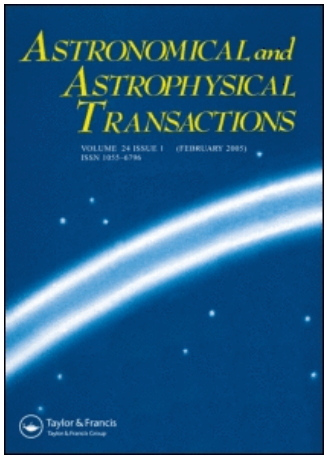

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THE GASEOUS DISK ALMOST PERPENDICULAR TO THE GALACTIC PLANE

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Around the calculated position of the Magellanic Stream's great circle, two very extended zones (I and II) were chosen, situated azimuthally opposed each other. These zones were observed with the RATAN-600 telescope in the HI radioline at the relative low LSR-velocities. Six hours were necessary to cross the zones at every declination from -40 to $+62.5$ degrees. The comparison was made of the warp-like signals in the Magellanic Stream and those in the galactic gaseous disk (the North and the South warps). Their sizes, the amount and the direction of the displacements relative to the RA direction in the Magellanic Stream were evaluated. The position of the plane through maximum deformations was determined. The behaviour of HI in the stream shows that there is possibly a gaseous disk similar to that of the polar ring in external galaxy. The warp tendencies in the stream plane were firstly proposed using the observations with the Large Pulkovo Radiotelescope.

Keywords: Magellanic Stream; Neutral hydrogen in the MS; Galaxy disks

1 INTRODUCTION

In our paper (Bystrova, 1995) possible warps in the neutral hydrogen distribution for a part of the Magellanic Stream plane were demonstrated. As usually we imagine the stream as a gaseous flow joining the Large and Small Magellanic Clouds which extends along the great circle of the stream. Beginning from 1995 the same part of the Magellanic Stream was observed with the RATAN-600 telescope, and scans with larger declination were designated as zone I. The first conclusions for the zone I were obtained from the data of our Pulkovo Sky Survey of the interstellar neutral hydrogen radio line using the maps of the results. Previously all the maps were regenerated from the galactic coordinate system into special magellanic one in order to avoid the distortions of the images. Note that observations with the Large Pulkovo Radiotelescope allowed to study for the first time HI emission in the direction of the stream using small velocities relative to the local standard of rest. In order to continue this study a new part of the Magellanic Stream great circle was chosen – the zone II with the same area as the zone I. In Section 2 we describe our observations. In the Section 3 the position of the stream great circle in the galactic and equatorial coordinate systems, and discuss reasons for choosing the Zone II. In Section 4 we discuss our results. Conclusions are made in Section 5.

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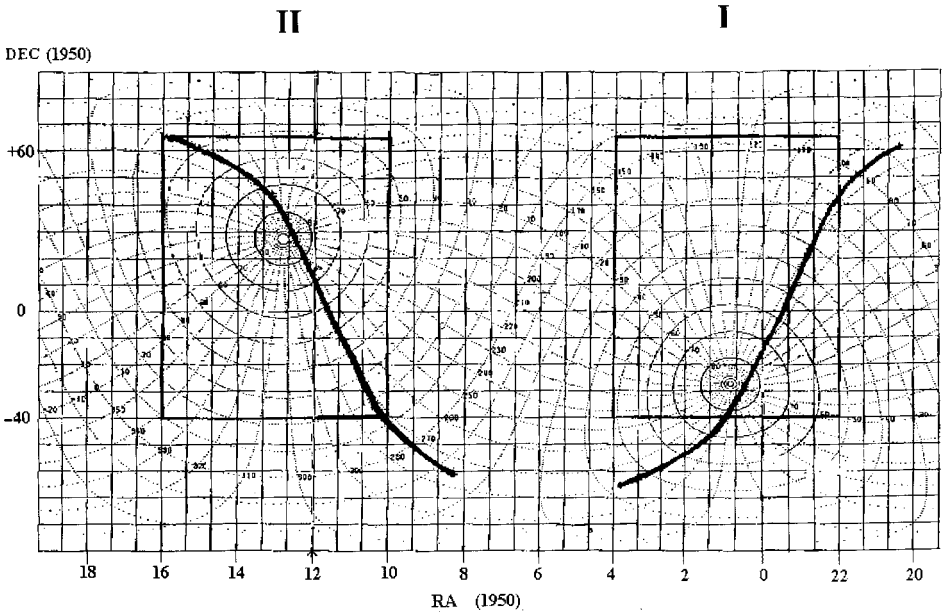

FIGURE 1

2 THE RATAN-600 OBSERVATIONS

The radiotelescope RATAN-600 has a fan beam of 2.5arcmin × 2.5deg. Its 39 spectral channels cover the velocity range of about 250 km/s. The bandwidth of one channel and the spacing between them is 6.3 km/s (or 30 kHz). The root mean square of the antenna temperature fluctuations is 0.25 K. The area on the sky of every zone is about 1000 sq. degrees. As a result of observations were the drift scans of 6 or 7 hours long for every 5 degrees in declinations. The precautions were made for detecting the signals of small intensity. Figure 1 shows the positions of the zones I and II in equatorial coordinate system. The zone I was observed for the comparison with the data of the Pulkovo Sky Survey. The zone II is situated also on the great circle of the Magellanic Stream, but in the azimuthally opposed direction to the zone I.

3 THE DESCRIPTION OF THE OBSERVATIONAL DATA

On Figure 2 an example of the record obtained for the zone I is given. The details of two types are present there. Those with halfwidths not larger than 20–30 minutes in the RA direction, are the details of the structural component of the galactic HI emission in this direction. Besides them there are broad signals with halfwidths more than two hours and amplitudes of several Kelvins. These emission regions on the drift scans across the Magellanic Stream are seen at least in 5–6 channels, which gives for the broad signals the velocity dispersion about 30–40 km/s. The signals are displaced in the RA direction when the absolute magnitude of the negative velocities grows. This effect is exactly as observed for the galactic HI emission forming the *N*-warp of the HI gas layer. However, the displacement the Magellanic Stream is several times larger than is seen in the Galaxy. Thus, this structure exactly corresponds to the definition of warps given by Battaner (1995): “A disk is said to be warped (at least in the

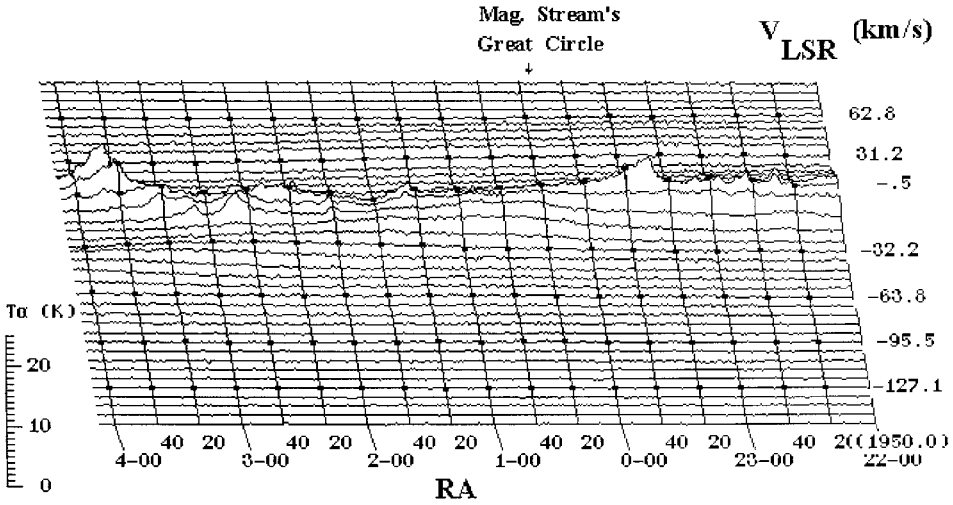

FIGURE 2

sense adopted here) if there is a smooth and moderate rise in a part of its outer region, accompanied by a descent in the azimuthally opposed region".

In order to find the position of the zone II on the great circle of the streamthe position of the circle on the sky map was determined (Fig. 1). The following values of the pole and the ascending node were calculated for the great circle in the galactic coordinate system in degrees:

$$\mathrm{AP} = 4.053$$
$$\mathrm{BP} = 4.988$$
$$\mathrm{A0} = 290.410$$
$$\mathrm{B0} = -72.783$$

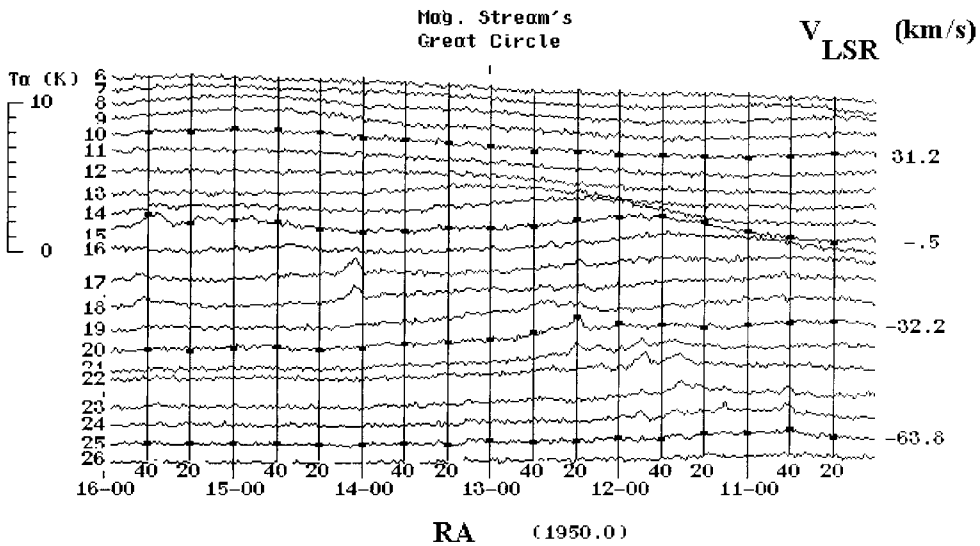

FIGURE 3

and in the equatorial system:

$$\mathrm{AP} = 263.31$$
$$\mathrm{BP} = -22.84$$
$$\mathrm{A0} = 17.41$$
$$\mathrm{B0} = -44.11$$

According to Wannier and Wrixon (1972) the HI emission in the Magellanic stream lies inside 4 degrees from the great circle.

Thus the coordinates of the zones are the following:

Zone I RA from -330 to $+60$ degrees, Dec from -40 to $+62.5$ degrees, Zone II RA from -150 to $+240$ degrees, Dec from -40 to $+62.5$ degrees.

On Figure 3 an example of drift scans obtained with the RATAN-600 observations the zone II is shown.

4 PRELIMINARY DISCUSSION OF THE RESULTS

In order to determine the position of the plane of the maximum warping in the Magellanic Stream plane all the scans through the zones I and II were compared, and the statement was made that this plane goes through the scans at declinations -20 and $+41.25$ degrees (Figs. 2 and 3). The position of the stream great circle differs in about 180 degrees when seen from the north Magellanic pole.

At least in the zone II HI emission does exist around the great circle of the stream which extends out the four degrees limit (Wannier and Wrixon, 1972).

It follows from the Figure 3 that the significant part of the emission has positive radial velocity relative to the local standard of rest (LSR). The displacement of the broad signals is in opposite direction as compared with the zone I, *i.e.* in the direction of the decrease of the right ascension. The value of the displacements is not smaller than on the Figure 2, and the velocity dispersion of the signals is larger than in the zone I. Both amplitudes and halfwidths of the signals and their displacements are several times larger than in the gaseous disk of our Galaxy. The galactic gaseous disk and the plane of the Magellanic Stream determined by their central parts have HI emission to the north and to the south from these planes in azimuthally opposed directions. The estimates show that the values of displacements for broad signals in zones I and II are approximately three times larger on the records for the Magellanic Stream observations than during the crossing of the galactic gaseous disk. In both cases these structures have possibly similar structure what can indicate that the Magellanic Stream is a gaseous disk almost perpendicular to the Galactic plane. One can mention for comparison that the polar ring of the galaxy NGC 4650A is also a gaseous disk (Iodice E. *et al.*, 2000) – according to optical observations with the Australian telescopes.

After the reduction of all observational data including the observations of the end 2001 and 2002 more exact conclusions can be made.

5 CONCLUSIONS

The preliminary results obtained to date can be summarized as follows:

- In the Galaxy there exists another object which has warps of the disk – the Magellanic stream almost perpendicular to the Galactic disk.

- In the zone I the size of the signals (their halfwidths) is more than two hours in the RA direction, with the amplitude of several K, the velocity dispersion is of 30–40 km/s.
- In the zone I the broad signals are displaced in the RA direction when the absolute magnitudes of negative velocities increase, similarly to what observed in the northern warps of the Galactic disk.
- In the zone II a considerable part of the broad signals has positive velocities relative to the LSR. Their displacement is in the opposite direction to the growth of RA, the velocity dispersion is 50–60 km/s.
- Broad signals are observed in the sky area which is more than 4 degrees from the great circle of the stream.
- The position of the plane of the maximal warp of the stream is determined.
- The displacement of the signals for the Magellanic Stream is approximately 3 times higher than for the Galactic gaseous disk.
- These formations have similar structure and the Magellanic Stream is apparently a gaseous disk almost perpendicular to the Galactic disk when the positions of their planes are determined by their central parts.

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