Galaxy Groups and Clusters

- Groups are sets of a few gravitationally bound galaxies packed into a region that's a few million light-years across.So Galaxies belonging to a group occupy the same region of space and they are virialized system.Galaxies that do not belong to any group are called field Galaxies.
- Our nearest Galaxy group is the Sculptor
- The following diagram gives a rough idea of the nearby clusters and their distances from local group

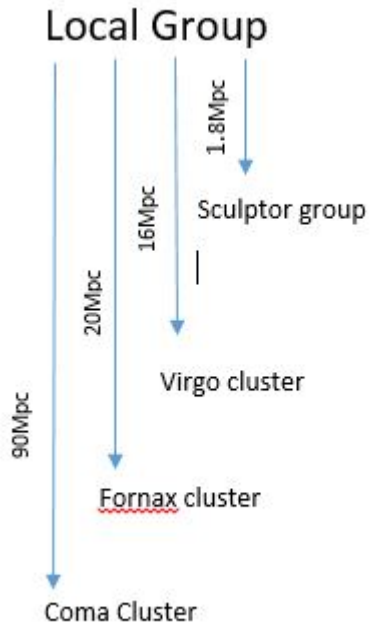

Figure 1: Neighbouring clusters and their distances

- The Virgo Cluster has approx 20% of bright ellipticals which occupy the central regions.The remaining bright ones are Spirals.It contains a few Dwarf ellipticals also.
- Clusters are the most massive gravitationally bound virialized systems.
- The distinction between Galaxy groups and Clusters is based on the number density of Galaxies within them.For this purpose,imagine a sphere of diameter approx.1.5 Mpc.If the number density is less than 50 then it may be classified as a Group and if not it is a Cluster.Caveat: If distance across the Group/cluster is nt known,then the actual number density cannt be accounted for.Neverthless,surface number density can be used in case.

- Another distinction is in the velocity dispersion of each.The 1-D velocity dispersion is less for Groups (200 Kms^{-1}) while that of a Cluster is far higher (1000 Kms^{-1})
- Also exist two orders of magnitude difference in the masses of Groups ($10^{13}M_{sun}$) ans Clusters ($10^{15}M_{sun}$) which is obvious because the number density is more within clusters.
- Analysis of the velocity dispersion curve for different galaxies across the cluster helps to find out the recession velocity of the cluster.All the galaxies with the same recession velocity belongs to the same cluster.Also at smaller radial distances the velocity dispersion is higher.

Core radius

- Typically,the size of a cluster is denoted by the Core Radius(r_c).Core radius is defined as that distance from the center at which the projected number density has declined to half of its value at the center.
- Based on the above definition of Core radius,the size r_c is 0.7 Mpc for groups and r_c is 0.3 Mpc for clusters.
- Estimate of crossing time of galaxies compared with the age of the cluster is a check on the question whether the clusters are gravitationally bound or not.

$$t_{cross} = \frac{R}{\sigma_v} = \frac{1Mpc}{1000kmps} \sim 10^9 yrs \tag{1}$$

- Where R is the sixe of the cluster and σ_v is the velocity dispersion of the galaxies
- Hence time to cross the cluster is approx.10^9 years.This compared with the age of the universe shows that the Galaxies had had enough time to become unbound.Hence the fact that they can still be found bound together implies that clusters are relaxed systems i.e they have lost memory of the initial direction in which they entered the cluster.