

COMMISSION 28: GALAXIES (GALAXIES)

Report of Meetings, 15, 16, 17, 18, 21, 22, and 23 August 1979

ACTING PRESIDENT: B. E. Westerlund      SECRETARY: V. C. Rubin

Dr. Westerlund was Acting President in the absence of the Commission President, Dr. B. E. Markarian, who was ill.

Commission 28 was involved in ten sessions, four of them all-day joint discussions:

Nuclei of Normal Galaxies (Commissions 28, 33, 34, 40)

Ultraviolet Astronomy/Results from Recent Space Experiments (34, 28, 29, 44, 45)

Very Hot Plasmas in Circumstellar, Interstellar, and Intergalactic Space (34, 10, 28, 44, 48, 49)

Extragalactic High Energy Astrophysics (40, 28, 44, 47, 48)

Details of these joint meetings will appear in Highlights of Astronomy. Of the remaining sessions, two were joint with Commission 33 (Structure and Radio Astronomy). The remaining sessions were Commission 28 alone. Programs for these meetings and abstracts of some of the papers presented follow the discussion of the business meeting below.

16 August 1979

BUSINESS MEETING

I. NEW OFFICERS AND MEMBERS

The Commission unanimously approved the election of the new President, B. E. Westerlund, and Vice-President, V. C. Rubin. The President proposed, and the Commission unanimously accepted, the list of names proposed for the new Organizing Committee.

The list of IAU members who wish to join Commission 28 was read and adopted, with one addition from the floor. A second list of 79 new members to the Union who indicated an interest in joining Commission 28 was discussed. In 1976, Commission 28 had decided to accept for membership only those IAU members of three years standing. After some discussion, it was voted to set aside this previous decision, and to accept as members all new members who wish to join Commission 28, subject only to the IAU rule that they belong to only one Commission during their first three years.

II. PROPOSED RESOLUTION

Dr. J. Heidmann proposed the following resolution, "In view of the various values of the Hubble constant  $H$  it is recommended to keep track of their influence in calculations and results by writing  $H = 100 h \text{ km s}^{-1} \text{ Mpc}^{-1}$  where  $h$  is a dimensionless number." A discussion and a straw vote indicated little support for the resolution, so the resolution was not voted upon.

III. REPORT OF COMMISSIONS

Following the discussion by the Commissions' Presidents concerning the reports of Commissions, it was decided to change the format for references and to use abbreviated journal references, rather than the Astron. Astrophys. Abstracts numbering system. This change should make the reports more readable and useful.

## IV. ATLAS OF GALAXIES IN COLOR PREPARED BY JAMES WRAY

Dr. Wray presented color slides of over 20 galaxies. The slides were made from color prints produced by a dye transfer technique, using image-tube photographs taken in three colors. The three colors have a linear response throughout the entire dynamic range, and the presentation was spectacular and impressive for the wealth of science contained in the prints. Dr. Wray asked for an expression of support from Commission 28 in his efforts to obtain financial support for the publication of an atlas of about 170 galaxies.

The following statement, signed by B. E. Westerlund, was given to Dr. Wray.

"Commission 28 (Galaxies) recognizes the important scientific value of the color photographs of galaxies which you have prepared, and considers that they will be a continuing source of value in many ways for astronomers working in extra-galactic research. In this regard the members of Commission 28 present at the administrative session introduced and unanimously passed by general acclaim the following resolution in support of your work:

'In view of the high scientific quality and potential usefulness of your photographs for galaxy research we hereby express our strong support for your efforts to publish an atlas of color photographs of galaxies.'

## V. ASTRONOMICAL NOMENCLATURE

Dr. G. de Vaucouleurs reported on the meeting called by Dr. C. Jaschek (Commission 5: Documentation) which he attended as a representative of Commission 28. The attempt to set up a universal IAU system of nomenclature for all types of objects was described, with special reference to the report of Dr. Bidelman's working group for non-stellar objects. After some discussion, there was general agreement among Commission 28 members that authors should give two designations for every object; one a familiar or catalogue name and the second a position conforming to the rule for designating objects adopted earlier by the IAU. Although some members expressed strong preference for coordinates for the epoch 2000, it was recognized that stellar astronomers have a preference for 1950 coordinates. Commission 28 is invited to submit a statement to Dr. Jaschek by the end of 1979 containing its suggestions on this matter.

## PROGRAMS OF SCIENTIFIC SESSIONS

## GALACTIC DYNAMICS August 15 Joint with Commission 33

- A. Kalnajs: Bar Modes of Disks.
- A. Toomre: What Amplifies the Spirals?
- R. H. Miller: Numerical Simulation of Galaxies.
- G. Contopoulos: Integrals of Stellar Motion and their Disappearance.
- P. O. Vandervoort: Resonance Phenomenon in the Dynamics of Spiral and Barred Galaxies.
- C. C. Lin: Progress in Density-Wave Theory.
- W. W. Roberts: Gas Flow in Galactic Bars.
- P. Schwartz: Gas Flow in Inner Disk Forced by Oval Distortion.

## RADIO STUDIES OF GALAXIES August 16 Joint with Commission 40

- P. C. van der Kruit: Nearby Galaxies in Continuum and the Hydrogen Line.
- E. M. Berkhuysen: Radio Spectral Index and Polarized Emission of M 31 and M 33.
- H. van der Laan: Progress Report on the Westerbork M 31 Study.
- R. Wielebinski: Radio Haloes of Galaxies.
- E. Raimond: H I in NGC 4278.
- L. J. Rickard: CO Emission from Nearby Galaxies.
- R. D. Davies: Integral Properties of 100 Sbc Galaxies.
- D. E. Harris: Overview on Active Galaxies.
- R. Wielebinski: High Frequency Observations of Very Large Radio Galaxies.
- E. B. Fomalont: Radio-Tail Structure of Jets in 3C31 and NGC 315.

- J. F. C. Wardle: Radio Jets in Quasars.  
 K. Weiler: Statistics of BL Lac Objects.  
 D. Stannard: BL Lac Objects.  
 A. Bosma: Fleurs Map of Fornax A.  
 B. F. Burke: VLA Observations of the Double Quasar 0957 +561 A, B.

## NEW RESULTS IN EXTRAGALACTIC RESEARCH August 16

- A. Yahil: The Determination of the Deceleration Parameter in the Local Supercluster of Galaxies.  
 G. de Vaucouleurs:  $H_0$ : 50 or 100?  
 F. H. Chaffee, Jr., R. J. Weymann, M. Davies, N. P. Carleton, D. Walsh, and R. F. Carswell: The Twin Quasars 0957+561A, B: A Summary of the Current Observational Knowledge.

## NEW IDEAS CONCERNING LARGE SCALE STRUCTURE OF GALAXIES August 17

Morphology

- J. S. Gallagher: A Relationship between Morphology and H I Content in SO Galaxies.  
 J. Heidmann: Giant Clumpy Irregular Galaxies.  
 W. Eichendorf: The Physical Parameters of Double Galaxies.

Rotation

- F. Bertola: Structure and Dynamics of Early Type Galaxies.  
 H. van Woerden: Distribution and Kinematics of Gas in Early Type Galaxies.  
 V. Rubin: Rotation Curves of Sa and Sc Galaxies.  
 J. W.-K. Mark: Global Dynamics in Disk Galaxies: Do They Provide Indicators for Haloes?

Formation

- R. B. Larson: The Early Evolution of Galaxies.

Chemical Properties

- S. M. Faber: The Chemical Composition of Galaxies: Recent Results.

Clustering

- J. Einasto (read by M. Longair): Cluster Chains as Basic Elements in the Cell Structure of the Universe.

## GALACTIC ENVIRONMENT August 17 Joint with Commission 33

- W. E. Kunkel: Galactic Environment: Optical Data.  
 A. N. M. Hulbosch: High-velocity Clouds.  
 B. M. Tinsley and J. Jaaniste: Galactic Environment: Theoretical Considerations.  
 R. B. Larson: Nature and Cosmogony of Population III Objects.

## NEW DATA ON GALAXIES August 18

- G. Wynn-Williams and E. Becklin: Infrared Studies of the Central Regions of the Spiral Galaxies NGC 253 and IC 342.  
 B. Tully: A Hierarchical Description of Galaxy Clustering in the Region of the NGC 1023 Group.  
 W. A. Sherwood and G. F. O. Schnur: Spectra of Early Type Galaxies.  
 M. Whittle: Emission Line Profiles in Pictor A.  
 J. W. Sulentic: Old and New Properties of the M87 Jet.  
 G. de Vaucouleurs: The Inclination of the LMC.  
 T. Murai: The Dynamics of the Triple System: The Galaxy, LMC, and SMC.  
 M. W. Feast: Cepheids, the P-L-C Relations, and the Distance to the LMC.  
 M. Azzopardi: Determination of the SMC Distance Modulus by Hy Photometry.  
 P. Dubois: Distance Modulus and Depth of LMC.  
 M. Penston: Motions in the Interstellar Medium in Some External Galaxies.

## ABSTRACTS OF SCIENTIFIC PAPERS:

P. Vandervoort: The resonance regions of a galaxy are defined in the first instance by conditions under which resonances occur in the stellar orbits. Theories of the role of resonant stars in galactic dynamics must take proper account of the intrinsic nonlinearity of the resonance phenomena. Current theories of equilibrium structures of galaxies are nonlinear in this sense. Even when resonant stellar motions are unimportant, the resonance regions of a galaxy are well defined regions which play a special role in the dynamics.

W. W. Roberts: Recent steady-state and time-evolutionary gas dynamical studies help to provide a deeper understanding of barred spirals. The dark narrow dust lanes observed against the bar can be understood as a tracer of the shocks formed in the gas. Large non-circular motions occur in the calculated gas flows with magnitudes up to 100 - 150 km s<sup>-1</sup>, and these can account for the strong velocity gradients observed in some bars.

R. D. Davies: A study has been made at Jodrell Bank of the integrated neutral hydrogen properties of Sbc ( $T = 4$ ) galaxies. Correlations between optical and H I properties show that the radius is a better discriminant of galactic properties than is luminosity class.

G. de Vaucouleurs: The two main approaches to the Hubble constant by Sandage and Tammann (1974-75) and by de Vaucouleurs (1978-79) were compared. The need for proper treatment of interstellar extinction, for independent checks of linearity, and for allowance for distortion of the velocity field by the Local Supercluster was emphasized.

F. H. Chaffee et al.: The combined optical observations from the Kitt Peak 2.1-m, the Steward 2.3-m, and the MMT reveal that the twin QSO's, whose angular separation is 6 arc sec, are nearly indistinguishable spectroscopically. The most stringent parameter is that provided by the Mg II and Fe II absorption lines in the two objects which give a velocity difference of  $7 \pm 15$  km s<sup>-1</sup>. Such a small difference is difficult to reconcile with explanations of the objects as two distant QSO's. We discuss the possibility of the objects being the double image of a single QSO produced by a gravitational lens lying between us and the QSO.

J. Heidmann: Clumpy irregulars contain  $\sim 6$  clumps, each 100 times more important than HII regions with respect to optical luminosity, total mass, UV luminosity, and early star content. These bursts of star formation of unprecedented power deserve further investigations (IR, X, CO, VLA, abundances) of their nature, age, origin, and evolution (see "First Year of IUE Symposium," London, 1979).

Bertola: It is well established that the velocity of rotation in these galaxies is remarkably less than in S O and spirals. The study of the shape of their isophotes shows that all the possible trends of ellipticity can be found and that often a twisting of the axes is present. These observational facts are not consistent with the conventional view of elliptical galaxies as oblate spheroids and we have to consider other solutions such as triaxial or prolate structures.

van Woerden: A survey of 54 southern lenticular (SO and SO/a) galaxies at Parkes has yielded 15 unconfused HI line detections. The gas content is not correlated with colour, luminosity or bulge-disk ratio. The "Tully-Fisher relation" (blue or yellow luminosity vs. inclination-corrected profile width) for (northern + southern) lenticulars is closely similar to that for southern late-type (Sc - Im) galaxies.

Westerbork observations of NGC 4203 (SO-) reveal HI extending over 3 optical diameters, with considerable structure and a flat rotation curve. NGC 4694 (SBOp) has an unresolved HI concentration at the centre and two clouds of  $\sim 10^8 M_{\odot}$  4 - 5 arc min west, at relative velocities  $\sim 60$  km/s.

V. C. Rubin: For a set of 21 Sc and 10 Sa galaxies of both high and low luminosities, optical rotation curves have been determined. All rotation curves are flat. This implies a significant mass beyond the optical image. Correlations between  $V_{\max}$ , radius, mass, luminosity, and morphology are discussed.

J. W.-K. Mark: Three classes of internal dynamical indicators were considered. (1) The absence of a strong global stellar bar is evidence for a halo only if the galaxy does not also have a nuclear bulge amounting to about 30% of its mass. Such a bulge is sufficient to suppress strong bar-focusing disk instabilities, even with no halo (Berman and Mark, A & A July, 1979). (2) Haloes comparable or heavier than the disk drive self-excited waves (Bertin and Mark, A & A submitted). Isolated galaxies with warps are thus possible evidence for haloes. (3) Indirect indicators may be developed from spiral structure. Absolute amplitudes of density waves are affected by halo sizes. For example, large halo masses within the disk radius would produce more chaotic spiral structure of small pitch angle.

S. M. Faber: Nearby E and SO galaxies usually show color and line-strength changes within the innermost 10 kpc, which are commonly attributed to composition gradients. Beyond 10 kpc, the gradient may flatten. The global mean composition of ellipticals is strongly correlated with luminosity and flattening. These correlations are consistent with gaseous collapse models, but harder to understand in the context of stellar collapse or merger models. The abundance differences seen among spiral galaxies are larger than expected from a single-zone model, which predicts a close correlation between mean gaseous abundance and remaining gas content. Evidently at least one additional parameter other than gas consumption must be important in controlling the chemical evolution of disk galaxies. This factor might be radial gas flows or variations in the nucleosynthetic yield, but its identity is presently unknown.

F. G. O. Schnur and W. A. Sherwood: We have 9 A resolution spectra from 3800A to 7000A of the inner 1" x 4" region of 50 galaxies classified as SO by Sandage or having T = -3 to 0 in RC2. We find 70% show emission lines, i.e., contain gas, and 18% contain [OIII]. One galaxy is a Type I Seyfert.

J. W. Sulentic: The 1956 polarization photographs of the knots in the jet of M 87 have been repeated in 1978. A comparison reveals that at least the brightest knot has varied both in total (0.1 - 0.2) and polarized (0.3 - 0.4) intensity. Relative to the nucleus, no proper motion of this knot was detected at 3σ limit (√7pc). Extensive attempts to detect features in the optical spectrum of the brightest knot using the 5-m SIT digital spectrograph were unsuccessful. A striking similarity was noted between the radio and optical properties of the knots and the BL Lac class of objects.

de Vaucouleurs: 1. The Large Cloud is a disk system: spiral structure; rotation; photometric major axis (170° ± 5°) and kinematic line of nodes coincide; Z velocity dispersion of young stars (√10 km s<sup>-1</sup>) agrees with values in galaxy and other spirals; edges of Magellanic systems are flat (NGC 55, 2188 ...).

2. If main arms are trailing, east side is near side.

3. Inclination derived from ellipticity of outer isophotes in red light, b/a = 0.89 ± 0.01, is i = 27° ± 3°; it is confirmed by other methods.

4. Stars of identical absolute magnitude should be brighter on near side by Δm<sub>1</sub>/ΔY = 2.17 tan i/57.3 = 0.019 mag/degree. However, if cosec law applies across field, differential extinction should amount to Δm<sub>2</sub>/ΔY = -0.010 mag/degree if A<sub>B</sub> = 0.20 (minor axis of LMC coincides with galactic meridian). Four possible cases:

Predicted slope (Δm<sub>1</sub> + Δm<sub>2</sub>)/ΔY

Near side

With A<sub>B</sub> = const.

with A<sub>B</sub> = 0.2 cosec B

W

-0.019

-0.029

E

+0.019

-0.009

5. Use of cepheids apparent magnitudes reduced to constant period P<sub>0</sub> via P-L relation was first applied to 3 groups of LMC cepheids from Harvard photographic data. The three period groups (I) 0.4 ≤ Log P < 0.8 (50 stars), (II) 0.8 ≤ Log P < 1.3 (25 stars), (III) 1.3 ≤ Log P < 1.7 (21 stars) were reduced to Log P<sub>0</sub> = 0.5 (I), 1.0 (II) and 1.5 (III) via Δm/ΔLog P = 1.65 + 0.50 Log P based on Shapley's empirical P-L relation. Least squares solutions gave:

(I) m = 16.095 + 0.0325Y  
±.078 ±.0234

$$(II) \quad m = 15.013 + 0.0059Y \\ \pm .072 \quad \pm 0382$$

$$(III) \quad m = 13.880 + 0.0483Y \\ \pm .101 \quad \pm .0637$$

The weighted mean of slopes  $\Delta m/\Delta Y = +0.027 \pm 0.019$  (m.e.) confirms that the east side is nearer and agrees best with  $A_B = \text{const.}$  case.

6. These results have recently been confirmed by Gascoigne and Shobbrook who made a similar analysis of 14 selected cepheids ( $0.635 \leq \text{Log } P \leq 1.099$ ). The cepheids were chosen to form two compact groups about 2°8 W and 3°8 E of the center of the Bar. They express their results as mean distance moduli calculated via the P-L and P-L-C relations

and 
$$M_V = -1.18 - 2.900 \text{ Log } P \\ M_V = -2.24 - 3.656 \text{ Log } P + 2.52 (\langle B \rangle - \langle V \rangle)$$

	$\langle \text{Log } P \rangle$	$\langle V \rangle$	$\langle B-V \rangle$	$\langle Y \rangle$	$\langle \mu \rangle$	N
E	0.842	14.98	0.68	-3°775	18.59 ± .034	8
W	0.910	14.93	0.71	+2°779	18.71 ± .038	6

The differential modulus  $\Delta \langle \mu \rangle = +0.12 \pm 0.05$  implies  $\Delta m/\Delta Y = +0.018 \pm 0.008$ , is in near perfect agreement with the predicted value (+0.019), if the near side is the E side and  $A_B = \text{const.}$

7. This analysis was again repeated by Martin, Warren and Feast for 26 cepheids with photoelectric BVI light curves and  $\text{Log } P < 1.7$ , divided into two groups E and W of the line of nodes:

	$\langle \Delta \mu \rangle$	$\langle Y \rangle$	N
E	-0.036 ± 0.041	-2°7	14
W	+0.043 ± 0.026	+1°3	12

The differential modulus  $\delta \langle \Delta \mu \rangle = 0.079 \pm 0.048$  corresponds to a slope  $\Delta m/\Delta Y = +0.0235 \pm 0.0145$  which once again confirms that the east side is nearer and that differential extinction across the field is negligible.

In summary we have 3 independent determinations of  $\Delta m/\Delta Y$

1955	de Vaucouleurs	+0.027 ± 0.019	(96 stars)
1978	Gascoigne and Shobbrook	+0.018 ± 0.008	(14 stars)
1979	Martin, Warren and Feast	+0.023 ± 0.014	(17 stars)

unweighted mean	+0.0226
weighted mean (W = 1/σ²)	+0.0202
weighted mean (W = N)	+0.0255
adopted	+0.023 ± 0.007

The slope implies an inclination  $i = 31^\circ \pm 8^\circ$  which agrees within errors with  $i = 27^\circ \pm 3^\circ$  from optical isophotes,  $27^\circ \pm 5^\circ$  from HI isophotes and  $25^\circ + 9^\circ$  from cluster distribution. The weighted mean  $i = 27.2 + 2.4$  is essentially unchanged from the previously adopted value.

**Azzopardi:** The computation of the H $\gamma$  equivalent width on objective-prism plates of 210 star members issued from the lists of Azzopardi and Vigneau (1975, 1979) using the method described by Azzopardi et al. (1978) and mean visual absolute magnitudes and intrinsic colors for MK luminosity classes for galactic supergiant stars allowed us to determine 19.2 as SMC distance modulus.

**Dubois:** has shown that the stellar absolute magnitude calibration based on hydrogen line intensities in the SMC is different from the galactic one. The temperature has greater influence in the SMC, consequently:

- 1) The distance modulus of the SMC depends on the temperature of the stars used.
- 2) It is necessary to use a SMC calibration to determine the SMC depth.

Report of Working Groups

## I. THE MAGELLANIC CLOUDS

The WG convened on August 20 with B. E. Westerlund as Chairman.

Dr. M. W. Feast was nominated as the new Chairman and elected unanimously. It was agreed that the WG should from now on consist of all astronomers working in its field of research and interested in joining it. About 50 astronomers present at the meeting joined the WG.

A monograph has recently been written on the Large Magellanic Cloud and related objects by J. V. Feitzinger in German "Galaxien vom Magellanschen Typ". Several members expressed their hopes that it should be made available to the members in English.

The following papers were presented:

- M. Azzopardi and J. Breysacher: Systematic Survey for Wolf-Rayet Stars in the Magellanic Clouds.
- M. Duflot and Ch. Fehrenbach: Radial Velocities of Stars in the LMC.
- H. B. Richer: Carbon Stars in the Large and Small Magellanic Clouds: A Comparison.
- E. Hardy: Some Colour-Magnitude Diagrams and Abundances in the Magellanic Clouds.
- M. T. Brück: The Distribution of Faint Stars in the SMC.
- E. Maurice: The Structure and Kinematics of the SMC.
- N. Sanduleak and A. G. D. Philip: An Objective Prism Survey for Faint LMC Member Stars.
- J. W. Feitzinger: Kinematics and Dynamics of the LMC.
- S. C. B. Gascoigne: Ages and Abundances for Some Magellanic Cloud Clusters.
- Th. Page and G. Carruthers: Distribution of Hydrogen and Hot Stars in the LMC.
- N. W. Broten: Ionized Hydrogen Mass of the Magellanic Clouds.
- K. Nandy: Ultraviolet Observations of LMC Supergiants.
- J. Koorneef: Ultraviolet Observations of Stars and Stellar Associations in the LMC.
- J. Hutchings: Groundbased and IUE Results on OB Star Stellar Winds in the Magellanic Clouds.
- P. Benvenuti, M. A. Dopita and S. D'Odorico: UV Spectra of two Supernova Remnants in the LMC.
- E. H. Geyer and U. Hopp: Star Counts in Spheroidal Emission Regions of the LMC.
- J. V. Feitzinger, W. Schlosser, Th. Schmidt-Kaler and Ch. Winkler: The Central Object of the Supergiant Gas Nebula 30 Doradus.

## ABSTRACT OF PAPERS

Azzopardi: An objective-prism survey using an interference filter led us to detect 4 new WN stars in the SMC and 17 in the LMC, increasing to 8 and 101 respectively, the numbers of known WR stars in these systems. The census of the WR population in the Magellanic Clouds can now probably be considered as complete within the survey limits.

Richer: Spectra and photoelectric VRI photometry of a sample of carbon stars found in the LMC and SMC survey of Blanco and McCarthy have been obtained. The main results are: (1) SMC carbon stars are bluer than those in the LMC by about 0.15 magnitudes in (R-I) and by 0.26 in (V-R). (2) SMC carbon stars are more luminous than those in the LMC by about 0.3 magnitudes if the difference in distance moduli of the two galaxies is 0.5 magnitudes. (3) At a given color, there are no major differences in the spectra of the LMC and SMC carbon stars. The first two results above are probably related to the relative metal deficiency of the SMC compared to the LMC, and imply that caution should be employed in using luminous late-type stars as extragalactic distance indicators to galaxies of varying metallicity.

Brück: The distribution of stars down to  $B = 21^m$  along the major axis of the SMC between  $2^\circ$  and  $6^\circ$  from the centre has been studied, using counts made by the COSMOS measuring machine on photographs taken with the UK 1.2m Schmidt Telescope. The distribution of stars brighter than  $19^m$  ( $M = 0$ ), taken to be disk stars, are closely correlated with the HI brightness, whereas very little correlation exists for the fainter stars, which are identified as halo objects. There is a difference in the correlation indices for the Bar and arm regions of the Cloud, a result interpreted as due to differing stellar populations in these two parts.

Maurice: From a study of the 24 brightest stars of the SMC, Ardeberg and Maurice find a differential distance modulus of the two Magellanic Clouds of  $0.50 \pm 0.07$  and a depth ( $\sim 40\%$ ) larger than that of the LMC; this is supported by surface distribution of distance moduli, radial velocities and polarization; no rotation curve can be traced. The major apparent feature, a high-distance and high radial-velocity line in the direction of the SMC Wing and of the LMC, is in good agreement with a disruption model of the SMC (Toomre) in a close encounter with our Galaxy; separation time ( $6 \times 10^8$  years) calculated from the depth ( $\sim 15$  Kpc) and radial velocity difference ( $\sim 25 \text{ kms}^{-1}$ ) in the SMC is in good agreement with the model.

Feitzinger: The presently known radial velocities of planetary nebulae, star clusters, stars, HII and HI regions have been catalogued. With this data set the basic kinematical and dynamical parameters of the LMC are determined, new rotation curves deduced and the velocity residuals (observation minus model) discussed.

Carruthers: Comparison of our far-UV (1050-1600 Å) flux measurements over the whole of the Large Magellanic Cloud with Henize's H-alpha measurements and the McGee-Milton 21-cm survey of the LMC reveal that interstellar hydrogen in the LMC is often concentrated in 100-pc clouds within the 500-pc clouds detected by McGee and Milton. Furthermore, at least 25 associations of O-B stars in the LMC are outside the interstellar hydrogen clouds, four of them appear to be on the far side. Measurements of atomic hydrogen toward selected stars by means of its 1216 Å (Lyman- $\alpha$ ) absorption are in progress using the IUE satellite.

Nandy: The ultraviolet observations obtained with the IUE and the complementary visible data of the reddened and comparison stars in the Large Magellanic Cloud, obtained with the ESO 3.9m telescope at La Silla, have been used to determine the interstellar extinction law for that galaxy. The present result indicates significant differences in the far ultraviolet extinction laws of the LMC and the Galaxy. The slope of the LMC extinction curve shortward of 1500 Å, normalised to  $E_{B-V} = 1$  and  $A_V = 0$ , is found to be steeper than that of the galactic extinction curve. If this result is confirmed by future observations of a larger sample of reddened and comparison stars in the LMC, this would imply a significant difference in the content of small particles in the interstellar media of the two galaxies.

Geyer: Star counts to the limits  $16^m.5$  and  $20^m.5$  respectively within the boundaries of 31 spherical emission regions of the LMC have been carried out and their average diameters  $\emptyset$  determined on U-Schmidt plates.

The slopes of the linear correlations between  $\log N$  - the total counted stars of the embedded cluster - and  $\log \emptyset$  depend on the magnitude limits of the counts. This shows that less luminous stars are also contributing towards the illumination of the nebulae. A method for the determination of relative ages of emission regions was found.

Schmidt-Kaler: Short exposure photographs in various colours and spectra of the central part of the 30 Dor nebula have been obtained with the ESO 3.6 m and Bochum 0.6 m telescopes to investigate the structure by digital image analysis. R 136 consists of 3 components, R 136a being by far the bluest, covering  $(0.7 \text{ pc})^2$  and providing 90% of the excitation of the nebula. The bolometric magnitude is brighter than  $-14^m$ ,  $T_{\text{eff}} \approx 52000 \text{ K}$ , the mass estimated at  $500 M_\odot$ . The inner structure of 30 Dor is explained as a result of stellar wind from R 136.



## II. GALAXY PHOTOMETRY AND SPECTROPHOTOMETRY

The Group met at two successive sessions on the afternoon of August 20. Dr. M. Capaccioli was reelected as Chairman for the next three years and Dr. S. Odamura was requested to serve as Secretary.

The following papers were presented:

J. Kormendy and D. Koo: Triaxial bulge components in barred spiral galaxies.

R. J. Talbot: Multicolor photometric study of the structure of M83.

G. Carranza: Line intensity variations across NGC 1313, 7552, 7793 and other peculiar galaxies.

K. Freeman: Galaxy photometry programs at Mt. Stromlo.

S. Okamura: Galaxy photometry programs in Japan.

P. van der Kruit: The Westerbork-Palomar survey.

G. de Vaucouleurs: Programs on photometry and spectrophotometry of galaxies at the University of Texas in Austin.

M. Capaccioli: Galaxy photometry programs at the Asiago Observatory.

During the discussion the importance of the Austin Conference on Galaxy Photometry, Kinematics and Dynamics (August 6-8, 1979) was fully acknowledged. Request was made to have it organized periodically. The problems of accessibility and archives of digital data resulting from two-dimensional mapping of galaxies were raised. It was proposed that, for the time being, the Chairman will take care to collect, file and distribute the basic information such as objects-list and data-format. It was noted that the proposal by the W. G. to provide standard luminosity profiles for a few well-observed galaxies (NGC 3115, 3379, 4486) has not yet been fully accomplished. In this context, suggestion was made to include some distant galaxies in the list of photometric standards.

## III. INTERNAL MOTIONS IN GALAXIES

On the morning of August 21 the W. G. held a 90-minute meeting. It was chaired by Paris Pişmiş and was attended by 30-40 people.

During the brief administrative session the question was put forward - as in the previous XVI Assembly - whether the Working Group should continue as such. It was agreed that it was useful to have such a W. G. The election of a new chairman was postponed. A ballot was circulated later by mail and Stephen T. Gottesman was elected chairman for the next three-year period.

The Scientific part of the Meeting included:

- a) A brief introduction by the Chairman where she recalled some of the problems of interest in the topic of the internal motions in galaxies.
- b) Seven papers on current research. The authors and the titles of the papers are listed below.

T. G. Hawarden: "Kinematics of N 5291".

V. I. Pronik: "Gas Motions in the Nucleus of N 4151".

Y. Terzian, B. F. Jones and R. A. Sramek: "VLBI of the Nuclei of Normal Galaxies".

G. Carranza: "Interferometric Study of N 5236".

D. Helou, E. Salpeter, Y. Terzian: "HI Survey of Binary Galaxies".

V. L. Afanasyev, L. A. Matik, I. I. Pronik: "N 1275, a Pair of Interacting Galaxies".

D. Burstein and N. Krumm: "The Gaseous Disk of the SO Galaxy N 4203".

A highlight in the activities of the W. G. during the past triennium was the "Conference on Photometry, Kinematics and Dynamics of Galaxies" held in Austin (August 6-8, 1979) in conjunction with the W. G. on the Photometry and Spectrophotometry of Galaxies. 13 reviews and 80 contributed papers were presented.

On behalf of the members of the W. G. on the Internal Motions in Galaxies, the W. G. extended its gratitude to the University of Texas, at Austin, the host institution of the Conference, to Dr. Harlan Smith, Director of McDonald Observatory, to Dr. G. de Vaucouleurs, Chairman of the Scientific Organizing Committee, and to Dr. D. S. Evans, Chairman of the Local Organizing Committee.

## ABSTRACTS OF PAPERS

P. Pişmiş: Spectral regions that yield velocity data of Galaxies are optical, radio, molecular, UV, etc.

Largest contribution to overall vel. field is from HI, though detailed field in nucleus is obtained optically.

Some overall properties of interest are: Rotation curves have extended maxima, waves in rotation curves are physically significant; interpretation: density waves, two component model.

Nuclear regions: activity or geometry?

Bars: gas flow along bars? Rotation can be either as a solid body or differential.

Overall velocity field: Isovelocity contours show bi-symmetry; interpretation: oval distortions, warps.

Desiderata: More data necessary to establish reliable correlations between global parameters of galaxies such as morphological type, luminosity,  $V_{\max}$ ,  $R_{\max}/R$ , mass, etc.;

VLBI and radio recombination line studies;

Velocity fields in double galaxies; and

Velocity fields in Magellanic irregulars.

Terzian: We have performed a 3-station (Arecibo, Green Bank, Owens Valley), and a 7-station (Bonn, Arecibo, Green Bank, Illinois, Fort Davis, Owens Valley, Hat Creek) VLBI experiment at  $\lambda 18$  cm of the nuclei of normal galaxies. More than 30% of the observed galaxies showed central radio compact sources. Preliminary results show that the sizes of the radio components are  $\sim 6 \times 10^{-3}$  arc second. Radio maps will soon be produced from these observations. We also plan to observe these sources with the VLA (resolution  $\sim 1$  arc second), and a further VLBI experiment will be performed at  $\lambda 6$  cm to obtain spectral information.

Carranza: The distribution and motions of the ionized medium in M83 were studied with the 150-cm reflector at Bosque Alegre equipped with high luminosity optics and interferometric devices. The H $\alpha$  plates (scale 110"/mm) allowed the identification of more than two hundred H II regions distributed on a nearly circular area of 7' diameter which roughly coincides with the galaxy main body; with the higher contrast of the interferograms a weak H $\alpha$  background was also detected on the same region.

The beginning of a quite symmetrical spiral pattern is clearly drawn by the emission regions but such structure becomes rather complex in the outer parts of the galaxy; the individual H II regions are, however, larger and brighter in the NW arm. The field of radial motions over the main body was established by means of more than six hundred individual radial velocities (the majority from interferograms and a few from spectra) fall between 400 Km s $^{-1}$  (NE) and 600 km s $^{-1}$  (SW). The systemic radial velocity is 498 $\pm$ 5 km s $^{-1}$ , in fair agreement with other determinations. The main features of the resulting velocity field are:

- a) an approximate symmetry with respect to the center of the galaxy,
- b) the kinematic major axis changes from the neighborhood of the NS direction in the bar and nucleus to PA 45 $^{\circ}$  - 50 $^{\circ}$  in the outer regions,
- c) local extrema of relative radial velocity (with respect to that of the nucleus) are found symmetrically disposed in the NS direction at about 1.5-2 arc sec. from the center of the galaxy.

A comparison of morphological and kinematical features of M 83 reveals:

- 1) the radial velocities with respect to the nucleus are larger along the arms than in between; 2) the central isoveocities from 470 km s $^{-1}$  to 530 km s $^{-1}$  are deformed (even twisted) when crossing the bar; 3) some intermediate isoveLOCITY lines are deformed towards the ends of the bar. A confrontation of morphological and kinematical features over the main body of M 83 might suggest a process related to the inner structure of the galaxy, perhaps some kind of bar induced dynamical disturbance to account for the observations.

Helou: The survey used the Arecibo telescope to observe 25 galaxies in 9 groups of at most 5, as a first phase. The sample was drawn from a list of

binaries obtained from an automated search of the UGCG, with further selection for HI detectability. The survey focuses on the internal dynamics of the galaxies, but a complete area map will be produced for some of the groups in the second phase of the project.

Burstein: We have observed the HI disk of N 4203 at Arecibo with 4 arc min resolution. These data yield: HI/optical diameter  $\sim 3$ ; M/L at 20 kpc  $\sim 20$ . This SO galaxy evidences no spiral structure or conspicuous star formation down to 27<sup>th</sup> mag. arc sec<sup>-2</sup> in B.

#### IV. EXTRAGALACTIC SURVEYS FROM SPACE

The WG met on two successive sessions on August 22 with an attendance of about 70 astronomers. R. Barbon, as chairman, briefly recalled the circumstances that led to the formation of the WG. During the discussion on business matters the WG agreed that formal contacts shall be taken with all the IAU Commissions showing interest in the type of data provided by a wide field space telescope. Owing to its widespread nature, the new name "Working Group for Space Schmidt Surveys" has been approved for this WG. K. Henize has been elected new chairman for the next three year term, with F. Bertola as vice-chairman. The WG agreed also to nominate a subgroup of astronomers to keep in touch with the various teams in different nations involved in space survey projects. This consists of: H. Arp, R. Barbon, R. D. Cannon, G. Carruthers, G. Courtes, G. Lemaitre, H. J. Smith, D. J. Schroeder, K. van der Hucht, R. M. West, B. Westerlund, J. Wray.

In the scientific session the following papers were presented:

H. J. Smith: The Spacelab Wide Angle Telescope (SWAT).

R. M. West: The ESA Space Schmidt.

R. D. Cannon and T. G. Hawarden: The UK Schmidt: Rehearsal for the Operation of a Space Schmidt Facility?

M. F. McCarthy: Research Projects with a Space Schmidt: Low Dispersion Spectroscopy.

At the end of the meeting the WG approved the following Recommendation:

This Working Group recommends that the space agencies of the IAU member nations incorporate in their space astronomy programs support for fast wide-angle Schmidt-type telescopes capable of recording images comparable in quality to that provided by the Palomar Sky Survey. Besides exploring in the UV region inaccessible to ground based astronomy, these instruments would also reach substantially fainter background light levels at all wavelengths because of the darker night sky. For example, such telescopes will:

1. discover and study new types of objects,
2. explore for faint extensions in galaxies and clusters of galaxies,
3. detect UV rich sources, and
4. provide, in a short time, UV and IR data of large numbers of objects of use to the entire astronomical community.

Now that the Space Telescope is an approved project, the urgency of such instruments as necessary complements to it, is increased. Therefore, this Working Group strongly recommends that steps be taken as soon as possible to ensure that such a large-field telescope will be available in the same time period as the launch of the S.T.

#### ABSTRACTS OF THE PAPERS

H. J. Smith: Wide field telescopes will play as important a role in space astronomy as they have on the ground, for reconnaissance and survey work, for studies of large scale and/or faint surface brightness features, for statistical studies and for reference including e.g. identifications of X-ray and radio sources. Wide-field surveys of significant parts of the sky contain information of interest to a wide range of astronomers for many years. A space Schmidt telescope is needed to accomplish the above ends, and to make more efficient the work of the Space Telescope. A relatively economical all-reflecting space-Schmidt is being proposed, for cooperative international construction, initially for single pallet operation on space shuttle spacelab missions. The Schmidt will have an

aperture of about 0.75m, operating at about  $f/3$  with images better than 2 arc sec. over a 5 degree field, recorded by an electrographic camera. Early specific applications include UV studies of galaxy morphology and interacting regions, the detection of early type stars at least to  $m = 26$  including important cases of close degenerate companions of normal stars, and the study of up to four magnitude fainter halos and extensions of galaxies - some of the missing mass? - in IR as well as UV thanks to the freedom from airglow.

R. M. West: A group of European astronomers has recently proposed to ESA an all-reflecting Schmidt telescope of medium size (70cm), fast focal ratio ( $f/3$ ) and wide field ( $5^\circ$ ) for incorporation into the Spacelab programme. This telescope will be particularly suited for work in the far UV, but can also be used for very important work at other wavelengths and for (objective) spectroscopy. An assessment study is carried out at ESA and a report will be available in late 1979.

R. D. Cannon and T. G. Hawarden: Experience in operating the UK 1.2m Schmidt Telescope as a facility for outside users suggests that several important points must be considered also in the organisation of the Space Schmidt. 1) The enormous amount of information ( $10^9$  pixel per frame) provided by a wide angle medium resolution telescope means that each frame will be of utility to many workers in different ways. 2) The dissemination of this information is a major project in itself and must be provided for by the time the telescope is operative. 3) It is suggested that this can best be achieved by provision of data in the form of a high quality photographic atlas and in digital form from a central institute or institutes whence users could request data for specific objects or areas.

M. F. McCarthy: The Space Schmidt will offer many possibilities and advantages for research done with objective prisms, gratings or grisms. Spectral studies on quasars, Seyfert galaxies and clusters will be done in the UV region although distinct advantages can also be expected in the IR (6800 - 9000 A) where a gain of 3-4 magnitude is foreseen. The problem of the determination of the ratio of Carbon to late type M giants in different galaxies has been illustrated.