cies entering the adaptive optics bandpass, is that of deformations of very thin primaries due to wind buffets. The possibilities and limitations of active optics in this area are still under investigation.

7. Acknowledgements

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[3] Franza, F., Le Luyer, M., Wilson, R.N., 1977, "3.6-m Telescope: The Adjustment and Test on the Sky of the PF Optics with the Gascoigne Plate Correctors", ESO Technical Report No. 8.

[4] Wilson, R.N., Noethe, L., 1988, "Mirrors and Supports", Proc. ESO Conf. on "Very Large Telescopes and their Instrumentation", Garching, March 1988, to appear shortly.

The 3rd ESO/CERN Symposium

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The 3rd ESO/CERN Symposium on "Astronomy, Cosmology and Fundamental Physics" was held in Bologna (16–20 May, 1988) at the invitation of the University of Bologna celebrating its 900-year anniversary. It was attended by approximately 250 participants, but on many occasions the audience was much larger due to the presence of local scientists and students.

The Symposium was focused on the various subjects important to cosmology and particle physics which were covered by a set of comprehensive review lectures, contributed papers and posters. The reviews included a critical discussion of the value of the Hubble constant (A. Dressler), the large scale distribution of galaxies (M. Geller), a discussion on the distribution and properties of classes of objects at high redshifts (R. Kron), the microwave background (B. Partridge) and the formation of structures in the Universe (N. Vittorio, A. Starobinsky), the evidence and particle constituents of dark matter (D. Lynden-Bell, M. Turner), the status of the standard model of particle physics (R. Peccei), the implications both for the inflationary model of the Universe and of particle physics of going well beyond the standard model (D. Nanopoulos), the fascinating results of ultrarelativistic nuclear collisions (M. Satz) and a review of the underground physics experiments (E. Bellotti). One afternoon was dedicated to the discussion of the Supernova 1987A, this extraordinary event which took place in the Large Magellanic Cloud and for which ESO has accumulated an impressive amount of observational material.

The introductory lecture was given by Prof. A. Salam, Nobel Prize for Physics, who, among other things, emphasized the fundamental importance of studying the Universe for the understanding of the basic laws of physics. As he put it, the extreme conditions to be found in the hot "big-bang" scenario would require man-made particle accelerators having sizes up to the distance to the nearby stars, which is obviously outside of any foreseeable technological development. The main results of the Symposium were beautifully summarized in the Closing Lecture by L. Van Hove.

According to many unsolicited comments the meeting was extremely successful, both scientifically and organizationally, and for this last point a special thanks should be addressed to the local organizers, the Departments of Astronomy and Physics of the University of Bologna. The organization of the meeting greatly benefitted from the generous support provided, among others, by the University of Bologna, the City Authorities of Bologna, the National Research Council of Italy (C.N.R.) and the National Institute of Nuclear Physics (I.N.F.N.).

The Proceedings will be published by Reidel towards the end of this year. Their availability will be announced in the *Messenger.*

At the end of the Symposium, in a ceremony that took place at 12 a.m. on May 20, the Rector of the University of Bologna presented Professor L. Van Hove, former Director General of CERN, and Professor L. Woltjer, former Director General of ESO, with a laurea "honoris causa" respectively in Astronomy and in Physics.

In parallel with the ESO/CERN Symposium, and on the same premises, the Departments of Physics and Astronomy of the Bologna University had organized an exhibition in astronomy and particle physics at which both ESO and CERN participated with their exhibition material. The exhibition was officially opened on May 7 by the Rector of the University and local authorities and was extremely successful, attracting about 30,000 visitors, including many organized school tours.

List of ESO Preprints

June–August 1988

592. P. Bouchet et al.: Infrared Photometry and Spectrophotometry of SN 1987A: March to October 1987 Observations. *Astronomy and Astrophysics.*
593. L. Milano et al.: Search for Contact Systems Among EB-Type Binaries. I: TT Herculis. *Astronomy and Astrophysics.*
594. R. Buonanno et al.: On the Ages of Globular Clusters and the Sandage Period-Shift Effect. *Astronomy and Astrophysics.*
595. J. Melnick et al.: The Galactic Giant H II Region NGC 3603. *Astronomy and Astrophysics.*
596. P.A. Shaver et al.: The Evolution of Structure. Paper presented at a meeting on "Large-Scale Structure and Motions in the Universe", Trieste, April 1988 (to be published by Reidel; eds. G. Giuricin et al.).

597. F. Barone et al.: Gravitational Wave Background from a Sample of 330+4 Pulsars. *Astronomy and Astrophysics.*
598. G. Contopoulos: Short and Long Period Orbits. *Celestial Mechanics.*
599. L. Milano et al.: Search for Contact Systems Among EB-Type Binaries. II: ES Lib and AR Boo. *Astronomy and Astrophysics.*
600. C.N. Tadhunter et al.: Very Extended Ionized Gas in Radio Galaxies: IV. PKS 2152-69. *Monthly Notices of the Royal Astronomical Society.*
601. D. Baade and O. Stahl: Rapid Line Profile Variability of the A-Type Shell- and Possible Pre-Main Sequence Star HD 163296. *Astronomy and Astrophysics.*
602. D. Baade and O. Stahl: New Aspects of the Variability of the Probable Pre-Main Sequence Star HR 5999. *Astronomy and Astrophysics.*
603. S. D'Odorico: Multiple Object Spectroscopy at ESO: Today's Facilities and Future Prospects. Invited paper to a conference.
604. G. Setti: The Extragalactic X-Ray Background. Invited paper to appear in the Proceedings of the YAMADA Conference XX on "Big Bang, Active Galactic Nuclei and Supernovae, Tokyo, March 28–April 1, 1988.
605. S. Cristiani et al.: Quasars in the Field of SA94. III. A Colour Survey. *Astronomy and Astrophysics.*
606. F. Barone et al.: Search for Contact Systems among EB-Type Binaries. III: UU Cnc and VZ Psc, Contact Systems Before the Common Envelope Phase? *Astronomy and Astrophysics.*
607. G. Contopoulos: Nonuniqueness of Families of Periodic Solutions in a Four Dimensional Mapping. *Celestial Mechanics.*

Seeing Measurements with a Differential Image Motion Monitor

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Concept of the DIMM

Seeing is possibly the most important parameter describing a ground-based astronomical observatory. Under conditions of good seeing, an aberration-free telescope will produce sharp and bright images. The astronomer can then explore the universe to greater depths than otherwise possible.

In recent years, a considerable amount of theoretical and experimental seeing studies have been conducted. The action of the earth's atmosphere on the quality of astronomical observations is now understood in quite some detail, and it has also become possible to measure the prevailing seeing, without the use of large and very expensive telescopes. This is obviously of great interest in the search for new observatory sites.

One particular instrument which can simulate seeing conditions at larger telescopes is called the Differential Image Motion Monitor, or DIMM. Its concept goes back at least to 1960, when it was used for qualitative seeing studies [1]. Later, F. Roddier [2] has shown its potential for quantitative measurements. This prompted ESO to use DIMM in the search for the site for the Very Large Telescope.

The detector unit of DIMM houses an intensified CCD and is attached to an alt-alt mounted, 350-mm aperture Cassegrain telescope. All essential functions are computer controlled, and tracking is assisted by an autoguider. The instrument is placed in open air on a 5 m high tower. Typically, the telescope follows a bright star for a couple of hours, while the star crosses the meridian.

The full aperture of the instrument is used for self-calibration, while, in its regular mode of operation, the entrance is restricted to two circular holes. These are 4 cm diameter, and spaced 20 cm, centre to centre. Under perfect conditions, light arrives as a plane wave, forming two images at fixed positions. The presence of turbulence in the earth's atmosphere causes the arrival direction to differ slightly between the two holes. The two spots on the detector will then shift relative to each other. Their time-averaged motion is proportional to the astronomical seeing. In principle, the scaling factor is defined by the system parameters, and does not depend on any empirically determined value. To demonstrate that this is really the case, we decided to compare the DIMM with standard seeing measurements at big telescopes. Such have been conducted on a regular basis for several years, using imaging CCD cameras [5]. In order to allow a comparison as realistic as possible, it was necessary to mount the DIMM inside a dome. For the presently described tests, May 26 to 28, 1988, it was mounted on the exterior of the 2.2-m telescope's mirror cell.

Measurement in Parallel with the 2.2-m Telescope

In spite of the fact that the instruments were observing in parallel, at least two effects tend to complicate the comparison. A relatively small effect is due to turbulence within the 2.2-m mirror cell. This is not measured by the DIMM, since it used its own optics. The size of the error is difficult to quantify. We believe it is comparable to the measurement accuracy (0.1″), or smaller.

A more severe effect is due to optical aberrations in the 2.2-m. In order to quantify this, we refer to the last optical tests, which were conducted in December 1987. A set of Shack-Hartmann plates show that the main error is due to astigmatism, decentring coma being negligible and spherical aberration absent. At best focus, 80% of the energy is concentrated within a diameter of 0.45″. For seeing ~ 1″, this corresponds to a quadratic contribution of 0.35″ in terms of FWHM. To allow also for the mirror-seeing problem, we have

Figure 1: *The Differential Image Motion Monitor mounted on the 2.2-m telescope.*