33. COMMISSION DE LA STRUCTURE ET DE LA DYNAMIQUE DU SYSTEME GALACTIQUE

Report of Meetings, 16 and 22 August, 1961

PRESIDENT: A. Blaauw.
ACTING SECRETARY: W. P. Bidelman.

Business meetings

The *Draft Report* was adopted, subject to a few minor corrections; the final version is printed in Vol. XIA of the *Transactions*.

After a brief explanation of changes in the structure of IAU Commissions and Sub-Commissions, the President informed the members of the Commission of the nominees for members of the Commission's Organizing Committee: President, B. J. Bok; Vice-President, L. Perek; and members: G. Münch, B. Strömgren, and either W. Becker or A. Blaauw. After some discussion, it was unanimously agreed that both W. Becker and A. Blaauw should be asked to serve as members, along with the others nominated, and the complete slate of nominees was then unanimously elected to the Organizing Committee.

The future of Commission 33's three Sub-Commissions was then considered:

33*a*: The President proposed that the duties of this Sub-Commission on the Co-ordination of Galactic Research be taken over by the Commission's Organizing Committee. Adopted.

33*b*: The task of this Sub-Commission for the Determination of the Galactic Pole and Galactic Longitudes is nearly completed. An extensive report of the Sub-Commission, containing its findings, has appeared in *M.N.R.A.S.*, **121**, 123, 1960, and tables enabling the determination of galactic co-ordinates in the new system have been prepared under the direction of I. Torgård and published as *Annals of the Lund Observatory*, Vols. **15**, **16**, and **17**. Charts permitting the rapid determination of galactic co-ordinates have not yet been prepared, but are planned. The President proposed that this Sub-Commission be made a Working Group of Commission 33. Adopted.

33*c*: It was proposed by the President that this Sub-Commission on Selected Areas remain permanently within Commission 33 as a Committee of that Commission. Adopted.

There was considerable discussion of L. N. Mavridis' proposal that those who have computed galactic co-ordinates for certain objects in the course of their work should publish these for the convenience of others. While this was felt to be useful, several members thought that the computation of galactic co-ordinates for various objects important in galactic research should be undertaken in a more systematic fashion. B. J. Bok suggested that an accuracy of $0^{\circ}\cdot01$ would be desirable, and that modern machines make the labour trivial. G. Abell stated that he already has available a program for such computations. The Chairman passed on a statement by L. Perek (who could not be present) that he has prepared tables facilitating the transformation of radial and tangential velocities to U,V,W components.

The recent English translation by J. B. Sykes of K. F. Ogorodnikov's "Dynamics of Stellar Systems" was appreciatively noted by the President.

Scientific meetings

Scientific communications were presented as follows:

S. Vasilevskis: The Lick Proper Motion Program.

The stars to be measured on the Lick 20-inch astrograph plates range in photographic

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magnitude from 6 to 17·5. The second-epoch plates, to be obtained starting in 1967, will be taken both with the original blue lens and with a new yellow lens giving an effective wavelength of about $\lambda 5500$. Positions, proper motions, magnitudes, and colors will be obtained. It is planned to measure on each plate about 70 galaxies, about 15 AGK2 stars, some 25 stars of about the 12th magnitude, and another 25 stars of the 16th or 17th magnitude, making a total of about 135 objects per plate. It will, however, be a simple task to measure at least 200 objects per plate, since the final measurement of such a plate will take less than two hours. Thus suggestions as to additional stars to be measured will be welcomed.

The limiting galactic latitudes depend, of course, on the nebular counts, but may be estimated to be in the neighbourhood of 20°. This is on the assumption that no more than 20% of the nebulae on the plates will be suitable for measurement. The fields studied will extend to at least declination −23°, but plate material that may be worthy of measurement is available to declination −33°.

J. J. Nassau: Luminous Stars in the Northern Milky Way.

An objective-prism survey of high-luminosity stars in the northern Milky Way is being carried out jointly by the Hamburg and by the Warner and Swasey Observatories. The aim is to catalogue, down to our limiting magnitude, all stars of the following types:

(*a*) OB stars, divided into three luminosity groups;

(*b*) late B, A, and F super-giants;

(*c*) OB stars with Hα in emission;

(*d*) Wolf-Rayet stars.

The limiting photographic magnitude of the survey is about 13·0. The present state of the project is as follows:

Vol. I (Hamburg): $l^{II} = 113°$ to 142°; $b^{II} = \pm 9°$. Published in 1959.

Vol. II (Warner and Swasey): $l^{II} = 42°$ to 80°; $b^{II} = \pm 10°$. Published in 1960. (The plates for this region were taken at Hamburg.)

Vol. III (Hamburg): $l^{II} = 80°$ to 142°; $b^{II} = \pm 10°$. To be published in 1961.

Vol. IV (Warner and Swasey): $l^{II} = 14°$ to 46°; $b^{II} = \pm 28°$. To be published early in 1962.

Vol. V (Hamburg): $l^{II} = 142°$ to 192°; $b^{II} = \pm 12°$. Work in progress.

Vol. VI (Warner and Swasey): $l^{II} = 192°$ to 226°; $b^{II} = \pm 12°$. Only a few plates have been taken in this region.

The above boundaries are approximate; the first two volumes published contain 3 000 stars.

Discussion: The President suggested that plans should be made for photometry of these important objects, and he stressed the importance of obtaining it in a uniform photometric system. If possible, the photometry of this valuable material should not be broken up into a number of limited, small projects with different systems.

P. Pishmish: Outline of a Theory of the Origin and Evolution of Spiral Arms.

In a series of papers published in the last two years in the *Tonantzintla y Tacubaya Bulletins*, the origin and development of the spiral features of our own and other galaxies have been treated. The starting point is the well-known expansion of the neutral hydrogen arm at 3 kpc from the galactic center; a vestige of such an expansion seems to be present in the motions of OB associations.

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The basic idea is that spiral features are formed as a result of the ejection of gas from a rotating nucleus. The emergence of arms from the extremities of a diameter of the nucleus (which may be embedded in an older population) is explained by introducing a novel assumption: that the magnetic field in the nucleus of the Galaxy — and similar galaxies — is poloidal, say a dipole, with its axis perpendicular to that of galactic rotation. Excess matter in the amorphous nucleus, in such a circumstance, will be funneled out through the polar regions, thus producing the observed symmetry.

A nucleus, while ejecting matter, will probably suffer a contraction. The matter and momentum that goes into the arms might thus be provided at the expense of the shrinking nucleus, which would leave behind spiral formations.

P. O. Lindblad: Stellar Orbits and Spiral Structure.

The effects of perturbations acting on revolving mass points in a Galaxy-like force field are well demonstrated by motion-picture techniques. A two-dimensional model is assumed, and the calculations have been done on an electronic computer. See *Stockholm Obs. Ann.*, **21**, no. 4, 1960.

H. D. Greyber: Dynamics of Spiral Galaxies.

From the investigations of F. D. Drake and others, it is clear that magneto-hydrodynamic effects must be important in the Galaxy. One may assume that the Galaxy possesses a ring current in the central regions, giving rise to a dipole field. Mass will flow in and out of the nuclear regions, in equal amounts. Small instabilities will exist, and occasionally a long-wavelength disturbance giving rise to a large surge will occur. This idea may be checked by polarization observations.

G. Contopoulos: Stellar Orbit Computations.

Some results found by B. Barbanis (Thessaloniki) in connection with the third integral of motion in an axially symmetric galaxy may be mentioned. Barbanis has applied the third integral in velocity space in order to explain the peculiar form of the orbits in the R, Z plane. In particular, he has introduced the first-order terms of this integral as an argument in the distribution function, in addition to the energy integral.

Concerning the third integral itself one may say:

(*a*) The convergence of this integral has not been established, but it is possible that an isolating integral exists, even if it is not uniform everywhere.

(*b*) There are other cases in which a third integral may exist.

(*c*) A study of periodic orbits would be illuminating.

(*d*) It would be interesting to calculate orbits in various potential fields, especially in those corresponding to actual galaxies.

I. Torgård: Three-Dimensional Galactic Orbits.

This work, done with A. Ollongren, consists of calculations done on the BESK electronic computer of galactic orbits in a potential field similar to that given by M. Schmidt's model of the Galaxy. A high-velocity family of orbits has been studied, defined by fixed energy and fixed areal velocity. Two different types of orbit were found: "box-orbits" (distorted Lissajou orbits) and "tube-orbits", which oscillate around a periodic orbit (a stable periodic orbit is surrounded by an infinite number of concentric tube-orbits together forming a tube). In an

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inclination diagram (π/z against $\tilde{\omega}$ for $z = 0$), a box-orbit is represented by a line, a periodic orbit by a finite number of points, and a tube-orbit by a finite number of rings. A tube-orbit corresponds to a rational number, a box-orbit to an irrational number. There appears to be an infinite number of each of the three types of orbit.

Discussion: I. R. King remarked that it would be of great interest to extend these calculations to slightly flattened elliptical systems.

G. Elwert: Theory of the Tilt of the H I Layer.

Analysis shows that the gravitational attraction of the Magellanic Clouds may be responsible for the observed tilt of the neutral hydrogen layer in the outer parts of the Galaxy.

Discussion: It was suggested by I. R. King that if this explanation is correct, we should expect distortions of the local velocity field of the order of 5 to 10 km/sec, which could seriously affect our interpretation of 21-cm data.

F. J. Kerr: The 15-Meter Survey and the H I Distribution in the Galaxy.

The southern hemisphere 21-cm line data and those from various thermal sources all agree well in showing the spiral structure; the 15-meter survey shows H II regions in absorption all along the Milky Way plane.

When attempts are made to combine the 21-cm data from both hemispheres into a consistent and plausible spiral-arm pattern, however, difficulties arise. These can be removed if one assumes that the local standard of rest possesses an outward velocity, relative to the galactic center, of the order of 7 km/sec.

Discussion: It was remarked by several members of the Commission that this rather surprising result does not seem compatible with the observation that stars of different ages in the solar neighborhood do not show differential motions of the sort that this would appear to imply.

33c. SOUS-COMMISSION DES "SELECTED AREAS"

Report of Meeting, 19 August 1961

PRESIDENT: T. Elvius.
SECRETARY: L. Plaut.

Selected Area Committee

Under the new By-laws of the Union the Sub-Commission will continue as a Committee under Commission 33, the members being: Elvius (chairman), Kharadze, Plaut, Weaver.

The *principal function* of the Selected Area Committee has been defined by Bok, the new President of Commission 33, as:

1. to report on work done and to make suggestions for extension and co-ordination of work under way or being planned;

2. to suggest specific new projects for work relating to Selected Areas;

3. to consider ways in which Selected Area programmes may contribute to the advance of our knowledge in galactic structure.

Kharadze drew attention to the possibility of coming outside the boundaries of Kapteyn's Selected Areas. It was felt that in such cases the whole Commission 33 has to consider the matter.

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