

International Astronomical Union

Commission 9

Working Group

on

'Wide-field Imaging'

Newsletter 4

Abstracts of papers to be presented at:

IAU SYMPOSIUM No. 161

"ASTRONOMY FROM WIDE-FIELD IMAGING"

Potsdam, Germany

23rd — 27th August, 1993

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Wide-Field Sky Surveys and Patrols

Infrared Wide-field Surveys

Wide-field sky surveys have proved to be essential tools for astronomical research: statistical astronomy, based on Schmidt photographic plate surveys, constitutes the keystone of accurate depictions of the stellar populations, and of the large scale structures in our Galaxy and in the Universe. Unfortunately, they have been long restricted to the optical spectral range, below 1 micron due to the limitation of the photographic plates. However, composite large scale images of the infrared sky obtained by space missions (IRAS or COBE), although limited by their low spatial resolution, recently led to major discoveries on large scale astronomical structures such as the galactic bulge, the infrared cirrus, the space distribution of nearby galaxies, the inhomogeneities of the cosmic background.

In the last decade, the technology of panoramic near infrared (1 to 10 μm) detector arrays has made such considerable progress in size and sensitivity that they are, today, comparable to the best optical CCD arrays. This technological breakthrough combined with the progress in computing power and rapidity allows us to achieve, now, with a 1 meter class ground based telescope and in a reasonable amount of time, complete digital sky surveys with an arcsecond resolution in the 1 to 2.2 micron bands (IJHK) down to the 14th magnitude at K. Several projects aimed at mapping large fractions of the sky or even the all sky, in this spectral range are now under way and should give rise to documents comparable to the Schmidt sky surveys before the end of this century. They will provide data sources that will lead to a complete renewal of star and galaxy counts and galactic structure research and to the investigations of unknown or poorly known stellar and galaxy populations.

Several ongoing projects of near IR surveys and, in particular, the European

programme DENIS (Deep Near Infrared Southern Sky Survey) will be described and intercompared. Future prospects in this field will be briefly presented.

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A Telescope for Infrared and Submillimetre Ranges

The 300-millimetre telescope for infrared and submillimetre ranges was designed and produced at the Astronomical Observatory of the Nikolaev State Pedagogical Institute in collaboration with the Space Research Institute (Russian Academy of Science). This telescope is a model of the cooling infrared and submillimetre telescope, which was intended for mounting on the cosmic satellite as a component of the main optical-cryogenic system. This system is needed for astrophysical observations by the program 'Aelite'. The main purpose of this research is to receive the spectra and images of different objects and data on fluctuations of the background radiation in the infrared range (from 2 to 20 micrometer) and submillimetre range (from 100 micrometer to 2 millimetre).

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Beijing — Arizona Colour (BAC) Sky Survey

A comprehensive spectral and temporal survey of 500 square degrees of the Northern sky will be carried out with the 0.6m f/3 Schmidt telescope + 2048 x 2048 Ford Aerospace CCD of the Beijing Astronomical Observatory. The spectral energy distributions of all objects to $V = 21$ in 500 separate fields will be measured from 3200 to 9000 angstrom with 17 narrow band filters of $\delta\lambda/\lambda = 0.05$. The variability of these objects will be sampled on time scales from minutes to about one year. Of the 500 fields, 150 are chosen centred on QSOs that cover the full range of known QSO properties; 150 are chosen on spiral galaxies $2' - 5'$ in diameter; 150 are chosen at random; and 50 are chosen for calibration purposes. This survey is specifically designed to:

- a) find QSOs of all kinds with redshift that range from $z = 1.7$ to 6;
- b) study the large-scale distribution of QSOs in the universe as a function of redshift;
- c) determine the interrelationships among the structure, stellar populations and interstellar media of nearby spiral galaxies;
- d) study the spatial distribution and spectral evolution of galaxies between the present day and a redshift of $z = 0.2 - 0.3$ (lookback time = 3 – 4 billion years); and
- e) determine the large-scale topology of the universe.

Comparable numbers of stars will be found as extragalactic objects, out of which separate studies of Galactic structure will be derived. More detailed investigations of individual objects will be pursued with U.S.-based telescopes via spectroscopy and infrared imaging.

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CCD Imaging with a 1° Field

At most research telescopes the physical size of CCDs currently still restricts the accessible field-of-view. However, for galactic as well as extragalactic work a field significantly larger than the typical 15 arcmin is desirable to study objects with large angular extent. This is in particular desirable for objects that are well studied in other wavelength regimes such as the radio or FIR. High quality surface photometry of structures ≥ 30 arcmin can be obtained by using CCDs with telescopes of short focal lengths.

Here we present results from observations obtained with TI 800 x 800 CCDs (15 μ m pixels) attached to 20 cm-aperture f/8 telescopes at Lowell Observatory, Flagstaff and Mt. Sinakas Observatory, Crete. This setup has ≈ 51 arcmin field-of-view at an image scale of 4 arcsec/pixel. The observations reported here were obtained with broad-band R filters.

We discuss surface photometry of NGC 3521 in comparison to recent HI data that show a declining rotation curve and present cut-off radii for the disks of several edge-on galaxies with large angular extent.

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Wide-field CCD Imaging from the MIR Space Station

This paper reports the results of wide-field CCD observations from the MIR Space Station in the period 1988–1989. A brief description of the digital CCD camera ROZHEN as a technological experiment, consisting in the observations of stellar fields (M45-Pleiades, NGC 7000, M31, LMC etc.) and automatic control of astrophysical experiments within the frameworks of the second Bulgarian cosmonaut programme is given. The quality and possibilities of the wide band photometry of the wide angle observations in manned space flights and from board of space stations also are considered. In the framework of two subprogrammes, STANDARD and PHOTOMETRY, of the basic space flight science programme the well studied fields like M45, and M31 areas have been used in order to make an estimation of the photometric capabilities of the camera. The photometric accuracy and the limiting detectable magnitude of the camera are discussed. At 3-sigma level a surface brightness limit of 26.5 mag/arcsec² in V-filter has been achieved with an ordinary 50mm visual lens.

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MOUSE: a Mini Observatory for UV Space Exploration for a Wide-field Survey of the Poles and Equator of the Galaxy

This small orbiting observatory is described in its essential guidelines. Some insights in the optical solution (2 mirrors, 3 reflections telescope using pure hyperbolic surfaces, no aspherics) is given. An *in-flight* recentering of the photons collected by a solar-blind photon counter device will allow for an equivalent angular resolution of 2-3 arcsec, while the covered Field-of-View will exceed one square degree. The capabilities of the proposed spacecraft (along with low resolution grisms, polarizers and filters) are described. The choice of the projected covered sky (the two Galactic Poles, the Equatorial galactic Plane and some Bulge Windows) are described together with a detailed list of astrophysical scientific objectives addressable with such a flying telescope. The science comprises UV analysis of a complete sample of quasars, stellar population in galaxies, White Dwarfs, Globular and Open Clusters. Moreover a plan for the early UV detection of SuperNova events is described.

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Relikt-HII: An All-Sky Survey in H(α)/H(β) Lines

Our group is preparing to carry out the 'Relikt-2' experiment (search for large-scale microwave background anisotropy). Within the framework of this experiment we are also planning to conduct independent measurements of the sky in H(α) and H(β) lines. The main scientific goals for this experiment are to study the large-scale distribution of extended HII emission. It enables us to separate cosmological signal and galactic free-free emission correctly. Besides, uniform all-sky measurements provide important information on the space distribution of HII regions in the Galaxy. In addition, a comparison between H(α) and H(β) maps can be useful in studying the galactic extinction, especially in combination with infrared data.

We are planning to equip the Relikt-2 spacecraft, which is scheduled to launch in 1995, with an optical spectrometer, operating in 4830–4880 Å and 6540–6590 Å wavelength ranges and having an angular resolution of 7 deg.

The main reasons for carrying out spaceborne experiments are:

- the absence of the atmosphere and consequent decrease in the brightness of the sky background and its instability;
- the absence of geocoronal lines;
- measurement sessions are independent of the seasons, 100% observational time;
- the possibilities of mapping the whole sky.

The instrument will be installed on board the Relikt-2 spacecraft (a modified version of the Prognoz spacecraft), which is planned to be placed into orbit at a distance of about 1.5×10^6 km from the Earth at the Lagrange point L2. The spacecraft rotates about its axis, directed toward the Sun, at approximately 3 deg per second. The instrument is so arranged that its optical axis is perpendicular to the rotation axis of the spacecraft. A constant orientation of spacecraft's rotation axis is maintained for about 7 days, which is sufficient to map a strip of 7 deg wide along the great circle of the celestial sphere. After that, the spacecraft's rotation axis is turned through 7 deg and a new series of measurements is made during the next

7 days. As a result, in half a year a complete map of the sky will be produced, and each area with a size of 7 x 7 deg will be observed approximately 1800 times. The spectrometer is expected to be operational for two years.

The optical spectrometer consists of an optics unit (a baffle, an objective, a slit, a diffraction grating and auxiliary optics), a detector system (a CCD array with a clock system and analog electronics; we are considering the possible use of an image-converted tube, mounted in front of the CCD array) and on-board computer.

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Sonneberg Observatory: Sky Patrol, Field Patrol, the World's Largest Living WFPA — Purpose and Opportunities Past, Present and Future

This paper describes the Sonneberg Sky and Field Patrols, and outlines their origin and aims. These patrols have been the suppliers of the Sonneberg plate collection for 6 decades. Some 10,000 variable stars — among them illustrious objects such as HZ Her, FG Sge and BL Lac — were detected and investigated on this basis.

The collection of about 250,000 photographic plates still holds a wealth of unexploited optical information on the past history of astronomical sources. Currently use concentrates on investigation of and search for optical counterparts of X and Gamma-ray sources.

Over Sonneberg plans for the future — introduction of modern observational and photometric techniques, search for new, unforeseen events and systematic study of evolutionary effects — however, hangs the threat of closure like the sword of Damocles.

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German Astrophysical Space Projects

The fundamental goal of the international astronomical community in space projects is the simultaneous use of telescopes in space for all different wavelength ranges, including cosmic ray research. For this endeavour international cooperation is mandatory. According to their knowledge and capability the German Space Agency, DARA, tries to participate in this challenging task.

After the successful launch of ROSAT and of CGRO Germany intends to take part in the ESA-missions: ISO, XMM, FIRST; the NASA-missions: ORFEUS-ASTROPAS on STS and AXAF; and the RKA-missions: SPECTRUM-X and RADIOASTRON. Other projects like: SOFIA, FUSE, SPECTRUM-UV and SIRFT are still under discussion.

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Very Wide-field Monitoring of the Sky

There is need for very wide-field monitoring of the sky in several branches of astronomy and astrophysics ranging from meteor research to monitoring of optical transients and counterparts to gamma ray burst sources. The photographic very wide-field monitoring of the sky is run at the Ondrejov Observatory and other stations of the Czech Meteor Network and is sensitive to record stars up to 11 mag on 3 – 4 h exposures or 1s flashes up to 3.0 mag over a field of view of 180 deg diameter. A CCD device for very wide-field monitoring is also in development with sensitivity of 5.0 mag for 1s flashes (and 10 mag for stars with 100s exposure) over a field of view of 50 x 60 degrees. Both systems will be briefly described and discussed.

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The Center for Analysis of Satellite Interference with Astronomy (CASIA)

An example is given of how CASIA is currently assisting astronomers with avoiding interference from artificial Earth satellites. Gamma-ray astronomers are eliminating many candidate optical counterparts from further consideration by readily identifying them as transient satellite phenomena. Another example details how, by computing ephemerides for the entire cataloged orbiting population in under an hour, CASIA can help surveys virtually eliminate satellite streaks from wide-field images.

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The Schmidt Telescope at Calar Alto Observatory

The Max-Planck-Institut für Astronomie, Heidelberg, is operating an 80cm, f/3 Schmidt Telescope at the observatory on Calar Alto, southern Spain. Technical modifications of the telescope are described which have improved image quality and telescope handling: e.g. new plate holders, also for much less expensive 8 x 10 inch plates and films instead of 24 x 24 cm plates (5.5 x 5.5 degrees field size); a new and more stable mechanism for fixing the plate holders to the focal surface; autoguiders at the two guiding telescopes. Overall plate quality will be demonstrated by the astrometric precision achieved in determining e.g. cometary orbits.

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Wide-field Imaging: 3-Mirror-Systems with High Light Gathering Power and a Wide Field

The desire of the astronomers for wide-field telescope systems which surpass the RCC (1:8 max 1.5 Grad) in light gathering power and field of view are relatively concrete today. For this type of telescopes detectors planned are CCDs in multichip arrangement.

3-mirror-telescopes permit fast focal ratios and large fields of view. Different optical systems are presented here with focal ratios up to 1:2.5 and wide fields up to 3.2 Grad with sectional drawing, aberration- and spot diagram.

The size of the fields requires a multichip arrangement of 2048 x 2048 pixel CCDs. The focal length of these systems is determined by the pixel size of 15 μm .

The linear field up to 400 mm, the spatial resolution and the aperture angle require some compromises. The optimal range for the focal length is from 6.25 to 10 m. Maximal resolution (1/3" per pixel) is attainable for a focal length of 8-10 m. Unfortunately, in this case the field is only 2 Grad. For fields of 3.2 Grad shorter focal lengths are necessary.

The aperture should be 2-3 m. It is determined by the attainable image quality and the focal ratio.

The calculations of the optical systems were carried out with optical design and analysis software developed by the author.

Telescope parameters investigated:

focal length	6.25 - 10 m
aperture	2 - 3 m
focal ratio	up to 1:2.5
image field	up to 3.2 Grad (for 400 mm linear field)
spectral range	365.01 nm - 706.52 nm (f dispersive effect for visible window of the CCD)

The systems investigated are:

- RRC-system with quartz-Gascoigne-plate and flattening lens
- RCC-system with Gascoigne-plate in reflection, 3-mirror variant
- 3-mirror systems with conic section and

overdeformed mirrors.

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First Steps toward a CCD-based Sky Patrol

Considering the last living photographic sky patrols (e.g. at Sonneberg) on the one hand and the application of large CCDs to wide-field imaging on the other it seems to be necessary to discuss the establishing of a CCD-based sky patrol.

The poster sketches the scientific justification of a CCD-based sky patrol, mainly the:

- recording of new events like Novae, Supernovae, CV outbursts, comets and asteroids, and the
- monitoring of known objects like variables in general, AGNs and solar system objects.

We present an overview of the instrumentation needed which depends upon the projects for which the sky patrol is intended. Also, a proposal for an actual system is presented.

As a first step of testing large CCDs we give a report about the application of a Thomson chip (1300 x 1600 pixels) to sky patrolling and about the usage of ETC (Explosive Transient Camera) images for sky patrol purposes.

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Digital Detectors in Wide-field Imaging

LITE: the Large Imaging Telescope

This paper presents a new German-French project aimed at a very deep CCD survey in the southern hemisphere. It is based on a 2.5m class telescope with a field of 1.5 degrees or more, dedicated to high-resolution, deep CCD imaging. This telescope is intended to become a complement to the ESO VLT and to be installed in the Paranal area. The operations should start in 1999.

Accompanying imaging observations are essential for the optimal use of the VLT. For large scale structure studies, the VLT allows us to measure redshifts in a 30 arcmin field-of-view of galaxies of magnitude 23 or even fainter. They are too faint to be reliably detected on Schmidt plates, so the input observation catalogue must be obtained from deep CCD imaging. In this example, outstanding image quality is needed to make a clear separation between faint galaxies and stars. The best compromise for obtaining such images is a middle size telescope of about 2.5m diameter and equipped with a wide field CCD camera.

This project was originally designed for observations of mainly cosmological interest. It has the technical capabilities to cover a much broader range of astrophysical problems. The consortium is now working on several programmes, galactic structure and low mass star luminosity function, the study of variable stars, properties of nearby galaxies, luminosity function and morphology-density relation of galaxies, survey of emission line galaxies and quasars, large scale structures combined with redshift measurements with the VLT, gravitational lensing effect due to dark matter distribution on very large scale, a very deep multicolour survey to study galaxy evolution on cosmological time scale, detection of supernovas up to $z=0.5$, and a second generation experiment for detection of brown dwarfs by micro lensing effects on stars in the Magellanic Clouds.

We have adopted a new optical concept worked out at the Tautenburg Observatory, with the assistance of Ray Wilson from ESO.

It is a modified version of the 3 mirror Paul-Baker telescope which provides a plane focal surface at the 'prime focus' location, behind the secondary mirror. A preliminary design study has shown that for a telescope with 2.5m diameter and focal ratio $f/4$, image quality of 0.4 arcsec can be obtained at the edge of a 2.5 degree field, and significantly better towards the centre. As a baseline, the CCD camera will be organized around thin, back-side illuminated Thomson CCDs, each with 2048 x 2048 pixels and 15 micron length. These CCDs are being developed for the VLT, and the thick version should become available in 1993 and the thin one in 1994. The three-side buttability allows us to make strips of 2 CCD width. A 1 square degree surface can be covered with 36 CCDs. Readout time of the whole array will be as low as 30 seconds, thanks to a parallel acquisition system. Cryogenic temperatures will be provided by a closed cycle cooler in order to simplify the operations.

Projects similar to ours are under development, in particular the Sloan Digital Sky Survey (SDSS) in the USA. We wish to emphasize the differences between our project and the SDSS. The main goal of the SDSS is to make a survey over a large fraction of the entire sky ($\sim\pi$ steradian), both in photometry and in spectroscopy, and with the same telescope. However, the use of the SDSS 2.5m telescope for spectroscopic measurements will naturally limit the observations to moderately faint galaxies only. The necessity of the all sky survey pushes towards the largest possible field, but at the detriment of image quality, and to a transit instrument which simplifies the operations.

In our case, the spectroscopic observations are planned with the much larger VLT, which, of course, can reach much deeper. Due to the increasing number of objects at fainter magnitudes, we cannot expect to cover a large fraction of the sky. On the contrary, we shall only be able to obtain images significantly deeper than the SDSS by limiting the sky coverage. For LITE, the priority of optimisation is then image quality first, and

field-of-view second. In addition, the pointing mode of operation is more suitable for very deep imaging than a transit mode. While many scientific areas are common to both instruments, the trade-offs are different, and the scientific programmes will be different too.

We believe that the combination of the VLT and LITE will offer a unique capability of probing the deep sky and will become a prominent instrument for future cosmological studies.

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The Hitchhiker Parallel Camera and Studies of Faint Galaxies

The Hitchhiker camera is a parallel observing instrument attached to the 4.2m William Herschel Telescope on La Palma. It performs simultaneous CCD imaging in an off-axis field while the telescope continues its normal scientific programmes, greatly increasing the efficiency of data acquisition. The camera images a 6 x 4 arcminute field centred 7 arcminutes from the optical axis with an image scale of 0.3 arcsec per pixel. A dichroic beam splitter allows data to be collected in two colours simultaneously. Over its three years of operation, a library of deep CCD frames has been built up covering a total area over 1 square degree, enabling survey work to be pursued.

Hitchhiker data have been used for studies of faint galaxy number counts, populations of faint field galaxies and of a medium redshift cluster. Current research programmes include studies of the distributions of galaxies, searches for low surface brightness galaxies, searches for candidate primeval galaxies, faint stars and Galactic structure. We present here results obtained from a number of our deepest frames and discuss their implication with regard to our understanding of the distant Universe.

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WWFPP: the Bonn Wide-Field Photometer/Polarimeter

The WWFPP has been built at the 'Astronomische Institut der Universität Bonn' to be used for surface photometry and surface polarimetry of galaxies, galaxy groups and diffuse galactic objects particularly the high latitude galactic cirrus. The two major components of the instrument are a focal reducer (reduction: 0.45) and a nitrogen cooled large area CCD (LO-RAL: 2048² 15 μ x15 μ pixels). The CCD detector system was developed in Bonn. At a 2m f/8 telescope the WWFPP field of view is about 15' x 15' with 0.43" per pixel.

B, V, R, I and H α filters are currently available. A Twin-Wollaston prism in the parallel beam section of the focal reducer is used for polarization observations. In combination with masks in the telescope focal plane four polarization directions (0, 45, 90, 135 degrees) are observed simultaneously, so that the complete set of linear Stokes parameters I, Q, U can be derived from a single exposure.

First observations with the WWFPP were made at the 1.82m telescope of the 'Osservatorio Astronomico di Padova' at Asiago.

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Near-Infrared Imaging with a Schmidt Telescope

We have carried out wide-field imaging observations in near-infrared bands with a large format array camera attached to the prime focus of the 105cm Schmidt telescope at the Kiso Observatory. The image sensor used is Platinum-Silicide shottky barrier diode array supplied by Mitsubishi Electric Co. The array size is 512 x 512 pixels, and the pixel size is 26 micron x 20 micron. The field of view is 14' x 11', and the image scale is 1.6" x 2.5"/pixel (binned into 512 x 256

pixels). The pixel size is smaller than the typical seeing size at Kiso, so we can take seeing limited images. The quantum efficiency of the sensor is low. But, owing to the excellent uniformity and stability, low read-out noise of this sensor and small F-ratio of the telescope, the calibration accuracy of 0.1% of sky-level was achieved in an image obtained through 70 min. exposure in the H-band. Although our camera does not have a mechanism such as a ryot stop to reduce any thermal emission, it was confirmed that the contribution of thermal emission from inside of the telescope was negligible in the J and H-band. We will present the performance of our camera system, some images of nearby galaxies, and future prospects for observations.

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Wide-field Imaging and Photometry with a 2k x 2k CCD

The Ford 2048 x 2048 CCD with UV coating is used at the BAO 60/90/180 cm Schmidt focal plan, giving a field of one square degree and spatial resolution of 1.67 arcsec per pixel. The paper reviews the following topics:

1. basic performances of the system;
2. importance and results of anti-blooming tech for large field CCD;
3. flat fielding for large field CCD;
4. photometric properties of compressed image, and
5. special filter holder for up to 32 filters with least obstacle in optical path used for multi-colour narrow band photometry.

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Experience with Large Mosaic Cameras

Over the last few years, we have demonstrated that a large mosaic CCD camera with a number of (> 10) CCD chips can be built and successfully used for wide-field imaging observations. In this symposium, we will show our past, present and future development/implementation of large mosaic cameras. Building a mosaic camera requires proper thermal, mechanical and electrical design. We built our first mosaic camera two years ago. It has 16 CCD chips and 2000 x 8000 pixels total. This camera has been operative for two years and is being used for wide-field observation with the 105cm Kiso Schmidt telescope. We are now developing three different mosaic cameras. The first one is the upgrade of the current 2 x 8 camera to 8 x 8 mosaic, which uses 64 1000 x 1000 pixel CCDs. The second mosaic camera, which a group at Princeton University (led by J. Gunn) and we are developing, is truly a 'monster'. It has 30 Tektronix 2048 x 2048 CCDs (most of them thinned) and 12K x 10K pixels total. We will use this camera for the Sloan Digital Sky Survey. This will be the most powerful camera for wide-field imaging in this century. The last camera is being developed for the prime focus of the Japanese 8.3m telescope (Subaru). This camera is a tightly placed mosaic with 10K x 10K pixels. We are collaborating with G. Luppino at the University of Hawaii who has very successful experience in tightly placed mosaicing. Finally, the analysis and reduction software for the mosaic camera will be briefly described.

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Photography in Wide-field Imaging

Photographic Sky Surveys

The first all-sky photographic survey was the multi-national Carte Du Ciel project, carried out on standard astrographic telescopes during the first third of this century. Several other surveys followed on small wide-field telescopes but new standards of depth and resolution were set by the first survey done by a large Schmidt telescope, the Palomar Observatory-National Geographic northern sky survey of the 1950s. This was followed by the joint ESO/SERC southern sky survey carried out from 1975 to 1985. At the present time the Oschin Schmidt at Palomar and the UK Schmidt at the Anglo-Australian Observatory are carrying out matching second epoch surveys of the entire sky, as well as extending the surveys into the near infrared. There have also been numerous special purpose or limited area surveys, for example using objective prisms or interference filters.

The surveys have been and are being used for an ever-increasing range of purposes: some involve selecting specific objects out of the multitude recorded, such as searches for rare objects or the identification of radio or X-ray sources; others exploit statistical data for large samples in studies of Galactic structure or the large scale structure of the Universe. The usefulness of the surveys has been enormously extended with the advent of fast automatic plate measuring machines. Some types of investigation requiring many exposures of the same field, such as precise astrometry or variability searches, are just beginning to be done systematically and have great potential. Substantial gains in sensitivity are still available with new emulsions and through plate combination techniques. However, the last few years have seen a dramatic increase in the size and sensitivity of CCD detectors and these now rival photographic plates for large scale surveys. Thus it is time to look carefully at the future of photography for sky surveys

and to concentrate on those applications which require the large format and high resolution of photographic emulsions.

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Microspots on Kodak Emulsions

This paper describes recent checks for microspot (gold spot) contamination which have been made on plates held in the ROE Plate Library. Original plates found to be affected by non-reflecting spots in 1990 have been re-examined to see if these spots become reflective with time. During the checks made in 1990 it was discovered that plates exposed and processed in a period between June 1982 and July 1984 were free from contamination although plates exposed both before and after this period were affected. These plates have been rechecked to see if they are still spot free.

Many plates have been bathed in selenium toner; the efficacy of this treatment has been checked by comparing the incidence of spot formation on toned and untoned plates exposed at the same time.

Plates most affected by spot formation are IIIa-J, IIIa-F and IV-N emulsions. Other emulsions, including process plates, have been checked to see which are susceptible to spot formation.

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Kodak Technical-Pan: New Light on an Old Emulsion

Kodak Tech-Pan emulsion is an extremely fine grained, high resolution, pan-chromatic negative film with extended red sensitivity. It has been available in various formats for well over a decade, being widely used by the amateur astronomical community with great success.

However, professional observatories have been very slow to adopt the material due to early hypering difficulties with the glass based emulsion and then with problems obtaining fully focused large-format Tech-Pan films at the curved focal surfaces of major Schmidt telescopes. These difficulties have recently been overcome at the UK Schmidt telescope (UKST) and Tech-Pan films are now routinely obtained. These Tech-Pan exposures exhibit excellent image quality and typically go ~ 1 magnitude fainter than the equivalent IIIa-F emulsion on glass but with considerably lower grain noise and greater photometric accuracy. This makes hypered Tech-Pan an obvious and much cheaper alternative to IIIa-F to which it seems superior in nearly every respect. Early concerns about the astrometric integrity of the film based Tech-Pan appear to be unfounded. Examples and comparisons of images on Tech-Pan and IIIa-F are discussed.

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Digitised Wide-field Surveys

Digitization in Astronomy

The next few years will see a shift away from photographic plates towards CCDs as the sensors of choice for wide-field surveys. This shift is driven as much by the rapidly improving CCD technology as by the decreasing availability and increasing price of photographic plates. Since digitization, reduction, analysis and storage are mandatory parts of a modern survey, the telescope, detector and data system must be integrated and optimized to form a single, efficient system. These issues will be discussed, and emphasis will be placed on using the experience gained from the reduction of photographic surveys and from recent developments of CCD technology.

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Digitization Programs at the STScI

The program to facilitate community access to the first generation of STScI scans of Schmidt plates continues with the publication of a lightly compressed (10x) version of the UK SERC-J/EJ materials this year, to be followed by the same for the POSS-I (E) material next year. This collection, approximately 100 CD ROMs, will be supported by a full set of photometric and astrometric calibrations, to be provided in 1995.

The STScI digitization of the POSS-II survey (J, F and N) has been initiated in a collaborative arrangement with Caltech. Additionally, by arrangement with the AAO, we are also scanning the Second Epoch Southern Survey, currently being made with the UK Schmidt.

About 250 second generation scans will exist at the time of the meeting, and microdensitometer enhancements to bring the scanning rate to about 1000/year are approaching fruition. All new scans are being made with 15 μ m sampling, 23040² rasters,

local metrology better than 0.5 μ m, and with good registration of densities to at least 4.2.

Ultimately the new scans will be published as another set of CD ROMs; in the meantime, some level of small-area access via the HST archive is contemplated.

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Scanning the Sonneberg Plate Archive with DIA

DIA (Digital Image Analyser) is a new dedicated CCD line scanner, which has been invented at Sonneberg Observatory in collaboration with the Institute for Theoretical Astrophysics at Tübingen for scanning selected fields of the Sonneberg Plate Archive.

The poster describes the whole scanning device, consisting of the 12-bit-scanner camera, its electronics, lighting unit, moving table, base and work station. It is intended to demonstrate this device during the symposium.

Some ideas concerning the automatic detection of objects on the plates scanned as well as brightness determination and position determination of these objects are outlined.

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Some Results of CCD-Camera based Astrometric Plate Measurements

Since 1991 the upgraded MANN 422F comparator (HAM I) at Hamburg Observatory has been in routine operation and more than 1000 plates have been measured with a speed of about 10 stars per minute using a Hamamatsu 256px sq. CCD camera.

The repeatability of x,y measures is about

0.2 μm , while the measuring accuracy is about 0.4 μm with no termal drift detectable at this level of precision. An external plate to plate error of less than 0.8 μm could be achieved over areas as large as 220 mm squared.

Results of some specific examples will be shown:

- 29 plates of 7 radio stars (USNO BBAO astrograph, New Zealand)
- 4 plates of > 2700 stars over the entire field (ZA astrograph, Hamburg)
- some ESO Schmidt plates with a 1 degree squared field at plate centre.

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A Universal Microphotometer and Solar Corona Polarimetry

Realization of solar corona polarimetry pertains to astronomical centre-symmetrical problems, but application of usual ways of digitization complicates this task. Coronal images obtained during solar eclipse consecutively at different angles of the polarizer should be digitized symmetrically in relation to the centre of the solar disk. Unfortunately, digitization of such centre-symmetrical images is usually performed by rectangular scanning with firmly oriented slit and corresponding pixels have to be found by methods of shifting the centres of the corresponding images and necessary rotation of them. The final fitting of the images can be, of course, tested by calculating the best correlation. Nevertheless, due to the incompatible networks of digitization, some information is changed or even lost.

To avoid complications with rectangular network when processing the centre-symmetric images, we used A universal microphotometer in the mode of polar scanning. The consecutively obtained solar corona pictures were properly oriented on the measuring table. Then, the centre of the Moon was precisely found using points at its circular periphery. After inserting the difference of coordinates between the Moon's and Sun's centres for each

time of observation, scanning of solar corona image in polar coordinates started, while orientation of the slit was controlled to the tangential to solar radius at each position. As the relevant pictures were measured at the same orientation, the corresponding pixel values were located at the same positions in the digitization matrix. Then the intensity values in corresponding pixels of relevant images can be easily processed to evaluate the real corona brightness and the degree and direction of its polarization. The principal advantage of the measuring process, its results, as well as the universal microphotometer characteristics are described.

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Digital Surface Photometry of the Milky Way

This paper presents surface photometry of the Southern Milky Way ($200^\circ < l < 60^\circ$, $-40^\circ < b < 40^\circ$) with an angular resolution of $0.25^\circ \times 0.25^\circ$ in the standard photometric bands U, B, V, R. The photometry is based on 7 to 10 photographic plates (in each band) which were calibrated photographically as well as by simultaneous photoelectric scans, and corrected for zodiacal light, airglow, and atmospheric extinction and straylight. The photometry was also combined to form colour maps in U-B, B-V, V-R. The maps show clearly the large-scale and small-scale structure of the Milky Way. Basic information on the galactic absorption layer, the spiral structure, the parameters of the disc and of the bulge, extracted from an analysis of the photometry, will be presented.

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Object Identification and Classification

Cataloging of the Northern Sky from the POSS-II using a Next-Generation Software Technology

Digitization of the Second Palomar Observatory Sky Survey (POSS-II) is now in progress at STScI. The resulting data set, the Palomar-STScI Digital Sky Survey (DPOSS), will consist of about 3 TB of pixel data, or about 1 GB per plate (1 arcsec pixels, 2 bytes per pixel, 23040 x 20340 pixels/plate, approx. 900 survey fields in 3 colors). In order to extract useful information from this set of images, we have developed a software system to catalog, calibrate, classify, maintain and analyze the scans. This system, called SKICAT, incorporates the latest in machine learning and expert systems software technology, in order to classify the detected objects objectively and uniformly, and facilitate handling of the enormous (by the present-day astronomical standards) data sets resulting from DPOSS. We are also conducting an intensive program of CCD calibrations using Palomar 60-inch telescope; these CCD images are used both for magnitude zero-point calibrations, and as training and test data for star-galaxy object classifiers. The resulting Palomar Northern Sky Catalog (PNSC) is expected to contain about 50 million galaxies, and over 500 million stars, in 3 colors (JFN ~ BRI ~ gri), down to the limiting B magnitude of ~ 22, with the star-galaxy classification accurate to 90 - 95% down to the B magnitude of ~ 21. The catalog will be continuously upgraded as more calibration data become available. It will be made available to the community via computer networks and/or suitable media, probably in instalments, as soon as scientific validation and quality checks are completed. Analysis software (parts of SKICAT) will also be freely available. The first, partial releases may be available within a year or two from now, depending on the funding support. A vast variety of scientific projects will be possible with this data base, including the studies of large-scale structure, Galactic structure, automatic identifications of sources from other

wavelengths (radio through x-ray), generation of objective catalogs of clusters and groups of galaxies, searches for quasars, variable or extreme-color objects, etc.

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Star Images Identification and Characterization in Astrographic Plates

We present our results on the automatic process of detection and measurement of objects in astrographic plates measured by overlapping of adjacent fields.

It includes several steps:

- The identification of objects in each field.
- The storage of coordinates, magnitude, size and shape parameters in a file.
- The global analysis of the plate, getting final positions and other parameters.

This process will be applied to different kinds of plates:

- Asteroid plates with single or overlapped exposures.
- Field plates with high star density.

The main purposes of our process are:

- The automatic measurement of star and/or asteroid plates.
- The identification of special objects (faint asteroids, comets, galaxies, supernovae) in astrographic plates.

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Image Inventory by the Wavelet Transform

In order to get the required information from large astronomical images we need a *vision model*. Many kinds of such models are implemented. The classical vision models used on many sets of images failed to bring a complete analysis because they are based on a single scale for the adapted smoothing and for the background mapping. A multiscale analysis permits us to get a background adapted to a given object and to optimize the detection of different size objects. This is the reason why we were interested in the use of the Wavelet Transform. It is a linear transformation covariant under translations and dilations. Our vision model is based on the splitting of the image into scale space allowing us to detect objects of different sizes.

For the discrete wavelet transform we choose an isotropic wavelet and the à trous algorithm which provides a redundant transform. The wavelet images correspond to the difference of the images at two successive B-spline approximations.

An object is defined in the 3D wavelet space. In a first step, we perform an image segmentation scale/scale in this space. Secondly, we link the labelled fields from a scale to the following one. That leads to the construction of a tree of neighbourhoods, from the largest scale to the smallest one. After this operation we can say if a large scale field contains smaller ones which contains smaller ones, and so on. The image is a set of connected trees, corresponding to different objects. We define an object as a subtree resulting from the image segmentation in the wavelet space.

A reconstruction algorithm based only on the wavelet coefficients corresponding to a given object provides its image. Then it is easy to compute from each of them any kind of parameters: mean position, total intensity, pattern parameters, etc. Now, our experiments show us that the quality of the detection is very nice in this procedure and that photometric quantities are available.

This vision model may be improved using the stellar profile. In the wavelet space, we

can recognize the wavelet images connected to star-like objects. The procedure is more complicated and we used it only for the image restoration.

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Analysis of the Palomar-STScI Digital Sky Survey: an Overview of the SKICAT System

In this paper we present a general overview of the Sky Image Cataloging and Analysis Tool (SKICAT), a suite of programs designed to facilitate the maintenance and analysis of astronomical surveys comprised of multiple, overlapping images. More generally, SKICAT provides a powerful, integrated environment for the manipulation and scientific investigation of catalogs from virtually any source. The system serves three principal functions: image catalog construction, catalog management, and catalog analysis. Through use of the Faint Object Classification and Analysis System (FOCAS) and the GID3* decision tree induction software, SKICAT automates the process of cataloging and classifying objects within CCD and digitized plate images. To exploit these catalogs, the system also provides tools to merge them into a large, complex database which may be easily queried and modified when new data, or better methods of calibrating or classifying the old, become available. The most innovative feature of SKICAT is the facility it provides to experiment with and apply the latest in machine learning technology to the tasks of catalog construction and analysis. The very same classification learning software used to create the classifiers in SKICAT's automated image cataloging tools are available for use on any SKICAT data set, or even data from external sources. SKICAT provides a unique environment for implementing these tools for any number of future scientific purposes.

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From Radio to Gamma-Ray Sources: Accurate MAMA Identification and Measurement of Optical Counterparts

Besides programmes for which special purpose or survey plates are the basic origin of observational data, the fast and accurate MAMA microdensitometer is used in a variety of studies conducted at wavelengths ranging from radio to gamma rays. Such contributions provide identification of optical counterparts as well as astrometric/photometric calibrations.

One typical situation requiring accurate positions, is the preparation of new observations with instruments which have to be positioned on the sky within a (small) fraction of second of arc, for instance a multi fibre optics spectrograph mounted at the focus of a large telescope for redshift determination. It should be noted that the need for more and more accurate coordinates is no longer specific to the optical domain: radio aperture synthesis (VLA, VLBA...) is working at levels below one tenth of a second of arc; the coming HIPPARCOS and TYCHO catalogues will allow MAMA (accurate to 0.6 micron), to reach this quality on Schmidt plates.

Original positions around which optical counterparts have to be detected and calibrated by MAMA, are coming from observations taken at infrared wavelengths (IRAS sources), in the millimetre range (VLA mapping), or in the high energy part of the spectrum (X or gamma-ray sources). This last domain was open by the advent of space astronomy and is rapidly developing.

From EINSTEIN and GINGA to ROSAT, from PROGNOZ 9, INTERNATIONAL COMETARY EXPLORER, SOLAR MAXIMUM MISSION, VENERA 13..., to CGRO and the INTERPLANETARY NETWORK (PHEBUS, BATSE/CGRO, ULYSSES, MARS OBSERVER), the error boxes are continuously decreasing. However, the combination of Schmidt plates (taken with the appropriate emulsions and filters), an accurate measuring machine like MAMA, and a high quality astrometric catalogue (PPM), remains indispensable to the study of objects as various as pre-main sequence objects

embedded in molecular clouds, variable X-ray emitters in the LMC or other galaxies, or gamma-ray bursters of still mysterious origin.

References

- Feigelson, E.D., Casanova, S., Montmerle, T. and Guibert, J. 'ROSAT X-ray Study of the Chameleon I Dark Cloud. I. The Stellar Population' to appear in the *Astrophysical Journal*, Oct. 20, 1993.
- Pakull, M.W., Motch, C., Bianchi, L., Thomas, H.-C., Guibert, J., Beaulieu, J.-P., Grison, P. and Schaedt, S., 1993. 'Optical/UV Counterpart of the Supersoft Transient X-ray Source RXJ0513.9-6951 in the Large Magellanic Cloud', *Astronomy and Astrophysics Letters*, in press.

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Image Simulation for Schmidt Plate Astrometry

In this poster we present the principles of a new method of producing realistic synthetic star images of typical digitized Schmidt plates. It is shown that the method can successfully simulate very bright (and highly saturated) stars as well as stars close to the plate limit.

The simulation can be used to test a wide variety of image processing methods, like image finders and classification algorithms. In particular, we present results on the performances of different astrometric centroiders with emphasis on the capabilities of non-parametric techniques.

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Classification: Astronomical and Mathematical Overview

We begin with a short description of modern statistical graphics environments. We will then proceed to a discussion of (1) feature selection, and (2) discrimination methods. The latter are also referred to as supervised classification methods. We will consider linear and non-linear methods, and contrast model-based to non-parametric methods. Such methods are highly dependent on the features used to characterize the objects under investigation. We will describe a number of experiments to assess features based on measures of texture. Object texture, we find, can be a useful complement to other object features. We conclude with a look towards other features and other discrimination methods, which show potential for the type of problem posed by object classification using digitized images.

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Faint Object Classification using Artificial Neural Networks

We propose a method to classify faint objects from digital astronomical images based on a layered feedforward neural network which has been trained by the backpropagation procedure (Werbos 1974).

The classifier proposed in this work (Artificial Neural Network Classifier, NNC hereafter) is briefly described in Serra-Ricart et al. (1991), and follows the general concepts of optimal classification described by Sebok (1979) using the fact that neural network techniques behave as a Bayesian decision rule (Garrido & Gaitan 1991). A comparison of the classification results obtained from simulated data by the NNC and by the well-established resolution classifier (Valdes 1982) is performed in order to assess the reliability and limitations of the NNC. A similar behaviour, up to the same faintness limit to which the resolution

classifier works, is found in both classifiers.

The NNC has several practical advantages over well-established astronomical classifiers. The NNC allows uniform and objective classification of large amounts of astronomical data in short computing times. The NNC is trained according to a subset classified by a human expert and then it can classify the full data set; if more than one investigation contributes to the initial classification, the NNC learns each decision rule, and produces a final uniform classification. The NNC algorithms are based on the dot-product calculation, so software implementations in conventional computers are very fast. On the other hand neural network architecture is intrinsically parallel, and therefore computer performance can be increased considerably using vectorial/parallel computers. Neurochips implementations could strengthen even more the potential of the NNC.

References

- Garrido, L. and Gaitan, V., 1991. *International Journal of Neural Systems*, 2, 221.
- Sebok, W.L., 1979. *AJ*, 84, 1526.
- Serra-Ricart, M., Gaitan, V., Susana, D. and Pérez-Fournon, I., 1991. *Astronomical Data Analysis Software and Systems I*. In PASPC 25, 254, Worrall, D.M., Biemesderfer, C. and Barnes, J. (eds).
- Valdes, F., 1982. *Resolution Classifier*. In "Instrumentation in Astronomy VI", Crawford, D.L. (ed).
- Werbos, P.J., 1974. *Beyond Regression: New Tools for Prediction and Analysis in the Behavioral Sciences*. PhD Thesis, Harvard University, Cambridge, USA.

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An Extended Scheme of Spectral Classification for Objective Prism Spectra

An extended set of criteria has been developed in order to exploit the information contained in objective prism spectra taken with the UK Schmidt telescope. The medium dispersion spectra (830 Å/mm at H_γ) which detect stars as faint as V≈16.5 mag can be classified with an accuracy of about 2 spectral subtypes and for the brighter stars the luminosity class can also be specified. Under this scheme an automatic technique is under implementation at the Observatory of Trieste in order to provide spectral types of stars in extended regions of the Magellanic Clouds and make use of the existing surveys of the southern skies.

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Automatic Morphological Classification of Galaxies

We propose a simple method of morphological classification of galaxies based on two photometric parameters in a single colour band. One is the central concentration index of the luminosity distribution and the other the mean surface brightness. Both are measured within the isophote of a fixed brightness level and are distance independent. The method is little sensitive either to the image size or to the inclination of galaxies.

We have applied the method to about 800 nearby bright galaxies with a reasonably high success rate to classify galaxies into early and late types. The method is applied to galaxies in a few clusters at different distances. The clusters were observed with the Kiso 105-cm Schmidt telescope with a 2000 x 8144 mosaic CCD camera and, in part, with photographic plates. The performance and limitation of the method is investigated in terms of the magnitude and the image area of galaxies and of the seeing size.

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Slitless Spectroscopy with Photographic or CCD Detectors

We have undertaken a search for ultraviolet-excess and emission line objects using the ESO 1m Schmidt telescope with and without the 4 degree objective prism. A reduction scheme leading to obtaining accurate (160 km/s) recession velocities of the emission-line objects is described. The prism objective plates are digitized with the MAMA microdensitometer of the Observatoire de Paris. The quality of the velocities allows large structure and luminosity function studies without the need for slit spectroscopy follow-up. Spectrophotometric results are also derived from the plates allowing a classification of the discovered emission-line objects. This work may be easily extended to slitless spectroscopy performed with CCD detectors. The foreseeable advent of large CCD mosaics adaptable to Schmidt telescopes or large-field prime foci of 3 – 4 m class telescopes will open new prospects which are beyond the reach of photographic plate work (such as recession velocities of galaxies with only absorption line).

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Present State of the Work on Automated Spectral Classification by Means of Objective Prism Spectra

An automated spectral classification technique for objective prism spectra has been developed by Malyuto and Schvelidze (*Astroph. Sp. Sci.*, 1989, 155, 71) and by Malyuto, Pelt and Schvelidze (*Baltic Astronomy*, 1992, 1, 473).

To improve our classification technique and to extend the spectral type range a recalibration of the spectral criteria has been performed with the use of additional calibration stars. Application of the results to fields near the North Galactic Pole is discussed.

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Astrometric and Photometric Calibration

Reference Catalogues: Present Status and Future Prospects

This review paper discusses the properties of the present IAU optical coordinate system, FK5 and its extension to fainter magnitudes and higher star densities. An outlook to developments in the near future is presented, special emphasis to Hipparcos and Tycho is given. Relations to the radio-VLBI system are discussed.

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Astrometric Standard Fields for CCD Observations

The use of the astrometric information of CCD frames, especially for double stars, depends on suitable reference fields for the astrometric calibration. In addition to the list of standard double stars we present positions and proper motions of stars in eight small ($3' \times 4'$) fields distributed uniformly over right ascension and within ± 20 degree declination of the sky. The data were taken partly from the literature, from new reductions of already existing data, and from new data mainly taken with the double refractor of Sternwarte Bonn (now at Observatorium Hoher List). First results of the calibration of CCD frames are given.

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Calibration and the Large-scale Clustering of Galaxies

The machine measurements of UK Schmidt plates have produced two very large galaxy surveys, the APM survey and the Edinburgh-Durham Southern Galaxy Catalogue (from COSMOS). These surveys can constrain the power on large scales of $\geq 10h^{-1}$ Mpc better than current redshift surveys, simply because such large numbers provide very high signal/noise in the estimated two-point correlation function for galaxies. In particular, the APM survey has been central to the many claims in the literature that the very attractive canonical cold dark matter model of the universe is not supported by observational evidence. However, the Lick survey, a visually measured catalogue, and the APM and COSMOS surveys give different scales for the 'break' in the correlation function, finding 10, 20 and 30 h^{-1} Mpc, respectively. We show here that even with the best determined survey so far, the APM survey, there could still be possible systematic errors present, making the estimation of the angular correlation function on large scales somewhat uncertain. With the estimate we find for such errors using the limited CCD data of Maddox et al. (1990), it would reduce the scale of the APM 'break' to $\sim 10h^{-1}$ Mpc, making it consistent with the Lick catalogue's result. Thus, because the APM $\alpha(\theta)$ results are of such cosmological significance, even in the event of the acquisition of large galaxy redshift surveys, it is important to validate the APM and COSMOS surveys with external CCD calibrations. We consider here the calibration requirements for the surveys to constrain with confidence the amount of power needed on scales of $\geq 10h^{-1}$ Mpc for the large-scale structure seen in the universe, as well as the form of the spatial correlation function on smaller scales.

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The System and Quality of the AGK3U

During the course of the last few years my colleagues and I have:

- 1) developed new methods to objectively examine the internal consistency of star catalogs — both from the perspective of the worth of the position and proper motion mean errors and their residual systematics — and applied these new techniques to the FK3, the FK4, the FK5, the GC and the N30;
- 2) developed new algorithms to produce astrometric quality positions from wide field-of-view Schmidt plates and shown how to combine them with positions deduced from the more traditional astrographic plates to make an updated version of the AGK3 (i.e. the AGK3U), and
- 3) extended our work on the fundamental catalogs, wherein comparison showed the widespread presence of significant residual systematics in the FK3 and the FK4 but not to the same extent in the GC or the N30, to the large-scale catalogs the AGK3, the AGK3U, the ACRS (Part 1) and the PPM (North). (These results were reported on at the Cambridge meeting last June).

In the latter case the reference catalog was the GC at B1900.0 to ensure a large enough overlap set ($\sim 10,000$ stars) to obtain statistically significant results while minimizing the effect of the GC proper motions. The AGK3RN/GC comparison was used to 'normalize' the results. Finally, the existence of the FK5 Extension, which has a 626 star overlap with the AGK3U, allows us to expand our fundamental catalog treatment to the AGK3U once the FK5 Extension has been placed on the system of the FK4 at B1950.0. We have both reduced the FK5 Extension to the system of the FK4 and used it to test the AGK3U. This confirms the system, the level of precision and the absence of systematics in the AGK3U.

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Optimized Model-Functions for CCD-Camera based Astrometric Plate Measurements

While digitizing the first 1500 photographic plates (astrograph plates and primefocus plates of various telescopes) using our CCD-based measuring machine, we gained a detailed understanding of the properties of the digitized stellar images. These images are different from those obtained by digitizing photographic plates with microdensitometers and similar scanners. Therefore it was necessary to reject the modelling methods given in the literature and compose new models, which describe the stellar images more accurately. We will demonstrate that the improved modelling of the stellar image decreases the centring error, which is our main concern doing astrometry.

First results of simulating the whole imaging process, starting with the atmosphere, aberrations of the telescope etc. and ending by including the imaging properties of our measuring machine, show good agreement with the measured images as well as the modelling functions.

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Determination and Application of Stellar Proper Motions of the Photographic Survey of the North Sky

In 1977 a project of photographic fourfold coverage of the northern sky (FON — shortened from Russian) was proposed at Kiev Observatory. FON is carried out by means of six wide-angle astrographs. Observations were started in 1982 and about 95% of required plates have been obtained over the past ten years. Measurements of the Kiev part of FON plates are carried out by means of the automatic measuring machine PARSEC. Nearly 300 plates have been measured by now.

The measurements of FON plates are used

for the construction of an astrometric catalogue of positions and proper motions of all stars of the Astrographic Catalogue (AC). Using the Fresneau catalogue and PPM as reference system at present proper motions of all stars with magnitudes up to 12^m in declination zone (+24° – +28°) and in selected areas of the north sky have been obtained. Comparison of the results with PPM and CMC data have been accomplished. Some thoughts on future prospects of FON project are discussed.

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Photometric Calibrators for All-Sky Surveys: The GSPC-II Program

Digitized all-sky surveys, calibrated to sufficient photometric accuracy (0.05 to 0.10 mag), provide an enormous database for exploring astrophysical problems. The Guide Star Photometric Catalog-II (GSPC-II) program will provide CCD sequences in the B, V and R passbands with an accuracy of 0.05 magnitudes. The GSPC-II extends the existing GSPC to a magnitude limit of V=18, with an ultimate goal of V=20. The program is led by teams at STScI and OATo with observations taken at CTIO, ESO, Wise, KPNO, Mt. Megantic, MacDonald, Mt. Laguna and Lowell observatories. We present sky coverage statistics, reduction status, data accuracy, and publication plans.

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HI Survey of the Galaxy and the Magellanic Stream. Problems of Presentations and Comparisons of Large Sky Areas

While constructing contour maps of our 'Pulkovo Sky Survey in the interstellar neutral hydrogen radio line' as well as of RATAN-600 observations of very extended galactic regions in Orion and Scorpius-Ophiuchus, problems arose during comparisons with very wide field H α photographs and with observations of other components of the interstellar medium emission. The same reference stars were taken for our and other data on the whole area surveyed. Their coincidence could show the degree of accuracy by comparisons.

For the Magellanic Stream zone a special 'magellanic' coordinate system was chosen to avoid the distortions in traditional systems and to judge features belonging to the Stream.

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Astrometry with the f/8 Harmer-Wynne Corrector on the Jacobus Kapteyn Telescope

The JKT has a photographic camera at its f/8 Harmer-Wynne focus, which provides a highly corrected 1.5 degree diameter field, designed with astrometry in mind.

The IAU at Patras adopted a list of quasars, unresolved at both radio and optical frequencies, which can be used to tie the two frames together. They have been photographed with the Wide Field Camera on the JKT and in each of these 1.5 degree fields the CAMC has measured the positions of some twenty reference stars.

Not only does the JKT extend the transit circle work to fainter magnitudes, it also smooths the accidental errors in the transit circle positions. This fact has been exploited by Argyle et al., 1991, *Mon. Not. R. astron. Soc.*, 250, 576.

The most important proper motion programme with the JKT is a search for

common proper motion companions to stars of large parallax. The luminosity function of faint stars is poorly known and an improved knowledge would help to answer two outstanding questions. First, do brown dwarfs (i.e. non core Hydrogen burning stars) exist and if so in what numbers? Second, are there sufficient low luminosity stars to account for the 'missing mass' in the solar neighbourhood?

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Self-Consistent System of Stellar Magnitudes through an Internal Method of Characteristic Curve Derivation

For the purpose of performing UBV stellar photometry 4'3 x 4'3 area in the well resolved central region in GC M5 on six short exposure plates, as well as areas containing standard stars were digitized with the Joyce-Loebl microdensitometer of the National Astronomical Observatory. In the absence of an external photometric calibration scale on the plates, an internal calibration method using density profiles of the standard stars was used to obtain the characteristic curves. Peculiarities of the method are discussed in detail.

It was found that the method is very sensible to the uncertainties of the stellar magnitudes and can be used directly for stellar photometry. This feature is used to build up a secondary standard on the plates with a variable background and when necessary to correct some standard magnitudes in order to gain a self-consistent system of stellar magnitudes — the calibration curves using this stars show smaller r.m.s.

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Stellar Photometry with a Wide-field CCD: NGC 6822

It is well known that the advent of CCDs has triggered a major improvement in the photometry of bi-dimensional sources and, in particular of rich star fields with important crowding, making it possible to get data of much better accuracy and in an easier way. The only disadvantage of CCDs compared with photographic plates has been their small field size, which made them almost useless for the study of objects of large angular size. Since a few years ago, a new generation of large CCDs has become available in most observatories. These detectors provide wide field sizes which, in some cases, are beginning to compare with those of the traditional photographic plates.

We have used wide-field (11.5' x 10.5') CCD images to derive photometry of the resolved stars of the Local Group Dwarf Irregular galaxy NGC 6822. The large field is very useful for this kind of object, of relatively large angular size (about 12' x 8') for this galaxy). But care has to be taken in order to obtain reliable photometric data from these images, where undersampling is severe (0.55"/pixel, for seeing under 1"). DAOPHOT and DAOPHOT II have been used to derive the photometry of the stars. The most important difference between the two runs is the analytical form of the PSF (see manual of DAOPHOT II by P. Stetson): gaussian for DAOPHOT and Moffat function for DAOPHOT II. The results in *B*, *V* and *R*, obtained with both versions, for a total of some 25000 stars in the galaxy, show that the choice of the analytical PSF model has critical effects on the quality of the final photometry.

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Intensity Calibration in the Presence of a Disturbing Effect Dependent on Wavelength

Conversion of signal measured by any light detector to intensity values is one of the most important factors that influence the precision of spectro conversion function (or calibration curve). It is determined and therefore valid for a fixed wavelength and certain measuring conditions. When a broader wavelength region is studied, some complications arise in connection with wavelength dependent sensitivity of detectors (i.e. light present in the spectrum, especially in some types of spectrographs). Generally, these effects can be considered as a disturbing factor, the level of which is slightly variable with wavelength. In such cases, a number of individual conversion functions has to be determined to calibrate spectral measurements properly.

We propose a more general method for evaluation of a calibration curve. Its shape is taken to be slightly dependent on wavelength and thus the curve takes into account the present disturbing factor. A brief description of the method, including some examples are presented.

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Brightness Calibration on Objective Prism Plates

We present the method for brightness calibration applied to the Hamburg Schmidt Survey, which uses digitized objective prism plates for several purposes. The calibration simulates the Johnson B filter and uses in general standard stars from the Guide Star Photometric Catalogue. We achieve an accuracy of 0.3 mag for $13 < B < 16.5$ mag and of 0.5 mag for $B < 18.5$. Constraints on the selection of brightness limited complete samples are discussed.

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A Photometrical Investigation on the RC System of the 2 m Ritchey-Chretien-Coude Telescope of the Rozhen Observatory

Surface photometry techniques of data processing are applied for the qualitative analysis on reflectivity of the two-mirror system in the prime focus of the 2 m Ritchey-Chretien-Coude telescope of the Rozhen Observatory. There are considerable variations in the reflectivity reaching to $\pm 30\%$. An estimation on the upper limit of the average reflectivity (about $68\% \pm 1\%$) of the two-mirror RC system is made. A loss of about 0.5 magnitudes in the limiting magnitude, due to the low reflectivity and to the decrease in the reflecting surface is found.

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Digital Processing on Comets

Several digital techniques have been used to remove large-scale background variations on old photographic plates ORWO ZU2, caused by manufacturing and technology of photographic processing. Suppression of these large-scale background variations made it possible to study large-scale phenomena in cometary plasma tails better and to determine the solar wind characteristics.

The same digital experiments were done with KODAK IIIaJ and KODAK IIIaFH plates and with CCD images. The results obtained from images of several different comets were compared. It has been shown that the simple digital techniques used were applicable also to photographic plates which did not have high quality images. They may be utilized in treatment of old photographic plate stacks.

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Unbiased Multi-Parametric Estimations of Distances and Peculiar Velocities of the Galaxies

Accurate Hubble distances $1gR$ may be derived using together two or more distance indicators p_k (corrected apparent sizes, luminosities, other distance-dependent quantities) and some calibrators q_k (velocity dispersions of the ellipticals or HI-line widths of the spirals, mean surface brightness, colours, other distance-independent quantities).

The deceleration laws in the nearby universe are $1gV = -1gp_k + const_k$, where using the Hubble law $1gV$ changes $1gR$. The deviations $\Delta 1gV_{ik} = 1gV_i - 1gp_{ik} - const_k$ are unbiased raw estimations of the peculiar velocities. The regressions $\Delta 1gV_k = f_k(q_1, q_2, \dots)$ are the multi-parametric generalizations of the Faber-Jackson or Tully-Fisher relations. The initial velocity estimations are $\langle 1gV_{ik} \rangle = -1gp_{ik} + const_k - f_k(q_{i1}, q_{i2}, \dots)$ and the final ones $\langle 1gV_i \rangle$ are obtained by the linear regression $1gV = g(\langle 1gV_1 \rangle, \langle 1gV_2 \rangle, \dots)$. The mean-square value of the final peculiar velocity estimations $\delta 1gV_i = 1gV_i - \langle 1gV_i \rangle$ occurs about 1.2 times lower than that obtained by the pure methods of Faber-Jackson or Tully-Fisher.

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Multi-Parametric Iris-Photometry

Good magnitude estimations may be reached by iris-measurements using two or more different comparative light beams, giving for the i -th star image iris-data d_{i1}, d_{i2}, \dots , including the background measurements d_{ib} and the distances from the centre of the plate r_i . The initial estimations $\langle m_{ik} \rangle$ are determined from the regressions $d_k = f(m, d_b, r^2)$ including up to third order term of m and linear terms of d_b and r^2 . The final estimations $\langle m_i \rangle$ are derived from the regression $m = g(\langle m_1 \rangle, \langle m_2 \rangle, \dots)$. The typical accuracy of the multi-parametric method is about 2 times better than the classic one and the colour coefficient of the instrumental system occurs about 2 times lower. The proposed method needs well-exposed background and a rich standard sequence, well-distributed in magnitude, colour, background and position.

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Archiving and Databases

The Future of Memory: Archiving Astronomical Information

The database equivalent of humans remembering their perceptions is the archive, where the basic measurements are stored, as raw or reduced measures. This is the foundation for all future work.

Currently the rapidly declining cost of digital storage and processing technologies are racing with the astronomer's rapidly increasing capabilities for obtaining digital data. Which will win? Which astronomical projects will not be done due to the cost of data storage and reduction?

There is currently no satisfactory long term digital storage medium, nothing with the long term stability of paper books or photographic plates. How does this unpleasant state of affairs affect our ability to remember our measurements? Certainly it raises the cost of maintaining a measure as something which can be remembered. The experience of the space agencies (e.g. NSSDC) is perhaps most pertinent here.

Given that there is a cost per bit per year for maintaining archival information, how do we decide what to keep, and for how long. How does one judge the value of the archive compared with other possible expenditures, such as a new instrument?

Given interconnected archive systems of enormous size how can the astronomer find that subset of data which addresses a particular scientific problem? Intelligent information retrieval techniques are required to permit this.

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Storage Media and Archive Technology

Early data archival systems depended upon whatever tape media were available, hand-written experimenter notes, and whatever simple labels had been applied to the data itself to locate and identify datasets of interest. Current file management technologies offer computer searchable indices and automated data management, moving data among different classes of storage media in response to user needs and stated policies. Future systems, which can just now be glimpsed, will provide integrated, object oriented, storage management that seamlessly manages multiple media types. This paper will briefly survey some earlier systems, describe in some detail currently available media and file management technologies and their uses, and point the way toward the future.

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Aladin: An Interactive Deep Sky Mapping Facility

Any astronomer, whether preparing observing runs or reducing data, requires access to various information concerning the objects under investigation, including data from several wavelengths. This information must be as quantitative as possible. This leads to the concept of developing simultaneous interactive access to sky surveys, initially at optical wavelengths, and to state-of-the-art information systems on all field objects.

In order to satisfy this requirement, the CDS (Centre de Données astronomiques de Strasbourg) is developing an 'Interactive Deep Sky Atlas' project: Aladin. The CDS has many years experience in managing astronomical catalogues and object-orientated astronomical data, as represented by the Simbad database. In the last six years, the

CDS has developed new software based on Unix C, object-orientated database techniques and client-server philosophy for this purpose.

The Aladin project aims to connect the data stored at CDS (catalogues and Simbad), which are continuously updated, to deep optical sky surveys pixel data. These pixel data are now available from different sources, as digitized photographic sky surveys, and will be obtained in the future from CCD sky surveys.

Aladin will be mainly dedicated to quantitative preparation of observations, verification of astronomical catalogues content, locally optimal astronomical and photometrical calibrations, and determination of optical counterparts for radio, infrared, ultraviolet, X-ray and gamma ray sources.

The software architecture of Aladin will be based on the client-server philosophy. Each set of stored data (catalogues, data contained in Simbad and pixel images) will be accessed through a dedicated server. Each external user will use a distributed software (the graphical interactive interface) connected to a general CDS data server through the network. The pixel data and the catalogues will be archived on a juke-box of optical discs.

A project report and a prototype (using digitized ESO-Schmidt plates of the Large Magellanic Cloud) are presently under development at the CDS. If accepted, this project will be funded by INSU and CNES in 1993.

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Client Server Access to the Simbad Database within the Aladin Project

Aladin, the Deep Sky interactive Facility, is a new CDS project whose main concept is to give interactive access to sky surveys (starting with optical ones), and simultaneously to what is already known about the studied field objects (Paillou et al., 1993). A prototype of Aladin has been developed in 1993. In this prototype the user interface directly communicates with the Simbad database and with a set of catalogues extracted from the CDS catalogues archive, in a client/server mode.

The Input/Output functionality of the Simbad software possesses now a server mode. In this server mode Simbad exchanges with a client program. The client generates standard Simbad queries and communicates with the server over a network layer. Beside the Aladin prototype user interface, other clients such as a Graphical User Interface to the Simbad database are presently under development.

The design of the client/server communications between the Simbad software and the Aladin prototype user interface is an anticipation of what will be implemented between Simbad and the general CDS data server.

Because each server within Aladin will use a low level Simbad-like interrogation language, this design will also be implemented in the future for the communications between the different pieces of the Aladin software.

References

Paillou, Ph., Bonnarel, F., Ochsenbein, F. and Crézé, M., 1993, this newsletter.

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Pickles: a Wide-field Imaging Tool

The program Pickles was developed as an aid for HST observations using the Space Telescope Science Institute's Guide Star Catalogue which was generated from short exposure Palomar Schmidt plates. Pickles accepts input from certain catalogues on CDs and in the Pickles file format. Almost any database catalogue stored on almost any computer readable medium can be written into the Pickles format. Pickles then allows editing of the resulting catalogue (including adding stars and objects) and printing the results in tabular and graphical form at almost any scale an observer would require. Pickles' use as an HST observing tool will be demonstrated. Its utility as a general observing tool will also be demonstrated by following the discovery of Ryan's Star from June 1989 to the present where it is identified as Ryan's Starburst Galaxy. Pickles is a program developed for use on Apple Macintosh computers and runs on workstations supporting Macintosh emulators.

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Digitized Sky Surveys and Data Compression

For working with digitized surveys of large parts of the sky, a powerful data compression is indispensable. The compression is accomplished in at least two steps: the information concentration (i.e. the decorrelation of the data) and the coding. For 'lossy' compression one more step, the removal of the noise, is to be introduced after the decorrelation.

It can be shown that there is an optimal transform for the information concentration; and for an image model which fits the typical properties of a sky survey, this is the H-

transform. The connections between data compression, adaptive filtering, H-transform and wavelet transforms are considered.

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Databases for Radio/Optical Objects: Radio Stars, Extragalactic Radio Sources, and Intermediate Reference Stars

The main task of this work is to create a reliable base for studying linkage between optical and radio reference systems and estimating the regional features of optical systems.

There are three main sets of data compiled at the Kiev University Observatory and in the Institute of Applied Astronomy (Russian Academy of Science, St. Petersburg) within the framework of the linkage problem:

- 1) radio and optical astrometric positions for about a hundred radio stars;
- 2) radio and optical astrometric positions for about two hundred extragalactic compact radio/optical sources (ERS);
- 3) optical positions of 2575 reference stars up to 9 mag. in the fields with 238 ERS compiled from various catalogues as well as from the special program similar to that of CONFOR etc.
- 4) a database for the 12-14 mag. system of reference stars in the fields with radio sources (in preparation now).

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The ROSAT All-Sky Survey X-ray Sources: Cross Correlations with Various Catalogues and their Identification

The Germany X-ray astronomy satellite ROSAT has completed the first all-sky X-ray and XUV survey with imaging telescopes. This contribution will deal with the results of a first preliminary analysis in which about 50,000 new X-ray sources were detected. Results from correlations performed with various catalogues in other wavelengths will be presented.

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The Collection of the Wide-field Patrol Plates of the Astronomical Observatory of Odessa

Exposures of the stellar sky have been obtained in Odessa since 1945. Initially 1-, 2-, 3- and (since 1957) 7-camera astrographs were used. The last one is characterized by an exposure time of 0.5 hours and allows observations of a region of sky up to 80 degrees in declination and up to 30 degrees in right ascension with limiting magnitudes 12.5 in photovisual and 14.5 in photographic systems. 36 bright guiding stars located in the northern hemisphere are used which mark centres of the observational fields. Patrol exposures cover all parts of the sky from declination from 90 to -15 degrees. The total number of plates in the Odessa Collection is nearly 100,000.

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The WG WFI Plate Database: Present Status

The preparation of a wide-field plates database, initiated in the Working Group on Wide-field Imaging, is in progress at the Institute of Astronomy in Sofia. The purpose of this project is:

- 1) to collect the available information for about 2 million wide-field plates (angular dimension > 1 deg.) which are the result of the operation of more than 225 telescopes since the end of last century, and
- 2) to organize the data for the wide-field plates into a database with an on-line access through the international data networks.

Thus, a powerful tool for future research will be provided. By the middle of 1993 some 55 files with catalogues of wide-field plates, received from 12 observatories, have been prepared for merging into the database. As a result now it contains the data for more than 300,000 plates (about 60% of all plate catalogues available in computer-readable form at present). A database management system ORACLE, installed on a TELMAT TR 5000 computer, has been used to create and maintain the database.

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Flare Stars Database

As a result of the long term monitoring observations (8500 hours effective observing time) with wide-field telescopes, more than 1500 flare stars (UV Ceti type variables) have been discovered in the Galaxy until now. A standard data-processing package of programmes for the existing catalogues of flare stars in computer readable form in the field of the stellar aggregates Pleiades, Orion M 42/43, Cygnus, Praesepe, Coma Berenices, in the Solar vicinity, as well as for the subcatalogues of flare stars from the General Catalogue of Variable Stars, subsequent Name-lists of Variable Stars and the New Catalogue of Suspected Variable Stars has been prepared. The programme package has been developed for personal computers IBM XT/AT, or compatible ones, in Turbo C 2.0++. It gives flexible environment for easier access to the data for the characteristics of the flare stars and the registered flare-ups, and the corresponding references.

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Direct-Photography Observations with the 2 m RCC Telescope at NAO-Rozhen: Catalog of Plates and Archive-data Analysis

A computer-readable catalog of the direct-photography observations with the 2 m Ritchey-Chretien-Coude telescope of the National Astronomical Observatory at Rozhen is presented. The catalog contains the data (equatorial coordinates, object designation, photographic emulsion, band filter, plate dimensions, observation date and time, exposure time, estimation of seeing, observer and notes) for nearly 2000 plates obtained

since 1980 when the 2 m telescope started operating. The catalog of plates will be useful for those who are interested in the repeated use of observations from the Rozhen Observatory plate archive.

The data from the observations catalog have been analyzed in order to determine some characteristics of the plate archive, which may be of interest for the potential user, as the distribution of the number of plates or the pure exposure time in dependence on: the time (year, month), the object type, the spectral band, the photographic emulsion type, the seeing, etc. The catalog data have also proved very useful for the determination of the periods (months) of the year with most favourable observational conditions (high number of clear nights and good seeing) at the Rozhen Observatory site.

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The Photographic Catalogue of 55000 Stars in the Declination Zone from -16 to -30 Degrees obtained from Observations with the 40cm Astrograph of Hissar Astronomical Observatory, Tadjikistan

In 1977 at Pulkovo Observatory the work for the creation of the Catalogue of southern stars was started. It received later the name FOCAT-S. A little later to this work was joined the Astrophysical Institute of Tadjikistan at Dushanbe (which undertook the zone from -16° to -30° on declination).

In 1985 the first results were obtained at Tadjikistan. 840 plates were observed and a preliminary Catalogue was formed. Now the observational part of the work is finished. The reduction will be made at the Pulkovo Observatory using modern computers.

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The Plate Archive of the Tautenburg Schmidt Telescope

The poster will first show some details on the world's largest Schmidt telescope at the Thüringer Landessternwarte Tautenburg. (Free diameter 134 cm, spherical primary mirror 200 cm, focal length 400 cm, field of view 3°3 x 3°3).

Then some information on the plate archive will be given. Since 1960 more than 8300 plates have been taken with this telescope. The most important data of these have already been available in computer-readable form since 1983.

Many original plates were loaned to astronomers all over the world. In accordance with the aims of the WFI working group we hope to recover some "lost" plates to our archive. The IAU-Symposium in Potsdam should allow the possibility to retrieve such plates.

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The Harvard College Observatory Plate Collection

The collection of astronomical plates at the Harvard College Observatory contains of the order of 500,000 plates taken between 1885 and 1989 (with a gap in the 1950s and 1960s). The majority of these are direct blue plates, taken with a variety of refractors having focal scales of 60 – 600 arcsec/mm. For objects having blue magnitudes of 15 or brighter, normally from several hundred to a thousand or more images can be found in the collection; for those with blue magnitudes of 17, from a few to a hundred or more images can be located. The limit of the best plates is near 18 in the blue. Coverage is excellent in both hemispheres of the sky, with the southern hemisphere having perhaps the advantage.

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The Wide-field Plate Archives Data Base in Latin America

During the creation of the Working Group on Wide-field Imaging of the IAU Commission 9, it was unanimously agreed that one of the most important tasks of the new WG would be the creation of a computer-readable Data Base, with the existing wide-field plate archives and all astro-photo plates obtained from the end of last century until now. Latin America has an important collection of plates from several Observatories.

The preparation of a list of wide-field plate archives is a necessary first step for the creation of the future data base. The second step is to computerize the data base for individual plates in plate archives. The third step consists of establishing a Data Bank with digitized wide-field plates. In this way, we wish to describe the up-to-date status of the project in Latin America.

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The Sonneberg Observatory WFPA Database

We report on the database of the 250,000 plate archive of the Sonneberg Observatory: contents, structure, instructions for the user. The database will be included in ADS.

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Catalogue of the Rozhen Observatory Schmidt Telescope

The analysis of the computer-readable version of the catalogue of the Potsdam donated 50/70/172 cm Schmidt telescope at the Rozhen Observatory of the Bulgarian Academy of Sciences is presented. Specialized novel software for personal computers was used.

During the period 1979-1992 a total of 6437 plates (196 of them taken with an objective prism) were received with the effective observational time of 2865 hours.

The observational programmes are in correspondence with the telescope characteristics and concern search for comets and asteroids, patrol observations of flare stars in stellar aggregates, research of variable and double stars in stellar clusters, photometry of near galaxies, research of nova-like objects, etc.

The computer readable form of the catalogue is included in the wide-field plate database, created in Sofia.

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Pulkovo Astronomical Database for Personal Computers

Personal computers have become more and more popular at the Pulkovo Observatory. Today there are more than 40 PC IBM type computers. For this reason the formation of the Astronomical Data Bank and network for the personal computers at Pulkovo is very real.

According to the main outlook of the Observatory we plan to form the Data Bank from the following basic components:

1. modern star fundamental and reference catalogues;
2. some special astrophysical catalogues;
3. the data for astronomical computations;
4. ephemerides for planets and the Sun and some special stellar objects.

The local Observatory's network will combine the computers in a united system which will permit the use of all facilities belonging to different laboratories. For example, it will be possible to have only one laser printer for the needs of all astronomers, etc.

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Solar System Surveys

Asteroid and Comet Surveys

The use of wide-field photographic instruments in the discovery of asteroids and comets is reviewed, from the early applications in the late nineteenth century to the present. The particular role of sky patrols is discussed. Some thoughts are given concerning the changes new technologies are likely to bring to this activity in the future.

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Galactic Structure

The Luminosity and Mass Functions at the Bottom of the Main Sequence

IIIaF and IVN plates taken in ten fields (covering a total of 270 degrees²) as part of the POSS II and UKSRC surveys and scanned with the COSMOS measuring machine, have been used to construct complete samples of VLM candidates for study in the infrared. Using K-band photometry of these stars subsequently obtained, combined with the I-band colours from the photographic catalogues we estimate a bolometric luminosity function which extends to $M_{bol} = 13.75$.

Combining these data with a purely photographic luminosity function for more luminous stars, we find significant evidence for a luminosity function decreasing towards the bottom of the main sequence. We also find that our data are consistent with the results of studies based on the Nearby Star sample, when those data are presented as a bolometric luminosity function. We convert our observed LF into the form of a mass function, which extends with reasonable statistics to $0.08M_{\odot}$ — the H-burning minimum mass. We find significant evidence for features in the mass function at these masses. Specifically, the mass function ‘turns over’ at $\approx 0.25M_{\odot}$, goes through a local minimum at $\approx 0.15M_{\odot}$, and seems to increase again below $0.1M_{\odot}$ — none of these features are predicted by any of the current theories of star formation. Lastly, the mass density we observe just above the H-burning minimum mass makes it difficult to envisage brown dwarfs contributing significant quantities of missing mass without invoking either a mass function in this region significantly steeper than that seen for main sequence stars, or an extremely low cut-off mass to the mass function.

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Activity Analysis of dM Stars based on Wide-field Photographs

Our Galaxy is abundant in red dwarf stars and the large majority of these objects seems to be unstable. Conversely more than 60% of the variable stars known in the solar vicinity ($r < 20\text{pc}$) are flare stars and taking into account the number of BY Dra stars too the proportion of red dwarfs amongst local variables is superior to three quarters. Their absolute visual magnitudes range from +6 to +17.5 or even more. During flare events their brightness may reach a maximum corresponding to an enhancement of 1000-10,000 times. The amplitude of a large flare in the U band may be as high as 8-10 magnitudes. These events take place non-periodically in unpredictable moments; no unquestionable periodicity has been found in the time distribution of stellar flares. However the activity level of various flare stars is considerably different. Some of them show observable flare ups with a mean frequency of 1 per hour whilst others produce only one event per annum. For the scarcity of the phenomenon photoelectric photometry of individual stars is not the adequate means to a better understanding of flare stars. The other way: wide-field photographic photometry is definitely more advantageous for the possibility of simultaneous recording of the possible brightness variations of hundreds of objects and for the high limiting magnitude offered by fast Schmidt-cameras in the U spectral band. This latter made the statistical investigation of flare stars and their flare ups in open clusters possible, since their red dwarfs are too faint (especially in the ultraviolet) to be readily measurable by photometers mounted on moderate-sized telescopes. Some of the younger and richer open clusters are perfectly disposed for such a study. Their distance modulus is inferior to 7.5 but their angular diameter fits nicely that of the viewing angle of the photographic telescopes used in the observing campaigns. The quasi-uniformity of these devices and the similarity of the emulsions and other important parameters of

the photographic procedures permitted the combination of the results of many individual runs and the spatial and photometric filtering of the published data led to more reliable and more convincing conclusions concerning the flare activity of dM stars.

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Star Counts as Constraints for Galactic Evolution

The Besançon model of population synthesis of the Galaxy has been built as a tool to constrain our knowledge of the Milky Way by allowing us to compare predictions of evolution scenarios with photometric and astrometric observations (Robin and Crézé, 1986; Bienaymé et al., 1987). It uses the age distribution in the HR diagram (Haywood 1993), coming from galactic evolution scenarios, to parametrize the distribution functions (densities, velocities and metallicities). The model is made dynamically selfconsistent through Poisson and Boltzmann equations. It allows us to nicely reproduce the proper motion distributions in the solar neighbourhood (Robin and Oblak, 1987) and at remote distances (Bienaymé et al., 1992; Soubiran, 1992).

We describe here how photometric star counts at $10 < V < 18$ towards the galactic pole and the anticenter at low latitude, and one sample at bright magnitudes from the Hipparcos Input Catalogue allow the constraining of the history of disc star formation in the ($d < 2kpc$) solar neighbourhood. The comparison with the data is made on an extensive range of models and provide new constraints in the time variation of the SFR, together with a new consistent description of the solar neighbourhood.

References

Bienaymé, O., Mohan, V., Crézé, M., Considère, S. and Robin, A.C., 1992. *A. & A.*, 253, 389.

Bienaymé, O., Robin, A.C. and Crézé, M., 1987. *A. & A.*, 180, 94.

Haywood, M., submitted to *A. & A.*

Robin, A.C. and Crézé, M., 1986. *A. & A.*, 157, 71.

Robin, A.C. and Oblak, E., 1987. *Evolution of Galaxies*, X IAU European Meeting, J. Palous (ed.), Publ. Astron. Inst. Czech. Acad. Sci. 69, 323.

Soubiran, C., 1992. Ph.D. Thesis, Observatoire de Paris.

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Wide-field Observations of Variable Stars in the Region of NGC 7129

During our programme for investigation of nonstable and flare stars in the regions of star formation more than 250 UBV photographic plates in the field of the bright nebula NGC 7129 were obtained. The observations were made with the 50/70/172 cm Schmidt telescope and 2m RCC telescope of the Rozhen Astronomical Observatory of the Bulgarian Academy of Sciences during the period September 1984 - April 1993.

For V 350 Cep known as a T Tauri star we have obtained that in this period the star brightness gradually increases. The results of the photometric observations of newly discovered variable stars probably of T Tauri type and CCD spectral observations are presented.

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CCD Imaging of Nearby Evolved Planetary Nebulae

We present results from narrow band CCD images in $H\alpha$ + $[\text{NII}]$, and $[\text{OIII}]$ of 9 very faint, nearby (less than 0.5 Kpc) planetary nebulae, of large angular extent.

The images were taken using the 30cm Schmidt-Cassegrain telescope equipped with a CCD camera which operates at Mount Skinakas on the island of Crete. A brief outline of the existing instrumentation as well as the reduction procedure followed for such wide field images is presented here.

The PN images we present are calibrated using a spectrophotometric standard star. The faintest structures revealed in our images are as faint as 10^{-17} ergs $\text{sec}^{-1}\text{cm}^{-2}$ arcsec^{-2} . New structures are revealed at large distances from the central part of those nebulosities which are hard to reconcile in the current frame-work of well established evolutionary models. The individual peculiarities of each object merit further study by deriving kinematic data. Finally features reminiscent of the interaction of the former Red Giant Envelope with the ambient Interstellar Medium are evident from our images. The observations presented here are part of an ongoing program to study a large sample of extended and evolved PNs.

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Wide-field Imaging Photometry and Spectrophotometry of Orion Population Stars

Wide-field imaging detectors can assist us in answering problems in the study of Orion population stars, in particular T-Tauri stars. Highly sensitive modern digital detectors make the study of faint stars accessible to small telescopes. Compact groups of stars, field stars and noise levels can be observed simultaneously.

On the television complex of the Crimean Astrophysical Observatory MTM-500 (0.5m meniscus telescope + purpose-built instrument

+ high sensitive detector) there is provided the capability of complex monitoring of Orion population stars. Several objects from the Herbig-Bell catalog of Orion population emission-line stars were observed during June 1990 to June 1992. Accurate increases in brightness were registered using simultaneous observation of the target star(s), noise level and a comparison star (or stars) in one of the U, B, V or R colour systems. With the help of the original system, quasi-simultaneous photometry of objects in the BVR colour system could be undertaken. On the purpose-built slitless spectrograph, low dispersion data can be obtained for the evaluation of the distribution of energy in the spectra and of integrated magnitudes of stars. All spectra are obtained on the slit spectrograph with a spectral extent of 4000 to 7000 Å, with a resolution of 5 Å and time resolution of 15 mins.

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High-velocity Clouds: Estimation of Gas/Dust Ratio based on All-Sky Survey Data

We have developed a method of gas/dust ratio estimation for high-velocity clouds (HVC) based on all-sky survey data in the microwave spectral range. The data from the 'Relikt-1' experiment and HVC catalogue were used to obtain this estimation. The Relikt data were compared with the all-sky distribution of HI column density in HVC. Three criteria of comparison (the difference between measurements near north and south elliptical poles, RMS on maps, quadruple component values) were applied. The evaluated gas/dust ratio is approximately 3 – 7 (for $T_{\text{dust}} = 5 - 10$ K accordingly) times higher than the ratio in interstellar medium (where $\text{gas/dust} = 100$). If dust in HVC is heated by radiation of the Galaxy, the estimated average distance to clouds is equal to 150 kps.

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First Observations with the Bonn Wide-field Photometer and Polarimeter — Surface Polarimetry of the Crab Nebula

The Crab Nebula was observed on 17.2.93 at the 1.82m telescope of the 'Osservatorio Astronomico di Padova' at Asiago using the Bonn Wide Field Photometer and Polarimeter (WWFPP).

This focal reducer system was designed for simultaneous observations of four directions of polarization using a twin wollaston prism in the collimated beam in combination with a masking technique in the telescope focal plane. This method is independent of fluctuations of atmospheric transparency and variation of the seeing during exposure time.

The field of view at this telescope was 14 x 14 arcmin with 0.42 arcsec/pixel and 2048 x 2048 pixels, ideally suited for observations of extended objects with low surface brightness.

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Objective Prism Surveys of the Galaxy

The main results of the low dispersion objective prism surveys of the Milky Way undertaken in the last thirty years for the study of the distribution of late type stars, namely M and C stars, are discussed.

Among them are two surveys made at Abastumani. One is a yellow-red (IIIa-F, IIIa-J) spectral survey (about 2000 A/mm at 5100 A) of the region from $l = 30^\circ$ to $l = 165^\circ$ and $-5^\circ < b < 5^\circ$ and another is a near-infrared (IV-N+RG8) spectral survey (about 7000 A/mm at A band) of the region $50^\circ < l < 115^\circ$, $-5^\circ < b < 5^\circ$. The limiting magnitudes of the surveys are $V = 16.0$ and $I = 15 - 15.5$ mag. As a result more than thirteen hundred new Carbon Stars were revealed in both surveys.

The study of the latitude and longitude

distribution of all detected C stars shows that the former is uniform while the latter is nonuniform. The mean surface density of C stars in the yellow-red survey is one per sq. degree, while in the near-infrared — three per sq. degree.

Using the nearest neighbour method it is shown that statistically significant numbers of C star pairs and members of the open star clusters are not observed. The connection of C stars with dark clouds was also studied.

The C/M5 ratio has been determined for different regions of the Milky Way.

Further prospects related to objective prism surveys for late type stars are discussed.

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Space Distribution of Stars in the Milky Way Selected Region

The main goal of this research is to investigate the structure of the nearby part of the Local Spiral Arm of the Galaxy in the direction of Kapteyn Selected Area No. 64 with $(l, b) = (67.5^\circ, -0.2^\circ)$ on the basis of photometric and spectral data for the relatively bright stars.

Photographic UBV photometry to a limiting magnitude of $V = 12.5$ is reported for about 1000 stars for which MK spectral classification was recently carried out at the Abastumani Astrophysical Observatory using the 70cm meniscus-type telescope equipped with an 8 degree objective prism.

On the basis of the catalog data the spatial distribution of stars and the stellar density for various spectral types have been determined. The spatial variation of interstellar absorption is also studied.

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Photometry from Schmidt Plates Digitized with the MAMA Microdensitometer

A survey of proper motions and B, V photometry from Schmidt plates digitized with the MAMA microdensitometer is under realization. The aim is to obtain a large data set representative of the stellar populations probing the Galaxy to a few kpc in several directions. Computational, statistical, photometric and astrometric skills have already been tested on a 7 square degree field. Thanks to the high precision of the MAMA machine, the large number of plates, the long time baseline and the optimised methods of reduction, the accuracy of differential proper motions was estimated to be better than 2 mas/yr. The absolute reference frame was provided by carefully selected extragalactic sources. The photometric and astrometric data were combined to derive kinematics of 2500 stars. The deconvolution of the velocity distributions of the old disk, thick disk and halo has provided a reliable determination of their kinematical parameters. Radial velocities and metallicities are now being measured for a part of this preliminary sample.

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Galactic Dynamic and Kinematics from a Deep Proper Motion Survey

Strasbourg and Besançon observatories (France), CAI (Paris Observatory) and UP State Observatory (India) are conducting a sample survey in UBV photometry and proper motions as part of an investigation of galactic structure and evolution supported by Indo-French centre for the Promotion of Advanced Research. The project is based on Schmidt plates (from Tautenburg, Palomar, ESO and OCA telescopes) digitized with the MAMA machine. The high astrometric quality of the MAMA gives access to micronic accuracy

leading to a few mas per year accuracy using plates spread over a 30 year baseline. Medium photometric accuracy and high proper motion accuracy for complete faint star probes in large fields will give access to the properties of star samples out of the solar neighbourhood. The Schmidt sample survey is complemented by deep CCD photometry in some fields in order to get a wider magnitude range and to give access to faint or remote populations. To interpret this multidimensional data set we have developed a synthetic approach of galaxy modelling. Model simulations compared to observed stellar distributions in space (V, B-V, U-B, m_1 , m_2) will lead to suitable tests for galactic structure, dynamic and evolution.

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A Complete, Multicolour Survey of Absolute Proper Motions in the Anticentre Direction at Intermediate Latitude

As part of an investigation of galactic structure and evolution, we present the observational results of UBV photometry and absolute proper motions in the anticentre direction at intermediate latitude ($l = 170^\circ$, $b = 45^\circ$) for a 8.6 square degrees. The sample is complete down to $V = 17$, and the accuracy of the proper motions is better than 0".25 per century for stars brighter than $V = 16$. We discuss the implications of present data on stellar kinematics and the structure of our Galaxy.

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Wide-field Stellar Statistics from Tautenburg Schmidt Plates

The combination of Tautenburg plates and automatic measuring machines provides a powerful means to obtain accurate proper motions of a great number of stars for statistical investigations of the kinematics of our Galaxy. With two plate pairs and a 20 years base line a proper motion accuracy better than 5 mas/year can be achieved for stars over a wide range of magnitudes. Outside the galactic plane proper motions are obtained with respect to an extragalactic reference frame defined by hundreds of background galaxies. More than 70 fields with at least 4 Tautenburg plates taken before 1970 provide an important observational basis for different proper motion programmes.

We present current results of statistical investigations in the main galactic meridian as well as of a kinematical study of open and globular clusters which has been carried out in Potsdam using Tautenburg plates.

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Stellar Kinematics in the Galaxy North Pole Region on the Basis of Tautenburg Schmidt Telescope Plates

The spatial velocity components and their dispersions in the galactocentric (X) and rotation (Y) directions, eccentricities of galactic orbits, parameters of spatial distribution and the change of all these characteristics with Z-distance from the Galaxy plane are investigated. These results have been determined on the basis of the absolute proper motions and stellar B, V magnitudes in two sky regions near the North Galactic Pole (NGP) by means of the plate set of the Tautenburg Schmidt Telescope.

Four subsystems distinguished in the direction of the NGP on the basis of the relation between the velocity V_Y with respect

to the Local Standard Rest and velocity dispersion have spatial boundaries between them $Z = 0.3, 1, 4.5$ kpc and age boundaries 10, 90, 95% of the Galaxy age. The relation of velocity dispersion ellipsoid axes $\sigma_X : \sigma_Y$ for these subsystems changes from 1 : 0.7 to 1 : 0.9. The semithicknesses of the subsystems are equal to 0.15, 0.3, 0.65, 1.5 - 2.5 kpc and the bulk of the Galaxy stellar populations is contained in the disk with semithickness 5 kpc and radius of 20 kpc.

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Galactic Orbits of Globular Clusters from Schmidt-Plate Astrometry

Plates from the Tautenburg Schmidt telescope have for the first time opened the opportunity to determine absolute proper motions of galactic globular clusters with direct reference to a large number of background galaxies. Combining plates with epoch differences of 20 to 27 years, absolute proper motions of the two clusters M3 and M92 could be measured with an accuracy of about $0.06''/100a$. Together with known values for distance and radial velocity these give a complete description of the clusters kinematics and allow the determination of their galactic orbits. We present results of orbit integrations based on a three component mass model for the Galaxy and discuss the behaviour of important orbital parameters during an interval of 10^{10} years backwards in time. The types of motion found for M3 and M92 are shown to be quite different.

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New Proper Motions in Open Clusters: I. Milli-arcsecond Proper Motions in Pleiades

As a first step of our open cluster programme a preliminary catalogue of proper motions and photographic B, V, R magnitudes for stars up to 18 mag within a region centred near Alcyone is presented. The catalogue is based on MAMA measurements of plates taken with Tautenburg and OCA (CERGA) Schmidt telescopes. The photometric survey includes ca. 65,000 stars and covers a total field of about 25 square degrees. Proper motions have been obtained for ca. 20,000 stars within a central 9 square degree region of this field. For the majority of stars in the survey an accuracy of 0.15 mag and 2 mas/year has been estimated for photometric data and proper motions, respectively. The results of the determination of the Pleiades membership up to magnitude 18 are presented.

The extension of the proper motion survey to a field of 18 square degrees is in progress.

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Absolute Proper and Space Motion of the Globular Cluster M2

M2 is a globular cluster, which is supposed to have a large velocity component of about 280 km/s in the direction perpendicular to the galactic plane (Cudworth, *AJ*, **105**, 168). It is the fourth globular cluster on our programme for the determination of its absolute proper motion. We use measurements of plates on the double refractor of Sternwarte Bonn (now at Observatorium Hoher List), of glass copies of Palomar, and of recent deep Schmidt plates.

Eleven refractor plates with an epoch difference of up to 85 years have been used to derive relative proper motions with an accuracy of the order of 0"1/100a for all stars up to $V=15.5$ m in a field of 1.5 x 1.5 square degrees. The membership of the stars in the region of M2 has been determined. A first

result of the absolute proper motion and space motion of the cluster M2 based on measurements of 30 extragalactic objects is given.

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Membership and Internal Motions of Faint Stars in the Globular Cluster M3

A proper motion study from Tautenburg Schmidt plates is presented for the globular cluster M3 and its vicinity. The plates were scanned with the Automated Photographic Measuring (APM) system in Cambridge (UK). With a limiting magnitude of about $B = 21$ proper motions with an accuracy from 2 to 3 mas/yr have been obtained for stars with $B < 19$. The proper motions were determined applying a stepwise regression method with 3rd order polynomials in the plate-to-plate solutions with about 2000 reference galaxies. We used the results for the determination of membership probabilities and looked for internal motions of M3.

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Photographic UVB Photometry of the Globular Clusters M3, M15 and NGC6712

Photographic intermediate band uvb observations of RGB and some AGB stars in fields centred on the globular clusters M3, M15 and NGC6712 are presented. The photometry confirms the existence of the gaps in the giant branch of M15. For NGC6712 the

Stromgren colours point at a bimodal carbon abundance for the bright giants in the central part. 42 stars from the central part of M3 which have not yet been photometrically and astrometrically investigated, are found to be photometrical members of the cluster. The possibilities of the uvby system for a classification of RGB and AGB stars are briefly discussed. Good dependence exists between the average value $\langle v-b \rangle$ of the RGB stars of each cluster and the values of $\%Fe/H!$.

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NGC 4833 and NGC 4590: First Results of a New International Project of Photographic and CCD Photometry in Globular Clusters

Co-operation has been established between the Isaac Newton Institute (Santiago, Chile), Institute for Astronomy of the Russian Academy of Science and Sternberg Astronomical Institute (Moscow). The photographic plates of globular clusters, taken in Chile by Gonzalo Alcaíno and collaborators, are being measured with the Sternberg Institute automatic densitometer. We also reduce Chilean CCD observations of globular clusters. The poster will present, as the first results, the photographic $V - (B - V)$ diagram for the globular cluster NGC 4833 and the most complete CCD $I - (R - I)$ diagram for the globular cluster NGC 4590. Some technical details of the measurements and reductions, as well as some properties of the clusters' colour-magnitude diagrams, will be discussed.

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The Magellanic Clouds

The Magellanic Clouds

The study of the Magellanic Clouds has developed significantly with the advent of automated digitisation of wide-field photography (COSMOS, APM), large format CCDs and multi-object fibre spectrographs.

In recent years we have been studying aspects of the geometry, structure and evolution of the Small Magellanic Cloud making extensive use of such tools. Photometry (using COSMOS) over an area of 100 square degrees in and around the SMC has allowed us to conduct a detailed study of the nature and spatial distribution of stellar populations in the SMC. The three dimensional structure of the SMC revealed by these data, in conjunction with radial velocities obtained with multi-fibre spectroscopy have led to a quantitative estimate of the effect of the tidal interaction between the LMC and the SMC.

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Carbon Stars in the Small Magellanic Cloud

A set of deep objective prism plates covering the outer regions of the Small Magellanic Cloud have been systematically searched for carbon stars. An extensive catalogue has been produced. Carbon stars are found up to 5 degrees from the centre of the SMC; their surface distribution is described.

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Extended Surveys of MC Star Clusters

The star clusters in the Magellanic Clouds are found to offer a rich variety of properties which can be used as a test of our theories on stellar and dynamical evolution. They also provide objects for testing the circumstances under which stellar systems form and survive in their parent galaxy.

The location of the clusters, distribution of their ages and dynamical parameters has shown that two star clusters systems exist in the LMC. These two systems may reflect the way our Galaxy has triggered star cluster formation during its very close encounter with the LMC:

- i) one extended elliptical in shape system, which contains all intermediate and old star clusters either poor and/or rich in star number, and
- ii) A system again elliptical but smaller, superimposed on the other (inlined by about 60 degrees from the latter), consisting of the most massive, very young LMC globular clusters, not yet conventionally relaxed.

The existence of very rich stellar associations, binary star clusters and very elliptical ones located in this system, may indicate that

- a) massive star clusters have formed very recently and are still under formation, and
- b) merging of two or more stellar systems is one mechanism which leads to the formation of large globular clusters in a galaxy.

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Grism Survey for C-stars in the MCs

A survey for carbon (C) stars in the Magellanic Clouds has been carried out with a green grism at the prime focus of the ESO 3.6 m telescope equipped with a triplet adapter. The spectral range obtained on the plates (4350-5300 Å) is achieved by combining a IIIa-J emulsion with a Schott GG435 filter. Two dimensional photometry of the grism spectra resulted in a magnitude m_{5220} , a colour equivalent $m_{4850} - m_{5220}$, and a carbon abundance index $C_2(EW)$. This technique was applied to 13 fields covering the main body of the Small Magellanic Cloud and to some selected fields in the Large Magellanic Cloud. The calibration of the derived quantities, using slit spectra of selected stars, allowed us to determine bolometric magnitudes for about 2000 C stars. The existence of natural groups of C stars has been pointed out. In particular a number of very faint C stars has been discovered.

From the experience we gained from this technique, we are now using the ESO Faint Object Spectrograph and Camera devices in the slitless spectroscopy mode equipped with low dispersion prisms and suitable interference filter in order to perform very deep surveys and identify very low-luminosity C stars in selected regions of the MCs and Local Group dwarf spheroidal galaxies.

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H α Survey of the Milky Way and Magellanic Clouds

A survey of the ionized gas in the Milky Way and Magellanic Clouds is now being made by a team from Marseille Observatory with a small dedicated telescope (36 cm) at La Silla. It includes a scanning Fabry-Perot interferometer and a photon-counting system (see A. & A. 1992, 257, 389). Each field covers 38' x 38' on the sky and provides radial velocities for the 256 x 256 pixels (1px = 9" x 9") with a high spectral resolution (better than 5 km/s). H α is the most observed line but a lot of fields in the SMC and LMC were also observed in OIII line.

The aim of our observations is to improve our knowledge and understanding of the structure and kinematics of the SMC and LMC (including detection and detailed study of SNR). By now the SMC has been completely covered with 30 fields (Le Coarer et al., 1993, accepted in A. & A.) and a large part of the LMC (about 40 fields, most of them at both H α and OIII).

About 150 fields have been already observed in the Milky Way, covering areas especially selected to help precisising the number and shape of spiral arms. The radial velocities enable us to distinguish HII regions from different spiral arms seen along the same line of sight.

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CCD and Schmidt-plate Photometry and Astrometry in Region E of the LMC

We have investigated the possibility of crowded-field photometry on Schmidt plates of the LMC. ESO Schmidt plates of the SRC field 85 in the blue and visual passbands were scanned with the PDS2020GM^{plus} microdensitometers at Münster. This field includes Shapley Constellation III and the supergiant shell LMC 4. As a first test a field of $0.6^\circ \times 0.6^\circ$ was extracted from the scans and has been reduced with DAOPHOT2. The subfield contains the LMC Key Programme Region E (de Boer et al., 1991. *Messenger*, 66, 14), where Johnson BV CCD photometry of five overlapping fields centred on the association NGC 1948 is available (Vallenari, Bomans, de Boer, 1993. *A. & A.*, 268, 137). The CCD photometry is used to calibrate the Schmidt-plate photometry. The resulting large number of stars with BV photometry is useful for a census of the brighter part of the colour-magnitude diagram in a very large area. One especially interesting topic is to look for hints of sequential star formation in this part of the LMC: we divided our region into a grid of subfields and compared the main sequence turnoff locations. As a second method we investigated the stellar density distribution of the blue stars. The next step will use several more plates of the region to enhance the reliability of our photometry.

Spherical positions for all stars on the Schmidt plates are derived using the PPM (Röser & Bastian 1991) as reference catalogue. Positions of stars appearing on the CCD frames only are determined relative to secondary reference stars from the first step.

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Wide-field Star Count Mapping of Large Regions of Star Formation in the Large Magellanic Cloud

A large area of the LMC central 'disk' ($\approx 1.8 \times 1.3$ Kpc) has been studied by means of star count and spectral classification, to examine its morphology and stellar population. The star counts were carried out on a U plate taken with the 1.2m UK Schmidt Telescope, in order to derive the isodensity contour mapping of this region, which comprises the Shapley IX complex and some associations, catalogued by Lucke and Hodge. A smaller area ($\approx 0.36 \times 0.36$ Kpc), centered on Shapley IX complex, was also studied on two I and V plates to define the boundaries of LMC complexes.

Spectral classification of stars brighter than $B \approx 18.5$ mag was also carried out in the same areas using low dispersion objective prism plates taken with the 1.2m UK Schmidt Telescope. It is found that the studied stellar complexes are defined by the minimum isodensity contours where the dominant stellar content is OB stars. These regions delimit the loci of recent star formation events.

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Qualitative Analysis of the Stellar Content in LMC Clusters and Nearby Fields from Objective Prism Spectra

A large number of stellar fields in and around star clusters at various regions covering the entire LMC have been studied by means of objective prism spectra taken with the 1.2m UK Schmidt Telescope. Spectral classification of stars (as faint as $B = 18.5$ mag) in the central crowded cluster regions is possible only with low dispersion spectra, which give one spectral type accuracy. Medium prism spectra provide better classification accuracy (3 spectral subtypes) but they only detect stars at $B = 16.5$ mag.

The distribution of spectral types in each area corrected for completeness and field contamination is a very good age indication of the stellar population in the examined area. The age distribution of spectral types in the studied areas shows that in the central LMC 'disk' the age of the stellar population is mixed with various age groups from 10^7 to very old whereas the extended large elliptical 'disk' comprises stars from 3×10^8 to a few times 10^9 . Between the central 'disk' and the large one there is a north and south population with age of about $1 - 3 \times 10^8$ yr.

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Local Galaxies

Dwarf Spheroidal Galaxies

The dwarf spheroidal (dSph) companions of the Galaxy offer a tremendous opportunity to investigate objects at the faint end of the galaxian luminosity function (LF). Their proximity and low stellar densities allow for very deep and relatively uncrowded optical imaging. A major difficulty is their angular size: on the order of a few degrees. Thus wide-field techniques are required to study the global properties of these galaxies.

This review will concentrate mainly (but not entirely) on the use of Schmidt plates for the study of the dSphs. A crucial advantage of Schmidt plate data is that the large field of view (*fov*) allows for a straightforward assessment of background/foreground contamination: even for Sculptor (at $b \approx -83^\circ$), $\sim 45\%$ of all stars in the line of sight with the apparent magnitude of the Sculptor horizontal branch ($m_b \approx 20$) are foreground objects.

Schmidt plate data has been used to study the stellar populations of the dSphs, based both on their stellar LFs and their color-magnitude diagrams. This provides a much better sample of the bright end of the LF than is available with small format CCDs. The large *fov* allows for the determination of the radial profiles of the dSphs based on star counts. However, although different studies tend to agree at small radii, there are significant discrepancies in values for the tidal radii for several systems. The 2-D structure of dSphs have also been investigated from star counts in order to both study radial variations in quantities like the ellipticity, and to search for departures from axial symmetry. It remains a puzzle that significant deviations from smooth 2-D structure are known to exist in the three dSphs that have been so studied (Ursa Minor, Sculptor and Fornax).

Stretching the notions of 'wide-field' imaging, important studies of dSphs are also possible with non-Schmidt photographic techniques and Schmidt CCD cameras.

These are especially valuable for the more distant dSphs (including Tucana and the M31 companions). The latter technique also provides an enormous improvement in the accuracy and precision of the surface photometry of dSphs over what is possible with plates. Finally, there is also the possibility of imaging studies at other wavelengths. While most of the flux from the dSphs is in the optical/infrared, surprises certainly exist in deep studies at both higher and lower frequencies.

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Absolute Proper Motions of the Dwarf Spheroidal Galaxies in Draco and Ursa Minor

Palomar and Tautenburg Schmidt plates with a base line of about 35 years have been measured with the Automated Photographic Measuring (APM) system in Cambridge (UK) in order to obtain the proper motions of the Galactic dwarf spheroidal satellites (dSph) in Draco and Ursa Minor with respect to a well defined extragalactic reference frame. The investigations were encouraged by the accuracy level achieved for the mean absolute proper motion of galactic globular clusters (0.05 arcsec/century from 25 years base line Tautenburg plate pairs) which is comparable to the expected proper motion of the Draco and Ursa Minor dSph if we assume tangential motions of about 100 km/s. Different methods for the removal of systematic errors in the absolute proper motion introduced by the measuring and reduction process are discussed. The more accurate relative proper motions in both dSph obtained by Stetson (1980) and by Cudworth et al. (1986) providing an external comparison are also used to obtain the mean absolute proper motion of the dSph.

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Properties of Nearby Galaxies

Photometric Properties of Nearby Galaxies

The first part of the paper will be a review of the methodological needs and of the astrophysical reasons calling for a 'global' photometric mapping of galaxies, i.e. for an accurate measurement of the surface brightness in 2-D and out to the faintest isophotes reachable with state-of-the-art techniques. One of such techniques, which quite successfully combines deep Schmidt plates with centred CCD images, will be demonstrated to exemplify the methods and discuss the uncertainties in the derivations of global quantities such as the total luminosity L_T , the effective parameters a_e , r_e , and μ_e , and the geometrical range-parameters ϵ_{max} and $\Delta P.A._{max}$. Technicalities such as background subtraction, colour matching, seeing and scattered light deconvolution, noise suppression, and even linearization of photographic plates, will be shortly outlined.

The second part of the paper will present and comment on the results obtained in the study, by a global mapping technique, of a luminosity limited sample of early-type galaxies (Capaccioli, Caon and D'Onofrio 1993). It will be shown that the correlation properties of the global parameters between themselves and with several morphological and physical parameters indicate the existence of two distinct families of galaxies; one of such families is possibly a genetic variety, the other being instead the product of evolution.

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Surveys of Low Surface Brightness Galaxies with 4415 Films

Searches for very faint low surface brightness galaxies (LSBGs) are generally limited either by detector efficiency (for photographic plates) or detector area (for CCDs). Here we report on a recent advance which enables us to make simultaneously deep and wide-angle surveys. This is the use of the new high efficiency Kodak 4415 film on the UK Schmidt (see also Parker, this meeting). Experiments with films of the Virgo Cluster have shown that the sky noise in deep (75 – 100 minute) exposures is only 0.8%. This means that we can routinely survey whole Schmidt fields with a limiting isophote of about 25.5 R magnitudes per square arc second (Rp). Moderately large low surface galaxies such as those in the Virgo Cluster Catalogue can be traced out to an isophote around 27 Rp.

We find that LSBGs with surface brightnesses around 4% of the sky background, effectively the limit for conventional IIIa plates, are extremely easy to see. Conventional techniques will already allow us to detect LSBGs down to 2% of the sky brightness over very wide areas. Using more intensive image processing and digital coaddition of the films we expect to be able to reach surface brightnesses below 1% of sky, 25.5 to 26 Rp.

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Automatic Detection of Low Surface Brightness Galaxies on Photographic Plates

The importance of Low Surface Brightness Galaxies (LSBGs) in the evolution of the Universe is at present uncertain. For instance, the 'excess' faint galaxies seen in deep CCD frames are now thought to be a population of medium distant dwarfs not seen locally. Two competing theories to explain this population are that the dwarfs have merged to form present-day giant galaxies or that they have

faded to such an extent that they have not yet been detected in nearby surveys. Although detailed CCD studies have shown that large numbers of LSBGs exist in nearby clusters, the area covered by these detectors is relatively small and few conclusions can yet be drawn about the abundance of LSBGs throughout the local Universe. Wide-field images are thus required to investigate this possibility further.

Photographic plates still provide the greatest volume sample of the local Universe. Microdensitometer scanners (such as the APM and COSMOS) can provide accurate parameters (such as position, magnitude, shape and classification) for all objects detectable almost down to the plate limit. However, the algorithms employed all assume that pixels above the detection threshold within the images are contiguous. These algorithms thus either miss or incorrectly parameterise very extended objects whose surface brightnesses are close to the sky. To search for such objects has, until recently, relied on eyeball scans of the original plate material or 'massaging' by photographic means. These searches have been successful in finding several low-surface brightness objects such as Malin 1, 2 and 3. However, these searches are very subjective and it is, as yet, unclear how many LSBGs exist. We have thus begun to investigate alternative image-finding algorithms specifically designed to detect LSBGs on digitised scans. We present and discuss the results of three new, different types of analysis on a test field, with simulated LSBGs of known properties added. The results are compared with the contiguous pixel algorithms previously applied to such data.

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Surface Photometry of LSB Galaxies in the Area of NGC 972 Group of Galaxies

A nearby group of galaxies, centred on the luminous spiral galaxy NGC 972 and conspicuously rich in low-surface-brightness

(LSB) dwarf galaxies, has been investigated photometrically on the Tautenburg 2m Schmidt B, V-plates. For 14 certain and probable group members the equivalent B- and V-profiles have been derived by means of sophisticated adaptive filtering technique down to the $\sim 27 B/(\text{arcsec})^2$ and $\sim 26 V/(\text{arcsec})^2$, correspondingly. The four dwarf spheroidals from the list of Karachentseva K 16, K 17, K 19 and K 21 have very similar asymptotic B-magnitudes 17.1 ± 0.3 . The comparison of their equivalent profiles with King models yields central surface brightnesses ranging from 24.1 to 24.7 $B/(\text{arcsec})^2$. Typically, the dwarfs show a "subexponential" (i.e. a convex curvature over linear radius) SB-profile and often a central excess.

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Dust in Nearby Dwarf Galaxies

About 40 per cent of the galaxies in the extragalactic neighbourhood have been identified with sources of the IRAS point source catalog. In most cases the infrared is due to heated interstellar dust in the galaxies. The dust masses in dwarf systems have been estimated using simple models of dust clouds. There is no clear relation between the luminosity and the estimated dust mass of a galaxy.

The gas-to-dust ratio in the interstellar medium of the dwarfs is more than one order of magnitude larger than in the interstellar medium of the Milky Way System confirming the well-known fact of low metal abundances in low-luminosity systems.

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A Powerful Method to Survey the Stellar Content of Nearby Galaxies

Slitless spectroscopy through either transmission gratings (grisms) or prisms with suitable intermediate band-pass interference filters allows the detection in crowded fields of a number of objects with outstanding spectral characteristics. Using the ESO NTT, 3.6m and 2.2m telescopes equipped with either EMMI or EFOSC devices we are carrying out this kind of survey. The spectra of interest are searched for on the CCD frames by means of a semi-automatic procedure. As typical examples of our nearby galaxy surveys, we display some results concerning the detection of H α emission-line stars in the young SMC cluster NGC330 and of carbon stars in the Fornax dwarf spheroidal galaxy, as well as the identification of very faint Wolf-Rayet stars in the Sculptor group galaxy NGC300.

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Luminosity Function and Spatial Distribution of Nearby Galaxies

A sample of nearby galaxies ($r < 7.15$ Mpc) has been analyzed with regard to their luminosity function and spatial distribution. Excluding the zone of avoidance the sample is complete down to $M = -14.5$. It includes several loose groups of galaxies which contain roughly 80% of the whole sample. The main results of the analysis are as follows:

- 1) a relation between the slope of the luminosity function of the members of a group of galaxies and the earliest morphological type among the brightest members in this group has been detected which possibly is a new kind of environmental effect;
- 2) the virial masses of the groups of the galaxies are, on the average, by a factor 3 or 4 greater only than the luminous masses derived from the individual galaxy masses;

- 3) the nearby galaxies are concentrated in a thin disk-like layer around the supergalactic plane the thickness of which is some few hundred kiloparsecs only;
- 4) a population of field galaxies with nearly constant density (about 3 per cent of the number density in the supergalactic plane) is extended into the voids on both the supergalactic hemispheres.

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Photographic Surface Photometry of Bright Galaxies in the M 81 Group

A programme for surface photometry investigation of bright galaxies has been started at the Rozhen Observatory since 1991. In a series of papers we are going to explore the optical morphology, photometric properties and some peculiarities, suggestive of galaxy-galaxy interaction, of bright galaxies NGC 2976, NGC 3031, NGC 3034 and NGC 3077 in M 81 group. Most of the plates were taken with the 2 m Rozhen Ritchey-Cretien-Coude telescope, but at our disposal there are plates from the 2 m Tautenburg Schmidt and the 6 m BTA telescope. Now we discuss some preliminary results for optical morphology on the basis of two B-plates from the Tautenburg Schmidt telescope. It shows the edge-on like face of NGC 2976, the grand-designed spiral structure of NGC 3031 and the filament-jet peculiarities in NGC 3034 and NGC 3077.

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Photographic Study of Early Star Groups in Nearby Galaxies with the Bulgarian 2m Ritchey-Chretien

Taking into account the appropriate plate-scale of the Bulgarian 2m Ritchey-Chretien telescope a project to reconsider earlier recognized OB-associations in M31 and M33 was started about 10 years ago. As a result we stated that the concept 'association' in the nearby galaxies had been used for the larger group of stars than in the Galaxy and LMC groups, which Efremov named 'star complexes' (Efremov et al., 1987, *A. & S.S.*, 135, 119; Ivanov, 1987, *A. & S.S.*, 136, 113).

In this paper are reviewed some tens of papers on: the differences and hierarchy in groups in nearby galaxies; relations between the OB-groups and other objects; some of the revealed characteristics of the large groups and tendencies among them; considerations about the spiral structure and star formation in connection with the association ages and their location in the spiral arms.

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Wide-field Imaging of Nearby Galaxies in Near-Infrared Bands

Near-infrared imaging observations in J, H and K bands have been made of nearby galaxies using the 105 cm Kiso Schmidt telescope attached with a 512 x 512 PtSi camera. The large format array has a field of view as large as 14' x 10' with 1.4"/pixel and enables us to observe nearby large galaxies with sufficiently large spatial resolution.

The wide field is important for accurate subtraction of strong and variable sky-background OH radiation at near-infrared. The small f ratio of the Schmidt telescope (F/3.1) is also favourable for observing galaxies in high background radiation. Regardless of low quantum efficiency of MELCO PtSi chip (about 2% at 1.65 micron), the chip has advantages in homogeneity and stability which make accurate flat-fielding possible. As a

result, we achieved the observation at a level of 20.5 mag/arcsec² in 20 minutes exposure in the H band.

We present the images of M 82, NGC 891, NGC 2903 and some others in J, H and K bands as well as their wide-field CCD images in optical B, V, R, I bands. The structure of bulge and disk components of these galaxies and the dust distribution will be discussed.

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Properties and Distribution of Galaxies and Clusters

UBV Surface Photometry of Seyfert Galaxies MKN 358, 991, 993, 1040

Results of UBV surface photometry of Seyfert galaxies MKN 358, 991, 993 and 1040 are presented. UBV photographs of these galaxies were taken on the 2m Tautenburg Schmidt telescope and reduced using the Rozhen package of programs. Isophote and isochromatic maps of galaxies, brightness profiles and U-B, B-V distributions along main axes, morphological functions, indices of concentration, integral apparent and absolute magnitudes, colour indices were obtained. The elliptically averaged brightness profiles were divided into two components: a bright steep internal disc and an external disc. The latter has the central surface brightness by 0.5 mag higher and the scales of lengths somewhat larger than in normal galaxies of the same morphological type. Peculiar morphological and colour details were found in all the studied galaxies. This allows to suppose that possible reasons for activity of the nuclei of these galaxies may be the merging in the past (MKN 358, 991, 993) or interaction with a companion (MKN 1040).

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Observations of Star Formation in the Group of Galaxies NGC 2805, NGC 2820, NGC 2814 and M81

We have identified blue spots ('stellar aggregates') in central regions of the spiral galaxies NGC 2805, NGC 2814, NGC 2820 and in M81 (the Group Holmberg 124) on U, B and V-plates of the 1-metre RC Zeiss telescope at Maidanak Observatory.

The two-colour diagram shows that the observed aggregates of stars are found in regions of young objects, with ages of starburst 1,000,000 — 10,000,000 years using the model of photometrical evolution of galaxies.

The observed activity of star formation in galaxies of the Group Ho. 124 are perhaps related to intergalactic interaction.

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A Burst of Star Formation in Galaxies of the Group M 81

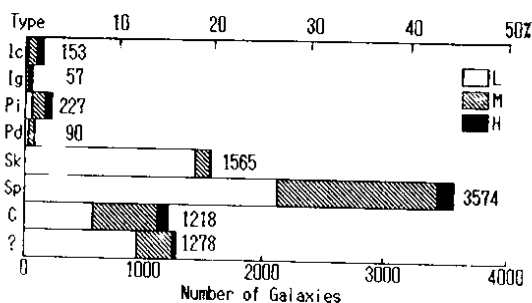
We have identified dozens of hot spots in M 81 and in NGC 3077, and hundreds of hot spots in NGC 2976 on U, B and V-plates of the 1 metre RC Zeiss telescope at Maidanak Observatory in Middle Asia in subsecond seeing. We have obtained some spectra of hot spots in these galaxies with the echelle spectrometer of the 6-metre telescope.

We have estimated the ages of hot spots (young star clusters) by means of the classical model of photometrical evolution of galaxies. We discuss the results of our observed data.

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A Survey for Ultraviolet-Excess Galaxies with the Kiso Schmidt Telescope

We have detected 8,968 ultraviolet-excess galaxies in the sky area of some 5,100 square degrees by means of the UGR three-image photographs with the 105cm Kiso Schmidt, giving a number density of 1.8 per square degree. A net count of the objects is 8,162, deleting those which appear repeatedly in the neighbouring survey areas. The limiting magnitude of the survey plate varies from 17 to 18.5 depending on the plate quality and observational conditions. For each of these galaxies which we call KUG, coordinates, morphological type, size, magnitude and UV-excess degree are given, together with its reference names, if any. These data are compiled in a catalogue series of 17 volumes (see *Publ. Natl. Astron. Obs. Japan*, 3, 21, 1993), which are supplemented by the finding charts for all KUGs. Vol. 18, now in press, is a merged catalogue of all KUGs, arranged in order of the right ascension, with some general descriptions and statistics of the data.



A figure attached here shows the frequency distribution of 8,612 KUGs in respect of the morphological type (legend: Ic=Irregular with clumpy HII regions; Ig=Irregular with a giant HII region; Pi=Pair of interacting components; Pd=Pair of detached components; Sk=Spiral with knotty arms; Sp=Spiral with peculiar bar and/or nucleus; C=Compact and ?=unclassifiable), and UV-excess degree (legend: H=High; M=Medium and L=Low).

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Rapid X-ray Variability and the Fe II Problem in I Zw 1 Objects

X-ray variability in the 0.1 - 2.4keV ROSAT energy band with a doubling timescale of 800s and a factor of 4 within a few hours has been detected in a 20 ksec pointing on the IRAS AGN 13224-3809. The optical spectrum indicates that IRAS 13224-3809 is a narrow-line Seyfert 1 galaxy with strong permitted Fe II emission, a member of the unusual I Zw 1 class objects. IRAS 13224-3809 appears to be one of the most rapidly variable AGN known so far. This is the first time that variability on a timescale smaller than 1000 s is reported at such high $L(0.1 - 2.4keV) = 3 \cdot 10^{44} \text{ erg} \cdot \text{s}^{-1}$ X-ray luminosity in Seyfert galaxies. It is also the first reported X-ray variability in I Zw 1 class objects. The $\Delta t = 800\text{s}$ variation indicates that the X-rays come from a compact region of about 17 light minutes in size. Our results from the X-ray spectral analysis favour a scenario in which a hard X-ray source irradiates the accretion disk which re-emits at soft X-ray energies. The absence of broad H I wings can be explained if only a part of the BLR, far from the centre, is observed and the bulk of the region, which emits the wings, is hidden. We want to draw attention to the fact that rapid X-ray variability could also be connected with the absence of broad H I lines in IRAS 13224-3809.

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Surface Photometry of Galaxies in the Pisces-Perseus Region

Photographic surface photometry of galaxies in the Pisces-Perseus region (700 square degrees) has been made in the B-band using the 105cm Schmidt telescope at Kiso Observatory. Selected galaxies for measurement are all CGCG galaxies, UGC galaxies and optically identified IRAS galaxies in the region. Aperture photometry data by Longo and de Vaucouleurs (1983), Burstein et

al. (1987) and our CCD photometry were used for the calibration.

With HI 21cm data for 1119 spiral galaxies in this region given by Giovanelli and Haynes, which are complete as deep as $m(\text{Zwicky}) < 15.7$, we can study various biases such as Malmquist bias for distance estimates of galaxies.

Using the Tully-Fisher relation with careful consideration of these biases, we obtained, for a global Hubble constant within $cz < 10000$ km/s, $H_0 = 80 \pm 6(+15, -17)$ km/s/Mpc with respect to the CMB rest frame.

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Nuclear Activity in ROSAT Narrow-Line X-ray Galaxies

ROSAT All Sky Survey observations of IRAS galaxies have revealed 10 Narrow-Line X-ray Galaxies (NLXRGs) with $(0.1 - 2.4)keV$ luminosities up to few $10^{43} \text{ erg} \cdot \text{s}^{-1}$. The brightest of these sources are more luminous by at least 2 orders of magnitude than previously detected Narrow Emission Line Galaxies (NELGs). The optical classification of the ROSAT NLXRGs is based on follow-up spectroscopy which indicates clearly the non-Seyfert character of their spectra (LINERs and HII galaxies). On the basis of the present observational material we propose that, in addition to stellar X-ray contributors, an obscured non-thermal active nucleus produces most of the X-ray luminosity of these galaxies. Our results link ROSAT NLXRGs to the AGN family by adding X-ray galaxies which were previously not known to be active. The objects are of interest, too, in comparing starburst models versus black hole models for the central engine in AGN.

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Cross Correlation of the ROSAT All-Sky Survey with the IRAS Point Source and the IRAS Faint Source Catalogue

We present results from cross-correlations of the ROSAT All-Sky Survey with AGN candidates from the IRAS Point Source Catalogue (IRAS PSC) and the IRAS Faint Source Catalogue (IRAS FSC). From the IRAS PSC a sample of 14708 extragalactic IRAS sources has been selected via statistical classification. 244 IRAS galaxies are positionally coincident with ROSAT X-ray sources. It is dominated by galaxies with active nuclei, unlike the sample of IRAS galaxies which have not been detected at X-ray wavelengths, at least in part due to the flux limitations of the ROSAT survey. An unexpected result is the discovery of several HII- and LINER galaxies with luminosities up to $10^{43} \text{ ergs}^{-1}$ well above those found with previous X-ray satellites. We show that an obscured non-thermal active nucleus could produce most of the X-ray luminosity in these objects.

The higher detection rate of IRAS galaxies we are getting for the IRAS FSC doubles about the number of ROSAT detected IRAS galaxies. The results are compared with those obtained from the IRAS PSC - ROSAT All-Sky Survey correlation.

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A Detailed Photometric Study of the Compact Group Hickson 90

Nearby compact groups of galaxies cover a large angular extent. We present a detailed multiband photometric study of Hickson 90, where tidal plumes and a common distorted halo cover more than 30 arcmin on the sky. The photometry has been obtained by means of mosaics of 5-8 NTT images. The matching between various frames has been performed by means of multi-aperture photoelectric photometry with an accuracy better than 5%. The material has also been used to derive the luminosity function of the globular clusters population of the group members, yielding a distance of 27.4 Mpc.

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Observational Properties of the Shakhbazian Groups Shkh 30 and Shkh 360

The Shakhbazian groups are small, relatively isolated and very compact groups of galaxies with a diameter of ≤ 400 kpc. Considering the n-body simulations of Barnes, these Shakhbazian groups should undergo a strong dynamical evolution. Therefore, these compact galaxy groups could be excellent "laboratories" in which to study gravitational interactions as dynamical friction, tidal disruption, galactic collision and galactic cannibalism, which result in a radical restructuring of the galaxy groups within the Hubble time.

In order to get insight into different evolutionary steps the X-ray luminosity of these groups should be used as an important tool because tidal interaction and ram pressure could transform the interstellar gas into hot intergalactic matter. This was confirmed by the detection of X-ray emission from 6 groups

(out of 12 investigated ones). This may be an indication that hot diffuse X-ray emitting intergalactic gas in small groups is not the exception but rather a common phenomenon.

Here we present the results for the groups Shkh 30 and Shkh 360. The data of Shkh 30 fit into the correlation between the X-ray luminosity and velocity dispersion found for clusters of galaxies and marks the lower end of the correlation.

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New Whole-sky Catalog of Flat Edge-on Galaxies

A systematic search for disklike edge-on galaxies with a diameter larger than $a = 40$ arcsec and major-to-minor axis ratio $a/b > 7$ has been carried out by means of Palomar Observatory Sky Survey and ESO/SERC Survey.

As a result, we present a new catalog of flat galaxies (FGC) containing 4455 objects and covering the whole sky, of these, about 56% for the first time.

The catalog is designed for the study of large-scale cosmic streamings and other problems of observational cosmology.

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The Photometric and Geometric Parameters of Galaxies in Clusters A1983, 2065

The programme for investigation of more than a hundred clusters of galaxies undertaken at Abastumani is described. It includes the study of the overall properties of clusters of galaxies and determination of the photometric, geometric and dynamic parameters of brighter galaxies. Among them the fifteen clusters were measured in one or two colours.

The photometry is reported for the galaxies in two clusters A1983, 2065 with redshifts 0.046, 0.072 respectively. The plates were obtained using the 2.6m telescope at Buyrakan Observatory and scanned and processed at Babelsberg Observatory. The magnitudes were integrated up to the isophote 25.0 mag per sq. arcsecond with completeness limit 19.5 mag in the photographic band. Luminosity segregation is observed only within a magnitude from the brightest galaxy. Observed ellipticities do not depend on the luminosity, diameter and position angle of the galaxy.

The radial density profiles were studied for up to sixty clusters. They were approximated by the sum of exponents, parameters of which were determined by the Proni method.

The intermediate distance clusters ($0.05 < z < 0.15$) will be studied by CCD, mounted on 125cm RC and 70cm meniscus type telescopes.

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The Initial Results on Galaxy Counts and Searches for $z > 4$ Quasars using the Palomar-STScI Digital Sky Survey

Using the SKICAT system described in these proceedings, we are constructing star and galaxy catalogs from the Palomar-STScI Digital Sky Survey. Here we present our initial results on galaxy and star counts in two colors (photographic J and F, calibrated to Gunn g and r bands), for a multi-plate region near the north Galactic Pole, covering up to 5 Survey fields (~ 125 square degrees), and up to 11 Survey fields (~ 275 degrees) in a single color. The data have been uniformly calibrated using CCD sequences and plate overlaps over the range $16 < r < 20$, within which we are over 90% complete. We also performed extensive tests to assure the accuracy of automatic galaxy classifications over this magnitude range. Previous results from the southern APM Survey implied dramatic evolution of galaxies at low redshift. We will present our new galaxy counts as a function of magnitude and color in the context of these measurements and galaxy evolution models. We also started a pilot program to identify quasars at $z > 4$ using their (J-F) colors alone. Our improved star-galaxy classification techniques result in a lower contamination by galaxies, which was the principal problem in similar searches to date. Spectroscopy of the first set of candidates is now in preparation, and may be presented at the meeting.

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Galaxy Clustering to $B=27^m$

We investigate the angular two-point correlation function, $\omega(\theta)$, for faint galaxies on 12 CCD frames with a magnitude limit $B=25.0$ and a single deeper frame reaching $B=27.0$. It is found that the correlation amplitude is significantly lower at these magnitude limits than would be expected for a model in which clustering is stable in proper co-ordinates and the redshift distribution maintains a no-evolution form. These results suggest then that the very blue (flat-spectrum) objects appearing at $B>23.0$ are, if they are clustered as normal galaxies, broadly distributed in redshift over $1<z<3$ approximately. If they are at lower redshifts their clustering must be much weaker than expected from a stable clustering model.

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Galaxy Counts to $B = 28^m$

We present blue-band galaxy number-magnitude counts to a 3-sigma detection limit of 28th magnitude based on 24 hour and 10 hour CCD exposures on the Isaac Newton 2.5m and William Herschel 4.2m telescopes respectively. Our results show a clear flattening of the slope of the counts faintward of $B=26$, and we discuss this feature in the light of current cosmological and evolutionary models. We also present a compilation of counts from various authors encompassing an 18 magnitude range from $B=10$ to our current limit, and consider the constraints and problems posed by the data over this wide range.

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The Evolution of Galaxies over the last 10 Gyr

Rest frame narrow band blue colours are presented for 504 galaxies in 16 rich clusters between $z = 0$ and $z = 1$. Photometry in the Strömgen system (3500 Å, 4100 Å, 4750 Å and 5500 Å) is used to isolate blue versus red galaxies and to trace the evolution of colour in red objects (i.e. ellipticals). Our observations confirm a strong, rest-frame, *Butcher-Oemler* effect where the fraction of blue galaxies increases from 20% at $z = 0.4$ to 80% at $z = 0.9$. We interpret this as the evolution of S0s in cluster cores from star-forming 8 Gyrs ago to non-star-forming 4 Gyrs ago and the building up of ellipticals and S0s by merging processes. After isolating the red objects in each cluster, we then compare the mean colour of these old, non-star-forming objects for comparison with SED models in the literature as a test for passive galaxy evolution in ellipticals. We find good agreement with single burst models which predict an epoch of galaxy formation from $z_s = 2$ to 8.

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Wide Field Galaxy and Cluster Surveys using COSMOS

We describe the main galaxy and cluster surveys undertaken with the COSMOS plate-scanning facility in Edinburgh. The principal survey to date has been the COSMOS/UKST Southern Galaxy Catalogue, which is a catalogue of some 7 million galaxies to $b_j = 20.5$ from scans of the UKST Southern sky IIIa-J survey. Cluster-detection algorithms have been developed and also applied to the catalogue producing a cluster catalogue with some 30,000 entries. The clusters have been characterised automatically. We plan to extend this work to the Southern sky red plates and the POSS II red and blue plates on the second generation Edinburgh machine (SuperCOSMOS) which is due to begin full operations in September of 1993.

In parallel with these all-sky 'shallow' galaxy and cluster catalogues, we are also applying the same techniques to deeper samples covering several hundreds of square degrees which are obtained from digital stacking of several fine-grain films of each of several fields at the NGP. The resulting material are being used to obtain information on a statistically useful sample of very distant clusters.

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Luminosity Distribution in cD-Clusters

The ratio of contributions from cannibalism and from cooling flows to the final cD galaxies in diverse clusters seems to be different. It should be determined by some general cluster properties as for instance the central mass concentration. Assuming that mass distribution is tantamount to luminosity distribution we analyzed the question of possible luminosity segregation in the radial galaxy distribution of galaxy clusters.

Our results favour cannibalism as a possible factor for the evolution of cD galaxies. We discuss radial luminosity segregation in clusters and the properties of the central dominant galaxies (envelope structure, radial colour gradient, velocity offset, and radio activity) for a sample of galaxy clusters. Dominant cluster galaxies exhibit a broad spectrum of properties ranging from normal brightest E-galaxies (not evolved objects) to highly evolved objects. There seems to be a connection between the degree of central luminosity segregation and these properties. We interpret the diversity of cD properties as reflection of different evolutionary stages of these objects, which are determined by the parent cluster population. Our results favour the view that cD galaxies are not simply the brightest E galaxies in clusters but are formed by special processes from elliptical-like dominant galaxies.

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Analysis of Galaxy Counts in the Shapley Supercluster Area using the Wavelet Transform

The general field of the Shapley supercluster is analyzed using an objective two-dimensional galaxy catalogue. Homogeneous equatorial positions and magnitudes have been obtained using the MAMA facility (Paris) on ESO R Schmidt plates and CCD calibration frames. This photometry is near completion for a 10° area centred on A3558. The analysis of this field by means of classical image processing techniques provides a preliminary catalogue complete down to about $R = 19$ with a low level of star contamination.

The multi-scale clustering which occurs in the whole Shapley supercluster is investigated using a wavelet analysis of the galaxy distribution. All the Abell clusters and Raychaudhury's groups are clearly exhibited, excluding the faintest ones. Several new large groups and filamentary structures are detected with a high confidence level and parameterized. Special interest is devoted to the bridges or clouds of galaxies connecting the different clusters.

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Deep Spectral Survey on the 6-Metre Telescope: A Sample of Objects in One-Degree Field 09h40m+50 Complete to B=21

Taking into account the interest in the large-scale distribution of matter in the Universe, we began in 1990 on the 6-metre telescope a spectral survey of a complete sample of objects. The field and depth of the survey were selected according to the characteristic size of large-scale structures to be observed: the size of field is 1 square degree and limiting magnitude is 23 in B.

We report here results of the first stage of

our investigation — the creation of a sample of objects in one-degree field complete to B=21. Photometrical data were obtained with the 1-metre telescope at Mt. Maidanak. Observations and preliminary data processing were described by us earlier (Afanasiev et al., 1990). For data reduction with a personal computer specialized software were written. This software includes amongst others procedures for: sky subtraction, automatic search for objects, isophotal and aperture photometry, classification of detected sources: star-like and extended.

The resulting sample contains more than 3000 objects, brighter than B=21.25. Photometrical errors are less than 0.15 mag for objects brighter than B=20, and slightly larger for fainter ones. The mean error in coordinates is near 0.25" - 0.3".

The derived differential counts for stars and galaxies demonstrate good agreement with data of other authors: for example, this dependence for galaxies is well approximated by the formula:

$$\text{Log}(N_{\text{gal}}) = (0.473 \pm 0.003) \times \text{Mag}(B) + \text{Const}$$

where N_{gal} is the number of galaxies per 0.5-mag interval.

Identification of one radio source from the 5CI catalogue in our field was recovered, 5 of them were newly identified.

Plans for future investigations are briefly described.

Reference

Afanasiev et al., 1990. *Astrophys. Issled.* (*Izvestia SAO*), 32, 73. (In Russian)

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Large-Scale Structure in the Distribution of Galaxies

Mapping the Large-Scale Structure

The nearby galaxy distribution suggests a remarkable structure in which large voids are delineated by dense walls of galaxies in a cell-like pattern. The nearby voids range in diameter from ~ 10 to $\sim 50 h^{-1}$ Mpc (with a Hubble constant of $100 h$ km/s/Mpc). Deeper surveys appear to be consistent with the nearby distribution and show no evidence of voids larger than $\sim 100 h^{-1}$ Mpc. We might thus have reached the scale where the universe becomes homogeneous. The size of the largest inhomogeneities in the galaxy distribution is an important issue because it can put tight constraints on the theoretical models when confronted to the high degree of isotropy of the microwave background radiation.

Although deep pencil-beam surveys are best suited for probing a large number of voids and walls, understanding the nature of the intercepted peaks and valleys in terms of large-scale structure requires that the angular coverage of the surveys be larger than the galaxy auto-correlation length. If this condition is not satisfied, the size of the voids and the density contrast of the walls can be overestimated.

These considerations emphasize the need for systematic redshift surveys over significant areas of the sky out to intermediate and large distances. Medium size telescopes with wide-field CCD imaging capabilities will be important tools for providing the necessary galaxy catalogues.

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Large-Scale Structure in the Durham/UKST Galaxy Redshift Survey

Here we report on the progress of the compilation and analysis of the Durham/UKST galaxy redshift survey. This survey will cover a large contiguous area of sky in the SGP region and contain redshifts of some 4000 galaxies of $b_j < 17^m$ providing detailed topological information about the structure of the Universe on large scales. Large features on scales of $\sim 100h^{-1}$ Mpc are clearly visible on examination of the completed section of the survey although a statistical analysis of the survey by means of the two-point correlation function is close to zero on scales of $r > 10h^{-1}$ Mpc.

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A Redshift Survey to $b_j \leq 19.4$ in the Southern Sky

In September 1991 we started a galaxy redshift survey over a strip $22^\circ \times 1.5^\circ$ (plus a nearby area $5^\circ \times 1.5^\circ$, five degrees west of the strip) in the South Galactic Pole region. We plan to fill this area with a regular grid of circular fields with a diameter of 32 arcminutes. This size corresponds to the field of view of the multifiber spectrograph (OPTOPUS) we use at the ESO 3.6m telescope, which allows us to observe 46 galaxies (plus four skies) at one time.

The limiting magnitude of the survey is $b_j \leq 19.4$ and the target objects have been selected from the Edinburgh-Durham Southern Sky Galaxy Catalogue.

Up to now we have observed 76 fields and fully reduced data for 47 fields in the first strip (90% coverage) and 16 in the second strip, covering about 12 square degrees and totalling about 2000 galaxy redshifts.

Some preliminary results will be shown, among these:

- 1) A new determination of the galaxy luminosity function;
- 2) The statistical properties of emission lines galaxies, with particular emphasis on the OII $\lambda 3727$ equivalent widths distribution (which traces the star formation rate).

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Search for Faint Galaxies towards Nearby Voids

Recent large-field redshift surveys, all based on intrinsically bright galaxies, have revealed a cellular structure of the nearby universe, where large voids are surrounded by sheet-like concentrations of galaxies. This picture may depend on observational bias. Here, we present a search for intrinsically faint galaxies towards three nearby voids, where we tried to overcome at least some of the bias inherent in the available surveys. We tested three strategies, namely searching candidates on the old Palomar Sky Survey Prints, and searching such objects on Prime focus images of the Calar Alto 3.5 m telescope. While the Prime focus images have a relatively small field (1 square degree for plates, 35 square arcmin for CCD), they have better resolution and deeper limiting magnitudes than the POSS plates. Follow-up spectroscopy was obtained in all cases. We will describe our observations, their reductions, and their relative efficiency in finding galaxies within the expected redshift range.

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Properties and Clustering of Objects at Large Redshift

Quasar Variability from Microlensing

A large scale programme to detect quasars from their variability has yielded a sample of some 1000 quasars with light curves covering 17 years. This paper argues that the variability observed is best explained as a result of microlensing by compact substellar objects along the line of sight. This in turn implies that the density of such objects must be at least 0.1 of the critical density, sufficient to account for the 'missing' baryonic matter.

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A Study of Optical Long-Term Variability of Quasars

The optical long-term behaviour of a sample of quasars has been investigated on plates from the archive of the Tautenburg 134 cm Schmidt telescope. The basic sample consists of 28 quasars and quasar candidates (from published catalogues) in a field centred on M3 which were identified on deep plates by their coordinates. More than 100 *B*-plates were inspected and magnitudes were measured on about 60 photometric plates covering a time interval of nearly 30 years. A final sample was constructed from the 18 objects with $\langle B \rangle \leq 19^m.5$ which is about 1 to 2 mag below the limit of a deep exposure plate. The standard deviation σ_B was used as an indicator of variability. 50% of the final sample objects were classified as variable by the *F*-test with $\alpha = 0.02$. For the brightest object in our sample, Q1340+289 ($\langle B \rangle = 17^m.2$, $z = 0.90$), the comparison of our data with published measurements on 40-50 year old Harvard plates reveals a dimming by about 2 mag; no flare-like activity is seen in our data. The other bright object, Q1337+283 ($B = 17^m.5$, $z = 2.52$), shows no sign of any variability.

We further measured plates from the north ecliptic pole to study the temporal behaviour of Q1808+676 = Kaz 102 ($z = 0.138$). This object is found to become brighter by $\Delta B \approx 0.5$ mag over the last 15 years. It shows 'anti-flares' of $\Delta B \geq 0.1$ mag.

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Search for Quasar Candidates using the MAMA Microdensitometer

In order to get a better understanding of the physics, evolution and spacetime distribution of quasars, it is still necessary to increase the number of known objects, especially nowadays in the high redshift range. A prime interest is the possibility, provided large, deep and homogeneous quasar surveys are produced, to address the distribution of matter in the Universe at intermediate redshifts; this is especially important to make a link between the high local degree of structure and the homogeneous Universe of widely used cosmological models.

Two deep ($B \sim 21$) and homogeneous surveys for quasars are being conducted in collaboration with Centre d'Analyse des Images (Paris, France); one of them covers a wide 300-square-degree region around the North Galactic Pole and the other one deals with three southern 40-square-degree fields (NGC 450, NGC 520, ESO 300). Quasar candidates are systematically selected, using photometric criteria, among exhaustive catalogues of objects produced from Schmidt plates with the MAMA microdensitometer. The candidates selected are to be confirmed by multi-object spectroscopy.

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The Second Byurakan QSO Survey

From the Second Byurakan Survey (SBS) we have produced the new complete sample of bright QSOs.

The observations were obtained using 1.5, 3 and 4 degree objective prisms with the 40-52 inch Schmidt telescope at the Byurakan Observatory. The total sky coverage area of SBS is 1000 square degree from R.A. 07.40-17.15 and Dec. +49-+61.

In all in SBS are selected about 3000 objects — 1600 stellar objects and about 1400 galaxies down to a limiting magnitude $B < 19.5$.

Spectroscopy was made on the 6m telescope of SAO (Russia), 2.6m telescope of BAO (Armenia) and 4.5m MMT (USA). Photometry on the 0.9m Burrell-Schmidt at Kitt Peak and 1.2m at Wipple Observatory.

A new estimate of surface density and luminosity function for bright QSOs in the magnitude range $15.5 < B < 17.5$ on the basis of new complete sample of bright QSOs are discussed.

The surface density of bright QSOs in magnitude range $16.0 < B < 17.0$ will be corrected by a factor of 2.

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The Hamburg/ESO Survey — Slitless Spectroscopy at High Resolution

In extragalactic survey work, in particular QSO surveys, reaching faint magnitudes with slitless spectroscopy can only be achieved with very low spectral resolution. We demonstrate a very different approach: digitised objective-prism plates taken at rather high dispersion (450 Å/mm at H_α) can provide excellent material to conduct a wide-angle spectral survey. One prerequisite is the ability to process a large number of fields in a short time. In Hamburg we have developed such

techniques, including plate scanning and automated selection of peculiar objects. The Hamburg/ESO survey, based on plates taken with the ESO Schmidt telescope, aims at performing a complete QSO survey over 5000 deg² in the magnitude range $13 < B < 17$. The spectral resolution allows quasar candidates to be selected by the absence of typical stellar absorption line patterns, without demanding colour excess or emission lines to be present. The survey is also a rich source for other object classes which can be efficiently identified and classified already in the objective prism spectra.

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The Hamburg Quasar Survey

A machine based search for quasar candidates has been developed at Hamburg (Hagen et al., 1993). Our aim is to provide bright quasars to make follow-on studies on the physics of quasars and the cosmic matter in front of them (Reimers et al., 1989; Reimers et al., 1992; Hagen et al., 1992). In selected fields we pursue completeness down to 17.5th B-magnitude.

The survey plates are taken with the Schmidt telescope on Calar Alto equipped with a 1.7 deg objective prism yielding a dispersion of 140 nm/mm at H-Gamma. Two prism plates and one direct plate are taken for every 5.5 deg x 5.5 deg Schmidt field with galactic latitude greater than 20 deg and positive declination. All exposures are made on Kodak IIIa-J emulsion.

Complete scans of prism plates are made perpendicular to the direction of dispersion in a low resolution mode. In this mode the range from the emulsion cut off at 540 nm to 340 nm has 15 measured pixel with increasing resolution. Online background recognition yields to 90 to 95% data reduction. Direct plates are scanned with 1.7" x 1.7" slit with the same background reduction. All digitized data are stored on magneto-optical disks.

The continua of all low resolution spectra are fitted with polynomials of 2nd degree. The slopes at 440 nm are plotted against the density sum, and all spectra above a density sum dependent slope with a signal-to-noise ratio of at least 10, and below the density where saturation effects appear, are selected as quasar candidates. This means for plates with average quality a range from 13th to 17.5th magnitude and about 500 candidates for high galactic latitudes up to 2000 for low latitudes. These candidates are scanned in high resolution mode (10 times higher than low resolution) and are interactively classified on a vector graphics screen. In every field typically 5 to 10 quasar candidates remain besides hot subdwarf stars and narrow emission line objects.

Candidates are verified by follow-up slit spectroscopy with the 2.2m telescope at the DSAZ on Calar Alto, Spain

References

- Hagen, H.-J., Engels, D., Groote, D. and Reimers, D., 1993. 'The Hamburg Quasar Survey: I. Schmidt observations and plate digitization', in preparation.
- Hagen, H.-J., Cordis, L., Engels, D., Groote, D., Haug, U., Heber, U., Koehler, T., Wisotzky, L. and Reimers, D., 1992. 'HS 1946+7658: the most luminous QSO so far', *A. & A.*, 253, L5.
- Reimers, D., Clavel, J., Groote, D., Engels, D., Hagen, H.-J., Naylor, T., Wamsteker, W. and Hopp, U., 1989. 'The luminous quasar HS 1700+6416 and the shape of the 'big bump' below 500 Å', *A. & A.*, 218, 71.
- Reimers, D., Vogel, S., Hagen, H.-J., Engels, D., Groote, D., Wamsteker, W., Clavel, J. and Rosa, M.R., 1992. 'The O/C abundance ratio in absorbing gas clouds at high redshift', *Nature*, 360, 561.

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