Basically, one uses diagrams like that given in Fig. 3 for mode identifications (Weiss and Schneider, 1983b). The abscissa is calibrated in phase differences between brightness and flux variations. The linear pulsation theory tells that this phase difference depends not only on the pulsation mode l, but also on the phase lag (ψ) between brightness and radial velocity variations and on the value of f, a parameter which characterizes the relative importance of the flux variations in the total luminosity variation. A ψ of about 120° can be expected for CP2 stars. The shadowed area in Fig. 3 represents our observed phase difference for HD 128898 (α Cir), ① represents the corresponding value for HD 101065 and ⓘⓘ for HD 83368 as determined by Kurtz (1982). From our figure it is evident that more observations and in particular an improved theory are required, if one considers that f larger than 50 has not yet been determined in pulsating stars of comparable temperature and that Kurtz identified the pulsation modes of HD 101065 and HD 83368 as $l=1$ and 2 modes on the grounds of his oblique pulsator model. For us it seems that the only way out of the dilemma is to try to get high accuracy spectral line variations for the brightest pulsating CP2 stars and to use this information for an independent mode identification. A corresponding telescope time application is submitted to ESO.

This is the substance of the report of Dr. Hensberge, which was followed by a discussion from the ESO audience. The WG on CP2 stars then continued its work in one of the conference rooms of the ESO headquarters. This way the most recent results were discussed as well as the imminent observing runs and finally the individual applications for observing time for the next period. The next (spring) meeting of the WG will be held in Zürich or Paris.

The Working Group is very grateful to ESO for the hospitality shown once more. We hope that this time we could give the opportunity for some participation by preparing and presenting a report to the ESO public.

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Automatic Parameter Extraction for the 16,000 Galaxies in the ESO/Uppsala Catalogue

A. Lauberts and E. A. Valentijn, ESO

Introduction

Since the completion of the ESO/Uppsala survey for southern galaxies last year a follow-up study of that survey has been prepared. The main purpose of the original survey was *to find and classify* galaxies on the ESO Quick Blue Survey (QBS). The copy plates were visually inspected and all parameters such as position, size and morphology were determined with the help of the human eye. A close inspection of the QBS down to the plate limit of ~ 21 mag would have revealed about 1 million galaxies. For the ESO survey it was decided to restrict the number of galaxies by including only those objects with an angular diameter larger than 1′. This limit roughly corresponds to the 15th magnitude and also had the advantage that the detected systems showed enough structure to classify them morphologically. 14,000 galaxies passed the angular size criterion and together with ~ 2,000 peculiar galaxies, ~ 1,000 star clusters and ~ 1,000 planetary nebulae they were brought together in a single volume (ESO/Uppsala Catalogue, A. Lauberts, 1982).

As soon as ESO initiated the new red survey on IIIa-F emulsion, plans developed to extract all possible photometric and morphological parameters from the complete set of B and R survey plates. At that time less than 10% of the ESO catalogue galaxies had published magnitudes and almost no red photometry existed for these objects. Detailed photometry was known for perhaps 100 of the brightest objects. Here we describe an extensive project that aims to calibrate both the R and B survey plates and to extract automatically both photometric and morphological parameters for all the galaxies present in the catalogue. A flow chart linking the different steps of the project is given in Fig. 1. Essentially the project contains the following parts:

1. Scan the 16,000 galaxies with the PDS on 606 Blue and 606 Red original ESO survey plates.
2. Bring together existing photometry in a catalogue and add complementary photometry using own measurements at the ESO 1 metre telescope.
3. Calibrate the plates and determine the properties of the galaxies automatically using the ESO VAX computers.
4. Produce a catalogue on paper, magnetic tape and possibly on video disk.
5. Investigate the data base scientifically.

By October 1983 over 600 plates, mostly in B colour, have been scanned, a preliminary catalogue of photometric standards has been compiled and satisfactory versions of the software are in operation on the VAX computers.

Below we give some more detailed information on the different steps and present some preliminary results of our test field No. 358, covering the Fornax cluster.

Digitizing the Plates

As soon as a plate is manually positioned in the PDS (emulsion up) and the machine is set to zero density at the plate fog level, the scanning procedure is fully under control by the

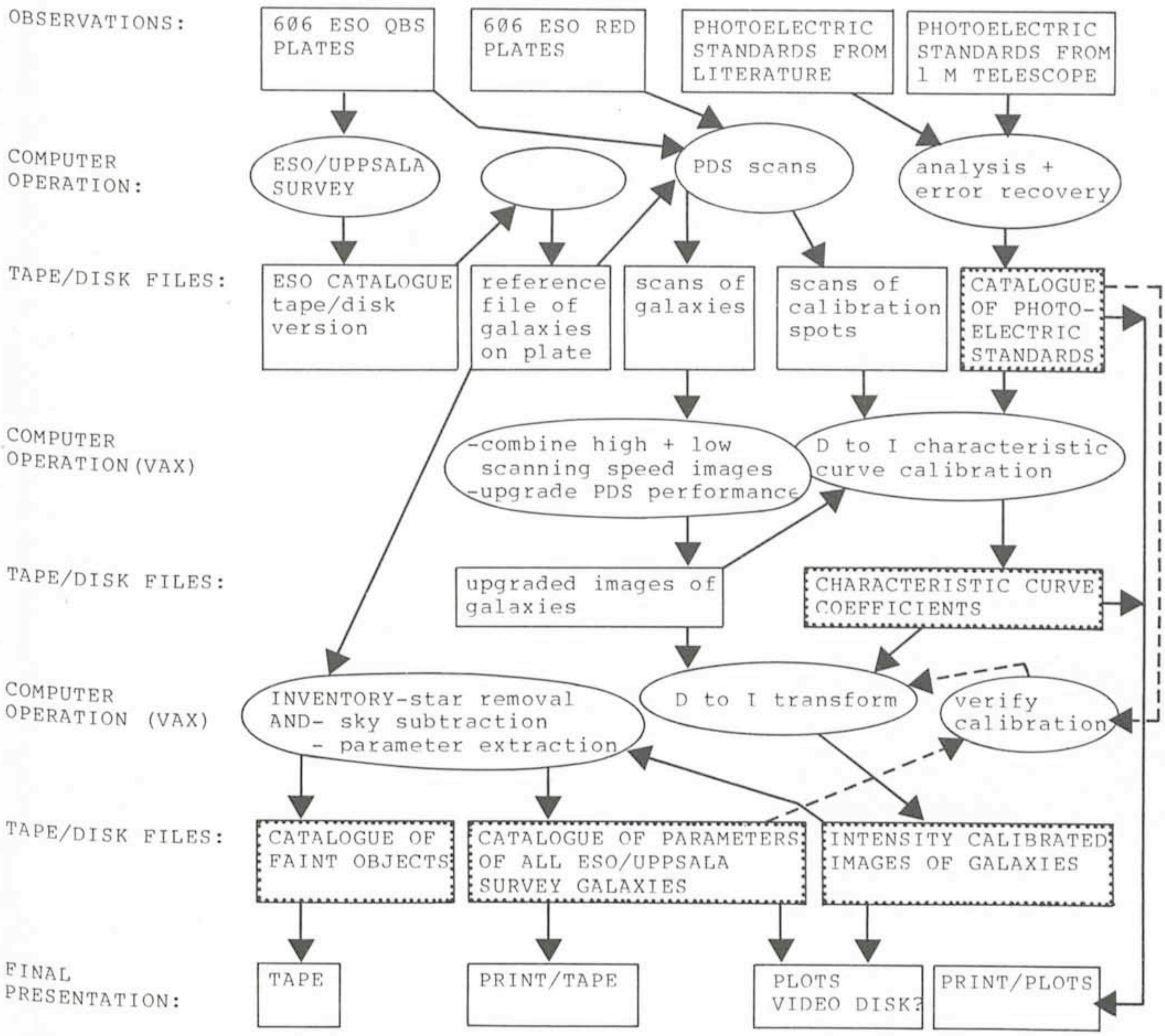

Fig. 1: *Flow chart of the automatic parameter extraction listing the computer operations and the resulting disk files. Marked disk files indicate that they provide a useful data base to the astronomical community.*

HP computer. From a reference file the computer selects and is able to find the objects to be scanned and determines the size of the scanning area. An area as large as three times the visible size (which corresponds to 25^m B surface brightness) of the object is scanned at high speed (20 mm/sec). A second scan of the central area of presumably much higher density is performed at a low speed (2 mm/sec). Later, the two images are combined into one using the VAX machine. The artifacts of the logarithmic amplifier of the PDS which produces asymmetric scan profiles at high densities are mainly recovered by a 2-dim interpolation.

The scanning procedure is relatively quick, the main bottleneck in this step being the availability of the Red Survey plates which are still being taken.

Photometric Calibration

During three runs (1982–1983) at the ESO 1 m telescope, multi-aperture photoelectric U, B, V, R, I measurements of 200 standard elliptical and SO galaxies have been acquired, selecting one object per survey field. Together with existing measurements 6,000 entries have been created in a disk file for the photometric calibration of the survey plates. Polynomial fits to plots of observed magnitude versus the log of the aperture used have been made for every standard galaxy. Next, the computer was instructed to make a plotted version of the "photometric catalogue" drawing the radial distribution of the V, U–B, B–V and V–R measurements, together with the polynomial fits. This served to recover any mishaps in the observations or the polynomial fits.

The characteristic curve is found by fitting $\log I = A^*\log(D_{sat}-D) + B^*\log(D-D_{fog}) + C$ to the standard galaxy aperture photometry and the calibration spots for the lower densities. This formula has been adopted from Llebaria and Figon in "Proceedings on Astronomical Photography", Nice 1981. The resulting transformation coefficients are stored in disk files. At present we have the data to calibrate ~ 400 Blue and ~ 250 Red original plates. Much more data are obviously still needed for the Red colour.

When more than one standard galaxy is available for a particular field, only one is used for the determination of the characteristic curve, leaving the other standards for a verification of the residuals of the photoelectric versus photographic measurements. An example of such a verification is given in

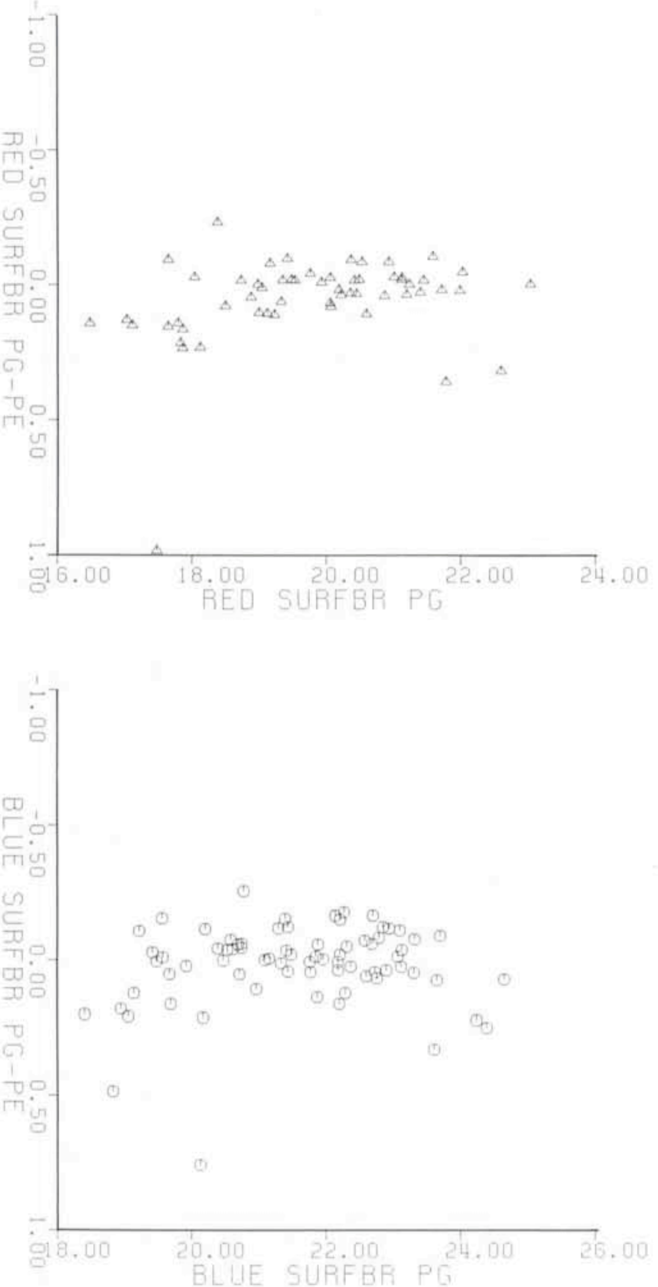

Fig. 2: *The residuals of photographic and photoelectric measurements versus the red and blue surface brightness is given in the upper and lower diagram respectively. Data points represent data of ~ 20 galaxies in the field 358. The dispersion is larger in the blue colour due to the higher noise in the IIa–O emulsion used for the QBS.*

IAU Colloquium No. 79

Very Large Telescopes, their Instrumentation and Programs

ESO, Garching, 9–12 April, 1984

Scientific Organizing Committee:

R. Angel, R. Cayrel, O. Citterio, M. Longair, G. Münch, N. V. Steshenko, J.-P. Swings, M.-H. Ulrich (Chairman), S. van den Bergh, H. van der Laan.

The meeting will last four days. Two and one half days will be devoted to the questions of Telescope design and fabrication, Domes, Sites, Instruments and Components:

- Primary mirrors, structures, support systems
- Active optics, wind loading, dome seeing, properties of the atmosphere
- Radiometric properties of telescopes
- Instrument matching in spectroscopy and direct imaging
- Large format detectors in the optical and IR
- Interferometry and speckle methods

One day will be allotted to Reviews of the Astronomical Programs and one half day to a panel discussion and a summary.

Invited Speakers include:

R. Angel, J. Beckers, H. Butcher, V. Castellani, F. Forbes, P. Léna, F. Low, R. Lynds, B. Mack, J. Nelson, H. Richardson, F. Roddier, R. Tull, J. Wampler, G. Weigelt, N. Woolf.

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IAU Colloquium No. 79, Ms. Christina Stoffer, European Southern Observatory, Karl-Schwarzschild-Straße 2, D-8046 Garching bei München, F.R.G., Telephone (89) 32006-0, Telex 52828222 eo d

Fig. 2 and shows a mean residual less than $0^m.08$ for the red surface brightness and $0^m.12$ for the blue surface brightness. The final photometric system will be determined through a study of $m_{pg} - m_{pe}$ residuals of all B and R plates simultaneously. The dotted line in the flow chart in Fig. 1 represents this "loop" in our calibration. Providing a catalogue with standard galaxies and the list of coefficients of the characteristic curve can be considered as the first two products of our project.

The Automatic Parameter Extraction

Once the characteristic curve coefficients of a plate have been determined, the images of the galaxies are converted from density into intensity and are ready for further analysis. Using a sequence of software routines the following is obtained in one main programme. First a version of the programme INVENTORY is run which detects and classifies all objects present in a single frame of a target galaxy and whose surface brightness exceeds that of the sky by a factor two. On average about 20 such objects are found per frame and their positions, magnitude and classification are calculated using a reference point spread function. The data are stored in a separate disk file for later investigation. In the future this data bank will be used to search for peculiar objects, such as quasars and novae, in the neighbourhood of the target galaxies. For instance, an automatic survey of objects with a certain colour excess will be feasible. The INVENTORY programme finally creates an image with all neighbouring objects subtracted from the input image. Next, as a first step in a string of our own routines, which we have called AND, the sky brightness distribution is approximated by a plane using 8 surrounding subregions, four of them being close to the corners. After the subtraction of the sky we are finally set to extract the photometric and structural information from the images. Radial B, R and B–R profiles are stored in the disk catalogue together with overall elongations and position angles from an octants comparison. For elliptical and SO galaxies ellipses are fitted to the isophotes determining the

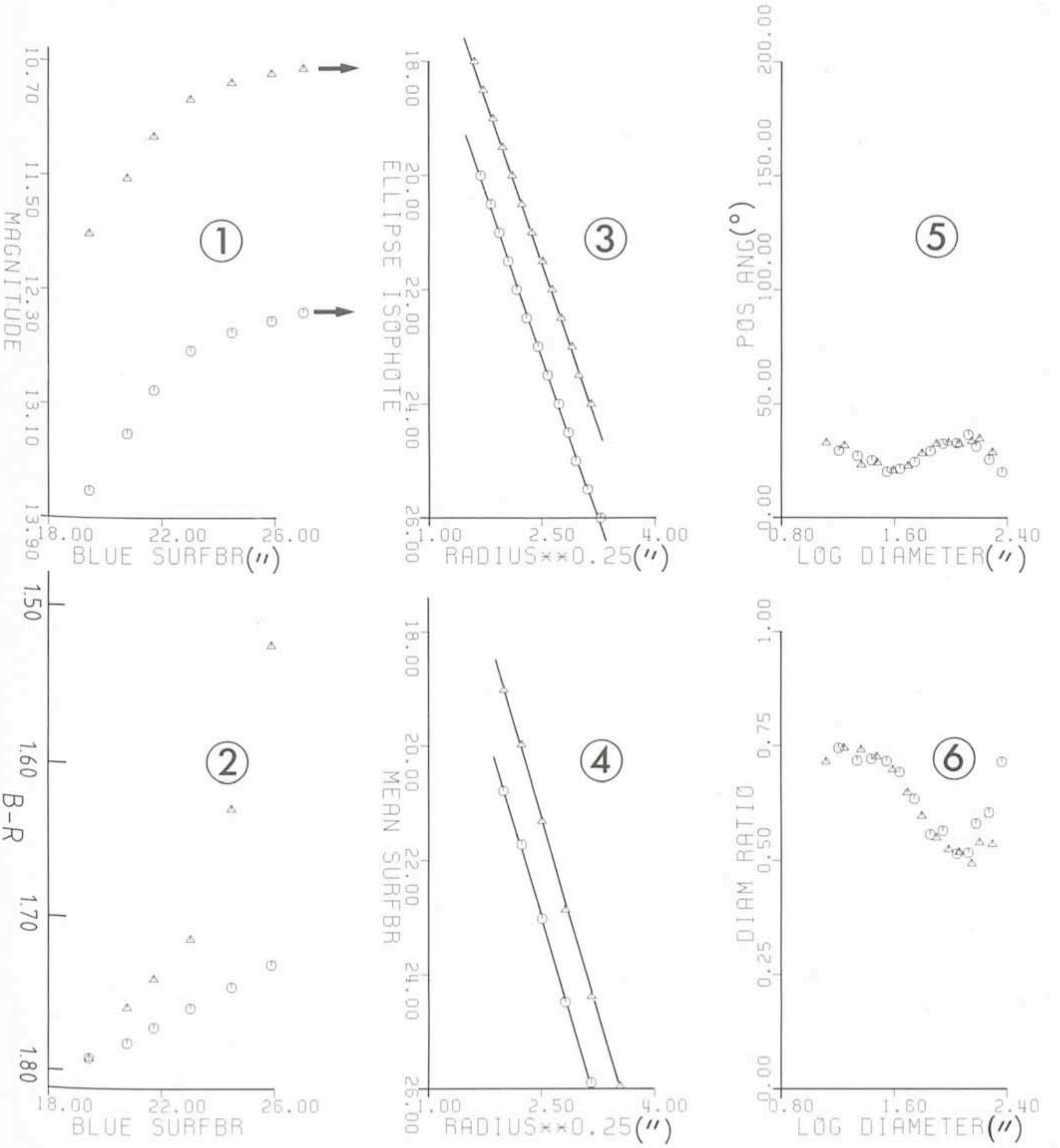

Fig. 3: *Photographic properties derived for the SO galaxy ESO 358–G38 in the Fornax cluster.*

1. MAGNITUDE vs BLUE SURFACE BRIGHTNESS. Integrated blue (circle) and red (triangle) magnitudes versus mean blue surface brightness in mags per square arcsec, sampled in ellipses according to the representative overall structure of the galaxy. For surface brightness < 22 the photographic values are replaced by, if available, more accurate photoelectric values in circular apertures.

2. B–R vs BLUE SURFACE BRIGHTNESS. Integrated (circle) and differential (triangles) B–R colour versus blue mean surface brightness.

*3. MEAN SURFACE BRIGHTNESS vs RADIUS** 0.25. Mean surface brightness versus major radius (arcsec) to the ¼ power. Data samples in ellipses of fixed shape and orientation, according to the representative overall structure of the galaxy.*

*4. ELLIPSE ISOPHOTE vs RADIUS** 0.25. Ellipse approximation to blue (circle) or red (triangle) isophote on smoothed image versus major radius (arcsec) to the ¼ power. Data sampled in the appropriate local ellipses as determined by the ellipse fitting.*

5. POSITION ANGLE vs LOG DIAMETER. Position angle (degrees) versus log major diameter (arcsec) for blue (circle) and red (triangle) ellipses fitted to isophotes.

6. DIAMETER RATIO vs LOG DIAMETER. Axial ratio versus log major diameter of ellipses fitted to isophotes. Seeing and low signal to noise ratio near the sky background both have a tendency to round off elongated objects.

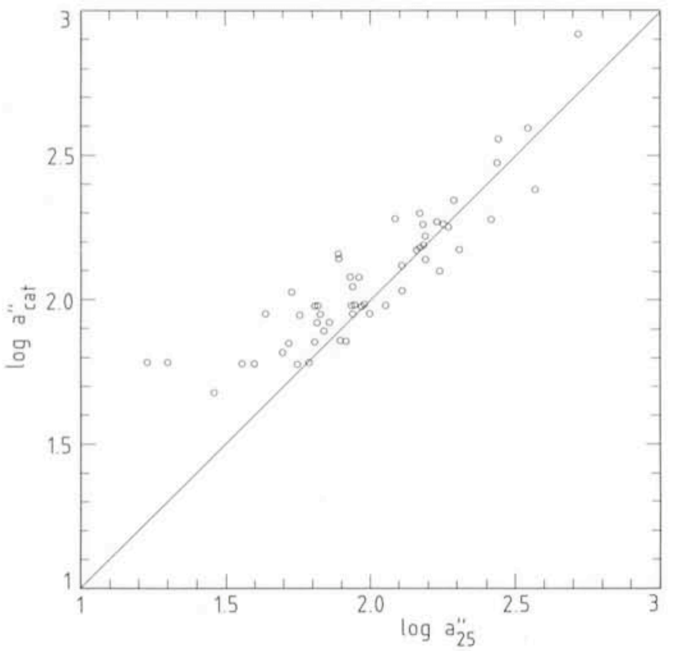

Fig. 4: *The angular size major diameter as listed in the ESO/Uppsala Catalogue versus the computer-determined maximum angular size at the Blue 25^m surface brightness.*

radial change of their eccentricity and position angle (isophotal twisting). We aim to obtain all these parameters for the 16,000 survey galaxies and to publish them on paper. However, a plotted version of the catalogue seems also very useful as is illustrated by Fig. 3 which presents one page of such a catalogue. The SO galaxy NGC 1389/ESO 358–G38 has a total m_R = 10.8 (panel 1), a central B–R = 1.80 and a bluer halo of colour B–R = 1.50 (panel 2), follows perfectly an $r^{1/4}$ law profile (panels 3 and 4) and shows, consistently on B and R plates, clear evidence for isophotal twisting (panel 5) and has a varying axial ratio (panel 6). The actual determination of the structural properties of the spiral galaxies requires an additional investigation using Fourier transform techniques, which is now under consideration.

The data for the 70 galaxies in our test field also give some results which are of general use. Fig. 4 shows that for objects with a diameter larger than 1′ the angular size as listed in the ESO/Uppsala catalogue actually corresponds closely to the angular size at 25^m Blue surface brightness. Fig. 5 shows an angular size-magnitude diagram for the same 25^m B diameter. With some caution (separation into morphological types!) this diagram can thus be applied to roughly estimate (~ 0.5^m accuracy) the B^{25} total magnitude from the angular sizes (major and minor diameters combined) as listed in the catalogue for all objects.

Once the catalogue has been completed, many items can of course be studied. We are highly interested in studying the influence of the environmental conditions of galaxies on their fundamental properties. Since the sample contains galaxies in all sorts of environments ranging from purely isolated systems to members of rich clusters or superclusters this objective becomes feasible. Systematic correlative studies between galaxy core radii, colours, colour gradients and isophotal twisting will be possible. An example of such a study is illustrated in Fig. 6 where we have plotted the central B–R colour of the Fornax galaxies versus the colour gradient between those centres and the outer haloes of the galaxies. There seems to be a general trend for galaxies with a relatively

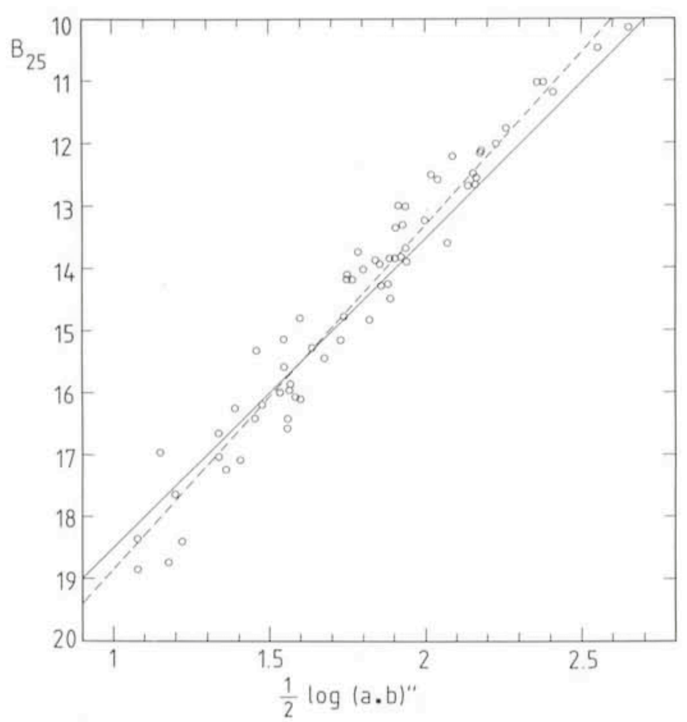

Fig. 5: *The characteristic angular size – magnitude relation determined on the QBS plate of the Fornax cluster. The characteristic angular size was calculated from the square root of the product of the major and minor axis. The dashed line represents a fit to the data. Distance variation moves all objects along the indicated solid line of slope –5. All values are automatically determined by the computer programme.*

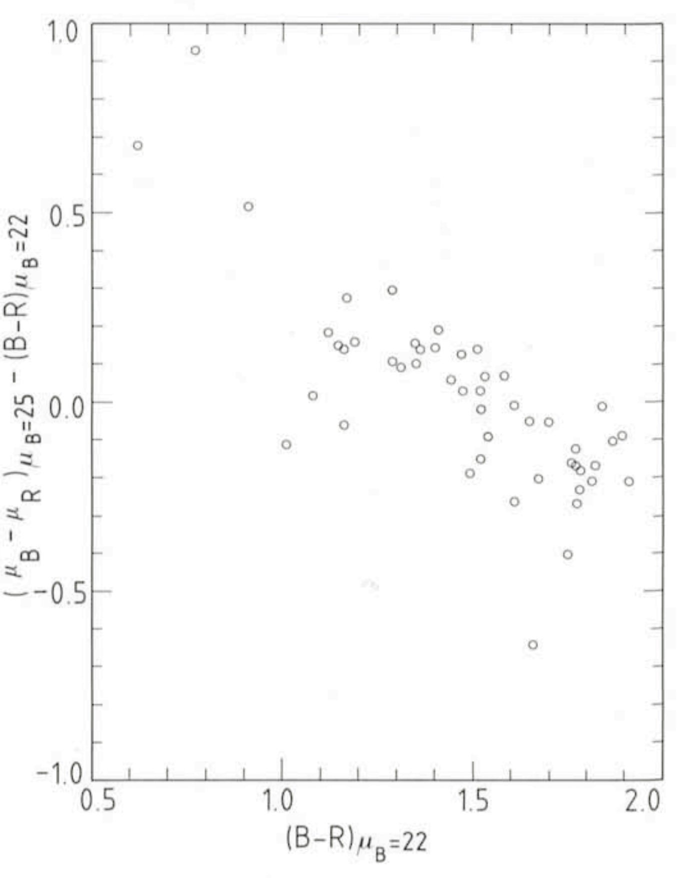

Fig. 6: *The total central B–R colour inside the 22^m blue surface brightness level versus the colour difference between this central colour and the local B–R colour at a 25^m blue surface brightness.*

blue central colour to have a redder halo, while those systems with a relatively red central colour (ellipticals and SOs) seem to have a bluer halo colour.

At the bottom of the flow chart in Fig. 1 we have indicated the possible presentation of the acquired data bases. Eventually our final data base of 16,000 galaxies will be expanded by two to three orders of magnitude compared to the preliminary results for the Fornax cluster. By then we will have acquired an unprecedented set of properties of Southern Hemisphere galaxies. The size of the sample and the uniform approach as attempted in this project should allow us to study the universe in an unbiased way.

The 2.2 m Telescope is Ready

M. Tarenghi, ESO

The 2.2 m Zeiss telescope is the last telescope to have arrived on La Silla, thanks to a 25-year loan to ESO from the Max-Planck-Gesellschaft (MPG) who will receive for their contribution 25 % of the observing time. ESO assumed responsibility for the installation of the telescope, the arrangement of necessary modifications, and construction of the building and dome according to specifications agreed with the MPG. ESO will also assume responsibility for the maintenance and operation of the telescope.

The erection of the telescope began on February 15, 1983, and as a result of a collaboration of qualified personnel from Zeiss and MAN and the services of many ESO technicians, we succeeded in obtaining the "first light" on the night of June 22, 1983. During the following weeks the telescope was used for optical, mechanical and electronic tuning. The end of the bad winter weather made it possible to start using the telescope with the photographic camera, the B & C spectrograph plus CCD camera, or a Danish RPCS detector and the CCD camera

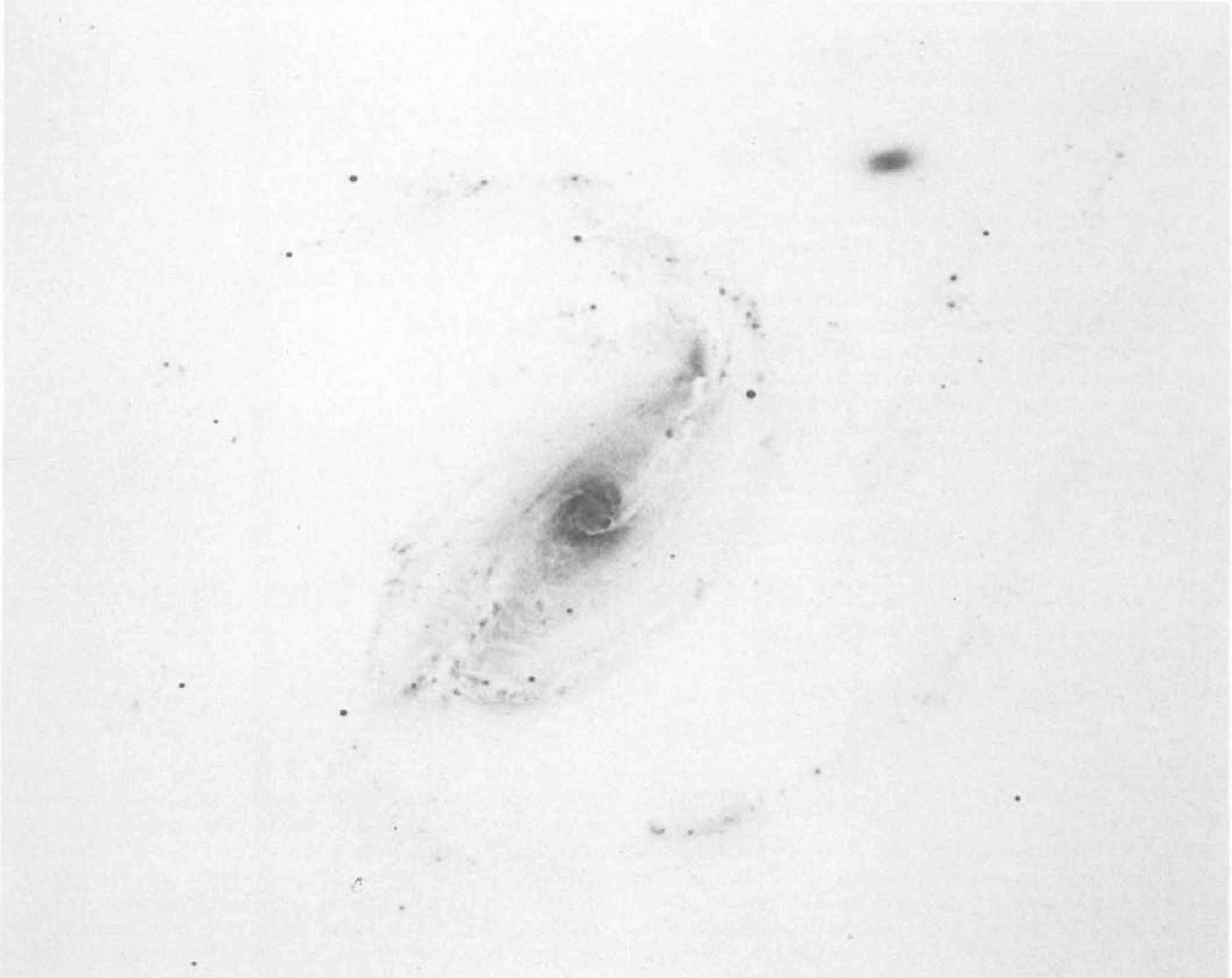

Fig. 1: *This image of the peculiar galaxy NGC 1097 (≡ ARP 77) is an enlargement of the third plate obtained during the commissioning time of the 2.2 m telescope on the night of September 30, 1983. A IIa-O emulsion was used, without filter, and the exposure time was 40 minutes. The star images are slightly elongated because of a field rotation around the guide star, caused by the fact that the polar axis had not yet been properly adjusted. Nevertheless, the excellent optical quality of the telescope (80 % of the light inside 0.4 arcesec) and a good seeing of about 0.7 arcsec, gave a superb view of this Arp galaxy where "the material of arm seems to flow around the companion" and a ring of HII regions surrounds a star-like nucleus.*