ABSENCE OF VELOCITY ANISOTROPY IN THE DIRECTION OF THE VIRGO CLUSTER

by

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Nous présentons une méthode de mesure des distances des galaxies elliptiques basée sur une relation entre la brillance superficielle et un rayon déduit de la distribution spatiale de l'intensité de lumière émise. Nous confrontons ensuite les distances calculées à partir de la vitesse pour 11 galaxies de l'amas de la Vierge, avec celles de 8 objets de plus grand décalage spectral pour la plupart. Ceci implique que l'amas de la Vierge est à une distance plus faible que celle donnée par sa vitesse : $\delta (m-M) = 0^m.07 \pm 0^m.23$, résultat négatif confirmant la conclusion de Sandage et Tammann (1974, 1975), à savoir la non existence d'une vitesse particulière de l'amas de la Vierge.

In a previous paper (Kormendy 1976), the systematics of elliptical galaxy brightness profiles were studied using the de Vaucouleurs (1948, 1953) relation, $\log (I/I_o) = -3.33 \left\{ \left(\frac{r}{r_o} \right)^{1/4} - 1 \right\}$. Here I (r) is the surface brightness as a function of radius r ; r_o is the radius containing half of the light of the model, and $I_o = I (r_o)$. The brightness and size scales of the objects studied were found to be closely related by :

$$B_o = 3.02 \log r_o + 19.74 \text{ mag arcsec}^{-2} \text{ (hereafter } \underline{\mu}\text{)(I)},$$

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where $B_o = -2.5 \log I_o$ (Figure 1). The dispersion of the points about the line was only 0.28 μ in B_o.

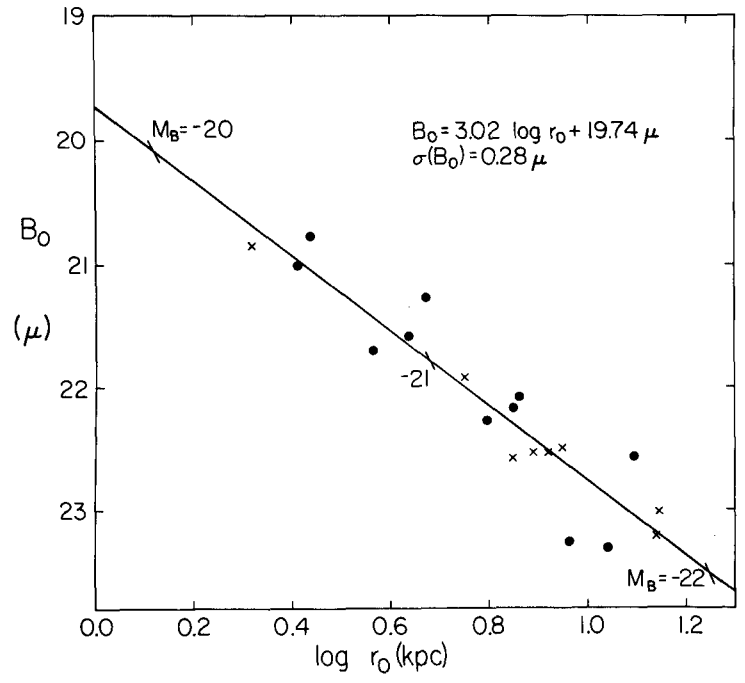

Figure 1. B_o versus log r_o for Virgo ellipticals (*filled circles*) and for non-Virgo galaxies (*crosses*). The *straight line* is equation (1). Average absolute magnitudes M_B inside a radius r_o are indicated; lines of constant M_B parallel the ticmarks. All magnitudes were corrected for Galactic absorption by $0^m.2$ csc b^{II}, b^{II} the latitude. Distances were determined using group velocities and a Hubble constant of 50 km s^{-1} Mpc^{-1}. In Virgo, de Vaucouleurs' (1961) subgroups were used, except for NGC 4365 and NGC 4636, which were assumed to be in the E cloud, i.e. at 22.2 Mpc distance.

Equation (1) can be used to measure relative distances, since B_o is essentially independent of distance while r_o is proportional to it. In the present paper, we use this method to test claims of Gudehus (1973) and others that the Virgo cluster is closer than its redshift distance by ∿30% corresponding to a peculiar velocity of 300 - 400 km s^{-1}. Eleven galaxies in Figure 1 are in Virgo; the other eight are not. Of the latter, one (NGC 3379, at upper left) has a velocity ∿250 kms^{-1} smaller than that of Virgo, while the others have larger velocities by factors of 1.6 - 3.5.

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Evaluating the mean deviations in log r_o of these groups around B_o (log r_o) we find,

for 11 Virgo galaxies, δ_V (log r_o) = +0.005 ± 0.039

($\sigma_1 = \sigma_{obs} / \sqrt{9}$), with obvious notation, and

for 8 others,

δ_O (log r_o) = -0.009 ± 0.024

($\sigma_2 = \sigma_{obs} / \sqrt{6}$).

Thus, $\delta_V - \delta_O = 0.015 \pm 0.046 \left(\sqrt{\sigma_1^2 + \sigma_2^2}\right)$.

This means that Virgo is closer than its velocity distance by

$$\delta(m-M) = 0\overset{m}{.}07 \pm 0\overset{m}{.}23 \qquad (2)$$

in the distance modulus. The corresponding peculiar velocity is 39^{+107}_{-121} km s^{-1} in the direction suggested by Gudehus.

Small cosmological corrections in the above have been neglected. For instance, the differential K-correction between the nearest and farthest galaxy is $0\overset{m}{.}05$; if included, it would decrease $\delta(m-M)$. The conclusions are also largely independent of a possible peculiar velocity of the Local Group (Rubin *et al.* 1976, and references given there), since most of the galaxies are fairly close to 90° from the suggested direction of motion.

The present null result therefore supports Sandage and Tammann's (1974,1975) conclusion that the Virgo cluster has no peculiar velocity. It is still preliminary, because the sample is very small, and because intrinsic differences between clusters, such as those suggested by Gudehus (1973) and Hoffman and Crane (1976), have not been investigated in detail. However, the smallness of the estimated error is already encouraging.

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