Minutes of the 9th SALT Science Working Group meeting

28th April 2003

SALT Boardroom
SAAO, Cape Town

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The ninth meeting of the SSWG took place on Monday/Tuesday 28th/29th April 2003, in the SALT Boardroom, Cape Town. Ted Williams volunteered to take the minutes.

1 Participants

Members:
Michael Albrow (Canterbury)
Gordon Bromage (UCLAN, UK)
David Buckley (Project Scientist, Chair)
Patrick Côté (Rutgers)
Brian Chaboyer (Dartmouth College)
Wolfram Kollatchny (Göttingen)
Janucz Kaluzny (CAMK, Poland)
Ken Nordsieck (Wisconsin-Madison)
Darragh O'Donoghue (South Africa)

Ex-officio attendees:
Stuart Barnes (Canterbury)
Peter Cottrell (Canterbury)
Robert Fesen (Dartmouth)
Kobus Meiring (SALT Project Manager)
James O'Connor (SAAO)
Marek Sarna (CAMK, Poland)
Nicholas Sessions (SAAO)
Arek Swat
Gerhard Swart (SALT Systems Eng.)
Patricia Whitelock (SAAO, South Africa)
Ted Williams (Rutgers)

2 Agenda

Monday 28th April (HRS & SALTICAM presentations)

1. Design status of HRS (Peter Cottrell / Michael Albrow / Stuart Barnes)
   a. Review of concept proposal and discussion of issues raised
   b. Current and future developments, plans for the PDR
2. Status of SALTICAM (Darragh O'Donoghue et al.)

Tuesday 29th April (SSWG meeting)

1. Science with SALT Workshop plans (David Buckley)
2. SALT engineering issues (Gerhard Swart)
   - summary of developments (edge sensors, mirror alignment, status report)
   - overview of Telescope Control System (TCS) developments
   - issues relating to the error budget
3. Tracker and Payload Report (Leon Nel/Arek Swat)
   - payload update (baffle, ADC, guidance, focusing, etc.
4. Calibrations (David Buckley/Arek Swat)
5. SALTICAM (Darragh O'Donoghue/Matt Bershady)
   - outstanding business ? filters etc ?
   - SPUD proposal
6. PFIS Critical Design Review report (David Buckley / Ken Nordsieck)
7. PFIS status report and near term goals (Ken Nordsieck)
8. PFIS Commissioning (Ken Nordsieck)
9. Coffee break
10. HRS Summary (Peter Cottrell)
11. FIF status (David Buckley)
12. Plans for observing time allocations, TACs, target priorities, etc.
13. Other business
    a. Brief partner reports
    b. 2nd Generation instruments

Business: Monday 28th April 2003

3 Minutes of previous meeting

There were some minor corrections to the minutes of the Oct 2002 SSWG:

- some dates were incorrect (2003 rather than 2002)
- missing participant
- inductive and capacitive sensors vs global radius of curvature. The sensors do measure gap changes.
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Following these corrections, the minutes were accepted (Moved: L. Ramsey; Seconded: B. Chaboyer; unanimous)

4 HRS Concept Proposal

The combined presentation by the HRS Team appear in a single PowerPoint file available on the SSWG website.

4.1 Overview (Peter Cottrell)

Peter Cottrell reviewed the concept design for SALT HRS, which was submitted in December following the resolutions from the previous SSWG meeting (Oct 2002).

The current design is for a R = 17,000 to 85,000 spectrograph employing a 3 x 1 mosaic of 2k x 4k CCDs. A 4k x 4k monolithic CCD is currently out of favour (less wavelength coverage, smaller pixels (13_m cf. 15_m). The total efficiency of HRS would be in the region 3-10% (comparable to other similar instruments).

Issues raised from the Concept Proposal include:

- The frame transfer mask option has been dropped due to added complexities and limited need for ~1Hz observations. Relatively high time resolution (~10 s) was still likely to be achievable without the FT mask, addressing most time-resolved science drivers.
- CCD: a 3 x 1 mosaic offered maximum wavelength coverage, therefore most information content per unit time (a useful metric). *[further discussions on this issue came later]*
- Optical design issues:
    - beam size, grating angles, coatings
    - image quality (e.g. camera requirements)
    - collimator design (e.g. on- or off-axis ?)
    - scattered light and baffling
- Comparisons to other spectrographs now made
- COTs optical bench vs. customized structure
    - few components in the concept design are in a 2D plane
    - difficult to put a conventional optical bench into a vacuum tank
    - a custom bench has a small footprint
    - the concept design is an integrated gantry
    - the concept design is simple, rigid and proven engineering (e.g. in HERCULES)
    - in light of comments, the HRS have looked into optical bench possibilities, costs, etc.
- Fibre issues: bundles will likely incur additional losses in buffer/cladding
- Moving pupil and fibre injection issues: Robert Content (Durham) is to be contracted to investigate
- Science issues: radial velocity precision requires removal of systematic effects
    - Discussion on HERCULES (Canterbury's 1-m fibre fed spectrograph)
        - achieves sky to 2 m/s
        - stars to 10 m/s over months
        - stars to few m/s in a night
        -

Questions were posed as to the necessity of a tank enclosure. A vacuum tank is proposed (only 1mm Hg, so quite 'soft' vacuum), rather the helium due to the difficulty in holding the latter. The new design simplifies things. In answer to the statement that other fibre-fed spectrographs can routinely obtain < m/s accuracy, without vacuum tanks, the response was that a vacuum vessel isolates environmental effects, keeps optics isolated and clean.

Larry Ramsey stated that a big issue with HET HRS was getting enough photons. When there a lots of photons, precision is 0.5 m/s. Some of this must also be due to the white pupil design.

4.2 HRS Optical Design (Stuart Barnes)

Stuart Barnes presented the optical design for SALT HRS. The choice of dispersive elements (and their parameters) depends on the required resolving power, throughput, focal plane characteristics, degree of cross dispersion required, and wavelength coverage needed. The amount of cross dispersion is constrained by the size/number of fibres and the maximum resolving power.

Darragh O'Donoghue mentioned that the assumed EE80 of 1.15 arcsec was incorrect [more like 2.1 arcsec (median) including telescope at 37° and the atmosphere].

For cross dispersion, prisms have significantly higher throughput, even with simple _ wave MgF_2 coatings, compared to surface relief gratings. They are also a better match to a CCD, with less varying cross dispersion. For gratings, the need for more cross dispersion in the blue/UV usually means that several gratings are required for cross dispersion. SALT HRS needs quite large inter-order spacing, for nod & shuffle mode, fibre multiplexing or fibre image slicing. This is also linked to the échelle groove density.

The camera focal length is determined from the maximum R (~100,000), the pixel size (15_m) and Nyquist sampling (n ≥ 2). The value has to be in the region 0.38-0.75 m. A dioptirc or catadioptric design is the only possibility, and the latter has been followed. An important parameter is the distance from the échelle to the camera entrance, which is in the region 3-3.5 m (for efficiency and constrained to the geometry).

Stuart mentioned his investigations into white-pupil designs, involving single or double white pupil mirrors. In the end he settled on a catadioptric camera with no white pupil, which is simpler, more efficient and shows good performance. The final design therefore has an R 2 échelle mosaic, with 87 grooves/mm and 5° Littrow angle. The efficiency is a strong function of this angle, and should therefore be kept as small as possible. With the parameters of P = 3-3.5 m (échelle to camera entrance distance), and _ = 4.5°, gives an overall camera efficiency of ~62% (with a 3 x 1 CCD mosaic). The camera would have a 1.2 – 1.3 m diameter spherical mirror.

The collimating beam size is 365 mm and grating mosaic ruled area is 310 x 860 mm. The two cross dispersion prisms will likely be split into two 37.6° prisms (oiled together), to ensure uniformity.

Final resolving power would be:

Slit/fibre size	R
2.2"	17,000
0.9"	43,000
0.5"	85,000

Darragh asked how the design could be altered to preserve throughput for a given resolution (some confusion in question), to which the reply was that slicing the fibres would achieve this.

The issue of two or three CCDs mosaics was discussed. A 2 x 1 mosaic would give complete wavelength coverage to only 540 nm compared to ~800 nm for a 3 x 1 mosaic. To obtain full wavelength capability (albeit non-simultaneously) would require changing the grating tilt angle. This would be less efficient and violates the maxim of maximizing the information content per unit time.

In response to the question of whether separate 'blue' and 'red' arms had been investigated, the answer was not really, since this would double costs (two spectrographs).

Some trade offs might still be explored in deciding the red/blue limits. For wavelengths > 510nm, 2 gaps will appear in every order (with 3 x 1 mosaic), which are ~0.5nm wide (~30 pixels). This presents some complications (surmountable) with data reductions, and gaps might be dodged by changing angle during once-off final adjustments. The gap orientation (in the cross dispersion direction) is driven by the “nod & shuffle” mode. It was pointed out by Larry that the HET HRS community demanded the gap was parallel to orders.

Overall, vignetting by the CCD detector (& mounting assembly) is predicted to be ~6.8% (for 3 x 1 mosaic), and is nearly wavelength independent. The central obstruction is ~90 x 110 mm.

Regarding the collimator optics, it has not yet been decided whether to employ an off-axis paraboloid.

Comparisons have now been made of the expected performance of SALT HRS with several instruments: UVES (VLT), HiRES (Keck), HDS (Subaru), bHROS (Gemini; though not yet built) and HRS (HET).

4.3 Mechanical Design (Peter Cottrell)

Peter gave Graeme Kershaw’s presentation on the mechanical design for SALT HRS (included in the SALT HRS PowerPoint presentation).

The design has been developed mostly since the initial Concept report, i.e. after Jan 2003. It consists of three main sections:

1. centre section. Comprising the fibre injection, collimator and first camera element.
2. dispersive section. Comprising the grating and prisms.
3. camera section. Comprising most of the camera optics and detector.

The grating is mosaiced by mechanically aligning, which is a lot cheaper than having grating manufacturer mosaic two gratings on a single substrate. Prisms will be manufactured by the preferred vendor (KiwiStar Optics), possibly split, and then optically coupled. This has an advantage in manufacturing and obtaining homogeneity.

A FEA analysis was done on the displacement of truss members, which have ~8000 N load, resulting in a 80_m of (static) flexure and a 16Hz natural frequency. Likewise an FEA of the camera truss indicates a 100 N load with ~3_m flexure. Other issues relating to the flexure were discussed, particularly whether vibrations from the telescope/dome could be an issue (everything is stationary during and observation).

Regarding the large camera lenses (>900 mm in diameter), various vendors have been identified: Glass Fab for the blanks, and IRL/KiwiStar for the optical fabrication. Making the negative lenses will be a challenge. Peter reported that IRL had just been awarded a Subaru contract (prime focus corrector) and are doing several other big jobs. They will also handle the opto-mechanics, but will send the optics outside the country for coating. In terms of the design, the lenses mountings are not yet designed (PDR task). A FEA on the camera truss indicates a static load of 3500N, giving 50_m flexure and 18Hz natural frequency.

The CCD housing needs more design work. Peter showed an example of the Keck HiRES as an example of a possible design concept. It was mentioned that the vignetting estimate may be optimistic. The very fast camera (f/0.6 (not monchromatic) will demand tight optical alignment tolerances. No analysis of this has been done yet. This is potentially a very big problem (to be investigated for PDR).

The glass is all BK7, which has good material properties, and has good transmission from at least 350 nm.

One question posed is the relative risk of having one or two piece prisms in terms of guaranteeing sufficient homogeneity. Also, what the relative contribution homogeneity has to the image quality error budget.

4.4 Fibre Issues (Michael Albrow)

Regarding the concept proposal idea of stripping the buffers on the fibres, for better packing fraction, it seems that this is unlikely to be successful. A nylon buffer is possibly easier to strip. The rule of thumb for cladding thickness is for it to be ~10x the longest wavelength to be propagated, or ~10_m thickness, or 20_m increases of cladding radius over the core radius. Another possibility is for image slicing at the input to the spectrograph, with re-imaging at ~f/20 onto slices. At least 4 slices are required for highest resolving powers. A larger slicing device, of ~cm proportions, will be possible, which is a lot easier to build than devices of ~mm in size. For various resolving power, different slicers could be used:

80,000	4 slices of a 400_m fibre
40,000	3 slices of a 500_m fibre

Nod & shuffle demands somewhat different choices of fibres/slices, in order to accommodate sufficient inter-order spacing.

Another alternative to be investigated are lenslet arrays in the focal plane (i.e. mini-IFUs). These would require foreoptics to match arrays which would deliver a pupil image onto the fibre cores. An example is a ~2mm hexagonal epoxy on glass lenslet array with foreoptics (f4/2 and f/87 lenses). A 117_m pupil image would be created by an f/4.9 lenslet array. This would achieve very high fill factors (99%).

Larry Ramsey commented that the varying pupil illumination could be a disaster for this scheme and recommends keeping it simple. Image slicers would seem to be more efficient than direct fibres in the focal plane (Larry measured 90% efficiency in a real slicer). Also, the non-telecentricity of SALT really complicates things. This is a further reason not to consider multi-object designs further, at least as far as HRS is concerned.

All of this requires more study up to PDR. Pupil variation effects will be done by the time of PDR, based on extant lab experiments and analysis software. It was noted that lenslet arrays would lead to an increase in the FIF cost, if they were adopted. FIF is current budgeted at $179K, in current Dollars.

4.5 Further discussions and motions

Peter mentioned that apart from the main HRS team, they also had the services of the following consultants:

Phillip MacQueen (HET)
John Hearnshaw (Canterbury)
KiwiStar Optics (Industrial Research Ltd.)

Total cost estimate at this time for SALT HRS is $1.64M inclusive of 4k x 4k CCD, but not including fibre feed. Expected increases would come from:

- fibre injection scheme (into spectrograph)
- a 3 x 1 CCD mosaic
- larger camera

Peter asked the SSWG to comment on the following:

1. The CCD options
2. fibre injection (fibre bungles, lenslet arrays, image slicers)
3. the short wavelength limit
4. any other concerns

Larry commented that there was really a need to justify the vacuum tank. He does not think it necessary for high precision radial velocities and it adds to the complexity. There are also significant challenges for the CCD mounting, with tradeoffs of obscuration vs stability. The decision to either mount gratings on their own mounts or mosaicing them onto a single substrate needed real cost numbers. The issue of using either LN_2 or a closed cycle cooler (i.e. Cryotiger) should be decided on servicing and operations implications and costs.

The issue of 2 x 1 or 3 x 1 CCD mosaic was discussed, and with the design pushing for complete wavelength coverage, it seemed crazy to throw that away with only 2 CCDs. The HRS Team were not keen to pursue two design paths (i.e. both options at once).

A motion was proposed by David Buckley, seconded by Ken Nordsieck, that the HRS Team pursues the 3 x 1 mosaic option to PDR. This motion was carried unanimously, with one abstention (Canterbury).

The issue of the short wavelength limit was briefly discussed. Since there was an important line at 3727Å (OII), it was decided to leave the short wavelength limit at 370 nm.

Darragh O'donoghue commented that there had been a lot of discussion but no resolution on any of the HRS parameters. He therefore proposed, and Larry Ramsey seconded the motion, that the HRS Team should generate and circulate a draft Functional Performance Requirements Document (FPRD) prior to PDR. The motion was passed unanimously, with one abstention (Canterbury). It was decided that this draft FPRD be completed by the end of May, in plenty of time for the 4 September PDR.

David mentioned that he'd secured agreement from the following people to act as external PDR reviewers: Steven Shectman (Carnegie Observatories), Richard Bingham (UCL) and Han Dekker (ESO).

5 SALTICAM Status Review (Darragh O'Donoghue)

Darragh's presentation can be downloaded from the SSWG website for the April 2003 meeting. He first summarised the salient features of SALTICAM and its two modes, VI (Verification Instrument) and ACSI (Acquisition Camera and Science Imager). ACSI will now be delivered mid-2004, instead of Oct 2003, as originally planned. This has no impact on the commissioning of SALT, since VI will be used for many of these tasks. This means that the CDR for ACSI will occur later in 2003.

ACSI optics, which were potentially long lead items, have been completed, and are now at the opto-mechanical fabricator (Bruce Bigelow). For the coatings, water resistant coatings are being used on all entrance/exit surfaces exposed to outside air. MgF_2 coatings will be used on filters and the cryostat window.

Work still to be completed includes:

1. opto-mechanics (lens cells, barrels, etc)
2. final stray light analysis
3. finish error budget
4. optical testing tolerance analysis
5. optical testing

Worries and risks, which were previously identified, included:

- optical breakages (didn't happen in fabrication)
- coating cost increase (didn't happen)
- element breakage during mounting (still a possibility)

VI Structure and Filter Wheel

The VI has a pneumatically driven x-y table to which the cryostat, filter wheel and baffle are mounted. The VI structure has been manufactured and assembled and testing will begin soon. The only current worry is the scheduled completion of the external covers.

Cryostat and Frame Transfer Mask

A major setback occurred with the breakage of the cryostat window when it underwent a 7.5ºC temperature change and reached ~30ºC. According to the FEA analysis, this should have only happened at ~60ºC, so the reasons are still not fully understood. This necessitated a redesign of the mechanical restraint, which now employs o-rings instead of being cemented. This will have a beneficial effects on the vacuum performance.

The cryostat fabrication is now complete, and cooling is working. Temperature control still needs to be finalized. Electrical and control tests were schedule for the coming week. Things still needing to be done include: insertion of the science CCDs, testing and optimising. Remaining risks include CCD damage (every possible measure will be taken to avoid this!) and schedule risk.

CCDs

The CCDs are all very good chips and were successfully mosaiced at E2V. Mosaicing harware is being procured (for PFIS). The CCD control software (SDSU II) was poor, and has been replaced. The shutter performance is good. The GLACE control boards were problematic initially, but are now fixed. Software is now being finalized.

Remaining to be done: tests, optimisation and delivery.
Remaining risks: read noise, speed, etc.

Software

Prototypes for the C- and ASM code are completed. The LabVIEW software is still to be done, although the design is complete and coding has begun. The PI (Darragh) insisted he was to blame for this, but there were no showstoppers, just lots of work. SALT TCS Software Engineer, Deon Bester, has been hired to do this aspect of the work, while Darragh has also been excluded SAAO duties for a month.

Filters

These were originally to be provided by Mt Stromlo Observatory, but the fire there has meant other options now have to be explored.

Budget and Risk
Grade 0 CCDs were delivered in the end. This meant an increased cost of $42K over the budgeted amount. Devaluation of the Dollar against the Pound and Rand has also led to increased costs by ~$64K (e.g. labour costs are fixed in Rands). Total expenditure to date is $241K compared to a predicted $231K. Cost to completion now stands at $629K compared to the PDR estimate of $515K.

The over-expenditure, due mainly to the Rand exchange rate improvement and the choice of Grade 0 chips, should be covered by contingency. This will be put to the Board for approval.

Summary
Technical: overall the instrument is progressing well with the PDR design working fine in most areas (cryostat window an exception):

- ACSI optics well in hand (big risk area)
- VI structure complete
- Cryostat starting to look good

Schedule: VI schedule shot to hell – 3 months late. ACSI schedule is quite comfortable (mid 2004) and FDR for ACSI mode later this year.

Budget: Well managed but all contingency is now used up by CCD grade 0 & improvements in the Rand/ devaluation of Dollar.

A vote of thanks was to Darragh was proposed by David; seconded by Larry and carried with one abstention (Darragh).

Business: Tuesday 29th April

6 Science with SALT Workshop (David Buckley)

Details of this, and other presentations by the Project Scientist can be downloaded from the website. David reported that the second "Science with SALT" workshop would be held at the UCT Graduate School of Business at the Cape Town waterfront from Wednesday 29th to Friday 31st October 2003.

Clifford Nxomani (SALT Collateral Benefits Manager) reported that a parallel student workshop would also be held on Friday 31st October. This was aimed at graduate students, or potential graduate students, and would involve some introductory talks be astronomers. The students will range from Honours, Masters and PhD students. Some (e.g. the latter) would be encouraged to attend the SALT workshop, but it did not make sense for most to.

David estimated a maximum attendance of ~75 people. The lecture room can accommodate 95. Ted pointed out that Rutgers were not on the list of estimates, and they could expect 4-6 people to participate, taking the possible total to ~80.

Registration deadline would be 1 July. Posters papers will be available.

7 SALT Engineering Issues (Gerhard Swart)

Details of Gerhard's presentation are available on the SSWG website. He gave an overview of SALT progress, first mentioning the recent hardware acquisitions:

- CONCAM, the all-sky camera. Uses and SBIG ST7 CCD.
- Physik Instruments actuators are used for primary mirror movement. They are encoded.
- A question was asked about the lifetime of the airbearings: they are indefinite.

Commissioning and Test Plan

The individual project managers are responsible of the subsystem acceptance tests, while the integration is the System Engineer's responsibility, as is the system acceptance tests. The latter are monitored and approved by the Project Scientist and Board-appointed Acceptance Test Committee. This is a hierarchical structure, following a systems engineering approach.

Test will be grouped to optimise telescope time.

Build processes are as follows:

- basic telescope telescope function
- basic science function
- PFIS function
- advanced science function

Future events:

PFIS is due to arrive July/Aug 2004
SALTICAM observing (ACSI) July 2004
PFIS observing Nov 2004
SALTICAM will be used in the following configurations:

- VI Oct 03 to Mar 04
- ACSI April 04 to July 04
- VI July 04 – Aug 05 (then enough mirrors for PFIS installation)
- ACSI Aug 04 – Dec 04

Trial operations will happen from May 04 onwards.

Progress to date:

- Structure and dome computer are now integrated with TCS.
- Structure lifts & rotates
- Dome rotates
- Shutter opens and closes
- Building is complete, including software management system, BMS (Building Management System)
- Mirror truss is being measured and will undergo acceptance testing soon
- mirror coating system installed and accepted
- building management system operating

Some failures of the ATP for the BMS occurred, namely air conditioning, louver controls, compressed air.

Gerhard gave a brief demo of the Labview logging GUI of the building management system.

Telescope Control System

CDR held December 02 and was passed with a few changes. Network bandwidth upgrades are expected in December 03. PI planning tool specifications are immature, and needing further inputs. TCS server can accept text based commands.
SOMMI has been released and SSWG needs to comment (more importantly SAMMI and also PI planning tool PIPT inputs in June).

Question: How many Labview programmers are there currently working on this?
Answer: Four, one part-time.

Error Budget
The CTE of accepted segments spans are specified to be ±150 ppb. Of the 63 segments delivered to date, the RMS CTE is only 57 ppb. This means we expect improvements in EE50 and EE80, but not linear.
If the rest of the segments follow this trend, then the contributions from segement CTE will be EE50 = 0.234" and EE80 = 0.392" (from thermal effects). The thermal and alignment are major contribution to the error budget.

ADC: this contributes less than 0.15" image degradation.
SAC:

- M5 surface is 22.6nm RMS (30nm is spec)
- M2 surface is 44.1nm RMS (also in spec)
- Coatings are exceeding specification and better than 96% everywhere (out to near infrared) and up to 99% in the 320 – 340 nm range.

8 Tracker and Payload (Leon Nel and Arek Swat)

Leon and Arek's PowerPoint presentations are downloadable from the SSWG website.
SAC: M2, M4, M5 and structure were complete at the end of Feb. Coatings were completed in April: >96% everywhere (to 2 microns)
99% in 320 – 400 nm (amazingly good result for the blue/UV)
97% at 600 nm

Final IQ assessment: SAGEM tests are on axis: model and mirror map are used to calculate off-axis performance.

Payload structure: mockups complete, material samples were shown.
Guidance system:

- Probe accuracy is 59 microns in Z, implying focus error of 6 microns (10 microns is spec total)
- 33 microns for x and y uncompensated
- 8 microns for x and y compensated

ADC/Moving baffle

Mechanical parts are now in house and ADC prisms will be completed by the end of May.
Fold mirror sub assembly: manufacturing to start in 2-3 weeks.
Question: Capabilities – how many mirror elements? Answer: current feed 3 ports.
Question: How many channels for SALTICAM. Answer: One fold mirror, one pellicle/beamsplitter.

The following motions were passed:
1: Thanks to David and the project team for overcoming the LLNL coating problems.

2. Thanks to Leon and Arek for guidance stage achievements.
Both motions were moved by Darragh, seconded by Brian, and carried unanimously.

9 Optics (Arek Swat, Systems Engineer)

Arek's presentation, and related material, is available on the SSWG website.

Guidance update
Testing prototype results – conclusions led to a modification of the proposal
Prototype guidance focus unit
Tests: good sensitivity to images
Problems: Vignetting on image fibre bundle (IFB) and vignetting on the CCD. Also poor throughput (unreliable results, though for these tests)
Get 9% change of flux with 10 microns focus with astigmatic images. Get 6% with astigmatic image with symmetric images

Question: What is the magnitude limit for autofocus ? Answer: expect: 17 – 18 mag in R.

Vignetting solutions will need a translation stage to compensate. Vignetting on the IFB requires a new design, with a beam splitter at the probe tip.

Question: What fibre bundles will be used ? Answer: Schott fibre bundles comprising 17000 fibres, 2.2 metres long, with about 40% throughput. IFB numerical aperture is 0.6

Advantages of re-design include: simpler, better throughput, better imaging quality. Also expect 25% better throughput.
Disadvantages: Thicker probe (slightly), more costly (but 18 arcsec FOV (versus 15 arcsec with old system)

Question: When will final system be complete? Answer: System to be done by end of June
Question: What is guidance error budget and rates ? Answer: closed loop error is 0.05" and total error budget is 0.1". Rates: 1 Hz to 19th mag, faster for brighter stars.

SAC mirrors – image quality
Differences in SAGEM versus SALT calculations, but they are all within specs still.
Arek thinks that geometrical model most applicable whereas SAGEM thinks diffraction model most applicable. This is summarised in the presentation on the SSWG April 2003 website.

Qusetion: Should we hire a consultant to determine who is correct ? Anseer: Yes
Question: Can you suggest a consultant ? Answer: Not yet, Darragh will pursue this.

Leon asked generally whether other telescopes do real time focus correction ? Yes, HET, VLT, Gemini all do so.

10 Calibrations (Arek Swat)

The presentation of Arek's can be downloaded from the SSWG webpage.

Requirements: try to mimic the sky illumination at the focal plane (vignetting and incidence angles). System needs to be low mass (compact), at least the moving component of it. Needs to be removable from the optical path. Ideally the focal plane illumination should be insensitive to inhomegenious illumination of the diffusing screen.

Location: near M3 hole is really the only available place. Principal: screen at a plane conjugate to the pupil, so is insensitive to inhomegenaities Concept design currently comprises 2 PCX lenses, 1 axicon, a reimaged diffusion screen. May replace lenses with Fresnel lenses (don't need high quality optics).

Question: What about ray bundle matching ? Answer: Not yet checked. On TBD list. Discussion ensued on ray bundle population, with agreement that this needs to be considered in more detail. Cannot be done independently of instruments (e.g. need to consider throughputs vs wavelength).

Question: What time scale for system completion? Answer: Leon has to answer, but sometime mide-2004 likely (before SALTICAM ACSI and PFIS requirements, though.

Qusetion :What about the dome white spot? Answer: That is a backup only.

Arek will calculate angles from calibration and compare with actual telescope beam and will circulate the results. Design is based on SOAR/Gemini concentrator and uses aspects of the CTIO Hydra calibration system, with 2 meter liquid light guides (good UV throughput).

11 SALTICAM (Darragh O'Donoghue, PI)

Filters is still an outstanding issue. Only UVBRI set is budgeted for, and there is no money available for additional filters. Need to raise additional dollars (but relatively small amounts). UW-Stromgren filters is still a possibility. Can someone else get Sloan filters? UVBRI set is less than $5000. Size: 106 mm round.

SALTICAM wheel has 8 filter slots. We do not want to change filters more than weekly.

Proposal: Look at filter issue after Science with SALT workshop. Proposed by Darragh, seconded by Larry, unanimous. David will also consider possibilities for funding.

12 PFIS Critical Design Review (Ken Nordsick, PI)

Ken's presentation is available on the SSWG website as two documents: the response to the CDR report, and presentation on the same topic.

The CRD was attended by the PI team, Ted Williams (etalon responsibility) and Darragh O'Donohue (detector responsibility), and the SALT team: D. Buckley, G. Swart, L. Nel, and threeexternal reviewers: S. Barden, B. Bigelow and G. Hill.

Main topics: Opto-machanics, AR coatings, structure and mechanisms, generic mechanism.
Final Report: Recommended to move to construction phase. No show stoppers seen.

Concerns:

1) Schedule for construction “Success-based”
2) No spare optical blanks
3) Test wedge at 37 degrees
4) thermal effects on optical performance
5) Support pad stiction
6) Enough contingency / budget reserve

The PIs response document (3100BP0011) is now on the PFIS website, and available for downloading from the SSWG website for Apr 2003. There are 19 actions, 9 decisions (some time critical)

Major concerns:

- Mechanisms schedule too tight – requires additional in-house design using sub-contractors for drawings. Additional people available to monitor manufacturing.
- Spare optical blanks actually have spare NaCl, 2 spare CaF2 blanks ordered ($32.8K). UW can sell any unused blanks.
- Test fixture, with rotator. To have a fixture at a fixed 37 degrees and rotatable to different azimuth positions. This would cost ~$30K and take ~4 weeks of ME time. Don’t have this time or dollars!. Therefore an alternative design was adopted, involving flipping PFIS plus or minus 37 degrees, and a model. It is proposal to build this into a designed dolly structure. This will cost only ~$12K and 1 weeks work.
- Stiction and pads. Current design is semi-kinematic. If there is stiction, then flexure will be unpredictable. Analysis is still in progress.
- Transient thermal effects on optics have been modelled with uniform temperature changes. Need to model temperature gradients – look at extreme case.
- Schedule is success oriented. Panel thinks a slip of one year is possible. We have 7 months budget reserve for slips and consider a1 year delay unlikely. Question: Can you estimate system by system effects? Discussion: Don’t estimate costs, just how to respond.

Time critical decisions

- NIR beam – more envelope will be investigated. Better to try now that later, when the structure is completed.
    - studying ways to remove curved I-beam.
    - other changes too big a perturbation
- test compatible immersion fluids and RTV
    - we have experience, and will investigate origin of dispute
- Construct jig for off axis image testing to verify alignment
    - Test expensive $10K-$45K
    - We can test an optical model to see if worth while
- Stray light/baffling insufficient
- Lens mount FEA
- Grating rotation stage – preloads necessary
- Capacity of INVAR beams all ok works no stop zones.

PFIS status

Passed CDR – moving to fabrication phase now

- Mechanical designs are complete.
- 3 CCDs delivered – they are good to excellent
- VPH complement defined
- Optical blanks received
- Lens and wave plates contracts awarded.

- 2 of 3 Fabry-Perot etalons are in final figure.
- Opto-mechanical subcontract has been placed with J. Alan Shier
- >95% of PFIS now costed with firm quotations.
- 63% of budgeted reserve used to date, leaving $268K, which will almost be entirely used for contingencies in schedule or mishaps.

Still to be done:
Interfaces, including with PFIP (i.e. Payload) and the guider unit. Fabrication drawings are complete and structure is due to begin fabrication in May.

Mass Budget

PFIS is still within the 500 kg limit (which includes 80 kg trim mass, which can become part of eventual near IR arm). With the assumption that the near IR beam has same mass as visible beam (i.e. ~190 kg), the total PFIS mass, including most supported modes, will be ~525 kg. Either the extra 20-25 kg is lost from the near IR arm (i.e. keep to < 165 kg), or trade off with tracker (e.g. auxiliary instrument allowance), or use better known (by then) payload mass margin.

Budget and Costs

Major capital purshases were estimated at PDR to be ~$590,930, while better fidelity CDR values, estimate is now $587,633 (i.e. hardly any movement).

Expected positive deltas:
- spare blanks: $32.8K
- design subcontractor ~$30K
- CDR requested changes: ~$15K
- machining underestimates?

Expected negative deltas:
- spare cost recovery if not used
- optics testplate redesign ~$25K
- cost savings on mechanisms ~$10K

Out of available budget reserve, this leaves ~$220,000, which if it were to be be spent on schedule slip, would cover ~6 months.

Schedule

The structure is on the critical, at least until the articulation mechanism is installed. Optics delivery has a ~5 week slack. The mechanism schedule is the most difficult, since the ‘waterfall’ schedule is easily disrupted by slippage.

The testing phase will make use of graduate students and postdocs at UW. The detector work has ~6 weeks slack, while the etalons have ~ 3 months slack.

Shipping is still on schedule for 21 June 2004.

13 PFIS Commissioning and Transitions to Operations (Ken Nordsieck)

The document discussing commissioning and verification can be downloaded from the Apr 2003 SSWG webpage.

Main commissioning steps:

- setup and test at SAAO
- setup and test in SALT spectrometer room
- mount and test on tracker and integration on telescope
- day tests on tracker
- nightime commissioning
- shared risk science observations as modes commissioned
- handover to SALT

SSWG needs to propose shared risk procedures, solicit proposals, etc.

Need to define success criteria. Project and PFIS Team determine when to go to next step and don't go to telescope until it is ready (e.g. utilities, guidance, instrument health and safety monitoring, calibrations). For testing will require offsetting accuracy to 1", images of 2", and hold image quality for ~15 mins.

Test data analysis:
Requires computers, software, people. Shared risk science will have to be processed fast. Shared risk science also tests proposal process and queues.

There will be a need to separate PFIS problems from those associated with SALT, and both teams (SALT and PFIS) will need to be working together.

Darragh proposed, Rob Fesen seconded, that the Project Scientist produces a document addressing commissioning and verification issues. Passed unanimously. In addition there should be a panel discussion on this at the next SSWG, or perhaps the SALT Workshop.

14 SALT HRS Summary (Peter Cottrell)

Peter summarised some of the discussion of the previous day. Input from the SSWG has been obtained on the following issues:

- CCDs, mosaiciong
- fibre input (bundles or slicers)
- short wavelength limit (370 nm)
- opto-mechanics
- cost-benefit analysis

15 Fibre Instrument Feed (David Buckley)

This presentation can also be download from the SSWG Apr 2003 webpage.

Some of the comparative test of fibres (between vendors) were inconclusive. Additional testing is desirable, but not likely before PDR.

Relative merits of direct imaging onto fibres or pupil imaging (e.g. using lenslets) part of overall HRS investigation. Need to have an answer by time of HRS PDR (4 Sep 2003). Employ analytical and experimental techniques (i.e. some lab work and some modelling). Will have to rely on the latter for PDR, and have discussed a consultancy by fibre expert Robert Content, who has sophisticated modelling software, used to design IFUs, etc.

Terms of reference for this would include the following:

1. An investigation into the necessity or merits of pupil versus direct imaging onto the fibres
2. The merits of employing microlens arrays for fibre bundles of varying sizes
3. Optimal sizes for both the fibre and lense diameters
4. Optimal focal lengths for microlenses
5. Design implications for the HRS if microlenses are employed, either at the entrances or exits to the fibres
6. Predictions on performance of the FIF in terms of throughput, FRD, etc
7. Possibilities and merits of using a double fibre scrambler to exchange radial for azimuthal scrambling to remove varying pupil effects in the far field
8. Relative merits of mini-bundles of fibres versus image slicing to improve spectral resolution while maintaining throughput
9. Provide appropriate data files containing sufficient output rays, with relative intensity and angular information, for each of the case studies, which can be used as input for SALT HRS and 2nd Generation fibre-fed instrumentation.

FIF development work has begun this year

- Nicholas Sessions (FIF Instrument Engineer) now full-time on FIF design
- FIF specification drafted
- Plans for prototyping positioner
  - Although HRS demands lessen multi-fibre needs, still need to design for this potential upgrade

- Will soon need a basic layout of the FIF 'box' plus resources required for controller box in PFIP (allocation of space, power, cooling, etc).
- Design work by Nicholas (help from the 'Matrix Team')
- Plan completion of FIF by April 2004

Following discussion it was recommended that a Functional Performance Requirements Document (FPRD) be produced, which should target the specific support of SALT HRS. This should be produced and circulated before a PDR, to be held at or before the HRS PDR (4 Sep). The scope of FIF should not encompass a more generic instrument supporting as yet undefined instruments.

Peter Cottrell argued that the FIF should be delayed until the HRS demands/specs were fully known. David responded that he could not keep Nicholas Sessions on an indefinite contract, and believed some compromise could be reached in providing an FIF suited to SALT HRS, within a suitable time frame (i.e. within the SALT commissioning period).

Darragh moved, Peter seconded, that the next step in the FIF development was a set of specifications in the form of a FPRD and Operational Concept Definition Document (OCDD), which should be circulated to the SSWG for comment. Motioned carried unanimously.

16 Observing Proposal Protocols (David Buckley)

David opened discussion on the following issues:

- How will SALT proposals be handled ?
- Assumption of individual TAC per institution
- Assignment of priorities to proposals ?
- Assignment of overrides ? ToO's
- Resolving conflicts

Many of these have a direct impact in the design of related software tools.

An overview of the software being developed to support SALT observations was given by Encarni Romero Colmenero. This includes:

1. The Science Database
2. The Observation Planning Tool (OPT), or “scheduler”
3. Principal Investigator Planning Tools
    - “calculators” (e.g. exposure, S/N) and proposal submission software
    - Phase I (pre TAC) and Phase II
    - Decisions on TAC output
    - Time allocations
    - Target priorities

The PIPT will be a web based system, with downloadable files, written in Java applications or applets.

- Applets:
    - runs in a browser
    - downloads slowly, but cached
    - automatically updated
    - some browser software issues
- applications
    - download, compile and run
    - install Java
    - does not work on browsers

A suggestion from Janusz was to look at ESO and Gemini scheduling. Gemini has several man-years of effort in software development in this area. [This is being done, in fact.]

Darragh moved that the Project Scientist draft a list of answers to the outstanding questions posed to the SSWG by Encarni and circulate these to the SSWG for comment. These will be needed soon for planning purposes and can then be discussed again at the next SSWG or SALT Workshop.

17 HET Status Report (Larry Ramsey)

Larry mentioned that SALT collaborations with HET were possible, and proposals for the August trimester were due in July.

HET is working on image quality improvement. Louvers have improved dome seeing by ~0.5”. Hartmann test show stacks can now reach 0.3” (within spec). The edge sensors can hold figure within a few degree temp range. It now takes ~15 min to stack with CCAS Shack-Hartmann instrument. Problems are still to do with dome seeing (heat sources), and mount model.
MRS will be commissioned in basic mode (1 star fibre, 1 sky fibre), with R ~ 7500 in visible (450-900 nm).

18 SALT Second Generation Instruments

18.1 SPUD

A letter of intent was submitted by Matt Bershady for SPUD (Simultaneous Parasitic Ultraviolet Dichroic), which would allow simultaneous UV imaging with SALTICAM and spectroscopy with PFIS.

Some discussion on the merits of this proposal ensued. The viability would need to be investigated with the SALT Team (e.g. how to accommodate in the payload). It was recommended that this issue be revisited, together with the filter issue, at the SALT Workshop.

18.2 Near IR arm of PFIS

This is an, as yet unexplored, upgrade possibility for PFIS.

A criticism by the external CDR reviewer, not of the PFIS team, was that to date no group in the SALT consortium has stood up to the task to investigate the near-IR arm upgrade possibility in more detail. This is outside the PFIS Team's brief, but the panel urged the SALT partners to address this sooner rather than later, when design flexibility may become restricted.

19 An STJ Camera for SALT

David presented a proposal for a potential Superconducting Tunnel Junction device to be used on SALT as a possible fibre fed camera, capable of very fast timing and photometry.

The energy resolution would be E/_E~15 at 500 nm. Two 6 x 6 Tantalum STJ arrays would be fed by 'star' and 'sky' fibres in the spectrograph room.

QE is expected to be ~70% and the camera could run at ~5 kHz.

The instrument would be provided by ESTEC as a turnkey instrument, supported by them, in turn for some guaranteed observing time on SALT.

Darragh moved that the proposal be put to the SALT Board to allow such an instrument to be used on the SALT facility, even if not all partners are interested in relinquishing time. The motion was seconded by David, and passed with one abstention.

A presentation on STJs by Peter Verhoeve (ESTEC) can be downloaded from the SSWG webpage.

20 Partner reports

The only significant report was from Janusz stating that Poland had raised an extra $250K explicitly for CCDs for SALT HRS. He expressed gratitude to the Project Scientist for support.