13. THE SPATIAL DISTRIBUTION OF NOVAE AND SUPER-NOVAE

I. M. KOPYLOV
Crimean Astrophysical Observatory, Simeis, Crimea, U.S.S.R.

(Abstract)

In 1945 McLaughlin found that novae form a comparatively flat sub-system in the Galaxy with an appreciable concentration towards the centre. B. V. Kukarkin came to the same conclusion in 1949. However, it was found later that this result, which contradicts our ideas of galactic structure, was a result of poor absolute magnitudes and the consequent underestimate of the distances of the novae.

Therefore, we decided to redetermine the characteristics of the novae sub-system. Including only novae within 1·5 kpc of the sun, allowing for interstellar absorption, and assuming that the absolute magnitude of the nova at maximum is given by: $M = -13{\cdot}7 + 3^{m}{\cdot}5 \log t_3$, where t_3 is the duration of the first three-magnitude decline, we find

$$\frac{\partial \log D}{\partial R} = -0{\cdot}22 \pm 0{\cdot}01,$$

$$\frac{\partial \log D}{\partial z} = -2{\cdot}39 \pm 0{\cdot}11.$$

The degree of galactic concentration is $\beta = 182 \pm 10$ pc. Thus, the novae form a typical, intermediate sub-system in the Galaxy.

The above results refer only to the region around the sun. To extend our results to other parts of the Galaxy, we can compare our Galaxy with the data obtained by Hubble and Mayall in M 31. The distance modulus of M 31, corrected for absorption, is $m_0 - M = 22^{m}{\cdot}9$. For $R < 2{\cdot}5$ kpc, the surface density of the novae increases more rapidly than for $R > 3$ kpc, outlining a nucleus of a considerably increased density. The radius $R = 1{\cdot}6$ kpc can be considered as the boundary of the central nucleus of the novae sub-system at which $\frac{\partial \log D}{\partial R}$ reaches its maximum value of $-1{\cdot}12$. The considerable apparent concentration of novae toward the centre in M 31 may be explained by a nucleus of increased density; at $R \sim 7$–8 kpc,

the parameters of the novae sub-system are also typical for an intermediate sub-system.

Additional evidence is given by the fact that both elliptical galaxies and Sc galaxies, typical of the spherical and flat sub-systems, respectively, have very few novae.

The apparent distribution of super-novae in other galaxies suggests that there are two types of these objects. About 20 % are found in the nucleus; the remainder are found far from the nucleus or in spiral arms. Moreover, the super-novae in the nuclei are about 4 magnitudes brighter and have different light curves from those found at greater distances from the centre.

By the identification of some discrete radio-emission sources in the Galaxy with remnants of super-novae, I. S. Shklovsky has found that there have been at least 9 super-novae outbursts in the vicinity of the sun during the last 2000 years. The apparent distribution of super-novae in other galaxies and the low galactic latitude of the super-novae in our Galaxy testify that super-novae belong to comparatively flat sub-systems. Near the sun we estimate:

$$\frac{\partial \log D}{\partial z} = -4{\cdot}9 \quad \frac{\partial \log D}{\partial R} = -0{\cdot}16.$$

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