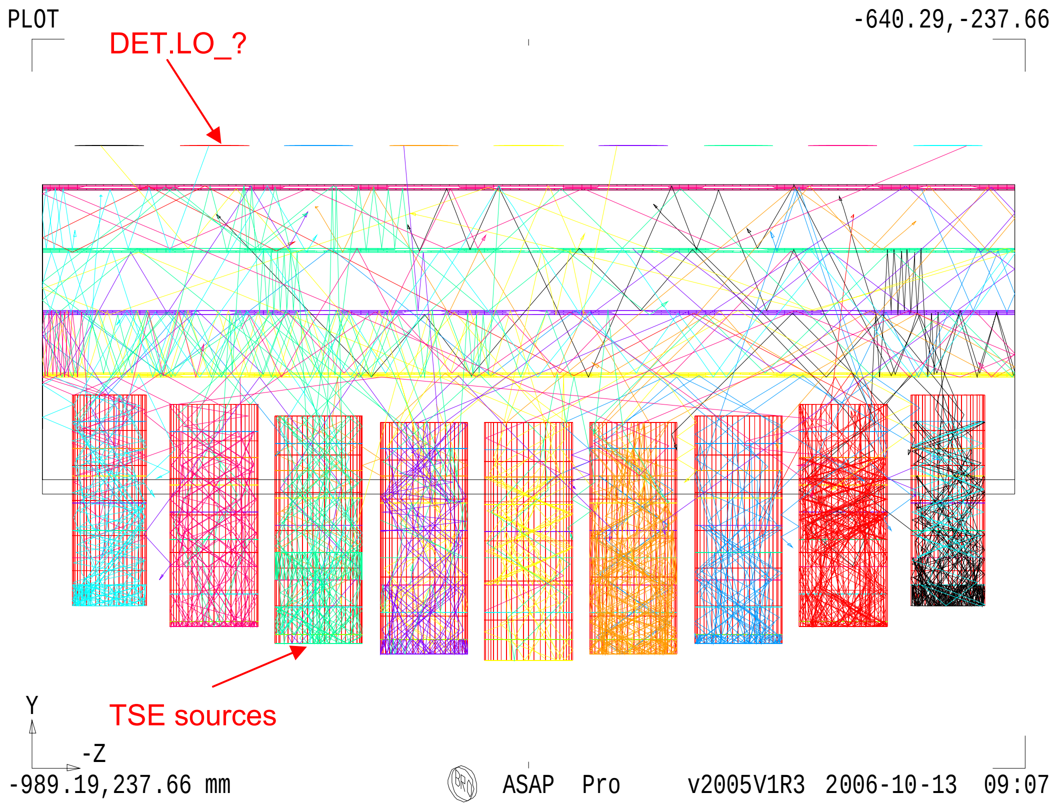

Figure 14 Ray trace representing thermal self emission (TSE) from the LO windows to the LO baffle and to the instrument shield openings (DET).

Object	Rays	Flux	
97	385695	23.21	DET.LO_0
98	488096	35.81	DET.LO_1
99	467945	37.25	DET.LO_2
100	446298	37.07	DET.LO_3
101	441102	36.59	DET.LO_4
102	447553	37.63	DET.LO_5
103	469688	35.50	DET.LO_6
104	487933	34.79	DET.LO_7
105	392953	22.45	DET.LO_8
TOTAL	4027263	300.335	

FLI	11622.3	(flux in)
FLO	300.3347	(flux out)
ATTENUATION	2.584 E-2	

Table 3 Thermal self-emission from LO windows and CVV into TS2 baffle simulation.

Table 3 shows the results obtained for the radiation transfer from LO windows and CVV surroundings through the LO baffle and to the instrument shield openings. The attenuation of self-emission from the LO windows within the LO baffle is 2.58 10^{-2}. The attenuation within the LOU baffle is used for the calculation of LOU window emission through HIFI M3, cf. line 7a of Table 5 through Table 9.

5 Assumptions made in the calculations

The cryocover mirror is polished now and therefore is assumed to have a BRDF with slope -1.7 and a value of 0.73 at 0.01 radians (as assumed previously in RD 02). The corresponding TIS value is 0.45%. For SPIRE wavelengths this assumption is considered conservative, the real BRDF for SPIRE might be even lower due to longer wavelength of observation.

The entrance section of SPIRE, i.e. the surfaces named POCKET, SIDE1MZ_UPPER, SIDE2PZ_UPPER, SIDE5PY_UPPER and SIDE6MY_UPPER in the ASAP code (see Figure 4-1) are assumed black with a total hemispherical reflectivity of 5%. All other structural surfaces are assumed to have a reflectivity of 95%.

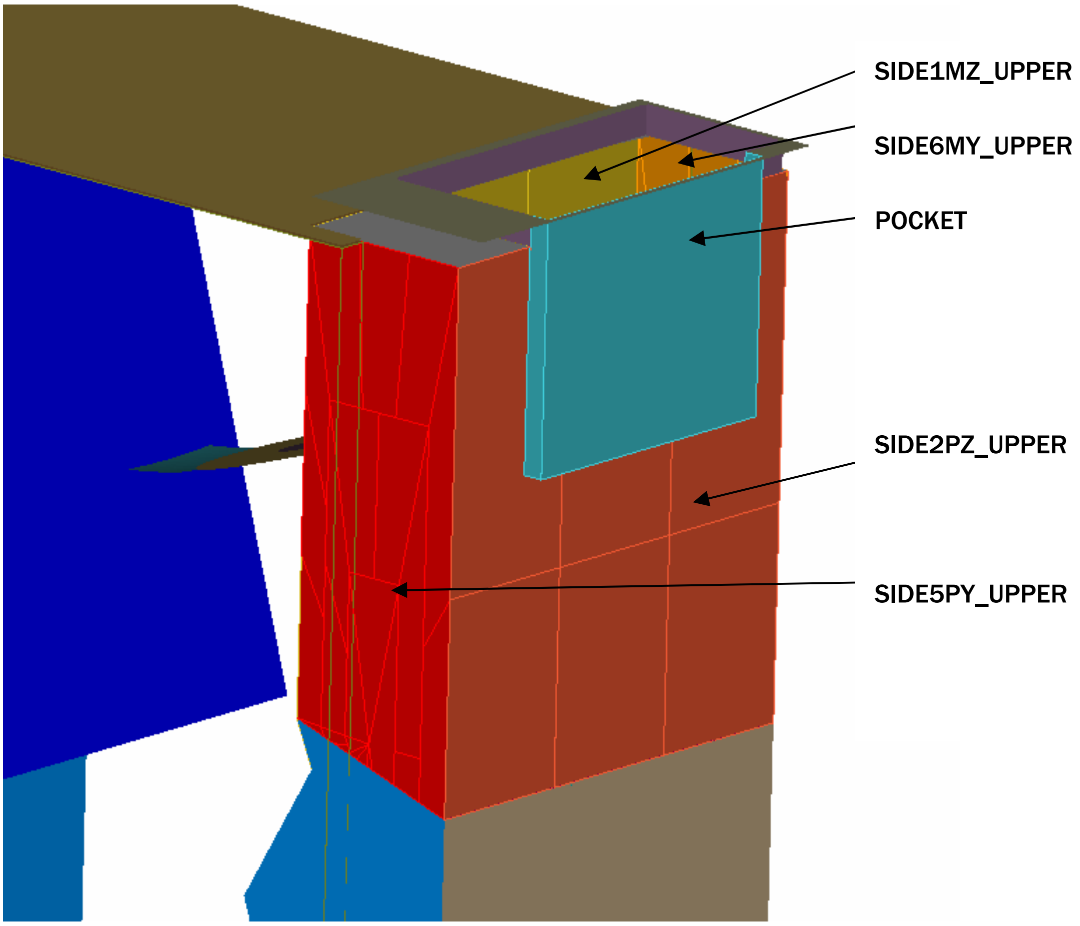

Figure 15 ASAP 3D plot of SPIRE entrance section showing which surfaces have been assumed to be “black”.

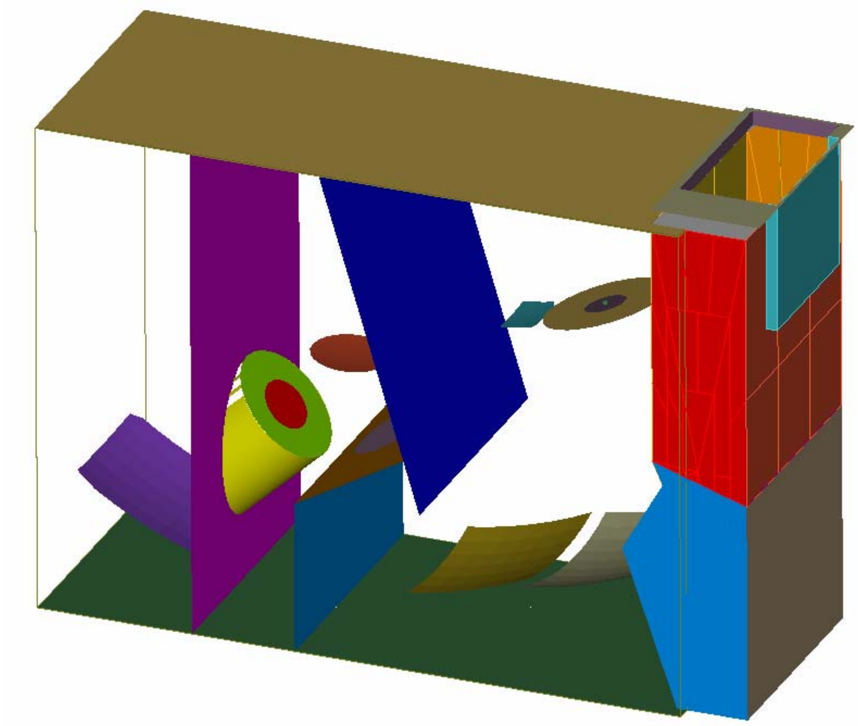

Figure 16 Other structural surfaces of SPIRE in the ASAP model

The surfaces of LOU TS1 and LOU TS2 baffles are assumed to have a reflectivity of 90% and 80%.

The HIFI cavity path was calculated by starting from the LO windows, through the baffles up to the FPU LO entrance openings (by ray tracing). The path through the HIFI FPU could not be calculated by ray tracing due to limitations of the HIFI straylight model. Therefore a theoretical attenuation of 6 has been assumed (this corresponds to about 99.8% reflectivity of HIFI internal surfaces). The path was then continued from M3 as Lambertian radiator to the instrument sensors by ray tracing again.

6 Tests conditions and results

The following test cases have been calculated.

	Case 1	Case 2	Case 3	Case 4	Case 5
OB / IS	5	5	5	8	9
TS1	13	11	11	30	35
TS2/ENB	62	38	38	75	79
TS3	102	48	48	102	111
CCM	11	11	80	196	13
HBB	1473.15 /off	off	off	off	off

Table 4 Temperatures in K used in the simulations.

The contribution from the hot blackbody (HBB) source was found negligible. Consequently the on/off states of the HBB source are not listed separately but the (negligible) contribution added to the overall result, i.e. the HBB source is always “on” in the results given in the following tables.

7 Results of straylight calculations

In the following results are given for the different temperature cases described in chapter 4. [2]

Emitting object	temperature / emissivity	PACS detector		SPIRE detector	
		88 µm	177 µm	230 µm	670 µm
0. CCM into FoV	11 K / 0.002	$6.4 \cdot 10^{-6}$	0.0091	0.033	0.40
1. CVV rim	293 K / 0.05	0.065	0.031	0.77	0.60
2. Crown surfaces	293 K / 0.05	0.31	0.15	0.51	0.40
3. Entrance Baffle (ENB) cylinder + aperture upper side	62 K / 0.50	1.57	1.81	3.28	3.44
4. Emission from gap below IS	5 K / 0.9	$1.4 \cdot 10^{-14}$	$9.3 \cdot 10^{-7}$	0.00002	0.018
5. Emission from CCM black rim	11 K / 0.5	$8.0 \cdot 10^{-8}$	0.00011	0.011	0.13
6. Emission from gap between ENB tube and IS tube	62 K / 0.5	0.23	0.27	0.35	0.37
7a. LOU window emission through HIFI M3	293 K / 0.9	0.0025	0.0012	0.0010	0.00080
7b. Emission from HBB source through LOU baffle and HIFI band 3	1473 K / 0.9	$9.4 \cdot 10^{-5}$	$3.9 \cdot 10^{-5}$	0.00017	0.00013
7c. Emission from LOU window through LOU baffle and HIFI band 3	293 K / 0.9	0.00048	0.00023	0.0011	0.00082
9. Emission from gap below IS, from holes in OB	13 K / 0.9	$3.6 \cdot 10^{-6}$	0.0013	0.0027	0.019
10. Emission from LOU through via gap below IS	293 K / 0.9	0.31	0.15	0.099	0.077
11. Emission from LOU via gap between ENB and IS	293 K / 0.9	0.15	0.073	0.082	0.064
sum self-emission without diffraction / misalignment and without CCM emission into FoV		**2.64**	**2.48**	**5.11**	**5.11**
Diffracted light (5% added)		0.13	0.12	0.26	0.26
Misalignment (30% added)		0.79	0.74	1.53	1.53
Total (incl. diffraction, misalignment and TSE from CCM into FoV)		**3.56**	**3.36**	**6.93**	**7.30**

Data for PACS and SPIRE are in % with 100% = telescope emission (70 K, total ε = 0.03)

Table 5 Straylight prediction for the temperature case 1.

[2] These results were obtained using the Excel-sheet TSE_Herschel_STM2.xls.

Emitting object	temperature / emissivity	PACS detector		SPIRE detector	
		88 µm	177 µm	230 µm	670 µm
0. CCM into FoV	11 K / 0.002	$6.4 \cdot 10^{-6}$	0.0091	0.033	0.40
1. CVV rim	293 K / 0.05	0.065	0.031	0.77	0.60
2. Crown surfaces	293 K / 0.05	0.31	0.15	0.51	0.40
3. Entrance Baffle (ENB) cylinder + aperture upper side	38 K / 0.50	0.24	0.65	1.37	1.87
4. Emission from gap below IS	5 K / 0.9	$1.4 \cdot 10^{-14}$	$9.3 \cdot 10^{-7}$	0.00002	0.018
5. Emission from CCM black rim	11 K / 0.5	$8.0 \cdot 10^{-8}$	0.00011	0.011	0.13
6. Emission from gap between ENB tube and IS tube	38 K / 0.5	0.036	0.098	0.146	0.201
7a. LOU window emission through HIFI M3	293 K / 0.9	0.0025	0.0012	0.0010	0.00080
7b. Emission from HBB source through LOU baffle and HIFI band 3	1473 K / 0.9	$9.4 \cdot 10^{-5}$	$3.9 \cdot 10^{-5}$	0.00017	0.00013
7c. Emission from LOU window through LOU baffle and HIFI band 3	293 K / 0.9	0.00048	0.00023	0.0011	0.00082
9. Emission from gap below IS, from holes in OB	11 K / 0.9	$2.9 \cdot 10^{-7}$	$4.2 \cdot 10^{-4}$	0.0011	0.014
10. Emission from LOU through via gap below IS	293 K / 0.9	0.31	0.15	0.099	0.077
11. Emission from LOU via gap between ENB and IS	293 K / 0.9	0.15	0.073	0.082	0.064
sum self-emission without diffraction / misalignment and without CCM emission into FoV		**1.11**	**1.16**	**2.99**	**3.37**
Diffracted light (5% added)		0.06	0.06	0.15	0.17
Misalignment (30% added)		0.33	0.35	0.90	1.01
Total (incl. diffraction, misalignment and TSE from CCM into FoV)		**1.50**	**1.57**	**4.06**	**4.95**

Data for PACS and SPIRE are in % with 100% = telescope emission (70 K, total ε = 0.03)

Table 6 Straylight prediction for the temperature case 2.

Emitting object	temperature / emissivity	PACS detector		SPIRE detector	
		88 µm	177 µm	230 µm	670 µm
0. CCM into FoV	80 K / 0.002	9.6	8.4	8.3	7.9
1. CVV rim	293 K / 0.05	0.065	0.031	0.77	0.60
2. Crown surfaces	293 K / 0.05	0.31	0.15	0.51	0.40
3. Entrance Baffle (ENB) cylinder + aperture upper side	38 K / 0.50	0.24	0.65	1.37	1.87
4. Emission from gap below IS	5 K / 0.9	$1.4 \cdot 10^{-14}$	$9.3 \cdot 10^{-7}$	0.00002	0.018
5. Emission from CCM black rim	80 K / 0.5	0.12	0.10	2.63	2.52
6. Emission from gap between ENB tube and IS tube	38 K / 0.5	0.036	0.098	0.146	0.201
7a. LOU window emission through HIFI M3	293 K / 0.9	0.0025	0.0012	0.0010	0.00080
7b. Emission from HBB source through LOU baffle and HIFI band 3	1473 K / 0.9	$9.4 \cdot 10^{-5}$	$3.9 \cdot 10^{-5}$	0.00017	0.00013
7c. Emission from LOU window through LOU baffle and HIFI band 3	293 K / 0.9	0.00048	0.00023	0.0011	0.00082
9. Emission from gap below IS, from holes in OB	11 K / 0.9	$2.9 \cdot 10^{-7}$	$4.2 \cdot 10^{-4}$	0.0011	0.014
10. Emission from LOU through via gap below IS	293 K / 0.9	0.31	0.15	0.099	0.077
11. Emission from LOU via gap between ENB and IS	293 K / 0.9	0.15	0.073	0.082	0.064
sum self-emission without diffraction / misalignment and without CCM emission into FoV		**1.23**	**1.26**	**5.61**	**5.76**
Diffracted light (5% added)		0.06	0.06	0.28	0.29
Misalignment (30% added)		0.37	0.38	1.68	1.73
Total (incl. diffraction, misalignment and TSE from CCM into FoV)		**11.25**	**10.08**	**15.82**	**15.68**

Data for PACS and SPIRE are in % with 100% = telescope emission (70 K, total ε = 0.03)

Table 7 Straylight prediction for the temperature case 3.

Emitting object	**temperature / emissivity**	**PACS detector**		**SPIRE detector**	
		88 µm	**177 µm**	**230 µm**	**670 µm**
0. CCM into FoV	196 K / 0.002	54.0	28.8	26.0	21.0
1. CVV rim	293 K / 0.05	0.065	0.031	0.77	0.60
2. Crown surfaces	293 K / 0.05	0.31	0.15	0.51	0.40
3. Entrance Baffle (ENB) cylinder + aperture upper side	75 K / 0.50	2.69	2.50	4.39	4.29
4. Emission from gap below IS	8 K / 0.9	$1.0 \cdot 10^{-8}$	$4.1 \cdot 10^{-4}$	0.0021	0.095
5. Emission from CCM black rim	196 K / 0.5	0.67	0.36	8.30	6.70
6. Emission from gap between ENB tube and IS tube	75 K / 0.50	0.402	0.374	0.471	0.460
7a. LOU window emission through HIFI M3	293 K / 0.90	0.0025	0.0012	0.0010	0.00080
7b. Emission from HBB source through LOU baffle and HIFI band 3	1473 K / 0.90	$9.4 \cdot 10^{-5}$	$3.9 \cdot 10^{-5}$	0.00017	0.00013
7c. Emission from LOU window through LOU baffle and HIFI band 3	293 K / 0.90	0.00048	0.00023	0.0011	0.00082
9. Emission from gap below IS, from holes in OB	30 K / 0.90	0.0092	0.048	0.047	0.078
10. Emission from LOU through via gap below IS	293 K / 0.90	0.31	0.15	0.099	0.077
11. Emission from LOU via gap between ENB and IS	293 K / 0.90	0.15	0.073	0.082	0.064
sum self-emission without diffraction / misalignment and without CCM emission into FoV		**4.61**	**3.69**	**14.67**	**12.76**
Diffracted light (5% added)		0.23	0.18	0.73	0.64
Misalignment (30% added)		1.38	1.11	4.40	3.83
Total (incl. diffraction, misalignment and TSE from CCM into FoV)		**60.24**	**33.73**	**45.83**	**38.24**

Data for PACS and SPIRE are in % with 100% = telescope emission (70 K, total ε = 0.03)

Table 8 Straylight prediction for the temperature case 4.

Emitting object	temperature / emissivity	PACS detector		SPIRE detector	
		88 µm	177 µm	230 µm	670 µm
0. CCM into FoV	13 K / 0.002	0.00008	0.028	0.080	0.58
1. CVV rim	293 K / 0.05	0.065	0.031	0.77	0.60
2. Crown surfaces	293 K / 0.05	0.31	0.15	0.51	0.40
3. Entrance Baffle (ENB) cylinder + aperture upper side	79 K / 0.50	3.08	2.72	4.74	4.55
4. Emission from gap below IS	9 K / 0.9	$1.2 \cdot 10^{-7}$	$1.3 \cdot 10^{-3}$	0.005	0.132
5. Emission from CCM black rim	13 K / 0.5	$9.8 \cdot 10^{-7}$	0.00035	0.026	0.184
6. Emission from gap between ENB tube and IS tube	79 K / 0.5	0.46	0.41	0.51	0.49
7a. LOU window emission through HIFI M3	293 K / 0.9	0.0025	0.0012	0.0010	0.00080
7b. Emission from HBB source through LOU baffle and HIFI band 3	1473 K / 0.9	$9.4 \cdot 10^{-5}$	$3.9 \cdot 10^{-5}$	0.00017	0.00013
7c. Emission from LOU window through LOU baffle and HIFI band 3	293 K / 0.9	0.00048	0.00023	0.0011	0.00082
9. Emission from gap below IS, from holes in OB	35 K / 0.9	0.022	0.073	0.066	0.097
10. Emission from LOU through via gap below IS	293 K / 0.9	0.31	0.15	0.099	0.077
11. Emission from LOU via gap between ENB and IS	293 K / 0.9	0.15	0.073	0.082	0.064
sum self-emission without diffraction / misalignment and without CCM emission into FoV		**4.40**	**3.61**	**6.80**	**6.59**
Diffracted light (5% added)		0.22	0.18	0.34	0.33
Misalignment (30% added)		1.32	1.08	2.04	1.98
Total (incl. diffraction, misalignment and TSE from CCM into FoV)		**5.94**	**4.90**	**9.26**	**9.47**

Data for PACS and SPIRE are in % with 100% = telescope emission (70 K, total ε = 0.03)

Table 9 Straylight prediction for the temperature case 5.

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	Name	Dep./Comp.		Name	Dep./Comp.
	Alberti von Mathias Dr.	ASG22		Steininger Eric	AED32
	Barlage Bernhard	AED13	x	Stritter Rene	AED11
	Bayer Thomas	ASA42		Suess Rudi	OTN/ASA44
	Brune Holger	ASA45		Thörmer Klaus-Horst Dr.	OTN/AED65
	Edelhoff Dirk	AED2		Wagner Klaus	ASG22
	Fehringer Alexander	ASG13	x	Wietbrock Walter	AET12
x	Fricke Wolfgang Dr.	AED 65		Wöhler Hans	ASG22
	Geiger Hermann	ASA42		Wössner Ulrich	ASE252
	Grasl Andreas	OTN/ASA44			
	Grasshoff Brigitte	AET12			
x	Hartmann Hans	AED32	x	Alcatel Alenia Space Cannes	ASP
	Hauser Armin	ASG22	x	ESA/ESTEC	ESA
	Hendry David	Terma			
	Hengstler Reinhold	ASA42		**Instruments:**	
	Hinger Jürgen	ASG22	x	MPE (PACS)	MPE
x	Hohn Rüdiger	AED65	x	RAL (SPIRE)	RAL
x	Hölzle Edgar Dr.	AED32	x	SRON (HIFI)	SRON
	Huber Johann	ASA42		**Subcontractors:**	
	Hund Walter	ASE252		Air Liquide, Space Department	AIR
x	Idler Siegmund	AED312		Air Liquide, Space Department	AIRS
	Ivády von András	FAE12		Air Liquide, Orbital System	AIRT
	Jahn Gerd Dr.	ASG22		Alcatel Alenia Space Antwerp	ABSP
	Kalde Clemens	ASM2		Austrian Aerospace	AAE
	Kameter Rudolf	OTN/ASA42		Austrian Aerospace	AAEM
	Kettner Bernhard	AET42		APCO Technologies S. A.	APCO
	Knoblauch August	AET32		Bieri Engineering B. V.	BIER
	Koelle Markus	ASA43		BOC Edwards	BOCE
	Koppe Axel	AED312		Dutch Space Solar Arrays	DSSA
x	Kroeker Jürgen	AED65		EADS Astrium Sub-Subsyst. & Equipment	ASSE
	La Gioia Valentina	Terma		EADS CASA Espacio	CASA
	Lamprecht Ernst	OTN/ASQ22		EADS CASA Espacio	ECAS
	Lang Jürgen	ASE252		EADS Space Transportation	ASIP
	Langenstein Rolf	AED15		Eurocopter	ECD
	Langfermann Michael	ASA41		European Test Services	ETS
	Mattia Stefano	Terma		HTS AG Zürich	HTSZ
	Much Christoph	ASA43		Linde	LIND
	Müller Jörg	ASA42		Patria New Technologies Oy	PANT
	Müller Martin	ASA43		Phoenix, Volkmarsen	PHOE
	Peltz Heinz-Willi	ASG13		Prototech AS	PROT
	Pietroboni Karin	AED65		QMC Instruments Ltd.	QMC
	Platzer Wilhelm	AED2		Rembe, Brilon	REMB
	Reichle Konrad	ASA42		Rosemount Aerospace GmbH	ROSE
	Runge Axel	OTN/ASA44		RYMSA, Radiación y Microondas S.A.	RYM
x	Schink Dietmar	AED32		SENER Ingenieria SA	SEN
	Schlosser Christian	OTN/ASA44		Stöhr, Königsbrunn	STOE
	Schmidt Rudolf	FAE12		Terma A/S, Herlev	TER
	Schweickert Gunn	ASG22		Terma A/S, Herlev	TERM