Classical Overview & Structure of the Virgo Cluster

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Once upon a time in Virgo...
An Epic...

Studies of the Virgo Cluster
(Actually came in Volume I – VI)

- I – Photometry for 109 Galaxies as Standards
- II – Catalog of 2096 Galaxies in the Virgo Cluster
- III - Classification system and an Illustrated Atlas of Virgo cluster dwarf galaxies
- IV - Atlas of Virgo cluster spiral galaxies
- V - Luminosity Functions of Virgo Cluster Galaxies
- VI - Morphological and kinematical structure of the Virgo cluster
...was told through

- Photographic Survey: 1979 - 1982
  - Las Campanas – du Pont 2.5 m Reflector
  - On 67 - Eastman 103aO, 50x50 cm photographic plates

- 109 galaxies served as Standard for rest ~2096

- Membership - Surface Brightness, Luminosity Class, Resolution into knots, Radial Velocity.

Mar 17, 2010
The Virgo Cluster Catalog

In summary, we have identified on the 67 du Pont plates:

- 1277 certain Virgo cluster members,
- 574 possible Virgo cluster members,
- 245 background (Zwicky) galaxies,
- 0 foreground galaxies,
- 2096 in total.

All “possible” members, independent morphological type. (B < ~18)

1. Surface Brightness – ID genuine dE and Im within VC
2. Resolution into knots – ID Late type Galaxies with active star formation. Background galaxies are much less resolved.
4. Radial Velocity – A low density region behind the VC helps in classification based on velocity data. Decisive for giant E/S0.
Kinematic Sample of VCC Galaxies

Fig. 1. A map of all VCC galaxies with known velocities. The survey boundary of Binggeli et al. (1985) is indicated.

Fig. 2. The heliocentric velocity distribution of all VCC galaxies with known velocities. The velocities are given in \( \text{km s}^{-1} \), as in all following figures. the bin size is 250 \( \text{km s}^{-1} \).
Cleansed Cluster Sample

- Cleansed: Using only the “Member” galaxies
- Sub Clusters A & B

**Sub Cluster A**
- Extended in Space & Velocity Range.
- *Small A*: Centered around M87 (Core?)
- *Big A*: Complex Structure, falling in (?)

**Sub Cluster B**
- *Small, Intermediate & Big B*
- Centered around M49, well behaved Spiral rich clustering.
Sub Cluster A

Spirals & Irregulars falling in at velocities around 0 & 2000 km/s

Sub-Clumps
Centered about M87 & M86/84 – in the process of merging

Asymmetric distribution of dE’s => “Speculation”

M87 clump is several times more massive than the M86 clump
Difficult Regions

**W Cloud**
deVoucouler ’61, Prolonged Structure w/ ~100 Galaxies.
30 Members – Low Surface Brightness and $cz < 500$ km/s

**M Cloud**
Ftaclas et al. ’84, Region ‘b’ – Shapely, Ames et al. (’29). Smaller Cluster (towards NW), at twice the distance but similar to W Cloud. No galaxies between 2800-3500 km/s => Void

Sheet like filament connecting W-M from 3500-6000 km/s.
W' Cloud
deVoucouler ’61, Seems to connect the W Cloud with the sub-cluster B

Southern Extension
deVoucouler ’61 & Yahil et al. ’80. Part of the Virgo SC Complex. Only the Northernmost tip lies within the survey.

Magnitude Distribution of galaxies in clouds is \(~1\text{-}2\) order below the sub clusters.
Conclusions

• The Structure of Virgo Cluster is Complex
• 5 Substructures from the galaxy distribution
  – Clusters A: Early type, E/S0 around M87 & dE
  – Cluster B: Late type, Mostly Spirals & Irregulars
  – Clouds W, W’, M
• dE’s outnumber every other type of galaxy
• VC is a dynamically Young Cluster
“Other” Interesting Stuff...

• I – Hevel's Uranographia image of Virgo approximates the direction of M87’s jet.

• II – VC has a rich history of observations from Messier (1785) – Shapely/Ames – deVaucouler – B/S/T (1980-90’s).

• III – No other cluster has its contents recorded to this level of detail and completeness.

• IV - Astronomy is a science of great patience.

• V - European Red Squirrel is also called Sciurus Vulgaris.

• No, there is no VI
References

- Tonry, J. 1995, Proceedings of Heron Island Workshop on Peculiar Velocities in the Universe
- Binggeli, B. 1999, Lecture Notes in Physics, 530, 9, Springer