# SPACE DISTRIBUTION OF RED GIANTS AND THE GALACTIC STRUCTURE

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## ABSTRACT

Stellar content contributing to near IR radiation do not show radial differentiation in the Galaxy. Late-type giants and supergiants supply about 70% of the total volume emissivity at the K band, in the solar vicinity within 1 kpc, and also at the distance of several kpc in the Scutum region.

## 1. STELLAR CONTENT IN THE SOLAR VICINITY

Space number density of stars in the immediate solar vicinity and its dispersion from the galactic plane were derived for every spectral-luminosity groups by Ishida & Mikami (1982) by simulating the cumulative number of apparent magnitude for the stars in the catalogue of Two-Micron Sky Survey done by Neugebauer & Leighton (1969). Stellar content thus derived makes possible to predict volume emissivity at every broad color bands in the visual and near IR wavelength. At the K band, late-type giants and supergiants supply about 70% of the total volume emissivity in the solar vicinity within 1 kpc.

Accordingly red giant is a most useful probe to investigate over-all space distribution of stars in the Galaxy, because 1) they have bright absolute magnitude in near IR wavelength where interstellar extinction is small (Ishida & Mikami 1978), 2) show clear spectral features to be discriminated from early type stars (Iijima & Ishida 1978), 3) belong to the disk population (Mikami & Ishida 1981), and 4) are a major contributor to the volume emissivity of near IR radiation of the Galaxy (Ishida & Mikami 1982).

## 2. OBSERVATIONAL MATERIAL

We have three different kinds of observational material available to specify a model of over-all space distribution of stars in the Galaxy;



M. Capaccioli (ed.), Astronomy with Schmidt-Type Telescopes, 257–260.


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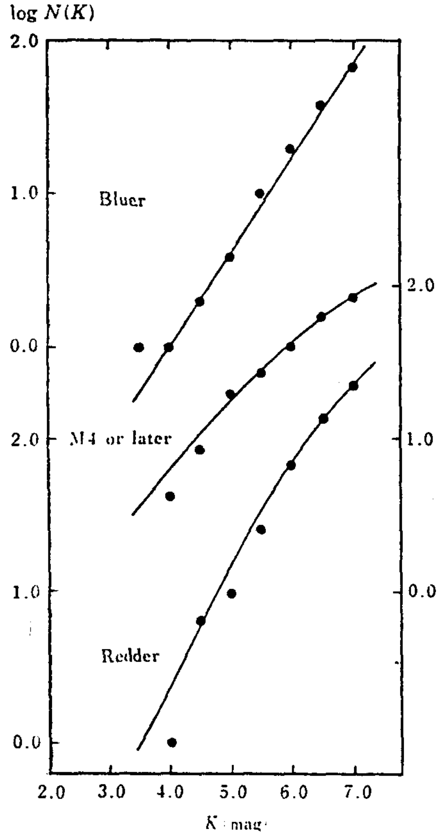


Fig. 1. Cumulative number function of point sources in 1.5 sq deg. of the Scutum region.

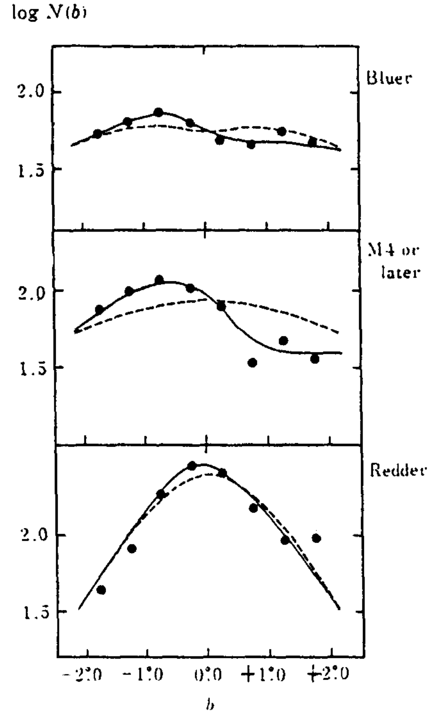


Fig. 2. Galactic lat. distribution of point sources brighter than K=7 in the Scutum.

viz. 1) objective prism plates (62.6"/mm and 1100Å/mm at the atmospheric A band) taken with the Schmidt telescope at the Kiso Observatory of the Tokyo Astronomical Observatory, which are used to know spectral type of stars out to a few kpc from the sun, 2) survey of two-micron point sources with broad band photometer at the Agematsu IR Observatory of Kyoto Univ., which presents information of deep inner part of the Galaxy, 3) contour map of two-micron surface brightness obtained by the small balloon-born telescopes (Hayakawa et al 1978, Okuda 1981), which is an edge-on view of the inner part of our Galaxy.

## 3. DETECTION

Nearly 900 point sources brighter than about 8 mag in the K band were detected in 1.5 sq deg. of the Scutum region ($l=26^\circ-27^\circ, -2^\circ \leq b \leq +2^\circ$) with the 1-m telescope (Kawara et al 1982). They were observed by broad

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band photometer for the H and K bands, giving K mag and H-K color. Cumulative number function N(K) of apparent mag K=4.0-7.0 is compiled for 469 point sources, and about 400 sources fainter than K=7.0 are rejected.

## 4. CLASSIFICATION

The near IR point sources were identified to stellar images on the photographic plates, and then to spectral images on the objective prism plates taken on IN emulsion through RG 695 filter. Spectral type of "M4 or later" is assigned to 115 stars, of which mean color is H-K=0.68. The rest of stars are divided into "bluer" group (H-K<0.68) of 93 stars and "redder" one of 261 stars. Cumulative number function N(K) is drawn for each of the three groups in figure 1 and galactic latitude distribution in figure 2. The "bluer" group is expected to be K-type and early M-type giants, the "M4 or later" is self-explanatory, and the "redder" group is supposed to be red supergiants at large distance contaminated with extremely cool giants, respectively. Mean absolute magnitudes and dispersions from the mean appropriate for each group are assumed for luminosity function.

## 5. MODEL FITTING

The luminosity function is integrated with weight of space distribution of number density of stars on each line of sight to simulate the cumulative number function and galactic latitude distribution. The model of space distribution contains main structural features of the exponential disk (scale radius 2.3 kpc), the 5 kpc ring, and the bulge of the Galaxy. The model of space distribution of interstellar absorbing matter also consists of three components. See Mikami et al (1982) for detailed discussions.

## 6. STELLAR CONTENT IN THE SCUTUM REGION

The cumulative number function and the galactic latitude distribution of the "bluer", "M4 or later", and "redder" groups are simulated by integrating with the space distribution of the assumed spectral-luminosity group. The numerical parameters in the space distribution include dispersions of the space distribution from the galactic plane, and the space number density in the immediate solar vicinity. The simulation is successful for the cumulative number function of the two-micron point sources with the assumed stellarcontents. The observed asymmetric distribution to galactic latitude is due to heavy interstellar extinction deviated toward north from the plane to a few kpc from the sun (see figure 2).

The over-all feature of the surface brightness contour map is also reproduced by the model if we assume that 30% of volume emissivity is

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radiated by objects which do not show up in the cumulative number functio of the present survey observations. It is concluded that late-type giant and supergiants occupy about 70% of the total volume emissivity at the K band. This is nearly the same proportion as that obtained in the solar vicinity within 1 kpc. It is indicated that stellar content contributing to volume emissivity of near IR radiation do not show radial differentiation in the Galaxy.

Some local deviations from the proposed model are interpreted as a galactic window in a case (Hamajima et al 1981, Ichikawa et al 1982) and a local concentration of supergiants in another case (Mikami et al 1982).

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