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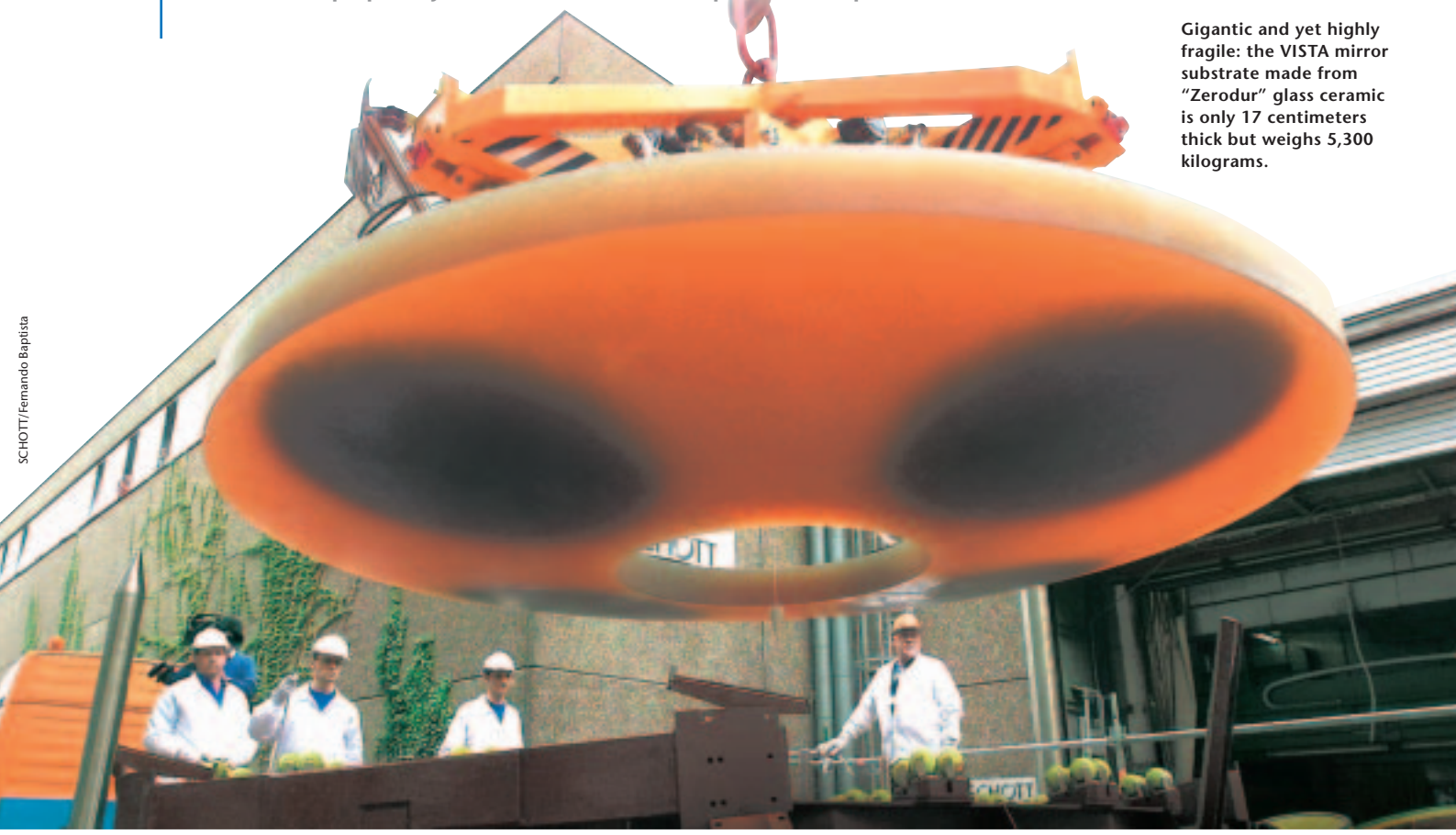
Top Optics with a Wide Field

When the innovative wide field survey telescope called VISTA (Visible and Infrared Survey Telescope for Astronomy)goes into operation in the year 2006, the European Southern Observatory (ESO) will have another top-quality instrument at its disposal to explore the heavens.



SCHOTT/Fernando Baptista

Gigantic and yet highly fragile: the VISTA mirror substrate made from "Zerodur" glass ceramic is only 17 centimeters thick but weighs 5,300 kilograms.

"VISTA will be the largest and most powerful wide field survey telescope in the world," says Professor Jim Emerson of Queen Mary, University of London. He heads the VISTA Consortium of 18 British universities. "We will be able to obtain individual images of the sky that will remain sharp across much greater areas of sky than has been possible till now. In particular, we hope to gain access to new and spectacular results in the still relatively unexplored infrared region of the spectrum. Infrared light can penetrate, for example, interstellar gas and dust clouds that are largely opaque to visible light."

VISTA will be located at a height of 2,518 meters on the NTT peak in the Chilean Andes. This peak is part of the Cerro Paranal Observatory, where ESO has already installed four 8.2-meter Very Large Telescopes (VLT). From this position, VISTA will take survey images that are primarily going to be used to produce new and detailed maps of large areas of the Southern Hemisphere sky. The astronomers will also extract interesting rare objects, which will then be studied in greater depth by the VLTs.

A novel optical design

VISTA's primary mirror must have a large light-collecting area so that it can detect faint objects. But to be able to image wide areas of sky as rapidly as possible, VISTA's overall optical system must also cover a much larger angle of view than a standard telescope. It is not easy to obtain good image quality with such a large primary mirror and wide field because the further the incident light is from being parallel to the optical axis of the telescope, the harder it is to form a sharp image. Therefore a completely novel optical design was introduced for VISTA. Professor Emerson summarizes the main features as follows: "The reflecting telescope alone does not produce high-quality images. These are created with the help of a camera, which means that the two instruments cannot be used independently from one another. The telescope and camera are optimized as a single instrument. The camera corrects the optical distortions towards the edge of the field of view that would unavoidably occur if only the secondary and primary mirrors were involved."

Primary mirror and infrared camera are both extraordinary

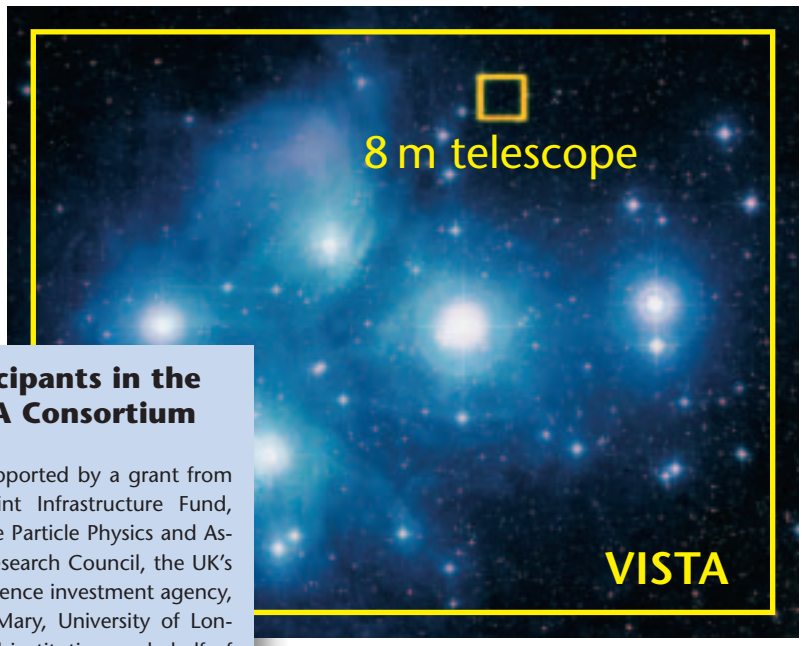
VISTA will thus be equipped with an aspherical primary mirror measuring 4.1 meters in diameter. Its curvature radius of 8,094 millimeters is extremely small, meaning that the mirror itself appears unusually curved. The curvature radius of a standard telescope

is four to five times larger. SCHOTT delivered the "Zerodur" glass ceramic mirror substrate required for this mirror at the end of April 2003. It remains to be optically polished and coated with a high-reflecting layer. A special camera will be produced for the infrared range (an alternative camera for the visible range may be built at a later date). At a height of 2.85 meters and a weight of 2.7 metric tons, it will be the biggest infrared camera ever constructed. Each high-resolution exposure will consist of 64 million pixels. Unlike the classic telescope design, the infrared camera is not positioned behind the primary mirror, but instead partly rises through the center hole of the mirror.

New astronomical findings in the infrared range

The images that can be produced by this unusual design will each cover an area of approximately 0.4 square degrees of sky, which is equivalent to about twice the size of the full moon. The image quality will be so good that exposures will even include stars and galaxies that are 10 to 100 times fainter than those previously registered in such sky surveys. Scientists thus expect to answer many astronomical questions, whereby the main focus will be on investigations that can only be conducted in the infrared region of the spectrum. One example is, for instance, observing the birth of a star. New stars form from clouds of gas and dust that are usually impervious to visible light, but not to infrared emission. Infrared images are also a prerequisite for investigating distant galaxies because the farther away they are, the more the emission of the galaxy shifts from the visible to the longer wavelengths of the infrared region of the spectrum.

In fact many believe that VISTA will lead to completely unprecedented discoveries. Professor Emerson: "This has always been the case when astronomers had a new top-quality telescope with a totally different design. We are convinced that VISTA will be no exception." ◂



Queen Mary, University of London

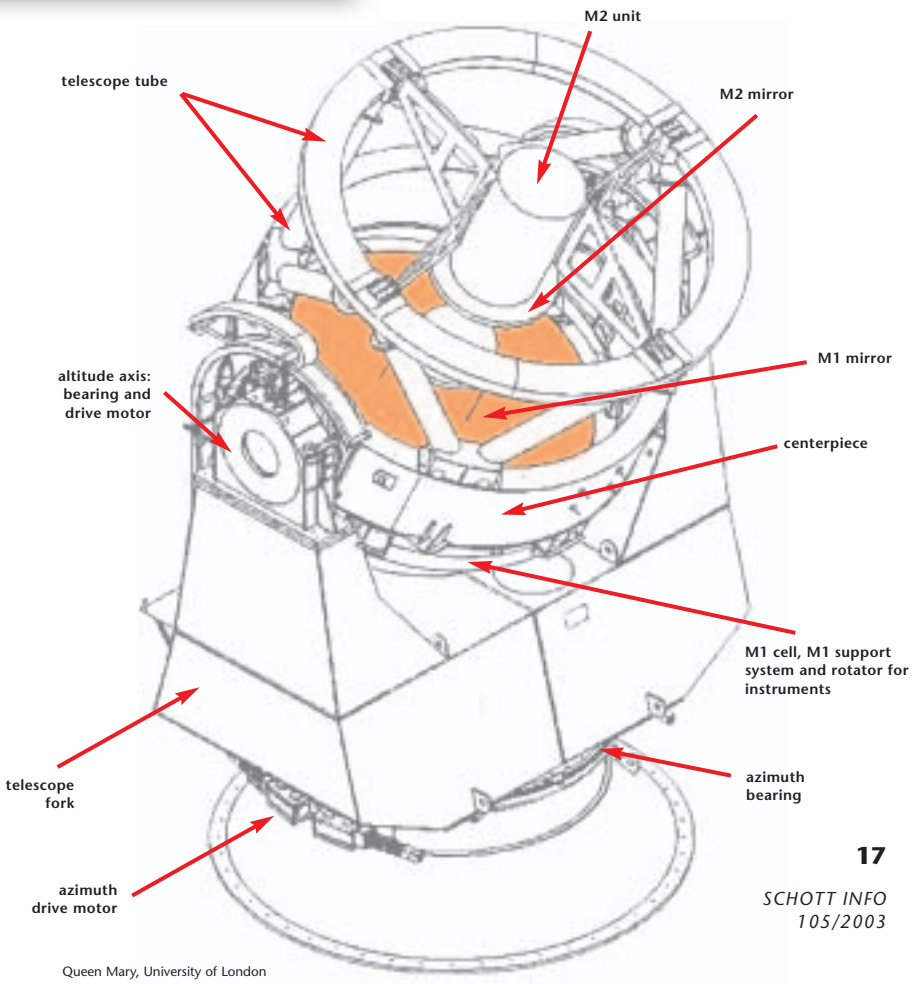
The large photograph shows the field of view of the VISTA telescope compared with the confined angle of view (small yellow square) of an 8-meter telescope.

Participants in the VISTA Consortium

VISTA is supported by a grant from the UK Joint Infrastructure Fund, through the Particle Physics and Astronomy Research Council, the UK's strategic science investment agency, to Queen Mary, University of London as lead institution on behalf of the 18 University members of the VISTA Consortium, and will cost more than £32 million (€46.7 million). The UK Astronomy Technology Centre manages design and production. VISTA is a part of the UK's entrance ticket for the European Southern Observatory (ESO) and thus entitles British astronomers to use ESO's telescopes. At present, ten European countries are members of the ESO.

The VISTA mirror substrate

Material: "Zerodur" glass ceramic from SCHOTT
Diameter: 4,100 mm
Thickness: 170.5 mm
Center hole: centric with a diameter of 1,200 mm
Mirror area: aspherical with a radius of 8,094 mm
Weight: 5,300 kg



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