to regard also these observational findings as dynamically necessary and not chance coincidences, unless the actual clusters of galaxies are stabilized by some continuously distributed intergalactic "hidden matter" instead of the masses of observable discrete bodies themselves. However one can hardly accept a radically different explanation for the apparently identical phenomenon in the case of systems of galaxies on the one hand and those of stars on the other. Estimates of the crossing time t_c of the systems together with morphological arguments and numerical experiments indicate that actual "rich" clusters of galaxies might typically be near a particular epoch of very rapid systematic cosmological evolution. A considerable decrease of the aforementioned "core radii" (a transition between two nearly constant values) with the other characteristic sizes of the systems almost unchanged (Figure 1 a-d). The corresponding phenomena were detected earlier observationally and consequently these empirical data, together with their consequences, now seem to be once again corroborated (see e.g. *Astron. Nachrichten*, 297, 311, 1976). These remarkable analogies suggest that a similar mechanism is responsible for the formation and evolution of conspicuous cores of clusters and a similar solution of the somewhat controversial situation with regard to mass segregation both for clusters of galaxies and open star clusters (e.g. by properly choosing the initial conditions).

STRUCTURES AND NUMBER-DENSITY DISTRIBUTIONS IN CLUSTERS OF GALAXIES

F. W. Baier

I would like to present some preliminary results of an investigation of 50 clusters of galaxies. For studying the clusters, Schmidt plates taken with the 2-metre universal telescope at Tautenburg and the prints of the Palomar Sky Survey were used. For all the clusters we determined isopleths to obtain detailed information about the distribution of galaxies. We have found well isolated clusters, double clusters, multiple systems and rather complicated structures.

Because we cannot say anything about physical connections between the various groupings in the cluster regions under investigation, we certainly have to expect a high percentage of random projections of independent clusters. But we cannot exclude the possibility of physical connections between the various groupings in those cases in which we observe an irregular but well isolated structure.

For the isolated clusters we calculated projected radial number-density distributions and radial cumulative distributions. From the latter we found the total populations and dimensions of the clusters. But these quantities have to be considered upper limits for those clusters which are not well isolated because neighbouring clusters produce secondary maxima in the radial number-density distribution and increase both the total number of galaxies and the distance from the centre to the apparent border of the cluster.

We find total cluster radii to be between 2 and 4 Mpc and total cluster populations between 30 to some hundreds of galaxies to the limiting magnitude of our counts which is about one and a half magnitudes brighter than the plate limit.

From the projected number-density distribution we determined the radius of the sphere around the cluster centre which contains 20 galaxies. We found that this radius is about 0.3 Mpc independent of the total population of the cluster if it contains more than 170 galaxies. In any case a value of 0.2 Mpc is a lower limit for the radius of the sphere defined in this way. This corresponds to an upper limit for the mean number density in this sphere for all clusters.

Of course we have counted galaxies to different absolute magnitudes because of the different distances of the clusters, all of which are detected to the same limiting apparent magnitudes. This effect has little influence on the radii of the spheres containing 20 galaxies because of luminosity segregation in the centres of clusters of galaxies. But the total cluster characteristics will depend on these magnitude limits.

We will discuss this effect in detail in connection with a more extensive sample of clusters in a future paper. Our results obtained up to the present time are published in a series of papers in *Astronomische Nachrichten*.

MATHEMATICAL APPROACH TO THE PROBLEM OF CLUSTERING

J. Burczyk and A. Zieba

The mathematical theory of the description of the structure of point-sets in a plane or in space can be applied to the investigation of the distribution of different extragalactic objects. Mathematically we can define rigorously such ideas as cluster, nucleus of cluster, mono- or polynuclear structure, background and so on. First we choose a critical distance that determines the scale on which we investigate the distribution of objects. The critical distance plays a similar role to the wavelength of radiation by means of which we investigate the internal structure of matter. It is obvious that the description is different for different critical distances. To obtain a complete picture we have to analyse the evolution of this description as the critical distance changes.

The mathematical theory of the description of the structure of point sets can be applied to investigations of individual clusters as well as to the statistical description of a family of clusters. We can characterize strictly the given distribution as well as compare different distributions.

If the point-set under under investigation is very numerous the

https://doi.org/10.1017/S0074180900144547 Published online by Cambridge University Press