Preliminary analysis of the data indicates that these stars are resolved and that they probably rival Betelgeuse and Mira in angular size. If this turns out to be the case, we will be able to look for evidence of asymmetries and surface features on these stars.

The number of stars that can be resolved by 4-m-class telescopes is small, but the results so far have proved very interesting. The new generation of 8–10-m telescopes will give a big improvement in angular resolution, and masking observations similar to those we have described should allow detailed study of stars with large angular diameters. At the moment, however, there are always practical difficulties with aperture masking. We therefore hope that future instruments will be designed to contain a reimaged pupil at which masks can be easily inserted.

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Optical Gyro Encoder Tested on the NTT

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The prototype of the optical gyro encoder (see [1] and [2]) has been successfully tested on the NTT telescope in the period of 5 to 10 September 1993. Day time tests until 20 September proved the repeatability of the measurements. The tests confirmed the specifications of the encoder and qualified this type of angular encoder for the use in an optical telescope.

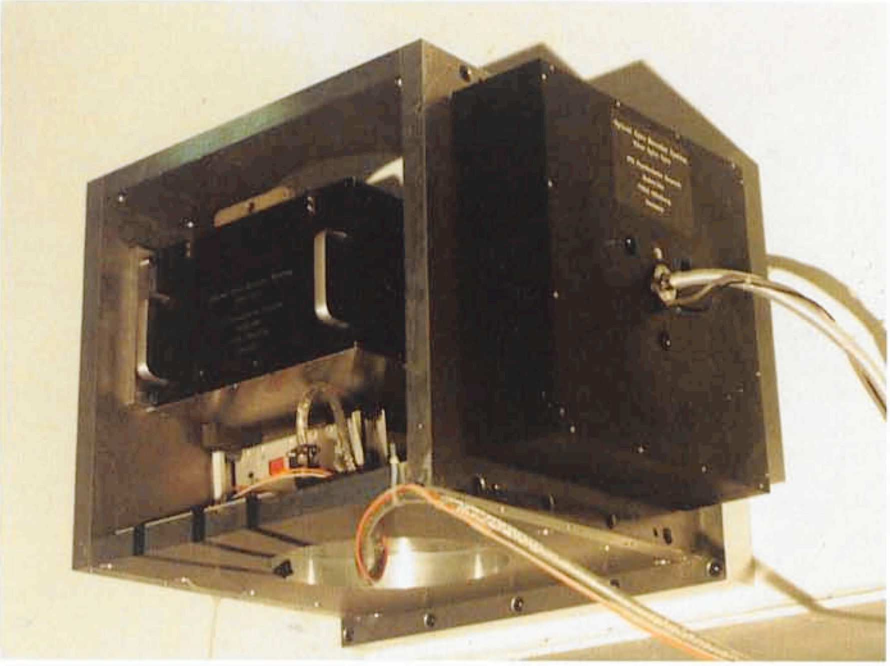
The optical gyro encoder (OGE) consists of two gyros:

1. A ring laser gyro. This gyro consists of a triangular or square light path with mirrors in the corners. Laser light from an ionizing laser source (e.g. HeNe) is emitted in the 2 directions of the light path and the resulting interference pattern is measured.
   The light path is made in a glass block with a thermal expansion coefficient of zero. It has therefore a very stable scale factor but the resolution is not sufficient.
2. A fiber optic gyro. This gyro consists of a polarization maintaining fiber, which is wound on a coil. A light source emits light in the two directions of the coil, and the interference pattern is measured. Compared with a ring laser gyro with the same enclosed area for the light path, the sensitivity multiplies with the number of turns. This results in an excellent resolution and low noise. On the other hand, the scale factor is not sufficient because of imperfections in the optical elements and thermal effects.

In principle, the OGE integrates the signal of the ring laser gyro and compensates it for misalignments and earth rotation in order to get the angles in telescope coordinates. The ring laser gyro data are also used to stabilize the fiber optic gyro. The data collection was however done for the two gyros individually and the data were evaluated offline in order to find the best integration time constant.

The OGE data were transformed into altitude/azimuth coordinates according to its system equations and calibration data. This was compared with the readings of the altitude and azimuth encoders of the NTT.

The OGE was first mounted on the



The optical gyro encoder mounted on the NTT centre piece (altitude axis). The ring laser with its front-end electronics is mounted in the box, while the fiber gyro is mounted on the right-hand plate. Dimensions of the mounting box are about 45 × 45 × 45 cm. The axis of the optical gyro encoder is from left to right on this picture.

azimuth box to measure azimuth rotation and was later fixed to the centrepiece in order to measure altitude rotation.

The OGE measures in respect to inertial space, while the NTT encoders measure in respect to altitude/azimuth coordinates of the earth frame. Because of this basic difference in operation, several special effects were detected:

1. Stressing of the azimuth bearing support ring. When the telescope starts to move from a stand-still position, the telescope is already moving before the NTT encoder measures a rotation. This is due to the friction in the radial bearing of the azimuth axis, which is also the mounting location of the NTT encoder.
2. Sag of structural parts of the centerpiece of the NTT according to the altitude position.
3. Minor nonlinearities of the NTT encoders in the sub arcsec range.
4. Details of the control loop behaviour.

The preliminary evaluation of the test data gave the following characteristics:

Pointing accuracy: Azimuth axis: < 0.7 arcsec rms
Altitude axis: < 1 arcsec rms

Tracking accuracy: < 0.1 arcsec rms over a time of 30 seconds

Resolution: $< 3\times10^{-4}$ arcsec at a readout rate of 10 Hz

Bandwidth: up to 120 Hz (adjustable by software)

No temperature compensation had to be applied.

In gyro terms the data are as follows:

Bias stability: $< 2\times10^{-3}$ degrees/hour

Scale factor stability: < 1 ppm

Random walk coefficient: $< 5\times10^{-4}$ degrees/$\sqrt{\text{hour}}$.

The high resolution and bandwidth make the OGE an excellent device for telescope tracking. Having fiber optic gyros mounted on the telescope tube, the rotation rate has to be zero during tracking for alt-azimuth mounted telescopes as well as for equatorial mounted telescopes. However, the intrinsic integration principle and drift require the use of an initialization reference and an autoguider.

The installation of an OGE is easy because it does not need to be mounted in the telescope axis and there are no tight mechanical tolerances to be respected.

On an equatorial mounted telescope, the application is even easier because no coordinate transformation is needed: If one OGE is mounted on the alpha and another one on the delta axis, they see an inertial rate of zero during tracking. This also means that, in this case, the tracking performance is not dependent on a pointing model: the OGEs drive the motors in such a way that the inertial rate becomes zero.

The test campaign proved that this device is also quite useful for calibrating existing encoders and for analysing existing telescope control loops and structures.

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Infrared Astronomy with Arrays: the Next Generation

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The title is that of a conference held at UCLA in July 1993 at which approximately 250 participants experienced a feast of 73 papers and 120 posters covering both recent astrophysical results and future prospects for the next generation of infrared array instruments on large ground-based telescopes and in space. Although it was a very exciting meeting both scientifically and technically with many highlights, the purpose of this article is not to review the conference (to be published as a book by Kluwer and edited by Ian McLean) but to draw attention to developments in the field of infrared array detectors reported there which are of great interest for both planned and future VLT instruments. Partly because the conference was in California, the infrared detector manufacturers were represented in force to present their products and solicit feedback from users on the performance of current arrays and their future requirements in a special "meet the industry" evening session. Such sessions have become a regular feature of specialist infrared conferences, and this one really demonstrated the extensive cooperation which has developed between astronomers and industry during the last few years and the remarkable progress made in the development/optimization of arrays for infrared astronomy.

Based on the quantity and quality of the scientific results presented, the standard in the near infrared (1–2.5 μm) region has clearly been set during the last few years by the 256×256 Hg:Cd:Te NICMOS3 array developed for the HST instrument with whose name it has become synonymous (and whose home was visited by many of the participants on an oversubscribed tour organized by the Rockwell International Science Center). This is the array installed in IRAC2 at the 2.2-m telescope on La Silla and currently baselined for the short wavelength channels of the ISAAC (see *The Messenger*, 70, 10) and CONICA (*The Messenger*, 67, 17) instruments for the ESO VLT. With its relatively short long wavelength cut-off this array yields extremely low dark current (~0.1 e/s) and read noise (~20 e) at comfortable operating temperatures ~70K. Results at the conference, however, revealed the strong competition it now faces from the new SBRC 256×256 InSb array, successor to their famous 58×62 device, which is sensitive out to 5 μm and has been baselined for the long wavelength channels of ISAAC and CONICA. Somewhat unexpectedly, the first tests of these arrays have shown that they can also compete with the Hg:Cd:Te arrays with regard to dark current and noise, albeit at less comfortable temperatures (~30K) and with much more stringent requirements on the instrumental background due to their longer cut-off wavelength. They also yield quantum efficiencies >0.8 which are higher than the Hg:Cd:Te