THE STRUCTURE OF THE HERCULES SUPERCLUSTER

M. Tarenghi, LFCTR, Istituto di Fisica, Milano
W. G. Tifft, Steward Observatory, University of Arizona
G. Chincarini, Dept. of Physics and Astronomy, University of Oklahoma and Universita di Bologna
H. J. Rood, Dept. of Astronomy, Michigan State University
L. A. Thompson, Dept. of Astronomy, University of Nebraska

Counts by Shane and Wirtanen detected a cloud of Galaxies - the Hercules Supercluster - centered at about $\alpha = 16^h02^m$; $\delta = 17^o00^m$. It is unclear whether there is a physical connection with another cloud located to the south for which no radial velocities are yet available and with the system A2197/A2199 located to the north. The latter is at slightly smaller redshift (velocities between 8000-11,000 km sec^{-1}) than the Hercules cluster.

The Hercules Supercluster contains 3 Abell clusters: A2147, F; A2151, F: III; and A2152 I : III. In A2147 a giant elliptical galaxy is located at $\alpha = 16^h00^m.0$; $\delta = 16^o:06'$ and the centroid of the X-ray source at $\alpha = 16^h00^m.4$; $\delta = 16^o25'.2$ - the cluster A2152 is of distance class 4. Preliminary estimates of the redshifts of the galaxies and of their morphology show that:

1. Velocities are sharply segregated into three ranges of redshift around 2500 km s^{-1} (local supercluster); 4700 km s^{-1} (group) and 9000-13,000 km s^{-1} (Hercules supercluster). This confirms the clumpy distribution of galaxies and the low density, if any, of homogeneously distributed "field" galaxies.

2. In the present sample various galaxies have velocities larger than 11,000 km s^{-1} (the limit of the Burbidge and Burbidge sample). The possibility of two systems of redshifts is unlikely and cannot be supported by the present results. The broader range of redshifts results, therefore, in a rather high velocity dispersion (see Table 1, preliminary analysis).

3. A2147 and A2152 have very similar morphology. In A2151 there is a smaller content of elliptical galaxies as shown in Table 2.

Table 2

Cluster	S/E	S/SO	SO/E
A2147	2	1.45	1.38
A2152	2	2.67	.75
A2151	4.6	1.77	2.6

M. S. Longair and J. Einasto (eds.), The Large Scale Structure of the Universe, 263–265.

Table 1

Preliminary virial parameters for the Abell Clusters embedded in the Hercules Supercluster. The separation of the clusters into velocity groups is, at present, merely indicative and no physical significance should be attached to it.

CLUSTER / PARAMETER	A 2152	V ≤ 10000 A 2152	V > 11000 A 2152	A 2147	V ≤ 11000 A 2147	V ≥ 11500 A 2147	A 2151	V < 11500 A 2151	V ≥ 12000 A 2151
$R.A._{1950}$	16 : 3 : 32	16 : 3 : 00	16 : 3 : 40	15 : 59 : 35	15 : 59 : 42	16 : 00 : 00	16 : 03 : 00	16 : 03 : 14	16 : 03 : 04
$D._{1950}$	16° 35'	16° 40'	16 : 26	16° 16'	16° 11'	16 : 26	17° 57'	17 : 57'	17 : 57
V_{cl}	10526	9425	11592	10975	10209	12221	11368	10724	12521
V_{cm}	10554	9343	11563	10860	10282	11960	11049	10543	12458
R_{vir}	3.49 Mpc	2.9	5.2	3.83	4.01	3.09	3.4	2.9	2.53
V_d	1965	-	819	1937	879	1030	1741	1039(*)	749
$L_{(obs)}$	$6.5\,10^{11}$	-	$4.01\,10^{11}$	$1.79\,10^{12}$	$9.6\,10^{11}$	$8.5\,10^{11}$	$2.2\,10^{12}$	$1.23\,10^{12}$	$9.1\,10^{11}$
M_{vir}	$3.1\,10^{15}$	-	$8.1\ 10^{14}$	$3.34\,10^{15}$	$7.2\,10^{14}$	$7.6\,10^{14}$	$2.4\,10^{15}$	$7.3\ 10^{14}$	$3.3\,10^{14}$

4. The P.A. distribution of the galaxies is somewhat peculiar for the region containing the three clusters. A non-random distribution seems to be present in A2147, with a peak between P.A. 150° and 180°.

5. Indicative virial solutions are given in Table 1. The clusters may be unstable and the supercluster, or its core region, may go through a formation process similar to White's theoretical model.

6. So far we have no evidence for the likely mechanism of X-ray emission. The X-ray source is centered on A2147. Two wide angle tail galaxies are in A2151. The differences in velocity dispersion among the clusters are not very significant. The main difference in content is not in the percentage of SO galaxies but in the number of ellipticals (see Table 2).

In conclusion, the redshifts obtained in the Hercules Region confirm the previous findings in the Coma Supercluster, indicating that galaxies are grouped in large asymmetric structures, groups and superclusters. Clusters are, generally, bound condensations embedded in superclusters. The gaps in the velocity field are a very important feature and can be used to estimate an upper limit for the density of "field" galaxies. The existence of such galaxies is however uncertain.

REFERENCES

Burbidge, G.R. and Burbidge, E.M., 1959. Astrophys. J., 130, 629.
Chincarini, G., 1976. Frascati (Italy) Workshop on galaxies, May 1976, Mem. S.A.I.
Chincarini, G. and Martin, D., 1974. Astrophys. J., 196, 335.
Chincarini, G. and Rood, H.J., 1975. Nature, 257, 294.
Chincarini, G. and Rood, H.J., 1976. Astrophys. J., 206, 30.
Cook, B.A., Maccacaro,T., Perola, G.C., Tarenghi, M., and Valentijn,E.A., 1977. Astro. Astrophys., 58, L17.
Tarenghi, M., 1976. Read at I.A.U. Colloquium No.37, Paris.
Tifft, W.G., and Gregory, S.A., 1976. Astrophys. J., 205, 696.

https://doi.org/10.1017/S007418090014464X Published online by Cambridge University Press

DISCUSSION

Ozernoy: Did you try to construct kinematic models for the velocity distribution in order to establish whether the Hercules supercluster expands isotropically or preferentially in only one direction?

Chincarini: I did look into the problem, of course. However, we are still somewhat limited by the observations. We should go to a fainter limiting magnitude to see better the Hubble flow. In fact, what we must find is a correlation between magnitude and redshift in the supercluster. Such a correlation is weak both in the Coma and Hercules systems, due to the small range of magnitude observed. In Hercules, however, some correlation may be present in spiral galaxies; the diagram for E/SO galaxies shows more scatter. Perhaps the best way to detect the effect is to select the 5 or 10 brightest galaxies and use these to look for evidence of the Hubble flow. This has not been done.

I did also consider the behaviour of the three clusters A2147, 2151, 2152 in the supercluster. The three point masses have a velocity dispersion of about 550 km s^{-1} and a reasonable virial mass. On the other hand, once errors are taken into account, we also have agreement with the Hubble flow.

These tests will have higher significance as soon as the detailed analysis of our observations is completed. We must go to fainter magnitudes. I should add that we have a confusion problem due to the fact that, having a magnitude-limited sample, we sample the luminosity function to different absolute magnitudes on the front and back sides of the supercluster.

https://doi.org/10.1017/S007418090014464X Published online by Cambridge University Press