SALT NEWS

(for public webpage)

25 November 2006

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SUMMARY

Activities since the last news update include the completion of the so-called "special PV" programs, and this issue includes summaries from the various PIs on some of these and other Performance Verification programs. Although we are still addressing the two issues with SALT, namely image quality and RSS throughput, significant progress has been made in getting SALT to be more efficient and reliable.

While there has been a gratifying increase in the percentage of time devoted to science (notwithstanding the spell of bad weather during winter), the shutter open time is still well below spec. This is because of the current lack of auto-focusing, the less than optimal procedures for setting up positions for targets and guide stars and the necessity to manually change slits, all of which will be improved when the full TCS, OCS and instrument functionality is realized.

SALT MEETINGS IN SUTHERLAND

The last SALT Board and Science Working Group meetings were held at Sutherland from of 23 to 26 October. Highlights of the meeting included:

- A decision that the University of Durham Centre for Advanced Instrumentation be appointed as preferred prime contractor for the SALT High Resolution Spectrograph (see below).
- Acceptance of the American Museum of Natural History (AMNH) as a new SALT partner. This followed the first successful video conference at SAAO, with the Board and Mike Shara at AMNH in New York city.

In addition the usual technical and operational reports were presented and presentations on some of the PV science that has been completed. The plans and schedules for the various engineering work still to be completed was reviewed, with particular emphasis on the RSS throughput fix and the various tasks that will be completed whilst it is off the telescope.

RSS UPDATE

On 16 November, just over a year after it was installed, the Robert Stobie Spectrograph was lifted off the telescope in order to dismantle its optics to send back to the US in order to remedy the low throughout of the instrument. Prior to this Ken Nordsieck (RSS Principal Investigator) and Eric Burgh (RSS Instrument Scientist) conduced some in situ throughput tests with lasers (at 375 & 635nm) and photodiode detectors in order to isolate the cause of the low throughput, particularly in the UV.

SALTICAM UPDATE

Good progress has been made recently on the completion of SALTICAM's guidance system, which has recently passed its positioning accuracy tests. This will be installed when SALTICAM is removed from the telescope in Feb 2007 for various upgrades, expected to be completed by early April. These changes were originally to take place late this year, but were postponed to allow the possibility of obtaining further image quality data, particularly after RSS was removed, and also to avoid the summer vacation period. Following its reinstallation, it will then be possible to undertake properly guided and focused observations with SALTICAM, something which has only been available for RSS.

SALTHRS UPDATE

Following the call for proposals to build the SALT High Resolution Spectrograph (SALTHRS), bids from three potential prime contractors were received: UK Astronomy Technology Centre (Edinburgh), the University of Durham Centre for Advanced Instrumentation and the University of Wisconsin. Following deliberations by the SALT Board and SSWG, the University of Durham group were selected to be the preferred prime contractor, and construction is expected to begin in early 2007.

The design of SALTHRS was completed by the University of Canterbury in 2005, and is a dual-beam white-pupil R4 fibre-fed échelle vacuum spectrograph. It will have a resolution of between 17,000 and 60,000 (depending on fibre choice) with simultaneous spectral coverage from 370-890nm and is designed for point sources with good background subtraction, achieved with dual fibres. In addition, the spectrograph will be well suited for precision radial velocity measurements. It is anticipated that SALTHRS will take some 2 ½ years to build and should be completed in 2009. The estimated cost is in the region of ~$3M and the SALT Foundation currently has just over half this amount available at present, although new initiatives are expected to bring in the remaining funds required.

CALL FOR SALTICAM PROPOSALS

In light of the fact that for the next ~6 months the only instrument on SALT will be SALTICAM, it has been decided to call for new proposals with this instrument, to be submitted by mid-December. This announcement is due to be posted shortly on the SALT Website and a Java tool will be available to PIs to submit their proposals with relevant information needed by SALT Ops (e.g. target coordinates, instrument configuration, finding charts).

The proposals will be for the period 15 Dec 2006 – 30 June 2007 and will be assessed, as before, by the SALT Project Scientist, the SALTICAM Principal Investigator and SAAO Director, just in terms of technical feasibility, with an attempt to be equitable in allocation of time in relation to the partner shareholding.

Proposers will need to bear in mind the following when submitting proposals:

- Programs will be done on a best efforts basis by SALT Astronomy Ops.
- PIs will be expected to provide timely feedback on their data, which will be made available to them shortly after (< 1 week) the observations are made.
- Programs for the period Dec – Feb will be without the benefit of auto-guiding and auto-focusing (i.e. exposures need to be short, < 30 sec).
- Image quality is still not to specification and it should be assumed that this will still be a problem during the period in question. It is *usually* possible to have a reasonable focus and image quality over a region of <2 arcmin extent, but the PSFs deteriorate significantly outside of this.
- Engineering time (e.g. image quality testing) may take precedence at times, depending on circumstances.
- Programs for the period April – June will have the benefit of auto-guiding and auto-focusing.
- While attempts are being made to remove the contamination due to the autocollimator laser (670 nm), it is likely that this will still be a problem for R-band exposure.
- Deadlines are:
    - For Dec-Feb period: 15 Dec (late proposals accepted if intention to submit is sent by the dealine)
    - For April – June period: 15 Jan.

Details of the new proposal tool and instructions will appear by 1 December on the SALT website: http://www.salt.ac.za/proposing/proposing-procedure/

SLOAN FILTER SET FOR SALTICAM

A set of SLOAN prime filters (u',g',r',i' & z') have been ordered for SALTICAM, which are expected to be delivered in January 2007. As there is only space for 8 filters in SALTICAM, which current has a set of Johnson-Cousins (U,B,V,R,I) filters, plus two specialized UV filters (340 & 380 nm), it will be necessary to undertake observations requiring either set in "campaign mode", when either filter set will be selected for a given period (maybe a week or two).

IAU GENERAL ASSEMBLY MEETING & SALT'S FIRST SCIENCE PAPER

Several of us from SALT Astronomy Operations and SAAO attended the IAU General Assembly meeting in Prague in August. SALT was featured in several papers presented at the meeting, including a talk in the special session on "hot topics". It also gained some publicity in the third issue of the daily General Assembly newspaper, *Nuncio Sidereo*, at the time of the press release on acceptance of the first science paper. This was a study of an eclipsing polar with SALTICAM led by Darragh O'Donoghue, with coauthors from the entire SALT instrument, construction and operations teams, and is due to appear soon in *Monthly Notices of the Royal Astronomical Observatory* (astro-ph/0607266):

First science with SALT: peering at the accreting polar caps of the eclipsing polar SDSS J015543.40+002807.2

D. O'Donoghue[1], D.A.H. Buckley[1,2], L.A. Balona[1], D. Bester[2], L. Botha[1], J. Brink[1,2], D.B. Carter[1], P.A. Charles[1], A. Christians[1], F. Ebrahim[1,2], R. Emmerich[1,2], W. Esterhuyse[2], G.P. Evans[1], C. Fourie[1], P. Fourie[1], H. Gajjar[1,2], M. Gordon[1], C. Gumede[2], M. de Kock[2], A. Koeslag[2], W.P. Koorts[1], H. Kriel[1], F. Marang[1], J.G. Meiring[2], J.W. Menzies[1], P. Menzies[1], D. Metcalfe[1], B. Meyer[1], L. Nel[2], J. O'Connor[1], F. Osman[1], C. du Plessis[1], H. Rall[1], A. Riddick[1], E. Romero-Colmenero[1], S.B. Potter[1], C. Sass[1], H. Schalekamp[2], N. Sessions[2], S. Siyengo[1], V. Sopela[1], H. Steyn[1], J. Stoffels[1], J. Stoltz[1], G. Swart[2], A. Swat[2], J. Swiegers[2], T. Tiheli[1], P. Vaisanen[1], W. Whittaker[2], F. van Wyk[1]

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Accepted Received

ABSTRACT

We describe briefly the properties of the recently completed Southern African Large Telescope (SALT), along with its first light imager SALTICAM. Using this instrument, we present 4.3 hr of high speed unfiltered photometric observations of the eclipsing polar SDSSJ015543.40+002807.2 with time resolution as short as 112 ms, the highest quality observations of this kind of any polar to date. The system was observed during its high luminosity state. Two accreting poles are clearly seen in the eclipse light curve. The binary system parameters have been constrained: the white dwarf mass is at the low end of the range expected for cataclysmic variables. Correlations between the positions of the accretion regions on or near the surface of the white dwarf and the binary system parameters were established. The sizes of the accretion regions and their relative movement from eclipse to eclipse were estimated: they are typically 4° -7° depending on the mass of the white dwarf. The potential of these observations will only fully be realised when low state data of the same kind are obtained and the contact phases of the eclipse of the white dwarf are measured.

Key words: accretion – binaries: close – novae, cataclysmic variables – X–rays: stars.

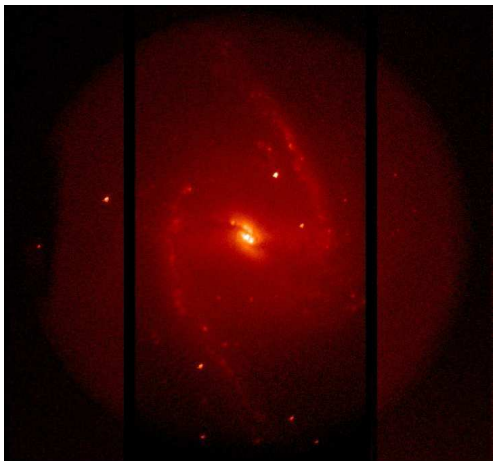
The unprecedented quality of the high time resolution light curves presented in this study highlights the potential for SALT to undertake such time resolved observations. Further observations of similar object have also been obtained and more recently some time resolved spectroscopy.

FABRY-PEROT SPECTROSCOPY COMMISSIONING BEGINS

The Fabry-Perot system of the Robert Stobie Spectrograph was used for the first time on the night of 22/23 September 2006 to acquire on-sky images with the Southern African Large Telescope. The instrument was used in its low spectral resolution mode to scan the H alpha line in NGC 1365, a

barred spiral galaxy, and NGC 1535, a Galactic planetary nebula. The observers at the telescope were Eric Burgh, the RSS Instrument Scientist, Steve Potter, the SAAO Staff Scientist for the RSS, and Ken Nordsieck, the RSS PI; Fred Marang was the telescope operator; Naseem Rangwala and Ted Williams provided remote commentary and encouragement from New Jersey.

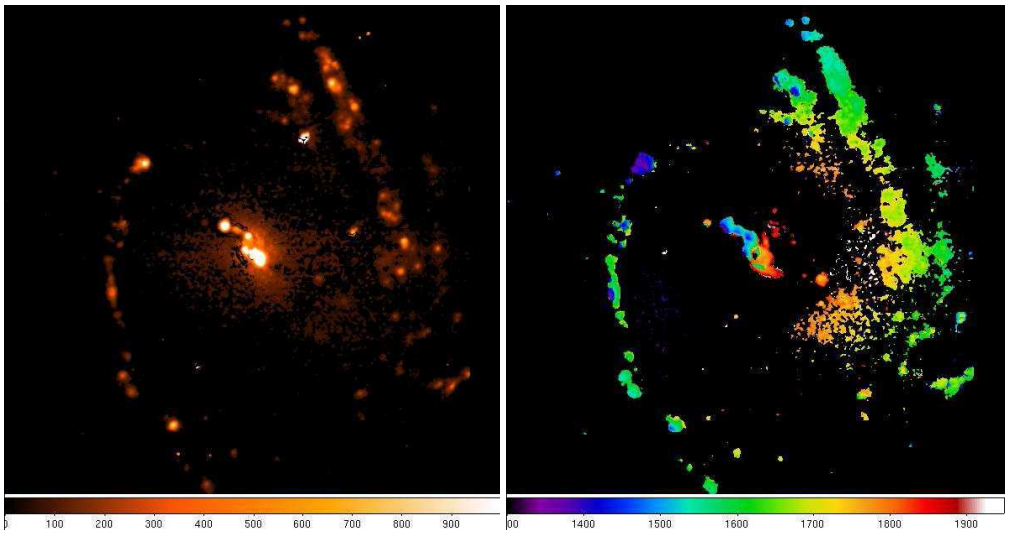
The image below, prepared by Eric Burgh, is the sum of several 120-second exposures of the barred spiral galaxy NGC 1365 which cover the 8.5 Angstrom FWHM passband of the RSS F-P Low Resolution (LR) mode.



An image of NGC1365 taken with RSS F-P system covering an 8.5Å passband, centred on Hα.

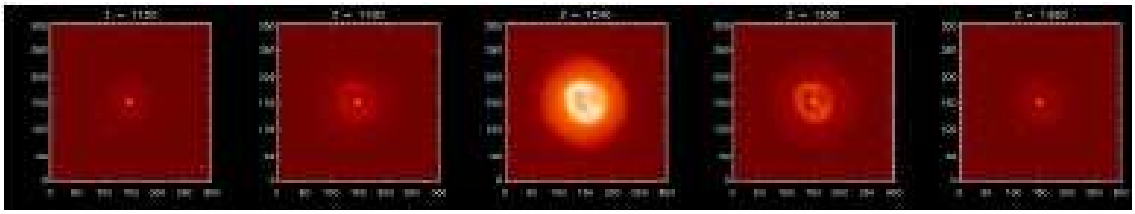
An initial scan of 19 x 1 minute exposure images covered the (redshifted) Hα region of the spectrum; a shorter scan of 8 images, each of 2 minute exposure, was then taken concentrating on the wavelengths close to the line; a final image of 5 minute exposure was taken near the peak of the line. All the images were included in the data analysis, which was carried out by Rutgers graduate student Ricardo Sanchez. No flat field or wavelength calibrations were obtained, so the reduced fits are only approximate. The individual images were smoothed over 2.25" x 2.25" blocks. In the absence of guide star brightness information, we instead measured the flux of one of the stars in the image and used this to calibrate the combined collecting area and atmospheric transparency variations. We assume the star's spectrum is flat over the spectral region, and this assumption can distort the line profiles. Also, the spectral resolution of the LR etalon is not optimal for measuring galaxy dynamics.

Despite various shortcomings, which will be rectified as the telescope and observing procedures mature, respectable maps of the Hα intensity and velocity were obtained. In the maps below, only points where the measured velocities have estimated precision of 20 km/s or better are shown. A quick comparison to maps of this galaxy obtained on the CTIO 4m telescope with the Rutgers Fabry Perot system show very good agreement in the measured velocities.



Left: an Hα intensity map of the galaxy. *Right: the derived velocity map of NGC1365.*

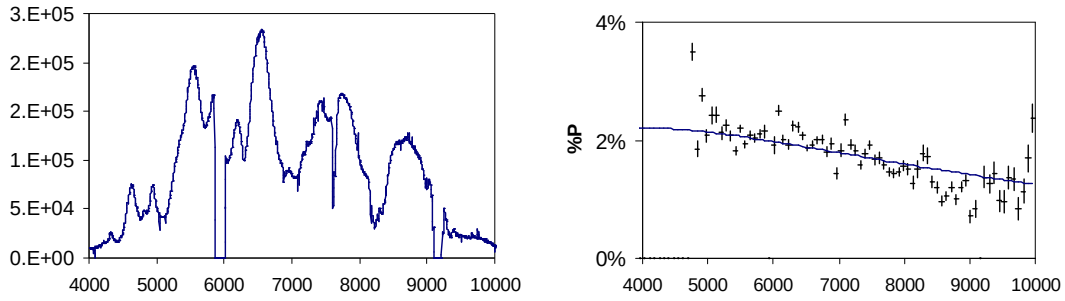
The thumbnails below are selected from the scans of the planetary nebula NGC 1535, using a logarithmic intensity scaling. The bright central part of the nebula is about 20" in diameter.



FIRST STEPS WITH RSS SPECTROPOLARIMETRY

During the weeks following the SALT Board/SSWG meeting in October and before the removal of RSS from the telescope, the first tentative spectropolarimetic observations were attempted using RSS by Ken Nordsieck, Steve Potter, Janus Brink and David Buckley. The waveplate control software was updated by Anthony Koeslag to allow for the correct sequencing of the waveplate positions to allow for both linear and all-Stokes polarimetry commissioning observations to be undertaken. These included observations of recent supernovae, HII regions and magnetic CVs using the low resolution 300l/mm surface relief grating.

Although there are still some systematics to iron out, the basic operation of the imaging and spectropolarimetry modes was proven, and polarized spectra were obtained, as seen below:

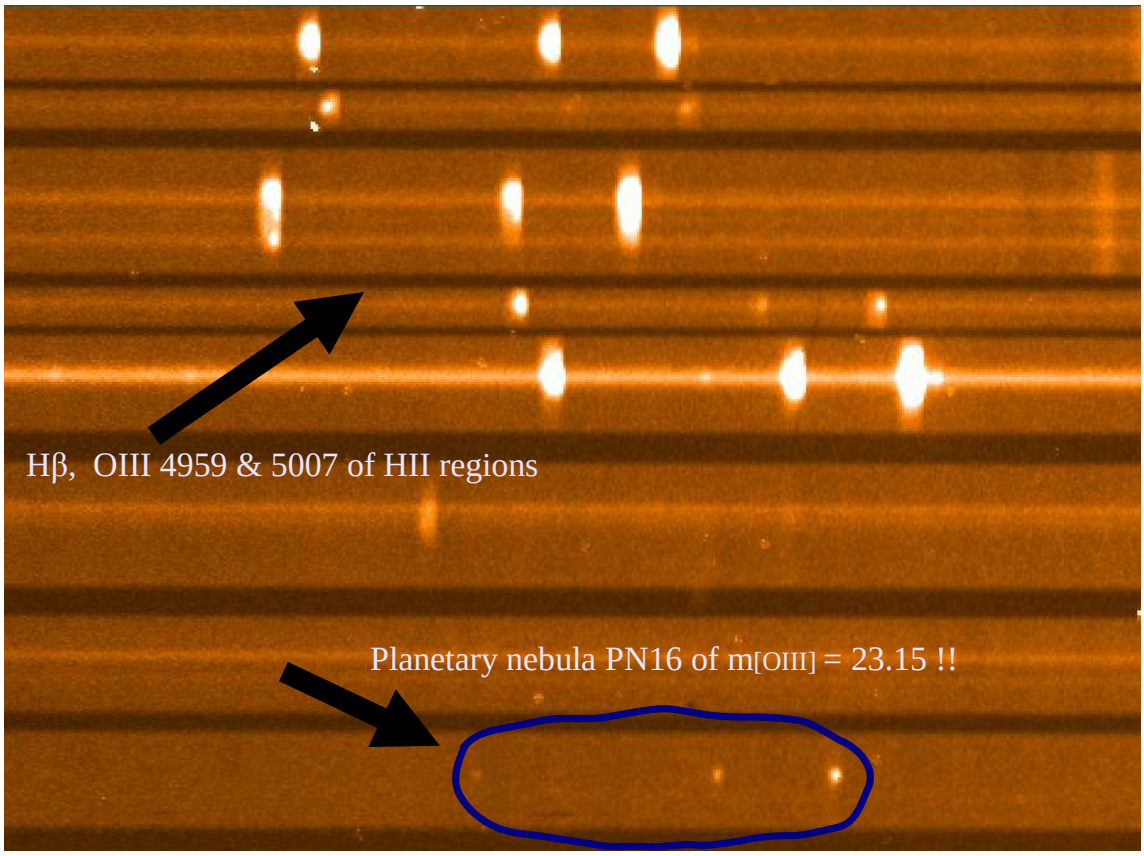


Commissioning spectropolarimetry of the SN2006mq. Left: spectrum Right: linear polarization

FIRST MULTI-OBJECT SPECTROSCOPY TESTS WITH RSS

The first tentative steps in conducting MOS observations with RSS have taken place under the guidance of SA Petri Vaisanen on three occasions: in August on two bright open clusters (with visiting University of Canterbury graduate student Mita Gopal) and in September and October on a Local Group dwarf irregular galaxy with slitlets placed on HII regions and PNe (Alexei Kniazev; PI for MOS PV-proposal). These initial tests were gratifyingly successful, particularly in light of the continuing image quality problems, in particular there were no major problems with field distortions. However, there were some issues with the Java slitmask tool, which failed to predict the correct orientation. The setting up at the telescope is also very inefficient at present, and much of a track is lost in orienting the field correctly. This will be improved with future TCS and OCS developments, as will the functionality of the Java tool.

On 20 October observations were taken of HII regions and planetary nebula in the vicinity of the local group dwarf irregular galaxy, NGC6822. Several masks were used, with up to 28 slitlets, and 8 PNe and over 20 HII regions were detected. The image below shows one of the RSS CCD frames with the detection of the faintest PNe.

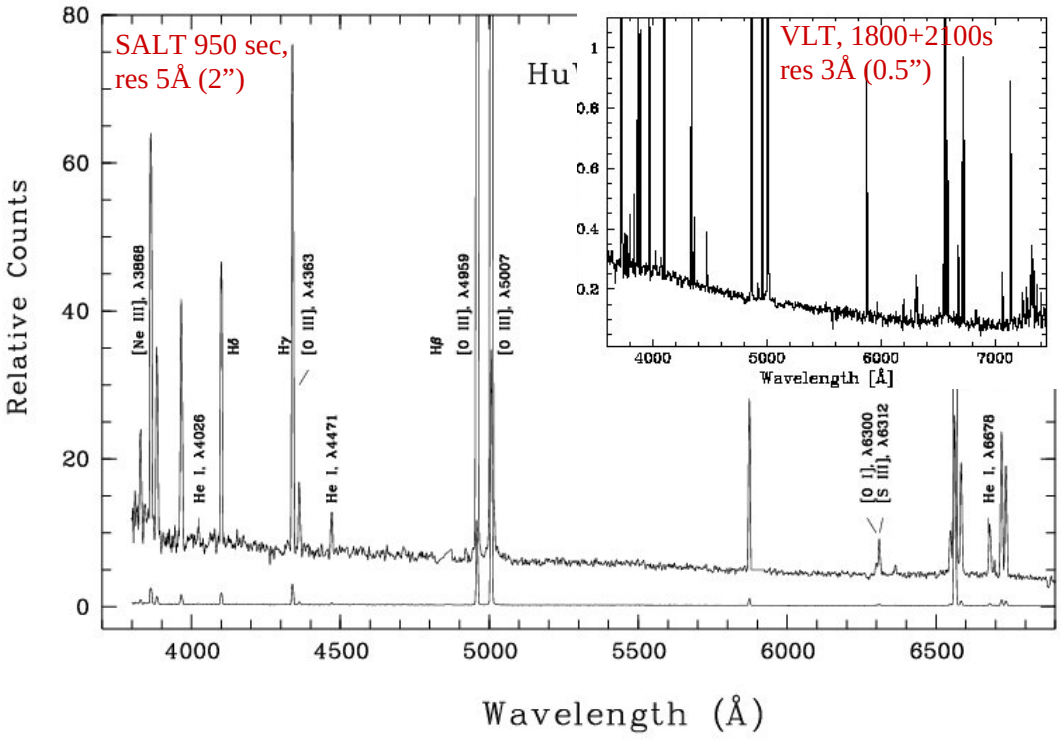


MOS spectra of PNe & HII regions in the dwarf irregular galaxy NGC6822

These first attempts at MOS have been very successful, more so than we'd initially anticipated, and basically demonstrates that MOS works, although there is some issues still to be resolved before we consider that it is fully commissioned, including:

- Software for automatic alignment of reference stars
- Improve guidance, particularly open loop field rotation (ρ)
- Add more features (e.g. tilted or arbitrary shaped slitlets) and improve user friendliness
- Telescope image quality (for narrower slitlets)

The comparative spectra (SALT and VLT) shown below of one of the objects observed demonstrates that RSS is capable of producing excellent MOS results.



Comparisons of spectra taken with SALT & VLT of an HII region in NGC6822. Note the Hβ line in the SALT spectrum falls in the interchip gap.

REPORTS ON PERFORMANCE VERIFICATION PROGRAM RESULTS

At the last SSWG meeting, presentations were presented by representatives on behalf of the various Principal Investigators for SALT Performance Verification programs. Appended below are some of the project summaries (in no particular order) that have been made available by PIs in a suitable format for SALTeNEWs.

1. Rutgers Special PV Proposal: Breaking the Disk-Halo Degeneracy in Huchra's Lens

K. Spekkens, T.B. Williams, C.R. Keeton, and J.A. Sellwood

The rotation curves of spiral galaxies provide useful information on the distribution of mass within these galaxies. Unfortunately, it has proven impossible to separate the contributions of luminous matter from those of dark matter in axisymmetric galaxies. Thus the mass-to-light ratio of the stellar component, the halo parameters of the dark component, and their relative mass proportions are not well constrained by the observations.

Huchra's Lens is a rare alignment of a distant quasar with the core of a nearby galaxy, producing four gravitational lensed images of the quasar. The positions of the four images are particularly sensitive to the shear from the bar in the galaxy and provide a powerful means of distinguishing baryons from dark matter in the galaxy's inner regions. This is the only known system where the lensing galaxy is close enough to allow a joint analysis of the disk dynamics and gravitational lensing that exploits their complementary strengths to provide a detailed mass decomposition of the galaxy.

We have used the Robert Stobie Spectrograph on SALT to obtain long-slit H-alpha region spectra at four position angles on the galaxy: along the disk major and minor axes and along the bar major and minor axes. The observations were made in June and September, 2006; particularly good seeing obtained during the latter observations. We present here the preliminary results of the analysis of the major axis September data; the reductions of the other position angle observations will be completed shortly.

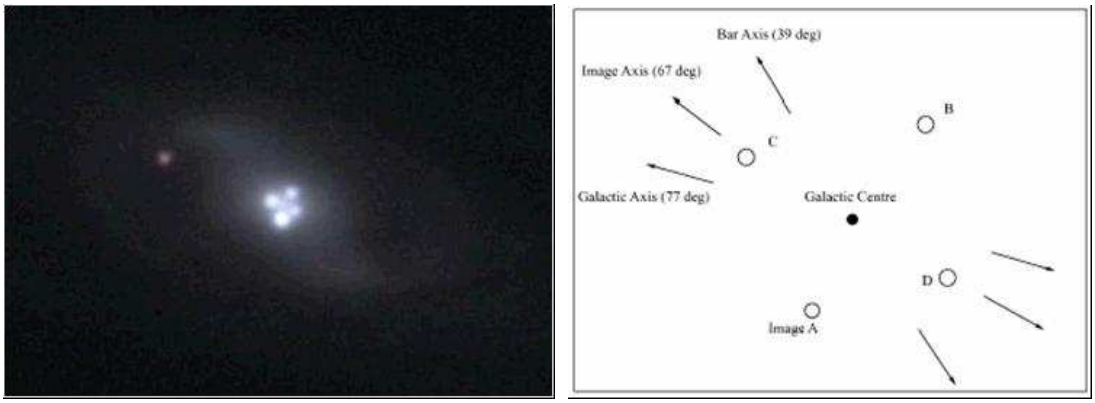


Figure 1: Huchra's lens

The image above (Fig. 1) is from J.Rhoads, S.Malhotra, I.Dell'Antonio (NOAO)/WIYN/NOAO/NSF, and shows the four quasar images and the lensing galaxy's central nucleus, bulge, and bar. The separation between quasar images A and B is1.8 arc-seconds. The SALT spectra were taken with a 1.5 arc-second wide slit under imaging conditions ranging from 1.25 to 3.25 Arc-seconds FWHM. Spectra were obtained at four position angles, along the galaxy major and minor axes (PA 77º and 167º) and the bar major and minor axes (PA 39º and 129º). As seen in the accompanying sketch from Yee, AJ **95**, 1331, 1988, none of these position angles align exactly with the axes of the four quasar images.

We used a 1.5 arc-second slit, the G1800 grating at 38 degrees, and camera articulation of 76 degrees to obtain spectral resolution 1500 at a central wavelength of 682 nm. We requested three 10-minute exposures at each slit position angle. Figure 2 (left) shows the center CCD from one of the spectra. The brightest feature is due to the laser autocollimator, which fortunately was somewhat to the blue of our spectral region of interest. Night sky OH emission lines dominate the red half of the spectrum. The Littrow ghost appears as the uncurved feature just blueward of the center, with a bright knot below the galaxy and quasar central continuum. Hα emission can be seen to the red of the ghost, extending approximately 30 arc-seconds above and below the galaxy center and with a readily apparent rotational offset between the two sides of the galaxy.

We used a copper-argon comparison arc to determine the wavelength solution. Comparison of the fitted wavelengths of the night-sky lines using this solution to the tabulated wavelengths shows excellent agreement (better than 0.005 nm residuals) for the June data, but an offset of approximately 0.012 nm for the September data. We also analyzed the flexure over a 30-minute track by comparing the night-sky lines in the three September major axis spectra, and found no significant effect (<0.005nm).

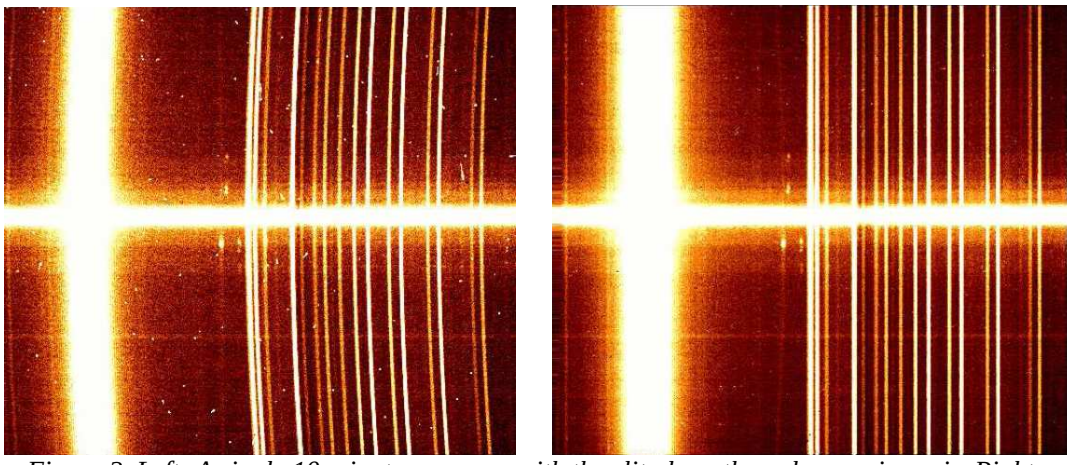


Figure 2. Left: A single 10-minute exposure with the slit along the galaxy major axis. Right: Wavelength-rectified, cosmic ray cleaned, combined spectrum of three 10-minute exposures.

We obtained Hubble Space Telescope Planetary Camera archival images for this galaxy, and used them to estimate the image quality of each of our spectra. We convolved the HST images with a Gaussian, and then synthesized the RSS slit on the convolved images and extracted a brightness profile along the slit. The best/mean/worst imaging was 1.25”/2.31”/3.25” FWHM.

We used the wavelength solutions to rectify the curvature of the spectra, and then combined the three 10-minute exposures with cosmic ray elimination. The combined spectrum is shown in Figure 2 (right). Note that the Littrow ghost now has a negative curvature. We next averaged the spectrum in positions along the slit well away from the galaxy’s location, and subtracted this background, eliminating the sky lines and the autocollimator laser line. We then fit a low-order polynomial to the quasar continuum spectrum and subtracted it. The final corrected image is shown in Figure 3. Removal of the light sky lines reveals the [NII] line to the red of Hα, and possibly the SII lines towards the red end of the spectrum. The [NII] emission is visible closer to the galaxy center than the Hα emission, and suggests a relatively slowly rising rotation curve.

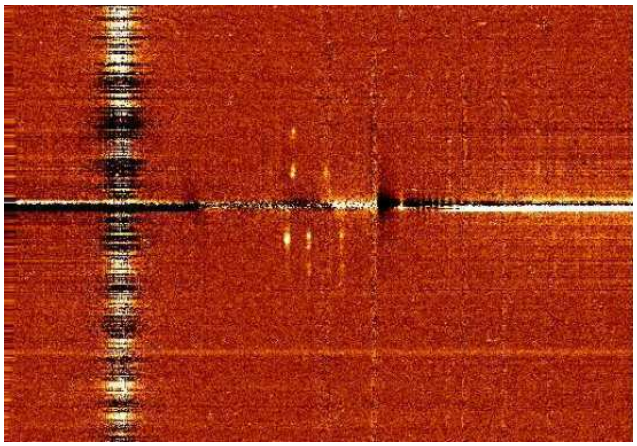


Figure 1 Sky and quasar subtracted spectrum

We then fit the Hα emission (only) to measure the rotation speed of the galaxy. The results are shown in Figure 4. Our data are the red and blue points, from the two sides of the galaxy. The curves are a model by Trott and Webster (2002) based on the gravitational lens data and low-resolution VLA observations (indicated by the black x’s with error bars). It is interesting to note that the SALT H-alpha data extend well into the range of the HI measurements. Our measured rotation is at lower amplitude, and suggests a (more believable?) flat rotation curve.

Our next steps are to incorporate the information from the other spectral lines, to analyze the spectra at the other three position angles, and to model the galaxy using these new observations in conjunction with the gravitational lensing measures.

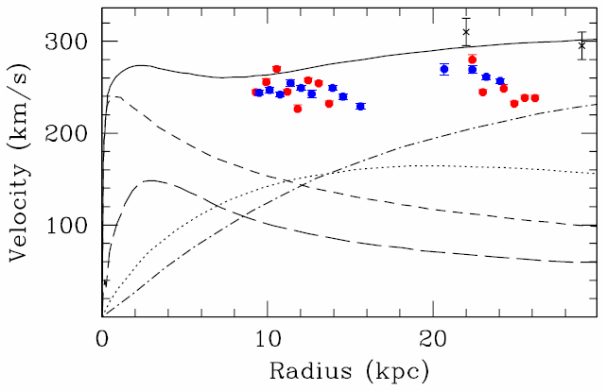


Figure 2: Rotation curve. The colored points are our SALT major-axis data, the black X’s are VLA HI measures, and the curves are a model incorporating the lensing and HI data.

2. South African PV observations of SDSS-II Supernovae

Bruce Bassett (SAAO/UCT), Kurt van der Heyden (SAAO) and Petri Vaisanen (SAAO)

SALT RSS and SALTICAM observations were undertaken on Type Ia supernovae (SNIa) candidates discovered as part of the 2nd year of the second Sloan Digital Sky Survey (SDSS-II) supernova survey during September 2006. This was an approved PV phase program involving both science and calibration/set-up work. Candidates were identified daily through the SDSS-II SN team who provide an optimal target list for SALT follow-up (the authors are external participants in the SDSS-II SN survey).

Spectra were taken of candidates (whose brightness varied from $r \sim 18$-21) at various grating settings and resolutions. Since identification of SNIa depends on the absense of H and He and the existence of broad absorption features, low resolution in the final spectrum is adequate. However, we found that currently the G300 grating does not allow sufficiently accurate removal of sky lines and hence we standardized to use of the G900 grating with grating angle determine depending on the photometric redshift estimate provided by the SDSS lightcurve photometry to ensure that the key spectral features did not fall in the CCD gaps.

These calculations were done in real time when all three investigators were at SALT and would have been essentially impossible if we had not been at SALT since there are only limited communication facilities currently between the control room and the outside world. A future set-up allowing for video conference or a web page showing some of the key screens visible to the SA would be very useful.
Reduction of the data was done at SAAO and released to the SDSS-II collaboration for input and help in classification. Two candidates were identified as SNIa (one is shown in Figure 1) while several other candidates have low S/N and await further reduction, flux calibration and/or host galaxy removal. In addition two spectra of host galaxies were obtained to help derive accurate redshifts for SNIa discovered in the first year of the SDSS SN survey. Finally we also took SALTICAM images of two candidates (see e.g. Figure 2) for press-related purposes.

The SDSS-II SN survey runs from September-November each year until the end of 2007. The web page for the survey is http://sdssdp47.fnal.gov/sdsssn/sdsssn.html

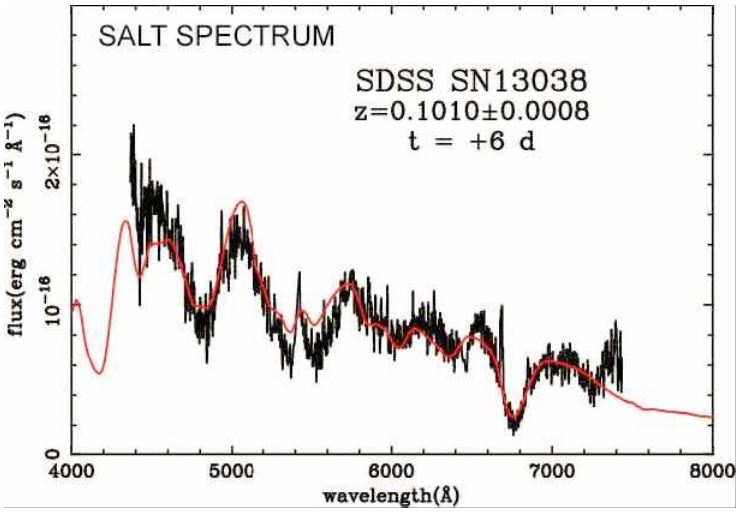


Figure 1: Confirming SALT spectrum of the SNIa SN13038 together with the best-fit spectral template confirming it to be six days past maximum brightness at a redshift of z = 0.10. The key Si II absorption feature at a rest-frame wavelength of 615nm is clearly visible redshifted to around 680nm. [Thanks to Chen Zheng and Masao Sako for the template fit].

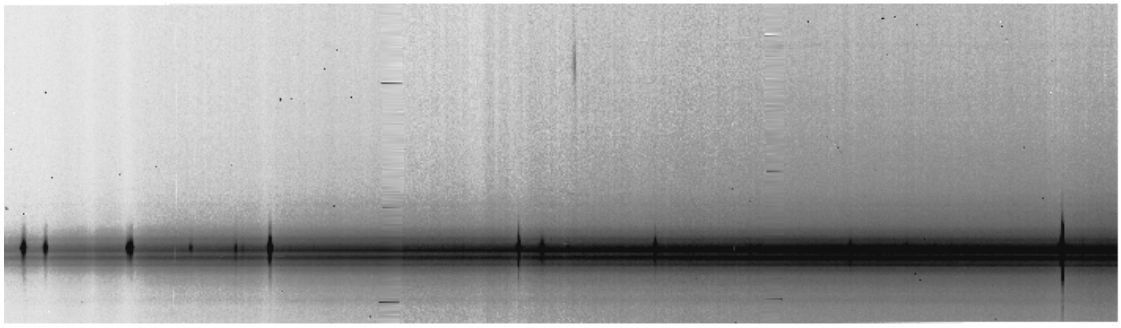
Figure 2: Combined 30-second SALTICAM images of the candidate SN12897 (marked by the arrow).

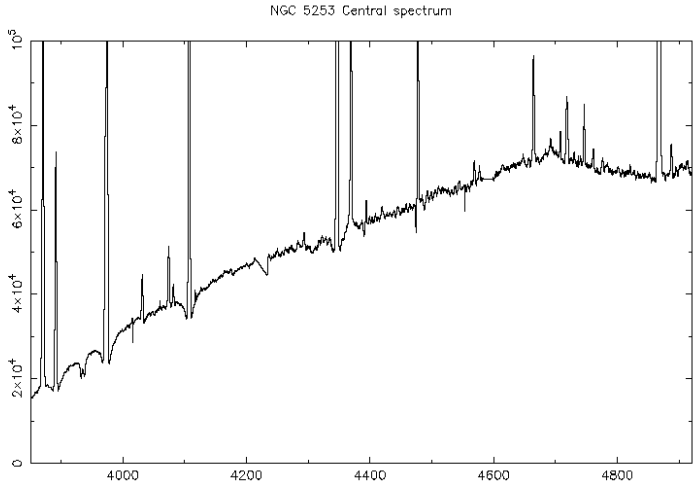
3. UK RSS PV program: Stellar populations in galaxies - NGC 5253 A nearby starburst galaxy

Anne Sansom & Ilani Loubser (UCLan)

Ilani Loubser holds a Stobie-SALT-UCLan PhD Scholarship, see:
http://www.saao.ac.za/public-info/education/astronomy-studies/scholarships/2007-scholarships/

A SALT PV observation of NGC 5253 was taken on 29 July 2006, for 40 minutes exposure. This is a nearby (3.2 Mpc) starburst galaxy, with a suggestion of the presence of older stars, from the redder colour of its outer regions. It is this older population that we aim to investigate with SALT RSS spectra. These PV data show the wavelength coverage achieved at resolving power of R~2000. The spectra were wavelength calibrated with a copper-argon arc-lamp observation and successfully corrected for s-distortion, leaving a well straightened spectrum across the 2-d data array. The spatial scale is 1 arcsec=0.93 kpc.

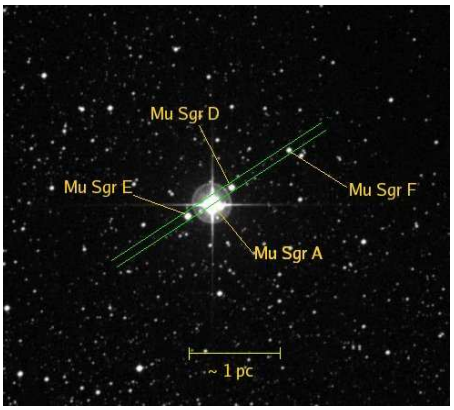


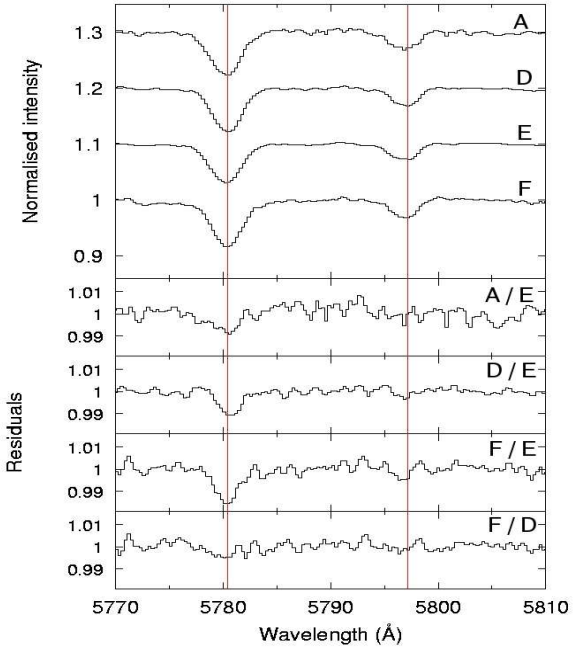


The spectrum shows emission from the centre of NGC 5253, with counts per pixel plotted against wavelength in Ångstroms. Emission lines from warm gas and absorption lines from the atmospheres of stars can both be seen. Only absorption lines can be seen further out in NGC 5253 (as seen in the inverse greyscale image above). Further observations of this and other similar galaxies are planned, to accurately disentangle their stellar populations from night sky emission.

4. UK RSS PV program: Small-scale structure of the interstellar medium (ISM) probed using diffuse interstellar bands (Martin Cordiner & Peter Sarre, University of Nottingham)

Whilst working at SALT as a Business Science Fellow for The University of Nottingham as part of UKSC, Martin Cordiner (with Peter Sarre) carried out observations of the physical structure and chemical composition of the diffuse interstellar medium towards the cluster of stars around μ Sagittarius. Spectra were obtained at a resolving power of ~ 5000 using the RSS with the aim of assessing the degree of small-scale structure in the ISM along these very diffuse sightlines (average gas density only ~ 0.5 cm^{-3}). Using the long-slit mode, diffuse interstellar band (DIB) spectra of S/N between 500 and 1400 per pixel were obtained simultaneously of four B-type stars.





Upper panel: Close-up of the spectral region containing the 5780 and 5797 DIBs observed towards the four μ Sgr stars. Lower four panels: Ratios of spectra show differences in the DIB strengths between sightlines.

Differences of ~ 1% were found in the strengths of the 5780, 5797, 6196, 6203 and 6614 DIBs, over distance scales of less than ~ 1 pc.

This study builds on initial results obtained by Cordiner et al. (2006) which indicate that small-scale structure in the diffuse band carrier distribution may be ubiquitous throughout the ISM, and is important as part of an ongoing study into the nature of the mysterious DIB carriers. The high quality of the recorded spectra demonstrate the strong capabilities of the RSS in low resolution optical absorption studies of the ISM.

5. University of Canterbury Special PV programs: Bright Stars in 47 Tuc & Faint Giants in ω Cen (Michael Albrow, Peter Cottrell, Mita Gopal & Clare Worley)

Bright giant stars in 47 Tuc

The aim here was to acquire spectra of a sample of RGB and AGB stars in 47 Tuc in order to compare the surface abundances of various s-process elements between the RGB and AGB. A total of 32 exposures were obtained with RSS covering two wavelength intervals for 11 stars. All images have been reduced using IRAF/kpnoslit and the spectra are now being modelled using Sneden's MOOG spectrum synthesis code.

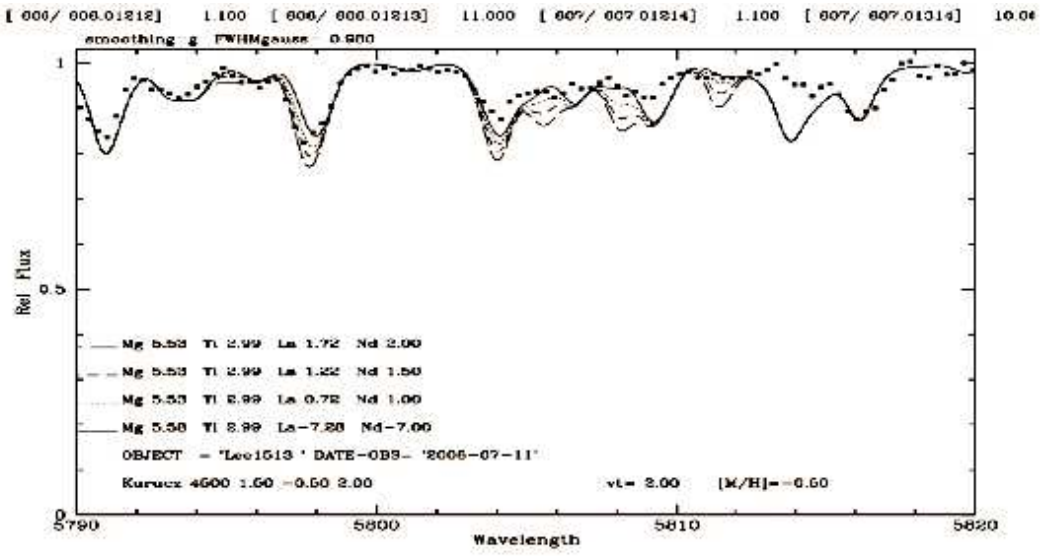


Fig. 1. RSS spectrum of Lee 1513 (dotted line) overlaid with MOOG synthetic spectra with varying Nd and La abundances.

An interesting effect found during the reduction was a variable resolving power across the detector, probably due to a focus variation.

Faint giant stars in ω Cen

The aim was to observe the CN and CH molecular bandheads of stars from the base of the giant branch in two of the stellar population sequences in ω Cen. A total of 37 exposures were obtained with RSS distributed over 8 target stars. The spectra are being reduced using IRAF/kpnoslit. This is turning out to be a challenging process due to the faintness of the targets and the crowding of the field relative to the focal plane seeing. Identification of the target stars in the images is quite time consuming and background subtraction is problematical. A sample image and spectrum for one of the anomalous giant branch stars is shown in Figs 2 and 3 below.

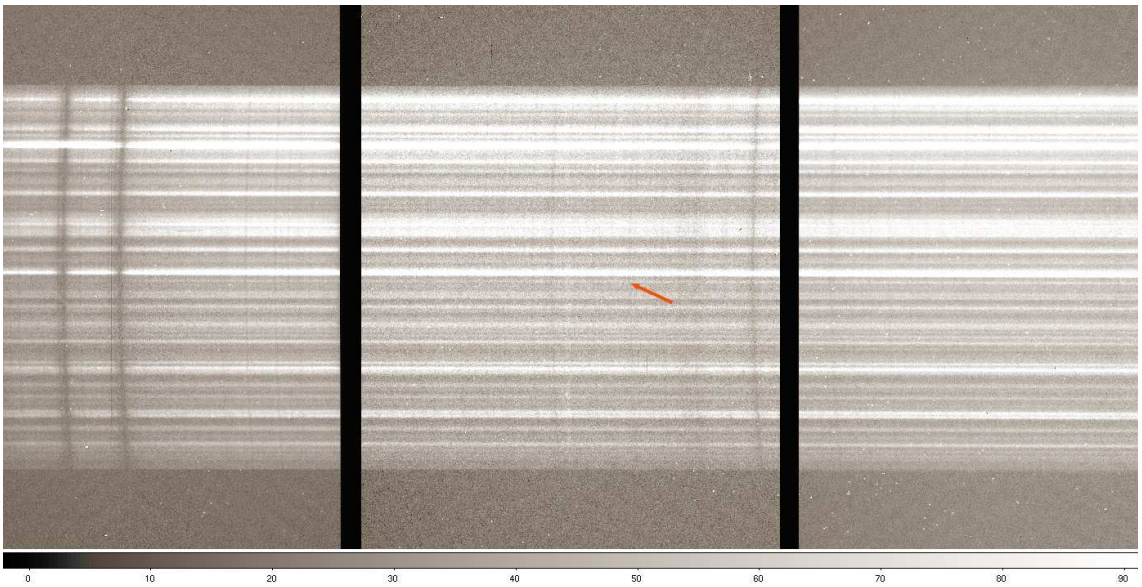


Fig. 2. Location of a (V=18) target star on one of the images.

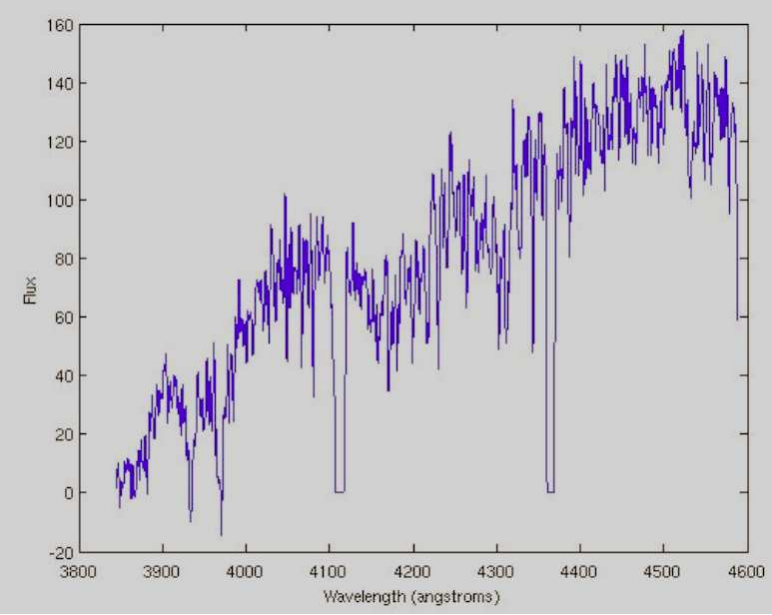
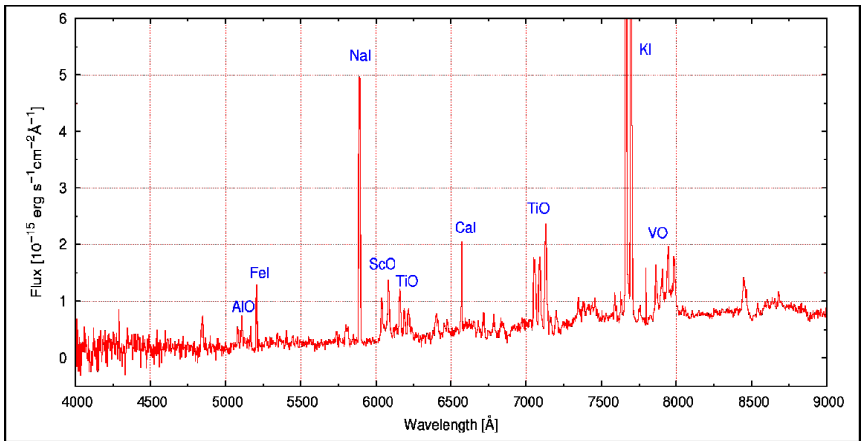


Fig. 3. The extracted spectrum from the image in Fig 3.

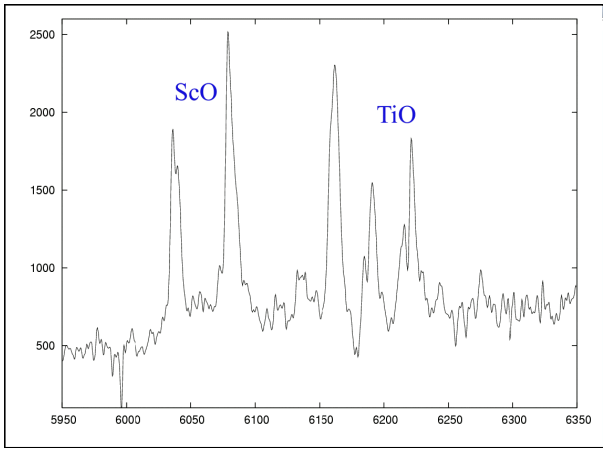
6. *Polish Special PV programs: Spectroscopy of V4332 Sgr (R. Tylenda[1], S.K. Gorny[1] & L.A. Crause[2])*

[1] Nicolaus Copernicus Astronomical Center, Poland
[2] South African Astronomical Observatory

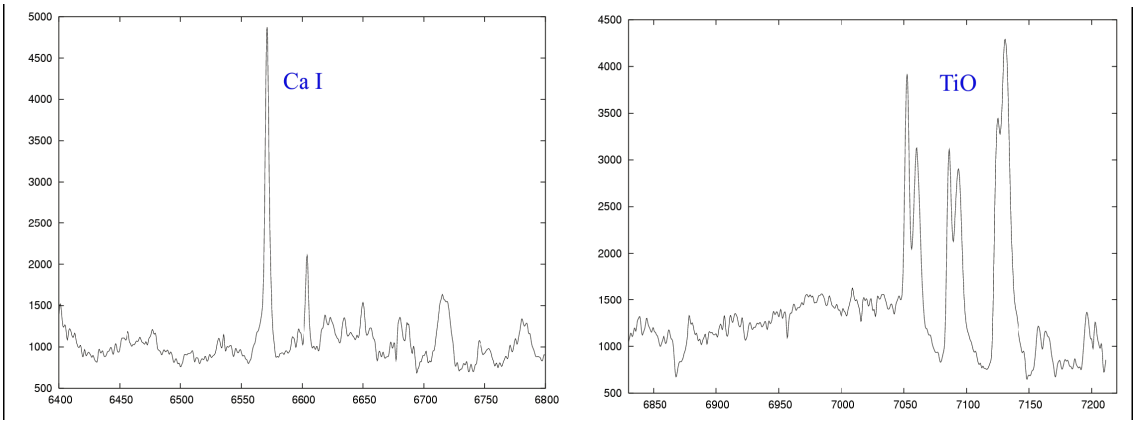
V4332 Sgr is an unusual object, whose eruption was observed in 1994. Most probably it is of the same nature as V838 Mon, which erupted in 2002. As discussed in Tylenda & Soker (2006) neither the classical nova mechanism nor the He-shell flash model can explain the observed outbursts of these object. At present the stellar merger scenario proposed by Soker & Tylenda (2003) and further developed in Tylenda & Soker (2006) is the most promising idea for explaining the nature of these eruptions. Although V4332 Sgr is now a decade after its outburst it still shows very unusual observational characteristics. First of all it displays a very unique emission line spectrum of very low excitation (Tylenda et al. 2005 - based on 1.9-m observations at SAAO).



V4332 Sgr is composed of lines from neutral elements (NaI, KI, FeI, CaI) and molecular bands (TiO, ScO, AlO). The origin of this spectrum is not clear. New spectra obtained with SALT are in better resolution that those obtained with the 1.9 m SAAO telescope and show much more details. In particular, almost all the molecular bands show a double structure. However the atomic lines are single. Therefore the splitting in the molecular lines cannot be due to kinematics of the emitting material (e.g. rotating ring or disk). Most likely the splitting is due to the fine structure of the molecular electron transitions in which two consecutive rotational components are of comparable intensity but are very narrow.



The narrowness of the rotational components and the presence of only two components imply a very low rotational temperature (a few 100 K). On the other hand the presence of the electron transitions (in emission) requires excitation energies equivalent to a few 1000 K. Similar energies (a few 1000 K) are required to excite atomic lines.



Thus it seems that in a very cold matter (in which collisions determine the rotational structure of the molecular bands) electron transitions in molecules and atoms are excited from an external source, most likely, of radiation. The point is however that we do not see enough radiation flux for this purpose. The optical continuum is very faint and mimics an early M-type star. The object is very bright in the infrared (~15 times brighter than in the optical - Tylenda et al. 2005). Thus it seems that the main object is hidden in an opaque cold matter. The observed "stability" of the spectrum over a last few years implies that all the structure is quite stable.

References:

Soker, N. & Tylenda, R. 2003, ApJ, 582, L105
Tylenda, R., Crause, L., Gorny, S. K. & Schmidt, M. R. 2005 A&A, 439, 651
Tylenda, R. & Soker, N. 2006, A&A, 451, 223