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PRIMARY DIRECTION OF SPACE R.A .= $14^{h}.5$, DEC.= 50°

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ABSTRACT. *Analysis of position angle orientation of radio sources and galaxies allowed to make a conclusion about real primary direction of space to R.A. $14^{h}.5$ and Dec. 50°.*

If spatial orientations of extragalactic objects are random, their position angles must have an equal probability distribution. But investigations of the galaxies from the Uppsala catalogue by Nilson (1973, 1974) and Mandzhos (1987) demonstrated a significant deviation from flat distribution. It is interesting to note that the maximum of distribution is located near the direction to the World Pole. This experimental fact has made investigators search for selection effects because it is difficult to explain the coincidence of the Earth's axis with the direction of anisotropy of extragalactic objects. Few investigations of radio sources demonstrate a flat distribution of position angles (see, for example, Sanders et al., 1986). It is possible to explain the absence of anisotropy of radio orientation by the scantness of the samples. Although Wilson (1972) has demonstrated a tendency of the 3CR radio sources' axes for parallelism. But Kapahi et al. (1985) have disproved this result. Lawrence et al. (1986) have published a catalogue of about 1000 radio sources observed by the VLA. It is important that these objects were extracted randomly from the MG catalogue (Bannet et al., 1986). The sample covers an area with R.A. 0^{h} - 24^{h} and Dec. -2.5° - 19.5° with a depth of about 80 mJy at 6 cm. The sample contains 302 objects with the double or more complex structure. The second sample used by me is the GB/GB2 catalogue (Machalski and Condon, 1986) containing 132 radio sources with a flux density of more than 0.5 Jy at 21 cm. These were also observed by the VLA. In Figs.1 and 2 the distributions of position angles for the MG and MG+GB/GB2 samples are shown. Similar to the papers by Nilson (1973, 1974); Mandzos et al. (1987) the unevenness and location of the maximum are estimated by the first harmonic of distribution of position angles. For calculation the optimum filtration by circular convolution with the first harmonic was used:

$$K_j = \frac{2}{N} \sum_{i=1}^{N} (X_i - \bar{X}) \cos\left(\frac{2\pi}{N}(i+j-1)\right),$$

where N is the number of intervals of the histogram. $\bar{X} = \frac{1}{N} \sum_{i=1}^{N} X_i$,

where X_i - the number of objects in the i-space.

It should be noted that the histograms "stick together" along 0° and 180°. The location of the convolution maximum and its value are phase (φ) and amplitude (A) of the first harmonic. The errors of the amplitude and phase are:

$$\sigma = \sqrt{\frac{2}{(N-1)N} \sum_{i=1}^{N} (X_i - \bar{X})^2}\ , \quad \text{and} \quad \sigma_\varphi = \sqrt{180\, \Delta\varphi \left(\frac{\sigma}{A}\right)^2 + \frac{\Delta\varphi^2}{12}}\ ,$$

$\Delta\varphi$ is the interval of the histogram (degrees).

It has been found that for MG and MG+GB/GB2 the maximum of the histogram as well as for galaxiesis located not far from the direction to the World Pole. This coincidence allows us to hope that the unevenness of the distribution is not random. There is another experimental fact in support of our assumption. Fig.3 demonstrates histograms for three intervals of R.A.: 20^h- 4^h, 4^h- 12^h and 12^h- 20^h. The first and second intervals have significant anisotropy, but the one between 12^h and 20^h has a flat distribution. What is the picture for galaxies? Figs.4 and 5 demonstrate distributions of position angles for the galaxies of the Uppsala catalogue. Fig.4 shows the following areas of the sky: Dec. 0°-30°, R.A. 20^h-4^h, 4^h-12^h and 12^h-20^h. Fig.5 shows Dec. 30-60°, R.A. 0^h-6^h, 6^h-12^h, 12^h-18^h and 18^h-24^h. We can see a surprising coincidence for the distributions of optical and radio objects: in the range 12^h-18^h anisotropy of orientation is close to zero. One can make a mental experiment. Let space have a primary direction. Let all extragalactic objects be oriented along this direction. Then the distribution of position angles with respect to this axis should be a δ-function with maximum at about 0°. If position angles are recomputed with respect to the World Pole the distribution will "spread" from 0° to 180°. If the sample covers 24^h along R.A., the distribution maximum will inevitably be at about 0°. Otherwise its position and amplitude will depend on the coordinates of the primary direction and sample of objects. For example, if their coordinates coincide, the histogram will be flat. Therefore, from Figs. 3, 4, 5 one can inevitably draw a conclusion: the primary direction is real and located between 12^h and 18^h. Parnovsky et al. (1992) have analyzed orientation of edge on galaxies. It has been found that anisotropy of orientation has a maximum in the direction R.A. 5^h, Dec. 30° and minimum in the direction R.A. 14^h, Dec. 35°. This result is consistent with the foregoing.

I have attempted to search for the primary direction in the analysis of the MG and GB/GB2 catalogues. The idea of the search is very simple. It is clear that anisotropy reaches maximum for the position angles measured relative to the primary direction. The search program "moves" with a definite step across the sky. For every point it calculates distribution of position angles and parameters of the first harmonic. Let the amplitude be negative if the phase value is between 45° and 135°. Otherwise the amplitude will be positive. This condition is needed for the creation of isolines of the first harmonic amplitude. Circular isolines must surround the primary direction, if it is real. The points of the large ring, which is perpendicular to the primary direction, must have the phase of the first harmonic at about 90°. The results of the calculations for MG and MG+GB/GB2 are demonstrated in Figs. 6 and 7. Anisotropy reaches its maximum at the point R.A. $14^h.5$, Dec. 50° (see the histogram). The histogram shows: first line - R.A. of the sample of radio sources, second line - coordinates of the point with maximum anisotropy, third line - amplitude of the first harmonic, error of the amplitude and error of the histogram, fourth line - phase of the histogram (degrees) and number of objects, fifth line - histogram. The right part of the histogram shows the celestial sphere with isolines of the amplitude of the first harmonic. Preparation of the MG+GB/GB2 catalogues increases the significance of the result without changing the position of the primary direction. In order to verify this result, the author has made a numerical experiment. For the radio sources of the MG catalogue the program has set a random orientation of position angles adhering to equal probability distribution. The result of the calculation is shown in Fig.8. The structure of the isolines is more chaotic and it has several positive maxima. The amplitude of the first harmonic decreases. Many random samples have been created. All calculations demonstrate a more chaotic structure than that found in the experiment. Later, 15% of randomly selected radio sources were oriented to point ($14^h.5$, 50°), and 85% have the equal probability orientation. The position of the primary direction has been found close to the preset one, and it is equal to $14^h.5$, 50° (Fig. 9), the phase of the first harmonic is about 0°, and the structure of isolines is obviously circular.

CONCLUSION

The above analysis allows us to draw the careful conclusion that radio sources and, maybe, galaxies have the tendency for orientation in the primary direction ($14^h.5$, 50°). For more reliable corroboration or refutement of this statement investigations by the VLA of the structure of thousands of radio sources of the fundamental survey (MG, Z or 87GB) are needed. It is interesting to repeat such analysis for the objects of the Uppsala catalogue.

Is the primary direction a property of the Local supercluster or of the Metagalaxy? Apparently, the MG radio sources are distant objects. The size of the Local supercluster is not large enough to allow location of 15% of the necessary radio sources. Therefore the author is inclined to think that it is the property of the Metagalaxy. Note the closeness of the coordinates of the primary direction and of the Pole of our Galaxy. Maybe, the coincidence of orientation of an ordinary galaxy with the primary direction justifies this argument. An experiment will show.

In conclusion the author thanks Mandzhos A.V. for the fruitful and interesting discussions.

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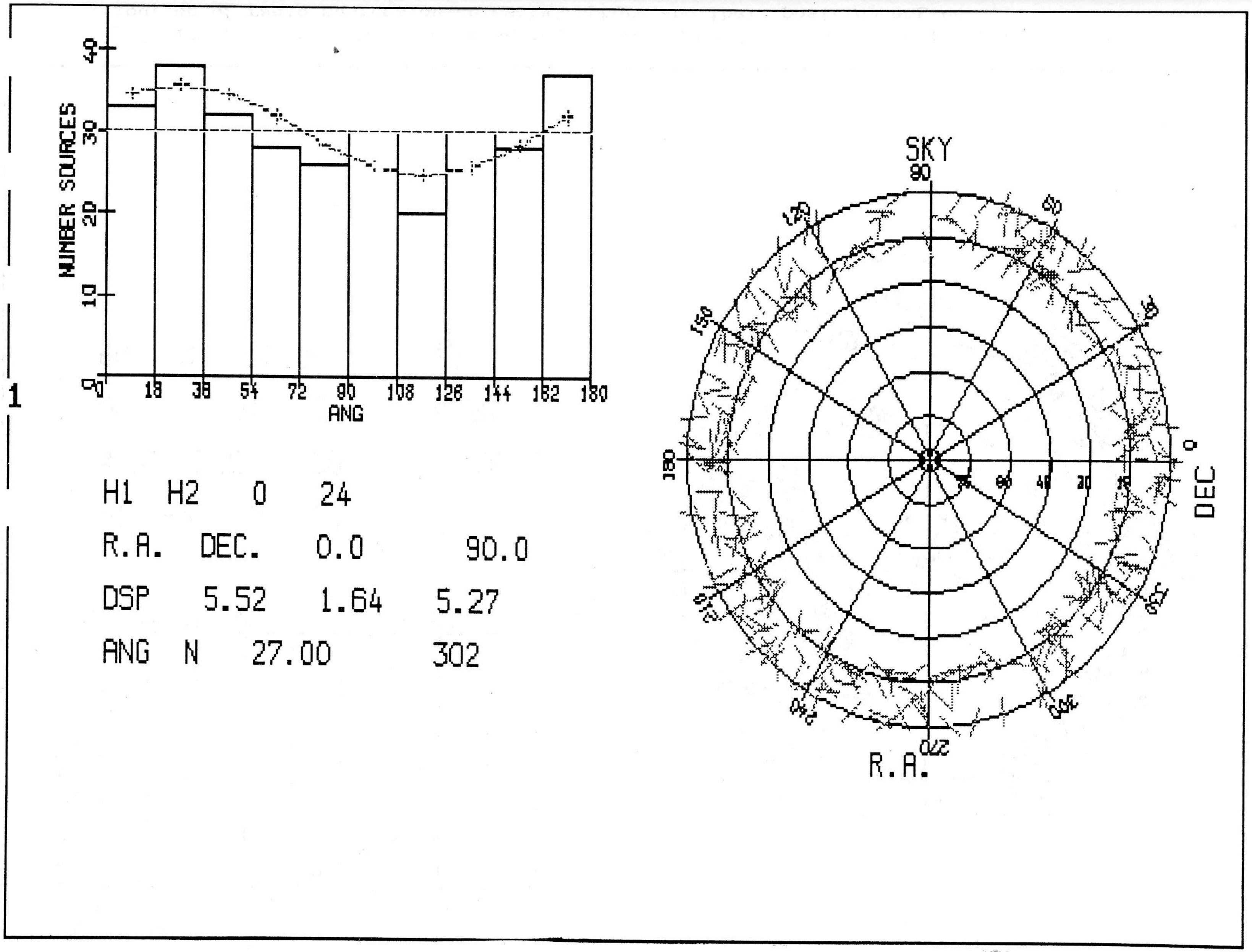


Fig 1. The distribution of position angles for MG sample. On the right - distribution of radio sources on celestial sphere and their position angles.

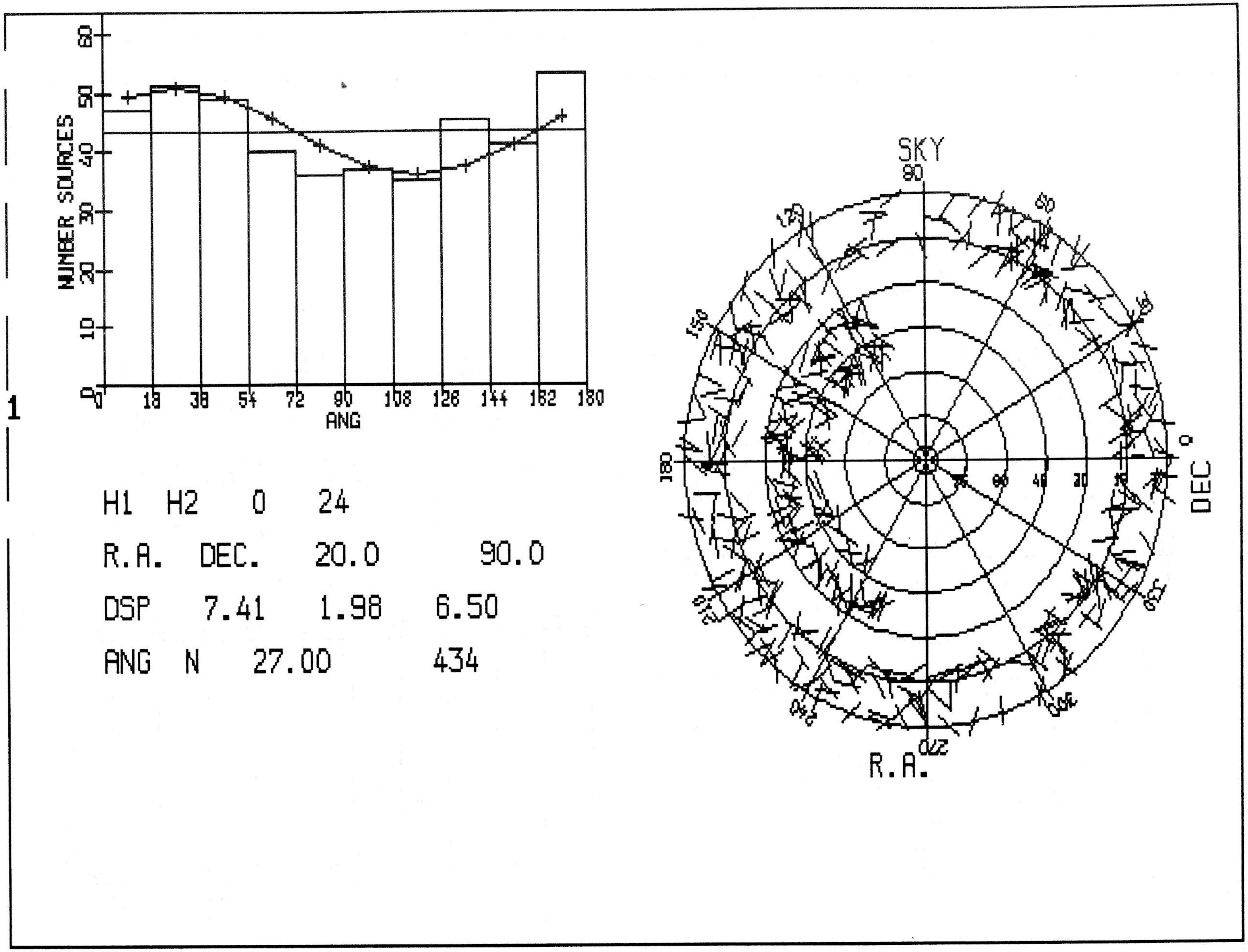
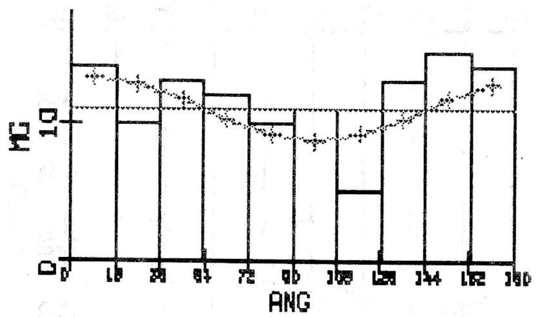


Fig 2. The distribution of position angles for MG+GB/GB2 samples. On the right - distribution of radio sources on celestial sphere and their position angles.



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ANG N 9.00 117

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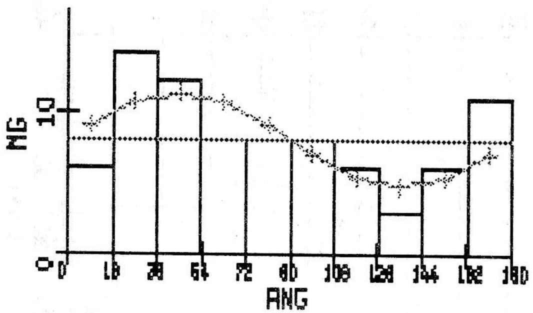

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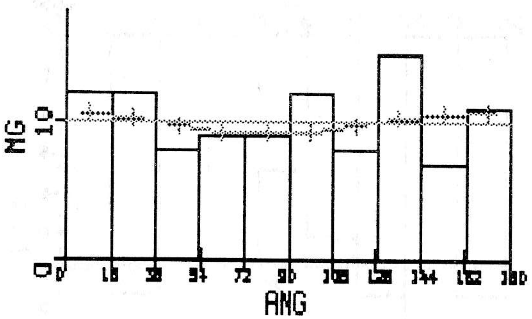

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ANG N 171.00 103

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Fig 3. The distributions of position angles for MG sample for 20^h-4^h, $4^h - 12^h$ and $12^h - 20^h$ correspondingly.

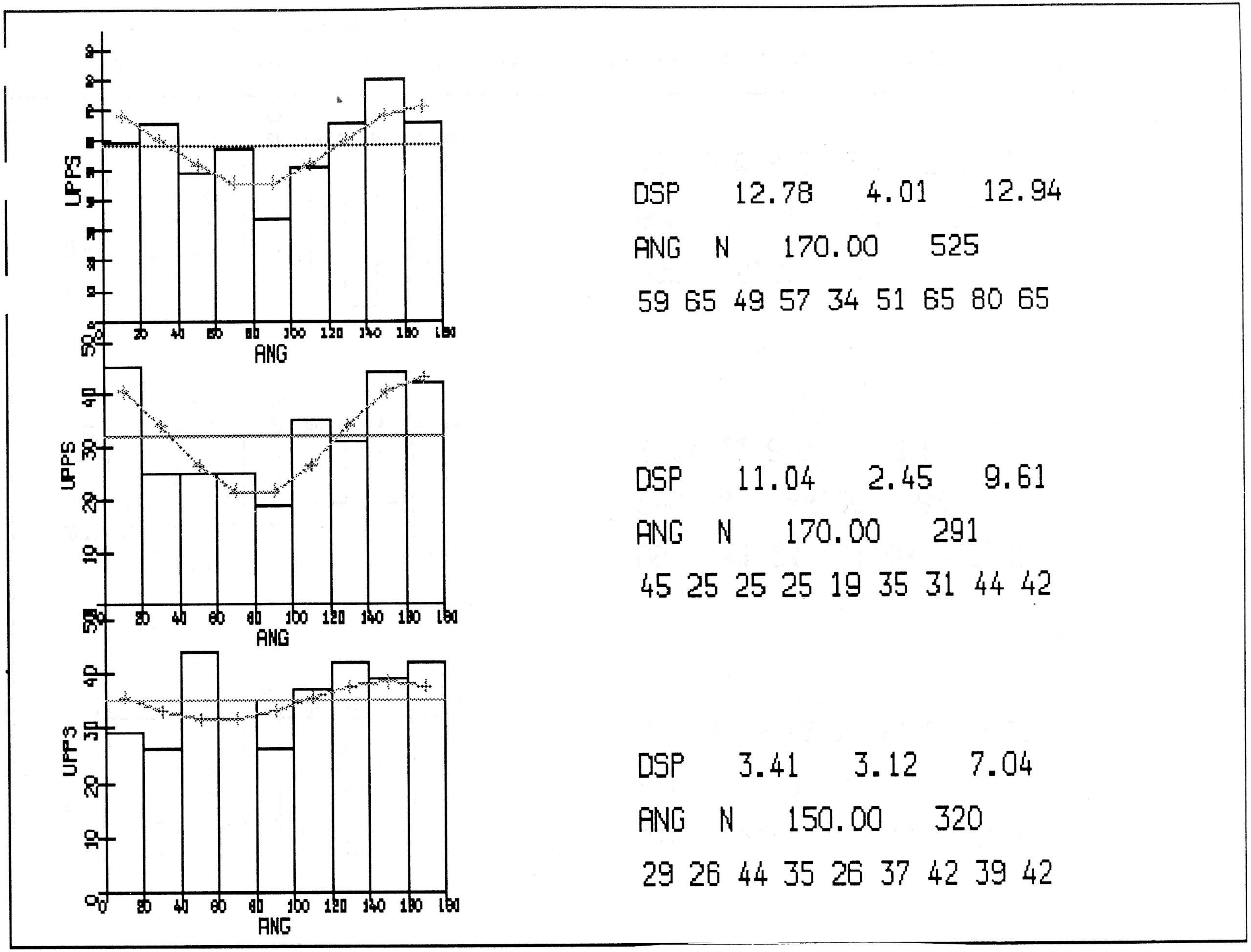
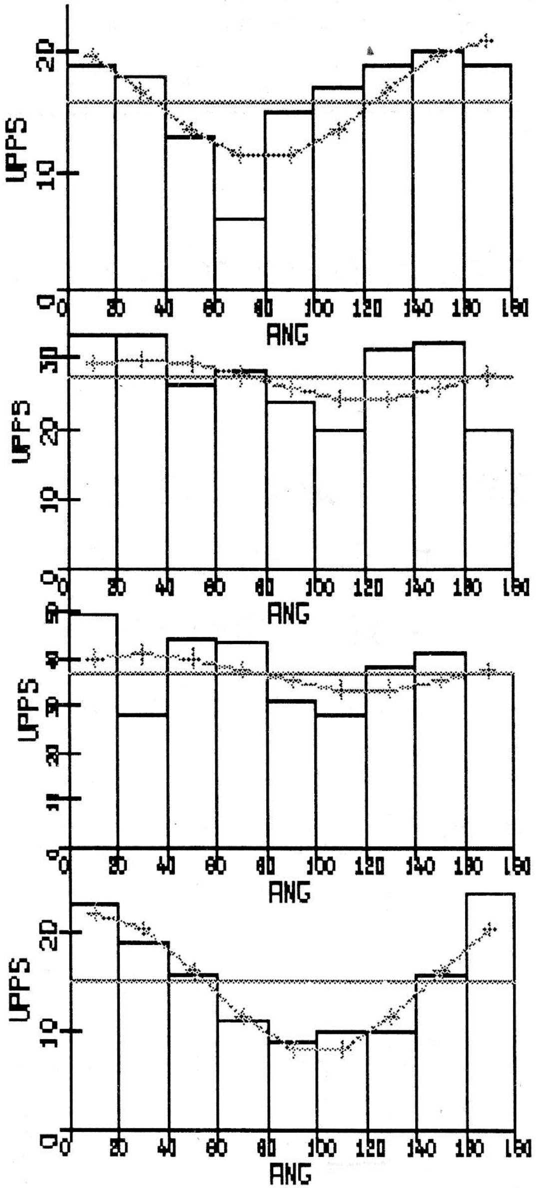


Fig 4. The distributions of position angles for Uppsala catalogue between 0° - 30° declination for 20^h - 4^h, 4^h - 12^h and 12^h - 20^h correspondingly.



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DSP 3.87 3.31 7.45
ANG N 30.00 339
49 28 44 43 31 28 38 41 37

DSP 7.13 0.77 5.76
ANG N 10.00 138
23 19 16 11 9 10 10 16 24

Fig 5. The distributions of position angles for Uppsala catalogue between 30° - 60° declination for $0^h - 6^h$, $6^h - 12^h$ $12^h - 18^h$ and $18^h - 24^h$ correspondingly.

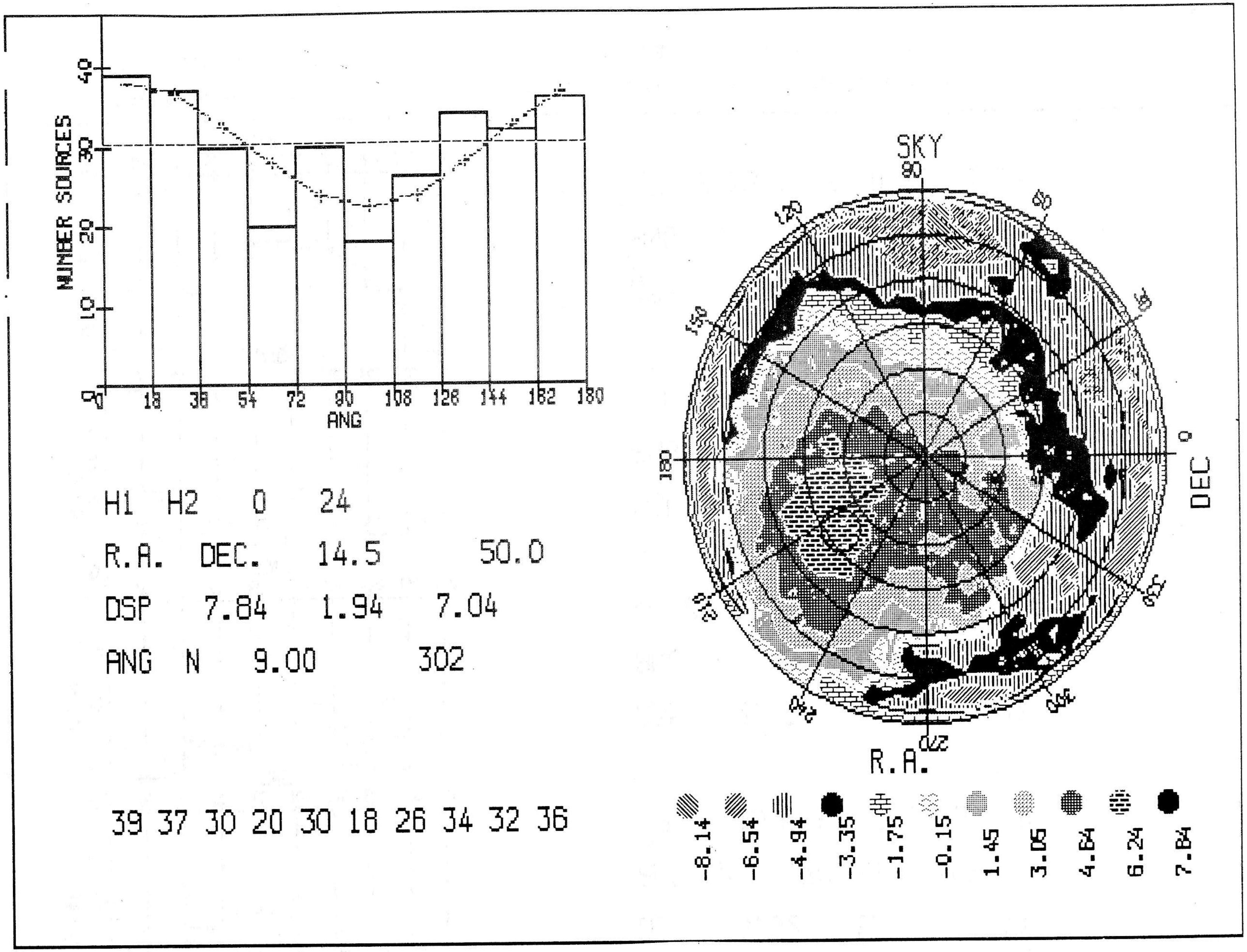

Fig 6. The distribution of position angles for MG sample measured relative to the primary direction $14^{h}.5$, 50°. On the right - celestial sphere with isolines of the amplitude of the first harmonic.

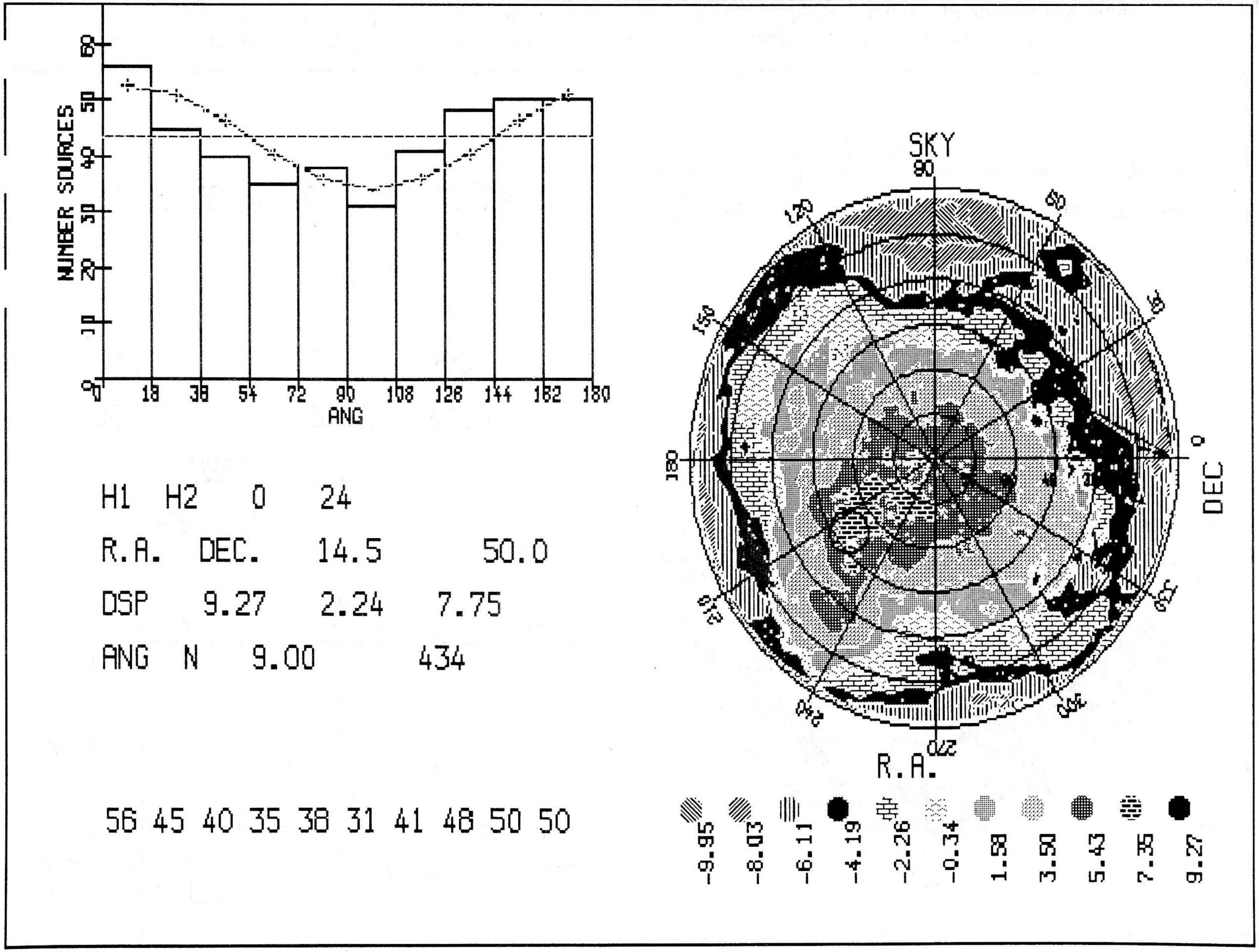

Fig 7. The distribution of position angles for MG+GB/GB2 samples measured relative to the primary direction $14^{h}.5$, 50°. On the right - celestial sphere with isolines of the amplitude of the first harmonic.

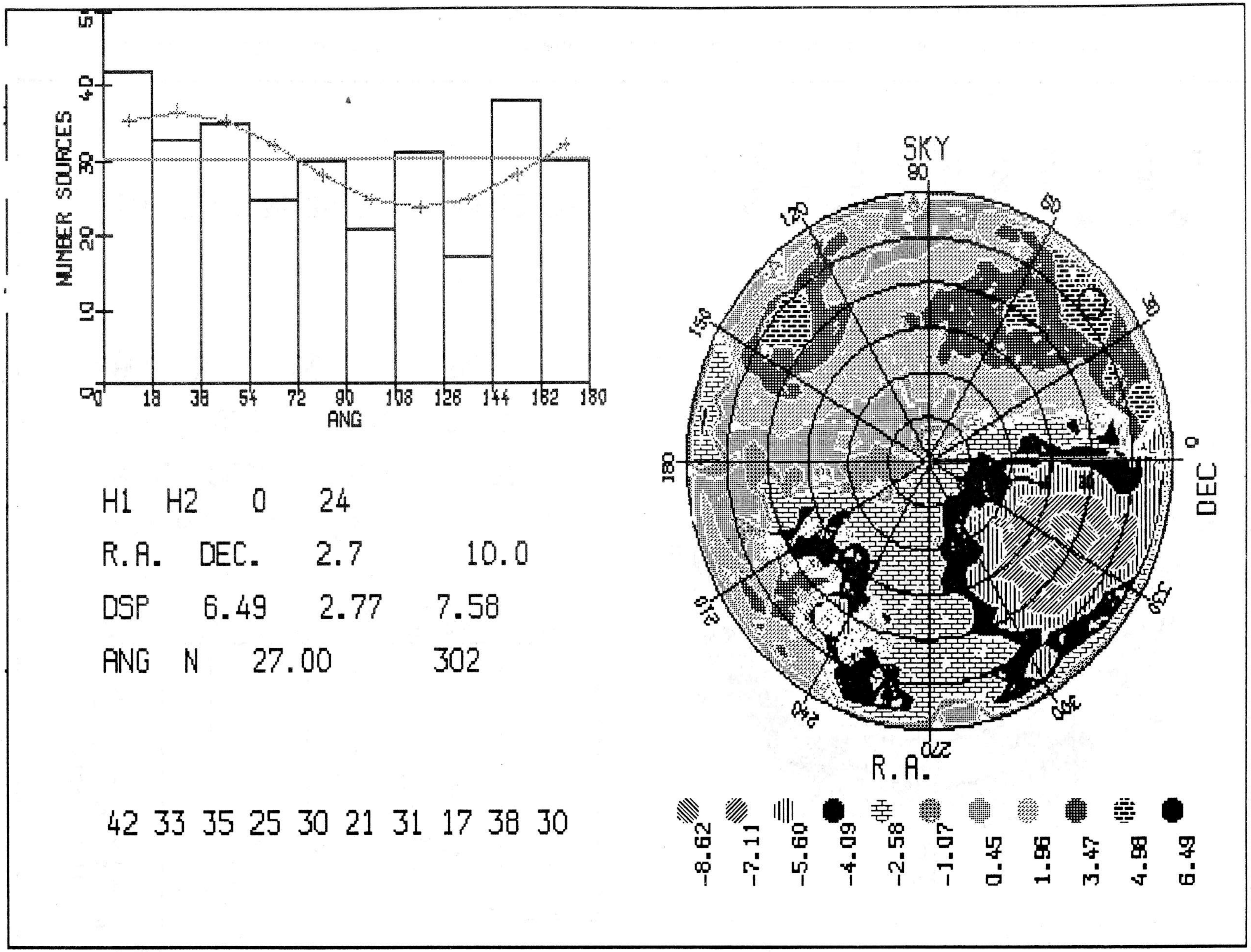

Fig 8. The distribution of position angles for MG sample measured relative to the primary direction. Position angles of the radio sources have equal probability distribution.

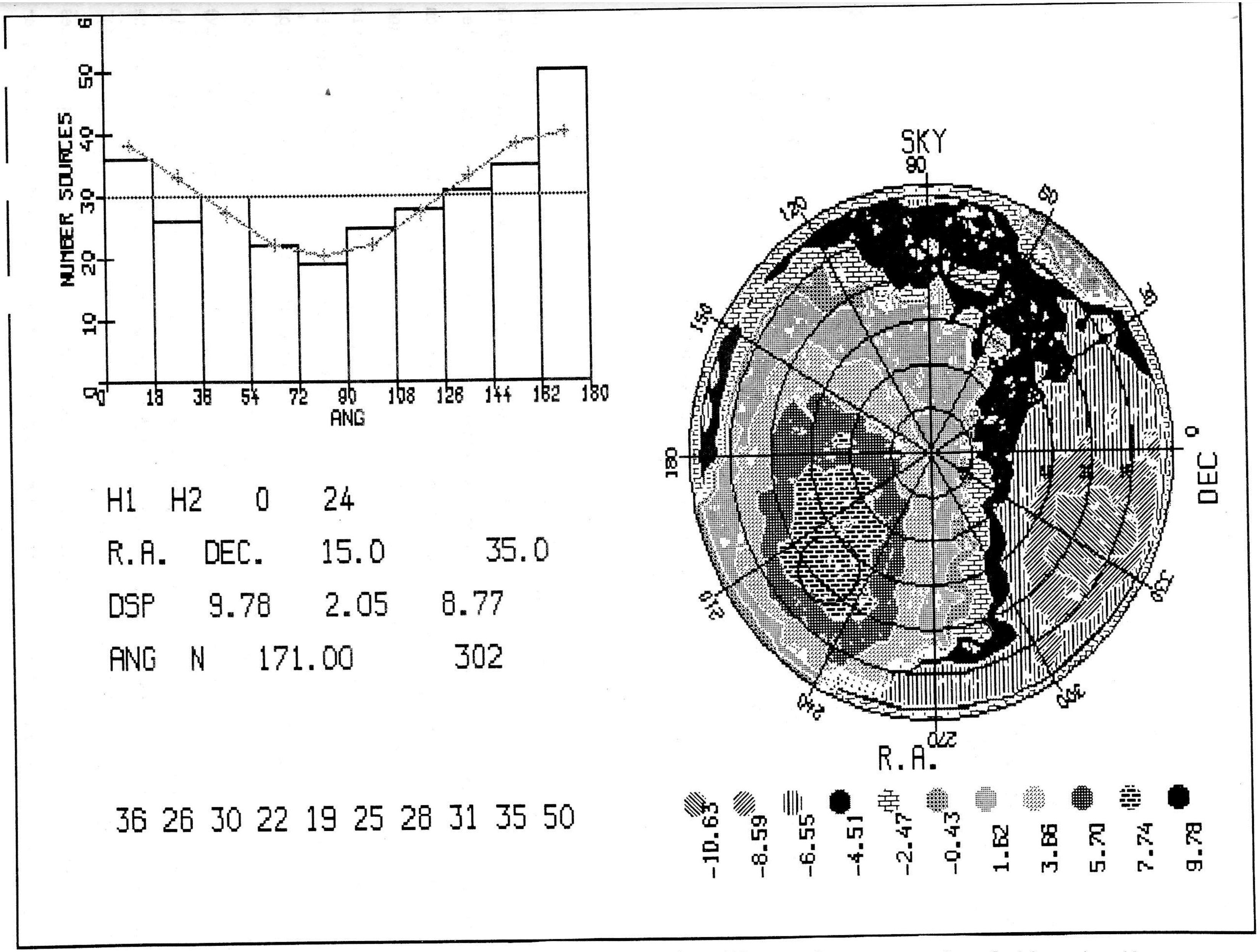

Fig 9. The distribution of position angles for MG sample measured relative to the primary direction. Position angles have equal probability distribution for 85% of the radio sources. The other 15% of the objects have orientation $14^h.5$, 50°.