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STREAMING MOTIONS IN THE CARINA-CENTAURUS REGION

by

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Abstract

An analysis of new velocity data for a large number of supergiants confirms results presented earlier that streaming motions of 8 km/sec occur between the sides of the spiral feature in the Carina-Centaurus region.

Non-circular motions on a large-scale have been found in several regions of the Galaxy for the young stars and the neutral hydrogen gas in the spiral arms (Burton 1966, Rickard 1968, Humphreys 1970). According to the density-wave theory (Lin, Yuan, and Shu 1969) deviations from circular rotation are expected to occur. The streaming motions should be against galactic rotation on the inner edge of a spiral arm and with it on the outer edge, and are estimated to have velocity components of the order of 10 km/sec. Burton's (1970) kinematic model of the galactic velocity-field based on the density-wave theory has streaming amplitudes between 3 and 8 km/sec.

In a previous paper (Humphreys 1970), Paper I, the velocity residuals for supergiant stars in the Carina-Centaurus region, ℓ = 285° - 305°, * suggested streaming motions in agreement with the density-wave theory, however only 37 stars were used in the analysis. The purpose of this paper is to present additional data which confirm the earlier results.

New radial velocities, MK spectral types, and UBV photometry have been obtained at Cerro Tololo Inter-American Observatory for 70 supergiant stars in the region ℓ= 285° - 305°. The velocities were measured from spectra taken with the Cassegrain spectrograph on the 60-inch telescope at 39Å/mm in the blue for the early-type supergiants and in the near-infrared at 78Å/mm for the M supergiants. A discussion of the velocities and their errors will be given in a later paper.

Model radial velocities were computed for the stars on the basis of the 1965 Schmidt model using their photometric distances corrected for interstellar absorption. The velocity residuals are given by $\Delta V = V_{obs} - V_{model}$. Defined in this way the negative and positive residuals imply motions toward and away from the sun, respectively.

Combining the information from Table I of Paper I with the new data, model velocities and residuals have been determined for 111 supergiants in the Carina-Centaurus region. Figures 1 and 2 show the surface and space distributions of the signs of the velocity residuals. It is clear from these diagrams that negative residuals are more frequent on the outer side of the spiral feature while positive residuals definitely dominate the inner edge.

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* New galactic longitude and latitude are used.

Dividing the region at $\ell = 292°$, mean residuals were formed for the two sides of the arm. The average was restricted to stars with photometric distances greater than 1.5 kpc. For some stars only one or two velocity measurements were available, however with over 50 stars in each group the mean residual should be significant. The mean velocity residuals with their standard deviations are -8.0 ± 1.9 km/sec and $+8.5 \pm 1.4$ km/sec from 52 and 51 supergiants on the outer and inner sides of the arm respectively. Since in this region we are looking directly along a spiral feature, the mean velocity residuals are indicative of the actual streaming velocity between the sides of the arm.

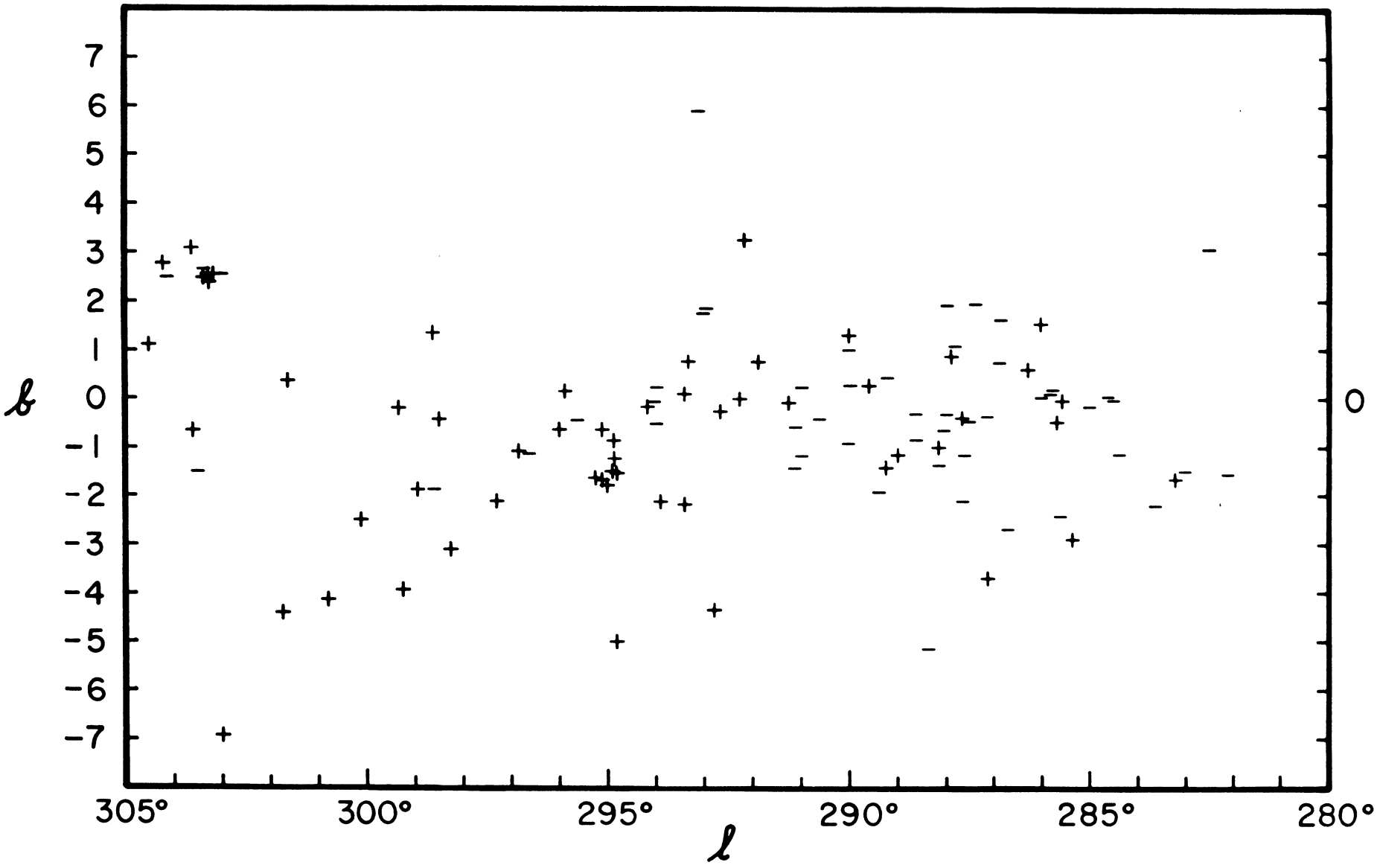
The improved velocity residuals confirm the preliminary results in Paper I. The streaming motions are with galactic rotation on the outer side and against it on the inner edge of the arm, and they are of the order of 8 km/sec, in accord with the density-wave theory.

Previous work (Bok, Hine and Miller 1970, Graham 1970) has shown that the Carina region is indeed a major spiral feature. In addition the presence of many luminous, young stars between $\ell = 295°$ and $305°$, apparently on the inner side of this feature, suggests that there is also a possible optical link with the Sagittarius arm.

It is a pleasure to thank the members of the staff of Cerro Tololo Inter-American Observatory for their assistance in obtaining the necessary observations.

Fig. 1 - The surface distribution of the signs of the velocity residuals. It is easy to see that negative residuals are more common shortwards of $\ell = 292°$ and that positive residuals dominate at greater longitudes.

Fig. 2 - The space distribution of the signs of the velocity residuals using the photometric distances of the stars.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6
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285°
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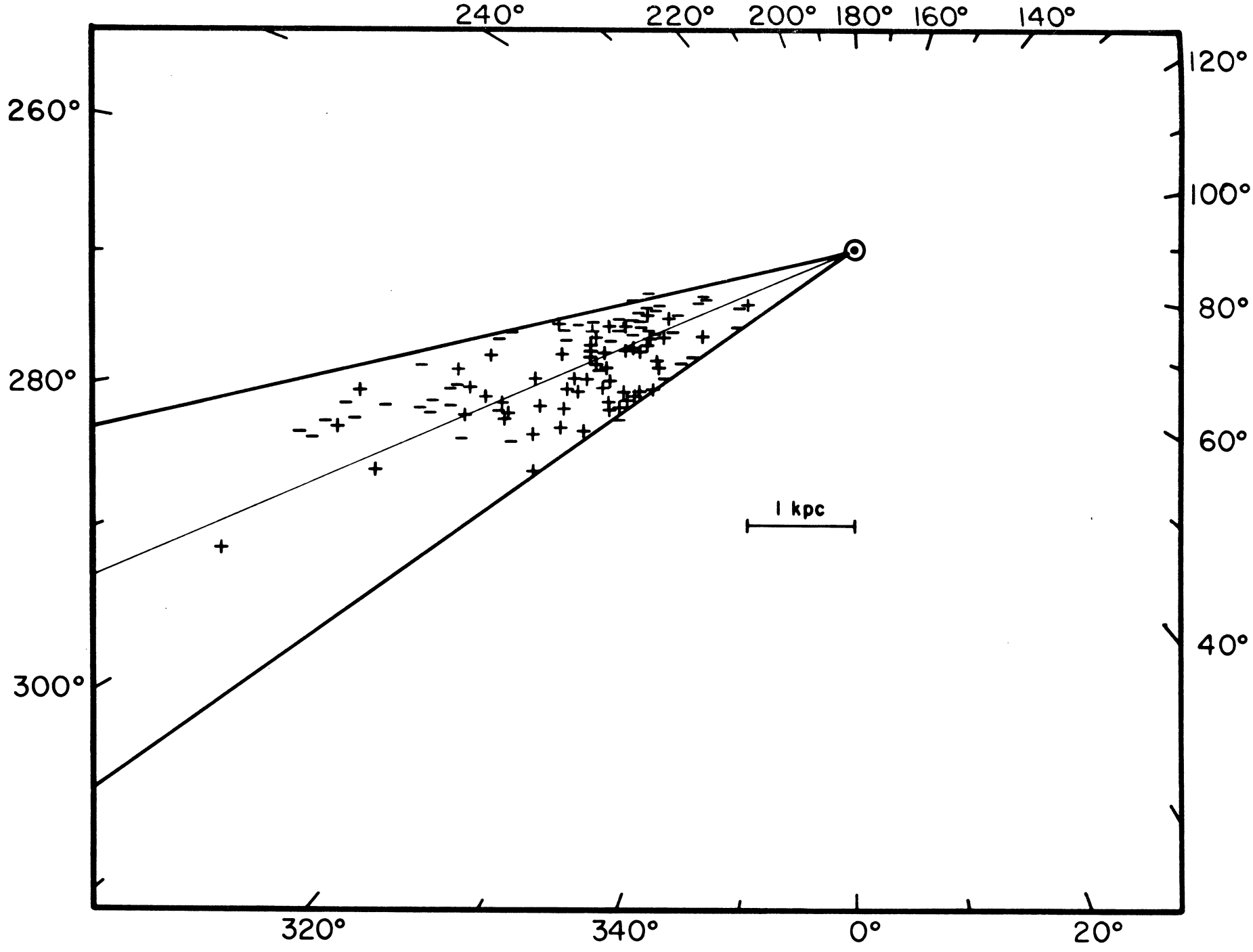
240°
220°
200°
180°
160°
140°
120°
100°
80°
60°
40°
260°
280°
300°
320°
340°
0°
20°
1 kpc

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