3. Objects at High Galactic Latitudes

Becker and Karaali (33.155.068) investigated a field near NGC 7006 using RGU photometry and determined density functions for both populations. The Basel halo program also includes several papers by Fenkart and collaborators (33.113.027, 34. 113.036, and Astron. Astrophys. (in preparation)). Staller et al. (31.155.003) found a large number of red objects near the South galactic pole and discussed the M-dwarf distribution. Trefzger et al. (1984) used Walraven photometry to show a metallicity gradient for stars in SA 141 at the South galactic pole. The density function of faint stars towards the North galactic pole was derived by Yoshii (32. 155.034). Early-type stars near IC 4665 were investigated by Paparó and Balázs (33. 155.124). Kron, Cudworth, and Rybski (Yerkes) are beginning a programme of photometry, spectroscopy and proper motions for complete samples of faint stars in about twenty fields at intermediate latitudes. Tobin (37.113.034, 1984) has continued the studies by Tobin and Kaufmann (37.114.030) of high and intermediate-latitude B stars; uvbyβ photometry shows that some of these are more than 500 pc from the galactic plane.

The globular cluster system was studied by Frenk and White (31.155.001), who concluded that the sun's distance to the galactic centre is R_o = 6.8±0.8 kpc.

4. References

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Tobin, W.: 1984, Astron. Astrophys. Suppl. (in press).
Trefzger, Ch.F.: 1984, IAU Symposium No. 106 (in press).
Winkler, Chr., Schmidt-Kaler, Th., Schlosser, W.: 1984, Astron. Astrophys. Suppl. (submitted).

B. RADIO STUDIES

Several regional surveys of southern HI made with the Argentine 100-m telescope were published (30.155.031). HI and other data were used by Dolidze (30.155. 044) to study the local distribution of gas and star forming regions. The Perseus arm region was the subject of an analogous study by Gerasimenko (34.155.139). Vallée (34.155.005) used rotation measure data from extragalactic sources in the direction of the Perseus arm to determine the magnetic field structure there and to constrain gravitational collapse theories of magnetic compression. HI in the direction of the Puppis window was surveyed by Stacy and Jackson (32.131.277) and used to study the turbulent characteristics of the interstellar medium. HI related to Gould's Belt was studied by Pöppel and Olano (32.155.024, 33.155.030). Salter (34. 131.014) reviewed radio and other observations pertaining to Loop I, the North Polar Spur, and considered the influence which this structure might have on the local medium.

Several regional studies were carried out in the radio continuum. Kononov and Pyatunina (34.155.017) surveyed the galactic plane in the region of Mononceros at λ7.6 cm. The extended component of the radio continuum at 408, 820, and 1420 MHz from the Cassiopeia-Perseus region was analyzed by Kallas et al. (34.155.069). Kanbach (34.155.020) reviewed the nonthermal radio emission from the local (< 2 kpc) region of the Galaxy and separated the emissivity into thin- and thick-disk components.

Shell-like structures in the interstellar medium received much attention during the triennium. Hu (30.155.006) searched for HI shells at $|b| > 10^o$, using filtering in velocity to enhance the shell features; she found correlations of the HI shells with radio continuum loops. Gosachinskij (31.132.048) saw little correlation of the HI shell phenomenon with supernova remnants, but Velden and Hirth (32.131.058) found a well-defined HI shell apparently associated with the nearby pulsar PSR 0809+74. Bochkarev (37.131.106) argued that the large-scale bubble structure of the interstellar medium is due to the combined operation of stellar winds from Wolf-Rayet, supernovae, and other stars. Heiles (33.155.045) found an explanation for some of the galactic noncircular motions in the HI shells, and stressed (34.131.106) the need for homogeneous and complete observational studies of the shells.

IV. Overall Galactic Structure

A. OPTICAL STUDIES

This section contains work appertaining to observations at wavelengths shorter than 1 mm and giving information on large scale properties of the Galaxy. The different subsections contain work regarding (1) the galactic disk, (2) the galactic centre, (3) the halo and the spheroidal system and (4) the evolution of the Galaxy.

Several conferences during the triennium have discussed our Galaxy as such. The Vancouver workshop 1982 (33.012.016) discussed the Kinematics, Dynamics and Structure of the Milky Way. At the General Assembly in Patras, a joint discussion was held on the subject "Evolution in Old Stellar Populations in Galaxies" (33.012.028). The Frascati workshop 1982 on the first stellar generations (34.012.057) contains a number of papers on the early evolution of the Galaxy. IAU Symposium No. 106 in Groningen was entitled "The Milky Way Galaxy"; its proceedings are being edited by H. van Woerden and published by Reidel. A conference was held in Prague 1983 (34.012.068) on the topic "Star Clusters and Associations and their relation to the Evolution of the Galaxy". The European regional meeting in Florence, December 1983, contained several contributions on galactic structure and about the centre of the Galaxy.

Review papers of interest in this section include the discussion of stellar populations by Mould (32.155.027), the presentation of galactic gamma-ray sources by Bignami and Hermsen (34.143.025) and the Henry Norris Russell Lecture by B.J. Bok (34.155.056) on "Current Trends in Milky Way Research".

1. The Galactic Disk

The galactic distribution of WR stars was discussed by Hidayat et al. (31.155.042, 32.155.040), that of WR run-away stars by Vanbeveren (32.155.011); Bertelli and Chiosi (31.155.029, 32.155.041) analysed the reasons for a gradient in the ratio of supergiants to WR stars in the galactic disk. Efremov (33.155.002) analysed the difference between cepheid distribution at 10-12 kpc in our Galaxy and in M31. The relation of giant clouds and HII regions to spiral structure was discussed by Elmegreen and Elmegreen (33.157.042), and again by Elmegreen (1984). The common origin of a group of open clusters was discussed by Lynga and Wramdemark (37.153.008), and the distribution of open clusters in the disk was reviewed by Lynga (1984). Fich and Blitz (37.155.064) studied the distribution of optical HII regions in the outer Galaxy. The distribution of interstellar sodium has been mapped by Ardeberg et al. (1984) for the southern sky. Three-dimensional structure of spiral arms has been discussed by Kolesnik and Guseva (31.155.019) and by Voroshilov et al. (33.155.118).

Metal abundances in distant RR Lyrae stars towards the galactic anticentre have been observed and discussed by Kinman et al. (31.122.029) and by Butler et al. (31.122.030). There is no direct evidence of an abundance gradient. Photometry and ephemerides for RR Lyrae stars in the field RRI are given by Kinman et al. (1984).

Abundance determinations of the ab type variables in this field show (Kraft, Kinman, Suntzeff) that these stars at a galactocentric distance of 6 kpc are more metal-rich than those at the North galactic pole or in the anticentre direction.

Garmany et al. (32.155.061) studied the IMF of massive stars and found more massive stars inside than outside the solar circle. Meylan and Maeder (34.155.004) determined stellar density functions for various types of massive stars. Considering absolute magnitudes of galaxies and the distribution of HII regions, Hodge (34. 155.098) concluded that our Galaxy is of Hubble type Sc or SBc.

Pritchet (34.155.022) used the deep star counts of Jarvis and Tyson (29.031. 530) to study the stellar population of the disk. Some problems of stellar statistics were discussed by Buser (32.155.054).

Sources of near-infrared radiation were detected and their stellar origin investigated by Mikami et al. (32.155.009) and by Kawara et al. (32.155.035). The origin of the far-infrared and sub-millimeter galactic emission is to be found in dust; models were proposed by Mezger et al. (31.156.006), by Gispert et al. (31. 156.007), by Puget (32.156.009), and by Hauser et al. (33.155.048).

Observations of γ-radiation from the Galaxy have made a great impact on our knowledge about the structure of the disk. A large survey was made by the ESA satellite COS-B (Mayer-Hasselwander et al., 31.157.002, 32.157.003), and observations towards the anticentre region were made by the Natalya-1 telescope (Iyudin et al., 33.155.098). The relations between γ-ray features, interstellar gas and other sources were studied by Strong and Wolfendale (31.157.012), by Haslam et al. (31.157. 014), by Salvati and Massaro (31.157.001), and by Bloemen and collaborators (33. 155.035, 34.155.031, 34.155.034, 37.155.065).

The emission of γ-rays as the result of interaction between cosmic rays and interstellar gas was analysed by Bignami (31.157.013), by Massaro (33.155.016), by Mayer-Hasselwander (33.155.052), by Riley and Wolfendale (34.155.033), and by Lebrun (34.155.032). The mass of H_2 as inferred from γ-radiation is much lower than that given by CO data (Li et al., 33.155.017; Bhat et al., 1984). A different view is presented by Korchagin et al. (33.155.100) who interpret the γ-ray emission in terms of galactic shocks.

The structure of the galactic disk in X-ray was studied by Worrall et al. (31. 157.003) and by Nousek et al. (31.157.010). Hertz and Grindlay (37.142.034) published the statistical analysis of the Einstein galactic plane X-ray survey.

The electron scale height of the disk was studied through a statistical analysis of pulsar dispersion measures by Harding and Harding (31.155.028).

2. The Galactic Centre

Observations and theories regarding the galactic centre were presented at the Caltech conference in 1982 (32.012.076) and at IAU Symposium No. 106 in 1983.

Use of CCDs and other detectors for observations in the infrared with large telescopes have made possible detailed mappings of galactic centre sources. Active groups have been Storey and collaborators (31.155.010, 32.155.068, 32.155.069, 34. 155.012), Biretta et al. (32.155.042, 32.155.070), and Ricker et al. (32.155.071). IR spectra of sources have been investigated by Wollmann et al. (32.155.001), Hall et al. (32.155.048), and Herter et al. (33.155.032). Several surveys of the centre of the Galaxy were presented, notably by Becklin et al. (31.156.019), by Dent et al. (32.156.018), by Stier et al. (32.156.019), and by Matsumoto et al. (32.156.020).

The high-resolution IR survey by Allen et al. (34.155.011) was interpreted in terms of stellar distribution. Genzel et al. (37.155.025) mapped the far-infrared radiation around the galactic centre and discussed the physical conditions in the nucleus.

The galactic centre is a source of continuum γ-radiation (Paciesas et al., 31.157.015, 32.157.017; Matteson, 32.157.014). Several other groups have also attempted to observe the 511 keV line of electron-positron annihilation (Jacobson, 32.157.006, 32.157.015; Leventhal and MacCallum, 32.157.005, 32.157.016; Ramaty et al., 32.157.007; Gardner et al., 32.157.018; Jardim et al., 33.155.029). γ-ray spectroscopy by Mahoney et al. (32.157.010) placed limits on emission in the 60-Fe, 26-Al and 22-Na decay lines. Implications of the γ-ray observations for the models of the galactic centre were discussed by Lingenfelter and Ramaty (32.157.019) and by Forrest (32.157.020). Stellar kinematics in the centre were studied by means of OH/IR stars (Baud, 34.155.042; Habing et al., 34.155.048, and IAU Symposium No. 106).

There have been a number of attempts to make a model of the galactic centre and to compare it with other galaxy nuclei. Oort (32.155.025, 32.155.073, and IAU Symposium No. 106) has investigated which models are possible in view of observed data. He finds the evidence for a central black hole "not compelling"; there has probably been a burst of star formation in the nucleus about one million years ago. Gatley (32.156.017) made a model of the galactic nucleus based on observations of infrared emission. Lacy et al. (32.155.038), Lacy (32.155.066), Townes et al. (33.155.022), and Rees (32.155.072) also examine arguments for and against the existence of a massive black hole in the centre of the Galaxy. Rieke and Lebofsky (32.155.074) compare the galactic nucleus with nuclei of other galaxies. Oda (34.155.021) related the infrared features near l = 356° to the γ-ray hump. Evolutionary scenarios involving shock-wave generation in the galactic nucleus and subsequent star formation are discussed by Loose et al. (31.155.012) and by Bhattacharyya and Basu (31.155.045). Shklovskij (34.155.010) gives arguments for explaining galactic-centre phenomena as caused by a recent supernova outburst.

The spatial distribution of RR Lyrae stars near the galactic centre is being studied by Wesselink (Nijmegen). M giants near the galactic centre appear to be super-metal-rich according to results by Frogel and Whitford (32.155.003).

3. The Halo and the Spheroidal System

The chemical evolution of the galactic halo was discussed at the IAU General Assembly Joint Discussion on "Evolution in Old Stellar Populations in Galaxies" (33.012.028), particularly by Spite (33.155.062), and also at the Vulcano workshop (34.012.057), particularly by Castellani (34.155.078). Busso (33.155.066) and Busso and Gallino (34.155.014) have studied heavy-element enrichment processes in the halo. Hartwick (34.155.075) has compared [Fe/H] distributions, space densities and kinematics for various halo components. Abundance gradients in the halo were studied by Daido (33.155.077). Smith (37.154.055) finds that globular clusters with galactocentric radii < 9 kpc are more metal-rich than outer ones but that there is no pronounced gradient. Extensive counts of faint stars have been used by Bahcall and Soneira (31.155.013, 33.155.050), by Gilmore and Reid (33.155.015) and by Gilmore (33.155.107, 37.155.016, IAU Symposium No. 106) to study the stellar distribution in the galactic spheroid. Gilmore and collaborators are completing their photometric survey in eight directions of the galactic spheroid. First results show a population that is old and relatively metal-rich. Blanco et al. (37.155.071) picked out and observed late-type giants in Baade's window confirming an earlier finding of an extremely small ratio of C to M stars in the nuclear bulge. B.M. Blanco (CTIO) reports from her blink survey of RR Lyrae stars in Baade's window that the majority of RR Lyraes are relatively metal-rich. Edmunds (34.155.001) and

Edmunds and Phillipps (37.155.017) estimate the luminosity and mass of the galactic spheroid, finding it a major component similar to an elliptical galaxy of $M_V \sim -20$.

The outer ranges of the halo have been discussed by Ratnatunga (33.155.057) and, particularly concerning population II giants, by Cayrel and Boulon (34.155.076). Hawkins (37.122.003) studied the galactic halo from RR Lyrae star distribution finding a power law out to r = 60 kpc.

4. The Evolution of the Galaxy

The chemical evolution of the Galaxy has continued to be an active area of research. Chemical abundances, abundance gradients and isotope ratios have been compared to model predictions assuming rates of star formation and of infall of matter. A review of the field was given by Güsten and Mezger (34.155.081). Particular aspects have been discussed by Tosi (31.155.005, CNO isotope ratios and evolution), by Twarog and Wheeler (32.155.033, heavy element production), by Audouze et al. (34.155.046, Li isotope evolution), by Yokoi et al. (33.155.003, ^{187}Re - ^{187}Os chronology) and by Yoshii (1984, a two-zone model of chemical evolution). Abundance gradients have been studied by Marsakov and Suchkov (33.155.058), by González (33.155.114), and by Binette et al. (32.155.043). The IR excess at 5 kpc galactocentric radius has been introduced in models of galactic evolution by Rocca-Volmerange and Guiderdoni (31.155.030, 31.155.049). Selected evolutionary models were examined by Lee and Ann (31.155.021), by Lee and Hong (34.155.080), by Meusinger (34.155.082), and by Yoshii and Arimoto (33.155.078). Comparisons of evolutionary models of the solar neighbourhood with photometry of edge-on galaxies were made by Lacey and Fall (34.155.006). Díaz and Tosi (37.157.159) compared models of chemical evolution applying them to our own Galaxy and to other spiral galaxies.

B. RADIO STUDIES

Several reviews pertinent to galactic morphology were published during the triennium. Bok's Henry Norris Russell lecture (34.155.056) and his other reviews (33.013.022, 37.155.087) summarized many of the current problems in Milky Way studies. Blitz (33.155.115) emphasized work on the outer reaches of the Galaxy based on new information on the galactic rotation curve. Downes and Güsten (32.155.053) reviewed radio investigations of the large-scale structure and kinematics of our system, including those dealing with the various phases of the interstellar gas. Reviews specific to the core of the Galaxy were given by Oort (32.155.025, 32.155.073) and by Kraus (33.155.020).

Two workshops were held whose proceedings contain contributions on the morphology of the Milky Way. The Green Bank workshop (31.012.048) dealt with the molecular content of our and other normal, nearby galaxies; the Leiden workshop (34.012.023) dealt with surveys of the southern Galaxy. IAU Symposium No. 100 on the Internal Kinematics and Dynamics of Galaxies (33.012.004) was co-sponsored by Commission 33. The proceedings of IAU Symposium No. 106 on the Milky Way Galaxy, held in Groningen, are scheduled for publication in early 1985. Bajaja (34.155.029) gave a compilation of HI surveys made with the Argentine radio telescope; Xiang (37.002.023) summarized galactic CO surveys.

1. Observational Surveys

a) Atomic Hydrogen. Most of the HI work done during the triennium was directed toward specific astrophysical problems, rather than toward general surveying, although a new survey of the southern galactic plane made with the Parkes 64-m telescope was reported by Riley (34.155.030) and by Strong et al. (32.156.010). Bregman et al. (33.155.009) spatially resolved the 21-cm HI Zeeman effect in the Cas A

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Perseus arm absorption features. Quiroga (33.155.112) studied turbulent motions in HI structures and their relations with galactic structure. Observations of galactic HI absorption against the continuum spectra of 69 radio sources were published by Mebold et al. (30.141.147). Dickey et al. (34.155.066) used the VLA to measure 21-cm absorption toward 88 sources at $|b| < 15^{\circ}$. Lockman (33.155.055) reported evidence for HI gas in the inner Galaxy more than 500 pc from the plane that corotates with the material in the plane but has a larger velocity dispersion than the HI confined closely to $b = 0^{\circ}$.

Bania and Lockman (37.155.074) used the Arecibo telescope to measure closely-sampled HI spectra which reveal numerous self-absorption features that arise in cool HI clouds, for which they were able to specify size parameters. Peters and Bash (37.155.021) sought correlations between CO clouds and HI self-absorption features in the galactic plane at large distances from the Sun.

b) Carbon Monoxide. The triennium saw the publication of several surveys of emission from CO; for the first time, extensive coverage of the galactic disk is available for this important tracer of the density of the interstellar medium. The CSIRO telescope extended the coverage in the ^{12}CO line to the southern portions of the galactic equator. Publications by Manchester, Robinson, Whiteoak, and collaborators deal with various aspects of the latitude and longitude distribution (32. 131.032, 33.131.126, 34.155.027, 34.155.039, 34.131.150). Southern observations of the $2\rightarrow1$ CO transition at $\lambda1.3$ mm were made at ESO by Israel, De Graauw, and collaborators (34.155.025, 37.155.066).

The northern hemisphere ^{12}CO data bank was substantially extended by the FCRAO survey (34.155.025, 37.155.015); the analysis of that material included discussion of the axisymmetric distribution of H_2. Conversion from CO intensities to H_2 densities was discussed by Xiang et al. (37.131.169), who also gave closely-sampled observations of ^{13}CO along the galactic equator. Comparison of the ^{13}CO and ^{12}CO aspects of a selected galactic-disk region was given by Stark et al. (34.155.045).

The Bordeaux Observatory telescope was used to observe ^{13}CO emission in the 1st and 2nd galactic quadrants (30.155.060, 34.155.043, 34.155.044, 37.131.095). Particular emphasis was paid to the mass spectrum of the observed clouds. The cloud-to-cloud velocity dispersion of the molecular clouds in the inner Galaxy was discussed by Liszt and Burton (33.131.125) on the basis of new ^{13}CO data and by Stark (33.131.320).

The 1st quadrant was searched by Verter et al. (34.131.009) to reveal over 100 directions in which no molecular cloud of consequence occurs along the lines-of-sight, constraining cloud size and distribution statistics. Evans et al. (33. 155.024) searched for ultra-cold ($T_{ex} < 5$ K) molecular gas but found no evidence for a large amount of such material.

c) OH and Other Radio Lines. Turner (31.156.005, 31.156.021, 33.155.047) observed widely extended, weak OH emission at 1720 MHz which is purportedly a good tracer of galactic structure. Southern galactic plane surveys of OH, H_2O masers, and other lines were reviewed by Caswell and Haynes (34.155.026) and by Whiteoak (34.155. 027). Hart et al. (34.155.028) reported on a southern survey of H166α emission from the galactic plane.

d) Continuum Emission. Haslam et al. (31.141.036) published their major 408 MHz all-sky continuum survey combining data from telescopes at Jodrell Bank, Effelsberg, and Parkes as sets of contour maps of radio brightness in α,δ as well as l,b coordinates. Reich (33.155.008) and Wielebinski (37.155.075) reviewed the various uses of this survey. Reich (31.141.085) published the part of the Stockert 1420 MHz survey of the northern sky at $\delta > +20^{o}$ in the form of contour maps. The combined 408 and 1420 MHz surveys yielded the distribution of the spectral index across the Galaxy to Reich et al. (34.155.100). The spectrum of galactic nonthermal radiation between 200 and 375 MHz was studied by Belyaev et al. (37.155.055).

2. Structural Properties of the Inner Galaxy

The extensive new CO surveys were the focus of several attempts to derive the morphology of the gas distribution. Analyses of the CO data in terms of spiral structure were made by Stark (33.131.124) and by Dame (37.131.091). Bash, Leisawitz, and collaborators used the ballistic-particle approach to cloud motions in several analyses of the CO and other data (31.131.277, 32.155.002, 33.132.038, 34.155.035). Kimura and Tosa (37.151.058) predicted the distribution of molecular clouds on the assumption that they move on ballistic orbits and confronted these predictions with the CO data. Sawa et al. (33.155.071) analyzed the CO distribution in terms of three alternative kinematic models. The kinematics of HII regions was investigated by Grivnev (30.132.018) supposing the existence of density waves in the Galaxy. Seiden (33.131.127) used the stochastic self-propagating star formation model to account for the observed radial distribution of atomic and molecular gas.

The distribution of free electrons in the inner Galaxy was the subject of work by Harding and Harding (31.155.028) based on dispersion measures of pulsars. Gusejnov et al. (30.155.037) studied the distribution of electrons using H_2O maser, radio recombination line, and other data. Those aspects of the overall structure which involve comparison of γ-ray data with nucleon densities from CO and HI observations are mentioned in Section VIF of this report.

3. Galactic Center

Several investigations were carried out dealing with scales of order 100 pc. Rohlfs and Braunsfurth (32.155.012) published closely-sampled HI data for the inner few degrees and discussed the material in terms of galactic rotation. Burton and Liszt (33.155.027) published a survey of the region $349 \leq l \leq 13^{o}$, $|b| \leq 10^{o}$, $|v| \leq 350$ km s^{-1} made with the NRAO43-m telescope and gave summarizing remarks concerning the anomalous central features. Surveys in the CO lines were reported by Inatani (32.131.289) and by Heiligman (30.155.024). Burton and Liszt (34.155.040) described a CO structure near the center with strong positional and kinematic gradients. Surveys in the OH lines were published by Cohen (32.131.228), who emphasized the tilted nature of the gas distribution, and by Cohen and Dent (33.155.025, 34.155.041). OH/IR stars and the information they reveal on the kinematics and mass in the galactic bulge were the subject of observational and interpretive work by Isaacman and Oort (30.155.042), Habing et al. (33.112.019, 34.155.048), and Baud (34.155.042). Ammonia in the neighbourhood of the galactic center was mapped by Güsten et al. (30.155.045), and its temperature distribution derived.

4. Structural Aspects of the Outer Reaches of the Milky Way

The rotation parameters of the outer Galaxy, found in studies mentioned elsewhere in this report, are now known firmly enough that renewed attention could be given to the properties of the warped HI disk at large radii. Henderson, Kerr, and Jackson (32.155.045, 33.155.043, 34.155.036) used the Parkes 18-m and Hat Creek 26-m telescope surveys to derive, assuming a flat rotation curve, the HI surface density, mean layer positions, and thickness as a function of galactocentric radius and angle. Kulkarni, Blitz, and Heiles (32.155.014, 33.155.044, 34.155.037) used the CO-derived rotation curve and the Hat Creek data to get the HI structural parameters to distances of 30 kpc from the center. The z-extent of the HI found in these studies implies that the large invisible mass in the outer Galaxy does not reside in a thin disk.

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Kutner and Mead (30.155.036, 31.131.271, 34.131.105) reported detection of extensive low-level CO emission from molecular clouds well outside the solar circle, whose distribution apparently followed the HI warp. Solomon et al. (33.155.031) were unable to reproduce some aspects of those observations.

Work on the high-velocity cloud phenomenon involved several detailed studies of selected regions. Evidence for interaction of a high-velocity stream with the galactic disk was found by Cohen (30.131.006) in Jodrell Bank observations and by Mirabel (31.132.022) in Arecibo observations of the anticenter region. A survey by Cohen (32.131.021) of the Cetus region led to the conclusion that the high-velocity HI there is debris from the tidal interaction between our Galaxy and the Magellanic Clouds. Mirabel and Morras (37.155.063) published results from a search for high-velocity HI in a large area of the sky around the direction to the galactic center.

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V. Kinematics

A. STARS

1. Galactic Center

Wollman et al. (32.155.001) present high-resolution 2 μm spectra of three red giant stars in the core of the Galaxy. The properties of OH/IR stars were studied by Baud et al. (29.131.023), Olnon et al. (29.155.032), Habing et al. (34.155.048), and Baud (34.155.042). Vanderspeck and Ricker (34.041.001) determined absolute coordinates for 19 stars within 2' of the galactic center for epoch 1958.3 and 1976.3 and calculated their proper motions. Mould (33.155.013) obtained the radial-velocity dispersion for M stars in the nuclear bulge.

2. Disk and Solar Vicinity

Stetson (30.111.009) published a list of 371 A-F population I stars of high velocity determined from proper motion studies. Kibblewhite et al. (33.111.018) analyze proper motions of disk stars to obtain measures of the galactic differential rotation. Murray (34.155.108) discusses the kinematics of dwarf stars and obtains histograms of proper motion for 900 stars with $B < 14$ near the south galactic cap. An observational program to measure absolute proper motions of stars with respect to galaxies was described by Kharchenko (34.155.018).

Zentelis (34.111.004) measured the radial velocities of 353 B0-A0 stars with $6.5 < V < 10.8$ in six galactic plane regions with a velocity uncertainty of 1.4 km/s. Fehrenbach and Burnage (29.111.003) and Fehrenbach et al. (32.111.001) published radial-velocity catalogues each containing four $4^{o} \times 4^{o}$ fields. Hartkopf and Yoss (32.155.062) obtained radial velocities for 302 polar giants.

A statistical study of 403 OB stars at $r < 630$ pc was performed by Quiroga and Tarsia (34.151.039) which shows that z motions are predominantly hydrodynamic. Ro-

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