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Status of SALT or what use is a large telescope for AGB science anyway?

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Abstract. With the advent of high-resolution spectrographs on large 10m class telescopes there are opportunities for detailed studies for AGB star research to be undertaken on individual objects in the Local Group of galaxies. This provides a range of abundance environments for the study of evolutionary processes in AGB stars.

Key words. AGB stars – large telescopes – instrumentation

1. SALT

The Southern African Large Telescope (SALT) is an 11m optical telescope which is nearing completion at an excellent site in South Africa (see http://www.salt.ac.nz). SALT is an almost exact copy of the Hobby-Eberly Telescope (HET) and SALT has benefited significantly from HET.

Table 1. Key science drivers for high-resolution spectroscopy with SALT.

• Element abundance studies
• Distance determinations
• Extrasolar planet detection
• Stellar internal structure and dynamics
• Star cluster & galaxy dynamics
• Outflow & accretion studies
• Follow-up of microlensing events
• High & moderate redshift galaxy spectra

HET and SALT are non-traditional designs, having a fixed, segmented spherical primary mirror and a moving secondary assembly. These telescopes have been built for about 20 percent of the cost of other similar sized, but traditional design, telescopes. This does lead to some restrictions - only 70 percent of the sky is observable and certain regions are only available at certain times of a given night - but using a queue-scheduling telescope assignment, an efficient telescope operation can be achieved.

SALT is on target to be completed at the end of 2004 and commissioning of the first two science instruments will begin in early 2005. These instruments are SALTICAM (an imaging camera covering the full 8 arc min field of view of the telescope) and PFIS (a Prime Focus Imaging Spectrograph which will provide resolving powers to about 8,000 for spectroscopy, spectropolarimetry and Fabry-Perot imaging over the full field). The third, first-generation instrument is a high-resolution spectrograph (SALT HRS) that is likely to be of interest to those undertaking science with

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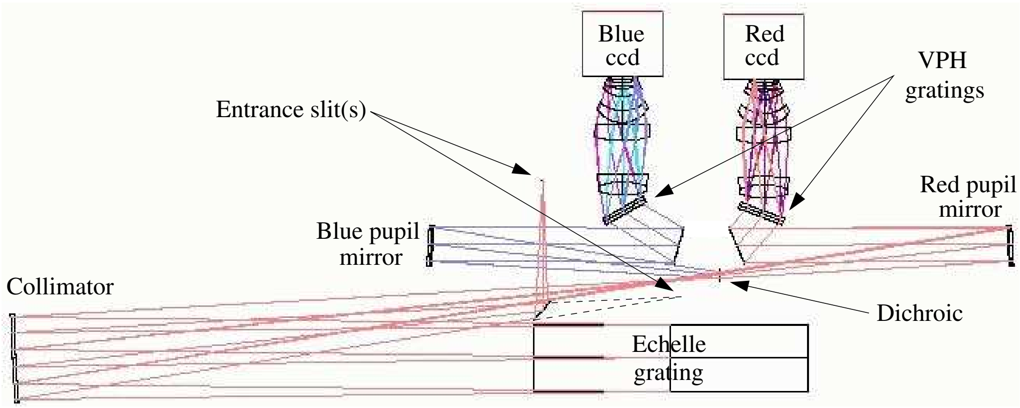

Fig. 1. Schematic layout of SALT HRS.

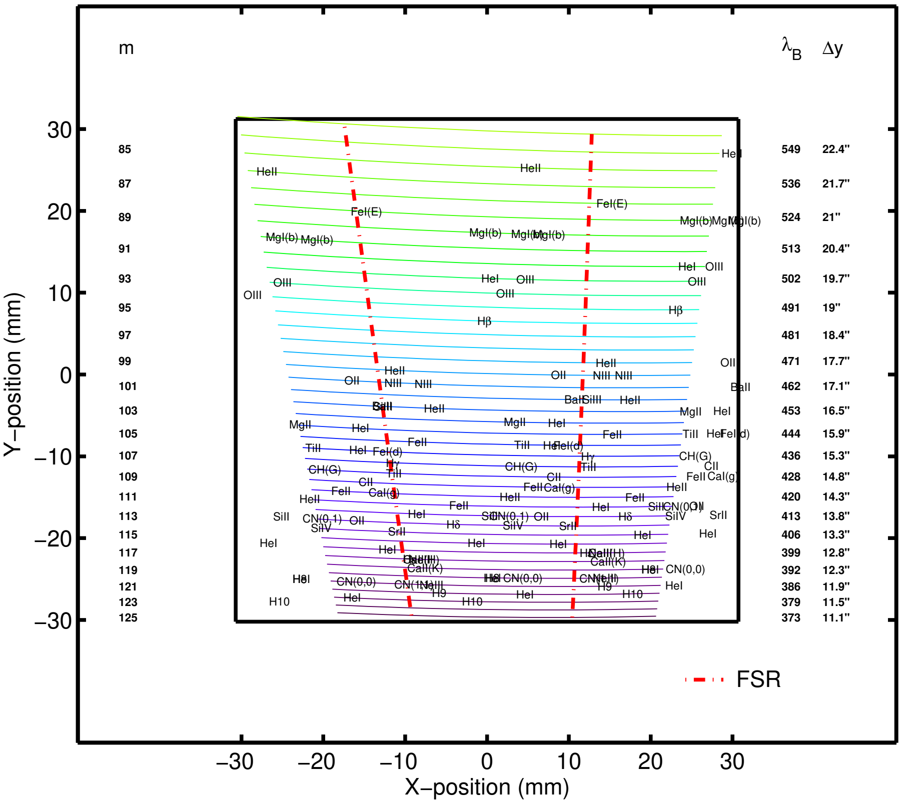

Fig. 2. Spectral format for SALT HRS blue camera with a 4k x 4k CCD outlined with the square box. Order number is shown down the left-hand-side and central blaze wavelength (nm) and separation (arc secs on the sky) on the right-hand-side. One free spectral range (FSR) is shown by the dash-dot lines. Key spectral feautures are identified throughout the image. Note that some lines are represented more than once as the CCD covers more than one FSR.

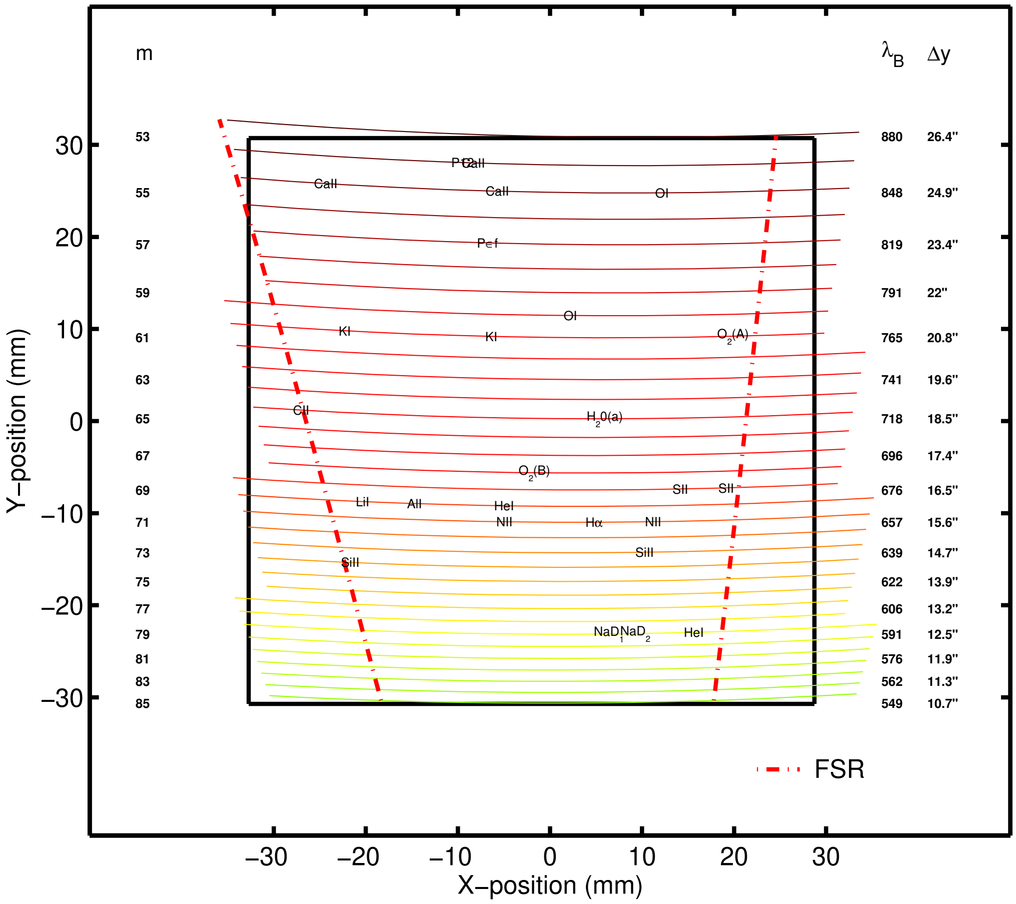

Fig. 3. As for Figure 2 except for SALT HRS red camera.

AGB stars within the context of these Torino meetings. SALT HRS has recently passed (August 2004) its Preliminary Design Review (PDR) and will be available on SALT in the first half of 2007.

2. SALT HRS science drivers

SALT HRS has been designed (see Barnes et al. 2003, 2004) to provide a single object plus sky, fibre-fed spectrograph for the science drivers given in Table 1. This provides a wide range of opportunities for precision radial velocity, line profile and abundance studies in and beyond the Milky Way galaxy.

3. SALT HRS

The overall optical layout of the post-PDR R4 spectrograph is shown in Figure 1. The dispersing element will be two R4 gratings replicated onto a single substrate. Dispersed light returns to the collimator mirror which then forms an intermediate focus after which a dichroic filter separates the beams into blue (370–555 nm) and red (555–890 nm) arms. Each arm will comprise a convergent pupil mirror to form parallel beams that are fed to a cross-dispersing Volume Phase Holographic (VPH) grating, camera optics and a cryogenic CCD detector. Wavelength stability is provided by enclosing the whole spectrograph in a vacuum vessel at a pressure of a few hPa.

Figures 2 and 3 respectively illustrate the blue and red wavelength range that will be obtained with the SALT HRS design shown in Figure 1.

Three resolving powers will be provided in the range from about 17,000 to 80,000, with bare fibres for the lowest resolving power and image slicers for the two higher resolving powers.

4. SALT HRS performance and AGB science

The performance of the design presented in Figure 1 is based on the best current estimates for reflectivity of the telescope mirrors and all reflective and transmissive surfaces in the spectrograph and the CCD detectors. On this basis it is expected that a signal to noise ratio of 100 will be possible on a 17.5 magnitude G0V star in 1 hour at the lowest resolving power.

With the higher resolving powers of SALT HRS it will be possible to undertake more detailed elemental and isotopic abundance work. This should provide some excellent opportunities for AGB-star science for the astronomical community. In particular, with the full wavelength coverage provided by this instrument many key light and heavy *s*-process element lines can be observed in a range of AGB stars in the Magellanic Clouds. This will extend the work of Wylie et al. (these proceedings).

References

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