THE BRIGHT PART OF PERSEUS ARM AND THE LENS

Shatsova R.B., Anisimova G.B.

Southern Federal University
Ростов-на-Дону, Россия
galina@iubip.ru

ABSTRACT. The part of Milky Way between l≈90° and 150°, related to the Perseus arm, stand out by its large brightness. It is due to the great number of supergiants, Cepheids, OB-associations, supernova, molecular clouds, γ-bursts, etc. The outlines of this part of the arm in the celestial projection almost coincide the Lens projection, formed by the intersecting radioloops' shells II and III, well known by their synchrotron radiation. It means, that the bright Perseus arm part is observing through nearby to it Lens (r=100-250 pc). The arm parts, observing outside this Lens, are fainter for several magnitudes. The Sagittarius arm is observing through the Loop I.

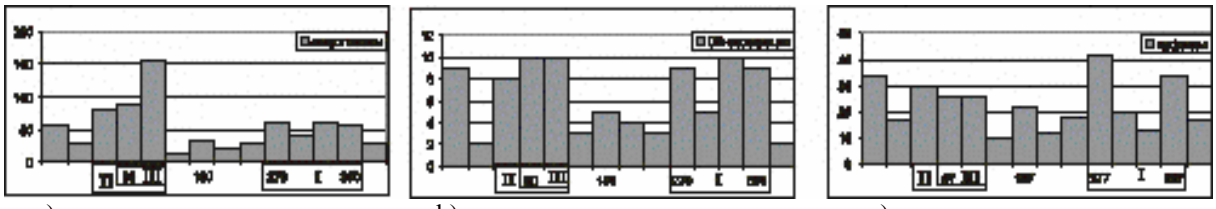
The modern data of the light absorption do not explain this phenomenon. This one and some other facts rise the hypothesis that the spur shells, in particular, the Lens are focusing, or in some other way make brighter passing through them radiation. It is important to estimate the role of the Lens effect in the existing picture of the spiral structure of the Galaxy, independently of the hypothesis.

The differences of brightness in the Perseus arm attracted the attention of several authors before us, for instance, Efremov in monograph "Sites of star formation in galaxies" [1].

One can distinguish the region at longitudes *l*(90° - 150°) in comparison to the neighbouring regions in the histograms in Fig.1 for the number of supergiants and OB-associations (over Humphreys [2]), the Cepheids on the map of Melnic et al [3], the (l, b) distribution of molecular clouds (over Huang and Thaddeuss [4]) – Fig.2a, the (x, y)- plane distribution of open clusters (over Dias et al [5]) – Fig.2b, etc.

We compared the visual magnitudes with the longitudes (V, l) for the supergiants (over [2]). Fig.3 shows the envelope curve from the bright side of this distribution for the distances larger 1 kpc. One can see at *l*<90° and *l* >150° both the number of these stars is several times smaller (Fig.1) and they are fainter for several stellar magnitudes. The third peculiarity of the bright part is its inclination to the galactic equator: between b≈+12° at *l*≈90°; and b≈-13° at *l*≈143°. The inclination is seen also in HII region (over Berdnikov).

The observation of arm region *l*(90°, 150°), distinguished in larger density, brightness and inclination may mean either real inhomogeneity of the arm, similar to the fragmental spirals of many galaxies, or it tells some circumstances, giving the visibility of inhomogeneity. In last case the simplest explanation of the visibility of differences would be the higher light absorption in the neighbouring sky regions. But the modern maps of light absorption (Hakkila et al, [6]) show the higher light absorption in the bright part, but not around it (Fig.4). So, the alternative to the real difference in the arm can be the other reason.



a) b) c)

Fig. 1. The number of objects at l(90°,150°)
a)supergiants, b) OB-associations (over Humphreys), c) the Cepheids on the map of Melnic et al

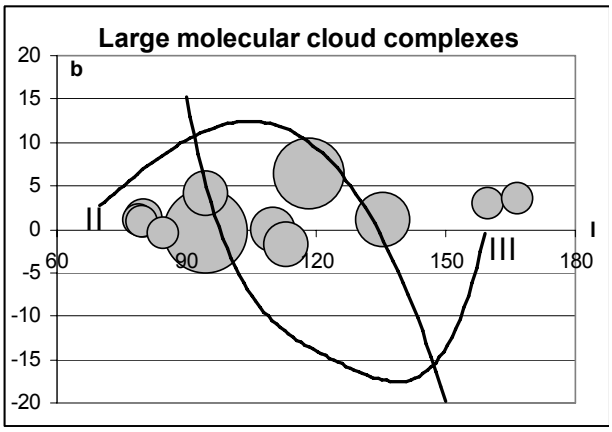


Fig.2a (l, b) distribution of molecular clouds (over [4])

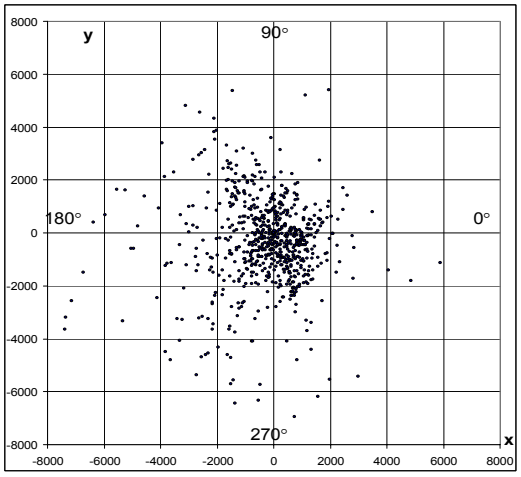


Fig. 2b (x, y)-plane distribution of open clusters (over [5])

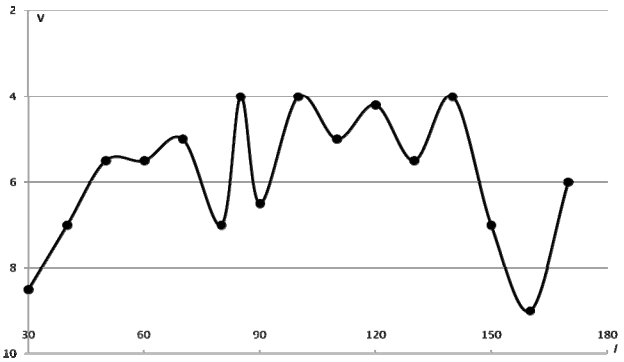


Fig. 3 (V,l) distribution for supergiants (over [2]). The envelope curve from the bright side of this distribution for the distances larger 1 kpc. The number of these stars both at l<90° and l >150° is smaller and they are fainter for several stellar magnitudes.

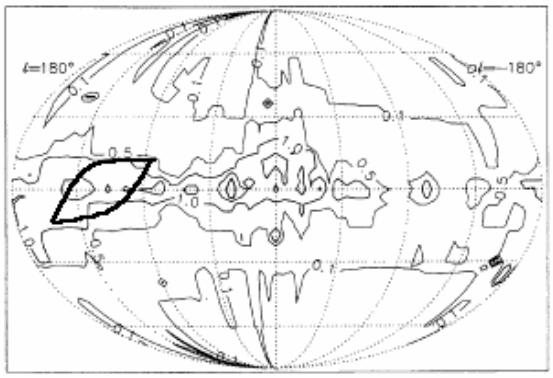


Fig. 4. The Lens on the map of light absorption ([6])

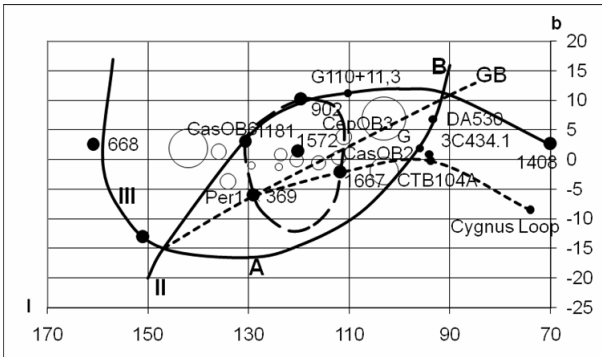


Fig. 5a. The Lens, formed by the Loops II & III on the map of supernovas (black circles) and OB associations (open circles).

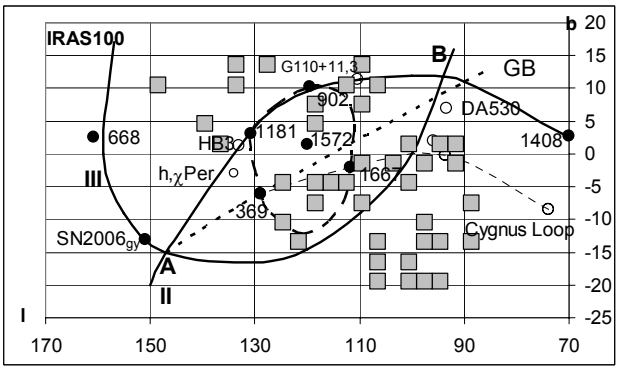


Fig. 5b. The Lens, formed by the Loops II & III on the map of supernovas and IRAS100 sources: grey areas (3°×3°), where the number of IRAS100 sources exceeds the average number $\bar{N}$ at the same latitude for $\sqrt{\bar{N}}$.

Examining the radiospurs – the shell structures, known by its synchrotron radiation, located at the distances of 100 – 300 pc – we turned our attention to the sky region, named as "Lens" [7]. It is formed by the intersection of Loops II and III, [8]. Many interesting objects are observed through this Lens, as we'll tell below. But firstly we'll begin by the fact, that the outlines of the bright part of Perseus arm is almost coinciding with the outlines of the Lens projection (Fig.5). The Lens is turned to us by its edge. It is stretched along the Gould Belt for almost 60° in the same way as the arm does, and it has the same inclination (≈20°). All remote galactic objects in this directions and the whole bright part of the arm are observed through this Lens. The Lens in its coordinates, angular dimensions and the inclination is similar to the avoidance zone of the galaxies. Only the galaxy IC10 is observed in the window of transparency (Fig.5), located near the Lens centre. The other galaxies are observed at the border of both Zone [9] and Lens, restricting the arm. Thus, the chain of the north part of Andromeda group galaxies (≥ 6 galaxies) is stretched along the southern border. There is only one galaxy of Local group – Sag – at such small latitudes (near the centre of Galaxy). One more chain consists of the discrete sources of microwave radiation. The WMAP-3 catalogue [10] contains the same number of objects of this chain. But such objects restrict the avoidance zone in the other places, too. The remote supergalaxy Perseus is observed through the Lens vertex A.

The observed picture has one more peculiarity – it is quasi-symmetry relative to the Lens elements (Fig.5a). It is similar to the eye, consisting of the pupil, iris, the eyeball and the eyelids. The eyelids are outlined by the chains of galaxies and several supernova (SN902, SN1181, SN1408, SN668) and remnants – HB3, G110+10.3, W63 are at the northern eyelid, and DA530, etc – near the southern one. The supernova Tycho (SN1572), the Cas OB4 association, and the galaxy IC10, form the "pupil" near the Lens centre. There are four historical supernova more: SN369, 902, 1182 and 1667 (CasA) [11] at the edge of "iris", having the radius about 8 – 10° around the "pupil". There are four associations (Cas OB2, CepOB3, Per1, Cas OB6) at the ring of four supernova. There are Cas OB1, 5, 7 and 8, over [2], between the "pupil" and the ring.

The large associations Per1 and SepOB2 are almost symmetrical relatively the "pupil". The same "eye" and the ring one can see also over the infrared radiation [12]. Fig.5b shows the areas (3°×3°), where the number of $IRAS_{100}$ sources exceeds the average number $\bar{N}$ at the same latitude for$\sqrt{\bar{N}}$. The IR-loops are projecting inside the ring, over [13].

Even the gamma bursts are quasi –symmetric relative the Lens. Its dense chains are seen in different sky regions, and in the Lens region, as well, over the maps of 1000, 2000, etc bursts, registered by the specialized satellites during different years. Some chains border "the eye" by "the eyelids", similar to the mentioned above galactic chains. The most dense chain passes along the small Lens axis. And it can mean either their extragalactic or Galactic nature, or, perhaps, the Lens itself. Other chains are rather symmetrically located inside the Lens. But the gamma bursts is the special and very actual theme, which cannot be solved by the way.

What is the probability of random location of the bright part of Perseus arm inside the Lens? That 5 of 12 historical supernova are randomly located inside the Lens, and 2 more are located nearby, at the shells II and III? That the bright Perseus supergalaxy is randomly located in the Lens vertex A? And several more facts.

It seems like that the Lens screening is making brighter the picture of remote objects, observing through it, and it is focusing them. And quasi –symmetry can be the effect of macro-lensing.

Page et al [14] discovered the polarization of microwave (relict) radiation inside the whole radioloops system area.

One can see that the number of physical phenomena, created by spurs, increases and it will attract the attention of astrophysics again and again.

Resuming the theme of Perseus spiral arm, we can conclude, that its objects are rather more remote, than it is considered now. We cannot even exclude the question about its reality. But it needs the special examination.

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