CATALOGUE OF CLUSTERS THAT ARE MEMBERS OF SUPERCLUSTERS

M. Kalinkov, K. Stavrev, I. Kuneva
Department of Astronomy
Bulgarian Academy of Sciences, Sofia

An attempt is made to establish the membership of Abell clusters in superclusters of galaxies. The relation

$$\log z = -3.637 + (0.135 \pm 0.014)\ m_{10} = (0.179 \pm 0.030) \log P \qquad (1)$$

is used to calibrate the distances to the clusters of galaxies with two redshift estimates. One is m_{10}, the magnitude of the ten-ranked galaxy, and the other is the "mean population," P, defined by:

$$P = p/2\pi^2 \ , \qquad (2)$$

where p = 40, 65, 105 . . . galaxies for richness groups 0, 1, 2 . . . , and r is the apparent radius in degrees given by:

$$r = 0.0286\ (1 + z_1)^2/z_1 \ . \qquad (3)$$

The first iteration for redshift, z_1, is obtained from m_{10} alone:

$$z_1 = -4.568 + 0.216\ m_{10} \ .$$

The standard deviation for Eq. (1) is 0.105, the number of clusters with known velocities is 342 and the correlation coefficient between observed and fitted values is 0.921. With z_i from Eq. (1), we define Cartesian galactic coordinates $X_i = R_i h^{-1} \cos B_i \cos L_i$, $Y_i = R_i h^{-1} \cos B_i \sin L_i$, $Z_i = R_i h^{-1} \sin B_i$ for each Abell cluster, i = 1,...,2712, where R_i is the distance to the cluster (Mpc), and H_o = 100 h km s^{-1} Mpc^{-1}.

The mean density of clusters from Abell's sample for B > 50° is $D_s = 5.5 \times 10^{-6}$ h^3 Mpc^{-3} and for all Abell clusters is $D_a = 7.65 \times 10^{-6}$ h^3 Mpc^{-3}. These values have been adopted for the entire investigated space and a limiting density D_l has been introduced.

Our procedure for supercluster searches consists of the following: Let us take an arbitrary cluster, C_1, from the catalogue, let C_2 be its nearest neighbor, and O_2 the mean point between the two clusters. Let the sphere defined by the radius $R_2 = O_2C_1 = O_2C_2$ have volume V_2; the mean density is D_2 is $2/V_2$. If $D_2 < D_l$, we conclude the

G. O. Abell and G. Chincarini (eds.), Early Evolution of the Universe and Its Present Structure, 185–186.

https://doi.org/10.1017/S0074180900038924 Published online by Cambridge University Press

examination of cluster C_1 and pass to another cluster. If $D_2 > D_1$, we look for the third nearest nearest neighbor of O_2. Let it be Cluster C_3. We define O_3 as a barycenter of the three clusters, supposing equal masses. We determine V_3 with radius $R_3 = \max(O_3C_1, O_3C_2, O_3C_3)$ and the mean density is $D_3 = 3/V_3$. If $D_3 < D_1$, we should say that clusters C_1 and C_2 form a double cluster. If $D_3 > D_1$, we seek the fourth nearest neighbor of O_3, and so on, until we reach $D_{q+1} < D_\ell$. In that case, q clusters satisfy the inequality $D_q > D_\ell$. For a high value of D_ℓ, we arrive at the same configuration of q clusters, regardless of which cluster is used to start the execution of the described procedure. In this manner, we select triple, quadruple,...clusters.

Among all clusters in Abell's sample, 290 clusters have been identified as participating in multiple clusters ($q \geq 3$), satisfying the condition $D_\ell = 50\ D_s$. Some examples: i) A2600 is situated near the center of a supercluster, including A2608, 2606, 2605, 2579, 2580, 2599 and 2583. The diameter is 26 h^{-1} Mpc and the mean density is 160 D_s; ii) A2540 is near the center of a supercluster with A2531, 2550, 2547, 2521, 2542 and 2509. At a distance of 19 h^{-1} Mpc from the center of this supercluster is located A2579 from supercluster i); iii) A1183 is almost in the center of a supercluster with A1201, 1209, 1159 and 1157, with a diameter about 20 h^{-1} Mpc and $\overline{D} = 200\ D_s$; iv) A998 is at the center of a supercluster with A1005, 968, 1046 and 1006, with a diameter 16 h^{-1} Mpc and $\overline{D} = 400\ D_s$.

Setting $D_\ell = 10\ D_s$, the number of clusters and members of configurations of high multiplicity increase sharply. The largest configuration then includes 36 clusters and it is around A2550, enclosing i) and ii).

It is interesting to note that the nearest neighbor of some clusters is at a great distance. The mean distance between clusters for the density D_s is 31 h^{-1} Mpc. From the distribution function for the nearest neighbor, we have $F_1(70) = 0.9996$, which means that for all clusters in Abell's sample we would expect only one case with a distance greater than 70 h^{-1} Mpc. Our processing shows that spheres with radii greater than 70 h^{-1} Mpc can be drawn around 21 clusters from Abell's sample. Examples are A380, 565, 583, 732, 1451, 1577, 1780, and 2155.

Another result concerning all clusters from Abell's catalogue is that almost one-half of the clusters are contained in regions with $\overline{D} > 10\ D_a$.

https://doi.org/10.1017/S0074180900038924 Published online by Cambridge University Press