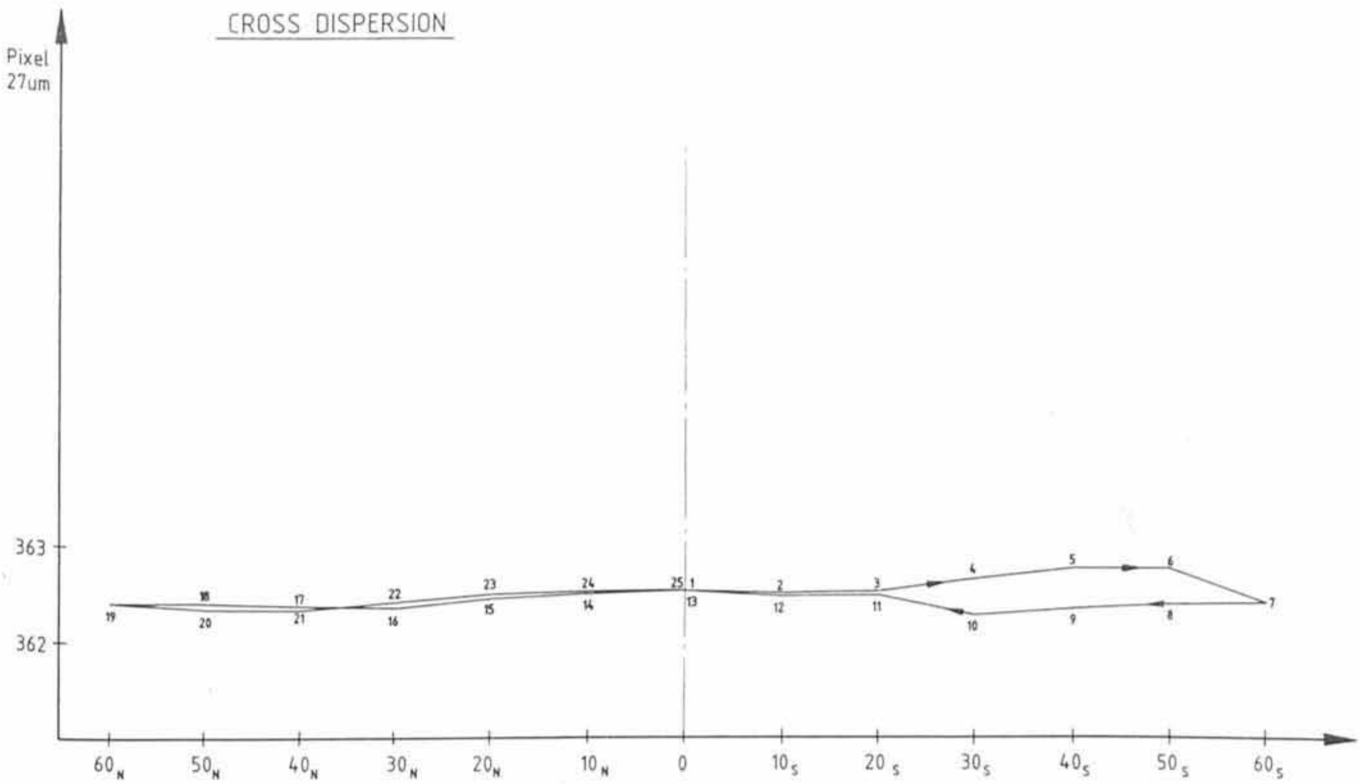

Figure 5: *An example of the tests performed to investigate CASPEC shifts: measured pixel positions of a Th-Ar line as a function of the telescope zenith distance. Slit was oriented E-W and the telescope was moved in declination.*

structive criticism they greatly contributed to these improvements.

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Optical Gyros for Astronomical Telescopes

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Pointing and tracking of telescopes requires high-precision angular encoders. Up to now classical rotary encoders have been used for this application. Their implementation in modern large telescopes with alt/azimuth mounts becomes rather difficult, because they have to be installed on the rotation axis, which has to be clear and free of any obstruction for the Nasmyth or coudé light path. In the NTT the largest monolithic encoders ever built are used, with a clear inner diameter of 50 cm. Its glass ring, which contains the division scales, has an outer diameter of 70 cm. For the VLT, with Nasmyth beams of approximately 1 m diameter, this type of encoder is not realistic any more and alternatively engraved steel scales mounted on precisely aligned cylinders will be used.

For these reasons, optical gyros have been proposed at ESO as an alternative solution, already in 1986 (1, 2). They have not to be mounted on the rotation axis because they would control the telescope (pointing and tracking) like an inertial navigation system used in airplanes, satellites, submarines, etc.

In order to assess this new approach and to demonstrate its usefulness for astronomical telescopes, ESO launched a feasibility study in April 1990. The In-

Optical Gyros

Optical gyros (J.R. Wilkinson (1987), *Prog. Quant. Electr.,* Vol. **11**, pp. 1–103) are based on the Sagnac effect (G. Sagnac (1913), *C. R. Acad. Sci*, Vol. **157**, 708). Two counterpropagating optical waves are travelling inside a ring interferometer and then combined and brought to interference. Is the interferometer not in rotation then the travel time for the two optical paths are the same and the interference pattern at the output is stationary. Is the interferometer rotating around an axis perpendicular to its plane, then one light wave sees its path shortened and the other one sees it elongated. This classical view leads to correct results for the path differences but a detailed physical description has to be based on the general theory of relativity.

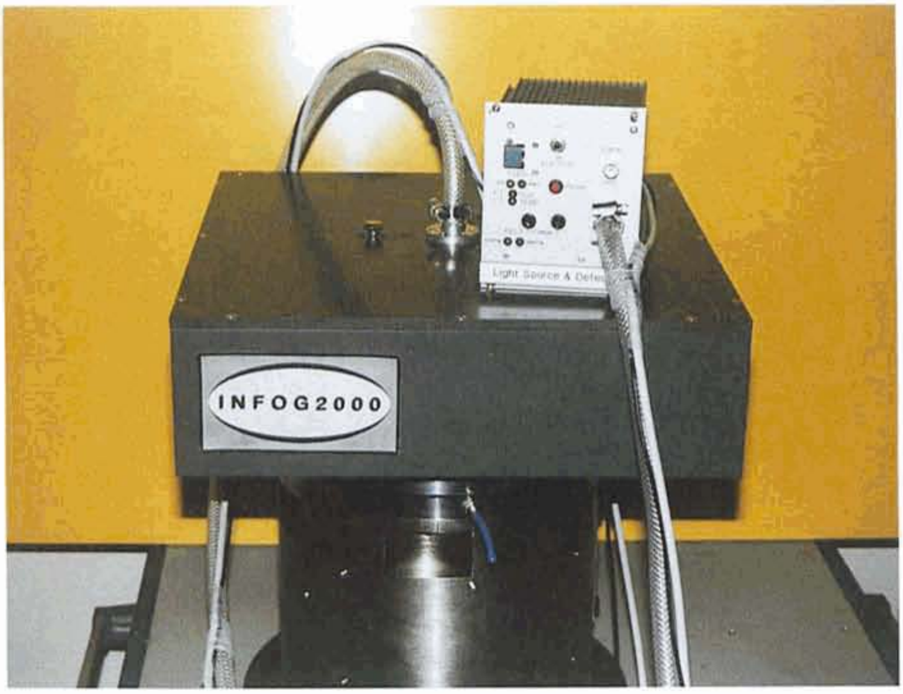

Figure 1: *View of the fibre gyro system (INFOG 2000) developed by Prof. Schröder at the FH Offenburg. The coil with 1100 m polarization maintaining fibre has 26 cm diameter and is inside the thermally stabilized and magnetically shielded square box (gyro head) mounted for test purposes on a rotation table. The small control box, which can be separated more than 15 metres from the gyro head, contains the light source (ELED at 1280 nm) and the detector and delivers the conditioned gyro output signal. (Photo: FH Offenburg).*

stitut für Physikalische Sensorik at the Fachhochschule Offenburg (FHO), Germany, started with a theoretical investigation of this concept in view of the specific requirements in astronomical telescopes and came up with a proposal for a fibre/laser gyro combination in order to cover the pointing as well as tracking phase in telescope operation.

A first prototype for the fibre gyro part has recently been completed at the FHO (see Fig. 1) which would already meet the VLT requirements for tracking with an accuracy of better than 0.1 arcsec over 30 seconds, and a resolution higher than 0.02 arcsec. Commercially available systems currently do not provide this accuracy and resolution. The construction for an improved version which will be delivered to ESO (3) and tested on the NTT next year has just started. This fibre gyro will be combined with a commercially available laser gyro covering the faster slewing and pointing operations of the telescope. A Litton LTN-90 laser gyro system has been considered for this.

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Multi-Object Spectroscopy with an Automatic Fibre Positioning System in a One-Degree Field

First Technical Run of MEFOS at the Prime Focus of the 3.6-m Telescope

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1. Introduction

Several scientific programmes require the acquisition of a large number of spectra to build up a statistically significant sample of data. Typical examples of this category are studies of galaxies in clusters or in the field and surveys of QSO candidates and peculiar stars in selected galactic regions or in nearby galaxies. In the last decade, optical fibres have been successfully used in gathering the light of different targets spread over the field of a telescope to a common spectrograph slit and thus to speed up the process of data collection.

In the first generation of instruments of this type, the fibres – typically between 40 an 100 – are manually inserted in predrilled plates mounted at the focal plane of the telescopes. The ESO facility OPTOPUS (1986, *ESO Operating Manual* No. **6**) is based on this principle and is successfully in operation at the La Silla 3.6-m telescope since 1986 as a common user instrument. Its performance has recently been upgraded with the introduction of two new fibre bundles and of a new F/6 collimator (Avila and D'Odorico, 1991, preprint). The plate drilling operation has recently been transferred to the ESO workshop at La Silla. In the second generation of fibre instruments, which came into use more recently, the positioning of the fibres in the field is done automatically at the telescope in order to skip the need of the predrilled plates and to retain real-time control of the fibre position. Systems of this type have been prototyped by Hill and Lesser at the Steward Observatory (1988, Proceedings of the 9th Santa Cruz Workshop, ed. S. C. Barden, p. 233), by Parry and Gray at the Anglo-Australian Telescope (1986, *SPIE* **627**, 118) and by Ingerson et al. at Cerro Tololo (1991, in preparation).

In 1989 ESO concluded an agreement