

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

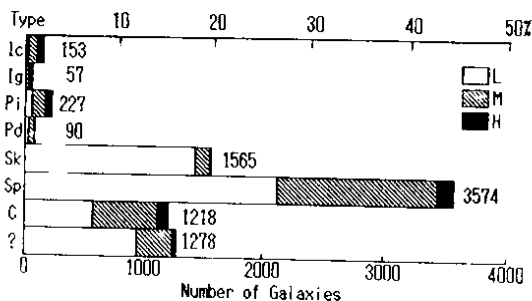
We have identified dozens of hot spots in M 81 and in NGC 3077, and hundreds of hot spots in NGC 2976 on U, B and V-plates of the 1 metre RC Zeiss telescope at Maidanak Observatory in Middle Asia in subsecond seeing. We have obtained some spectra of hot spots in these galaxies with the echelle spectrometer 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 $10^{43} \text{erg} \cdot s^{-1}$. 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}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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