THE GALAXIAN SURFACE DENSITY IN THE NEARBY UNIVERSE

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ABSTRACT : A simple study of the galaxian surface density maps of the nearby Universe, obtained from CGCG, MCG and ESO catalogues, has allowed to evidence 3 new large-scale structures. Analysis of the redshifts of the galaxies in the corresponding zones shows that two of them are probably real three-dimensional entities.

INTRODUCTION

A number of studies have been recently devoted to the structure of the nearby Universe ($V_r \leqslant 10\ 000$ km s^{-1}), thanks to various redshift surveys (for instance Huchra et al., 1983). However the distribution of the nearby galaxies is still poorly known at low galactic latitudes and in the Southern hemisphere, by lack of redshifts. In this communication, we propose a preliminary investigation of the nearby large structures on the whole sky by drawing galaxian density maps and by using the existing redshifts. As a result, three new large structures have emerged, two of them are likely to be real (South of Hydra cluster and North of Lynx supercluster).

CONSTRUCTION OF THE MAPS

In order to determine the galaxian surface density σ, the whole sky has been covered by a $0.5^\circ \times 0.5^\circ$ grid, and σ has been computed at the centre of each cell. The density has been defined in a way similar to Dressler's (1980) one, i.e. it corresponds to the average galaxian density within the circle centred at the cell centre and having a radius equal to the distance to the tenth nearest galaxy of this point.

Three catalogues of galaxies have been used, which cover well the depth zone $V_r \leqslant 10\ 000$ km s^{-1} we propose to investigate. These are the CGCG (Zwicky et al., 1963-1968) for the Northern hemisphere, the MCG (Vorontsov-Velyaminov, 1962-1964, 1968, 1974) for $-20^\circ < \delta < 0^\circ$, and the ESO catalogue (Lauberts, 1982) for $\delta \leqslant -20^\circ$. These catalogues do not present the same degree of completeness ; this effect has been tentatively taken into

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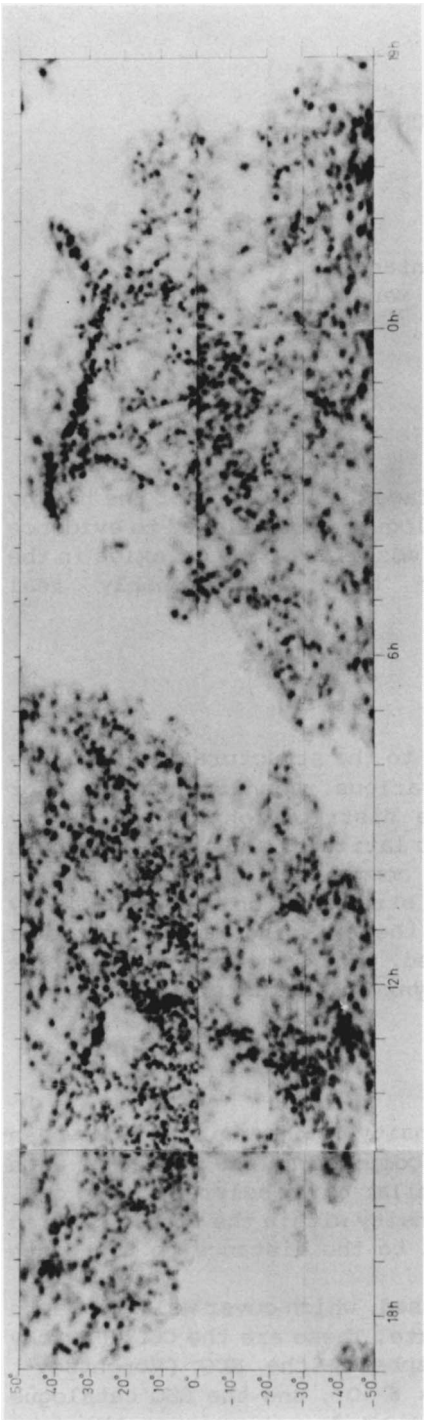

Fig.2 : Galaxian surface density in the zone $-50^{\circ}<\delta<50^{\circ}$.

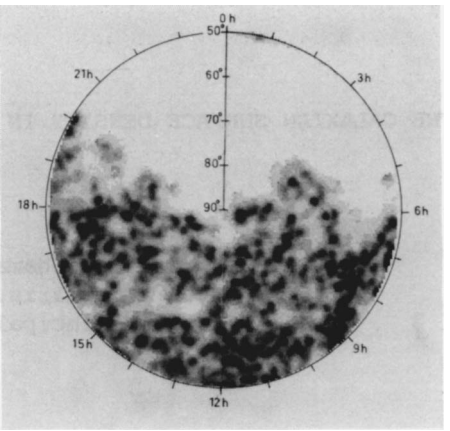

Fig.1 : Galaxian surface density in the Northern polar cap ($50^{\circ}<\delta<90^{\circ}$)

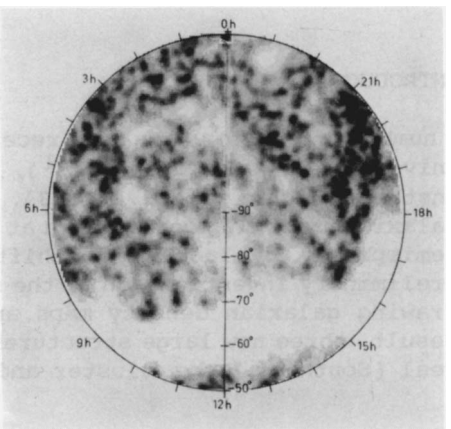

Fig.3 : Galaxian surface density in the Southern polar cap ($-90^{\circ}<\delta<-50^{\circ}$)

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account : in that way, zones having the same shading intensity on the maps and located in different catalogues correspond approximately to the same surface density in galaxies having a magnitude $m \leq 15.5$. Nevertheless, some difficulties still remain with the MGC, whose completeness varies with the right ascension !

The galaxian surface density for the whole sky is presented in the form of linear shade plots in 3 maps (Fig 1 to 3) which cover the zones $\delta \geq +50^{\circ}$, $-50^{\circ} \leq \delta \leq +50^{\circ}$ and $\delta \leq -50^{\circ}$, respectively. The darkest zones correspond to the highest densities ; the black pixels are for surface densities higher than 7 galaxies with $m \leq 15.5$ per square degree, i.e. 5 times the average density, and the white ones are for densities less than 0.35 galaxies per square degree.

ANALYSIS OF THE MAPS

On these maps, the irregularity and the complexity of the galaxy distribution is obvious (note also the zone of avoidance of the Milky Way, which goes across each map). A dozen of large-scale high density features appear, often as linear structures. Most of them are well known, in particular the conspicuous Perseus filament (α = 23h to 3h, $\delta \sim 35^{\circ}$). But three seem to have escaped to previous investigations ; they are located North of the Lynx supercluster, South of the Hydra cluster and South of the Perseus supercluster, respectively. From now on, we will concentrate uniquely on these 3 structures, and we will test their tridimensional reality, by comparing the distributions of the available redshifts in the zone concerned to the distributions expected for galaxies uniformly distributed in depth and having a Schechter's luminosity function. In order to simplify this test, we consider only the galaxies having a magnitude $m \leq m_1$, where m_1 is the limit magnitude for which all the redshifts of the galaxies with $m \leq m_1$ are known in the zone, or a certain proportion of them which does not depend on m. Practically, $m_1 = 14.5$ and $m_1 = 13.5$ for the Northern hemisphere down to $\delta = -2^{\circ}.5$ and the Southern hemisphere features, respectively. Of course, cluster galaxies are removed to perform the test.

THE NEW STRUCTURES

(1) In Figures 1 and 2, the main concentration seen between (α = 7h30, $\delta = 60^{\circ}$) and (α = 10h, $\delta = 45^{\circ}$) is the Lynx-Ursa Major supercluster, studied in details by Giovanelli and Haynes (1982).

For $\alpha <$ 7h30, this structure seems to divide into two branches, one towards $\delta = 50^{\circ}$ and the other one, cut off by the obscuration zone, towards high declinations. The first feature cannot be studied, by lack of redshifts. But the distribution of the redshifts of the galaxies in the second branch having $m \leq 14.5$ reveals a complete absence between 2500 and 3500 km s^{-1} and an excess between 3500 and 4500 km s^{-1} compared with what is expected for an homogeneous distribution. Although obtained from a small sample of 24 objects, this result suggests a real association of that branch with the Lynx Ursa Major supercluster, whose redshift range is similar.

2) In Figure 2, one can easily see the most prominent and best known

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large-scale structure in the Northern hemisphere, namely the Perseus-Pisces supercluster, whose ridge extends from α = 22h to α = 4h and δ = 30° to 40°. From the ridge four or five filaments seem to depart towards the South and reach a crowdy region around δ = 0° extending from α = 23h to α = 4h-6h. To study the redshift distribution of the galaxies in this region, it is necessary to consider separately the zones North and South of -2.5°, respectively, because of different values of the limit magnitudes (cf. previous section). The redshift distribution in the zone 0h-4h, -2.5° to +10°. shows a definite excess in the range 5000-7000 km s^{-1}, just as in the main ridge. No firm conclusion can be drawn concerning the Southern zone from -10°. to -2.5° because the galaxies with measured redshifts are too bright, but there is however a hint of an excess in the same velocity range.

3) In the Southern hemisphere the Hydra cluster is well visible (Fig. 2) at 10.6h, -27°. A high density region located between α = 9.5h and 11h from δ = -30° to -60° seems to be connected to the cluster ; in fact, it presents a velocity distribution with an excess between 2500 and 3500 km s^{-1}. compared to the case of an homogeneous spatial distribution, indicating a possible real association of the galaxies of this region to the Hydra cluster, which has also a mean velocity of 3500 km s^{-1}.

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