Minutes of the 6th SALT Science Working Group meeting

18/19 October 2001

260 Bascom Hall, University of Wisconsin-Madison

D. A. H. Buckley
Project Scientist

The sixth meeting of the SSWG took place on Thursday/Friday 18th/19th October 2001, at the University of Wisconsin-Madison.

1. Participants

Members:
David Buckley (Project Scientist, Chair)
Brian Chaboyer (Dartmouth College)
Gerald Cecil (North Carolina)
John Hearnshaw (NZ, proxy for G. Mackie)
Klaus Fricke (Goettingen)
Richard Griffiths (CMU)
Janucz Kaluzny (CAMK, Poland)
Ken Nordsieck (Wisconsin-Madison)
Darragh O'Donoghue (South Africa)
Larry Ramsey (HET)
Anne Sansom (UK Consortium)
Ted Williams (Rutgers)

Ex-officio attendees:
Matt Bershady (Wisconsin)
Eric Burgh (Wisconsin)
Gordon Bromage (UCLAN)
Dave Carter (SAAO)
Rob Fesen (Dartmouth)
Chip Kobulnicky (Wisconsin)
Wolfram Kollatshny (Goettingen)
Mike Lomberg (SALT Business Manager)
Kobus Meiring (SALT Project Manager)
Leon Nel (SALT Payload Manager)
James O'Connor (SAAO)
Jeff Percival (Wisconsin)
Marek Sarna (CAMK, Poland)
Bob Stobie (Chair of SALT Board)
Gerhard Swart (SALT Systems Eng.)

2. Agenda

18 October (Thursday)

9:00	Welcome and Minutes of the previous SSWG meeting	David Buckley
9:15	Status of SALT System Specification and Error Budget	Gerhard Swart
9:45	Progress on the SALT Prime Focus Payload	Leon Nel
10:30	Coffee break	
11:00	SALT Instrument Requirements/Statement of Work	David Buckley
11:30	Status of SALTICAM Status Review	SALTICAM Team
12:30	Lunch	
13:30	SALTICAM (continued)	SALTICAM Team
14:30	Status of the SALT HRS/Salome	John Hearnshaw
15:30	Coffee break	
16:00	SALT HRS/Salome (continued)	John Hearnshaw
17:00	Plans for the SALT Fibre Instrument Feed	David Buckley
17:30	Finish	

19 October 2001 (Friday a.m.)

9:00	Outstanding PFIS/Impalas issues	Ken Nordsieck
9:45	Reports from SALT partners (max 10 min each)	SSWG members
10:30	Coffee break	
11:00	Reports from SALT partners (continued)	SSWG members
12:00	SSWG recommendations to the SALT Board.	
12:15	Any other business. Future dates for reviews / meetings.	
12:30	Lunch	

Participants were welcomed by David Buckley, particularly Brian Chaboyer and Rob Fesen of the recently signed up partner, Dartmouth College, who were attending for the first time. All official representatives of the SSWG were present except Glen Mackie (NZ), whose proxy was given to John Hearnshaw (U. Canterbury).

The minutes for the 5th SSWG meeting (19 April 2001) were presented and accepted unanimously to be a true record of the proceedings (Moved DB, Seconded LWR). No immediate matters were arising from these minutes that were not dealt with in the main agenda.

One action item was the issue regarding the specification for secondary dispersion of the ADC, which was subsequently discussed during the presentation by Leon on the status of the payload design.

3. System Specification and Error Budget Report (Gerhard Swart)

Gerhard Swart (SALT Systems Engineer) gave an update report of the SALT design phase activities, including the status of individual subsystems.

Substantial analysis has been undertaken for the facility deign, particularly in the area of heat analysis and wind flow to ensure adequate ventilation of the facility using the open-air louvers. Predictions from the laminar flow model indicate that the currently designed louvers will ensure good flushing even for light wind conditions.

A secondary consideration is understanding the expected wind loading on the mirror segments, mount, tracker and truss.

The importance of using a 15 micron IR camera to locate local heat sources, which potentially generate undesirable air currents, was emphasized.

The design of the primary mirror segment handling arrangements was described.

Error budget update regarding the SAC was presented. The vendor, SAGEM, has offered a $52K reduction in cost if the total SAC error budget is increased from 0.226 arcsec (EE50) to 0.24 arcsec.

David requested that the current error budget tree be made available to the SSWG.

The Man-Machine Interface (MMI) for the TCS was described and examples of the GUIs available to the SALT Operator (SO) and SALT Astronomer (SA) shown. The general layout of the TCS displays was presented. One recent change is the addition of a large monitor dedicated to the acquisition field from SALTICAM. In addition there will be 2 monitors each for the SO and SA and 2 monitors displaying common information for both (e.g. weather).

It was recommended that a cirrus cloud monitor be employed as part of the weather system.

The LabVIEW application builder has been used to produce prototype display screen for the SO (SALT Operator) and SA (SALT Astronomer). These will eventually be distributed to the SSWG for comment.

(Gerhard's PowerPoint presentation ("Systems Engineering status" *) is available for downloading at http://www.salt.ac.za/images/science/restrict/sys-eng-Oct2001.ppt using username: sswg and password: t1meM@ch1ne.)*

4. Status of the SALT Payload (Leon Nel)

Leon Nel (Tracker & Payload Manager) presented the current status of the SALT Prime Focus Payload (PFP). The design will now incorporate the current model for the PFIS (Prime Focus Imaging Spectrograph).

Focussing & Guiding

The baseline SAC design is for an 11-m entrance pupil. Focus of the payload is critical with image quality (IQ) degrading at a rate of 12 arcsec per mm of axial displacement. This implies that the PFP has to be located to an accuracy of 10□m. The solution to this problem is to have a dual active focusing and guiding capability combined into a single system. Leon presented a preliminary design that used a beamsplitter and mirror to produce both in and out of focus images. Such a system could be expected to produce guiding good to 0.05" and focusing to 10□m, which are the performance requirement for stars brighter than R = 19.

There was considerable discussion on this preliminary design, with suggestions for improvements. Chris suggested that a diffraction analysis using Zemax should be undertaken and also that a different beam-splitter arrangement be considered. Because guiding corrections will happen more frequently than re-focusing, beam-splitters could be arranged to give 3 images: inside focus, focus, outside focus. Guiding would then be done on the focused images, using 60-80% of the light,

whereas the focusing would use only 10-20% of the light, but could integrate longer because of the longer duty cycle for focusing.

It was resolved that a report and analysis on the proposed guiding and focusing system be distributed to the SSWG for comment and for additional ideas or proposals. Feedback should be before 31 October 2001 (Proposed: DB, Seconded: DOD).

Ted reiterated the importance of the guidance system allowing intensity of the guide star to be logged during an observation. This information is crucial for Fabry-Perot observations, as previously mentioned at SSWG meetings.

Calibrations

Leon presented some of the drivers for deciding on the position for a calibration system in the PFP. These included:

- Evenness of illumination
- Reproducing SAC vignetting
- Reproducing the angle of incidence of rays on the CCD

Other issues may also be important.

Because it has already been agreed with the SAC vendor that there will be no moving parts inside of the SAC structure, only two possible positions exist for a calibration system

1. at, or near, the exit pupil position
2. before the entrance to the SAC

DOD expressed doubts about the use of a calibration screen before the SAC because of the effect of structure on the screen being recorded by the detector. An alternative, being investigated by Phillip MacQueen for the HET, was for an integrating sphere to be placed at this position.

A calibration screen at the position of the exit pupil would have to be placed before the moving baffle, to simulate the pupil motion during a track. Cognizance will need to be taken of heat source from calibration lamps, etc. Sky observations, for sky flat fields and airglow emission lines, will probably be very useful in calibrating data.

It was agreed that the following people will look into certain calibration issues:

- Ken Nordsieck will investigate the exit pupil position in terms of line centroid motion caused by the varying pupil
- Darragh O'Donoghue will investigate the potential use of an integrating sphere before the entrance of the SAC (i.e. below M3)

It was mentioned that the SAC optics on HET were very prone to dust. For SALT the entire SAC optics will be enclosed and dust intrusion could only occur from through the bottom hole (in M3).

Moving baffle

It was noted by Leon that the curved exit pupil presents problems if the pupil mask has to follow this curve, because of space limitations (i.e. constraints by the acquisition camera). Instead he proposed that the pupil mask be confined to in-plane

motion. The accuracy of repeatability at the entrance pupil (i.e. at M1) needs to be ±2.5 mm, according to Phillip MacQueen. Speed of motion is critical for calibrations to be done efficiently.

Atmospheric Dispersion Compensator

Previously DOD presented two potential options:

- Rotating Amici prisms
- Linearly translating prisms (LADC)

The current specification is for secondary dispersion of <0.15" and wavelength capability of 320-950nm.

Since the first-light instrumentation will have no IR capability, Darragh suggested that the current LADC design, optimized to above, be accepted. Ken, however, believed that the possibility to extend coverage to 1.7□m should be investigated as PFIS had an upgrade path to include capability out to this value.

It was resolved that the alternatives would be investigated ASAP and with a solution decided in time for its implementation in 1st Quarter of 2003.

(Leon's PowerPoint presentation ("Progress on SALT Payload") is available for downloading at *http://www.salt.ac.za/images/science/restrict/Payload-Oct2001.ppt*)

5. Instrument Statement of Work

David presented the latest version of the SALT Instrument Requirements/Statement of Work (SOW), which has gone through a number of iterations following comments from the SSWG and instrument PIs. It was stated that the SOW be seen as a guideline to instrument PIs and should not be overly prescriptive or legal in its wording. DB undertook to work with PIs to produce a 'toned down' version in terms of legal wording.

Ken felt that the term "pipeline reductions" should be removed because of the implications of providing a comprehensive and complete reduction package rather than instrument control software and some limited reduction code. It was agreed that the PFIS team would provide software to enable reduction of commissioning observations. In addition planning tools would also be provided to assist astronomers in planning PFIS observations. The SALT TCS will incorporate all the planning tools, which will require inputs from the instrument teams. These are seen as relatively simple, similar to the HET. Lack of software personnel will mean that only basic 'bare bones' software, observing scripts, planning tools, etc, will be provided by the instrument teams. The SALT user community should be tasked with taking on some of the responsibility of providing instrument/data reduction software rather than overburdening the PI and their teams.

It was generally agreed that the SSWG itself could undertake the task of developing 2nd generation software. By the time SALT is operational, the SSWG should be taking on more of a role as a user's group.

6. SALTICAM

Darragh presented an update on the SALTICAM status. SALTICAM, in its initial role as a SALT performance verification instrument, will be mounted, without any optics, at the PFIS position (i.e. on the 'straight through' focus position on the payload). It will be mounted there until the last of the primary mirror segments are installed. Following the verification phase, SALTICAM will be integrated with its optics and mounted at its focal station on the PFP, fed by a 45° pick-off mirror. This is where it will fulfill its role as both an acquisition camera for SALT and a science imager/photometer.

Science drivers

In response to the previous request from the SSWG, a questionnaire on the science requirements for SALTICAM has circulated by Darragh to all the SSWG representatives. Responses from the SALT community were collated, and Darragh presented a review of suggested SALTICAM science programs, which include:

- Photometry of faint SN and novae
- Broad-band colours (U to I) of stellar populations (e.g. in globular clusters, Galactic halo, Galactic bulge, local group)
- Surface photometry of galaxies
- Monitoring of extra-galactic Cepheids, AGB stars, etc
- Grism and drift scanning surveys
- Imaging of Plerions (e.g. Crab), pulsars and □-ray sources
- X-ray/optical campaigns with photometry < 1 s time res. (e.g. for echo mapping in AGN)
- Fast variability in quiescent soft X-ray transient objects
- Variable star studies, including high-time resolution studies of pulsating star and CVs
- Deep mapping of Galactic H□
- Time resolved studies of accretion phenomena (e.g. eclipse studies, QPOs)
- Monitoring of fain WR stars in the Galaxy and Magellanic Clouds

The FoV of SALTICAM will extend to a 10 arcmin diameter to allow guidance/focus objects to be acquired in the annular 4-5 arcmin radius region surrounding the science FoV.

Although time resolutions of ~75 ms were required, there may be problems running the CCDs at >10Hz (100 ms). The design work completed to date indicates some severe space constraints, particularly for the guide/focus probes, the filters and the shutter.

Optical design

SALTICAMs optical design has been changed to remove NaCl (salt) elements and instead now uses BaF_2. There are 5 elements with diameters in the region 100-130 mm, including crystalline materials (CaF_2, BaF_2) and fused silica. Blank procurement could potentially be split along these lines.

One of the biggest risks so far identified is the mounting of the optical elements, which need to take account of the differing thermal and chemical properties of the optical materials. Immersion oil will be required, possibly with expansion/contraction bladders. Darragh expressed concern over this aspect of the design, which will require some expertise in order to evaluate the solutions. The issue of ghosts was also still to be addressed. Broadband MgF_2 overcoating is planned for all elements

with air-glass interfaces. These will be satisfactory for the whole wavelength range of interest (320-900nm).

Quotations for the optics have been received. Although some quotes were within, or close to, the original estimate, some of these excluded mounting of the elements in cells. Darragh expressed concerns over some vendors, including their experience with crystalline materials and appreciation of mounting difficulties.

Although a manual focus adjustment will be possible for SALTICAM, it might be the case that some sort of controllable focus will be necessary, e.g. to ensure common focus of PFIS and SALTICAM. Likewise, filters potentially have different foci, necessitating some compensation to get the same optical path length.

CCD detectors

Because SALTICAM, in its verification configuration (sans optics), has to be delivered to SALT no later than 1 March 2003, the procurement of the CCD detectors needs to be done expeditiously. It has been planned for sometime to procure all of the CCDs for SALT's first-light instruments in a single order, to take advantage of price discounts for a bulk order. It was initially planned to purchase 8 chips (2048 × 4096 × 15μm pixels), 6 identical ones for PFIS and SALTICAM (including a spare), and two specifically for HRS. With the uncertainty of the status of HRS (see next section), it was decided not to purchase the 2 HRS CCDs at this time, but instead to go ahead with the purchase of 6 chips for SALKTICAM (2) , PFIS (3) and a spare.

Because of the technical requirements of the detectors, which demand frame transfer architecture and guaranteed performance (DQE, noise, good blue response and good cosmetics), negotiations have begun with the only vendor who can apparently deliver to these requirements, namely Marconi-EEV.

The chips being offered are deep depletion devices, which boosts the red performance significantly. However, the cosmetic quality of the chips is compromised to some extent. The current negotiations have been for the provision of Grade 1 deep depletion chips. There was some discussion regarding the relative merits of Grade 0 versus Grade 1 chips, particularly in reference to blemishes, black and white spots, etc. The consensus was that since we were expending effort to deliver efficient optics, that we should likewise ensure that the final link in the chain – the detectors – were equally optimized for best possible performance. Discussions of various strategies to ensure procurement of the best possible chips followed, with the result that Darragh and David would work together to clarify the issue with Paul Jorden (Marconi).

Cost

The estimated cost of SALTICAM now comes out at $529K, which includes a total figure of $140K for labour amounting to 3.5 person-years, and excludes the labour costs of the PI . The labour costs have a contingency of 15% on direct labour charges and 21% on overheads. Likewise a 15% contingency has been applied to hardware.

Various descope options were presented (e.g. reduce from 2 to 1 CCD chip, remove optics), but it was felt that these would lead to unacceptable compromises in performance and would not meet the specification. Risks include the possibility of lens breakages, since the material is fragile and mounting will be difficult. The schedule for delivery is also very tight.

Resolutions

It was agreed unanimously by the SSWG that SALTICAM should proceed to a Critical Design Review following a Preliminary Design Review to be held in Jan 2002 (Proposed: LWR, Seconded TW). The PI and Project Scientist would work together to define a specification, instrument SOW and contract for the instrument and in addition pursue the issue of chip cosmetic with Marconi-EEV.

(Darragh's SALTICAM report can be downloaded from www.salt.ac.za/images/science/restrict/sswg-2001oct.tar.gz)

7. SALT High Resolution Spectrograph (HRS)

John Hearnshaw presented an update on the design status of the HRS, which he proposes to name *CELESTIA* for *C*anterbury *E*fficient and *L*arge *E*chelle *S*pectrograph on the *T*elescope *I*n *A*frica.

The design is optimized for:

- High efficiency
- Continuous wavelength coverage from 380-880 nm
- High radial velocity precision
- Choice of Resolving powers (R = 22250-108000)
- Some sky subtraction (single fibres)

Basic design parameters include:

- Use of prism cross dispersers (for efficiency and simultaneous □-coverage)
- Fixed format and no moving parts (for stability and velocity precision)
- Range of resolutions (depending on use of different fibre sizes and microslits)
- Sealed inside a tank with He atmosphere (no *P,T* variations and n very close to unity.

Optical designs have explored using R4, R2 and R3 échelle gratings:

- R4 systems are compact, but because of high blaze angles, requires near-Littrow condition, resulting in difficulty separating incident and diffracted beams
- R2 systems, with smaller blaze angles, allow for departures from Littrow, but result in large dimensions (beam size ~ 40 cm) and expense
- R3 represents compromise between the above and the plan would be to design a grating for $\tan\square_B = 2.82$ (similar to Keck HIRES)

The expensive option would be to mosaic replica gratings on to a single substrate. Instead John proposes individually aligning two gratings of dimensions 320 _ 420 _ 74 mm. The coplanar grating would need alignment to a precision of 1 arcsec in terms of rotation, which can be achieved mechanically.

The prism cross dispersers are very large, weighing 62 and 57 kg respectively. Apex angles are 41.5º and 44.5º, respectively. Refractive indices of the prisms have to be constant to 1 part in 10^6.

With the above grating/prism combination, order 42-93 will be recorded simultaneously on a 4K □ 4K CCD (15□m pixels). The free spectral range will be recorded for all orders, excepting those below ~54 (□ > 652nm).

The collimator mirror will be 1.16m in diameter and will work at f/3.8 to account for FRD of the f/4.2 input beam to the fibres. The f/0.65 camera design will be based on the Epps-Vogt camera used in Keck HIRES, with a mirror diameter of 0.30m and working at f/2.2 in monochromatic light.

For radial velocity stability, the entire spectrograph is to be mounted inside a sealed tank, 6.9m in length, and filled with He gas. This will ensure temperature and pressure effects are minimized, since He has a refactive index of 1.000036, high thermal conductivity and low dependence of refractive index on temperature. A sealed tank also ensures a clean and light-tight environment.

Performance predictions

Three fibre sizes have been selected with core diameters of 300, 350 and 400□m. In addition, microslit on the exit faces of the fibres will allow for changes in resolution. Pairs of fibres will be mounted, separated by 600□m, for sky subtraction. Predicted throughputs and resolutions are as follows for assumed median seeing conditions. Spectrograph efficiencies and a typical CCD response curve for the best Marconi-EEV chips are assumed as well as the SALT system throughput and appropriate atmospheric extinction.

Fibre	***Microslit***		***Throughputs***		***Resolution***
(□m)	***(□m)***		***(%)***		***(□/□□)***
		Fibre/slit	***+spec+CCD***	***+SALT+atm***	
400	*no slit*	*67.8*	*19.8*	*11.6*	*22900*
400	*70*	*15.9*	*4.6*	*2.7*	*108000*
350	*200*	*41.9*	*12.2*	*7.2*	*37800*
300	*100*	*21.9*	*6.4*	*3.8*	*75500*

For R=37800, a S/N of 100:1 will be recorded in a 1 h exposure for a V=14.5 star in median seeing. This is comparable to the predicted performance of the HET HRS.
A limited magnitude of V~18 is therefore predicted for a S/N =30 spectrum at the lowest resolution (R = 22900) in ~ 1 hour.

Cost estimate

John presented the following cost estimates to build CELESTIA:

Labour (inclusive of overheads)			$200.9K	
Materials			$376.8K	
includes the following:	glass blanks	$186K		
	gratings	$118.2K		
	coatings	$36K		
Travel and transportation			$36.5K	
Overheads (45% on salaries)			$90.4K	
Contingencies (15% excluding committed)			$90.4K	(error?)

The total cost of CELESTIA, excluding contingencies and detectors, is currently estimated at $704.7K, and $794.2K with contingency.

A final figure on the costing of CELESTIA would be committed at PDR, currently planned for April 2002

(NB. Subsequent to John's presentation it was learnt that the University of Canterbury faced a funding crisis which meant a potential delay in payment schedules. It was decided by the SALT Board that the HRS/CELESTIA PDR be postponed indefinitely until the funding crisis was resolved.)

(John's PowerPoint presentation ("SALT high resolution spectrograph: CELESTIA"*) is available fordownloading at:*
http://www.salt.ac.za/images/science/restrict/SALT_HRS_Oct01.ppt)

8. Fibre Instrument Feed

David Buckley summarized the work currently completed and in progress on the fibre feed system for SALT. An initial investigation into the fibre feed design was completed by Nicholas Sessions. Development of the FIF was proceeding along the lines of a system initially dedicated to HRS/CELESTIA, i.e. single object spectroscopy.

The system would support pairs of fibres (star/sky) on an on-axis probe, with an off-axis fibre bundle(s) for guidance. The FIF would be so designed to allow a future upgrade to support multiple fibres, e.g. MOS or IFU.

Work on characterization of fibres, particularly in regard to throughput and Focal Ratio Degradation (FRD), began the previous week at Penn State. David and Nicholas used Larry Ramsey's fibre lab to test 13 different fibres, all 33-m in length and with core sizes of 200-400□m. Three different manufacturers supplied test fibres for this purpose: Polymicro, CeramOptec and Ocean Optics. Matt Bershady also provided two fibres which he had measured in order to compare results.

Most fibres were already measured, and the rest would be completed by Nicholas in the near future. Results in terms of FRD, MTF, etc, would be presented at the next SSWG meeting.

(David's PowerPoint presentation on the fibre feed, fibre testing, etc, is available for downloading at http://www.salt.ac.za/images/science/restrict/SALT-fibres.ppt)

9. Outstanding PFIS/IMPALAS issues

Following the all-day Preliminary Design Review meeting, Ken and David reported that the preliminary analysis of the feedback from the reviewers was encouraging and positive. Although there were a few areas of concern, PFIS/IMPALAS clearly passed the PDR and will proceed to CDR, with all 5 major sections scoring a 3 or higher ('sufficiently addressed/acceptable risk').

Reviewers strongly endorsed the science niches of the instrument plus the design concept. Quoting from the external reviewers report:

> *The PFIS team is to be commended for conceptualizing a viable and all-encompassing solution to matching the PFIS science drivers to instrument performance and functionality. PFIS covers very effectively much*

observational science that remains largely unaddressed by the other large telescope projects, inevitably resulting in a relatively complex, heavy and expensive instrument.

The areas of concern, roughly in order of importance, were:

- Cost & labour.
- Capability of supporting an upgrade path to the IR.
- Mass of the instrument (too heavy)
- Structural design (analysis weak)
- Optical element mountings

The external reviewers encouraged the PI and his team to attempt mass reduction and to be prepared to abandon the near-IR beam upgrade path, since without substantial cooling, the background will be too high at $\lambda > 1.4\mu m$.

PIs comments

In response, Ken Nordsieck (PI) believes that it is too premature to discard the near-IR beam and that the arguments regarding the specifications of wavelength capability (i.e. up to 1.3μm or 1.7μm) were not clear and needed further investigation. It was also argued that a major descope to a single-beam instrument, to save on mass, was unnecessary and not cost effective. Currently the two-beam design is only 50 kg over mass, and this for a yet to be design IR beam with an assumed identical mass as the visible beam.

The whole issue of the second beam is outside of the responsibility of the PI to deliver a first-light visible beam imaging spectrograph. The onus should fall on the SSWG to investigate this issue, rather than the PI and his team. Indeed the capabilities and complexity of the IR beam was still to be determined.

Similarly, Ken stated that the issue regarding mass was over emphasized given the still to be determined upper limit allowed for the tracker payload mass. Some tradeoffs on tracker/payload mass were still possible. Indeed it is one of the post-PDR tasks to reassess the mass budget for the instrument.

The criticism of Swales Aerospace in their mechanical analysis (e.g. by Chris) would be addressed now that an ME had been hired for the instrument team. Likewise the issue of optical lens mounting would need a lot further work.

Slit widths

The slit width issues was discussed, with opinions expressed at PDR that a nominal slit width of 1.5 arcsec should really be used in all throughput/efficiency calculation, since this was a better figure when taking into account the median seeing, SALT's error budget, plus the average zenith distance of 37°. We were reminded that background also plays a role in such calculations, and that wider slits compromise faint objects because of the increased background. Likewise, resolution is sometimes more important than throughput alone.

Future analyses will specify slit losses with both median and best seeing for the slit width specified.

Slit viewing

The relative merits of a direct slit viewing capability were discussed, since the alternative option is to rely either on blind offsetting or a guide probe system. A vote was taken and 8.5 out of 9 votes cast were in favour of a slit viewing system.

Post-PDR tasks

Ken listed the various tasks that he and his team would be attending to in the near term. These included:

- slit viewer
- mass budget
- definition of interfaces
- address flexure problems
- waveplate configurations

The final PDR estimate on cost for PFIS/IMPALAS was $3.645M (in March 1999 base-date dollars), without any contingency, and $3.942M with a 15% contingency on some items, which the external reviewers believed was too optimistic at this phase of the project. In response, Ken was reasonably satisfied with the independent estimate regarding the structure costs delivered by Swales.

The current baseline cost of $3.645M could only be reduced if the following descope options were considered:

1. Design phase descoping involving only ordering 2 CCD and descoping optics accordingly. Given the substantial amount of time to redesign, this would save at best ~$60K.
2. Decrease beam size from 150mm to 116 mm, resulting in smaller etalons, lenses, etc. Again, this involves redesign and would save <$36K. It would also seriously affect the instrument performance (e.g. resolution, blaze wavelength shifts in VPH gratings)
3. Fabrication phase de-scoping, which could involve the following cost savings:

• Postpone purchase of third etalon	~$120K
• Purchase smaller _ waveplate	~$71K
• Remove slitmask factory	~$106K
• **TOTAL**	**~$297K**

As it is, these purchases could be postponed or delayed as long as possible in case of cost overruns involving contingency spending. Such descopes potentially affect ~50% of science programs for multi-object spectroscopy and Fabry-Perot medium or high resolution imaging spectroscopy.

Most of the descope options were considered not to be cost effective trade-offs, and should not be pursued at this time. Following discussions it was agreed that the only really useful cost descope was the postponement of purchasing one of the etalons. It was proposed by Ted Williams, and accepted by the SSWG, that a decision on which two etalons to purchase initially would follow after feedback from the SSWG, and a deadline of 31st October 2001 was decided.

SSWG recommendations

The SSWG discussed the PFIS cost at length, including the issue of institutional overheads. One suggestion that the overheads be decreased once 15% contingency spending was exceeded would be problematic for Wisconsin. This could effect future

departmental funding and hiring. In support of PFIS/IMPALAS and the work so far completed by the Wisconsin group, Darragh stated an opinion shared by many, namely that without PFIS/IMPALAS, SALT would be nothing.

It was moved by Chris Clemens and seconded by Richard Griffiths that PFIS/IMPALAS be valued at $4M and that contingency be negotiated between the PI and Project Scientist. The motion was carried with 7 votes in favour, 1 against and 2 abstentions.

(NB. This motion was put to the SALT Board, but it was subsequently decided by the Board to value the instrument at the baseline value of $3.645M, but with a maximum 25% contingency available, which had to be negotiated on a case-by-case basis between the Project Scientist and PI.)

(Ken's PowerPoint presentation ("PFIS/IMPALAS issues"*) is available for downloading at:*
http://www.salt.ac.za/images/science/restrict/SSWG_PFIS_PDR_issues.ppt

The final PDR report can be downloaded from:
www.salt.ac.za/images/science/restrict/PFIS-PDR-report-2.doc)

10. Reports from SALT partners

Göttingen (Wolfram Kollatschny)
Wolfram stated that he was very happy with both the instrument proposals for PFIS/IMPALAS and SALTICAM, but had some concerns over the HRS/CELESTIA.

Dartmouth (Brian Chaboyer)
Brian felt that the prime instrument for Dartmouth would be PFIS/IMPALAS, which would satisfy the broad range of research interests.

An IR instrument (e.g. second arm of PFIS) would be of particular interest to Dartmouth, with 4 potential users.

UK Consortium (Anne Sansom)
Progress of formalizing the agreement between the UK partners was proceeding slowly, according to Anne.

The responses from instrument questionnaires indicate a strong interest in high time resolution for instruments.

There was also an interest in the possibility of supplying a 'user instrument' by one of the partners, namely a Planetary Nebula camera. David stated that although it was planned to accommodate auxiliary instruments on the payload, such instruments would be severely limited in mass and volume. It should first be checked that the existing instrument plans (e.g. F-P mode of PFIS) could not already satisfy this type of science.

New Zealand/Canterbury (John Hearnshaw)
Glen Mackie has resigned as the NZ/U. Canterbury representative on the SSWG since he was due to move to Australia shortly. The SSWG moved a vote of thanks to Glen for his work on the SSWG, particularly his part in securing Canterbury's

participation in SALT and his organization of the SSWG and Board meetings in New Zealand in February 2000.

John stated that Canterbury's SSWG representation would be shared between Drs Michael Albrow and Karen Pollard, recent joint faculty appointees.

John reported on the University of Canterbury's funding crisis and the fax which he received the previous evening stating that they would not be able to meet their funding commitments in the next two financial years (FY2002 and 2003). It was stated that this could be solved if another partner agreed to buy ~25% of Canterbury's SALT shares.

John, in reacted to comments regarding the current design of HRS/CELESTIA, stated that it was impossible to build an instrument that would satisfy all the high resolution requirements of both the stellar and extra-galactic communities, if it was to be affordable.
In addition he said that he would not be interested in being a PI on an instrument which would not satisfy his, or Canterbury's, stellar science interests. He reiterated the results of the HRS questionnaire, which showed a significant interest amongst the SALT community in a purely stellar instrument.

Carnegie-Mellon University (Richard Griffiths)
According to Richard, CMU's interests are exclusively in extra-galactic astronomy, which will be well served by PFIS/IMPALAS.

Richard mentioned that the GRANTECAN (Spanish 'Keck') was concentrating on IR instrumentation and that SALT needed to continue to identify niche science areas, continuing the trend set by PFIS/IMPALAS.

Hobby Eberly Telescope (Larry Ramsey)
Reporting on the HET status, Larry stated that there were now 26 papers published featuring HET observations.

Recent changes have been made to HET ventilation by employing openings in the dome and wall, covering up to 40% of the wall area.

Current figures for HET shutter open time (i.e. recording photons on a detector) are 43%, although a number closer to 70% is predicted eventually. In comparison Keck has ~50% shutter open time.

The MRS should be completed next 'spring' (i.e. March 2002). The 'ET' instrument, a moiré dispersive interferometer built by Jian Ge and capable of high precision single order radial velocity measurements, is due to be tried out on the HET soon. Larry distributed a paper describing the instrument and stated that such an instrument, once proven, may be of interest to SALT, since it is cheap to build and targets a specific niche area, namely precision radial velocity measurements. HET are now beginning to think about 2nd generation instruments of which ET could form a part. Larry said that if he were planning instruments now for HET, then he'd put IR (JHK) spectroscopy at R=5000-10,000 at top priority.

UNC (Gerald Cecil)
Gerald mentioned that UNC were hoping for another astronomy hire soon, in IR instrumentation. A decrease in the State budget has put a squeeze on finances recently.

Although UNC are preoccupied with SOAR they are still anxious to make an in-kind instrumentation contribution to SALT for 2nd generation instruments. Such a commitment would not be likely for another 1-1.5 years, though.

UNC are primarily interested in using PFIS/IMPALAS and SALTICAM.

Rutgers (Ted Williams)
Rutger's are heavily involvement in PFIS, and will be providing the etalons and have responsibility for the disperser mechanisms.

Ted mentioned that a Fabry-Perot instrument, ARIES, was being built at Rutgers and would be completed by the end of the year. It will then be used in Chile (CTIO).

Rutgers are also involved in a Midex mission, VIRGO, due to be launched 2006/2007. This will feature a Fabry-Perot instrument in space. In addition, Rutgers are applying to the NSF to set up a microwave anisotropy center with Penn State. SALT follow-up observations are planned to support this scientific endeavour.

Poland (Janucz Kaluzny)
Janucz reported that a meeting of the Astronomical Society held ~1 month ago was devoted to SALT. It was proposed to hold a conference in Poland in 2-3 years time devoted to SALT.

A group at CAMK (Nicholas Copernicus center) is interested in doing high resolution spectroscopy of stars in globular clusters. This would require HRS capability to V~18, but with good sky subtraction, comparable to that achievable on VLT and Magellan.

The extra-galactic community in Poland would be satisfied with the PFIS/IMPALAS capabilities.

University of Wisconsin (Ken Nordsieck)
Ken reported that Ron Reynolds would be attending a Fabry-Perot meeting in Mexico and will present a paper on PFIS/IMPALAS capabilities.

Matt Bershady was working on the HET IFU, SPARSEPAK.

11. SSWG recommendations (summary)

The following is a summary of the SSWG recommendations and decisions to be reported to the SALT Board:

1. PFIS passed its PDR and will now proceed to CDR. Several issues brought up by the review panel would be addressed by the PI in consultation with the Project Scientist.
2. SALTICAM will proceed to a CDR contingent on passing PDR in ~Jan 2002.
3. The evaluation of the instruments PFIS and SALTICAM is recommended to be the cost estimates as follows:
    - PFIS: $4M plus a negotiable contingency
    - SALTICAM $0.6M inclusive of contingency
4. Following on Darragh's concerns on the issue of institutional overheads, it was recommended that the Board undertake a rational assessment of the overheads for instruments.
5. That ~25% of the cost of SALTICAM should be funded out of the SALT Project budget (rather than science instruments budget) because of its dual

role as both commissioning and verification instrument and acquisition system.

(A summary of the SSWG decisions presented to the SALT Board can be found in the document tabled by the Project Scientist and downloaded from: www.salt.ac.za/images/science/restrict/PS-report-Oct2001-2.doc)

12. End of Meeting/Other items

First-light instrument budget

The situation regarding the budget for first-light instruments was discussed. It was reiterated by David that the original budget of $4.8M was never a high fidelity figure, being based as it was on HET instruments which were not always fully costed. The initial cost estimates provided by PI at the Concept Proposal phase should not be seen as final budget figures. Not until PDR would we expect to have reliable budget figures for instruments. This is now the case for PFIS and SALTICAM, so the instrument budget will be updated accordingly. If HRS/CELESTIA cost figures are included, plus an estimate for the CCD detector package, then the sort of numbers we are looking at are as follows. All figures are in $US March 1999 base-date dollars, which is assumed to differ from current dollars by ~10%.

Instrument	***@Oct 2001***	***@April 2001***	***Delta***	***Reasons for Change***
PFIS/	$4.00M	$3.22M	0.43M	Higher fidelity PDR figure plus some contingency
SALTICAM*	$0.36M	$0.36M	$0.00M	better est., overheads plus some contingency 25% cost to SALT
HRS/**	$1.03M	$0.81M	$0.22M	better est, CCDs plus 15% contingency
FIF	$0.16M	$0.16M	$0.00M	none
Misc***	$0.25M	$0.25M	$0.00M	none
Total	**$5.80M**	$4.80M	$1.00M	

* assuming a cost of $590K in current $'s (DOD) and only 75% of SALTICAM costs being charged to instrument budget, the other 25% to the project
** assuming a cost of $794K in current $'s (JBH), plus $350K for the CCD detector package in current dollars.
*** includes project.management costs., test equipment, calibrations, etc.

HRS/CELESTIA

The SSWG continued discussions regarding HRS/CELESTIA. Some members of the SSWG felt that the current design would result in an instrument that would be uncompetitive compared to other similar instruments on large telescope (e.g. VLT, Keck). Because John had not discussed this issue in very much detail, it was recommended by the David that this issue be seriously addressed in the near future.

The issue of sky subtraction and the need for multiple sky fibres was raised again, with disagreement on the question of whether it was possible to design an instrument capable of high resolution spectroscopy which could be used for both stars and galaxies. Larry expressed an opinion that it was, and John disagreed.

David restated the SSWG's previous resolution that HRS as currently conceived, i.e. targeted at single-object spectroscopy with some (single fibre) sky subtraction capability, should proceed to a PDR in April 2002. Whether this could still happen given Canterbury's funding crisis would have to be discussed by the Board.