



# OBSERVING GALAXY GROUPS AND CLUSTERS

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The Astronomy Connection

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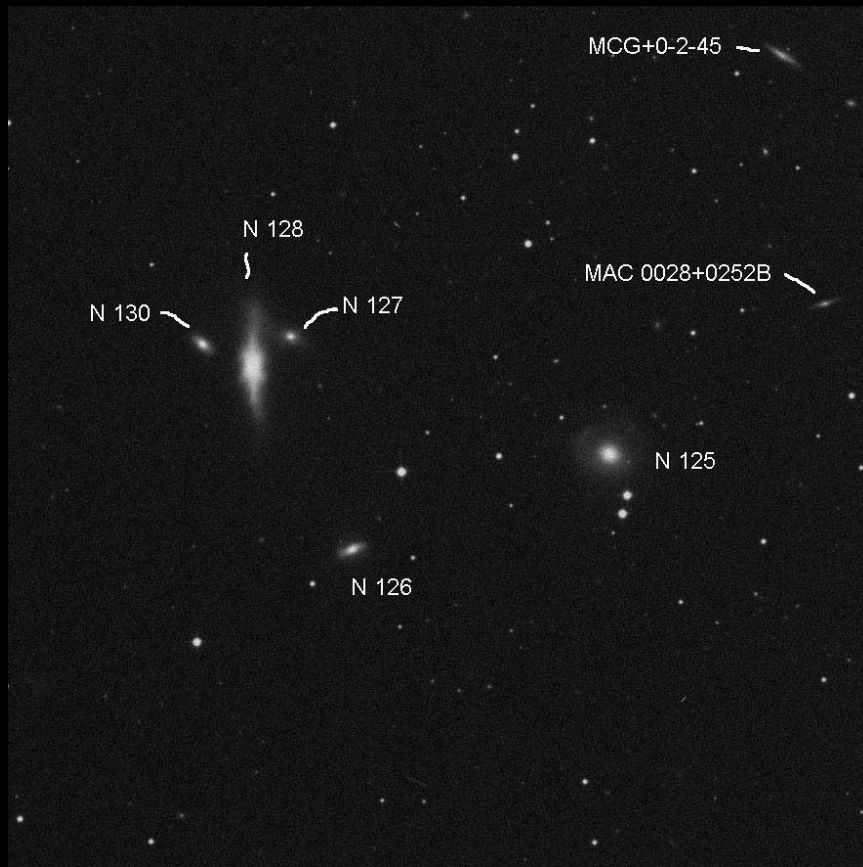
# Topics

- ▣ Galaxy Trios
- ▣ Compact Galaxy Groups
- ▣ Galaxy Clusters
- ▣ Observing Tips and Enhancements

# Galaxy Trios

- ▣ Many fun trios are observable in small telescopes
- ▣ Most fit in a medium power field
- ▣ The List was inspired by Miles Paul

# NGC 128 – Pisces

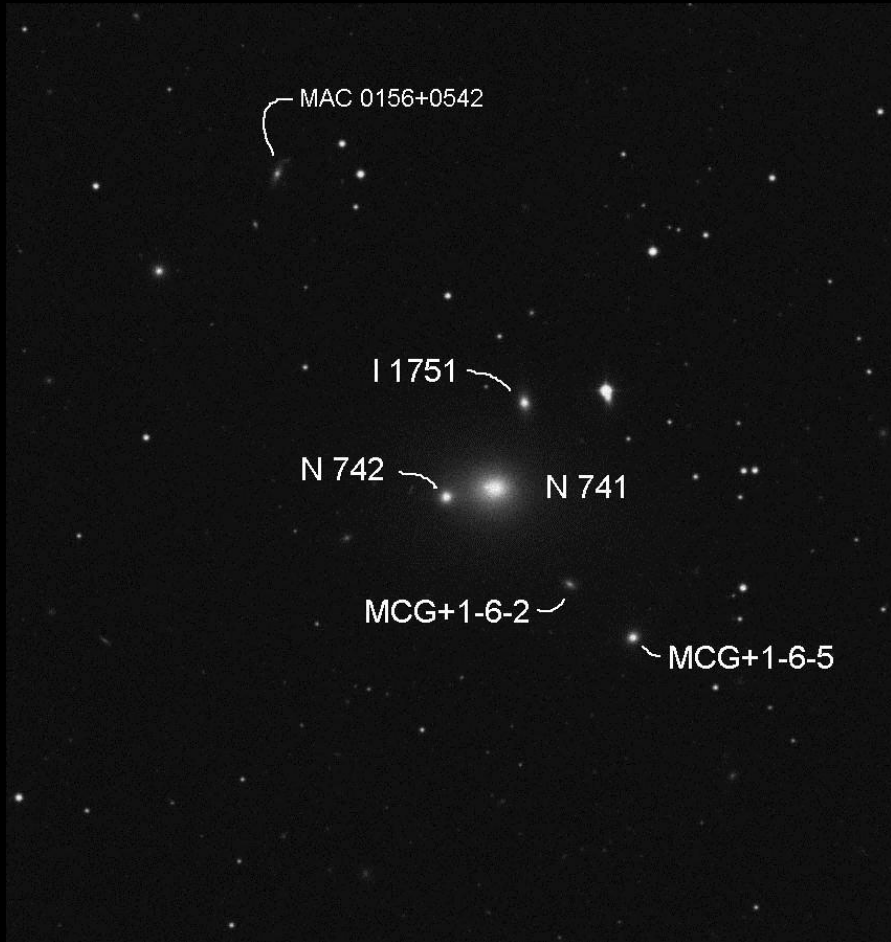


Flat galaxy with box core with two little guys

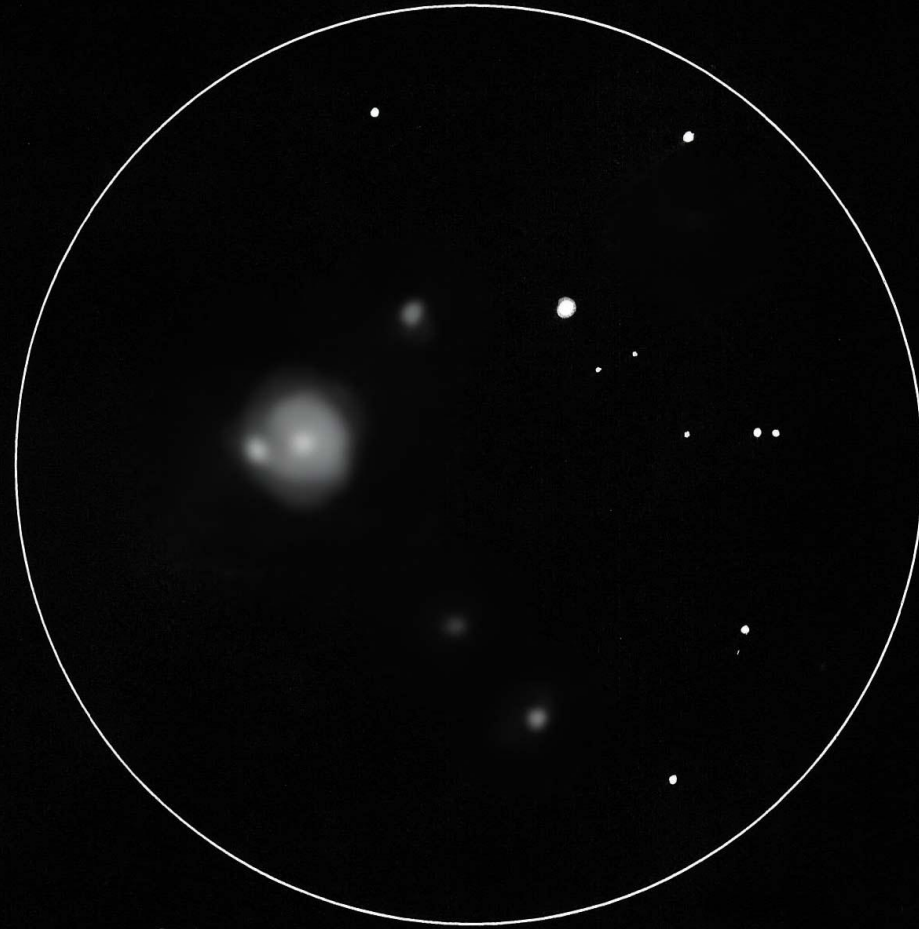


22" reflector at 230x and 11.0' field

# NGC 741 - Pisces



Large galaxy with 2 little guys  
plus a couple more



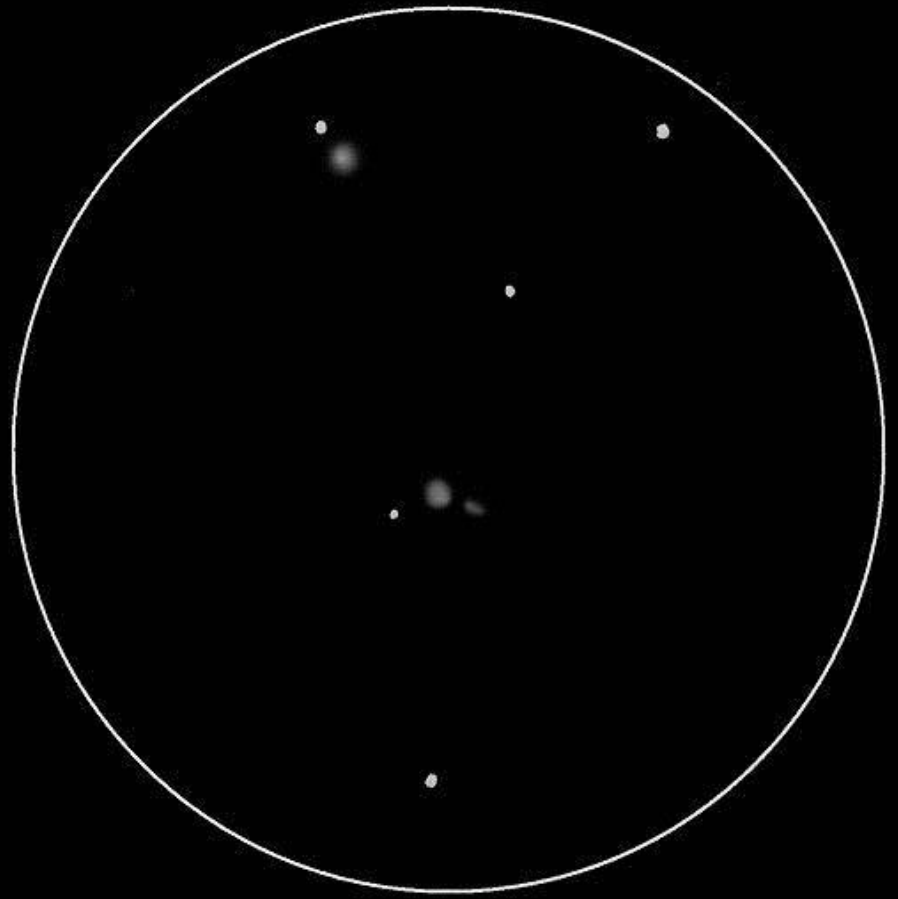
22" reflector at 306x and 10.2' field

# Zwicky's Triplet (Virgo)

## Arp 103

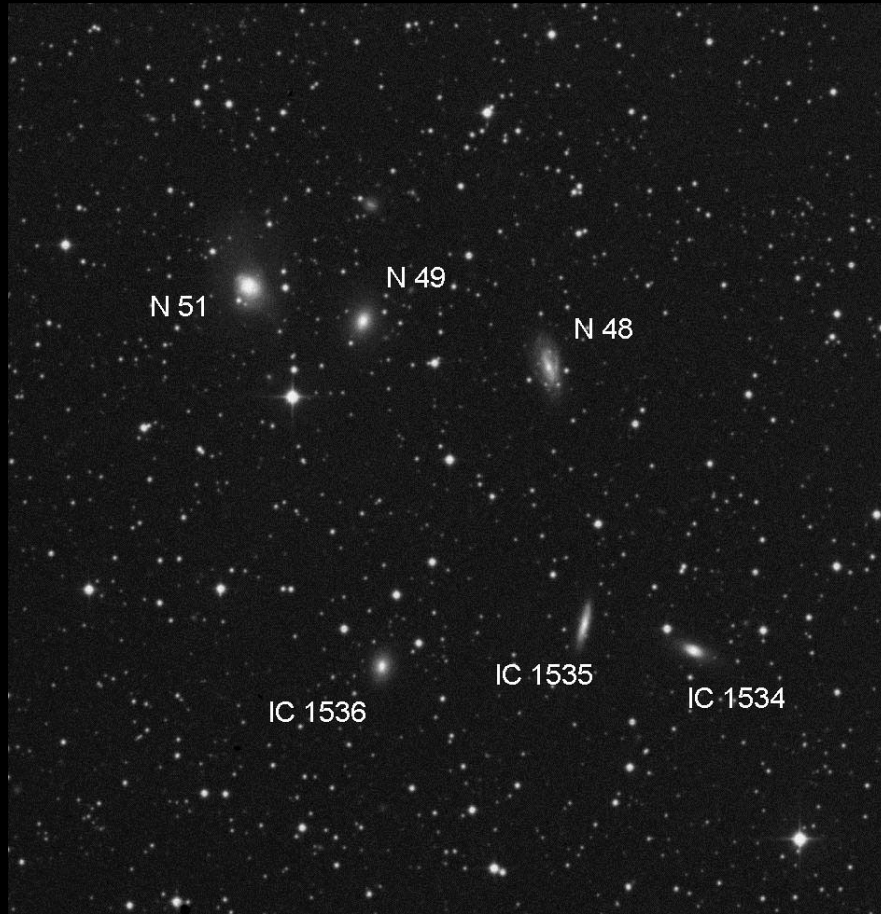


One of Arp's Peculiar Galaxies  
Elliptical galaxy connected to spirals

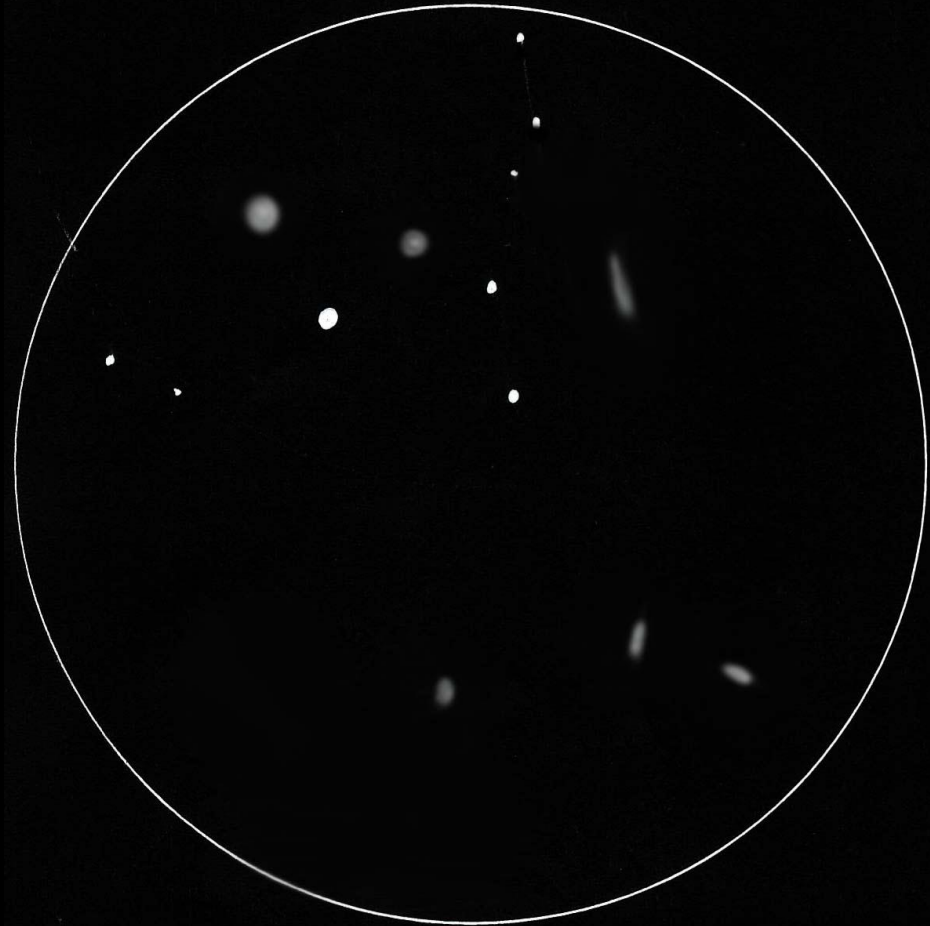


22" reflector at 528x and 6.8' field

# NGC 51 and IC 1535 - And



Two triplets  
Fits in a high power field



22" reflector at 383x and 15.7' field

# NGC 5982 (Draco)



Spiral, Elliptical and Flat galaxy



22" reflector at 282x and 20.4' field



# Compact Galaxy Groups

- ▣ Hickson Compact Galaxy Groups
- ▣ Rose Compact Galaxy Groups
- ▣ Shakhbazian Compact Galaxy Groups

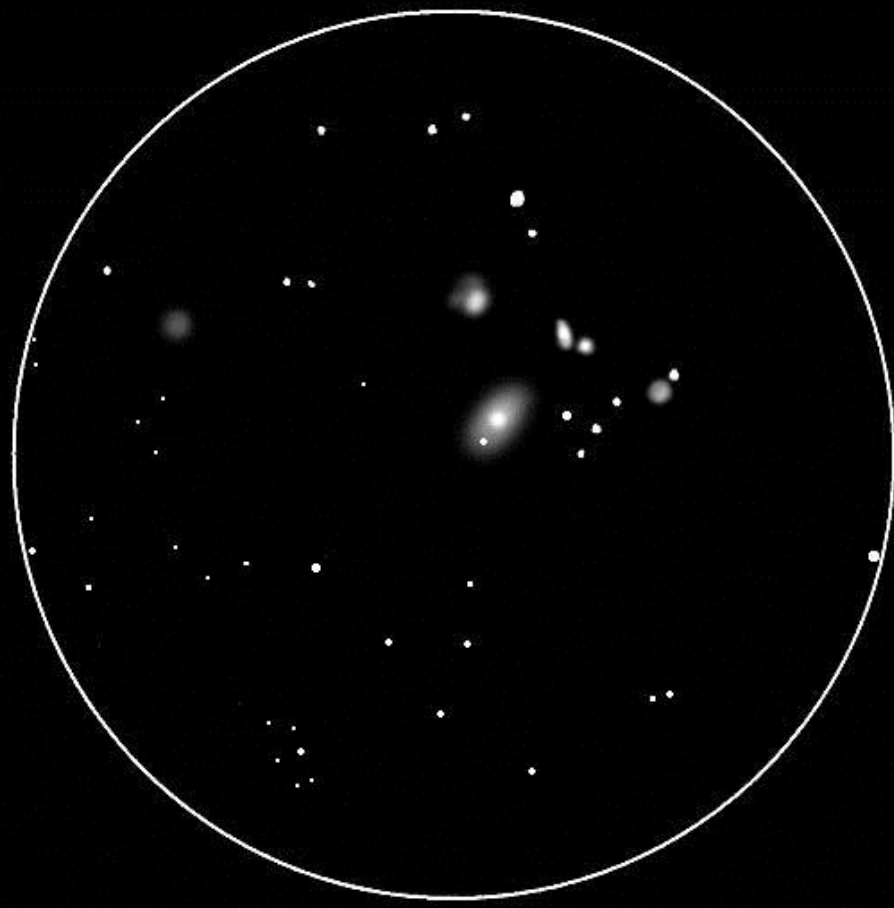
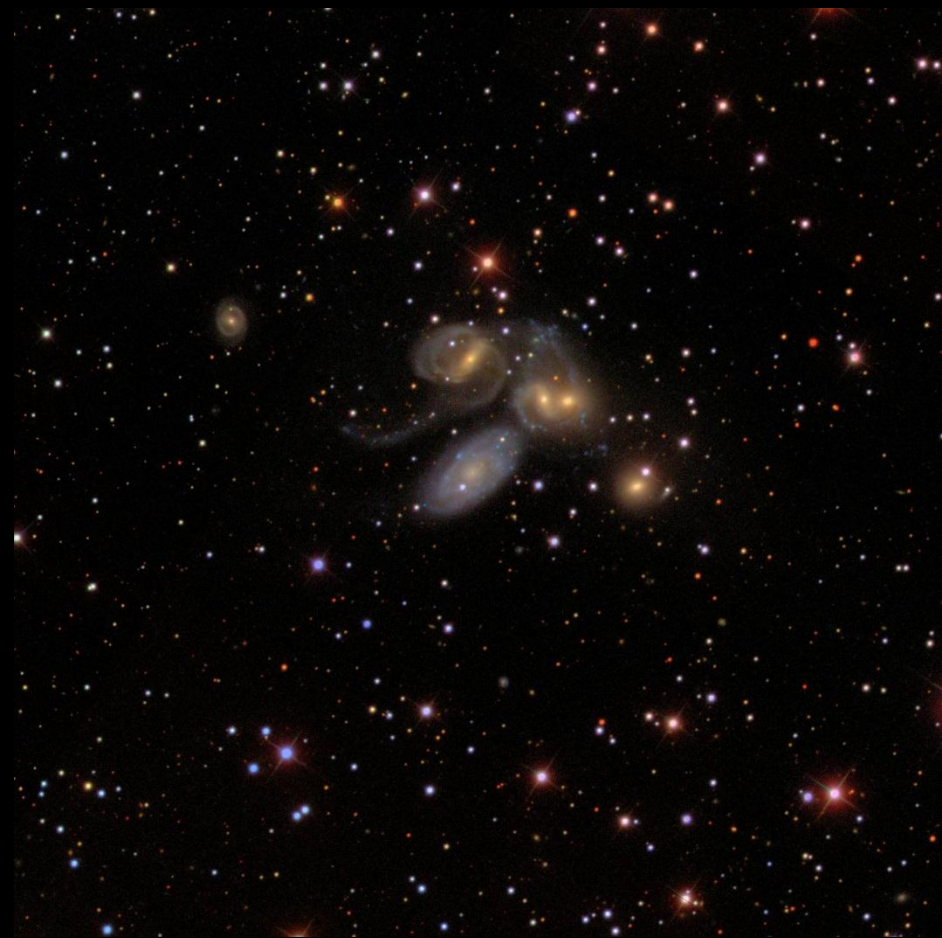
# Hickson Compact Galaxy Groups

- ▣ 100 compact groups researched by a professional astronomer, Dr. Paul Hickson, from University of Toronto, Canada.
- ▣ Studied discordant red shifts between members to see if there were any interactions between the “discordant” members.
- ▣ About  $\frac{3}{4}$  of the Hickson Groups have the brightest member of 14<sup>th</sup> magnitude or fainter, so it is recommended that you use a 16” or larger scope. 99 Groups are within reach of a 16”.
- ▣ Almost all Hickson Groups fits in a medium power field.

# Hickson's Selection Criteria

1. **Population** – at least 4 members and the magnitude range is no more than 3 magnitudes
2. **Isolation** – excludes groups that are subsets of larger groups
3. **Compactness** – separation of members are comparable to the size. He set the average surface brightness  $\leq 26$  mag/arcsec<sup>2</sup> to ensure that the fainter the members the more compact the group.

# Hickson 92, Stephan's Quintet in Pegasus



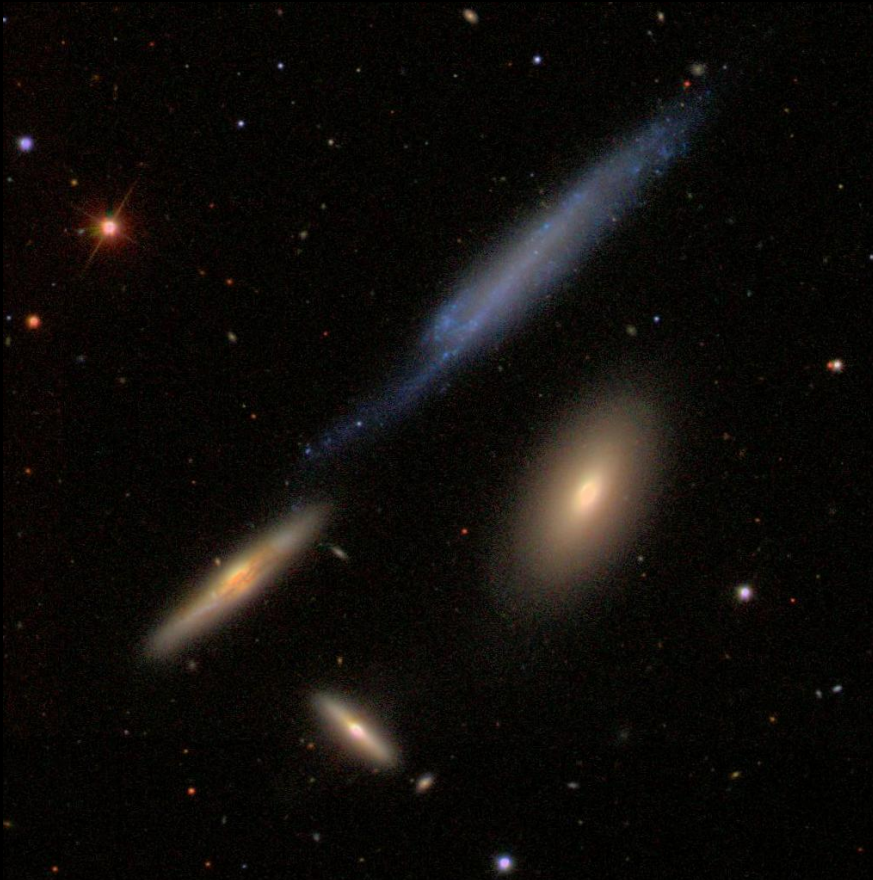
22" reflector at 377x and 10.3' field

# Hickson 82 in Hercules



22" reflector at 377x and 10.3' field

# Hickson 61, The “Box” in Coma Berenices



22" reflector at 294x and 16.8' field

# Hickson 79 (Copeland's Septet) in Serpens



22" reflector at 881x and 4.1' field

# Rose Compact Galaxy Catalogue

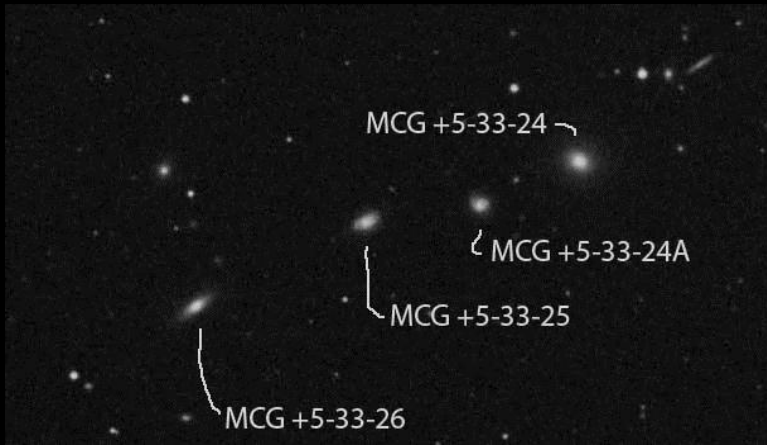
- ▣ Dr. James A. Rose, University of North Carolina, Chapel Hill (now retired)
- ▣ 33 total groups - 26 definite and 7 probable.
- ▣ Spring list - placed nice and high for northern latitude observers.
- ▣ Many are very tough, especially to “bust” it apart.
- ▣ I recommend an 18” or larger scope and steady skies to tackle this list.
- ▣ All members at least magnitude 17.5



# Rose's Selection Criteria

1. Aggregate of three or more galaxies occupies an area of  $A$  arcmin<sup>2</sup>.  $s$  is the average number of field galaxies per arcmin<sup>2</sup> with the blue magnitude  $\geq$  than the faintest galaxy enclosed in the area.
2. All members must be at least magnitude 17.5.
3.  $A\sigma < 0.0035$

# Rose 16 (Canes Venatici)

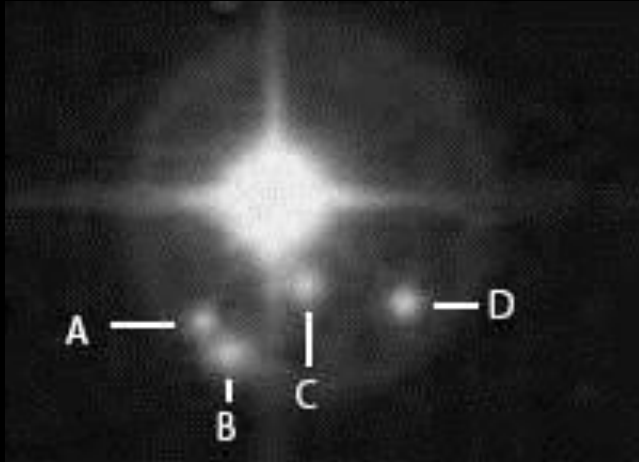


One of the easiest Rose Groups



22" reflector at 308x and 10.2' field

# Rose 33 (Bootes)



“B” is only 30” from a  
7.9 magnitude star!

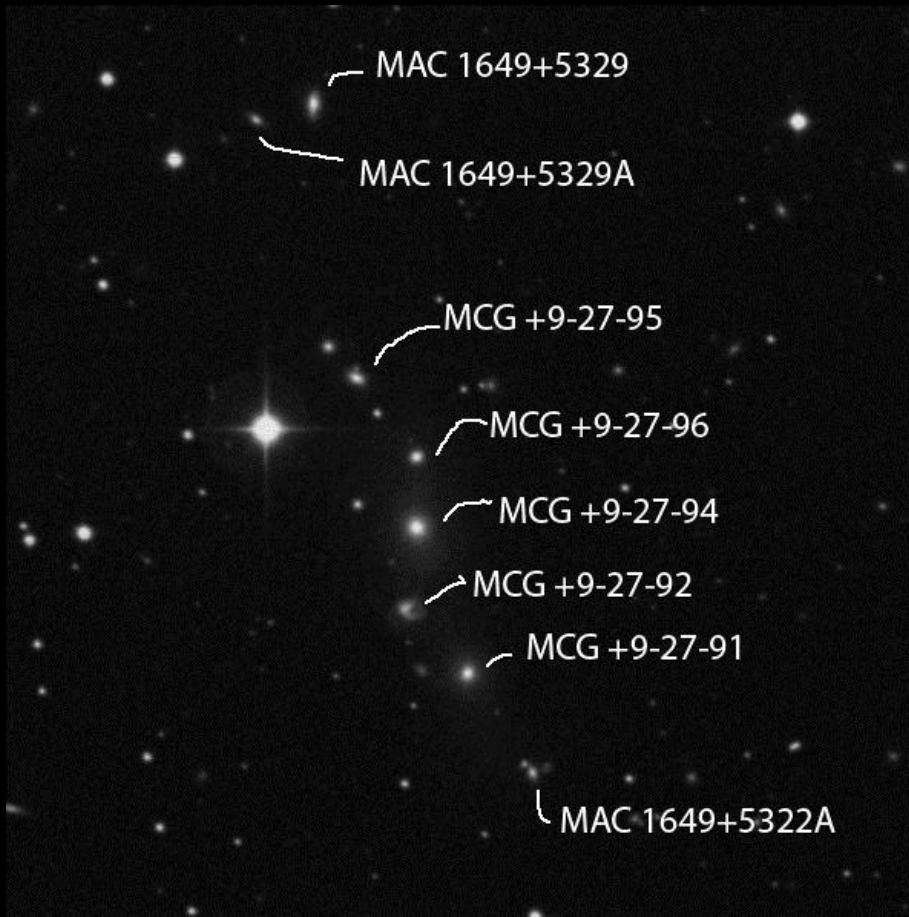


22” reflector at 821x and 3.1’ field

# Shakhbazian Compact Galaxy Groups

- ▣ Some observers consider the Shakhbazian Groups as the “next” Hickson groups.
- ▣ Way more difficult than the Hicksons Groups.
- ▣ Most are very tough...even in large telescopes.
- ▣ Recommend a 20” or larger scope.
- ▣ 377 total groups

# Shakhbazian 16 (Draco)

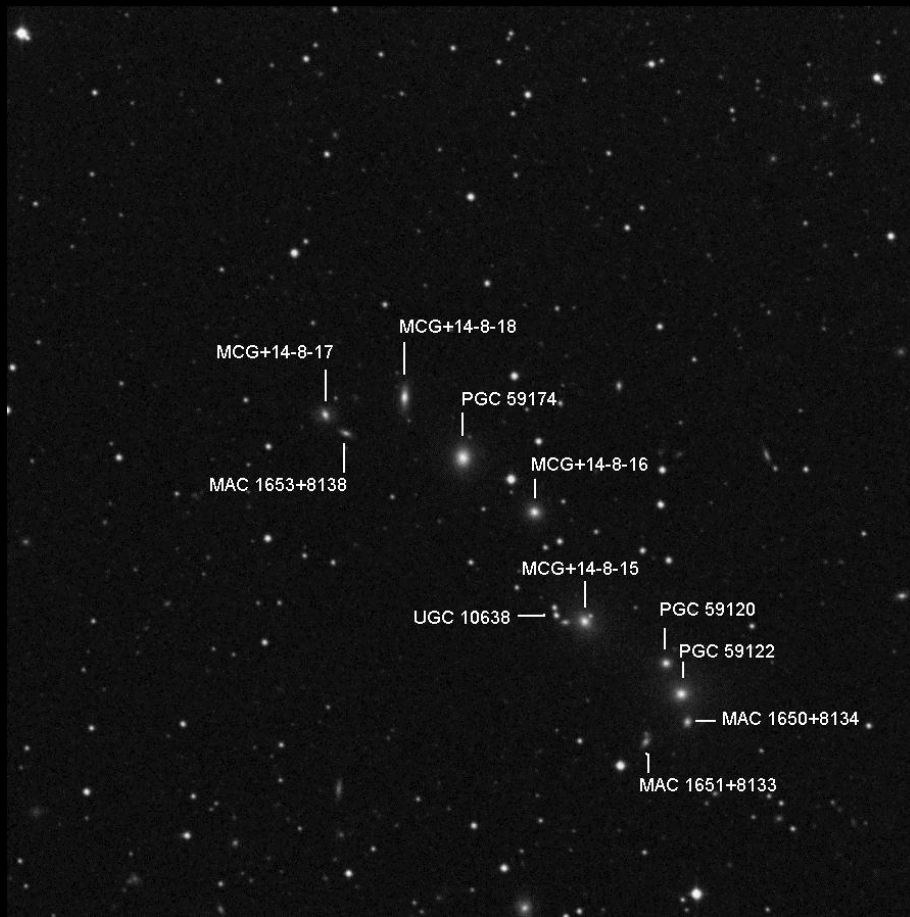


Chain is 8' long

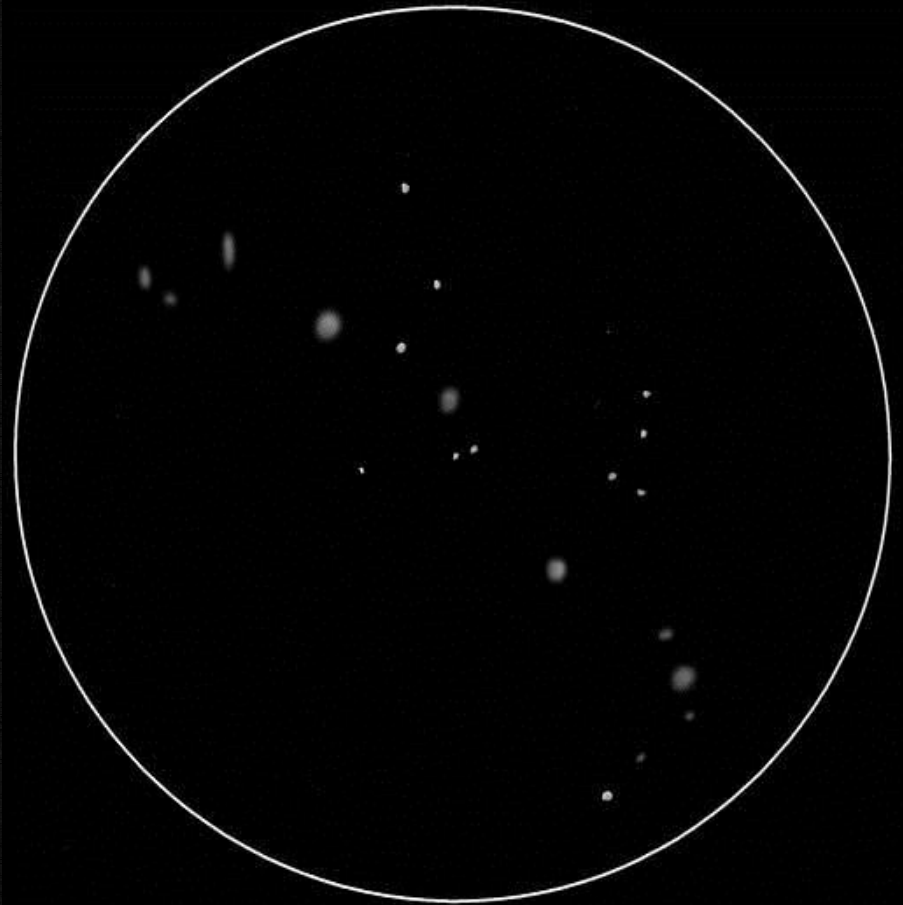


22" reflector at 308x and 10.2' field

# Shakhbazian 166 (Ursa Minor)



Chain is 8' long



22" reflector at 308x and 10.2' field

# Shakhbazian 1 (Ursa Major)

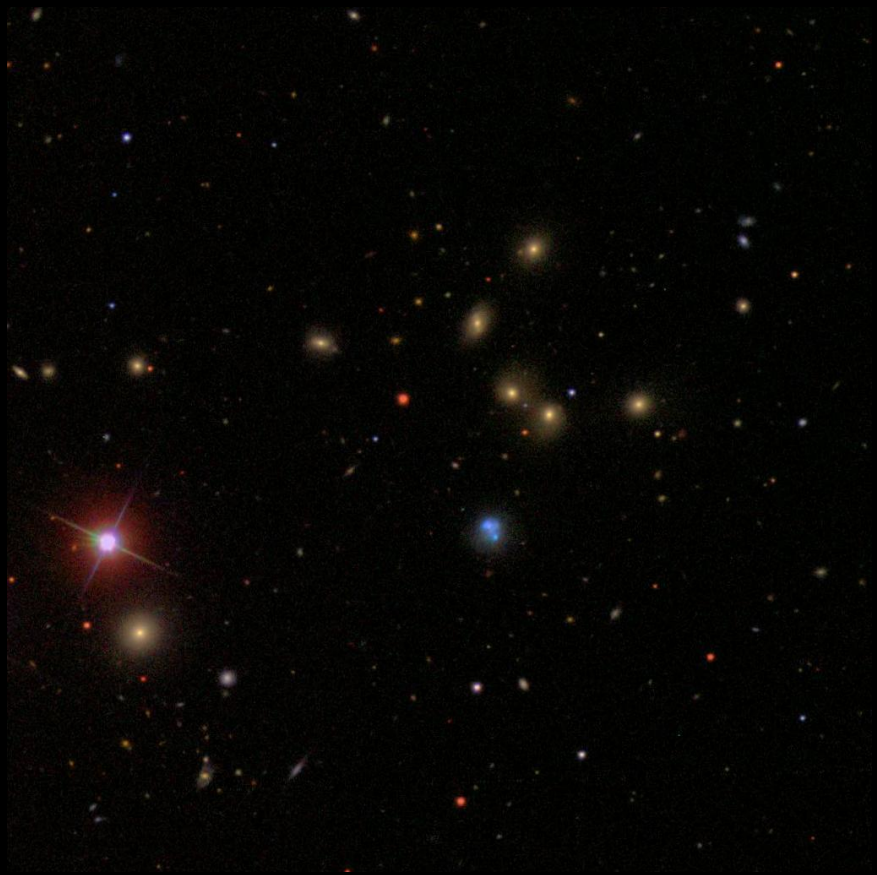


1.3' across and mag 17+



48" reflector at 488x and 5.2' field

# Shakhbazian 205 (Coma Berenices)



2.7' across and mags 15.4 - 16.5



48" reflector at 488x and 5.2' field



# Galaxy Clusters

- ▣ Abell Galaxy Clusters – Rich Clusters
- ▣ CGCG (Zwicky) – Mostly Poor Clusters
- ▣ Catalogue of Nearby Poor Clusters of Galaxies
  - MKW and AWM
- ▣ Small Galaxy Groups

# Classifying Clusters

- ▣ Rich clusters vs. Poor clusters
  - Rich clusters have 1000's of members. Masses are  $10^{15}$  to  $10^{16}$  solar masses.
  - Rich Clusters have a higher density of galaxies.
  - Poor clusters include galaxy groups (few to a few dozen members).
  - Poor clusters have 100's of members. Masses are  $10^{12}$  to  $10^{14}$  solar masses.

# Abell Galaxy Clusters

- ▣ Dr. George Abell compiled this list using the POSS1 plates
- ▣ 2712 galaxy clusters (limited to  $-27^\circ$  and above)
- ▣ Listed as A or ACG followed by 4 digits. Prevents confusion between Abell Galaxy Clusters and Abell Planetary Nebulae.
- ▣ More southern galaxy clusters added by Abell and Harold Corwin which includes 1361 clusters.

# Selection Criteria

1. **Richness** – At least 50 members not more than two magnitudes fainter than the 3<sup>rd</sup> brightest member. – *You'll see a bunch of fuzzy glows in the field.*
2. **Compactness** – The 50 members must be within a defined radius from the center. The farther the cluster, the smaller the radius. – *A bunch of galaxies in a field – almost like "Lumpy Darkness".*
3. **Distance** – The red shift in the range from 6k to 60k km/sec. He used the magnitude of the 10<sup>th</sup> brightest member to estimate.
4. **Galactic Equator** – must not be near the galactic equator – *no galactic extinction results in better view*

1682 of the original list of 2712 galaxy clusters meet the above criteria.

# Class

- ▣ {Abell Richness Class} {Abell Distance Class} {Blautz-Morgan Class}

Abell Richness Class	Number of galaxies between $\text{Mag}_3$ and $\text{Mag}_3 + 2$	# of clusters
1	50 – 79	1224
2	80 – 129	383
3	130 – 199	68
4	200 – 299	6
5	➤ 300	1

Abell Distance Class	$\text{Mag}_{10}$	# of clusters
1	13.3 – 14.0	9
2	14.1 – 14.8	2
3	14.9 – 15.6	33
4	15.7 – 16.4	60
5	16.5 – 17.2	657
6	17.3 – 18.0	921
7	➤ 18.0	

Blautz-Morgan Class	Mag difference between 2 brightest galaxies
I	Large difference
II	Moderate difference
III	Little or no difference

# Abell 1656, Coma Berenices Cluster



Class: 2 1 II

# ACG 2151, Hercules Cluster

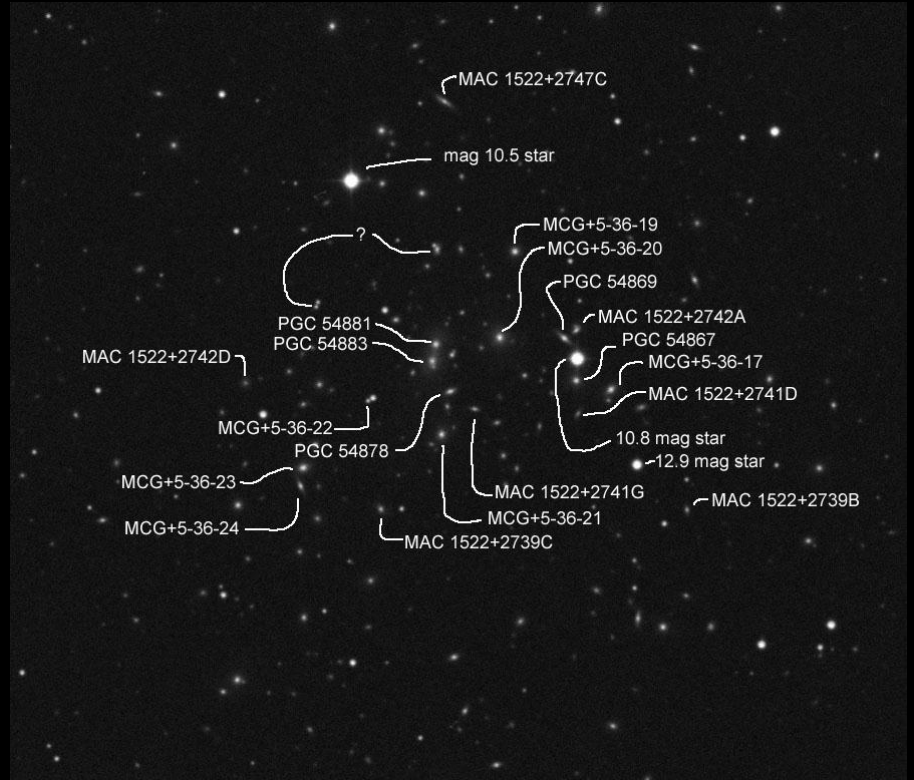


Class: 2 1 III

# ACG 2065, Corona Borealis Cluster



Class: 2 3 III



Galaxies detected at Lassen NP with a  
22" reflector at 458 and 575x  
NELM = 7.6



# “Poor” Clusters

## **MKW - Morgan, Kayser, White**

- 12 + 4 supplemental

## **AWM - Albert, White, Morgan**

- 7 clusters

Both are poor clusters with a cD galaxy

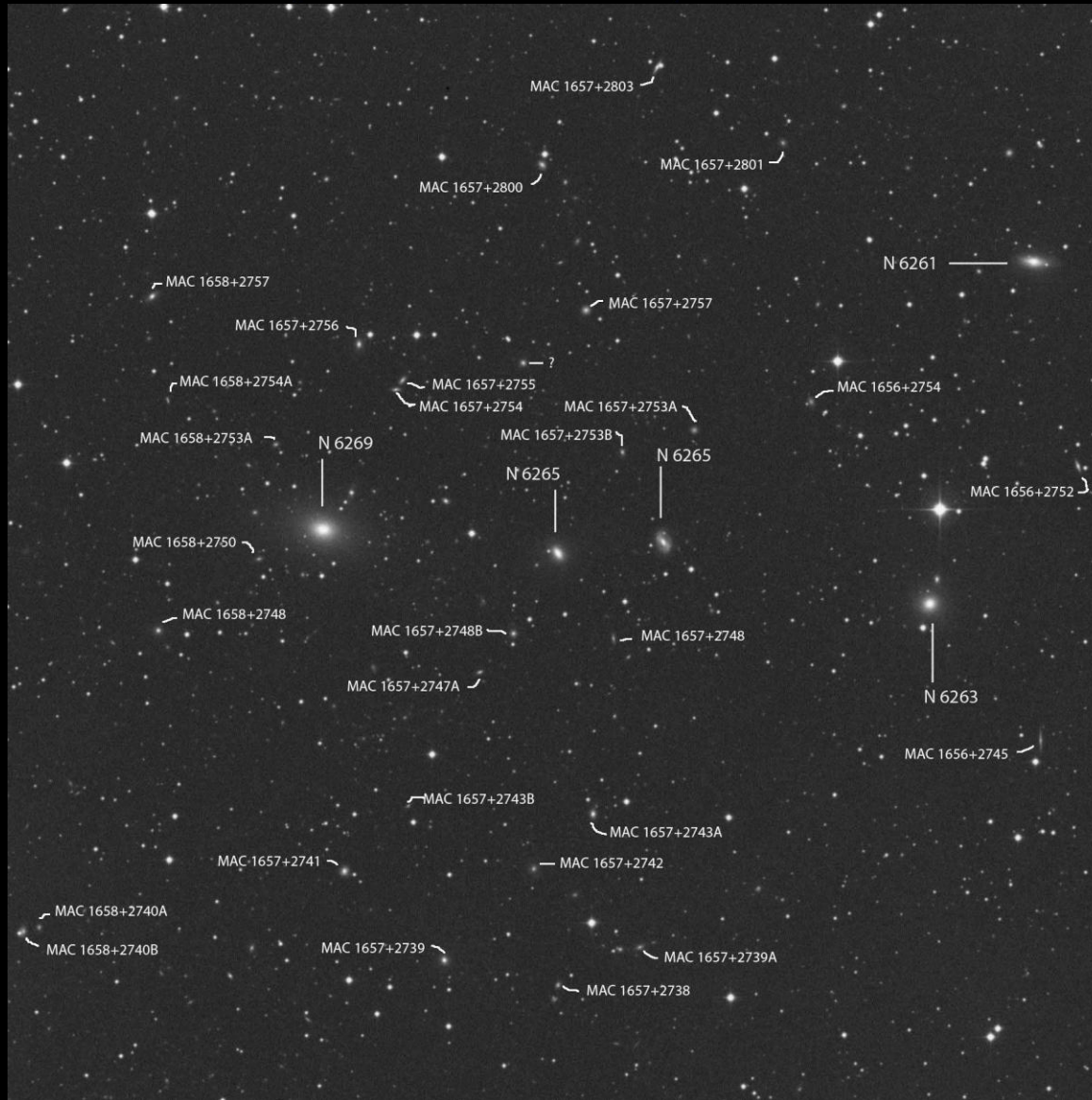
## **CGCG (Zwicky)**

- 6 volume catalog containing 9700 objects
- Most are single galaxies
- Galaxy Clusters are mostly poor

# NGC 5434 (MKW 12) in Bootes



# NGC 6269 (AWM 5) in Hercules



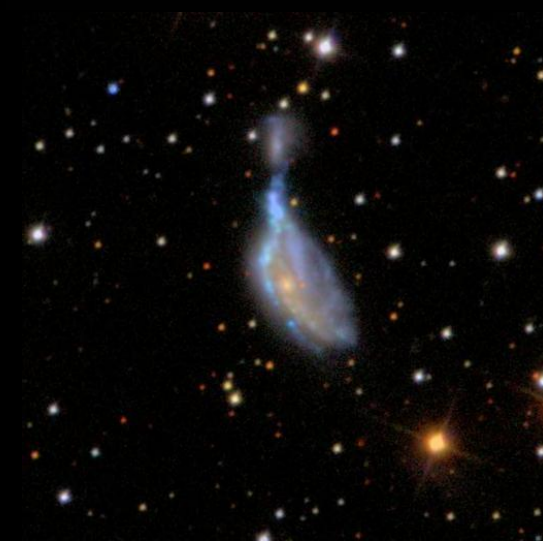
# Observing Tips

- ▣ Aperture! – Aperture Wins!
- ▣ Dark skies – Darker = Deeper
- ▣ Steady Skies – better seeing = ability to resolve (“bust”) apart close companions or seeing detail
- ▣ Wiggle test
- ▣ Magnification, magnification!

# Ethos versus Zeiss ZAO-II (6mm) NGC 6745 in Lyra



22" reflector at 383x



# Netbook as an e-book



# Hooded Observing Vest



Dark Skies Apparel

# Eyepiece Guards





# Medium to Large Telescopes



# 48" Telescope



# Questions

The background of the slide is a deep space image. It features a vast field of stars in various colors, including red, orange, yellow, and blue. On the right side, there is a prominent, large spiral galaxy with a bright yellowish core and distinct blueish spiral arms. On the left side, there is a cluster of several smaller, irregularly shaped galaxies, some appearing to be in the process of merging or interacting.