SUPERCLUSTERS AND THEIR PROPERTIES

A Presentation on

Graduate Seminar 730 on

Department of Physics & Astronomy

of

By

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Outline

❖Concepts

- From Big bang to formation of Superclusters
- About the debate between different cosmological models

❖Theory

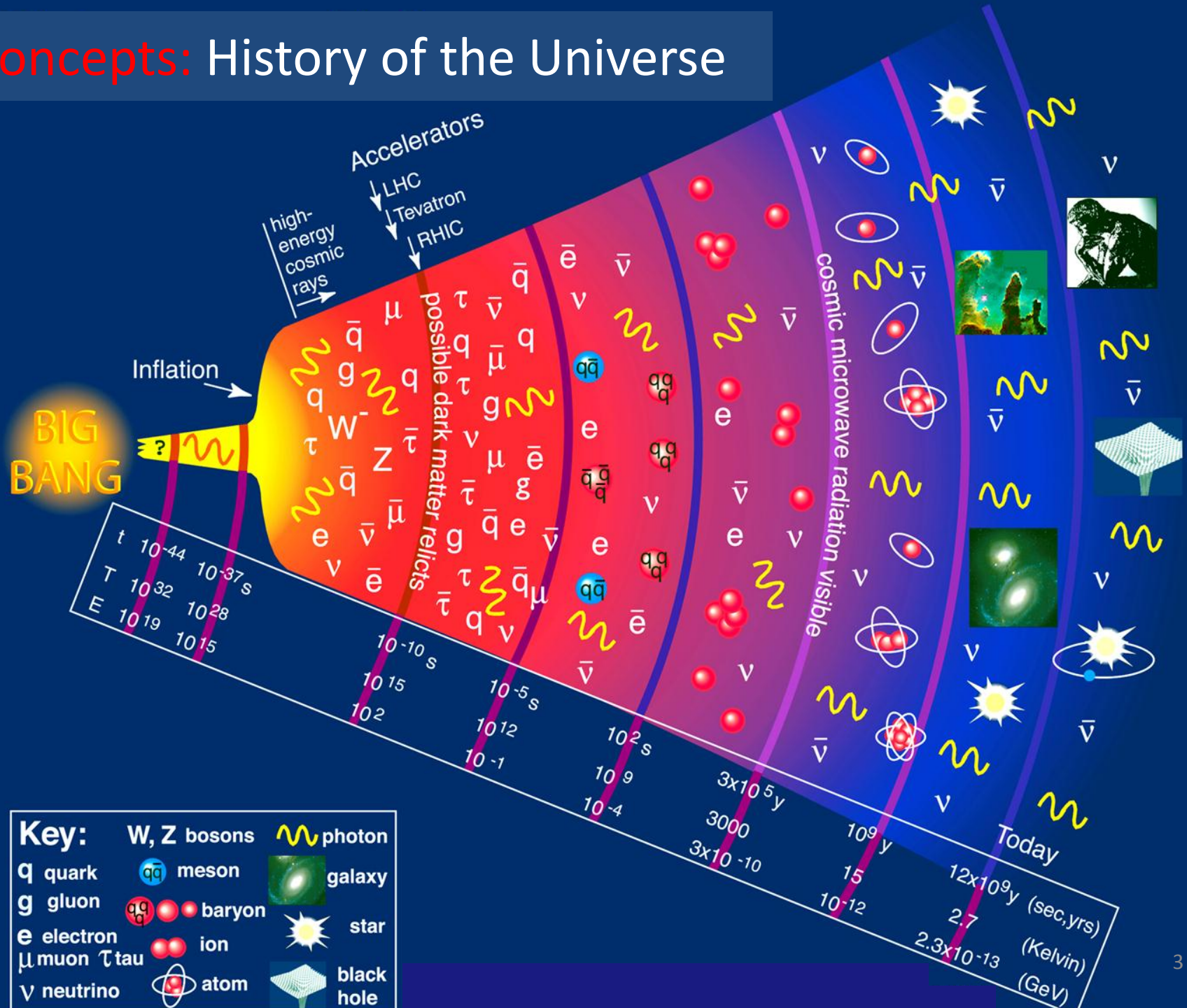
- Superclusters & their origin, mass, size & importance

❖Properties

- Which are significant to know the behavior of Supercluster
- Which will explore certain direction to further research

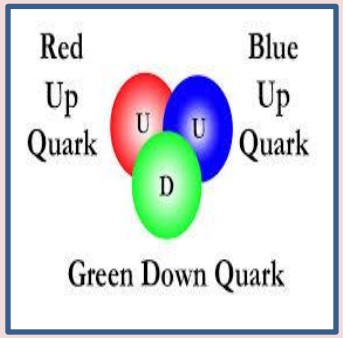
❖ References

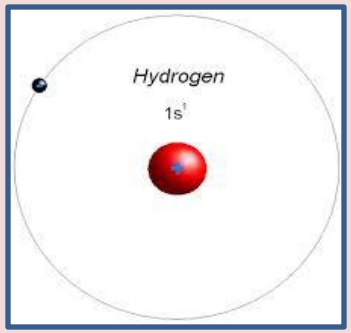
Concepts: History of the Universe

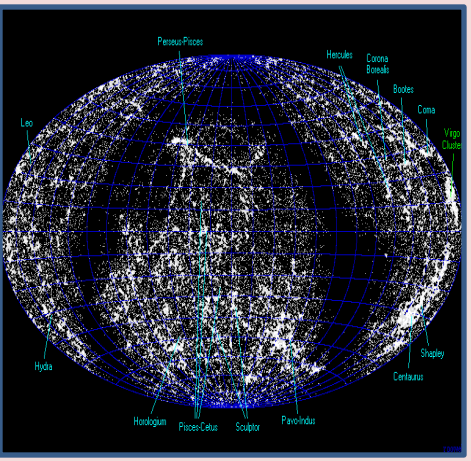


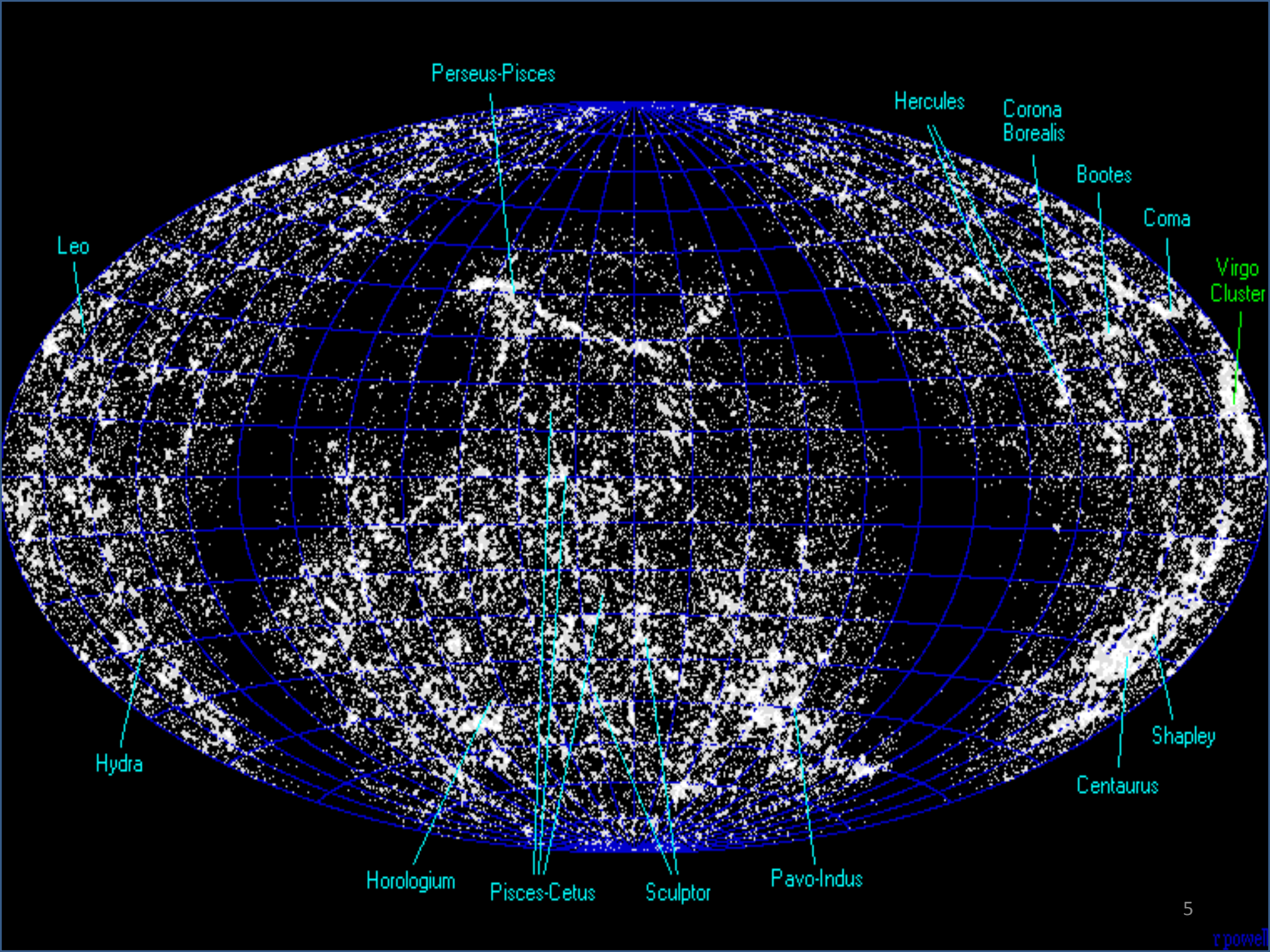
Concepts:

Big Bang








Perseus-Pisces
Hercules
Corona Borealis
Bootes
Coma
Virgo Cluster
Leo
Hydra
Shapley
Centaurus
Horologium
Pisces-Cetus
Sculptor
Pavo-Indus

Theory : SUPERCLUSTERS

The largest non-percolating galaxy systems are Superclusters of galaxies that contain clusters and groups of galaxies along with their surrounding galaxy filaments.

Usually consist of chains of around a dozen galaxy clusters, each with a mass of about (10^{13} to 10^{14}) Solar mass (Jones and Shaha 2004).

First evidence of superclusters as agglomerations of rich clusters of galaxies was provided by the Abell (1961).

Why it is important to study?

Superclusters evolve slowly and contain information about the very early universe; thus their properties can be used as cosmological probes to discriminate between different cosmological models.

Properties of galaxies and groups in various Supercluster environments can be used to study the evolution of galaxies on small scales.

Superclusters are massive density enhancements and thus great gravitational attractors which distort the background radiation, yielding information on the gravitation field through the CMB distortion via the Sunyaev-Zeldovich effect.

So, we need to know the properties of Supercluster.

Properties of Superclusters:

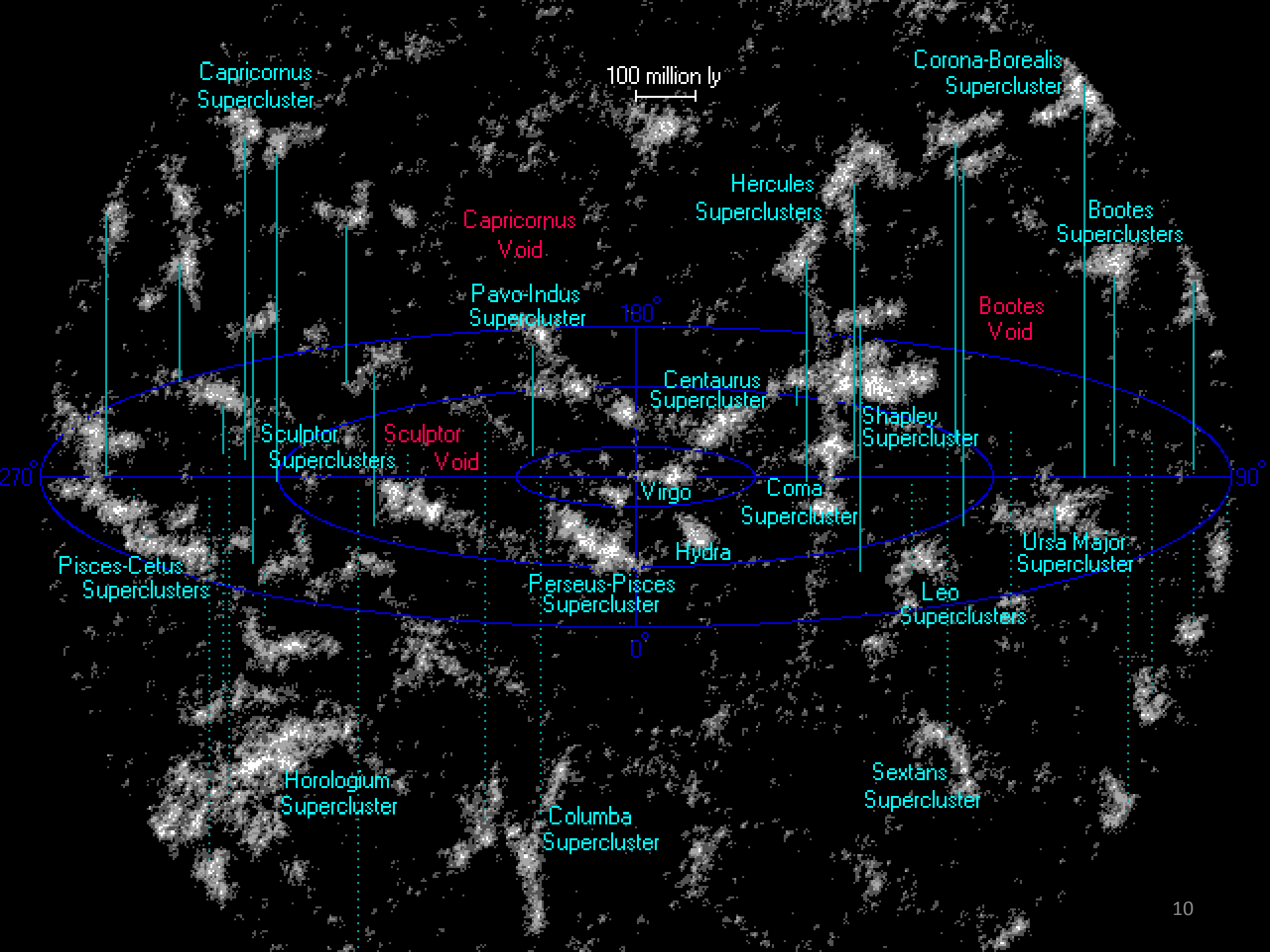
- Multiplicity
- High- Low Density environment
- Luminosity function
- Diameter
- Offset value

Multiplicity:

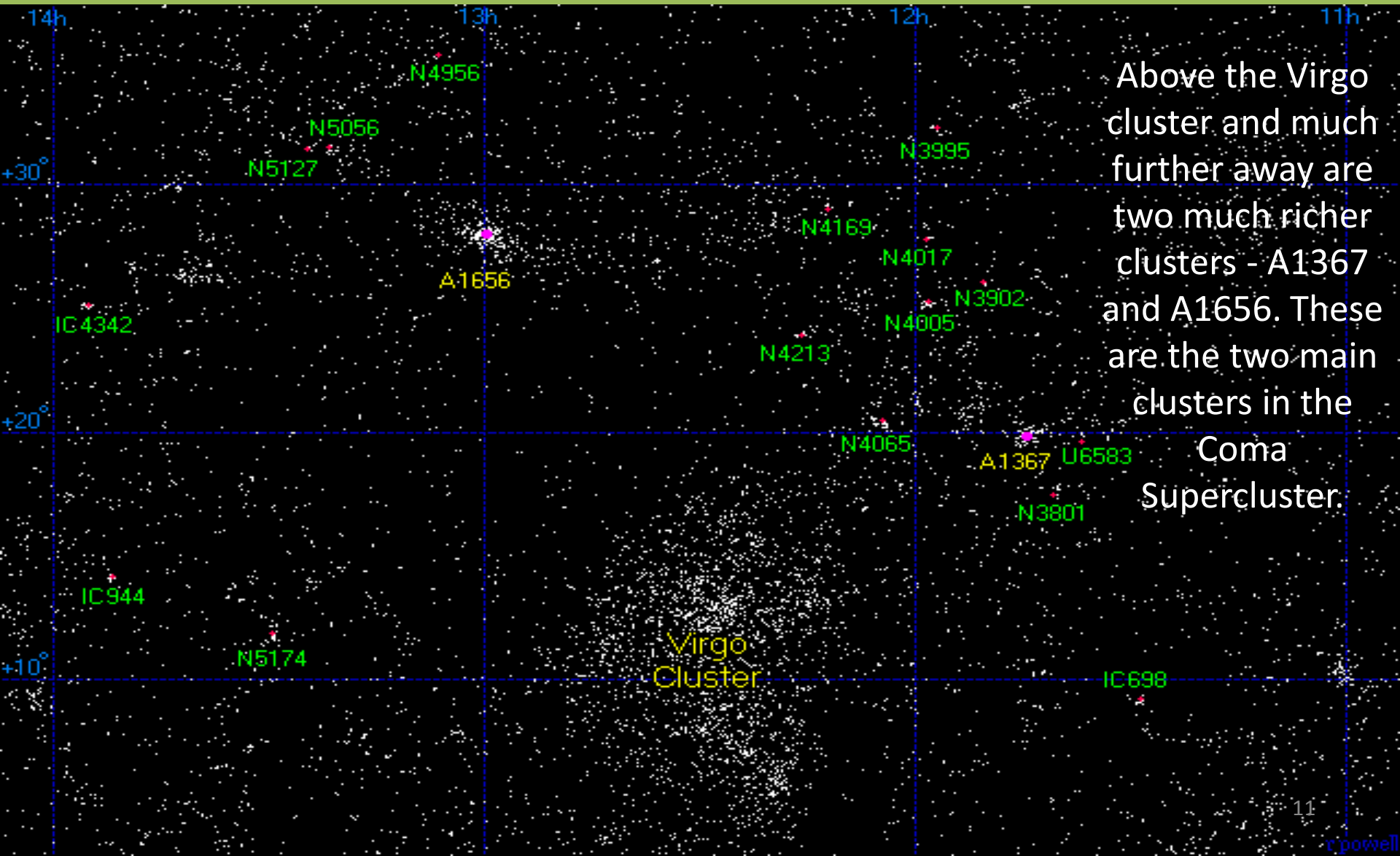
Multiplicity of Supercluster is defined by the Number of Density Field Clusters. This divides Superclusters into four classes.

We need this classification to know how the galaxies are distributed around the universe.

Poor Superclusters	Medium Superclusters	Rich Superclusters	Extremely Rich Superclusters
Poor Supercluster have less than 3 Density Field Clusters, eg. Virgo Supercluster, Coma Supercluster.	Medium Supercluster have 3 to 9 Density Field Clusters, eg. Perseus-Pisces Supercluster.	Rich Supercluster have 10-19 Density Field Clusters, eg. Leo-sextans, SCL126.	Extremely Rich Supercluster have more than 20 Density Field Clusters, eg. Shaply Supercluster.

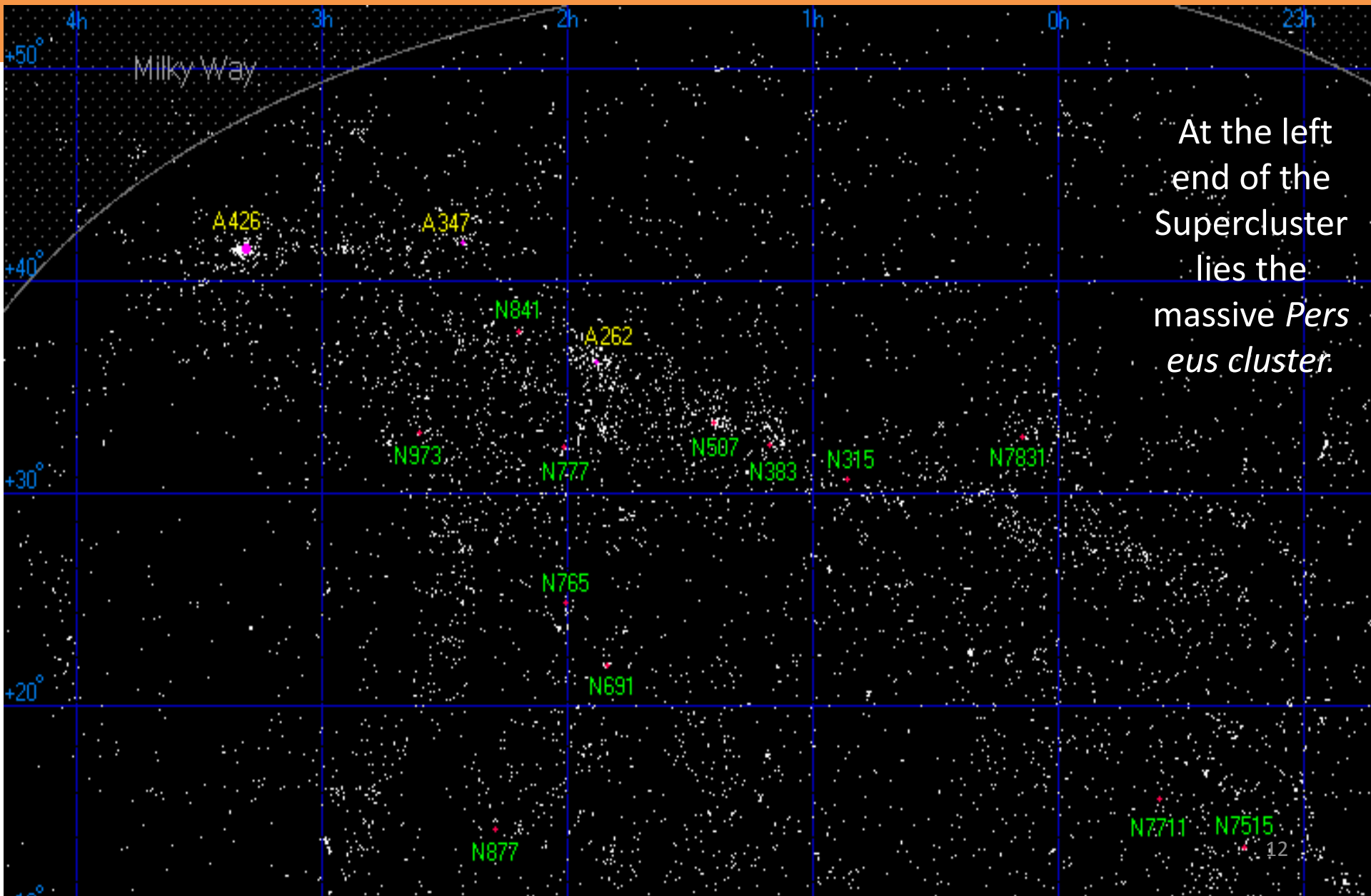

Capricornus Supercluster
100 million ly
Corona-Borealis Supercluster
Hercules Superclusters
Capricornus Void
Bootes Superclusters
Pavo-Indus Supercluster
180°
Bootes Void
Centaurus Supercluster
Shapley Supercluster
Sculptor Superclusters
Sculptor Void
270°
90°
Virgo
Coma Supercluster
Hydra
Ursa Major Supercluster
Pisces-Cetus Superclusters
Perseus-Pisces Supercluster
Leo Superclusters
0°
Horologium Supercluster
Columba Supercluster
Sextans Supercluster

Coma Supercluster



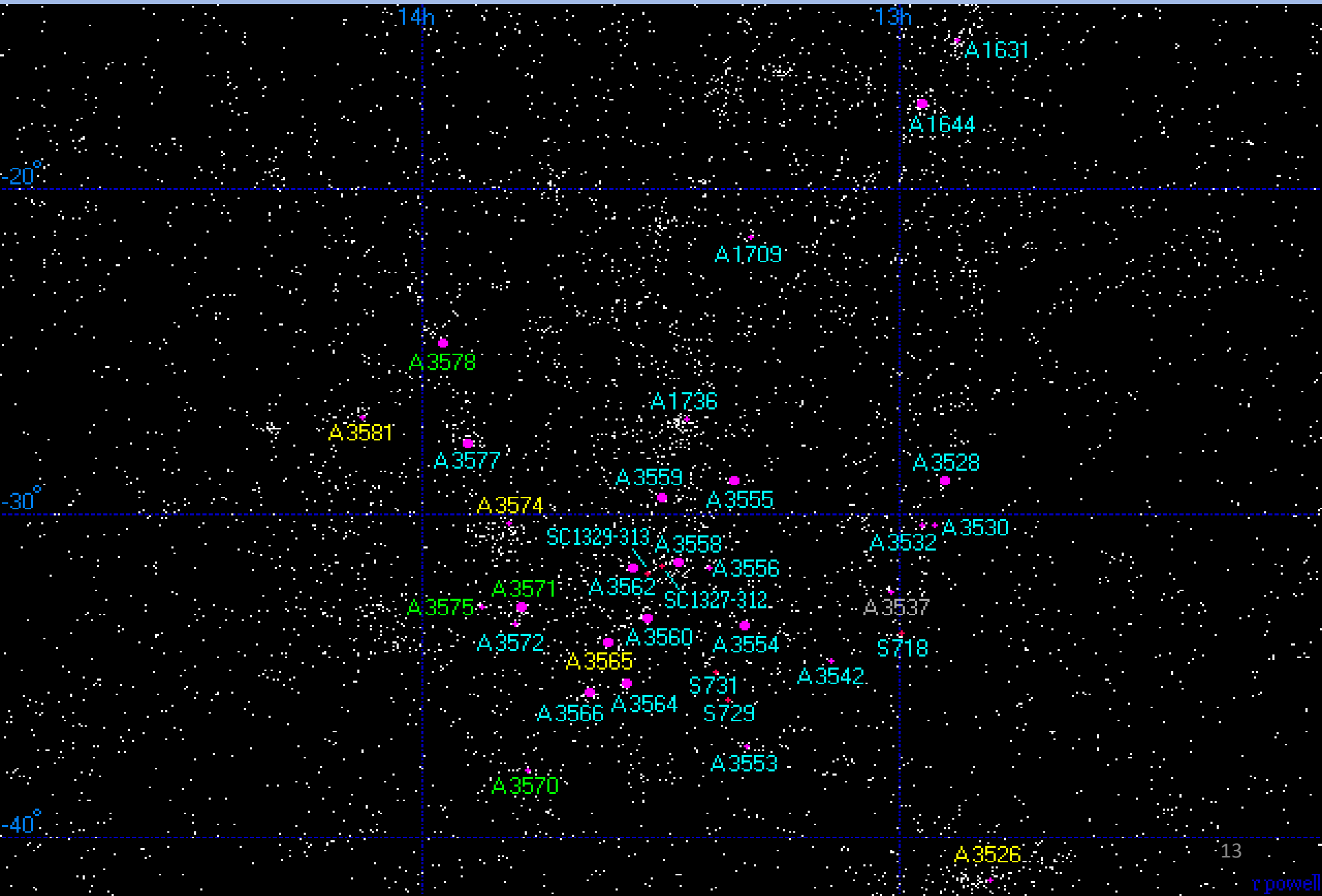
Above the Virgo cluster and much further away are two much richer clusters - A1367 and A1656. These are the two main clusters in the Coma Supercluster.

The Perseus-Pisces Supercluster



At the left end of the Supercluster lies the massive *Perseus cluster.*

The Shapley Supercluster



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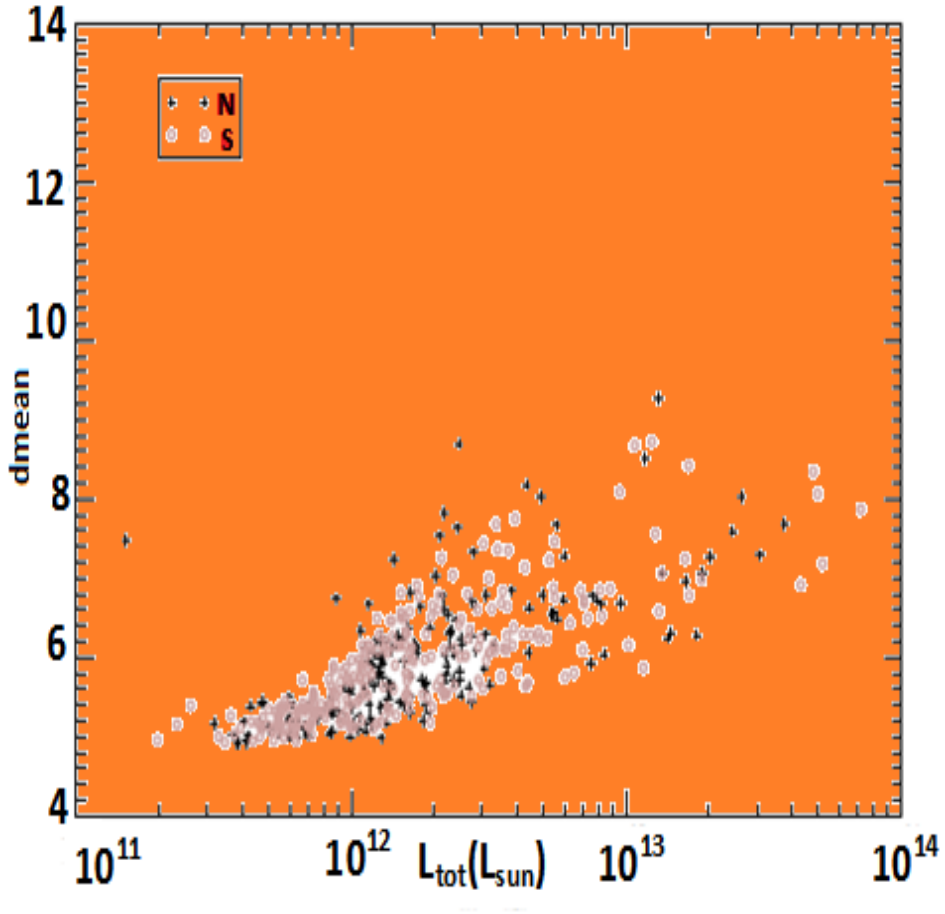
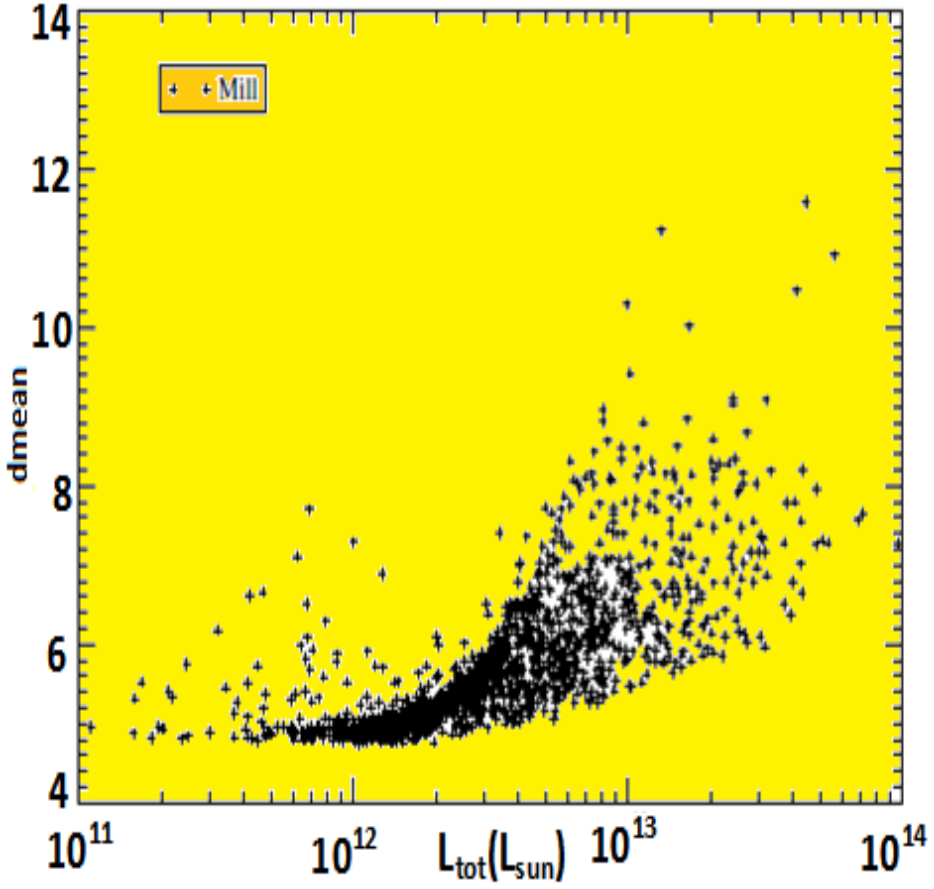
Density Versus Luminosity graph:

Luminosity is directly proportional to the richness. This vary from $10^{11}\ L_{\odot}$ to $10^{14}\ L_{\odot}$ ($L_{\odot}$= solar Luminosity= 3.83×10^{26}Watt)

The mean density rises from 4.5 for poor to 6–10 for rich superclusters. We see also a gradual increase of the mean density with increasing total luminosity. This fact demonstrates that rich superclusters are dense system.





Diameter:

The range of diameter of Superclusters is 30Mpc to 200 Mpc.

Minimum Diameter:

It is the shortest size of the supercluster along rectangular co-ordinate system.

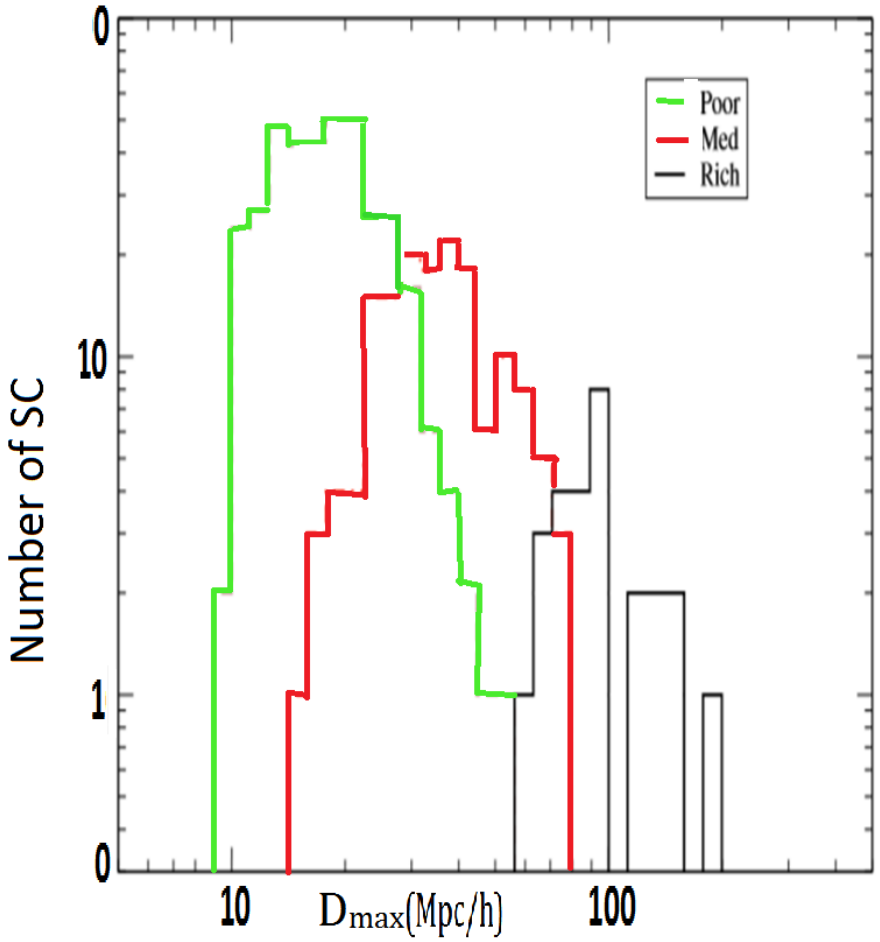
Effective Diameter:

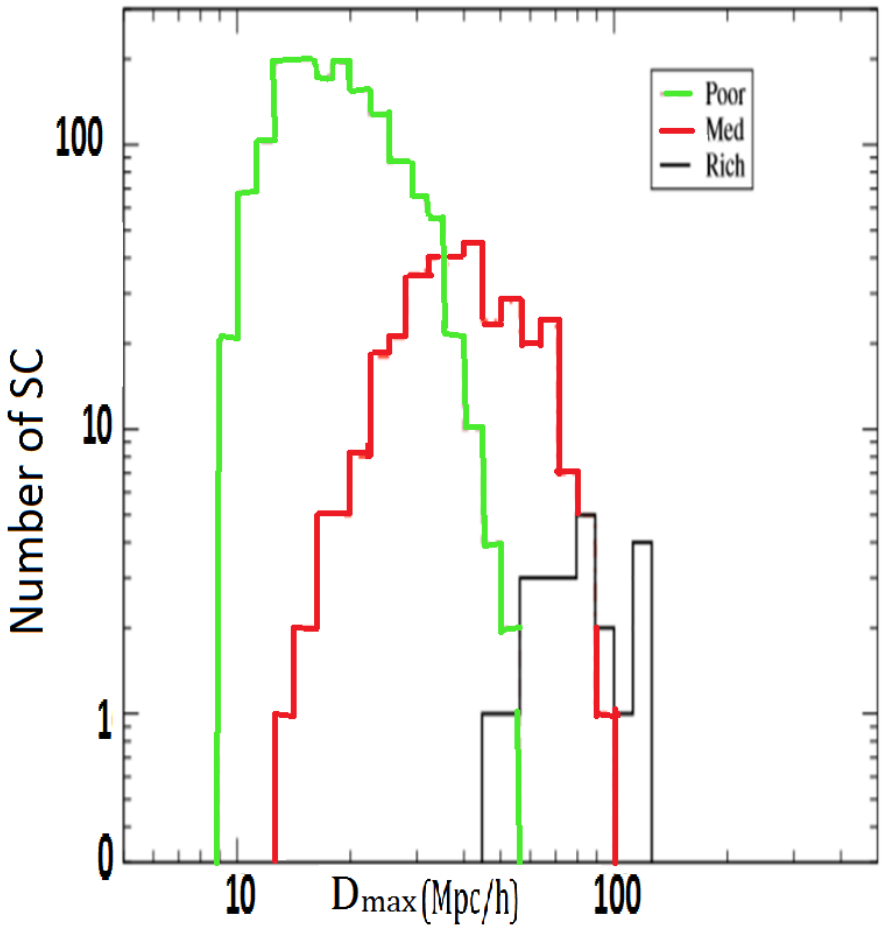
It is the diameter of the sphere whose volume is equal to the volume of the supercluster.

Maximum Diameter:

It is the diagonal of the rectangular box around of the supercluster.

Graph of Number of Superclusters versus maximal diameter





The maximum diameters depend strongly on the Supercluster richness.

Off Set Value:

- **This is the difference between the geometrical center and dynamical center of main cluster of the supercluster.**
- **This parameter characterized the asymmetry of the supercluster.**
- **For poor supercluster, its value is low (2-3 mpc/h), for rich super cluster its value is high(20-30 mpc/h). This signifies that the rich superclusters are more asymmetrical.**

References:

- J. Einasto, M. Einasto, E. Tago *et al.* from A&A (2007)
- Einasto, M., Einasto, J., Müller, V., Heinämäki, P., & Tucker, D. L. 2003c, A&A
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- http://www.eso.org/public/images/
- http://www.atlasoftheuniverse.com/superc.html

THANK YOU