esa

MINUTES OF MEETING

Herschel/Planck Project

SPIRE-ESA-MOM-001227

	reference SCI-PT/012138	page	1/5
meeting date	20 March 02	meeting place	ESTEC
chairman	D. de Chambure - ESA		
copy			
subject	Herschel Stray Light Meeting		

participants:

Name:	Affiliation:	Signature:
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Jacqueline Fischer	NRL	
Kotska Wallace	ESA - ESTEC	
Philippe MARTIN	Alcatel	
Volker Kirschner	ESA - ESTEC	
Göran Pilbratt	ESA - ESTEC	
Josef Schubert	MPE / PACS	
Dirk Kampf	Kayser-Threde	
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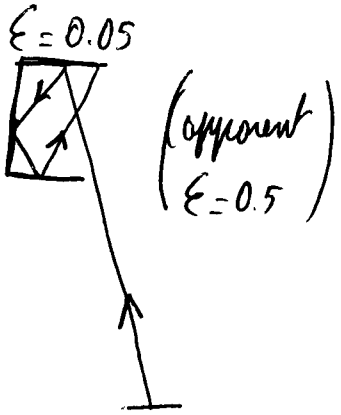
description	action	due date
ASED presentation (see annex ~~10~~ pages) thermal irradiance onto telescope plane		

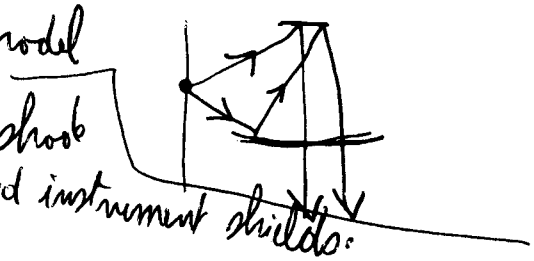
(i) Telescope temperature shall be 70K for stray light analysis (not 80K)

(ii) Thermal shield emissivity values shall be justified: it is an "apparent" emissivity (therefore worst case value).



(iii) The cryostat baffle is designed against the telescope beam size with no vignetting (not taking into instrument specific needs yet) - In other words, the diameter of the cryostat baffle would be reduced as part of the telescope optical beam is not entering the instruments (trade-off thermal - life time etc..).

(iv) The table of thermal irradiance shall be completed with the following contributions (at least)
- instrument shield + HIFI M3 mirror + support
- LOU windows (incl light path through M2)
- sunshade (via diffusion / reflection) → to be computed from telescope ASAP model
- cavity between telescope and sunshade
- holes through optical bench* and instrument shields at the instrument focus (and not only at telescope focal plane).



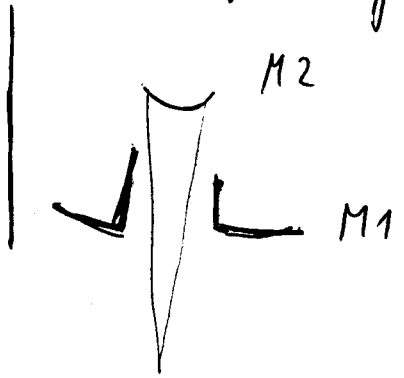
* MLI from the bench

description	action	due date

Indeed, scattering from telescope is likely one the most important contributor for thermo instrument.

(M) Configuration ~~of~~ the CV/thermal shield = accurate drawing to sent to all parties (ESA/Alcatel/instrument) with details on thermal shields

(M) ASED has to give requirements to ASEF for the telescope baffle (central hole).
In order to eliminate uncertainties on the optical surface definition, a proposal is made to have a cone at the primary hole



description	action	due date

Stray light from sources outside FOV

Sun has much lower effect than Earth and Moon in terms of stray light (Earth = 23° / Moon = 13°) → to be further justified

Stray light from sources inside FOV

- ASED has not really work on the issue. Everybody agrees that it is very likely less critical than the other stray light contributors. Main elements are: telescope + instrument mirror surface roughness / contamination image quality of telescope (and instrument → less important factor).
- Scatter model of telescope shall be compared to Ferlet technical note (issued in Nov 01).

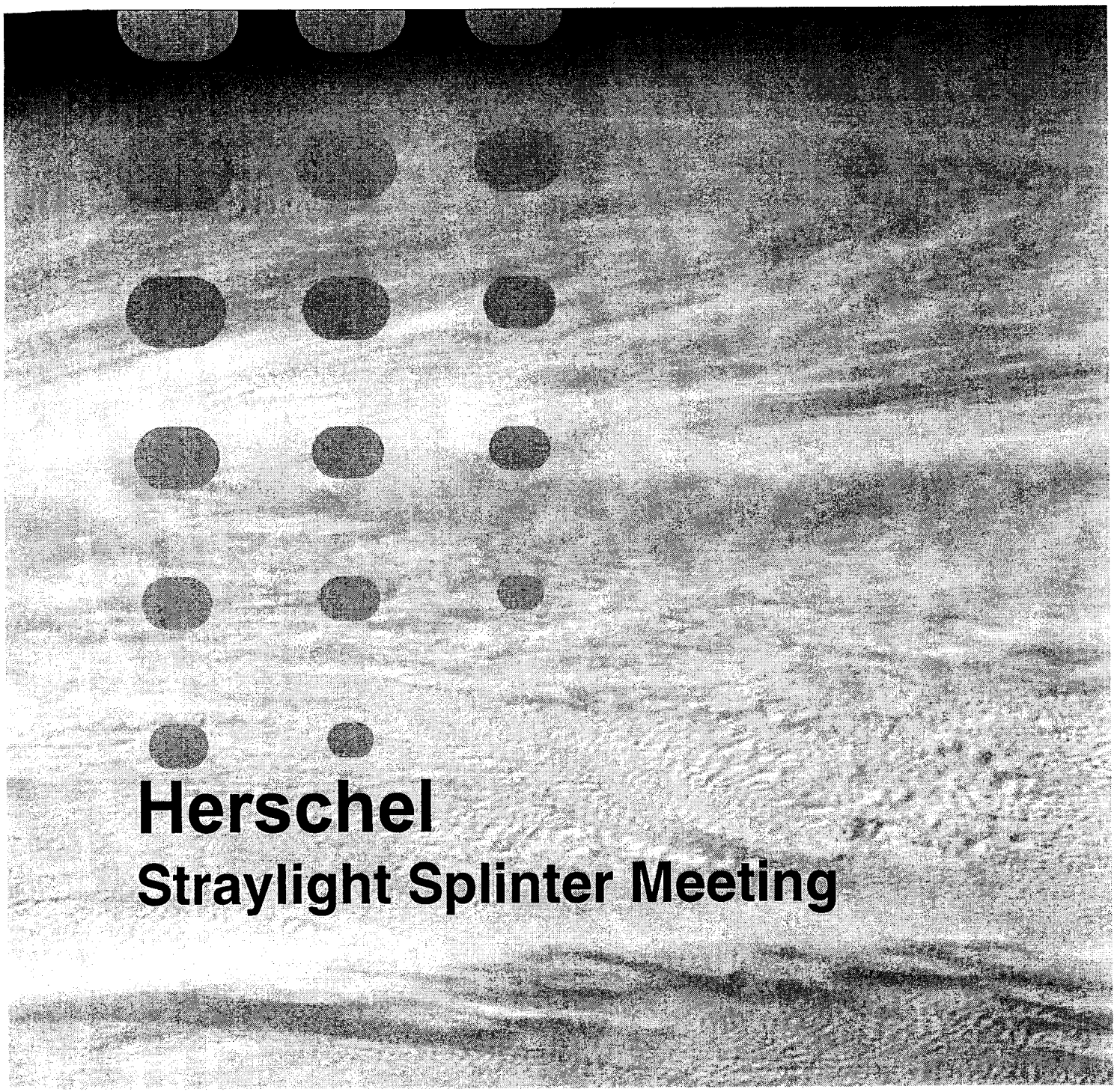
description	action	due date

Stray light evaluation tool

Discussion on diffraction modelisation with ASAP model.

Actions

- ~~PACS~~ new PACS model is being built for ASED containing top optics + old step + major mirrors - Delivery < end March 02
- ASED will deliver a report on stray light analysis for SPIRE on April 5, 02 with the most important stray light path. The report shall take all the remarks above with clear assumption / description of the configuration of the CVV / instrument / telescope (dimensions / E / T).
- Next meeting 23/4/02 Estec.



Herschel
Straylight Splinter Meeting

astrium

Albrecht Frey
20.3.2002

THERMAL IRRADIANCE ONTO TELESCOPE FOCAL PLANE

Surface	assumed temperature Kelvin	assumed emissivity	radiance of corresp. grey body (watt/m^2/sr/micrometer) wavelength (micrometer) 80	670	surface as seen from telescope focal plane degrees^2	surface as seen from telescope focal plane steradian	irradiance onto telescope focal plane (watt/m^2/micrometer) wavelength (micrometer) 80	670
Telesc. reflect.	80	0.04	1.72E-04	1.15E-07	33	0.0101	1.73E-06	1.15E-09
Therm. Shield 1	32	0.5	6.61E-05	4.61E-07	166	0.0506	3.34E-06	2.33E-08
Therm. Shield 2	39	0.5	1.82E-04	6.01E-07	268	0.0816	1.49E-05	4.90E-08
Therm. Shield 3	55	0.5	7.18E-04	9.23E-07	192	0.0585	4.20E-05	5.40E-08
CVV	70	0.5	1.51E-03	1.23E-06	180	0.0548	8.26E-05	6.74E-08
Cryostat baffle	76	0.5	1.88E-03	1.35E-06	670	0.2041	3.84E-04	2.76E-07
Telescope baffle	80	0.5	2.15E-03	1.43E-06	273	0.0832	1.78E-04	1.19E-07

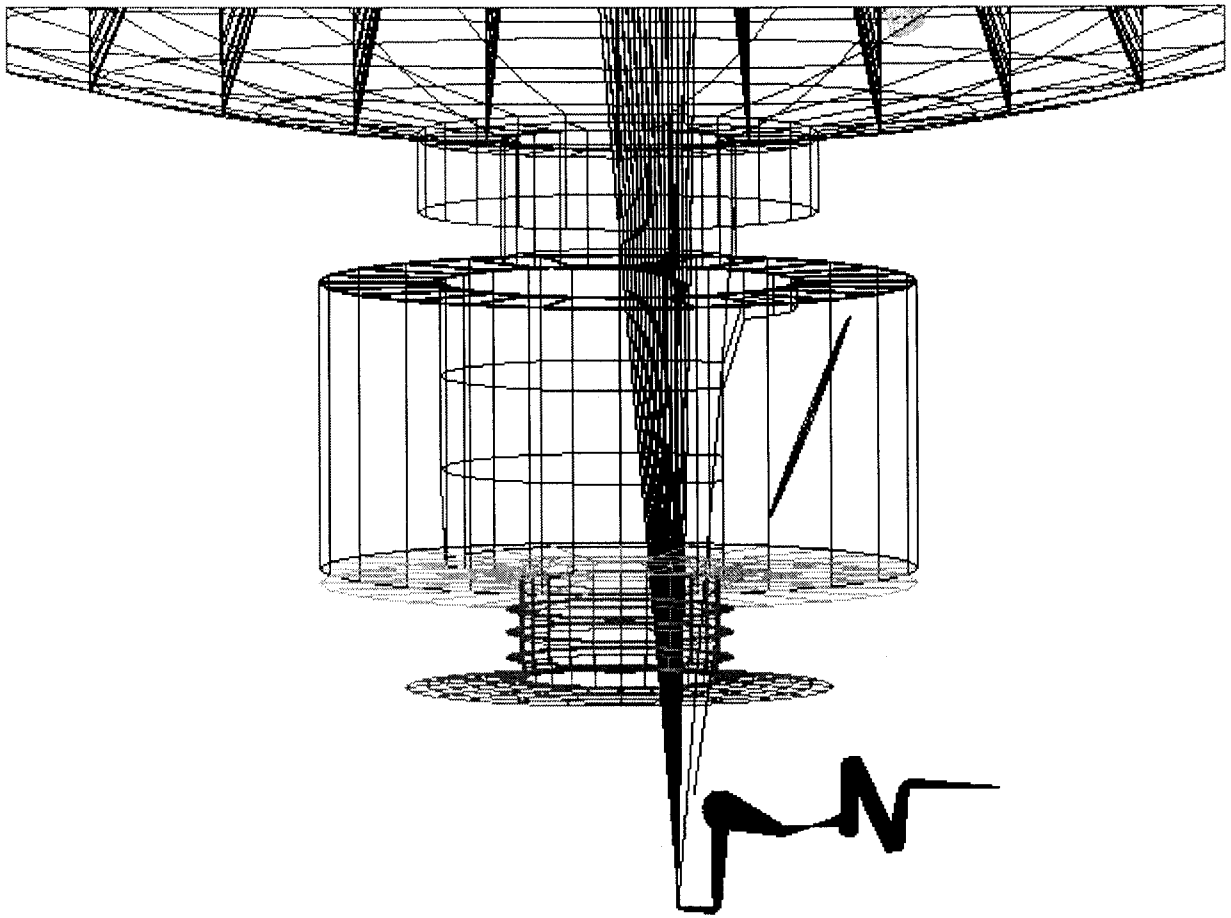
(see next page for relative numbers and comment)

THERMAL IRRADIANCE ONTO TELESCOPE FOCAL PLANE

Surface	assumed temperature Kelvin	assumed emissivity	surface as seen from telescope focal plane degrees^2	relative irradiance onto telescope focal plane (telescope reflectors=1) at wavelength (micrometer) 80	670
telescope reflectors	80	0.04	33	1.0	1.0
Thermal Shield 1	32	0.5	166	1.9	20.2
Thermal Shield 2	39	0.5	268	8.6	42.6
Thermal Shield 3	55	0.5	192	24.3	46.9
CVV	70	0.5	180	47.9	58.5
Cryostat baffle	76	0.5	670	222.5	239.3
Telescope baffle	80	0.5	273	103.4	103.4

Specification (=0.1 relative irradiance) exceeded by powers of ten (in that plane!).

The thermal straylight (except that from the reflectors) impinges inclined w.r.t experiment viewing directions. Thus experiment straylight rejection for inclined rays is vital for the fulfilment of the specification. The numbers above are expected to decrease appreciably up to the experiment focal plane.



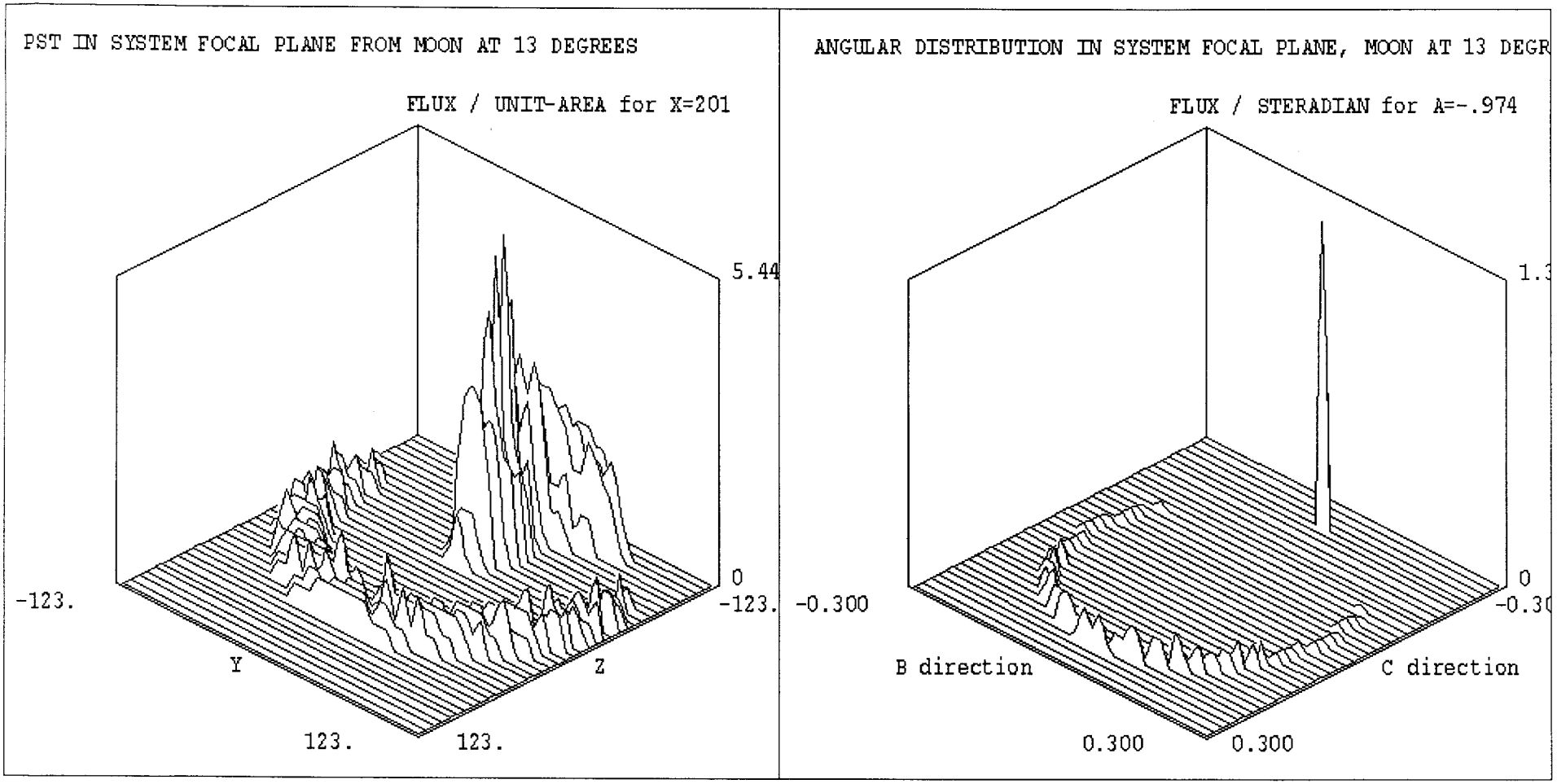
PACS beam for center of image plane. Most of the thermal radiation impinges inclined onto the system focal plane w.r.t. that beam (only two thermal rays shown).

IRRADIANCE ONTO TELESCOPE BY EARTH AND MOON

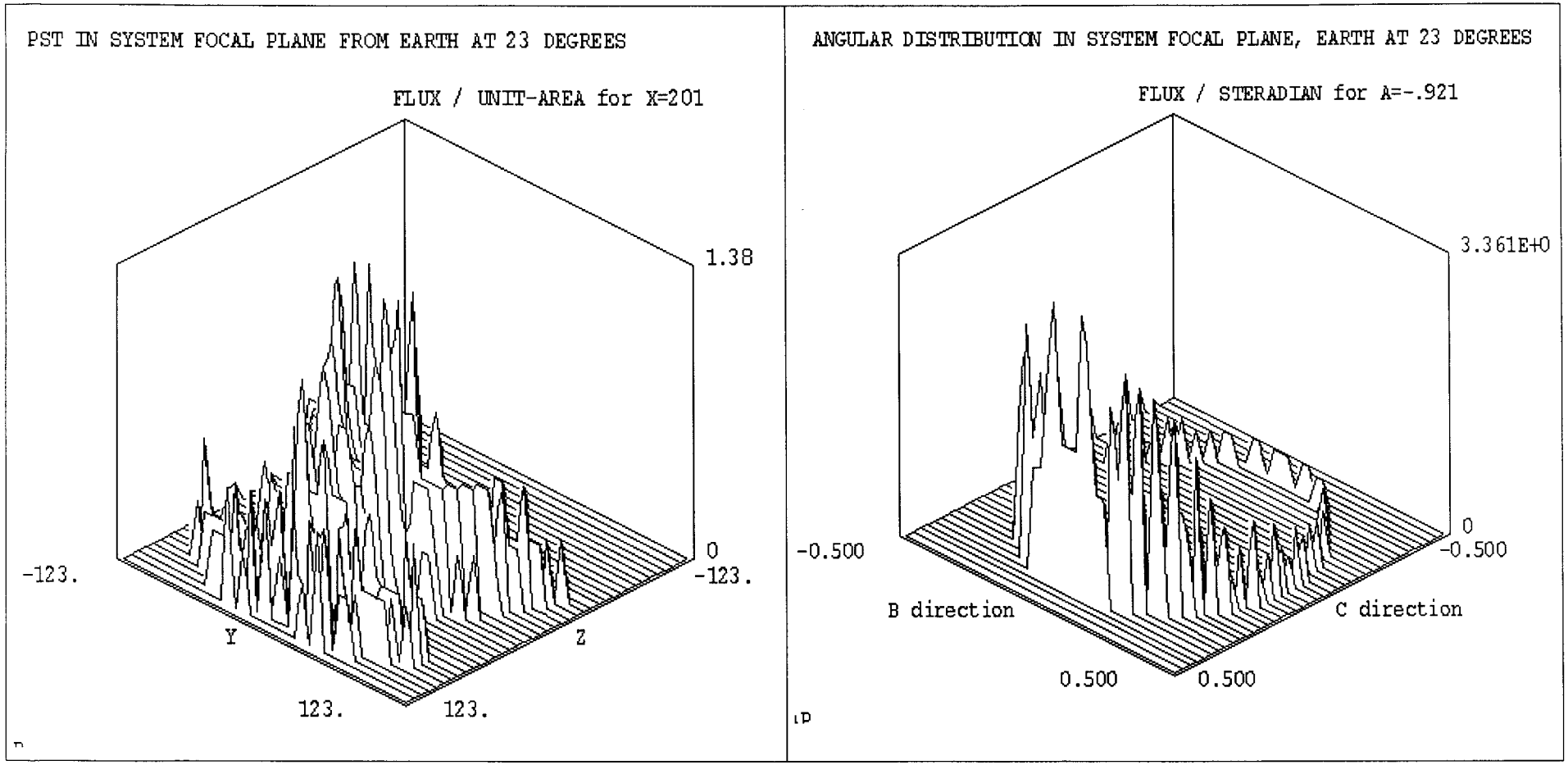
Object	assumed temperature	assumed emissivity or albedo	radiance of corresp. black body (watt/m^2/sr/micrometer)		diameter	solid angle (with fraction day/night)	irradiance (watt/m^2/micrometer)	
			wavelength (micrometer)				wavelength (micrometer)	
	Kelvin		80	670	rad	steradian	80	670
sun	5900	1	1.17E+00	2.42E-04	0.0093	6.79E-05	7.98E-05	1.64E-08
moon reflection	albedo	0.3	7.62E-06	1.57E-09	0.004	1.96E-06	1.49E-11	3.08E-15
moon em. day	400	1	6.40E-02	1.60E-05	0.004	1.96E-06	1.26E-07	3.14E-11
moon em. night	100	1	7.21E-03	3.68E-06	0.004	1.06E-05	7.65E-08	3.91E-11
moon sum							**2.02E-07**	**7.04E-11**
earth reflection	albedo	0.37	9.39E-06	1.94E-09	0.01	5.50E-06	5.16E-11	1.06E-14
earth em. day	288	1	4.19E-02	1.14E-05	0.01	5.50E-06	2.30E-07	6.26E-11
earth em. night	288	1	4.19E-02	1.14E-05	0.01	7.30E-05	3.06E-06	8.32E-10
earth sum							**3.29E-06**	**8.95E-10**
Telesc. reflect.	80	0.04					**1.73E-06**	**1.15E-09**

Specification (=0.01 of last line) may be violated, if purely specular paths occur.

⇒Specular traces (forward and backward) with the complete straylight model are planned.



Left: Point source transmittance (PST) for the moon (at 13 degrees) in telescope focal plane, spatial distribution across plane. Only specular reflections in telescope and cryostat.
Right: Angular distribution in telescope focal plane. 0.3 corresponds to 17 degrees.



Left: Point source transmittance (PST) for the earth (at 23 degrees) in telescope focal plane, spatial distribution across plane. Only specular reflections in telescope and cryostat.
Right: Angular distribution in telescope focal plane. 0.5 corresponds to 30 degrees.

Straylight Splinter Meeting

Object	irradiance before telescope (watt/m^2/micrometer)		point source transmittance		at off-axis angle	straylight process	irradiance onto telescope focal plane (watt/m^2/micrometer)	
	wavelength (microm.)		wavelength (micrometer)				wavelength (micrometer)	
	80	670	80	670	degrees		80	670
moon	2.02E-07	7.04E-11	3.00E-01	3.00E-01	13	specular *	6.06E-08	2.11E-11
moon	2.02E-07	7.04E-11	7.69E-07	7.69E-07	13	scattering+	1.55E-13	5.41E-17
earth	3.29E-06	8.95E-10	1.30E-01	1.30E-01	23	specular *	4.28E-07	1.16E-10
earth	3.29E-06	8.95E-10	1.95E-07	1.95E-07	23	scattering+	6.42E-13	1.74E-16
Telesc. reflect.							**1.73E-06**	**1.15E-09**

***: specular reflections in telescope and cryostat,**

+: scattering on main reflector

Specification (=0.01 of last line) exceeded by specular paths (in that plane!).

The angular distribution shows again, that experiment straylight rejection for inclined rays is vital for the fulfilment of the specification. The numbers for the specular paths are expected to decrease appreciably up to the experiment focal plane.

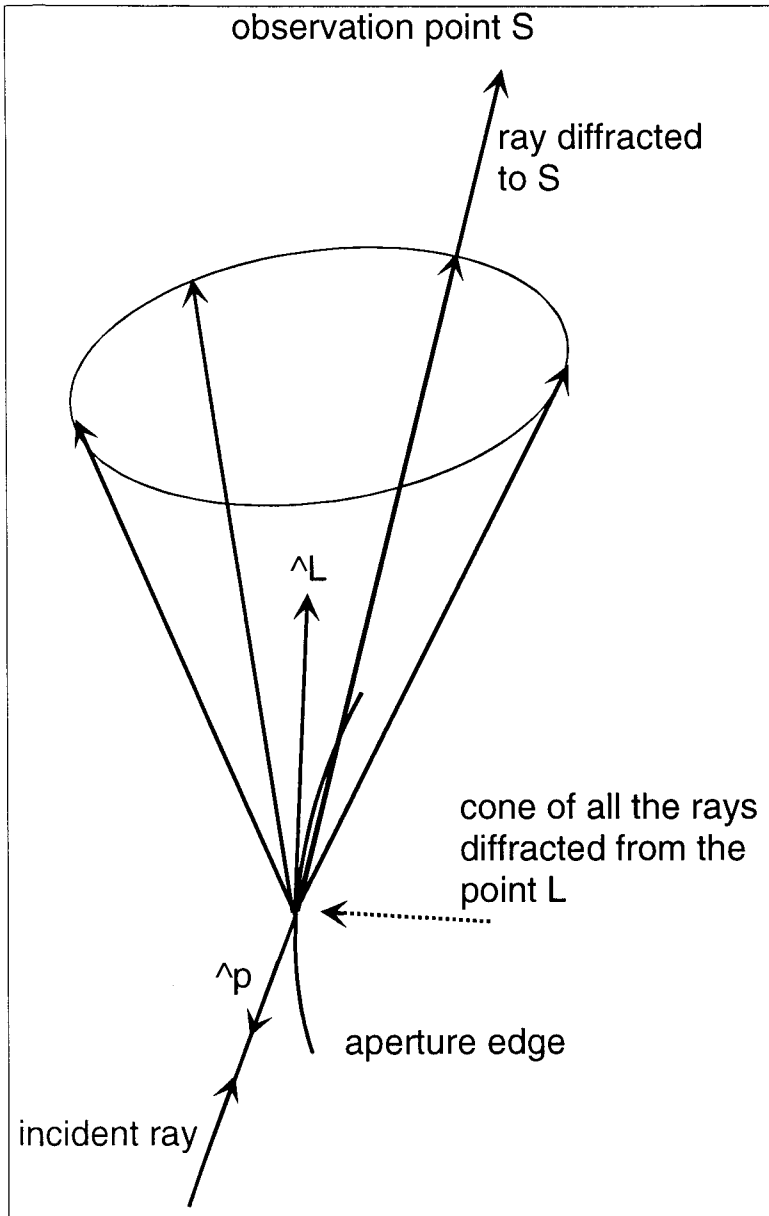
(Scatter paths to be completed, there are several ones).

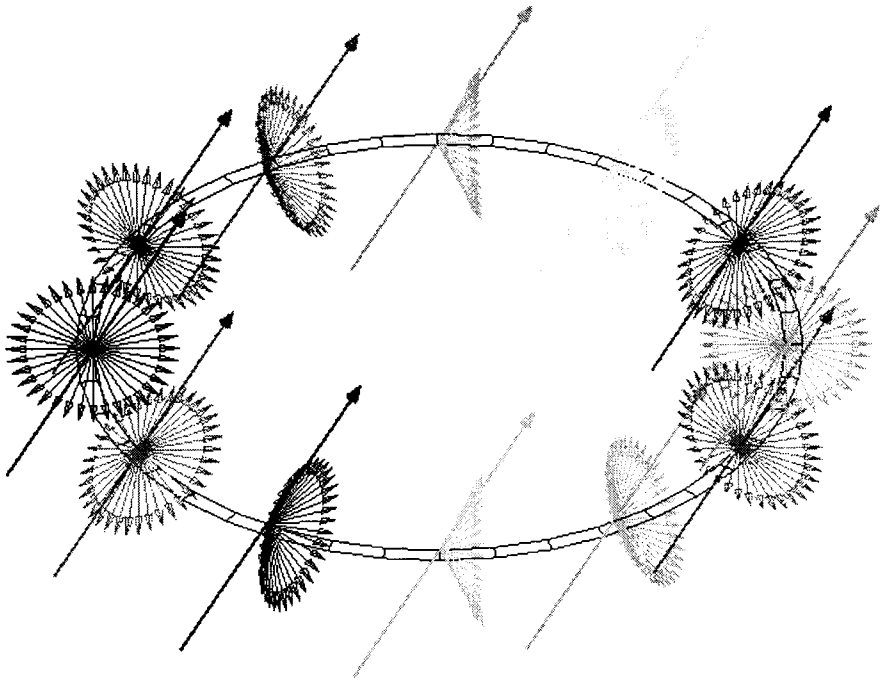
Straylight Evaluation Tools

Specular reflections: ASAP analysis program with non-sequential trace,
forward and backward trace.
Very important for Herschel for the detection of ‚hidden' paths,
since Herschel has many specular objects.

Surface scattering: surface scatter models available within ASAP,
model parameters as received by the responsible institutions.
‚Important' scatter targets selected in order to reduce number of rays.

Diffraction: ‚Method of stationary phase',
applicable for medium to large diffraction angles
i.e. beyond the range of coherent diffraction module of ASAP.
Angular properties explicitely used for targeting the diffration radiation (see sketch)
Not available as ‚standard' command sequence within ASAP,
may be programmed with ‚macro language' of ASAP, if necessary.



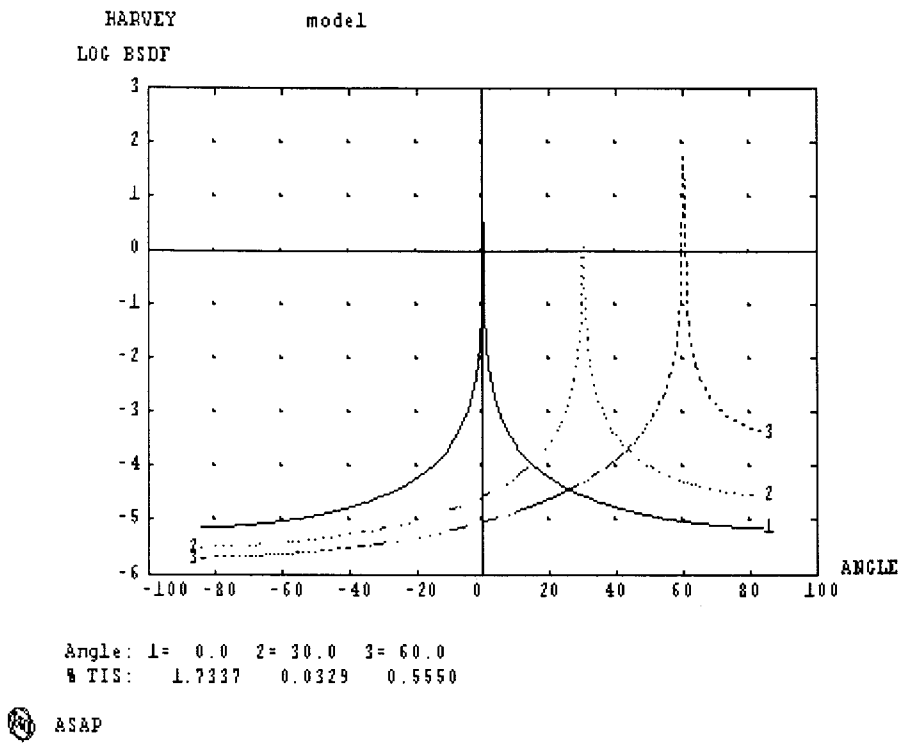


diffraction cones generated by several specular rays incident on a circular aperture,

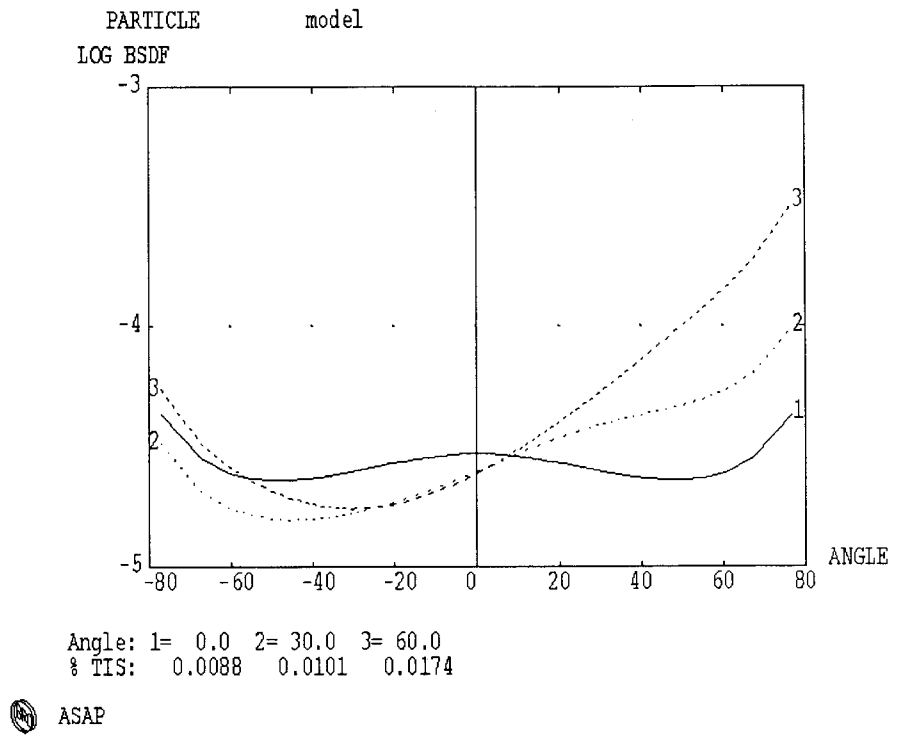
angle of inc. on plane of aperture = 30 degrees

angle between specular ray and edge tangent = 60...90 degrees

Left: angle between specular ray and edge tangent = 20 degrees



scatter model received for telescope mirrors
Harvey-parameters b=0.07, m=-2



scatter model received for SPIRE mirrors,
particle model at 350 micrometer

examples for mirror scattering models

