Evening Classes

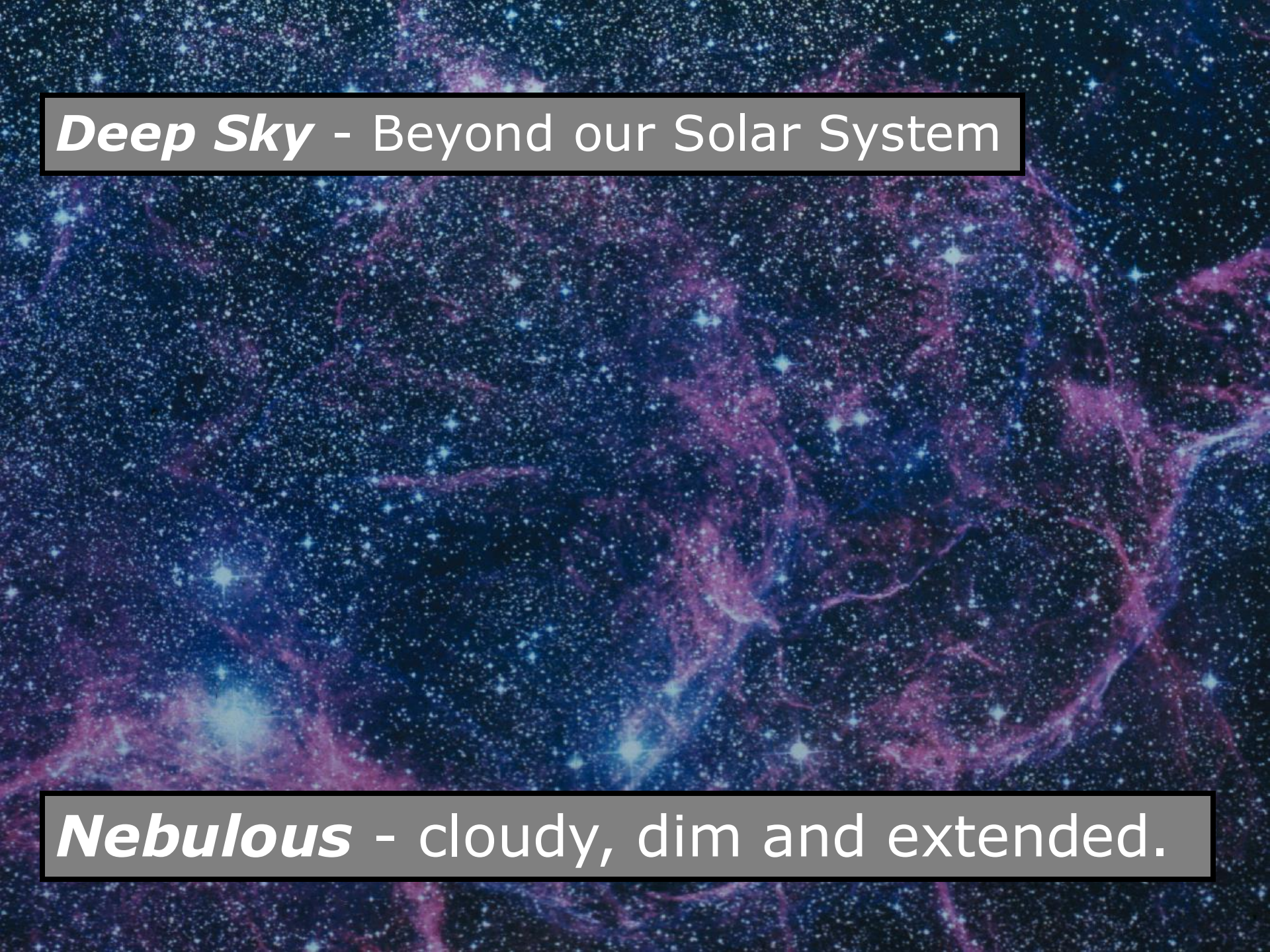
Week 6

Deep Sky Objects

Presented by John Campbell

Astronomy Course Outline

Week 1: The Sky | Week 2: The Planets | **Week 3: The Stars** | Week 4: History of Astronomy | Week 5: Telescopes | Week 6: Deep Sky Objects | Week 7: Cosmology | Week 8: Alien Worlds


Deep Sky - Beyond our Solar System
Nebulous - cloudy, dim and extended.

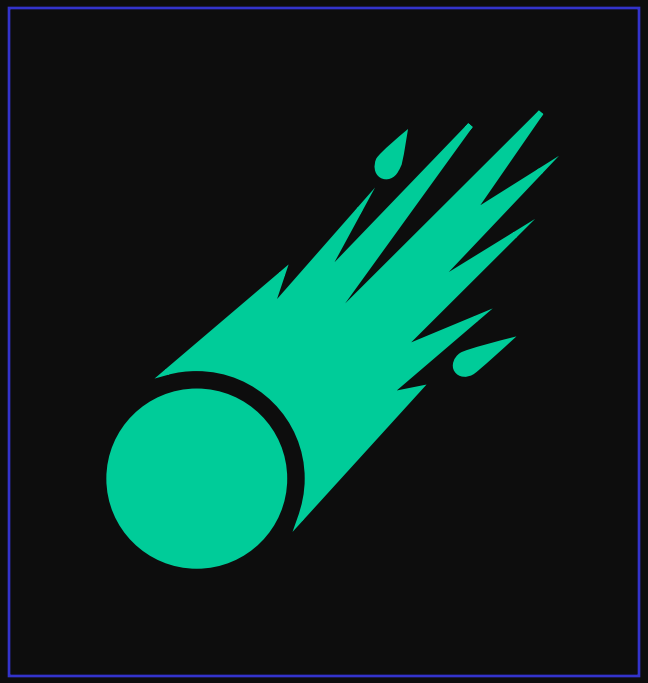
We've been looking at these objects since ancient times

First catalogued by Messier (mid to late 1700s)

Charles Messier

Catálogo Messier completo

- Messier was actually hunting for comets, his catalogue was a sort of wastebasket for objects that were not comets – turned out to be very interesting later on when telescopes got better!



The Periodic Table of Messier Objects

Photographs by Mike Keith www.cosmicneighbors.net

These 110 deep-sky objects were cataloged by Charles Messier (1730-1817) and Pierre Méchain to help other astronomers distinguish between fixed objects such as these and moving objects like comets. The original list contained 103 items but later astronomers added seven more, based on Messier's notes, for a grand total of 110. In this chart, inspired by the chemical Periodic Table, the Messier objects are organized into groups by object type (see color key at the right). Objects in each group are arranged roughly according to their position in the sky, with northern and southern objects in upper and lower rows and objects in each row ordered by their Right Ascension coordinates, from 0h on the right to 24h on the left.

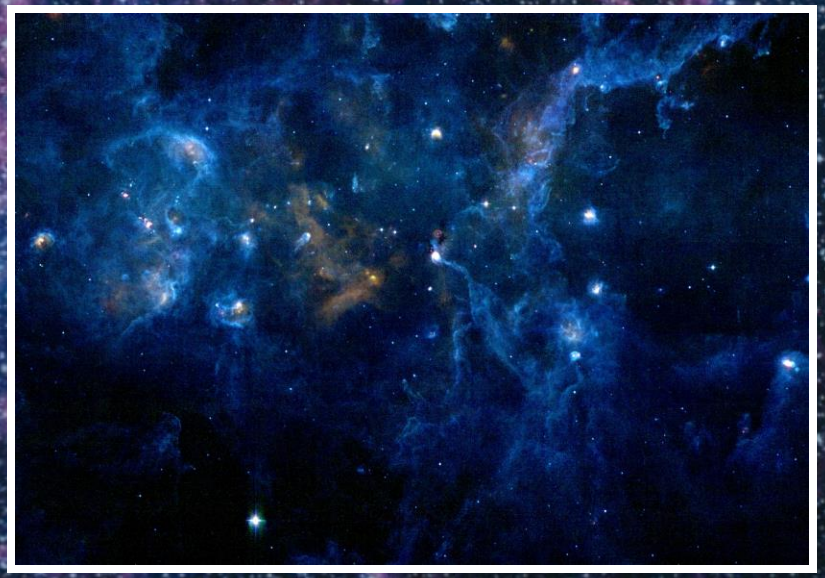
1 Tau 5h 8.2 6x4																	73 Aqu 20h 9.0 3	24 4.6	
17 Sag 18h 7.5 11	16 Ser 18h 6.4 35	8 Sag 18h 6.0 90x40	20 Sag 18h 9.0 20	78 Ori 5h 10.3 8x6	42 Ori 5h 4.0 85x60	43 Ori 5h 9.1 9									27 Vul 19h 7.4 8x6	57 Lyr 18h 9.7 1	97 9.9		
102 Dra 15h 10.0 S0 6x3	101 UMa 14h 9.6 Sc 29x27	51 CVn 13h 8.4 Sc 11x7	63 CVn 13h 9.3 Sb 10x6	64 Com 12h 8.8 Sb 10x5	94 CVn 12h 7.9 Sb 14x12	100 Com 12h 10.6 Sa 8x6	106 CVn 12h 8.6 Sc 19x7	98 Com 12h 11.7 Sb 10x3	109 UMa 11h 10.8 SBb 8x5	108 UMa 11h 10.7 Sc 9x2	81 UMa 9h 6.8 Sb 27x14	74 Psc 1h 10.2 Sc 11x10	33 6.7						
83 Hyd 13h 7.6 Sc 13x11	104 Vir 12h 8.7 Sb 9x4	58 Vir 12h 9.6 SBb 6x5	90 Vir 12h 10.3 Sb 10x4	91 Com 12h 11.0 SBb 5x4	88 Com 12h 10.4 Sb 7x4	61 Vir 12h 10.2 Sc 7x6	99 Com 12h 10.1 Sc 5x5	66 Leo 11h 8.2 Sb 9x4	65 Leo 11h 9.3 Sa 8x2	96 Leo 10h 9.1 Sa 8x5	95 Leo 10h 10.4 SBb 8x5	77 Cet 2h 8.9 Sb 7x6							
60 Vir 12h 9.8 E2 7x6	59 Vir 12h 10.6 E5 5x3	89 Vir 12h 10.7 E0 4x4	87 Vir 12h 9.6 E1 7x6	49 Vir 12h 8.5 E2 9x7	86 Vir 12h 9.8 E3 9x6	85 Com 12h 9.1 E2 7x6	84 Vir 12h 10.1 E1 6x6	105 Leo 10h 9.2 E1 5	82 UMa 9h 8.4 10 11x4	32 And 0h 8.7 E2 9x6	110 And 0h 8.9 E5 22x11								
2 Aqu 21h 6.3 13	15 Peg 21h 6.0 12	72 Aqu 20h 9.3 6	71 Sgt 19h 8.4 7	56 Lyr 18h 8.2 7	14 Oph 17h 7.7 12	92 Her 17h 6.5 14	10 Oph 16h 6.7 15	12 Oph 16h 6.6 15	13 Her 16h 5.7 17	107 Oph 16h 7.8 11	5 Ser 15h 6.2 17	3 CVn 13h 6.3 16	53 7.6						
30 Cap 21h 8.4 11	75 Sag 20h 8.6 7	55 Sag 19h 6.3 19	54 Sag 18h 7.6 9	70 Sag 18h 7.8 8	22 Sag 18h 5.9 24	69 Sag 18h 7.7 10	28 Sag 18h 7.3 11	9 Oph 17h 7.3 9	19 Oph 17h 6.6 14	62 Oph 17h 6.6 14	4 Sco 16h 6.4 26	80 Sco 16h 7.7 9	68 7.3						
52 Cas 23h 7.3 13	39 Cyg 21h 5.2 32	29 Cyg 20h 7.1 7	67 Cnc 8h 6.9 29	44 Cnc 8h 3.7 95	48 Hyd 8h 5.3 54	35 Gem 6h 5.3 28	37 Aur 5h 6.2 24	36 Aur 5h 6.3 12	38 Aur 5h 7.4 21	45 Tau 3h 1.6 110	34 Per 2h 5.5 35	103 Cas 1h 7.4 6							
11 Scu 18h 6.3 14	26 Scu 18h 9.3 15	25 Sag 18h 6.5 40	18 Sag 18h 7.5 9	21 Sag 18h 6.5 13	23 Sag 17h 6.9 27	7 Sco 17h 4.1 80	6 Sco 17h 4.2 33	93 Pup 7h 6.0 22	46 Pup 7h 6.0 27	47 Pup 7h 4.5 30	50 Mon 7h 6.3 16	41 CMa 6h 4.6 38							

Note: There are two theories regarding the identity of M102: (a) it was a duplicate observation of M101, and (b) it is NGC 5866. We have chosen to follow (b) in order to not have to omit M102 from the chart.

Deep Sky Objects -

Deep Sky Objects -

- Nebulae



Deep Sky Objects -

- Nebulae
- Clusters

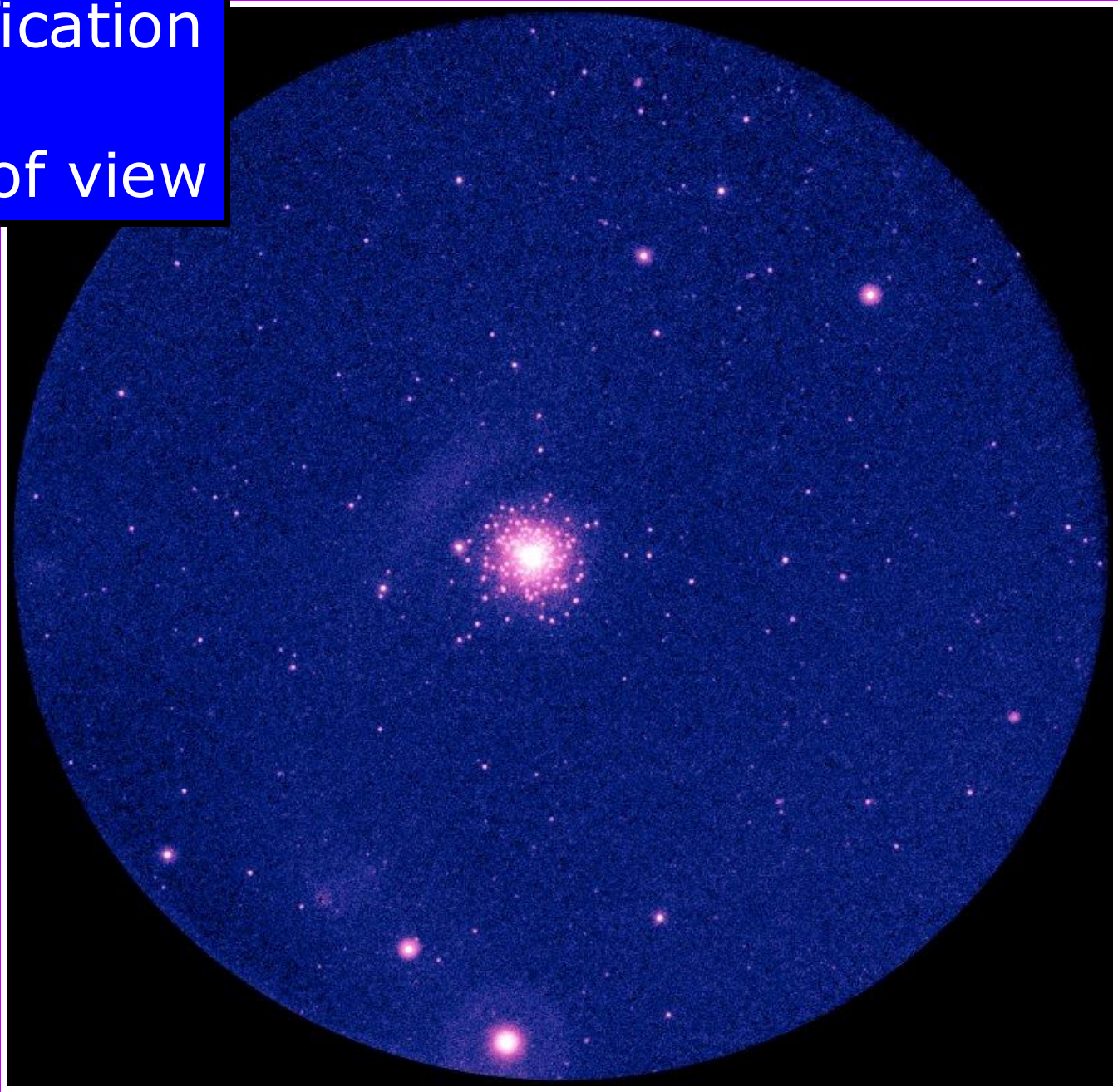
Deep Sky Objects -

- Nebulae
- Clusters
- Galaxies

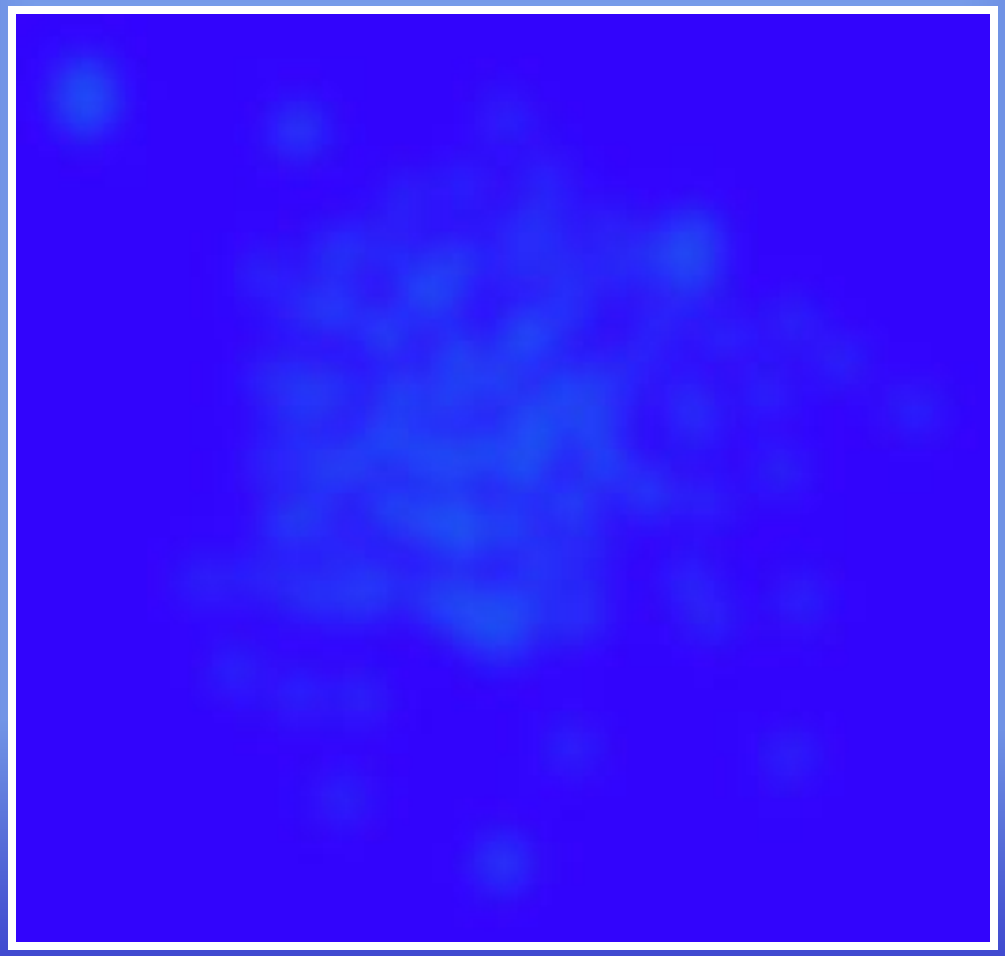
Viewing Tips-

- From dark sky locations
- With no Moon
- With dark-adapted eyes
- Using wide fields & low magnifications

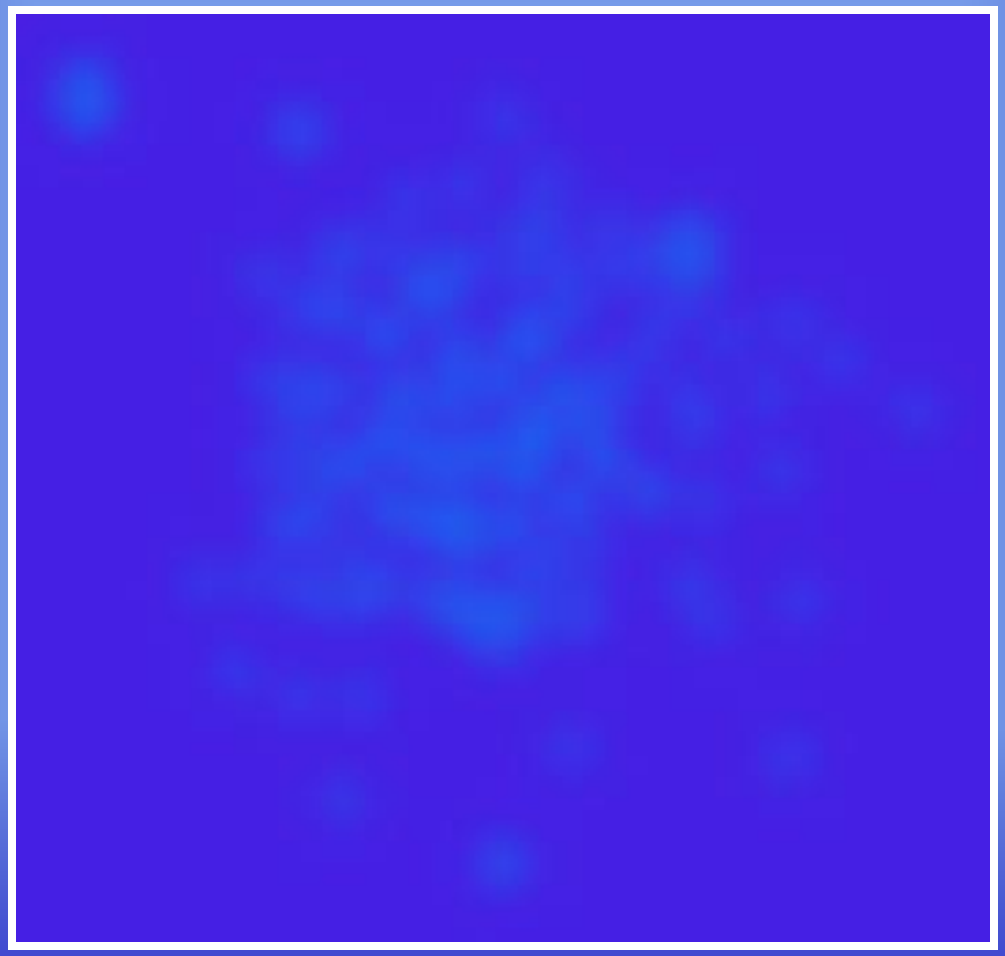
Low magnification
&
wide fields of view



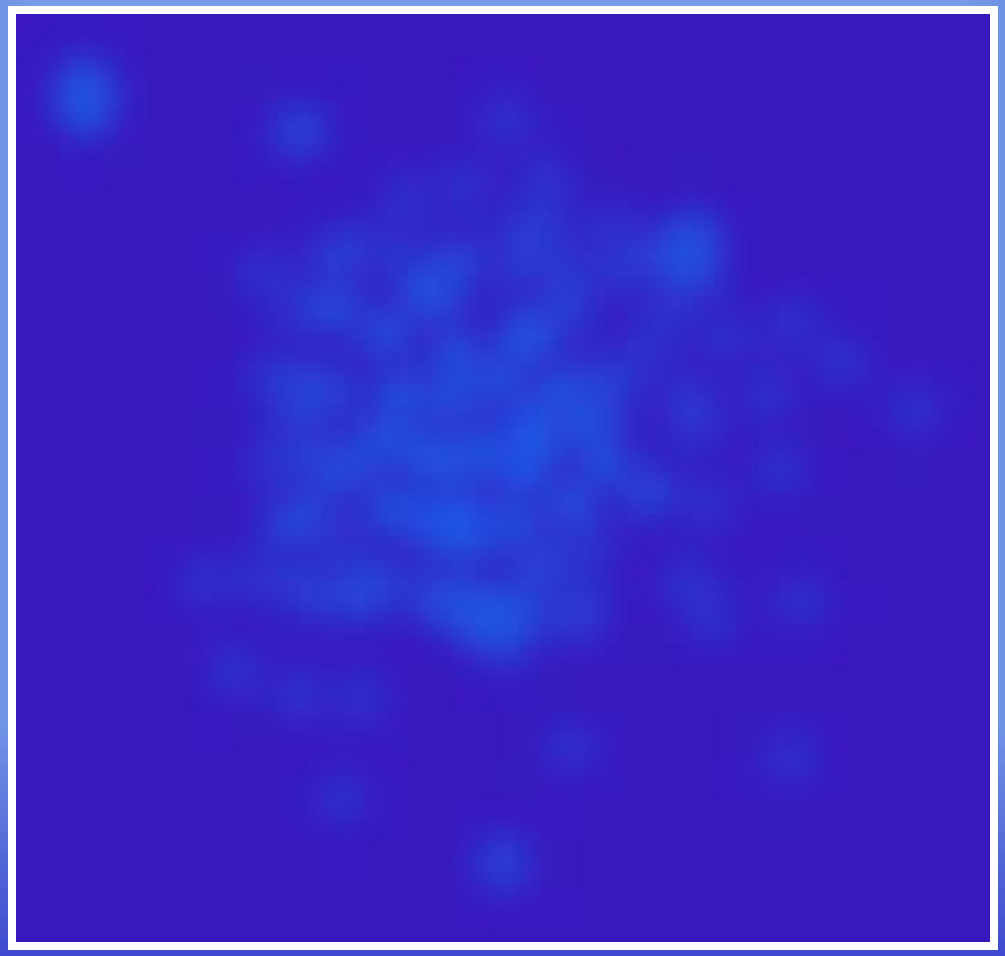
The need for dark skies



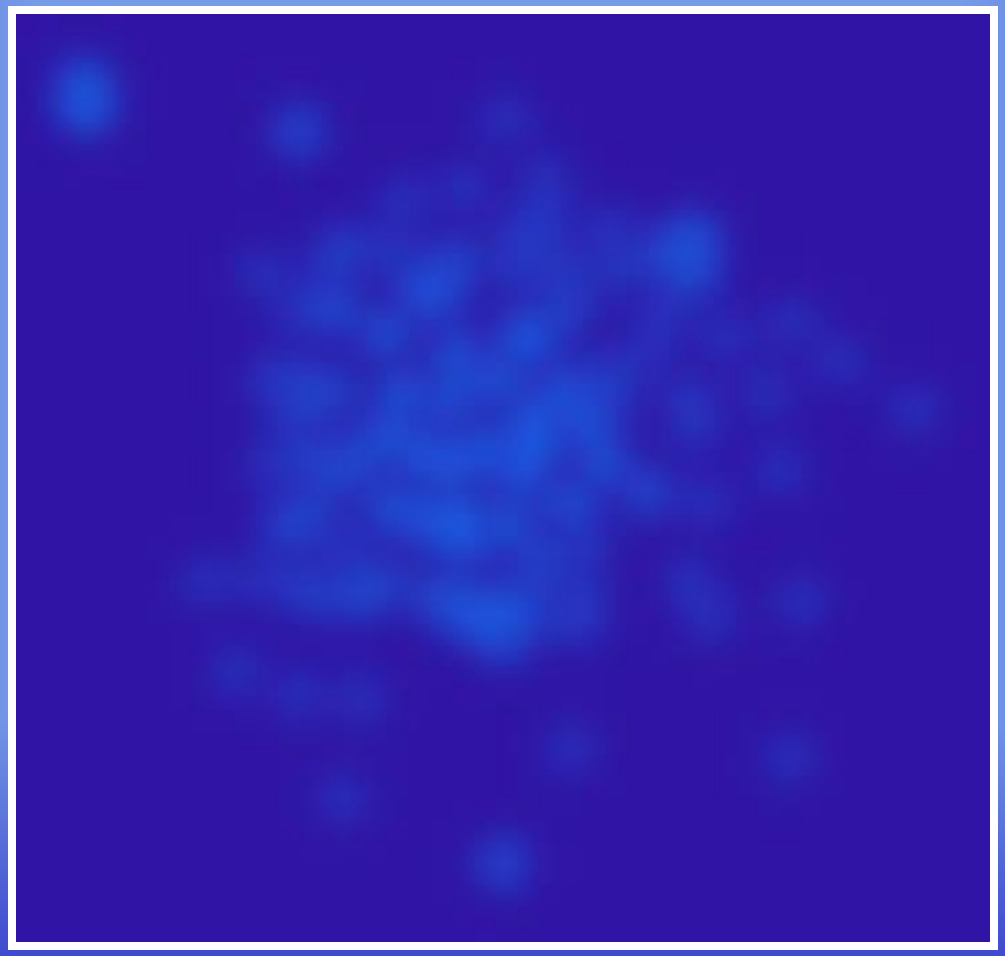
The need for dark skies



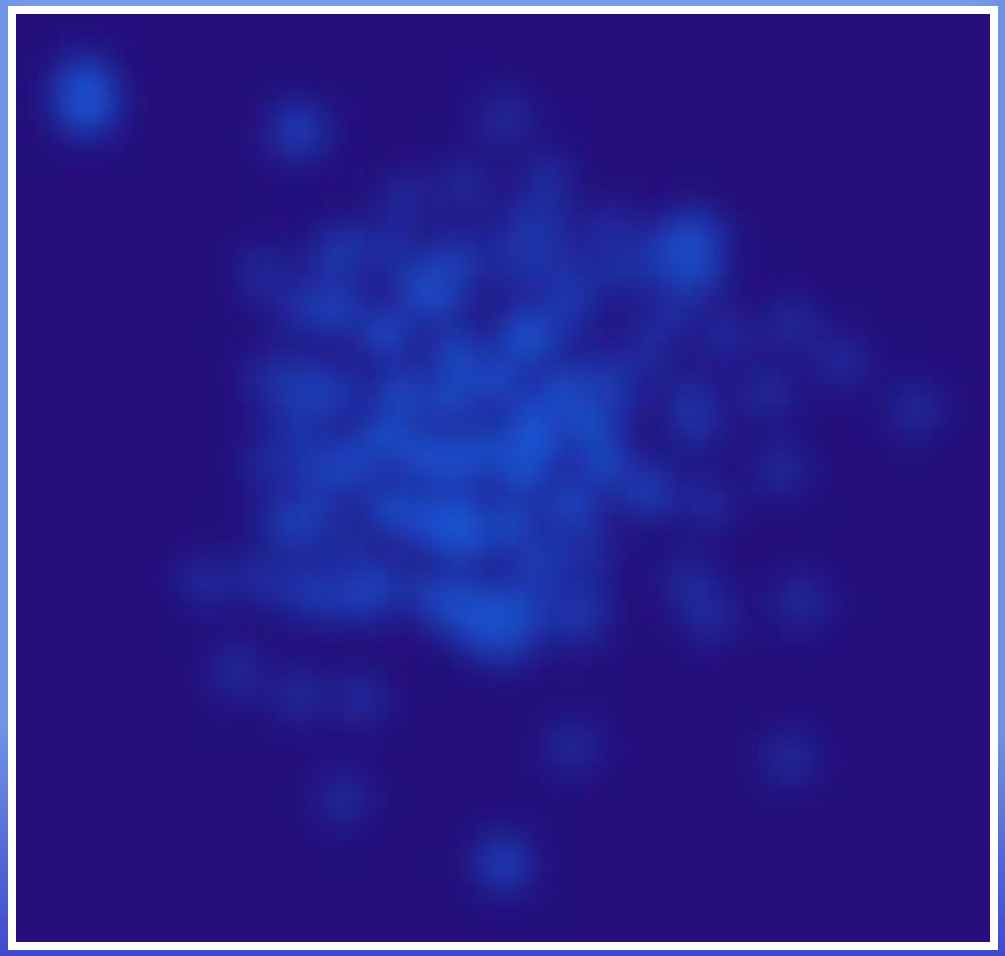
The need for dark skies



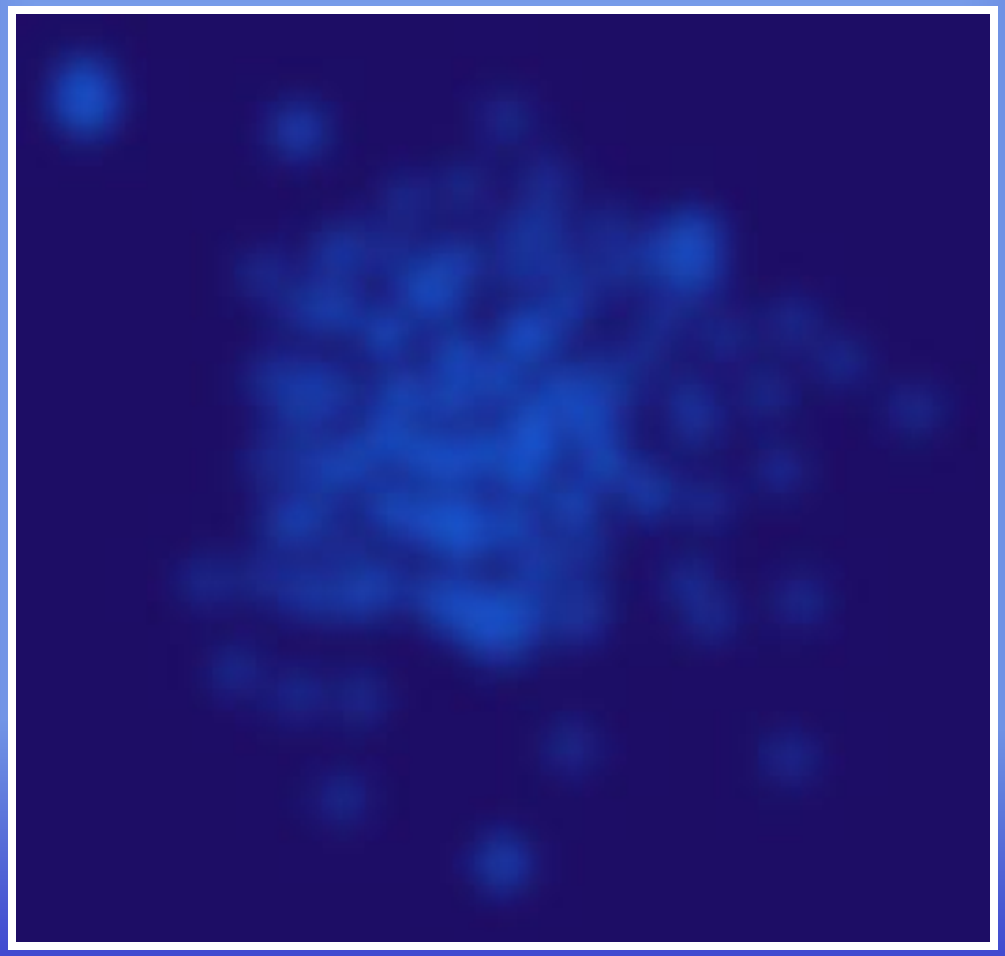
The need for dark skies



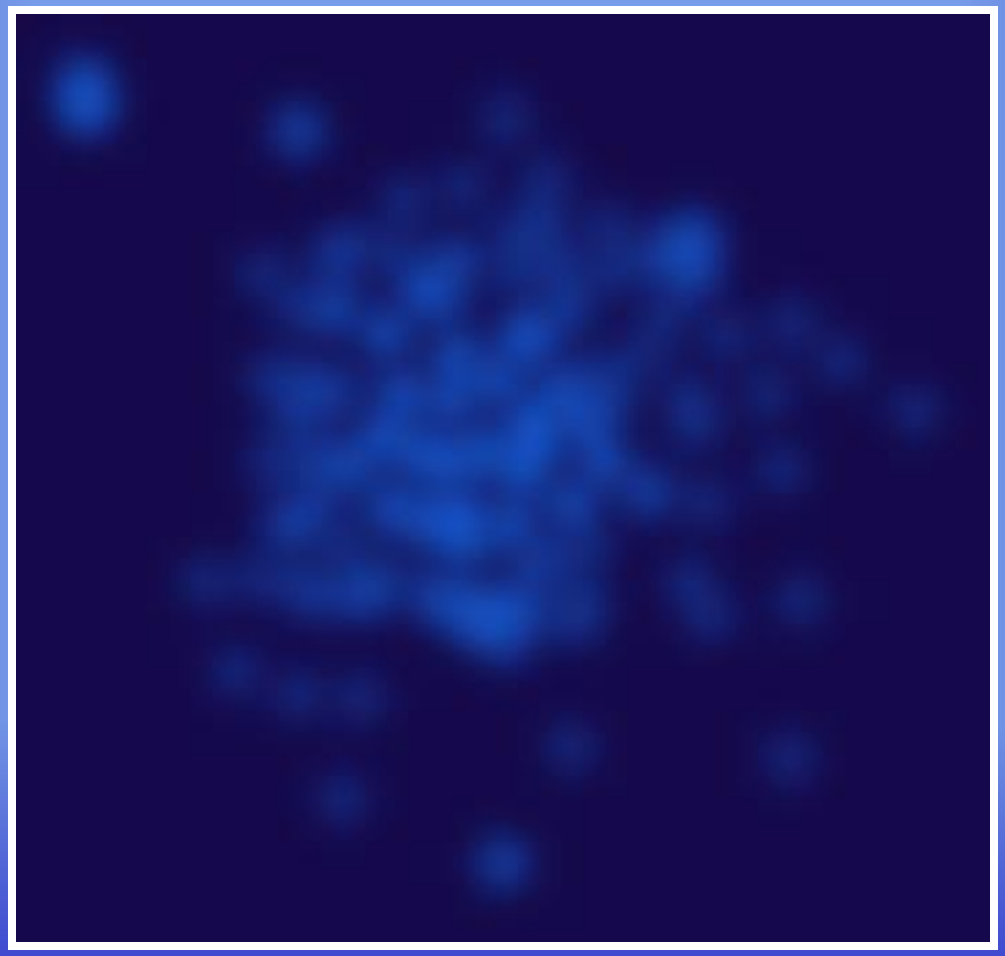
The need for dark skies



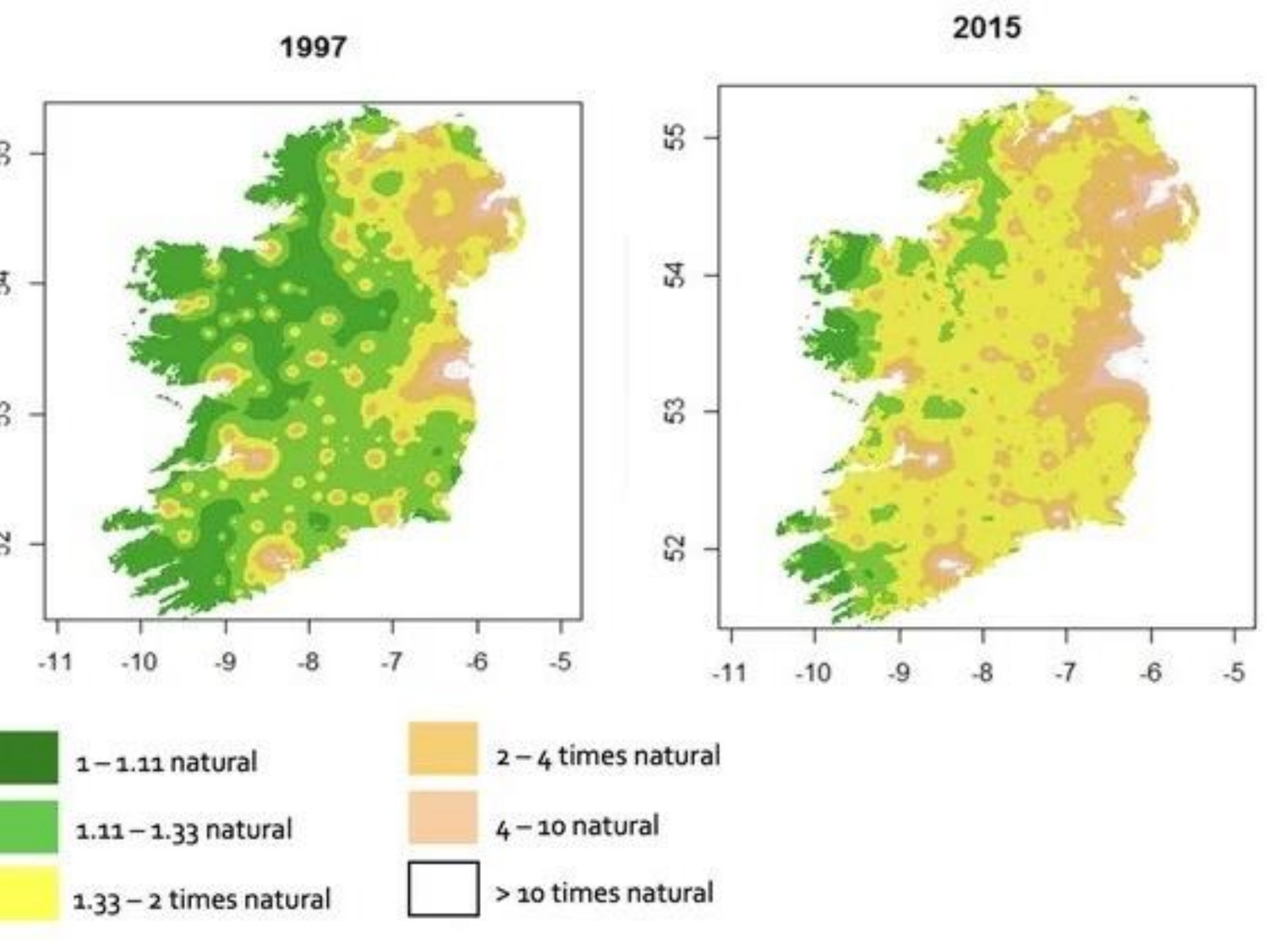
The need for dark skies



The need for dark skies



Light Pollution in Ireland
Circa 1990s


1997
2015
55
54
53
52
-11
-10
-9
-8
-7
-6
-5
1 – 1.11 natural
1.11 – 1.33 natural
1.33 – 2 times natural
2 – 4 times natural
4 – 10 natural
> 10 times natural

The Need for Astrophotography – even in a dark sky region, our eyes can work very well in a passive mode but cannot do the active exposure gathering over the timescales that a camera can do.

Cameras are mechanical, our eyes are not. Moreover we need to do exposure stacking and denoising, balancing to get some of the postcard style images we see.

Cameras to the rescue

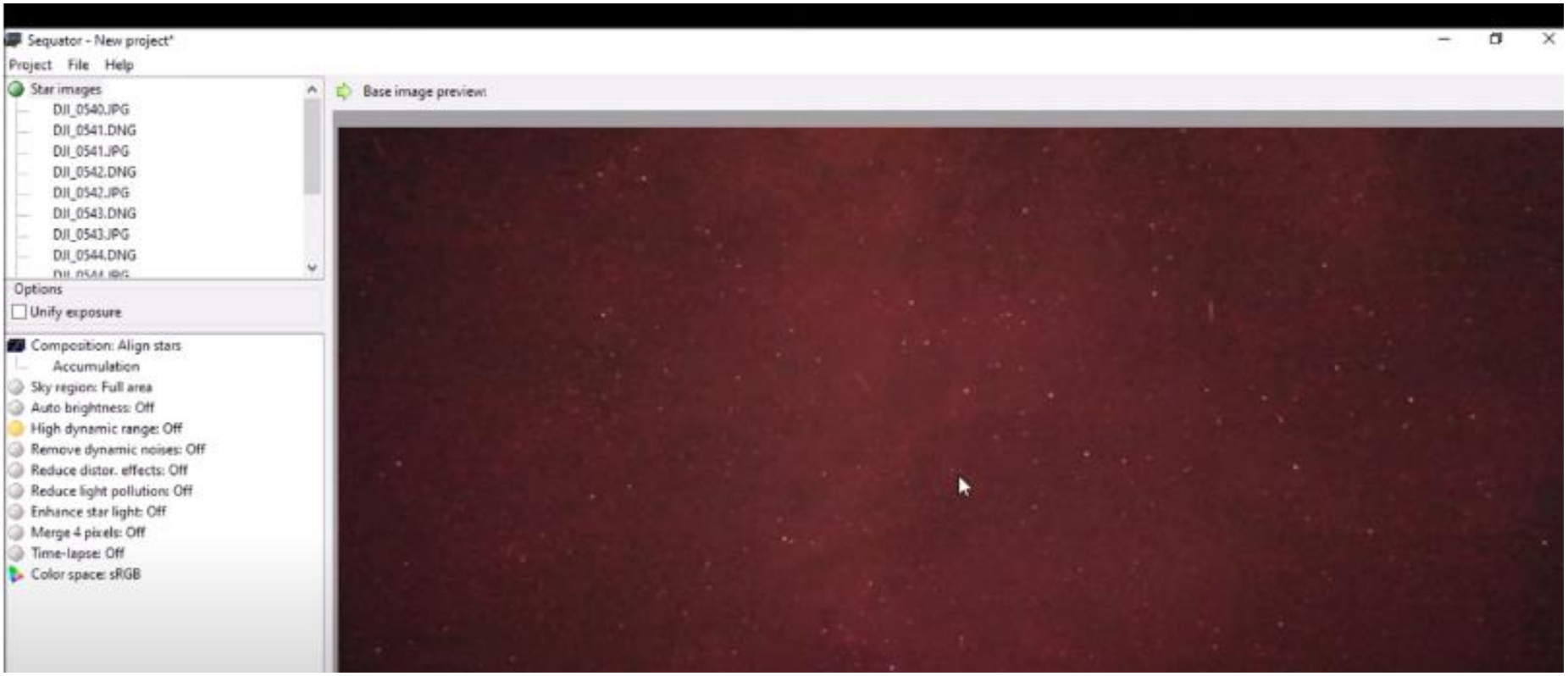
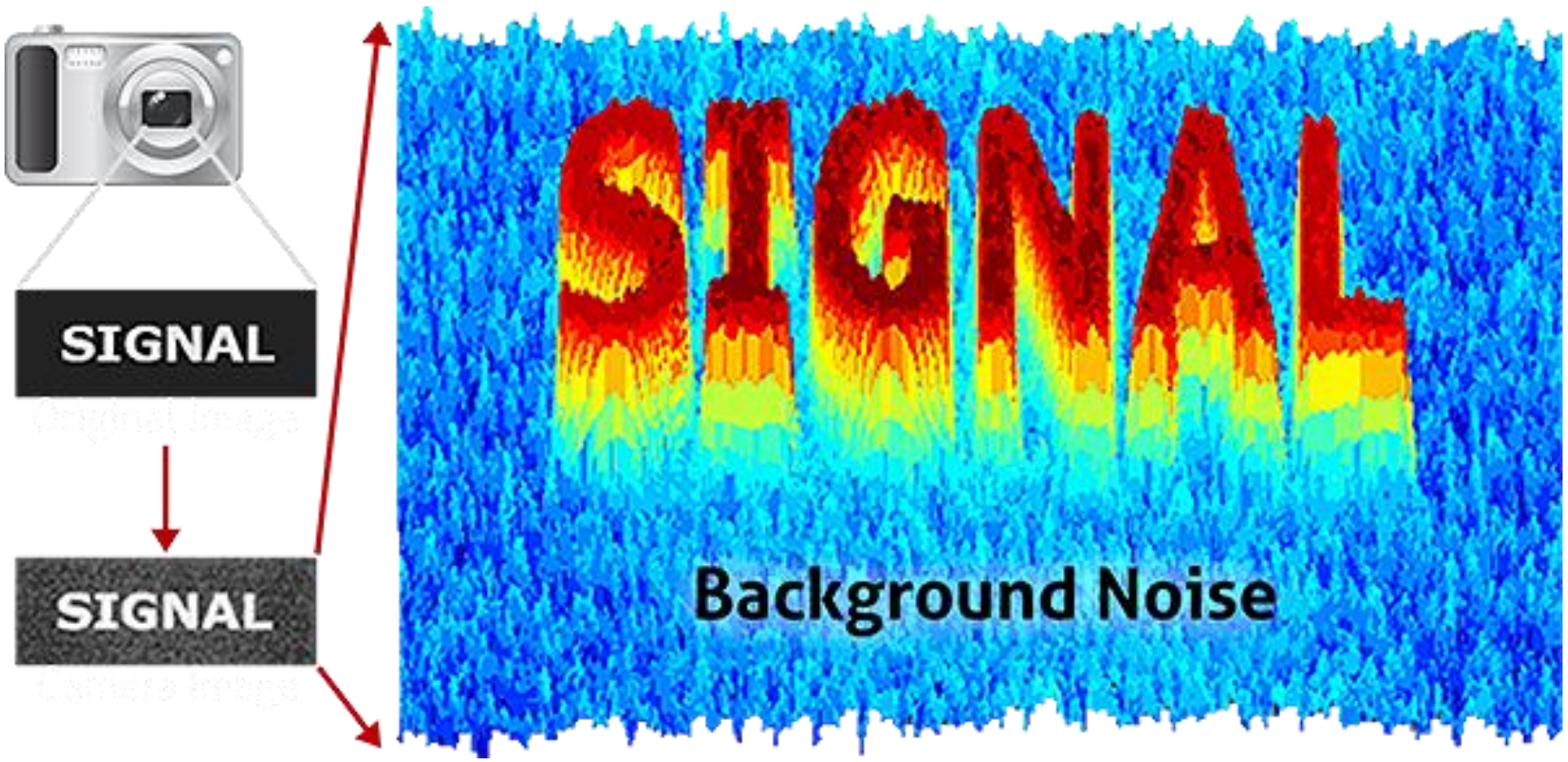


Image stacking increases the number of effective seconds we expose our cameras to light and/or combines different wavelengths to give richer more detailed images (containing more information)


SIGNAL
SIGNAL
SIGNAL
Background Noise

Sequator - New project*

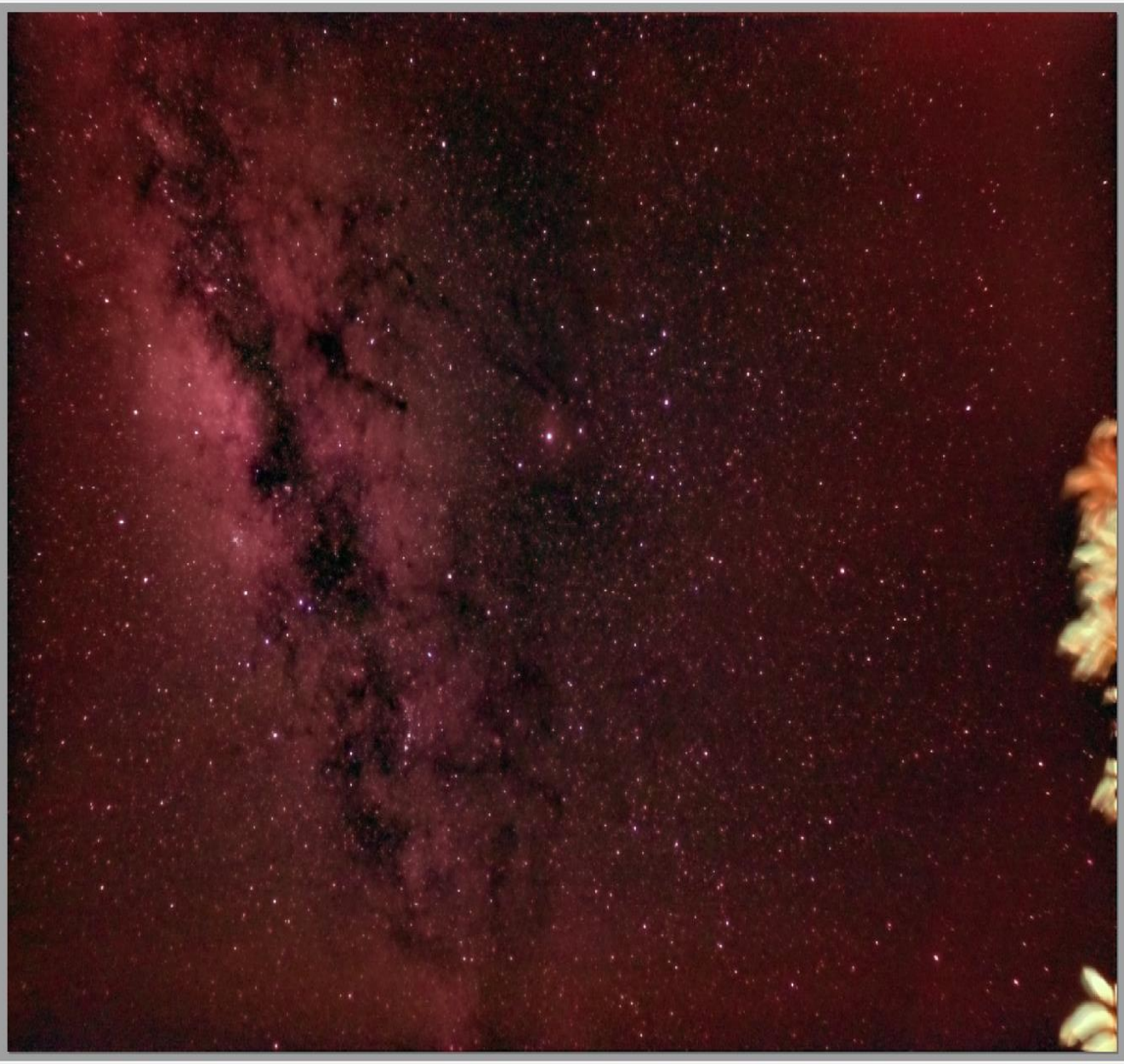
Project File Help

- Star images
  - 28 files
- Base image
  - (DJI_0226.JPG)
- Noise images
- Vignetting images
- Output
  - GCV2V5.tif

- Composition: Align stars
  - Accumulation
- Sky region: Full area
- Auto brightness: On
- High dynamic range: On
- Remove dynamic noises: Off
- Reduce distor. effects: Off
- Reduce light pollution: Uneven
- Enhance star light: On
- Merge 4 pixels: On
- Time-lapse: Off
- Color space: sRGB

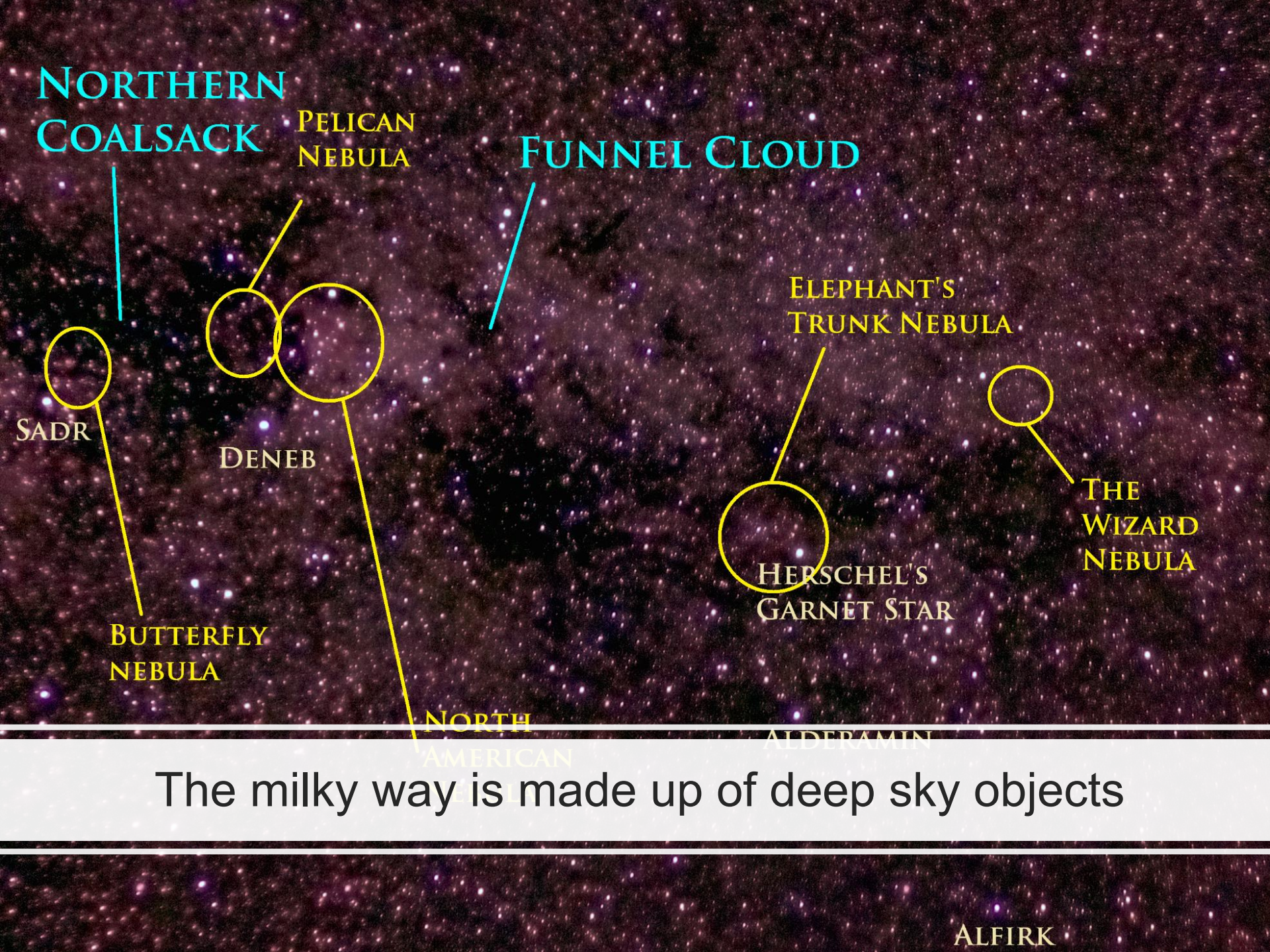
Start

Result: C:\Users\ektop\Desktop\La Palma and Tenerife\Galactic Center V2\GCV2V5.tif Open



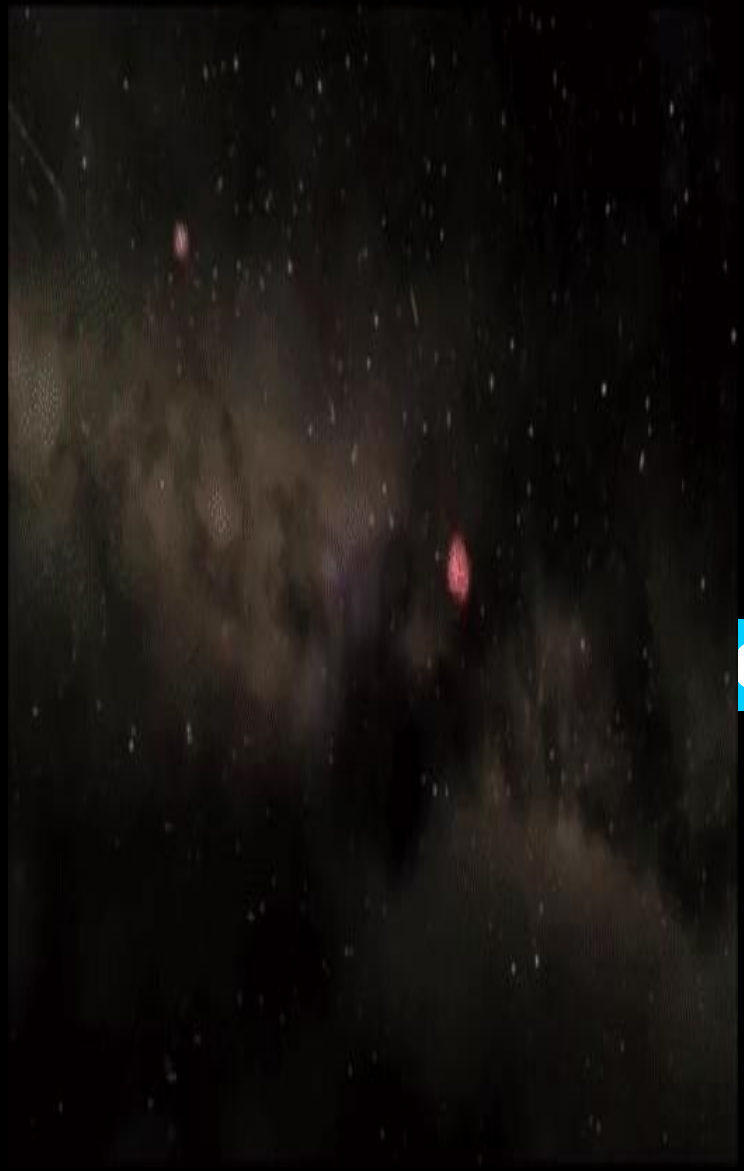
High dynamic range but maybe darker, lower saturation and lower constrast. Useful for post-processing

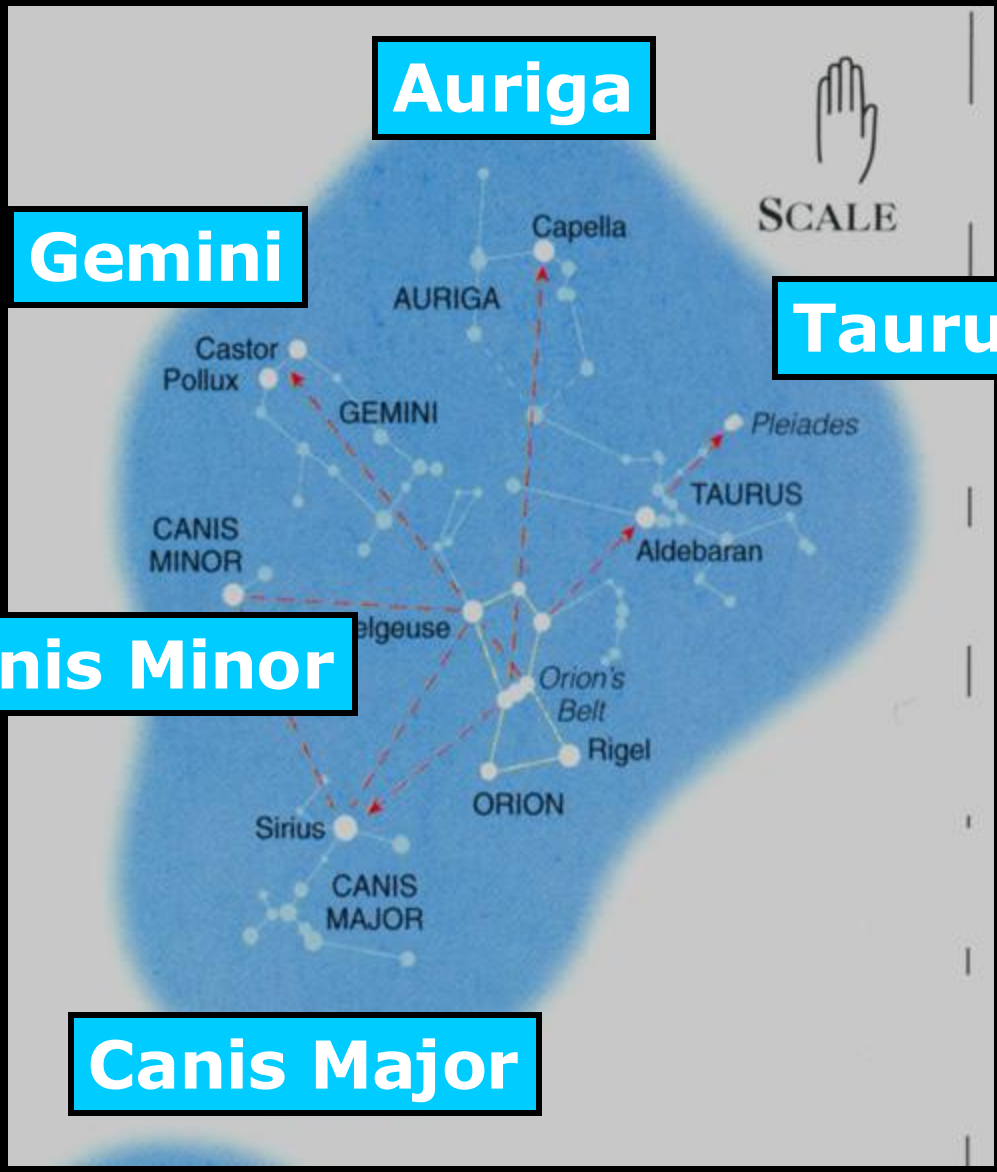
Our Galaxy



The milky way is made up of deep sky objects

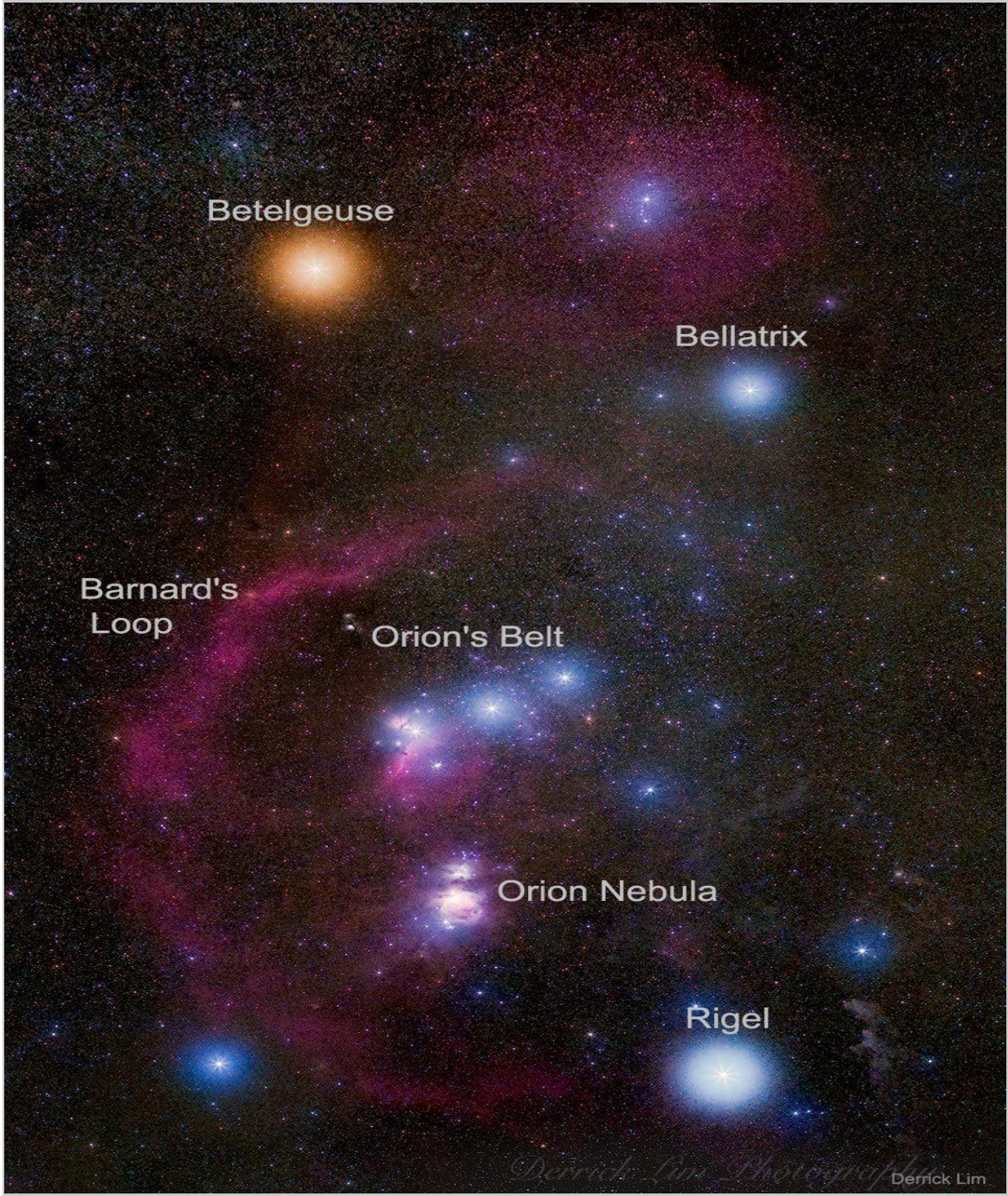
Orion as a perfect stellar signpost



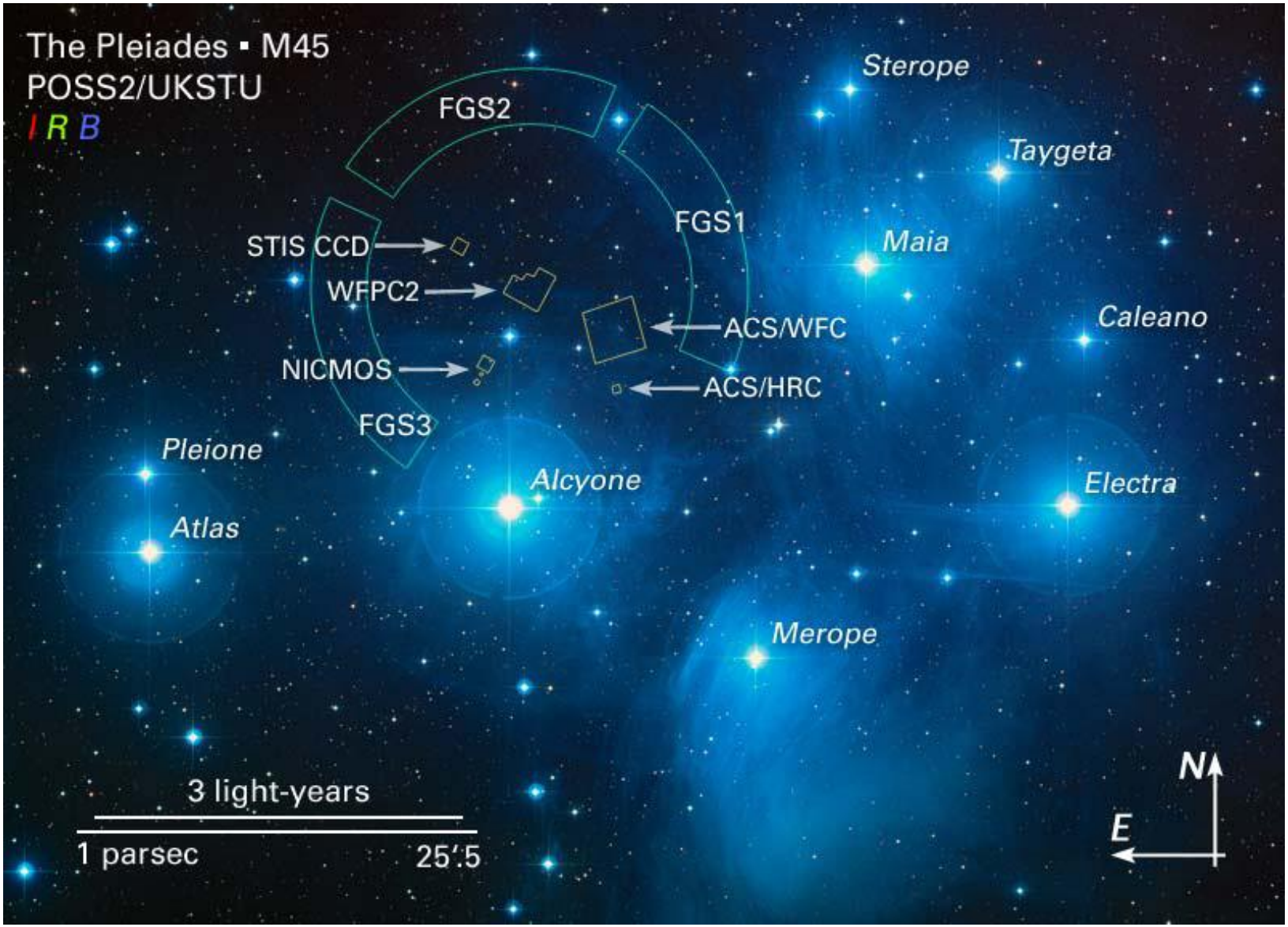


The Orion Nebula

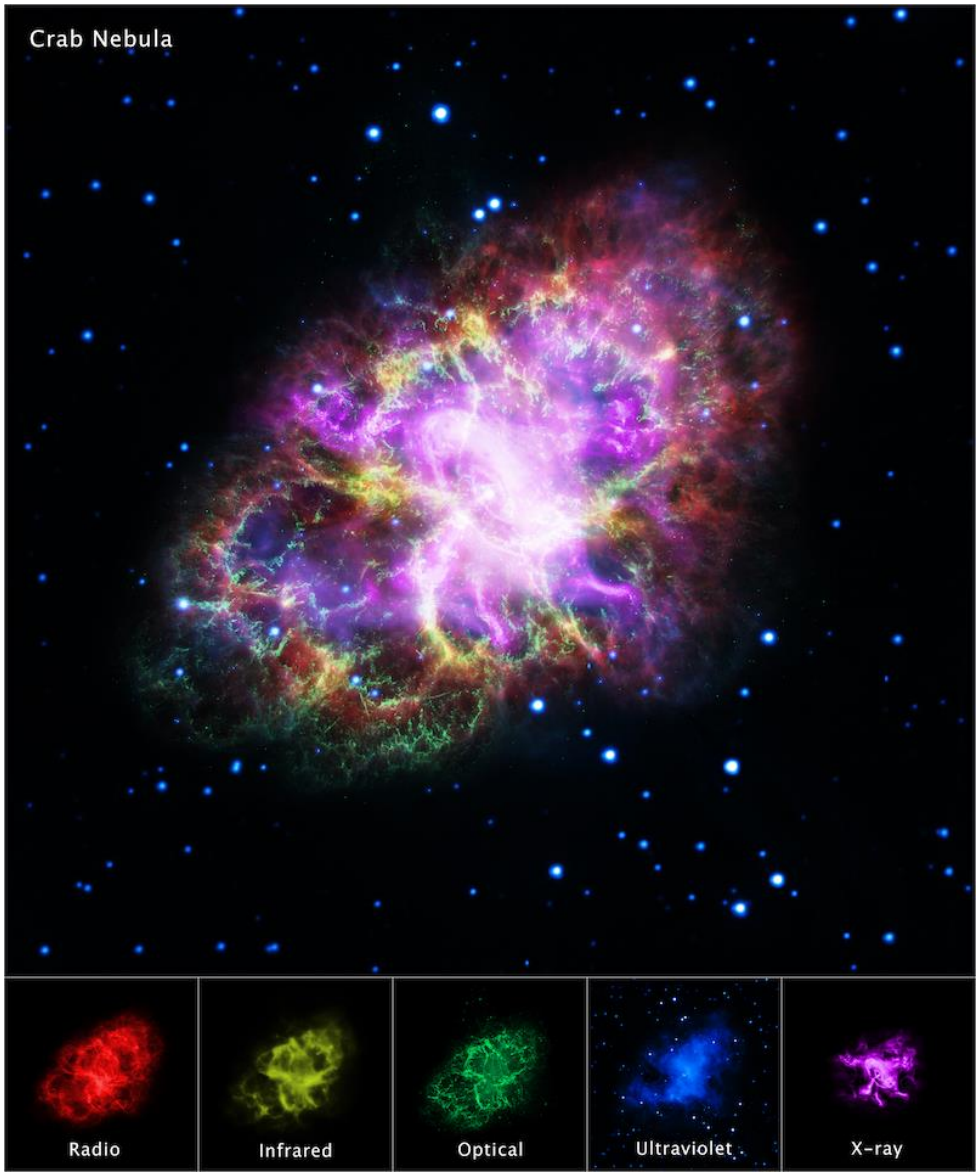
- Long exposure photography reveals the true extent of the Orion Molecular Cloud Complex



Pleiades in Taurus


The Pleiades ▪ M45
POSS2/UKSTU
I R B
FGS2
FGS1
FGS3
STIS CCD
WFPC2
NICMOS
ACS/WFC
ACS/HRC
Sterope
Taygeta
Maia
Caleano
Pleione
Atlas
Alcyone
Electra
Merope
3 light-years
1 parsec
25′.5
N
E

The crab nebula

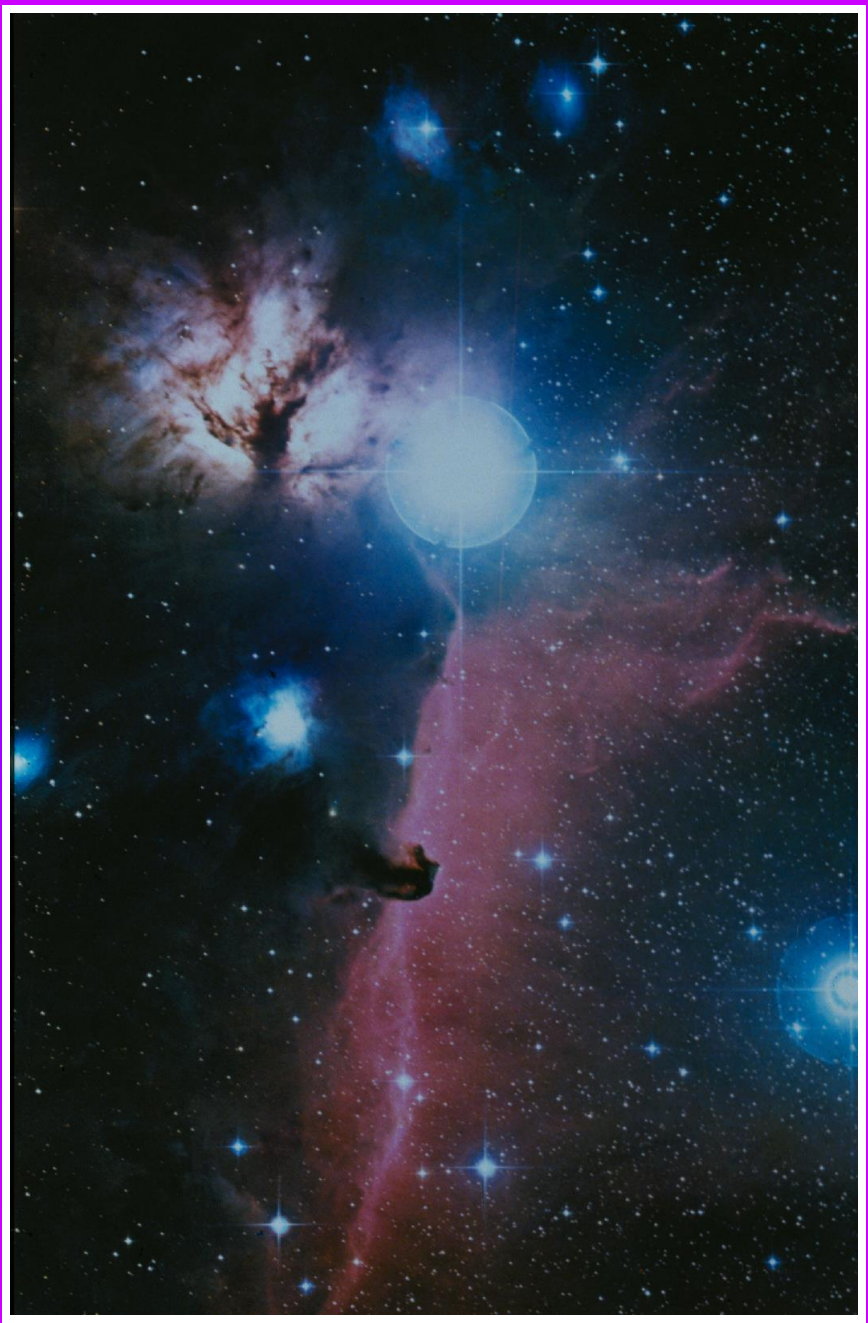



Crab Nebula
ζ Tau

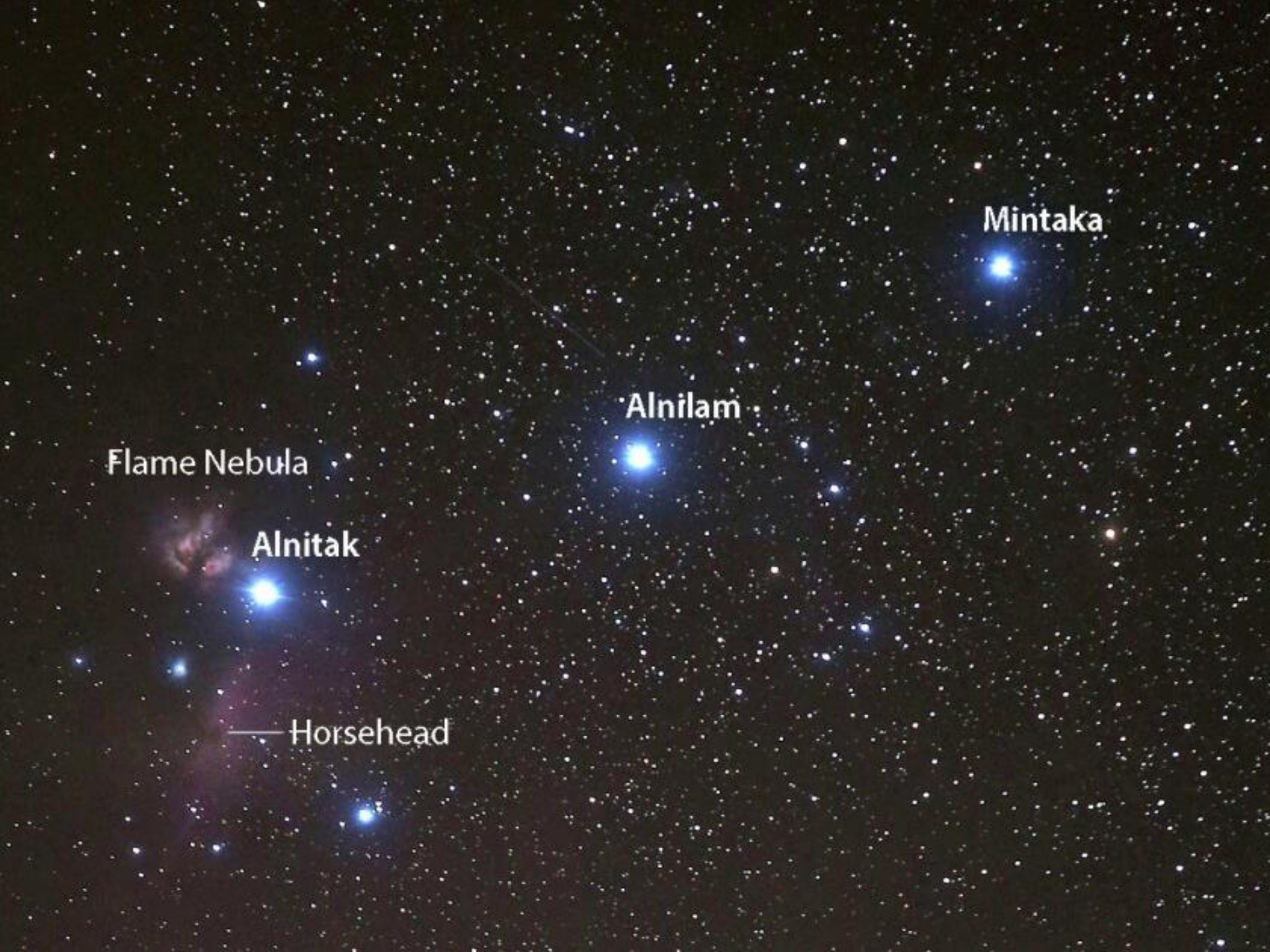

Taurus
Aldebaran
Crab Nebula (M1)
Orion
Betelgeuse

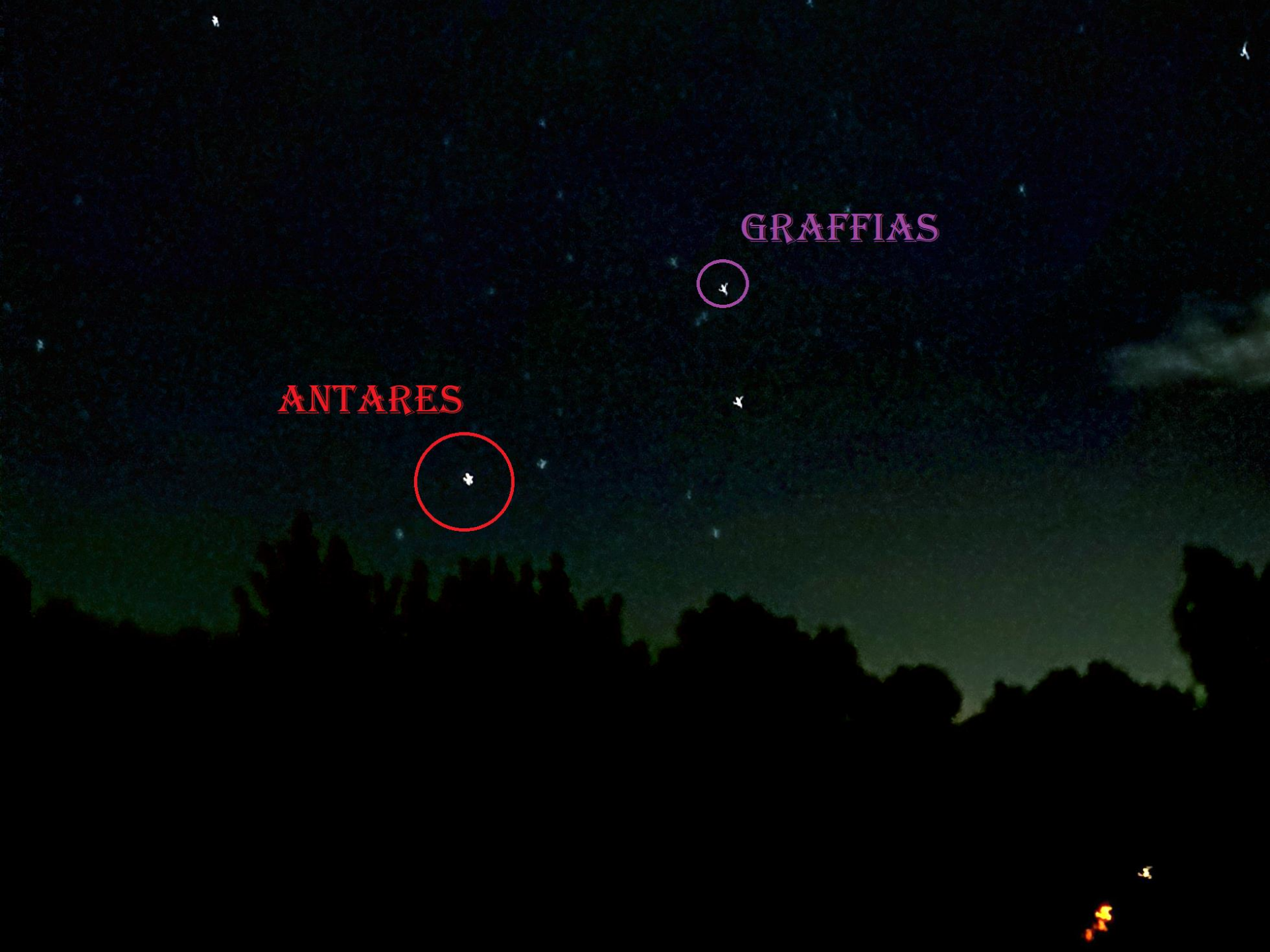
Absorption Nebula

The Horsehead Nebula



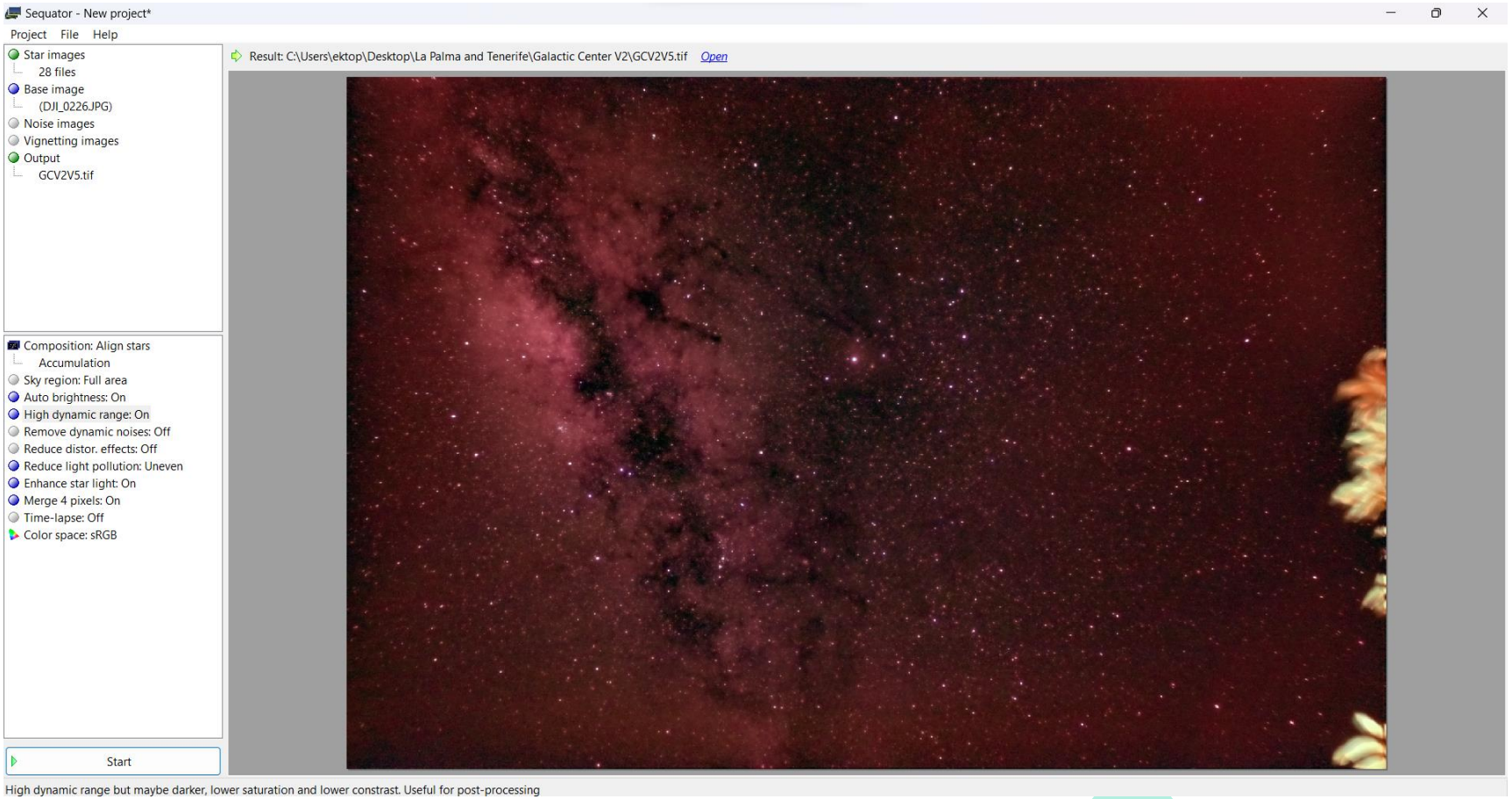

ζ Gem
λ Ori
α Ori
γ Ori
π3 Ori
π4 Ori
π5 Ori
δ Ori
σ Ori
B033 (Horsehead Nebula) - Dark Nebula
ν Eri
β Eri
ι Ori
γ Mon
β Mon
τ Ori
β Ori
κ Ori
η Lep
ζ Lep
53 Eri
μ Lep
α CMa
α Lep

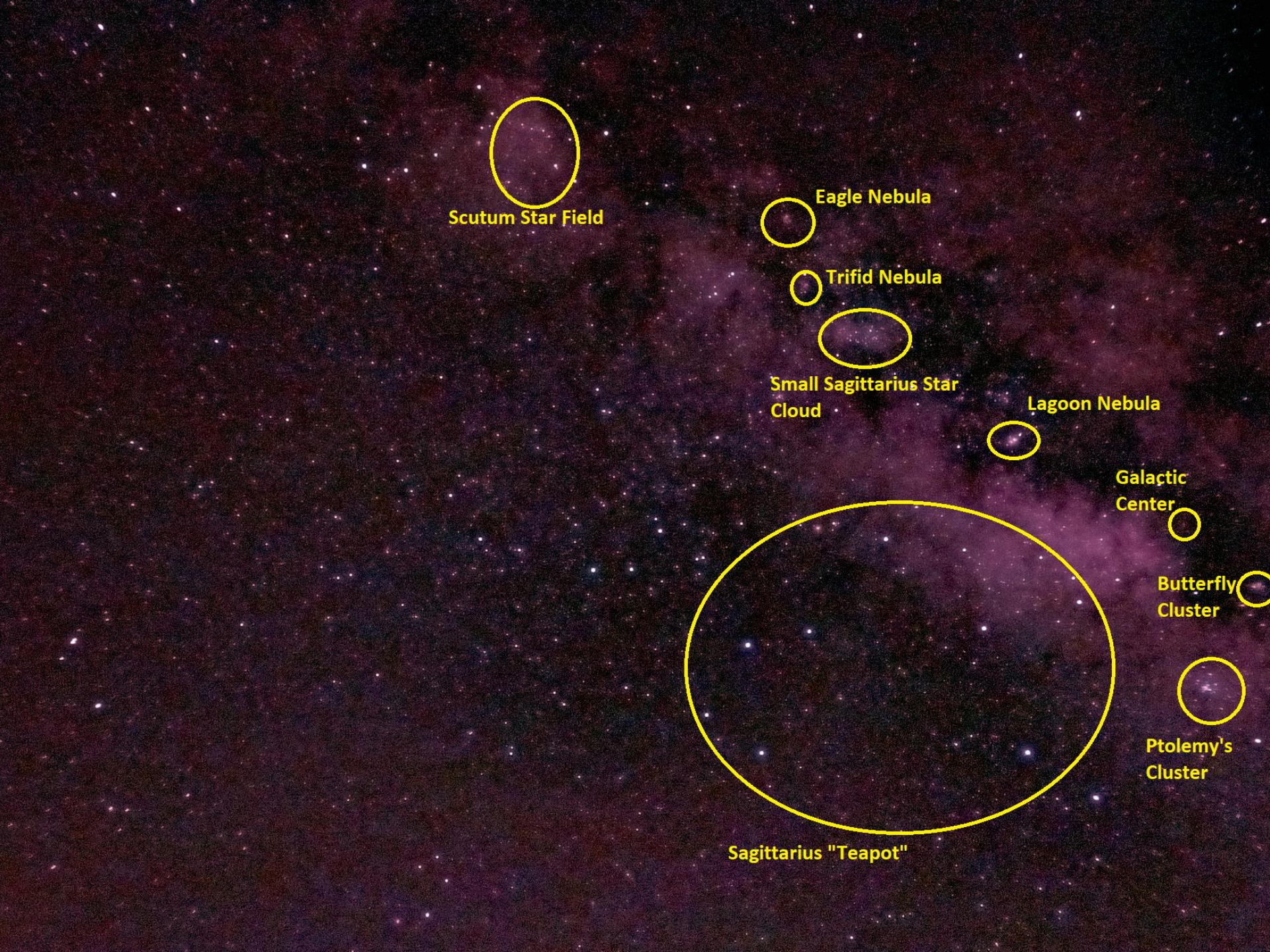

Mintaka
Alnilam
Flame Nebula
Alnitak
Horsehead


GRAFFIAS
ANTARES


M20 Trifid Nebula
M8 Lagoon Nebula
The Teapot
AstroBack

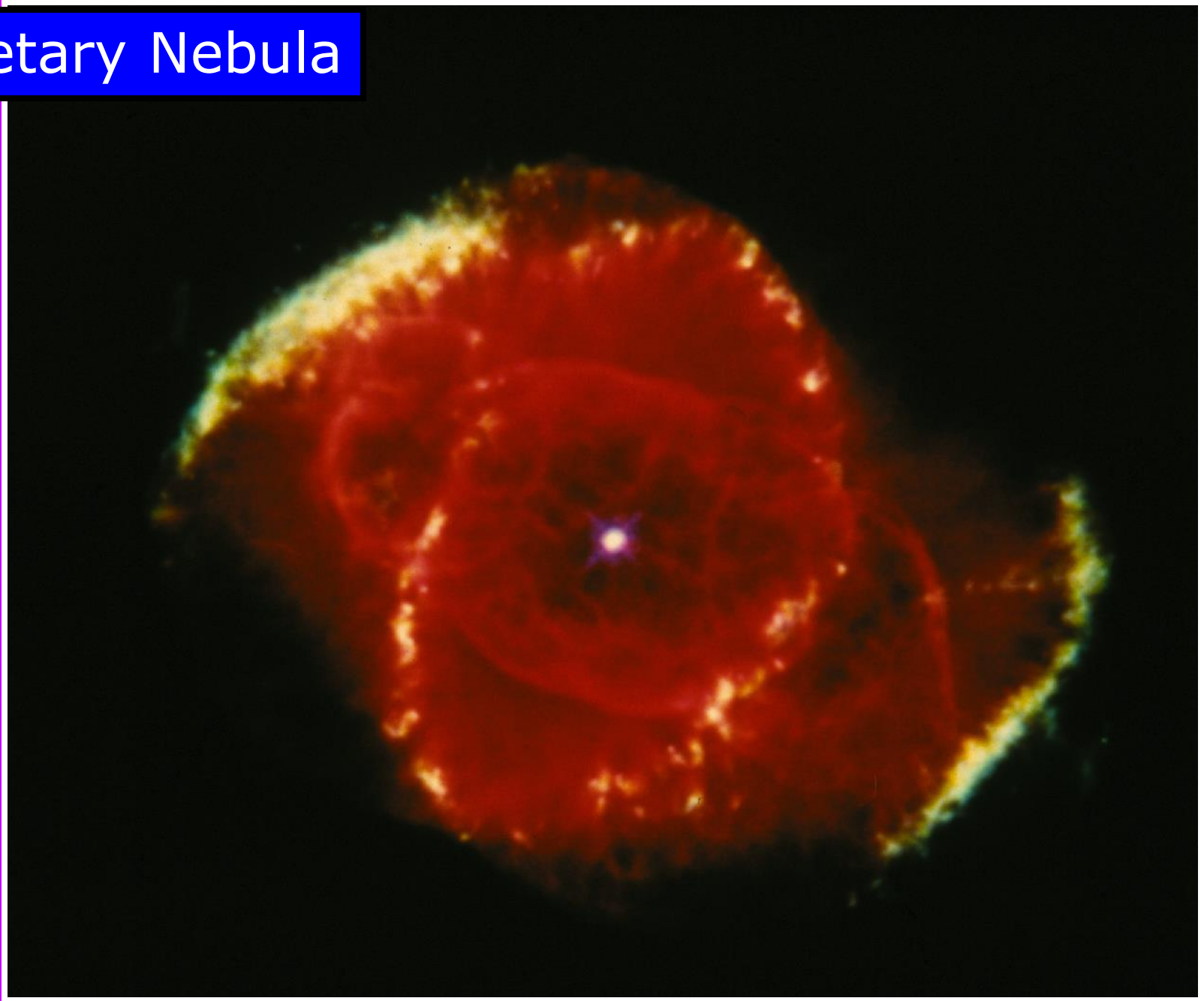
Images Taken in La Palma (Canary Islands) and stacked using Sequator




Scutum Star Field
Eagle Nebula
Trifid Nebula
Small Sagittarius Star Cloud
Lagoon Nebula
Galactic Center
Butterfly Cluster
Ptolemy's Cluster
Sagittarius "Teapot"

Triffid Nebula

Planetary Nebula



Supernova Remnants

Comets

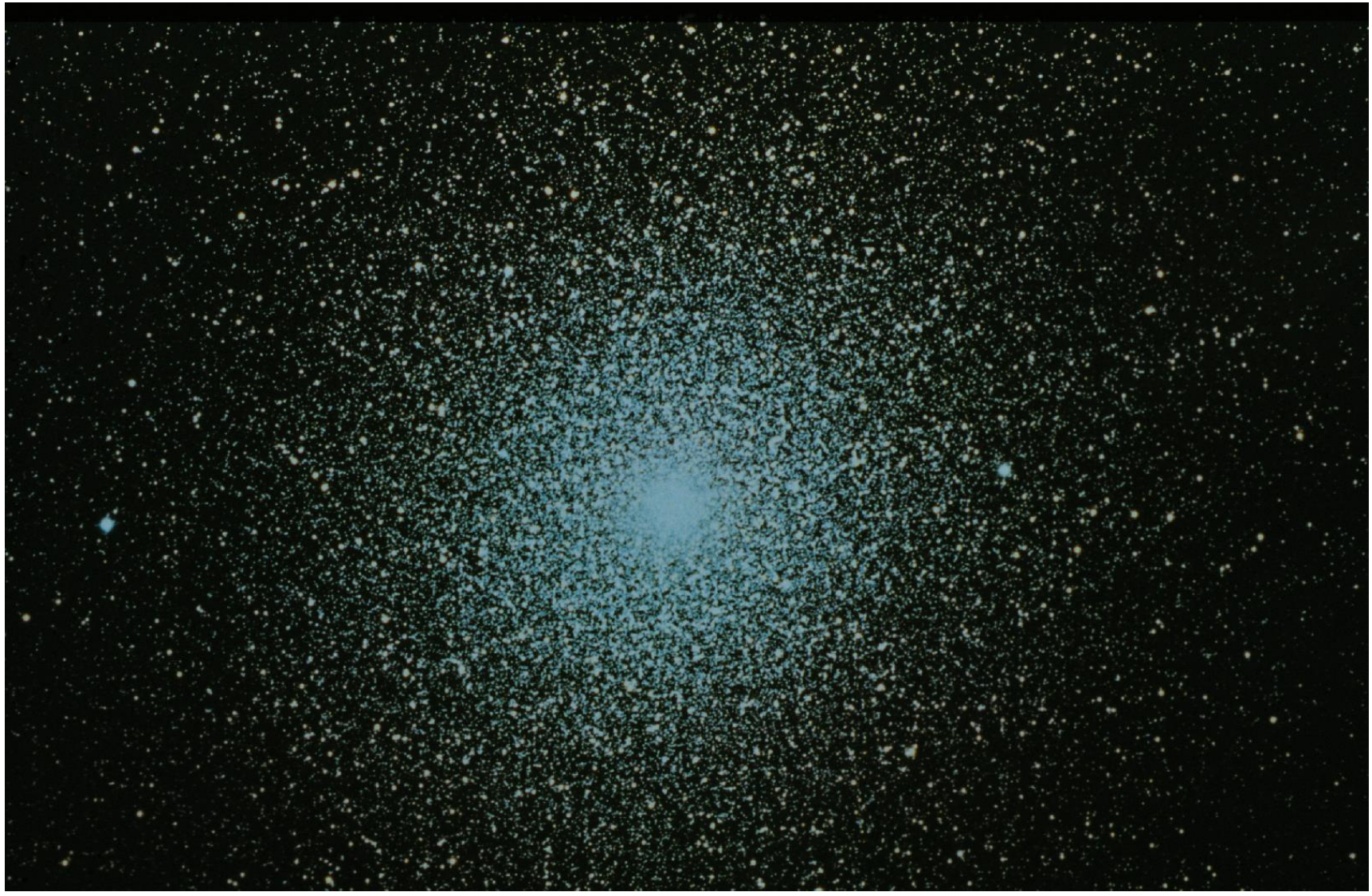
Open Clusters


Hyades
Pleiades


Aldebaran
Hyades
Orion
Orion's Belt

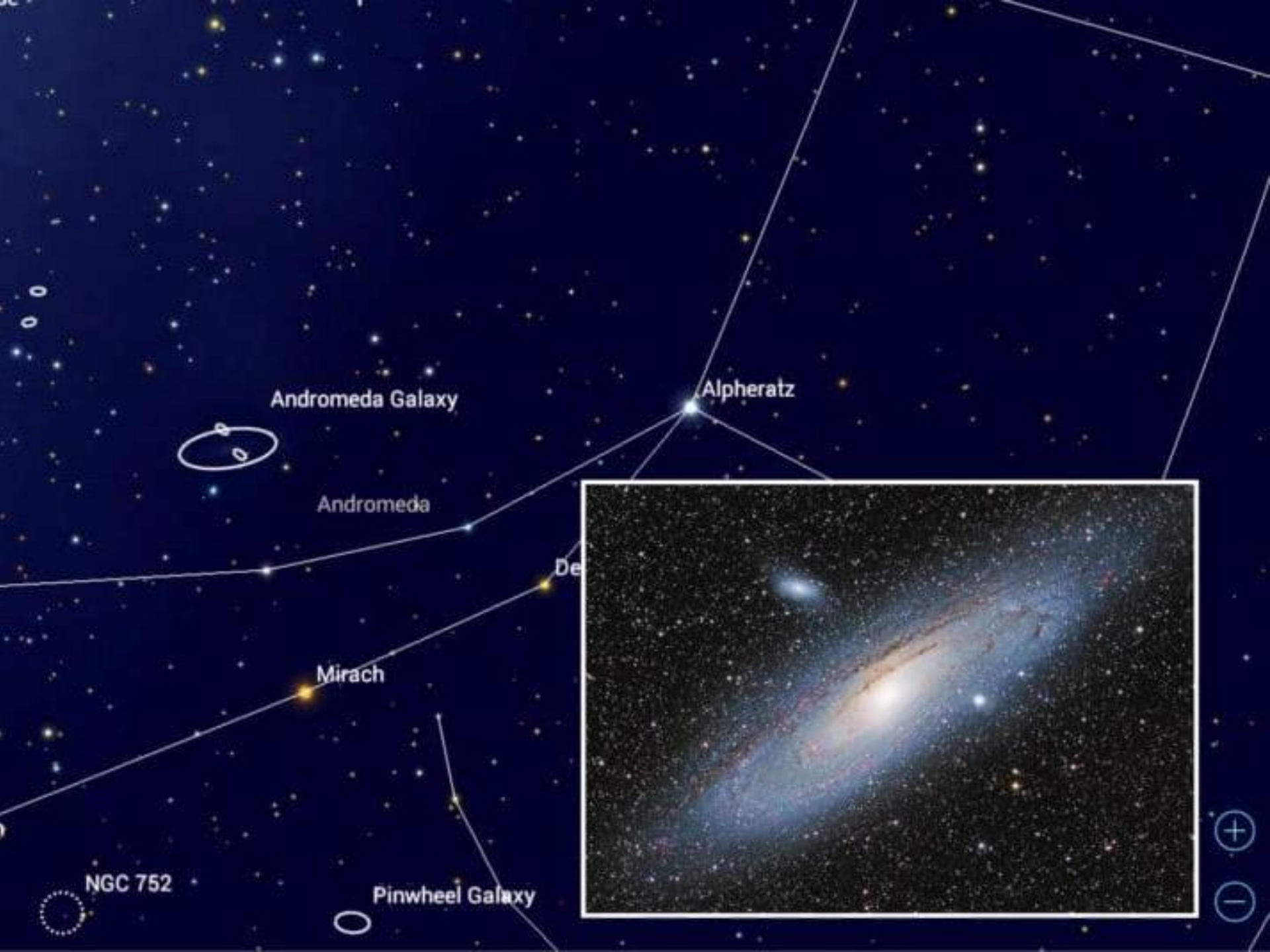
The ‘Jewel Box’

Globular Clusters

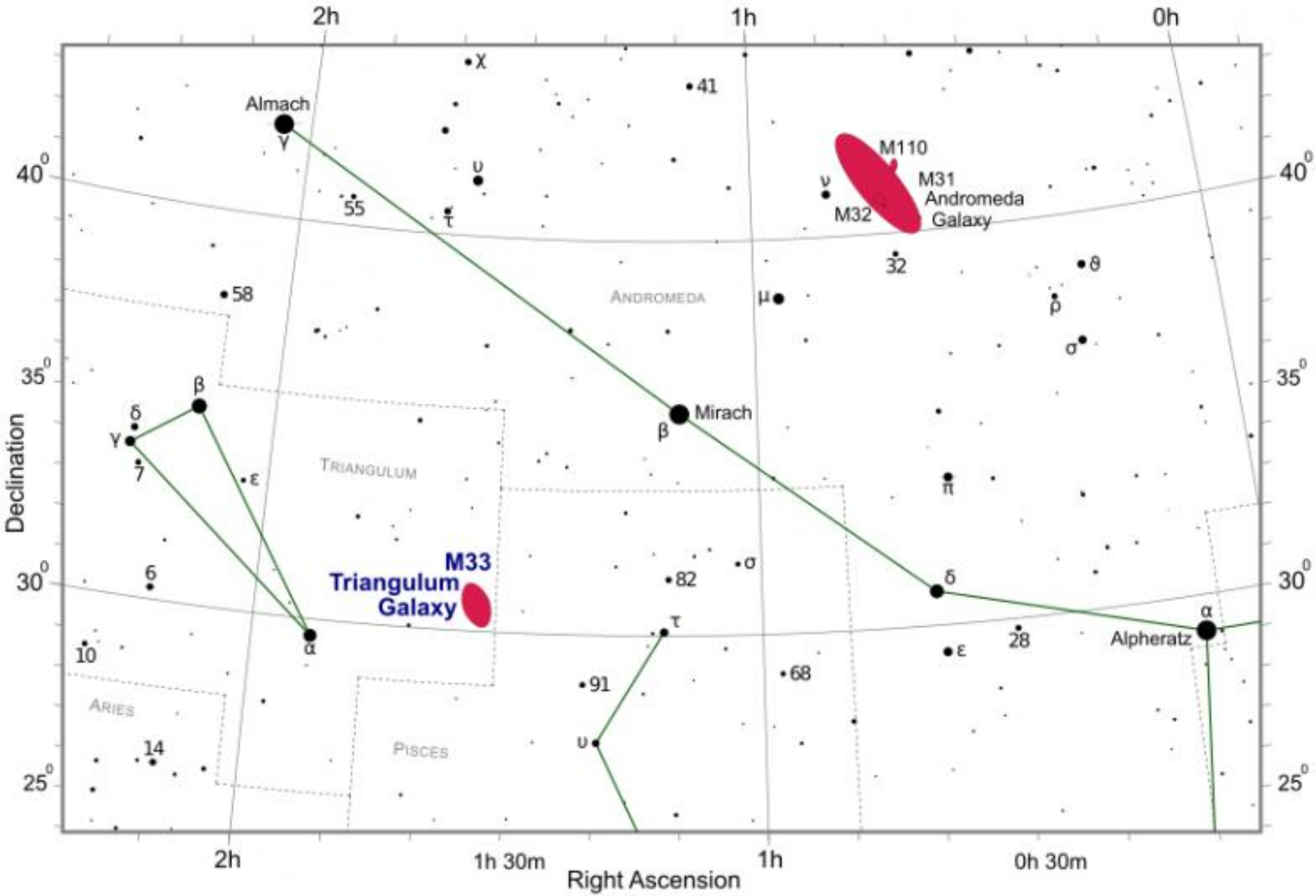


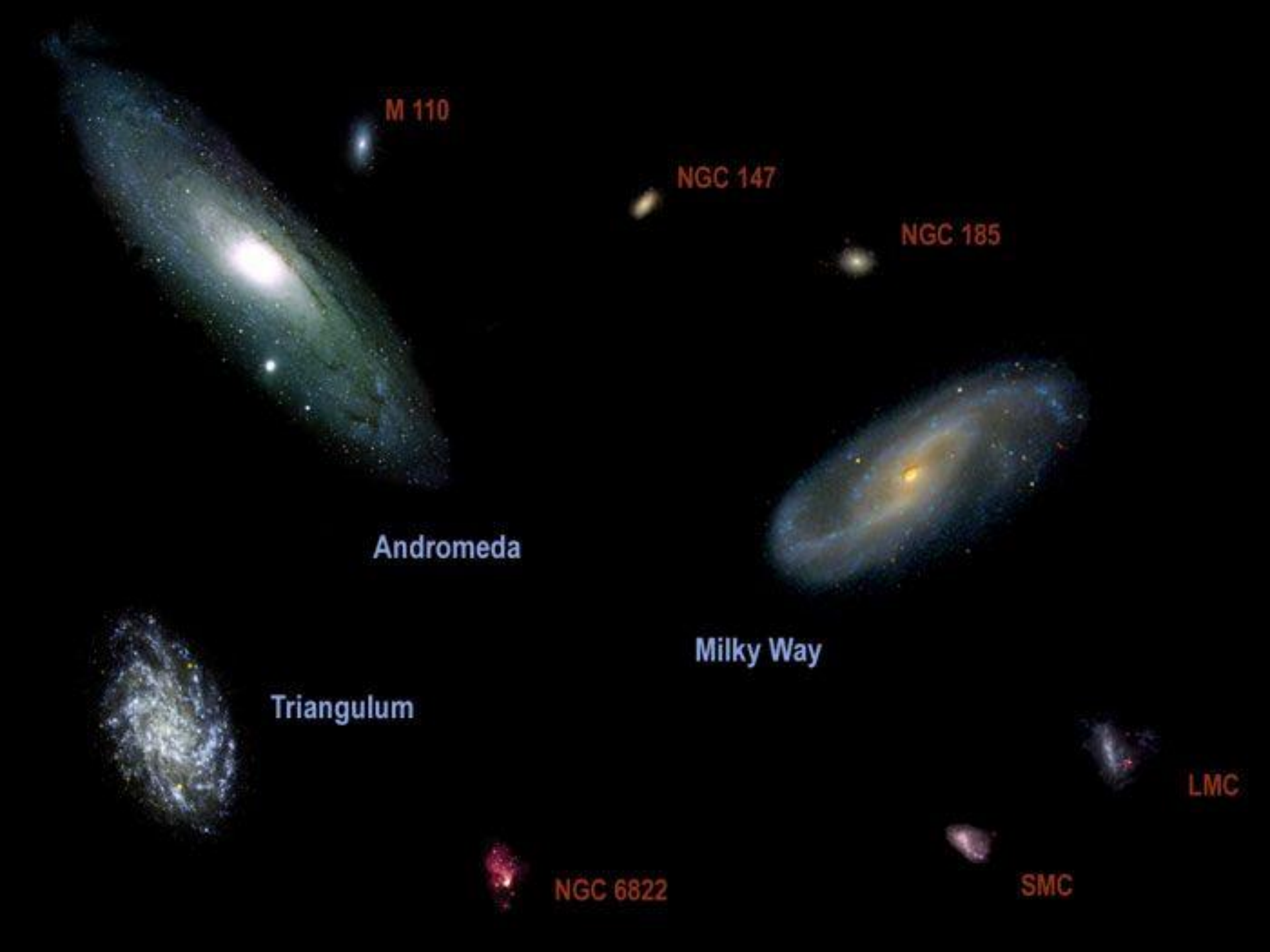

M16 Eagle Nebula
M17 Omega Nebula
NGC 6716 Open Cluster
M23 Open Cluster
M25 Open Cluster
M24 Sagittarius Star Cloud
M20 Trifid Nebula
M22 Globular Cluster
M28 Globular Cluster
M8 Laguna Nebula
Centre of the Milky Way

Spiral Galaxies

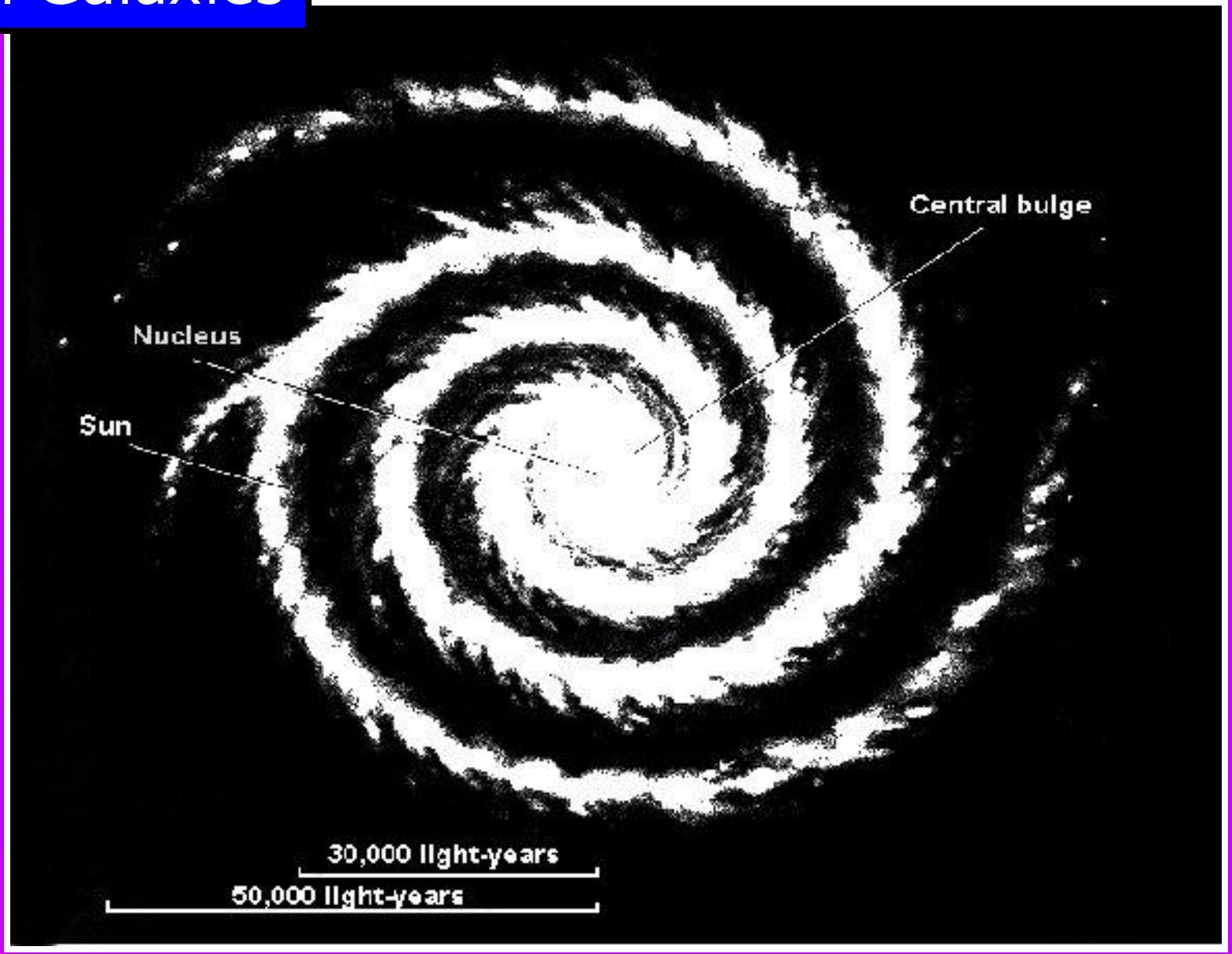

Andromeda Galaxy
Alpheratz
Andromeda
Mirach
NGC 752
Pinwheel Galaxy

Messier 33 - M33 - Triangulum Galaxy




M 110
NGC 147
NGC 185
Andromeda
Milky Way
Triangulum
LMC
NGC 6822
SMC

Spiral Galaxies

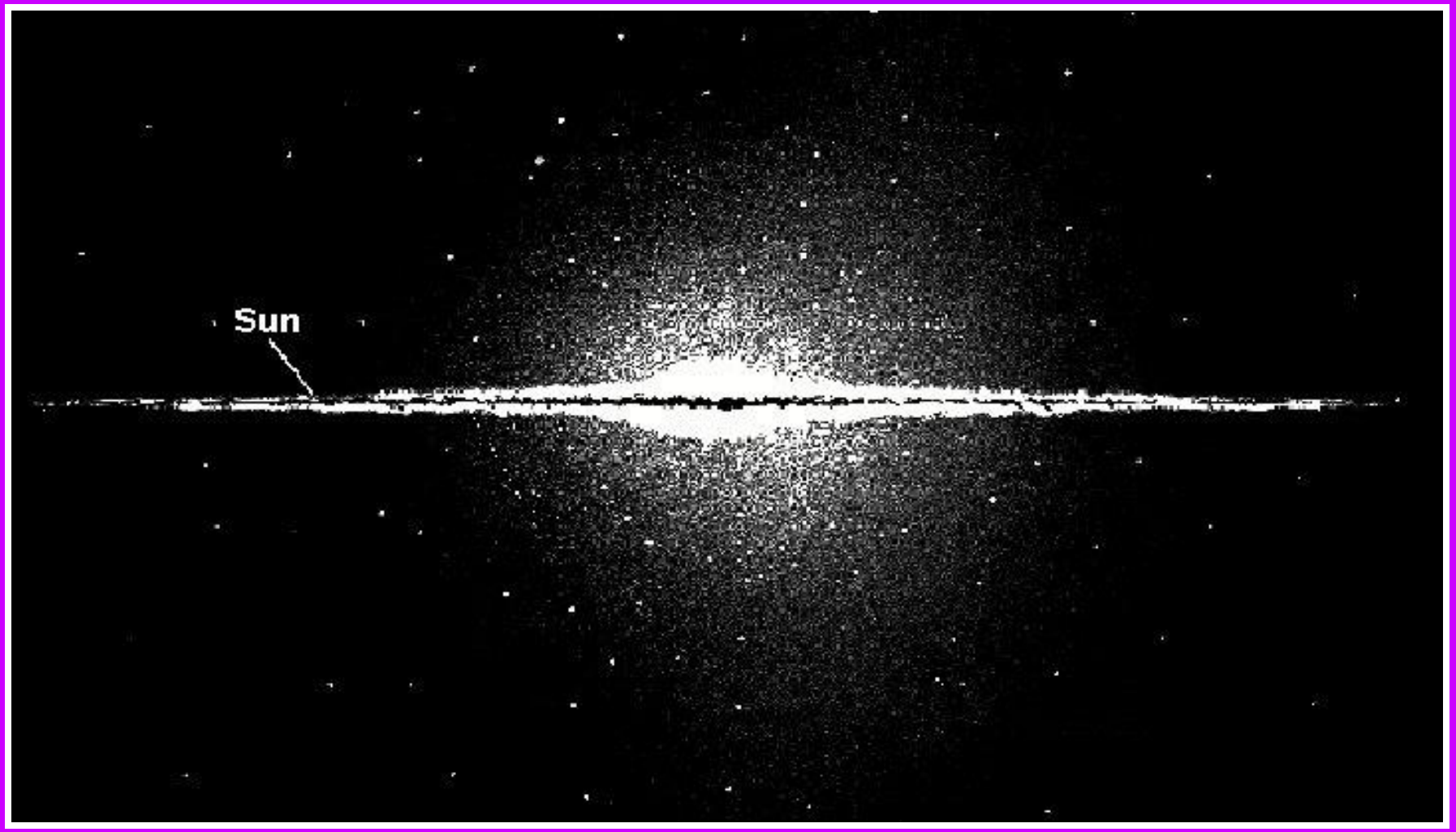


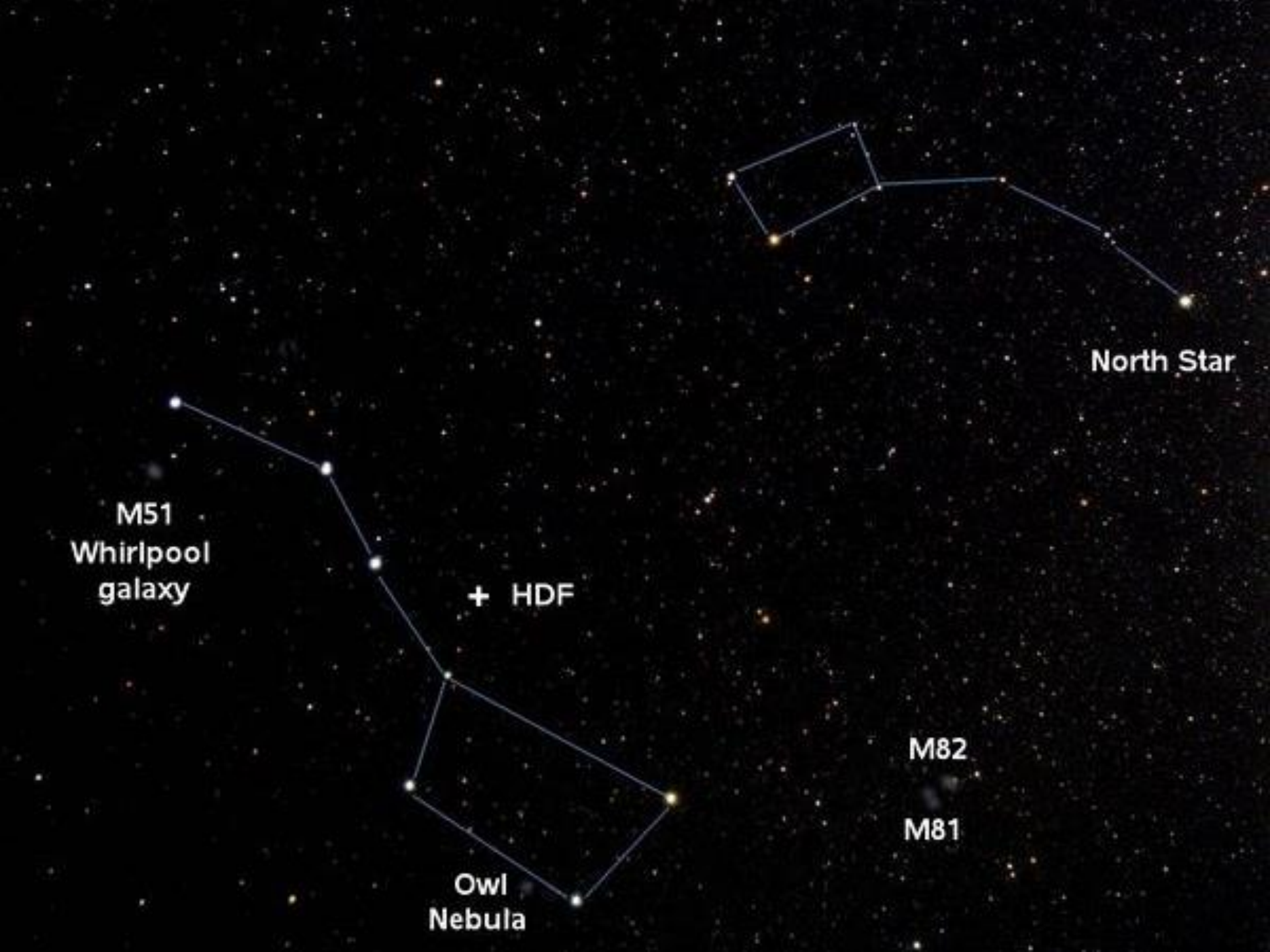
- Star Populations within Galaxies

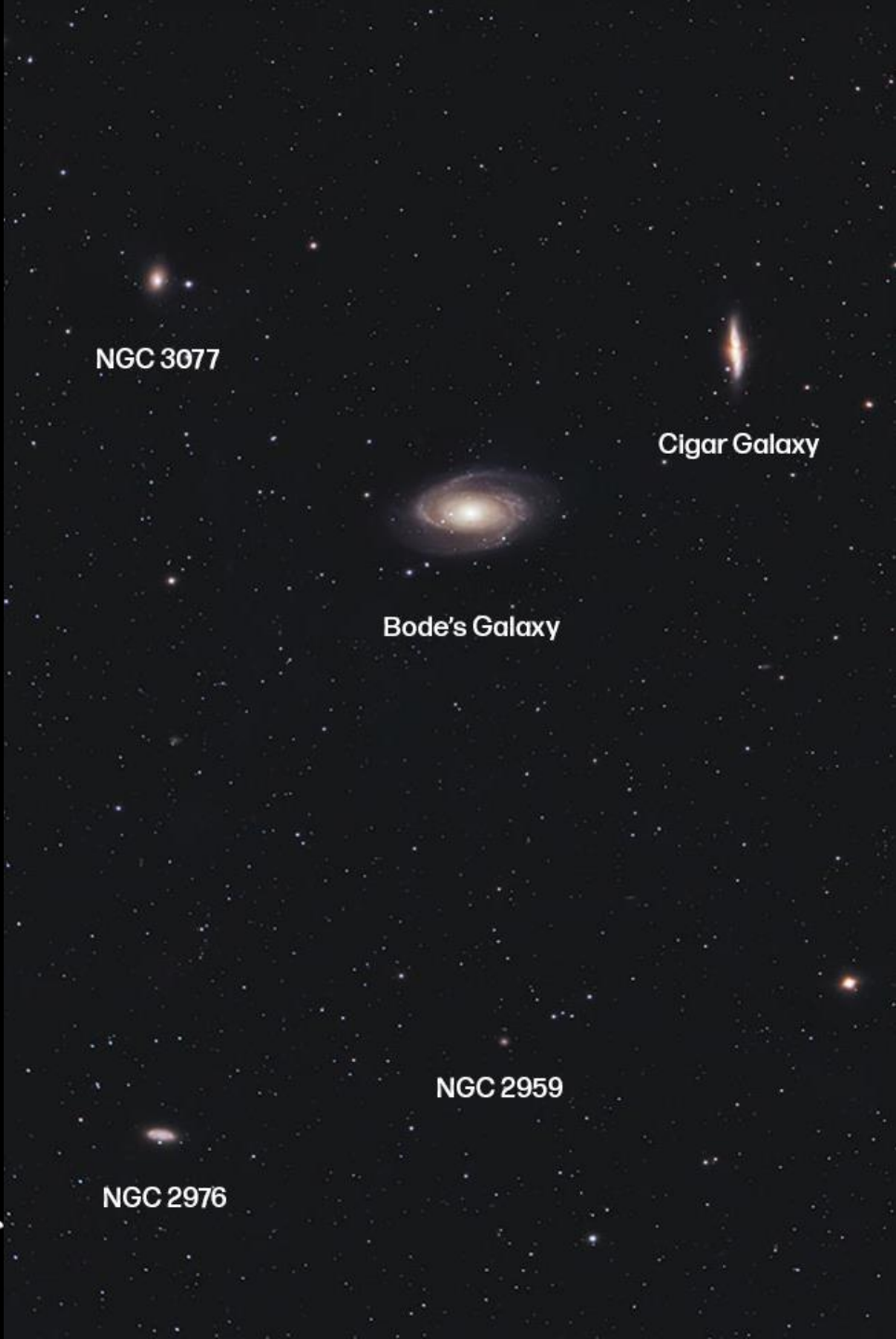
- Population 2 stars - 2nd & 3rd generation stars, enriched in metals. Found near the edge of a galaxy's spiral arms.

- Population 1 stars - formed from primordial
- galactic material, as old as the galaxy itself.(hydrogen and helium (some Lithium) from post Big Bang nucleosynthesis) - typically found within the spiral arms

Spiral Galaxies



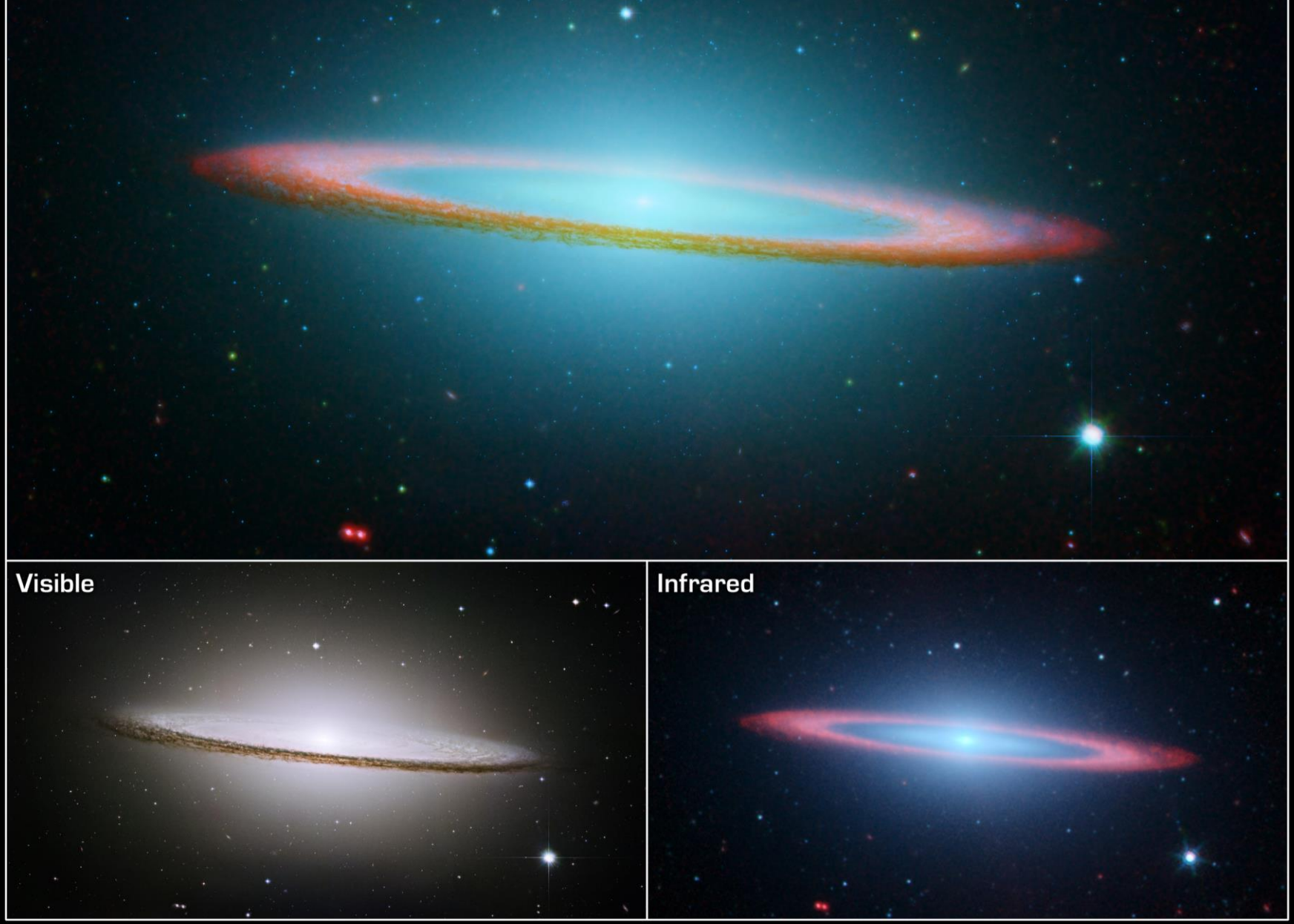

North Star
M51
Whirlpool
galaxy
+ HDF
M82
M81
Owl
Nebula


NGC 3077
Cigar Galaxy
Bode's Galaxy
NGC 2959
NGC 2976

Barred Spiral Galaxies

Giant Elliptical Galaxies


Regulus
Virgo
Spica
M104
Corvus
S
May at 10:00 pm



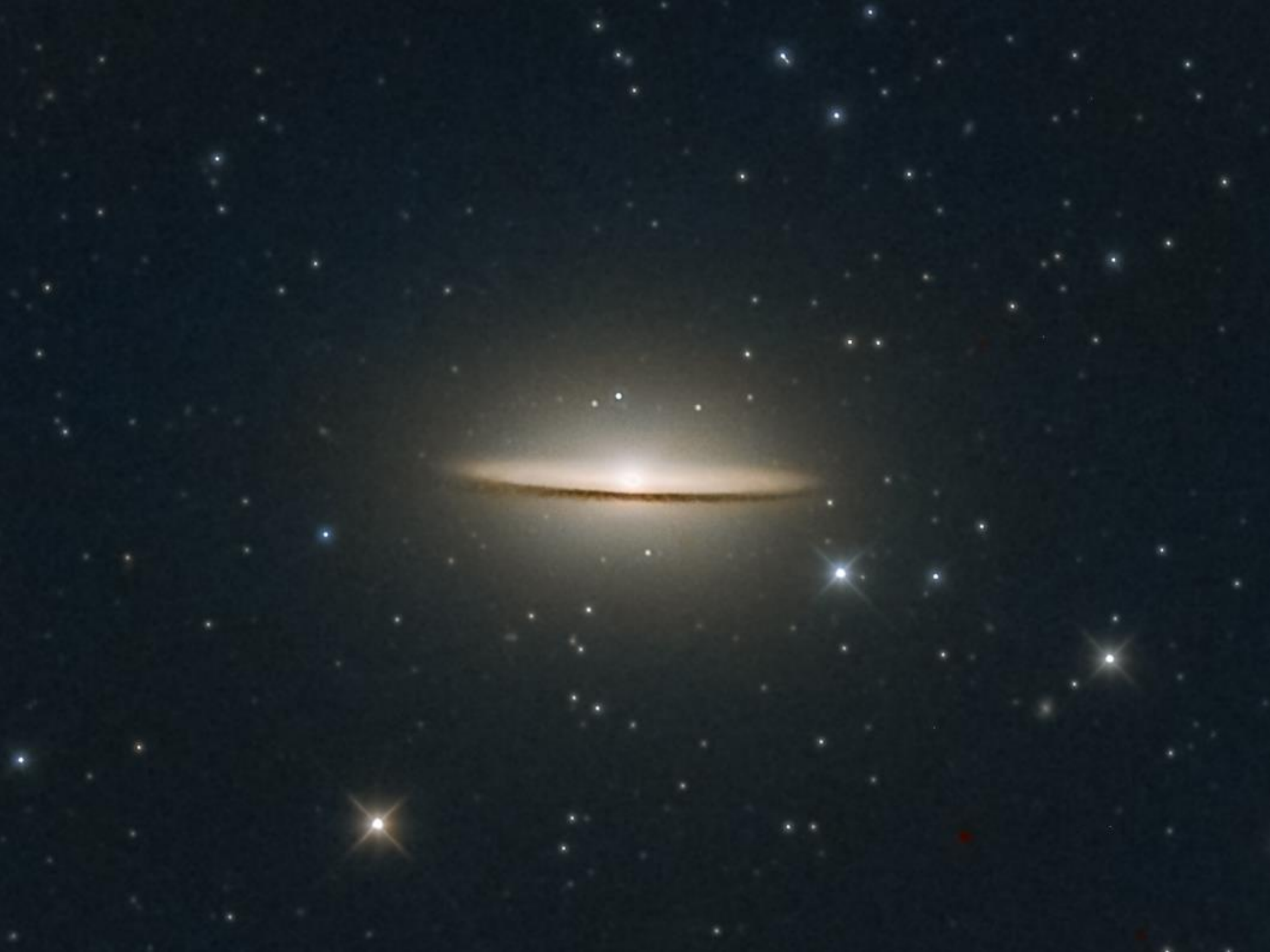
Sombrero Galaxy/Messier 104

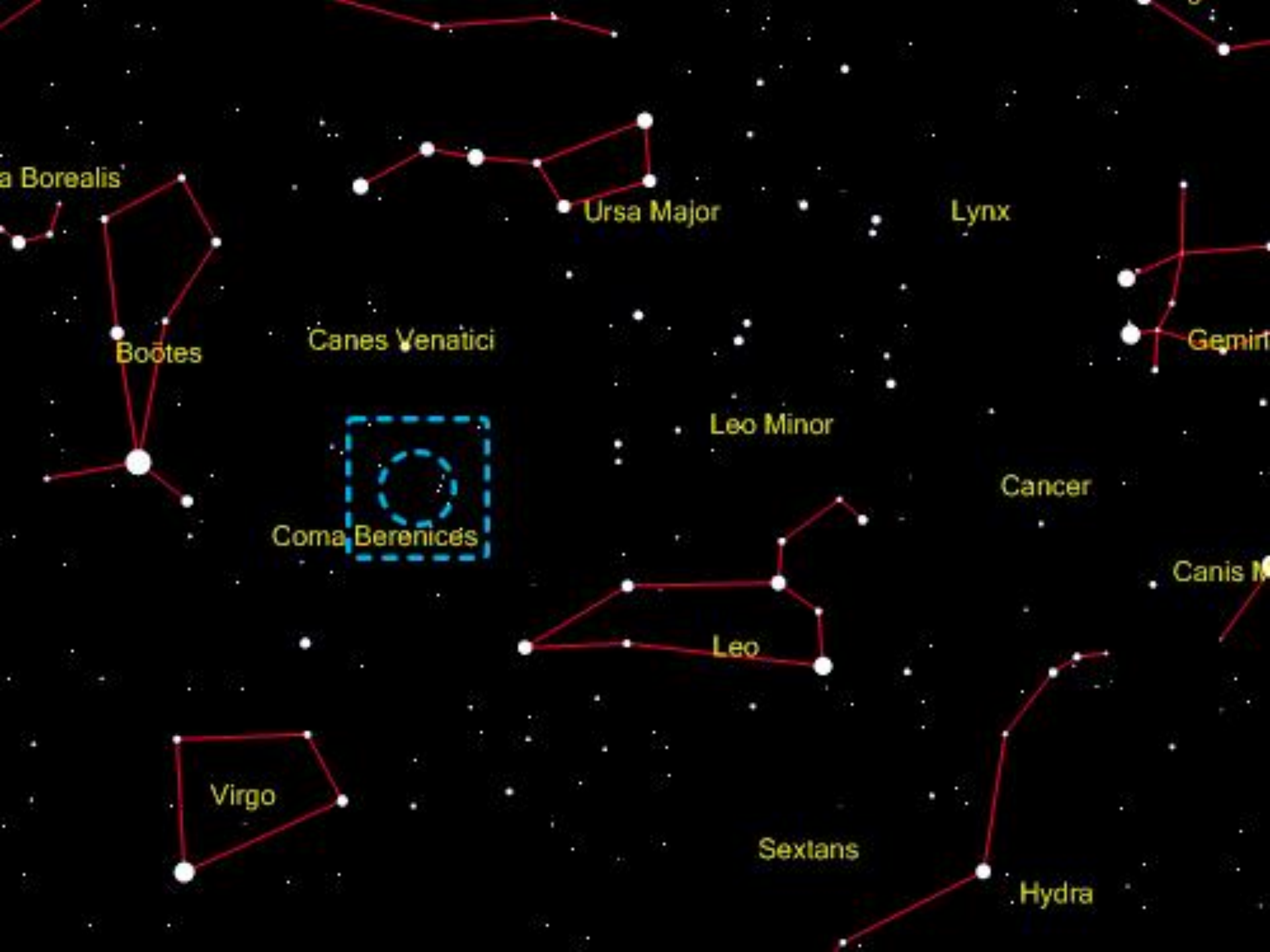
Spitzer Space Telescope • IRAC

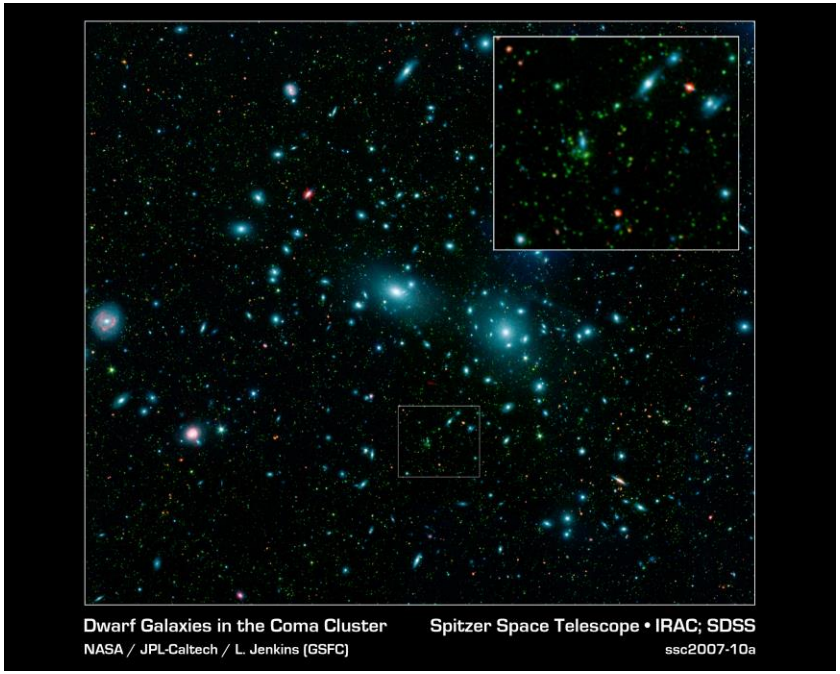
Visible: Hubble Space Telescope/Hubble Heritage Team

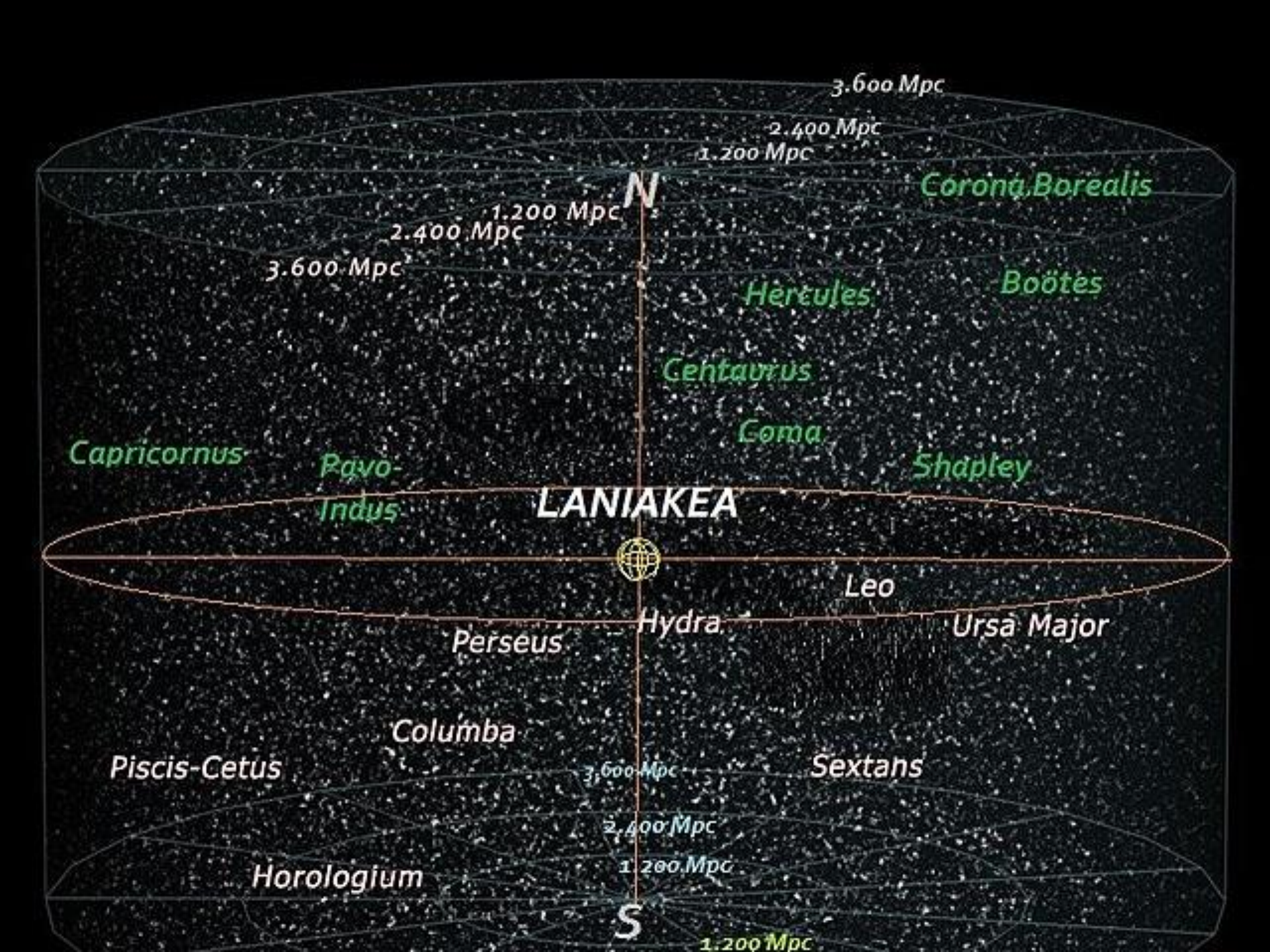
NASA / JPL-Caltech / R. Kennicutt (University of Arizona), and the SINGS Team

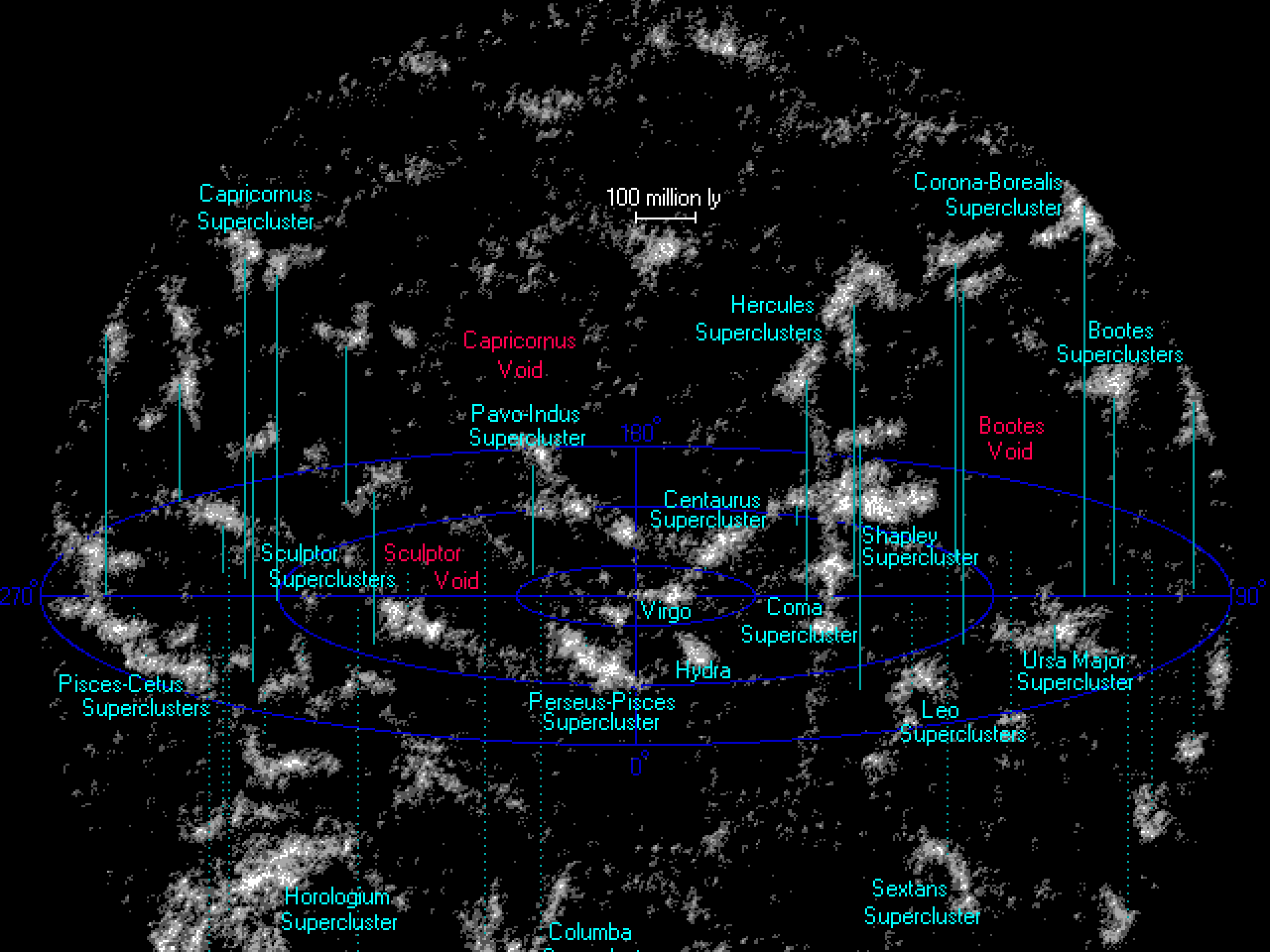
ssc2005-11a




a Borealis
Ursa Major
Lynx
Boötes
Canes Venatici
Gemini
Leo Minor
Cancer
Coma Berenices
Canis M
Leo
Virgo
Sextans
Hydra


Dwarf Galaxies in the Coma Cluster
NASA / JPL-Caltech / L. Jenkins (GSFC)
Spitzer Space Telescope • IRAC; SDSS
ssc2007-10a


3.600 Mpc
2.400 Mpc
1.200 Mpc
N
Corona Borealis
1.200 Mpc
2.400 Mpc
3.600 Mpc
Hercules
Boötes
Centaurus
Coma
Capricornus
Pavo-
Indus
Shapley
LANIAKEA
Leo
Hydra
Ursa Major
Perseus
Columba
Piscis-Cetus
3.600 Mpc
Sextans
2.400 Mpc
1.200 Mpc
Horologium
S
1.200 Mpc


100 million ly
Capricornus Supercluster
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
Sextans Supercluster

The End