SPIRE Optics Summit Meeting
18/19 July 2000

Present:
B Swinyard
K Dohlen
M Caldwell
P Hargrave
B Winter
A Richards

These notes are intended as a reminder to those present of the topics covered and decisions made.

Summary:
This meeting was convened so that all interested parties in the opto-mechanical system level design could "crawl" over the proposed optical design and address all outstanding issues with a view to putting the "baseline" optical design under configuration control. This will then allow all other sub-systems to proceed with ICD definition.

The following issues have been flagged as having system level design implications:

- Exit hole from the instrument is required to be large enough to let the chopped and jiggled beams out without clipping. This may require a structural redesign of this part of the instrument and a redefinition of the shutter location and operation – ultimately the shutter may have to be deleted.

- The final optics of the spectrometer are non-telecentric whilst the present design of the detectors is. The performance implications of this are to be considered. The present design may be compromised to an unacceptable extent. This would require a system level decision on
  a) redesign of the spectrometer optics or…
  b) redesign of the spectrometer detectors and/or…
  c) acceptance of reduced scientific capability in the spectrometer.

These issues are now under urgent consideration. Unfortunately this coincides with the summer vacation and key staff will be missing for a period of weeks. A resolution of these issues is expected in September 2000.

A number of other more detailed design issues have to be addressed before the baseline design can go under configuration control. These are noted below.

i) Adoption of Agenda
Agenda immediately ignored – but most of the topics covered…….

ii) **Reprise of optical design**

Which telescope are we using?
R-C Hyperbolic primary/secondary f/0.5
Thick primary 18 Feb 2000 – BOLPHT150 was first introduction
Telescope document is 1/FEB/2000 – find this on DMS – this was where the data came from – reference this in the optical design document.

ACTION:
BMS to verify which document specifies this telescope design and to reference this in the optical design document.
Priority: Non Urgent
Date: for next issue of optical design document (October 2000).

Unvignetted FOV is 0.25 degrees – and hole in primary is the only free parameter.
Unvignetted FOV will go through but have to decide on what field stop we have.

Instrument specification on required contrast – moons of Jupiter or BN/KL.
Look at extended region with total integrated scatter. Set specification at ½ the total integrated scatter. Look at what dynamic range we need in the imaging contrast.

ACTION:
BMS to set specification on required contrast for imaging of faint sources next to bright extended objects – this will be converted into total integrated scatter specification by KjD.
Priority: High
Date: Required for evaluation optical cross talk – End August 2000

How to compare models and ensure translations are accurate.
Metric – x,y,z of chief ray on each component.
And WFE of ray bundles at five positions in the FOV.

Physical location of each mirror will be referenced to FIRST zero point which is on the FIRST optical bench on the optical axis – 202 mm below focal plane.
Optical design is as cold. The mirror positions cold will be defined by the interaction of the gut ray with the mirror surface; the normal of the component and the circumference of the mirror with respect to the interaction point.

Gut ray is defined as that which goes through the instrument from the off axis position of the instrument and passes through the centre of the secondary.
Common optics are defined by the photometer gut ray.
Proposed that a marginal ray should also be traced to give correct orientation – Martin and Tony will propose a set of rays for verification. Translations should be to within a 30 microns. The gut ray will be defined as part of this process to 6 decimal places in degrees – gives position to within 5 microns.

The mechanical ICDs will be defined with reference to this table.

ACTIONS:
AJR/MEC to send KjD definition of rays that will define the positions of the optical components – gut and amrginal ray(s)
Priority: Super urgent
Date: By end Friday 21/7/2000
KjD to produce spreadsheet with locations of gut ray intersections; surface normal vectors and circumferences of all components in the photometer and spectrometer optical trains.
Priority: Urgent
Date: Before he goes on Holiday (1/8/2000)
KjD to write detailed specification of metric(s) for verification of optical and mechanical translations.
Priority: Urgent
Date: Realistically Mid-September

iii) **Oversizing of components and approach to diffraction.**
Procedure followed is to compare the geometric sub-pupil and diffracted beam at 500 um.
This doesn't work well at stops but does give over sizes as ok for all photometer and spectrometer mirrors.
Kjetil says: but can we actually go smaller – Martin will generate 1% and 0.1% clearance factors in addition to GO clearance.
Ideal is that all structure is 20% clearance on "half widths" of Tony's geometric beams – use largest dimension. Pupil Tony is using in the spectrometer is 12.01x11.31 mm semi-major axes and radius of FOV is 7mm – stop is tilted w.r.t. beam by 21.06 and 18.06 degrees. For the photometer the pupil is 22.55 and 19.54 semi-axes zero tilt – decentred 0.65 mm – sized for pupil falling within radius of secondary for all M4 positions. FOV is 22x11ish.
How to decide pupil size – Kj traces system forward and limits the pupil aberration of the M2 image at the pupil location. He then draws a "cosmetic" ellipse around the ray trace at the pupil and calls this the stop.
But how do we actually decide upon the pupil size. Kjetil will trace M2 image for on axis detector and use the exact fit around the aberrated image.

ACTION: *KjD to define exact size of photometer aperture stop at the entrance to the 2-K box*
Priority: Urgent
Date: Needed to allows generation of all beams and component oversize via CodeV and ASAP analysis 1/8/2000?
Tony Richards to produce IGES files for gut rays, geometrical beams and 20% oversized beams (diameter) separately. As proposed on the note, handed over during the meeting by Berend
Priority: Urgent
Date: Required to investigate accommodation issues surrounding entrance

aperture. ASAP after his return from holiday

For the spectrometer there is an issue with design of stop at 4-K – what is the effect of the clipping of the mirror at the fold – size the stop and the mirror to fit for the on axis beam. Mirror is 20% oversize compared to geometric. Martin -let this first mirror do the clipping and just see what happen to the beam. Another possibility is to place a mask at the average pupil image position.

Consequence would be loss of r=0.04 cm-1 over whole FOV. Realisation is that the detectors are in fact telecentric. Thing to do first is to take the existing design and evaluate the effect of simply implementing it as it stands. Model for just edge of FOV to take into account the telecentricity and pupil wander.

iv) **Day 2: Review of previous day:**
Photometer Field Stop wasn't discussed – Kjetil will trace the 4x8 FOV through the system and this will be used to define the size of the detector arrays.

For structure and oversizing of optics the 20% is a design rule – where there is a problem it should be treated case by case – should look at where the 1% level lies. Beams will be generated as these "stay out" beams. Tony will define both geometric and oversized beams for importing into CAD.

For spectrometer – check the performance of the existing design. Have to check for all effects all at once. Can we toe in the detectors to get better optical performance – possible to do this with the feedhorns – BMS put proposal together and send to JPL.

ACTIONS:
KjD to define exact size of FOV at detector locations in spectrometer and photometer.
Priority: High
Date: Needed for final confirmation of all stop sizes and beams through instrument and for final size of detectors.
MEC evaluate performance of existing spectrometer optical design using ASAP. Look at total efficiency and fringe contrast at edge of FOV for resolution of 0.4 and 0.04 cm^{-1}. Propose first system stop location and size.
Priority: Urgent
Date: Required to show whether there is a significant problem with the present spectrometer design at very latest by end August.
BMS to propose non-telecentric feedhorn plate solution for consideration by JPL
Priority: High
Date: Needed for consideration of total system level assessment of spectrometer performance and possible improvements. 14/8/2000

v) **Baffles and Filtering:**
Input filter will go at field mask above M3. Other 4-K filter will go on a piece of

structure between M7 and M8. All other filters remain the same. Dichroics are to remain as they are.

Spectrometer baffles will go across the instrument either side of the mechanism. Keep the 2-K box use the entrance aperture as the first stop? Heat strap baffle is presently over specified – can use a smaller radius with fewer sections.

vi) **Size of the stops:**
First size of M3- needs to be at least photometer and spectrometer FOVs moved by +-30 arcsec. To buy insurance against the failure of the BSM would need to well oversize M3 to fit spectrometer FOV moved by 2 arcmin (~20 mm on M3). Will also then oversize the Field plate correspondingly. Will oversized M3 fit? Kj will provide BW with size of proposed M3 and he will check.

Design guide for field plate:
On non-spectrometer side (+Y S/C) and top and bottom (+-Z S/C): +30 arcsec on photometer actual FOV + 20% photometer FOV half width
On spectrometer side (-Y S/C): spectrometer FOV moved to –2 arcmin or unvignetted FOV which ever is smaller. No oversize required. If the larger M3 doesn't fit in structural envelope then spectrometer FOV –30 arcsec +20% spectrometer FOV half width.

Problem with the size of the hole leaving the instrument – may have to move the structure very far back – i.e. no structure. Also possible that this will remove the location for the shutter. Tony will provide jiggled oversized beams and BW will check whether these fit within current structure concept or not.
M4 mask in front of the mirror – oversize hole to allow beams plus a bit for diffraction – propose to ATC – need to know where the mask would come.

ACTIONS:
KjD to provide BW with exact size of proposed M3 and BW to verify available envelope
Priority: High
Date: Preferably before 1/8/2000 (MEC/BMS will cover if necessary)
KjD to define size; shape and location of instrument entrance field stop with guidelines given above.
Priority: High
Date: For final definition of baseline September 2000
BMS to clarify requirements on BSM baffle and request details from ATC.
Priority: High
Date: Information needed for final definition of baseline September 2000 – proposal sent by 14/8/2000

vii) **Ghosting from the filters:**
In order to see whether there is a problem need to a) set a specification on the required contrast b) get realistic filter profiles c) do a ray trace analysis of the

present perpendicular set up. Kj will say which filters give a problem and how this will be dealt with.

Spectrometer – problem with 2-K filters being parallel – change to have slanted mount – 2-K box front will be slanted – Kj will propose position and angle of these filters.

Place all components into optical design document. BMS will co-ordinate this document and poke people into proposing locations for filters; baffles and stops where necessary.

ACTION: PH to send realistic spectral response curves for intened filter scheme to KjD for ghosting analysis
Priority: High
Date: For final definition of baseline September 2000 – send profiles by end August.

viii) **Alignment and integration**

Brief discussion covering the following:
STM mirrors will be used for CQM (and possibly flight spare) – only one set needed but must be optical quality
Optical alignment verification will be carried out at RAL. Necessary equipment and space appears to be nothing out of the ordinary. MSSL will provide MGSE, LAM will provide specialised OGSE.
A FIRST Optical bench simulator is required – this could be the bench used for the test facility cryostat.
Detailed sequencing of STM integration and alignment verification to be taken as normal work by BMS and BW.

Summary of Actions:

Actionee	Description	Priority	Need and Date
BMS	To verify which document specifies this telescope design and to reference this in the optical design document	Non Urgent	For next issue of optical design document (October 2000).
BMS	To set specification on required contrast for imaging of faint sources next to bright extended objects – this will be converted into total integrated scatter specification by KjD	High	Required for evaluation optical cross talk – End August 2000
AJR/MEC	To send KjD definition of rays that will define the positions of the optical components – gut and marginal ray(s)	Super urgent	By end Friday 21/7/2000
AJR	Produce IGES files for gut rays, geometrical beams and 20% oversized beams (diameter)	Urgent	14/9/2000

	separately. As proposed on the note, handed over during the meeting by Berend		
KjD	To produce spreadsheet with locations of gut ray intersections and surface normal vectors of all components in the photometer and spectrometer optical trains	Urgent	Before he goes on Holiday (1/8/2000)
KjD	To write detailed specification of metric(s) for verification of optical and mechanical translations	Urgent	Realistically Mid-September?
KjD	To define exact size of FOV at detector locations in spectrometer and photometer	High	Needed for final confirmation of all stop sizes and beams through instrument and for final size of detectors.
MEC	Evaluate performance of existing spectrometer optical design using ASAP. Look at total efficiency and fringe contrast at edge of FOV for resolution of 0.4 and 0.04 cm^{-1}. Propose first system stop location and size	Urgent	Required to show whether there is a significant problem with the present spectrometer design at very latest by end August.
BMS	to propose non-telecentric feedhorn plate solution for consideration by JPL	High	Needed for consideration of total system level assessment of spectrometer performance 14/8/2000
KjD	To provide BW with exact size of proposed M3	High	Preferably before 1/8/2000 (MEC/BMS will cover if necessary)
KjD	to define size; shape and location of instrument entrance field stop with guidelines given at optics summit	High	For final definition of baseline September 2000
BW/JAC	Check available envelope for PM3	Medium	Preferably before 1/8/2000
BW/JAC	Check available envelope for SFIL3S/L	High	before 1/8/2000
BW/JAC	Check Tony's IGES files when produced, against positions provided by Kjetil	Medium	Before October 2000
BMS	to clarify requirements on BSM baffle and request details from ATC	High	Information needed for final definition of baseline September 2000 – proposal sent by 14/8/2000