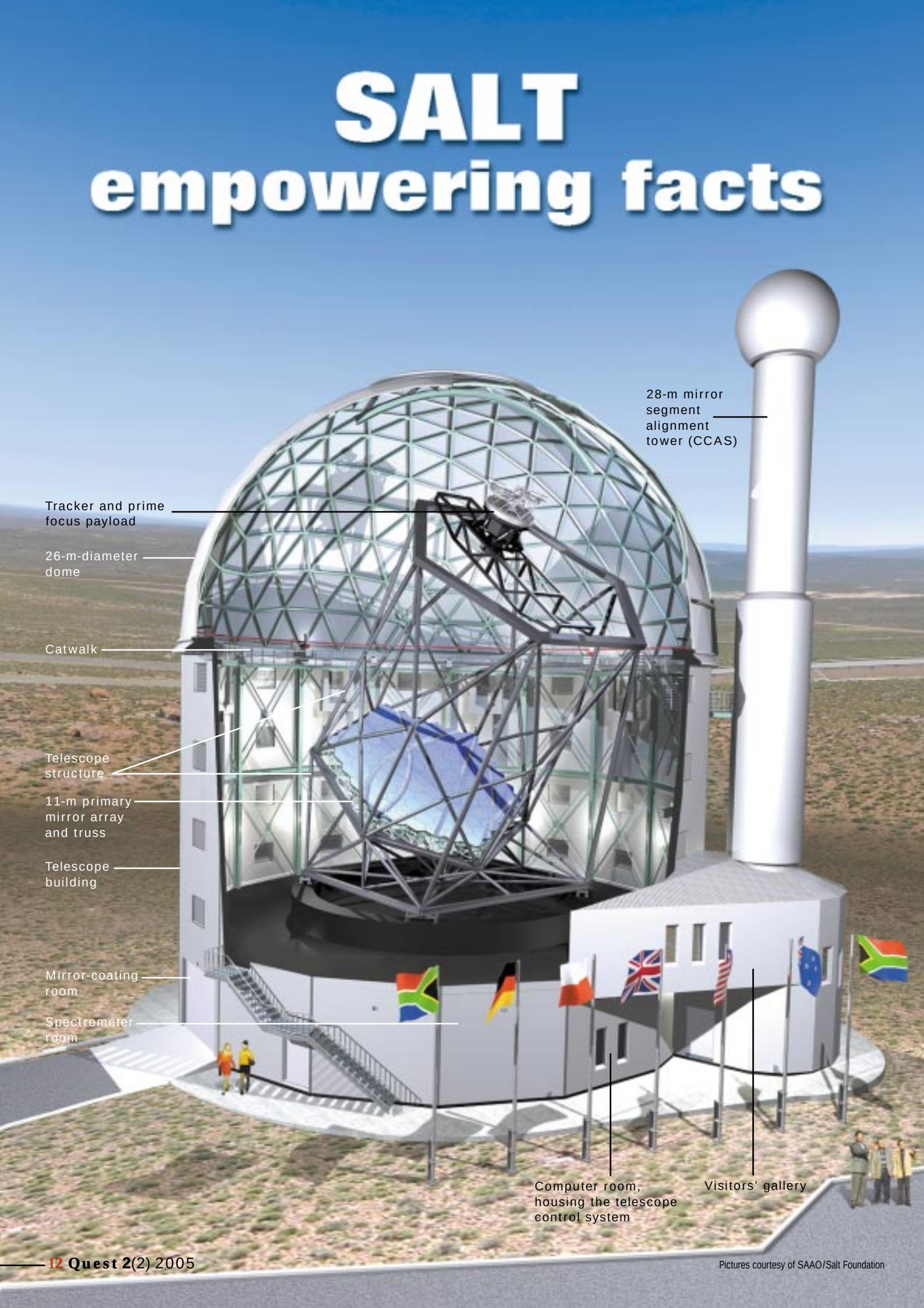
SALT empowering facts



Pictures courtesy of SAAO/Salt Foundation

More about SALT

- Design: modified version of the Hobby-Eberly Telescope (HET) at the McDonald Observatory in Texas, USA.
- Telescope: length 13 m; mass 100 tonnes; 91-segment primary mirror array with a total hexagonal area of 11.1 m × 9.8 m and a light collecting area of 77.2 m^2.
- Wavelength coverage: 320–900 μm (UV-visible) for the first-generation instrument (with plans for future extensions to 1.5 μm [micrometres] in the near-infrared).
- Telescope rotates in azimuth on 8 air bearings to acquire targets, with a precision of 3μm. A tracker with 10 degrees of freedom, with a positioning accuracy of 5 μm in space, then follows the target, as the Earth rotates, for up to about 3 hours. It can be moved from one target to another in under 5 minutes.
- Optical fibres will relay light from objects in the field of view to instruments in the basement room beneath the telescope.
- The tracker has an effective diameter of about 4.5 m and, combined with the obscuration by the bridge on which it rides, reduces the light collecting area to 57.3 m^2. It supports a prime focus payload, consisting of instrumentation that includes an efficient camera and imaging spectrograph capable of observing many objects at once.
- The concrete ring forming the base of the telescope pier is the smoothest, flattest piece of concrete ever cast in South Africa, deviating by no more than 1 mm from a flat plane over its ~50-m circumference.
- SALT's novel design as a fixed-elevation (53 degrees above horizon) telescope constrains the field of view to an annulus covering 12.5% of the sky at any one time, or 70% of the observable sky, and greatly reduces engineering costs.
- All observation time on SALT and HET is 'queue-scheduled', a unique feature among ground-based telescopes that is more akin to satellite operations. Astronomers tell SALT what they want observed and for how long; then SALT generates a queue of observations for when the desired object is most efficiently accessible to the telescope; finally, the data are recorded and sent electronically via the Internet to the proposers (who don't need to be physically present). The complex scheduling takes into account factors including weather conditions and cloud cover, and the number of observations and time intervals requested. The SALT partner institutions each receive a fixed percentage of the total viewing time.
- Many different observational programmes can be carried out efficiently in one night.
- SALT is able to undertake a wide variety of scientific studies. It can
  - detect rapid variations in brightness and motion of many different types of object, allowing the study of the most extreme physical processes
  - take images through narrow-band colour filters, building up virtual 3D images of objects
  - look for polarized light from highly magnetized regions or where scattering is taking place
  - observe very faint, distant galaxies.

A day in the life of SALT

Daytime

Daylight hours at SALT are used for instrument adjustments, engineering duties, mirror cleaning and re-aluminizing (performed annually, at a rate of two segments per week), and other tasks to keep the telescope in good working order.

The daytime SALT Astronomer (SA) on duty in Cape Town deals with the new scientific information collected during the previous night, checks and processes the scientific data, and sends them to Africa, Europe, North America, and New Zealand to the astronomers who have requested them.

Early afternoon

The air conditioning turns on automatically, to have the telescope at the same temperature as the outside air at dome opening time that evening. The telescope electronics and other electrical equipment are a significant source of heat, so they are housed in large, cooled cabinets (locally called 'igloos') whose doors must be kept tightly shut.

4 p.m.

The SALT Operator (SO) starts the evening shift, and

- checks the temperature control
- (once the engineers and technicians have left the telescope) checks the dome, louvres, and fans, and makes sure that the telescope structure can move freely
- makes sure that the lights are switched off and that the blinds in the building are closed (light leakages can contaminate the observations of SALT and the other telescopes on the plateau).

Sunset

The SO opens the dome and turns on the fans, which ensure a good flow of air from inside to outside, to minimize temperature gradients. The shutter of the centre of curvature alignment system (CCAS) (that is, the tall 'chimney' attached to the SALT building) is opened to prepare for mirror alignment. Once the dome is opened, the mirrors are aligned using the equipment in the CCAS tower.

The SA on duty in Sutherland arrives.

Nightfall

After the mirrors have been aligned and darkness has fallen, the observational work of the telescope begins.

Details of the first astronomical target are transferred from the SALT database to the SO's computer. The SA does this manually or uses the automated computer-controlled queue-scheduling system.

The SO initiates the pointing of the telescope at the target:

- the dome rotates
- the telescope structure rotates on air pads and is then 'set down' into position
- the tracker is positioned at the start of its 'track' for receiving light from the target and begins to move
- the instrument on the tracker starts observing the target
- the SA's computer receives an image (or spectrum, depending on the instrument that is being used)
- the SA is able to change the exposure time, set the instrument mode (for example, filtering different colours or wavelengths), and change the configuration of the charge-coupled device (CCD) – the detector used on all SALT instruments
- the data are immediately copied to a separate computer for 'quick-look' reduction and analysis so that the SA can verify that everything is working as expected (this is because the astronomer whose requested observations are being performed is probably not present at the time). Meanwhile, the SO monitors the functioning of the telescope, its subsystems, and, of course, the changing weather.

During the night, the SA instructs the SO to point to different target fields, typically from half a dozen to 15 times. They may observe hundreds, or even thousands, of astronomical objects during one night, such as asteroids in our Solar System, eclipses of wildly varying binary stars, signals from effects around black holes in our Galaxy or supermassive ones in distant active galactic nuclei, nearby spiral galaxies, and extremely faint galaxies at the edge of the visible Universe.

Midnight

SO change of shifts, with a half-hour handover period.

Sunrise

With the night's observing completed, the SO

- parks the telescope and tracker in a position giving easy access to the day staff for maintenance work
- closes the dome
- closes the louvres
- switches off the false-floor fan
- switches the power to standby mode.

Before the SO initiates instrument calibrations, the SA prepares a detailed calibration sequence on the instrumentation that was actually used during the night (most of the scientific data taken would be useless without accurate information about the configuration and performance of the instrumentation).

Now the SA and SO can get some sleep!

– Petri Vaisanen, SALT Astronomer (assisted by Lisl Robertson and Phil Charles)

For more, visit www.salt.ac.za/content/observing/pop3.htm; view the Sutherland night sky in real time with our webcam at http://nightskylive.net/sa/. ▷▷