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 e_{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.

Massimo Capaccioli
Dipartimento di Astronomia
Università di Padova, Italy

Osservatorio Astronomico de Capodimonte
Napoli, Italy

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 (Rμ). Moderately large low surface galaxies such as those in the Virgo Cluster Catalogue can be traced out to an isophote around 27 Rμ.

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 Rμ.

Steven Phillipps
University of Wales College of Cardiff, UK

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.

R.M. Smith, S. Phillipps, J.I. Davies and G.J. Privett
Dept. of Physics and Astronomy
University of Wales College of Cardiff
P.O. Box 913, Cardiff CF2 3YB, Wales

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 ~ 27 $B/(arcsec)^2$ and ~ 26 $V/(arcsec)^2$, 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 $B/(arcsec)^2$. Typically, the dwarfs show a "subexponential" (i.e. a convex curvature over linear radius) SB-profile and often a central excess.

J. Vennik
Tartu Astrophysical Observatory, Estonia

G.M. Richter
Potsdam Astrophysical Observatory, Germany

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.

K.-H. Schmidt
Astrophysikalisches Institut Potsdam

T. Boller
Max-Planck-Institut für Extraterrestrische Physik
Garching, Germany

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 Hα 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.

G. Muratorio and M. Azzopardi
European Southern Observatory
Karl-Schwarzschild-Strasse 2
D-W-8046 Garching, Germany

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.

K.-H. Schmidt
Astrophysikalisches Institut Potsdam

T. Boller
Max-Planck Institut für Extraterrestrische Physik
Garching, Germany

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.

Rumen G. Getov
Rozhen National Astronomical Observatory
P.O. Box 136, 4700 Smoljan, Bulgaria

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.

N.S. Nikolov
Department of Astronomy
University of Sofia, Bulgaria

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/arcsec^2 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.

T. Ichikawa, K. Yanagisawa, N. Itoh and M. Ueno
Kiso Observatory, University of Tokyo, Japan