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European Southern Observatory

European Southern Observatory scientists are currently designing and implementing the largest ground-based telescope to date. Set atop a Chilean mountain, Cerro Paranal, this telescope will see farther into the universe than any other.

CPU® played a pivotal role in this project. A complex computer "tool kit," used for a wide variety of applications, was personalized to meet the scientist's specifications. CPU® is pleased to have played a role in making optimum control of the giant telescopes possible.

The Paranal Observatory

The Very Large Telescope Array (VLT) is the flagship facility of European astronomy at the beginning of the 3rd Millennium. It is the world's most advanced optical instrument.

ESO Cerro Paranal Observatory

The VLT is a most unusual telescope, based on the latest technology. It is not just one, but several, interconnected telescopes. The main elements are four reflecting telescopes with main mirrors of 8.2-m diameter. The four telescopes are placed in a trapezoidal configuration. In addition, there will be four movable 1.8-m telescopes. Using an advanced control system strategy, the light from all the telescopes can be combined in the VLT-Interferometer (VLTI). This will allow observations with the unprecedented optical resolution whereby the VLTI in principle would be able to view an astronaut on the Moon.

The 8.2-m unit telescopes can also be used individually. With one such telescope, images of celestial objects as faint as magnitude 30 can be obtained in a one-hour exposure. This corresponds to seeing objects which are 4 billion times fainter than what can be perceived with the naked eye.

The VLT is equipped with many different astronomical instruments, including large-field CCD cameras, multi-channel photometers, high-resolution spectrographs and very fast, high-accuracy photometers, allowing observations in a broad spectral region, from deep ultraviolet (300 nm) to mid-infrared (20 μm) wavelengths.

Array of 4 Cerro Paranal 8.2-m Telescopes

The 8.2-m unit telescopes are housed in compact, thermally controlled buildings which rotate synchronously with the telescopes. This design serves to minimize adverse effects on the observing conditions, for instance from air turbulence in the telescope tube, which might otherwise occur due to variations in the temperature and wind flow.

The first of the VLT Unit Telescopes saw "First Light" in 1998, the last of the giant telescopes on September 3, 2000. With all the telescopes working simultaneously, the VLT is the largest optical telescope in the world.

The VLT Unit Telescopes are named after objects in the sky as these are known to the Mapuche, indigeneous people living mostly in the south of Chile. Unit Telescope No. 1 (UT1) is called Antu (the Sun); UT2, Kueyen (the Moon); UT3, Melipal (the Southern Cross) and UT4, Yepun (the "Evening Star", Venus).

Cerro Paranal is a 2,635 m high mountain, about 120 km south of the city of Antofagasta and 12 km inland from the Pacific coast, situated in the middle of the Atacama desert—that is believed to be the driest area on Earth.

Paranal offers up to 350 clear nights a year with unusually stable atmospheric conditions. Test observations have shown that, 15% of the time, local atmospheric turbulence spreads light from a star over an angle of less than 0.45 arcsec, allowing extremely sharp images to be obtained. There is very little water vapor in the air over Paranal, greatly increasing the atmospheric transparency at infrared wavelengths. Paranal is the best, known, site for an astronomical observatory in the southern hemisphere.

Following seven years of extensive site testing, construction work at Paranal commenced in 1991. About 350,000 cubic metres of rock and soil were removed from the summit to create a platform of 20,000 square metres for the large telescopes and the interferometric complex. In order to maintain a largely undisturbed wind flow around the mountain, of crucial importance for the astronomical observations, the laboratories are located underground. For the same reason, the control building is placed just below the main platform, while necessary maintenance facilities, including the advanced aluminizing plant for the giant VLT primary mirrors, as well as a hotel, are situated at the foot of the mountain.

Razorsharp Vision with VLTI

Astronomers have long sought to improve the sensitivity and spatial resolution of their observations in order to see as far back in time and as sharply as possible.

One of the most exciting features of the VLT is the possibility to use it as a giant optical interferometer. The VLTI with its four 8.2 m diameter telescopes and several 1.8 m diameter auxiliary telescopes will represent the most sensitive interferometric device in the world with a spatial resolution equivalent to that of a 200 meter diameter telescope covering the complete surface of Cerro Paranal. Light from the telescopes, in the form of collimated beams, is directed underground towards the delay line tunnel. Mirrors direct the light beams along the tunnel towards the opposite sides. Here a "cat's eye" optical element retro-reflects them back to another set of mirrors near the center of the tunnel. The light is then redirected towards the beam combination equipment in the central laboratory, where - at the coherent focus - the detection of the resulting interference fringes finally occurs.

The VLTI is expected to unlock a veritable cornucopia of exciting scientific results ranging from the direct detection of planets around nearby stars that are separated from the parent star by more than a few milliarcseconds, to the nuclei of active galaxies.

The VLTI began operations in 2001, and will be progessively expanded until, in 2007-2010, it will simultaneously orchestrate all the giant 8.2m telescopes and several auxiliary telescopes. For more images, please visit www.eso.org.