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THE H_o VALUE FROM LUMINOSITY CLASSES AND 21-CM LINE OBSERVATIONS OF GALAXIES

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Abstract. Nous montrons que la calibration des classes de luminosité les plus brillantes adoptée par Sandage et Tammann dans leur papier IV est trop élevée; nous établissons une nouvelle calibration de la classe I et nous obtenons ainsi une valeur de la constante de Hubble H_o égale à 76 au lieu de la valeur 55 donnée par Sandage et Tammann. Ce résultat est confirmé par une méthode indépendante à partir de nouvelles observations de galaxies en raie 21 cm de l'hydrogène neutre effectuées avec le radiotélescope de Nançay. En appliquant le critère de distance de Tully et Fisher, fondé sur la largeur du profil de la raie 21 cm, nous obtenons une valeur moyenne $H_o = 77$, pour notre échantillon de galaxies extérieures au Superamas Local.En conclusion, nous sommes conduits à adopter la valeur $H_o = 75$ qui est en désaccord avec la valeur $H_o=55$ de Sandage et Tammann, bien que fondée sur une même calibration locale.

1.THE H_o VALUE FROM LUMINOSITY CLASSES

In their series of papers, Sandage and Tammann (1974a, b,1975a, b), referred to henceforth as STI, STIV, STV and STVI respectively,have established three relations between the three following parameters : a= mean diameter of the core plus halo of the three largest HII regions in parsec; M_{pg} = absolute magnitude; LC = luminosity class, numerically coded as given by STI. From a sample of 11 calibrating galaxies STI give a first relation : (1) $\log a = -0.140M_{pg} - 0.202$, from which the distance cannot be determined. To overcome this

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difficulty they have plotted a as a function of the luminosity class LC and they gave a second relation :
(2) a = -96.5 LC + 557. As a mean luminosity is attributed to each luminosity class by STIV through the third relation :
(3) M_{pg} = 1.02LC - 22.27 , the relation (2) results from the relation (1) through the calibration of the luminosity classes (relation (3)). Since the relation (1) is distance independent, the distance dependence which emerges in (2) is a reflection only of the luminosity class calibration.

Moreover, these three relations as given in STI and STIV appear to be not compatible. When eliminating a between relations (1) and (2), one finds that the absolute magnitude of class I galaxies becomes -20.47 instead of -21.25 as given by STIV, which leads to an H_o value equal to 79 km s^{-1} Mpc^{-1} instead of 55.

In our mind, this unconsistency is a consequence of the unjustified extrapolation of relation (2) to the first three luminosity classes. The luminosity classes are only established by morphological criteria and so this extrapolation is questionable. There is no physical justification to put equal distances between two following luminosity classes. Thus it is dangerous to use the extrapolated part of relation (3) as done in STV and VI to determine the distance of ScI galaxies.

Using as a test of the shape of relation (3), van den Bergh's relative calibration, STIV found some disagreement that they attributed to the fact that van den Bergh did not consider inclination effects in his analysis. The results that we obtained (Bottinelli and Gouguenheim, 1976) when correcting van den Bergh's magnitudes using Sandage and Tammann's reci-

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pes show that the luminosity of class I galaxies appears to have been overestimated by 0.62 magnitudes in STIV. Our new calibration leads to $H_o = 76 \pm 8$ instead of 55 ± 6.

This first test of the shape of relation (3) proposed by Sandage and Tammann and applied here using their corrections for inclination effects leads thus to a discrepant value of H_o. However one could object that the van den Bergh'sample is magnitude-limited instead of being distance-limited and this could introduce some distortion in the shape of relation (3). It is thus important to use independent distance criteria which are not affected by such an effect.

2.THE H_o VALUE FROM 21-CM LINE OBSERVATIONS OF GALAXIES

We present here the preliminary results that we obtained from a 21-cm line survey of galaxies made at Nançay to obtain a determination of H_o. The observed galaxies were selected outside the Local Supercluster, in order to obtain an uncontaminated H_o determination; their morphological type is later than Sb and their radial velocity is smaller than 6500 km s^{-1}. We used our 21-cm line radial velocities and our 21-cm line widths (at the 20% level and corrected for inclination) to apply the distance criterion given by Tully and Fisher (1976) and we derived a set of 127 H_o values.

The determination of the corrected width is quite sensitive to the inclination for the small values of i. This can be seen in Figure 1 which shows a plot of H_o against the inclination i. In order to avoid distortion effects due to face-on galaxies for which the inclination is very inaccurate, we retained only galaxies less face-on than 30º. The remaining

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108 galaxies lead to a mean value: $\langle H_o \rangle = 70 \pm 3$ (standard er.) which is not in agreement with $H_o = 55 \pm 6$.

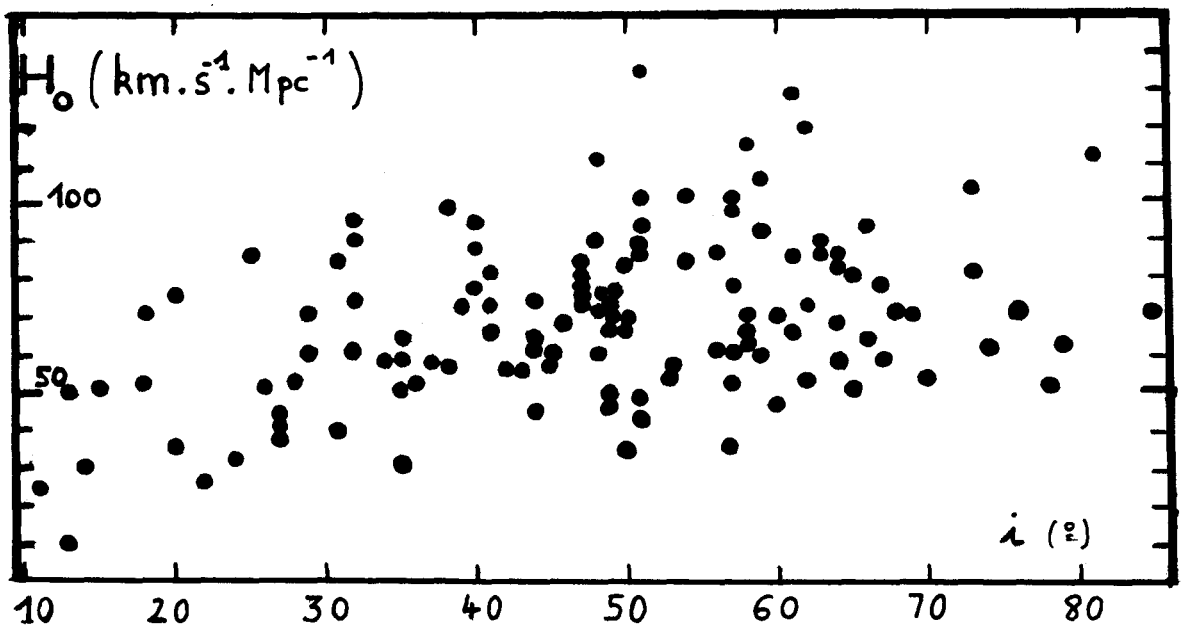

Fig.1. The H_o values obtained from Nançay 21-cm observations of galaxies outside the Local Supercluster, using Tully and Fisher's distance criterion are plotted against the inclination of galaxies (i=0º is face-on): no correlation is present for $i \geqslant 30º$

On the other hand, there appears to be no correlation of H_o with the observed line width, the absolute magnitude neither the morphological type. On the contrary, Figure 2 shows some dependence of H_o on the distance: H_o seems to decrease with increasing distance. However the velocity limitation of our sample introduces some bias shown by the upper curve in Figure 2 : for distances larger than 50 Mpc the galaxies giving large H_o values are missed. The mean H_o value obtained from the uncontaminated sample of 86 galaxies nearer than 50 Mpc is : 77 ± 3(standard er.). All these results are confirmed by using the other 21-cm line distance criterion established by Tully and Fisher which comes from the relation between the 21-cm line

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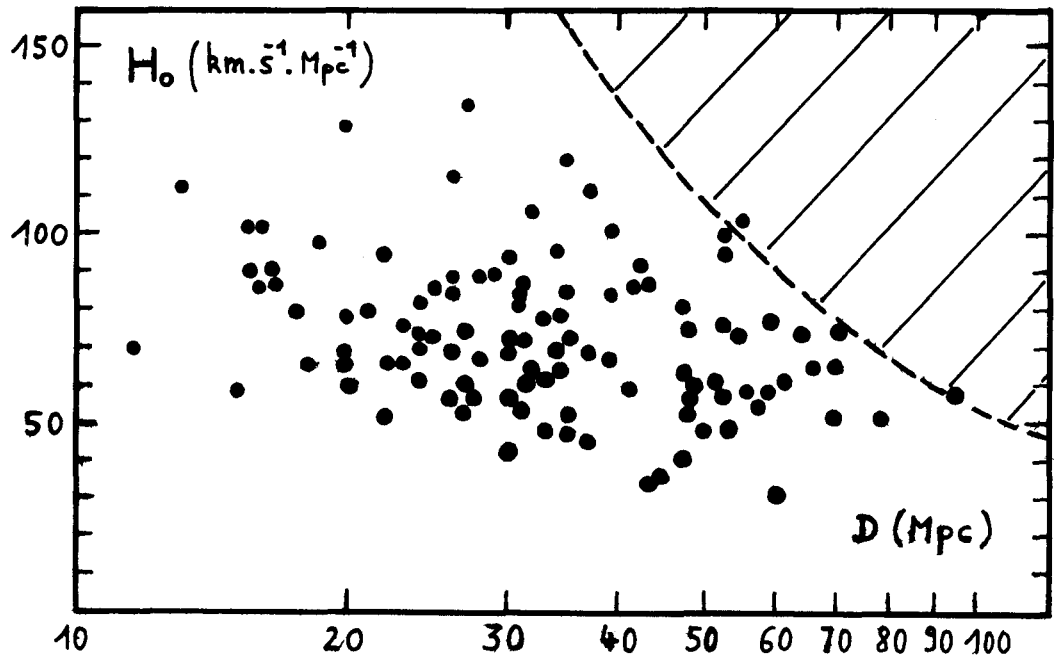

Fig.2. Hubble constant values obtained for galaxies more face-on than 30º versus distance in a logarithmic scale.The hatchings correspond to the region outside our velocity limitation which is indicated by the dashed curve.

width and the linear diameter.

In conclusion all our results using independent methods lead to : $\boxed{H_o = 75(1 \pm 0.3) \text{ km s}^{-1} \text{ Mpc}^{-1}}$ where the quoted error comes from the rms dispersion of our H_o values. This result is not in agreement with Sandage and Tammann's value 55, though we used the same local calibration.

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DISCUSSION

W.G. TIFFT: Has the Fisher-Tully method been applied to the low redshift member of Stephan's Quintet? With what result?

L. BOTTINELLI: We applied it to the Nançay 21-cm profile and we found a result in very good agreement with that we published from our own distance criteria. When applying it to both the Nançay and the Green Bank profiles of NGC 7319 it leads to a distance determination in very good agreement with that we published. However, it appears now that this method cannot be applied to NGC 7319, owing to the very peculiar HI distribution shown by Sullivan.

W.T. SULLIVAN III: If one applies the Fisher-Tully distance method to the HI global profile observed in NGC 7320, its distance is 20 Mpc, agreeing very well with the "Hubble distance" of 18 Mpc for H_o = 55 kms^{-1} Mpc^{-1} .

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