SALT Development Report
To The SALT BEC

23 Mar 2015

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in collaboration with Chris Coetzee, Petri Vaisanen and other SALT Ops staff

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1. Scope

This reports on work carried out since the 2015 Jan BEC meeting.

2. Management and Meetings

2.1 New Management Structure

Much time has been spent over the last two months in supporting the bedding-down of the new astronomy operations organizational structure. In my view, the new scheme is working extremely well with new initiative, energy, and a unification of the people who work on SALT. The management team is working very well together. The other people in management have expressed a similar level of satisfaction with the new arrangements. More details can be provided on request.

2.2 Priority Review (work carried out in collaboration with Petri and Chris)

In the past, there have been reports on reviews of progress by the entire SALT Ops team. Three reviews took place last year: in April, August and December. It was agreed in the December meeting to devote the first of this year's reviews to a reconsideration of the priorities for improving the telescope which were agreed almost a year ago. This review is to take place on Mon 23 March, everyone from SALT Ops is invited, and an update report will be given at the BEC.

The meeting has been 'put together' by Petri and me with, of course, input from Chris. An input discussion document was compiled, circulated for comment to the SALT Ops list, and revised in the light of the comment received back. This input discussion document is posted on the BEC website along with this report.

The output of the meeting will be captured in a table which will have for each improvement project a priority which will be agreed at the meeting. In addition, a person to drive forward the gathering of information still lacking will be the second most important outcome. The almost blank version of this table is also posted on the BEC web site.

2.3 Chinese Visit

A high level astronomical delegation of about 10 Chinese astronomers, visited South Africa in the week of 16-20 March. The majority of the group comprised radio astronomers but there were a couple of optical astronomers as well as a computational astrophysicist. I attended a 2.5 day scientific workshop in Cape Town and gave a presentation on SALT. Nithaya, Ted and I then hosted the delegation in Sutherland where they were shown SALT in the afternoon and a visit to the control room in the evening took place.

It seemed as though they were mainly interested in the new radio facilities but there was a lot of interest to explore the possibility of access to SALT. We advised them to: (i) engage with the SALT Board; (ii) attend the Science with SALT conference in Stellenbosch in June.

2.4 South African SALT Task Team

A 1-day meeting took place with a variety of items on the agenda: the SALT Risk Committee; Corporate Governance; SALT's financial situation; potential new partners; SALT's productivity as well as reports from the operations, and the instrument and optimization projects.

2.5 South African SALT Time Allocation Committee

Having established this committee following the resumption of SALT's operations in 2011, I stepped off the committee 2 years ago. Following the unavailability of a member of the committee, I was asked to rejoin the committee for just the current time allocation for the upcoming semester starting 2015 May 1. I was extremely pleased to have this opportunity as, despite it taking about a week of my time, it gave me an opportunity to see the kind of proposals being submitted at present. It also allowed me to impress upon the SA TAC the implications of how they allocate time for the scientific productivity and reputation of the telescope. I will come back to this issue later in this report.

3. Calibration System Upgrade

The BEC will recall that a x10 improvement in the Calsys performance was achieved. This was later broken down into a x2.5 intrinsic improvement in throughput, and the remaining x4 from a more condensed distribution of light on the focal plane. The more peaked light distribution was clearly unacceptable and the SALT Astronomers said that a factor of 5 improvement with a fairly uniform distribution of light over the science field of view would be satisfactory. This required rework but it can be achieved by replacing the beam splitter next to the liquid light guides by a small elliptical mirror which will be mounted on a rotating actuator and select the light from the relevant light guide, both of which will be mounted at 90 deg to the optical axis of the unit. This will avoid throwing away 50 per cent of the light from the light guides.

The required rework comprises:

- A redesign and fabrication of the mechanical interface where the light guides are inserted

- Procurement of an elliptical mirror
- Procurement of a suitable actuator
- Developing software to enable control of the actuator by the SALT operator.

The first two of the above items are essentially complete. The bottleneck has been a many-week delay in receiving the actuator from Faulhaber in Germany. Their actuator was selected because other actuators in the payload are also from Faulhaber so this would be compatible with the existing hardware and software.

The new actuator will finally be delivered on Mon 23 Mar and software development to get it going will immediately begin. Hopefully, the final system will be in operation by the end of April. In the meantime, the SALT Astronomers are continuing to prefer the performance of the new system rather than go back to the much less efficient old system.

4. ADC and RSS-NIR

As is widely known, the existing ADC will degrade image quality in the RSS-NIR bandpass. I decided to assemble a document to assist the process of deciding what to do, the options being to remove the existing ADC; construct the "New ADC Design" I proposed three years ago etc. During this process, I revisited the problem and managed to develop the "Latest ADC Design" which uses the existing prisms, gives satisfactory performance in the UV+Vis and NIR separately, and adequate performance across the whole bandpass. This is a much less expensive and better performing solution than the "New ADC Design" which comprised 3 new prisms, one of which was CaF2.

The document describing the situation and the "Latest ADC Design" is posted on the BEC website along with this report.

It appears that there is a broad consensus that the latest ADC Design should be built and I ask for endorsement by the BEC to take that process forward. A project plan will be developed and presented to the BEC/Board for approval in due course.

5. Control of Primary Mirror GRoC

At the last BEC meeting, the failure to control Primary Mirror GRoC was discussed and I was asked to assess the viability of alternative schemes. I completed a study and this is summarized in a document posted with this report on the BEC website. Ockert and Martin reviewed the report and agreed that at least one of the alternative techniques is simple in concept and inexpensive.

In the meantime, it appears that good progress with GRoC control is being achieved using the SAMS system, so that these alternative schemes will probably not be needed.

6. RSS-NIR

I have taken over as SALT's representative in the procurement of RSS-NIR. Paul Kotze, one of the SALT Astronomers, has been appointed as local instrument scientist

We received a quarterly report which is posted on the BEC website along with this one. The first meeting of the year took place on Feb 27 and included the UW instrument team, as well as Chris Coetzee and other engineering staff, Paul and myself. Significant points from this meeting and the quarterly report include:

- Technically, the instrument is proceeding as planned. The only hitch has been the CO2 cooling system. This has turned out to be prohibitively expensive ($500k). Alternative options are being explored. A promising avenue is a South African vendor who has already visited SALT.
- Schedule: the current schedule has the instrument ready to ship to South Africa by the end of 2015 (assuming money is found to resource the work).
- Budget: the shortage of money to get to the point of being ready to ship is $233k. The cost of commissioning, for which there is no budget, is estimated to be $640k.
- Risks: the risk table in the report seems reasonable. The major items currently comprise the budget and the cooling system.
- Marsha continues to draw SALT's attention to the de-scoped items and the need to procure them now (if they ever are to be procured) because of the long lead time. Currently, the instrument will be delivered with just one grating and no cryogenic/order blocking filters, no polarizing beam-splitter and a warm slit.
- Chris C and his staff have for quite some time been expressing concern over the lack of detailed information regarding what SALT Ops has to provide to interface the instrument to the rest of RSS and the telescope. They feel unable to make any preparations from their side for the integration of the instrument. This item was discussed and Marsha's team promised some written information to get the process going by the next meeting.

6.1 The Outlook for RSS-NIR

- For some years, RSS-NIR has had a precarious future because of the lack of funding to complete the instrument in Madison, and to commission the instrument on the telescope. It does not seem to me that the funding required ($233 + $640) will become available by the time the instrument team runs out of money. If so, the future is one of two outcomes: (i) there is insufficient money to finish the instrument in Madison so it will languish, incomplete, in the UW astronomy department; (ii) $233k is found which will enable the instrument to be completed, so it will be packed and ready to ship, but there is insufficient commissioning money.

- There has been growing concern by Chris and his staff, as well as myself, about the technical complexity of mounting the instrument on top of the telescope. The risks from SALT's point of view include:

  - The cost in local engineering effort to support installation
  - The technical complexity to achieve this
  - The HUGE loss of efficiency in RSS-VIS at least, and possibly the telescope as a whole, resulting from disturbance to telescope operations

  The last point should be taken very seriously by the BEC/Board: after recommissioning of the telescope in 2011, it was about 6 months before the telescope settled down into routine operation. After the RSS-VIS optical service in October last year, the disturbance to the system took about 3 months to settle down. Integration of RSS-NIR would take at least six months and maybe as much as a year. During this time, the availability of the telescope

for science operations will be severely comprised as the amount of engineering time required will shoot up.

From SALT's point of view there is little it can do if the instrument is not completed and ready to ship. If, however, it is completed and the next hurdle is commissioning, the situation might look different as described in the next subsection.

6.2 An Alternative Home For RSS-NIR

We have begun to explore seriously the suggestion made by Matt Bershady to mount RSS-NIR in the spectrometer room and feed it with optical fibers. The other end of the optical fibers would be arranged in an integral field unit mounted in either the FIF or Aux ports in the payload. If the Aux port is developed as a "smart focal plane" with movable fibers / IFUs, multi-object spectroscopy (fiber-fed) with RSS-NIR would eventually be possible.

In considering the options, let's start with why we would NOT wish to do this:

- Loss of capability: no simultaneous RSS-VIS + RSS-NIR observations
- Loss of capability: no multi-object NIR spectroscopy (at least initially)
- Loss of capability: no NIR (spectro-)polarimetry
- Loss of capability: no NIR imaging
- Loss of upgrade potential: no NIR Fabry-Perot
- Effort would be required from SALT staff to contribute to developing the new arrangement
- Money would be required for a new collimator and an IFU
- The RSS-NIR Collimator Doublet and Dichroic would be wasteful expenditure

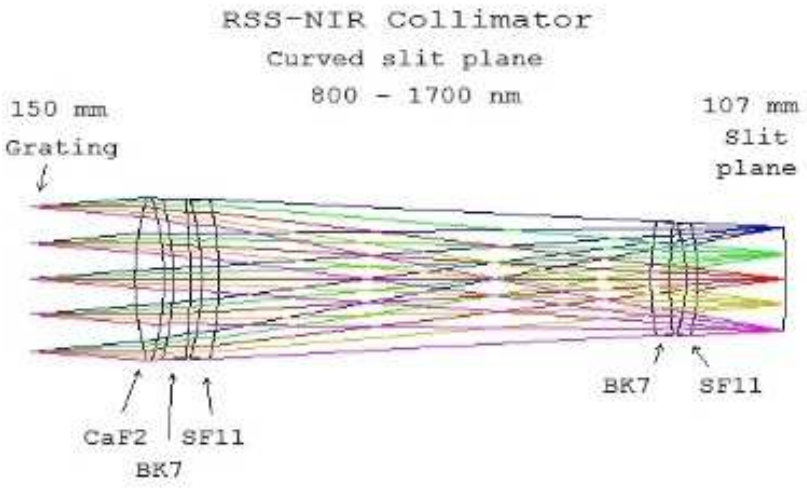


Fig. 1: New collimator for RSS-NIR

If RSS-NIR goes in the spectrometer room, how would this help?

- Commissioning of RSS-NIR would proceed almost entirely independently of the telescope whose operations would not be affected. Commissioning of the instrument can therefore proceed at whatever pace resources are available.

- Cooled slit and collimator become a reality (it seems technically inconceivable that the RSS-VIS slit could be cooled without major rework of the current hardware). Slit and collimator cooling will improve the instrument performance very significantly.
- The main problem with commissioning RSS-NIR, as things stand, is the commissioning cost ($640k). This cost could be met by SALT assigning its personnel to support commissioning and reduce the time UW personnel are required. Cash flow is therefore relieved.
- HUGELY simplified technical complexity.
- HUGELY simplified repairs and maintenance.
- RSS-VIS is being compromised by marriage to RSS-NIR: each optimization of RSS-VIS results in a loss of throughput because of the presence of RSS-NIR: anti-reflection coatings covering 320-1700 nm are less efficient.
- RSS-NIR becomes scientifically MUCH simpler. As will be argued in the next section, the diversity of capability on SALT results in fragmentation of the science and dilution of impact.

The central point of the alternative scheme from a resources point of view is solving the cash flow problem by SALT contributing its resources to execute the commissioning, using people funded out of operations. The alternative home for RSS-NIR makes sense only if the commissioning cash cost is substantially smaller than $640k. A realistic cost estimate is required for:

- The cash cost of a new collimator: I have designed a new collimator (see Fig. 1) comprising 4 singlets made of inexpensive glasses, and a CaF2 singlet. UW have a spare CaF2 blank (the main cost of fabricating CaF2 lenses). The required cash cost is therefore the fabrication of the optics. (The real cost, of course, involves the human resources needed to execute this).
- The cash cost of an IFU: Matt Bershady has indicated willingness to lead the effort to provide an IFU. He would have to source money for the IFU from outside, and is willing to do so.
- The net saving in cash from using a cooling system to be operated in the spectrometer room compared to on the telescope. Likewise with other hardware.

Clearly, a thoroughly reliable cash cost for the alternative scheme needs to be assembled. This is in progress. If the possibility continues to make sense, a document capturing all the pros and cons needs to be written and submitted to the Board.

Of course, a burning question is: “why should SALT take a major role in the commissioning of RSS-NIR?”. This only makes sense if SALT is compensated for this. Exactly how this is to occur (one-off observing time or whatever) is not addressed in this report.

Note that a case for decision making is not yet in hand and many of the above statements have yet to be verified by hard numbers. This report is therefore merely to inform the BEC of developments in this regard. Nevertheless, comment from the BEC is urgently solicited: if the BEC sees no merit in the alternative scheme, developing it should cease immediately.

7. Scientific Productivity of SALT (in collaboration with Petri and Chris)

7.1 Time Allocation Practices

There has been, since the implementation of the new operational structure at the beginning of Feb, a HUGE focus on efficiency of SALT. Much of this will be described by Petri and Chris in their BEC reports.

Since realizing the enormous discrepancy between completed observing programs, and science blocks coming out of the telescope, it has been obvious to me that we have a serious, intrinsic, problem in the way we are operating SALT. The facts are (thank you, Petri):

- The number of completed programs per semester is roughly 15-20 per cent.
- The number of blocks with priority P0-P2 is roughly 50 per cent.
- The total number of acceptable science blocks as a fraction of observing time (= night time – time lost to weather – time lost to technical problems – time lost to engineering [mirror alignment]) is about 80 per cent.

The rate of science data coming out of the telescope is therefore about 4 times the program completion rate. The reasons for this are set out in the letter. If we assume that a completed program is a prerequisite for science publication, then the telescope is being operated in a manner which favours scientific data production but does not support science publication, due to lack of complete data sets.

Why should we care? Won't publication eventually 'catch up'?

- The body responsible for the sustainability of SALT, the SALT Board, currently has no direct control over the way telescope time is being allocated. Thus, scientific productivity and impact are out of control of the Board.
- SALT badly needs not only additional investment to fund development, but additional monies to sustain the enterprise. One way to achieve this is to bring in "new money" through sale of time or shares to new partners. This is surely harder than persuading the principles of existing partners that SALT is worth further investment. From the lack of new monies, partners clearly do not currently find a sufficient basis on which to build a case to take to their principles. Lack of quantity and quality of publication is surely the dominant factor in this.

The visibility of the above factors has led to the realization that the manner of time allocation on the telescope (within the purview of the TACs) is a far more important factor than telescope operational efficiency in the sustainability of SALT.

Accordingly, Petri and myself, endorsed by Mike, wrote to the TACs (cc-ed to the Board) during the allocation of time for the upcoming semester to make them aware of these issues (letter posted along with this report). For my part, my involvement in the recent South African TAC was highly opportune. SASTAC had, in fact, been moving its allocation approach in the same direction as in the letter. After discussion of the relevant factors, SASTAC's allocation of time was characterized by a larger rejection fraction, attempting to assign the same priority to all targets in a given proposal, and greater than requested allocations of time to the best scientific cases in order to see that complete science data sets were delivered.

I urge that these matters be given a thorough discussion at ongoing BEC/Board meetings.

7.2 Publications and User Relations

The list of peer-reviewed publications can be viewed at:

http://old.salt.ac.za/science/publications/peer-reviewed/

This list is looking considerably healthier now and shows an acceleration of publications in quality journals over the last couple of years. The BEC / Board should keep an eye on the list in order to assess when to approach principles for an additional investment in the company.

There is no doubt that interest in SALT from partners is declining: over-subscription rates are falling; some of the smaller partners are undersubscribed (e.g. UNC did not submit any proposals for the upcoming semester); some scientists who have been regular proposers in the past are no longer submitting proposals.

It is obvious that SALT has acquired a poor reputation both inside and outside the consortium. Initial discussion has taken place over mounting roadshows to inform the community of the improvement in performance of the telescope and instruments in an effort to win back the disillusioned.

8. Miscellaneous

- I have consulted for SAAO astronomer Hannah Worters on the new SAAO, robotic, 1-m telescope. Apart from general advice regarding managing the contract, I have advised her that the wide field corrector proposed by the vendors, APM, has poor performance below 400 nm, implying that UV imaging with the telescope will have poor efficiency. I designed a new corrector with much better UV efficiency. This corrector has been acknowledge for excellent performance by APM, who have also agreed to adopt it and are willing to take responsibility for its performance in the final delivered telescope.

- At Ted's request, I reviewed the proposed imaging CCD photometer to be built at the Nainital observatory in India and attached to their 3.5 m telescope. A specification (small detector) was identified as being a significant driver for quite a complex optical design and that a more relaxed specification would lead to a much easier optical design and probably a saving in money as well. This assessment was accepted by the Indian optical designer.