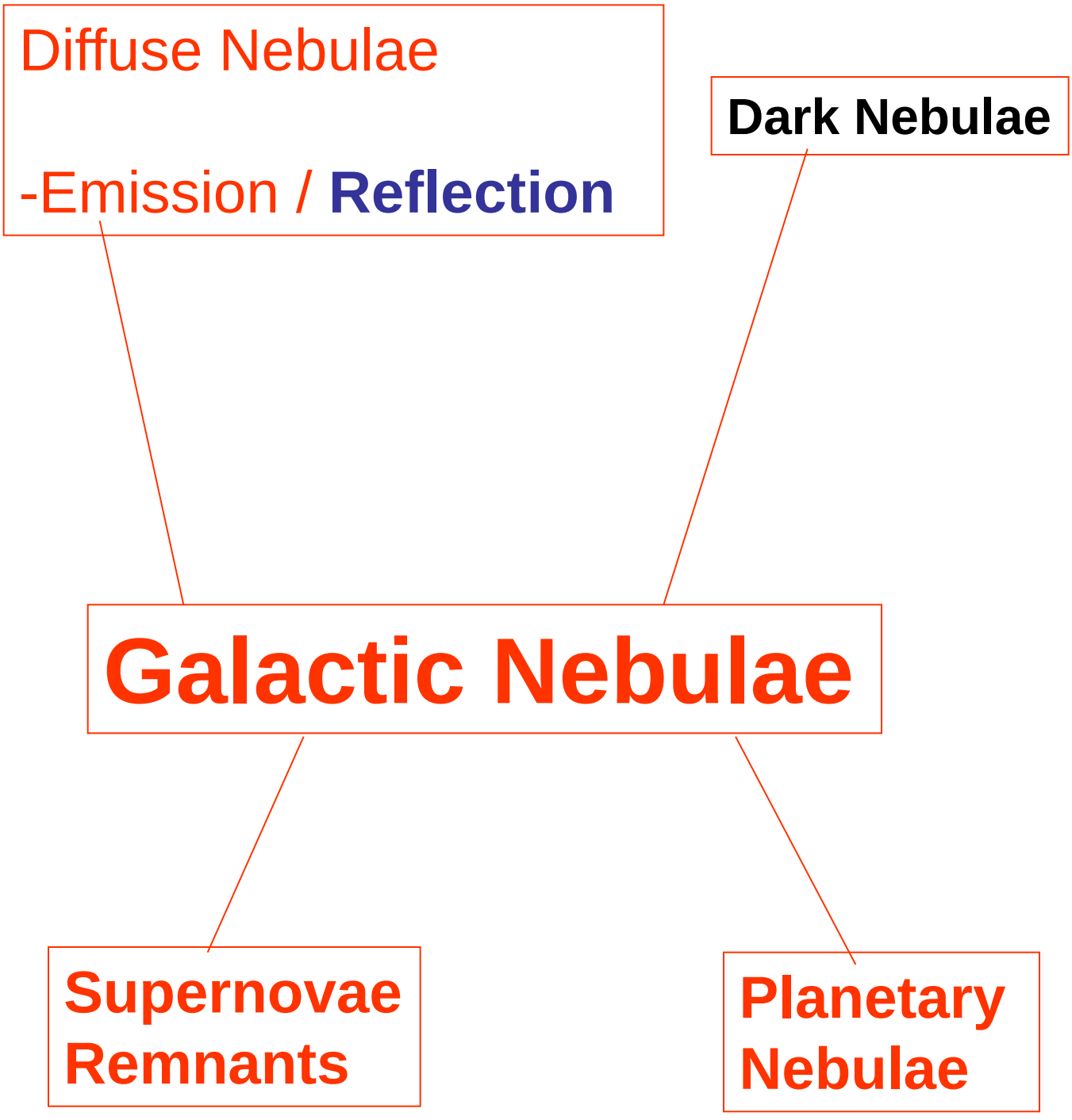

Diffuse Nebulae
-Emission / Reflection
Dark Nebulae
Galactic Nebulae
Supernovae Remnants
Planetary Nebulae

Diffuse Nebulae

- Extended with no well-defined boundaries

Emission Nebulae --------

Contains ionized gas – spectral line emission

HII regions – emission from ionized hydrogen

Reflection Nebulae--------

reflect light from near-by stars

Often surrounding star cluster(eg Pleaedes)

Dark Nebulae ----------

Seen as dark cloud in front of stars/ nebulae

Bright sources of IR emission - from dust

Planetary Nebulae(medium- low mass stars)

Layers of gas expelled from star at end of star`s life

Core of star – hot/ bright – uv radiation ionizes ejected layers

Ejected layers – radiate at visible wavelengths

Planetary nebulae – return elements to interstellar medium

Supernova remnants (high mass stars)

Structure resulting from explosion of star

Ejected material heated by collision with interstellar material

Dense remnant – pulsar – at centre of supernova remnant

Spiral arms of Milky Way : Location of Galactic Nebulae

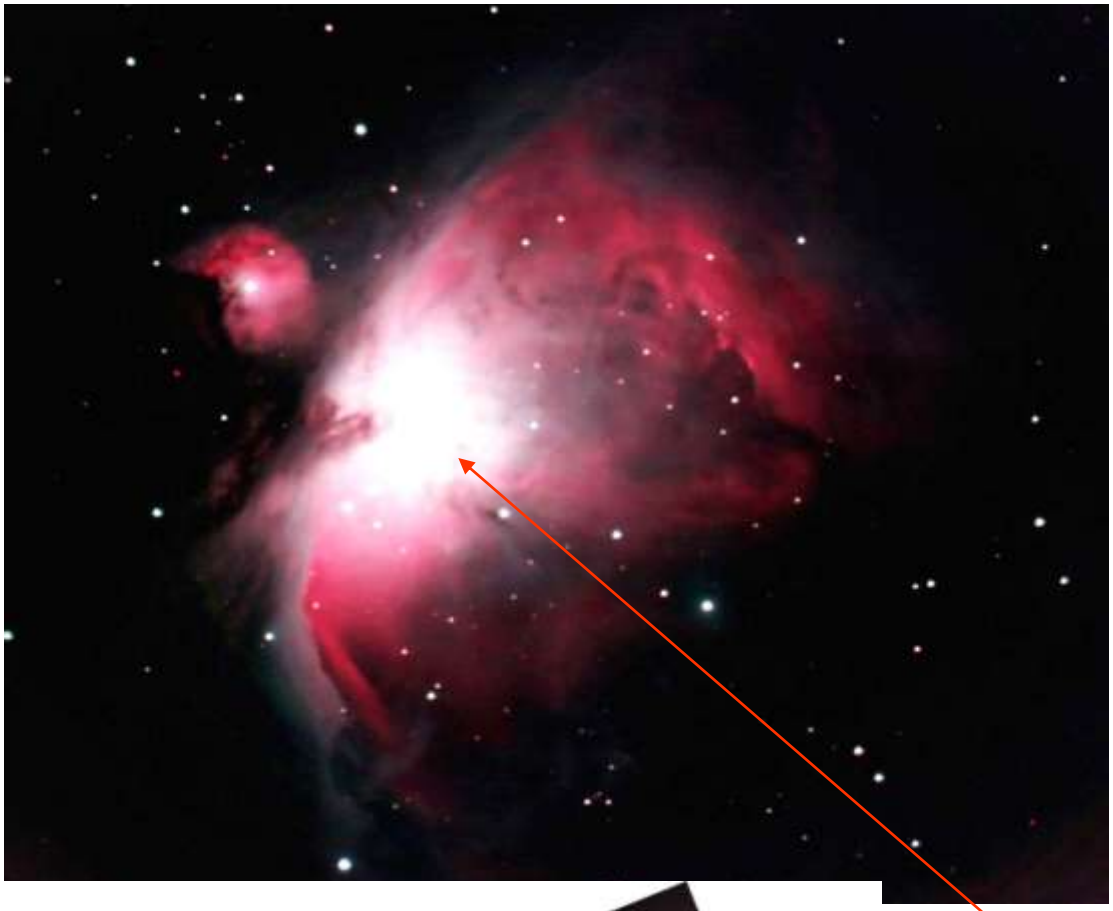
Orion Arm – location of sun – Orion nebula- Hyades- Pleiades

Perseus Arm – Double cluster- Crab nebula(M1)- IC443

Sagittarius Arm – M16(Eagle)-M17(Swan)-M20(Trifid)-M8(Lagoon)

Great Orion Nebula M42

LX200 8” SCT



Greatest of all HII clouds
-Enormous star forming
-region

D.Malin

Trapezium cluster –hot O-B stars –illuminating Orion Nebula (Theta1C Is 200,000 x more luminous than sun)

Composed mainly of :
H / He / C / N / O

Bright condensation of Orion A Molecular cloud (40 light years)

Distance of 1500 light years

Flame / Horsehead nebulae

canon350D/400mm lens

Flame nebula(NGC2024) :

Adjacent to bright star Alnitak

Bright HII region – 1500 lt yrs

Intersected by dark dust lanes

young star cluster (million Years old) within NGC2024

D.Malin(AAT)

Horsehead nebula(B33) :

Dark cloud of dust obscuring
Background emission neb(IC434)

Embryonic stars are buried within Horsehead nebula

NGC2023:

Bright reflection nebula to left of B33- dust/gas excited by star Embedded within NGC2023

Running Man Nebula (NGC1977) ---- Orion

10” LXD75 SN

D.Malin (AAT)

Distance -1460 light years

NGC1977

Catalogued as HII region but Actually complex mix of emission/ Reflection nebulae and dust clouds

Stars in NGC1977 are youngest in Orion OB1 stellar association

Numerous low mass proto-stars (2 – 4 million years old) embedded In NGC1977

Eagle Nebula M16 (Serpens)

Distance of 7000 light years

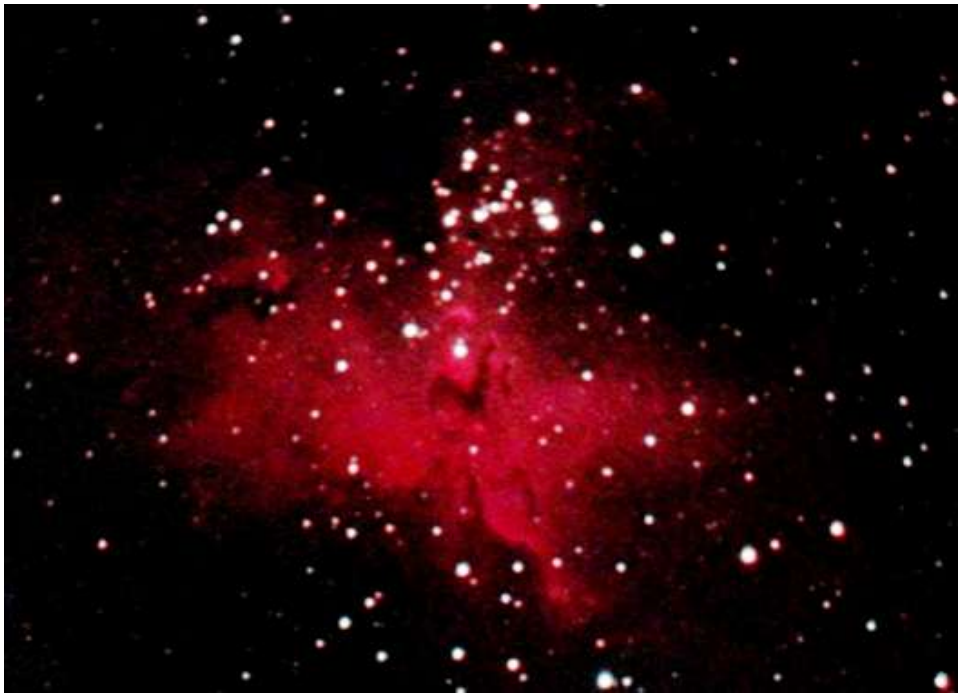
SLOOH – 14” SCT

Young open cluster NGC6611

M16 is a bright H II region
Illuminated by uv radiation
From NGC6611

Lighter gases
-boiled away
Leaving
Dense &
Dark pillars
Of material

Protostars are
Forming & emerging
From dark pillars



Brightest star in Nebula is +8.23

Size of nebula is 15 light years

LXD75 10” SN

Swan Nebula M17 (Sagittarius)

LXD75 10” SN

Distance of 5000 light years and about 15 light years in diameter
Omega Nebula represents over 800 solar masses of material

Largest HII region – **molecular cloud complex** in inner part
Of galaxy and one of closest to sun

Cascade of star formation within M17 – **open star cluster NGC6618** – obscured by gas and dust

Over 100 massive hot O-B type stars embedded with M17

Trifid Nebula M20 (Sagittarius)

LXD75 10” SN

Gem of summer sky

Young HII region
(30 light yrs across)
Illuminated by O-type Supergiant at centre
Of tri-lobed emission Nebula

Central star – 30x mass Of sun – triple system

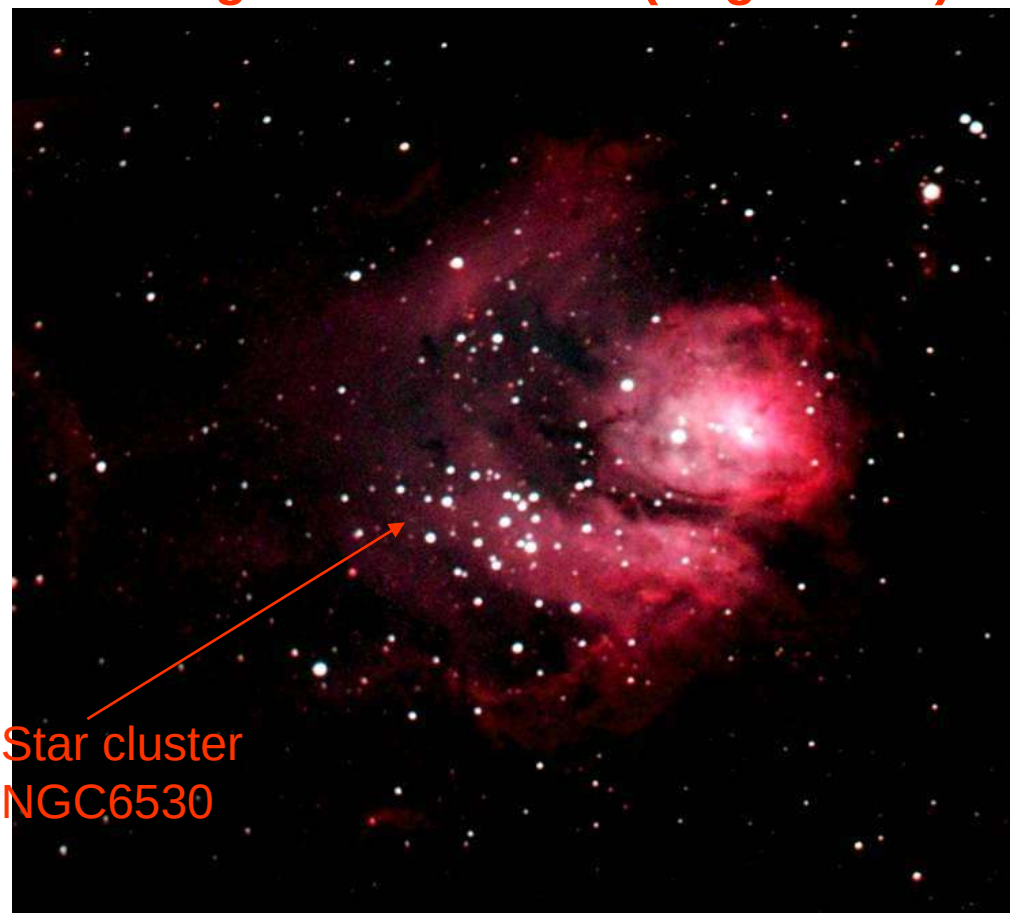
Reflection nebula-
Adjacent to nebula & Illuminated by F-type Supergiant star

Dark dust lanes within
Emission nebula are
Known as Barnard 85

Embryonic stars are hidden Within dense clouds of gas/ dust (Spitzer infra-red telescope Discovered 30 embryonic and 120 New born stars not seen in visible Images)

D.Malin (AAT)

Lagoon Nebula M8 (Sagittarius)



LXD75 10” SN

4100 light yrs
From Earth

110x50 light yrs

Bok globules – dark, collapsing Clouds of proto-Stellar material – Within M8

Large HII region in Sagittarius with Prominent dark dust lane

Massive O-type giants in NGC6530 Illuminating eastern part of Lagoon Nebula

Brighest (western) part - Hourglass nebula –is excited by **2 massive O-Type supergiants** to west of M8 .

60 B-type giants are embedded In Lagoon nebula - more than Orion nebula

SLOOH 14” SCT

Rossette Nebula (NGC2237) --- Monoceros

(D.Malin AAT)

Large HII region
(5000 ly yrs away)

130 light yrs in
Size with enough
Material to make
10,000 stars

Open star cluster
(NGC2244) at
Centre of nebula
- O/B type giants

Radiation pressure
/ stellar winds
from
Stars in NGC2244
Have excavated
Centre of Rosette
Nebula and excited
Gas in Rosette

Nebula expanding
At 4 km /sec

65 light yrs in size

(canon350D image – 400mm lens)

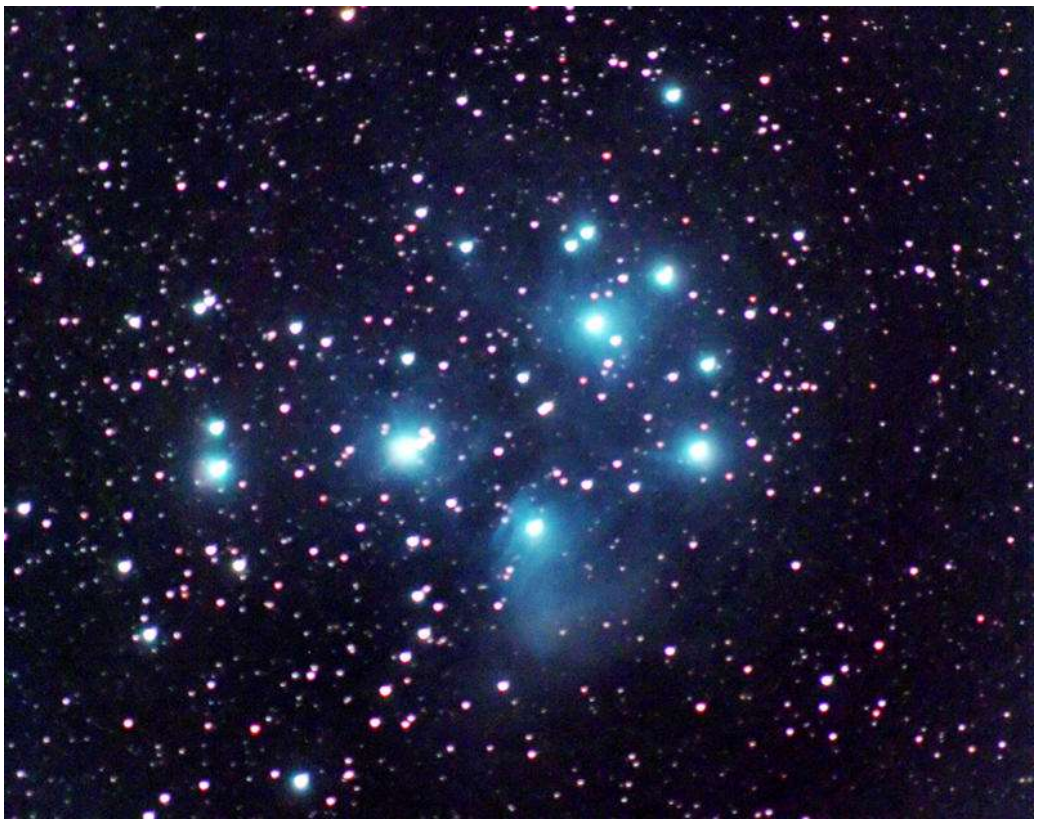
Pleiades Open Cluster M45

D.Malin(AAT)

Age of cluster – 100 million years / distance – 440 light years

Hot Blue / young stars – embedded in dust – reflection nebulosity

Dust – part of interstellar medium – unrelated to cluster



(canon 350D/400mm lens)

Cluster :

About 100 members
Size of 43 light years

Mostly hot / blue stars

Lot of brown dwarfs (8% solar mass)

California Nebula (NGC1499) --- Perseus

(Canon350D /400mm lens)

Bright emission nebula , NGC1499 , is over 4 deg across
Adjacent to Perseus OB2 stellar association

Nebula is illuminated by bright star Xi Persei which is a Runaway star . Xi Persei is an O/B type giant and has has been Ejected from the Perseus OB2 stellar association over 400,000 Years ago . It encountered NGC1499 about 100,000 years ago

Nebula is about 1100 light years away , and has a low surface Brightness – difficult to see visually

Discovered by Barnard in 1884

North American Nebula NGC7000 --- Cygnus

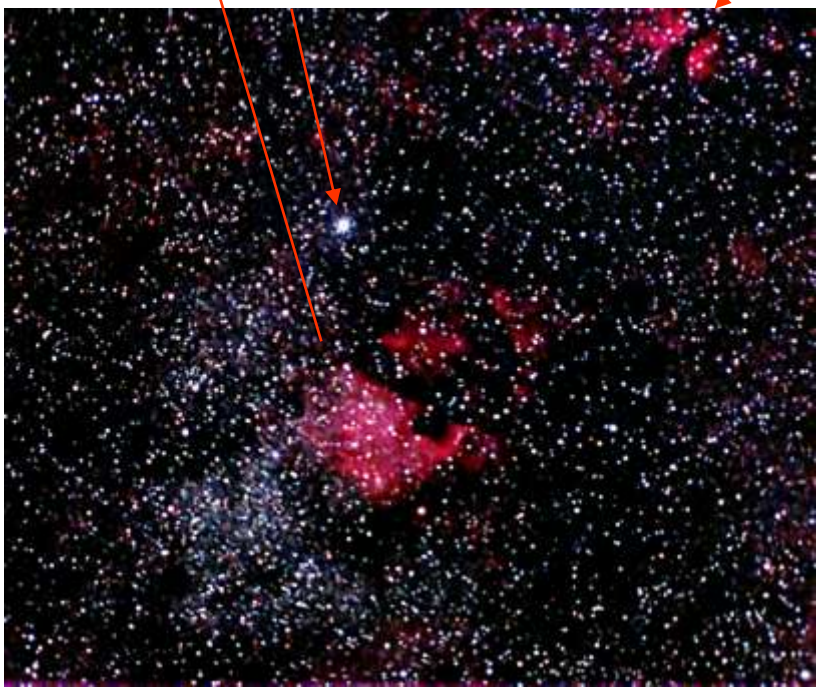
Pelican Nebula IC5070

(Canon 350D/400mm lens)

NGC7000

Deneb

IC1318(Butterfly Neb)



North American/ Pelican Nebulae rank as one of the Most famous in Summer Sky

Two HII regions are separated By thick dust lane .

HII regions / dust lane belong To a large / optically invisible Molecular cloud

Dust lane obscures massive O-type star which illuminates Nebula causing it fo fluoresce

Nebula is 1800 lt yrs away
- 4 x size of full moon and about 100 light yrs in size

Butterfly Nebula (NGC1318) & Gamma Cygni Region

(canon350D /400mm lens)

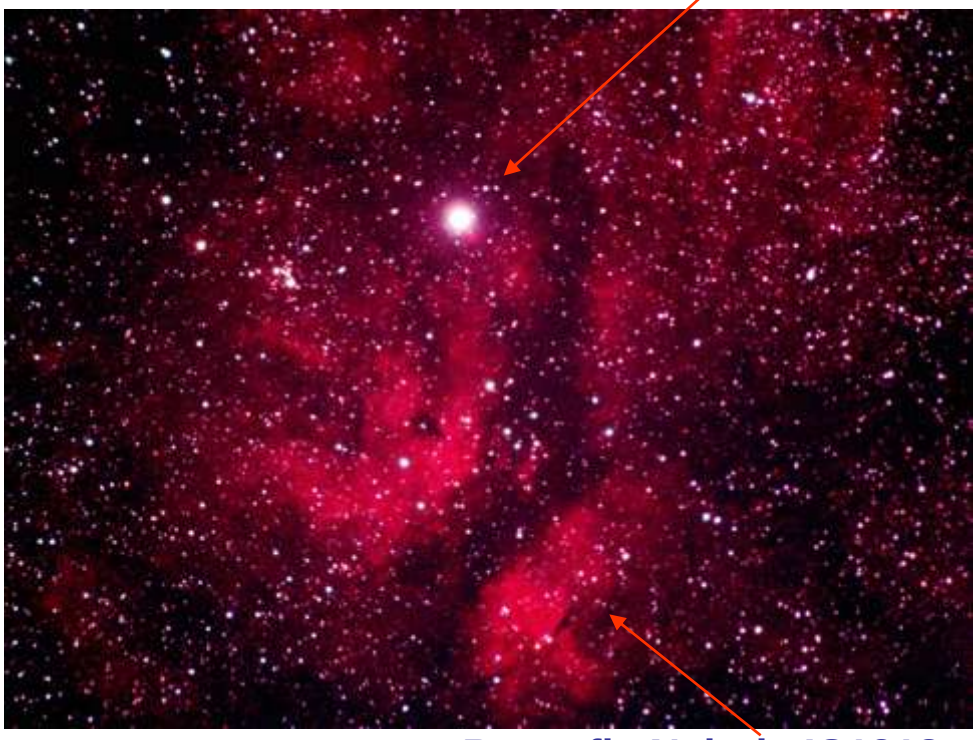
Giant HII region , IC1318 spanning over 100 light yrs
And at distance of 5000 light years .

Gamma Cygni

Close to blue star Sadr , Gamma Cygni, only at
Distance of 750 light years and not related to nebula

Entire HII region
Is illuminated
By powerful
O-type star
Embedded
Within clouds
And only visible
At infra-red
Wavelengths

Thick dust of
Milky Way
Obscures
Entire region



Butterfly Nebula IC1318

Cocoon Nebula IC5146 (Cygnus)

(DSS composite)

Distance of 3,900 light years

Beautiful **emission** / **reflection** nebula surrounding massive Ionizing central star . Nebula is located at eastern end of Dark clouds .

Cluster of stars at centre of IC5146 are of low mass and young (1 million years old) - pre main sequence stars.

NGC2261 – Hubble Variable Nebula (Monoceros)

(DSS composite)

Reflection nebula is illuminated by **young variable star R Monoceros**

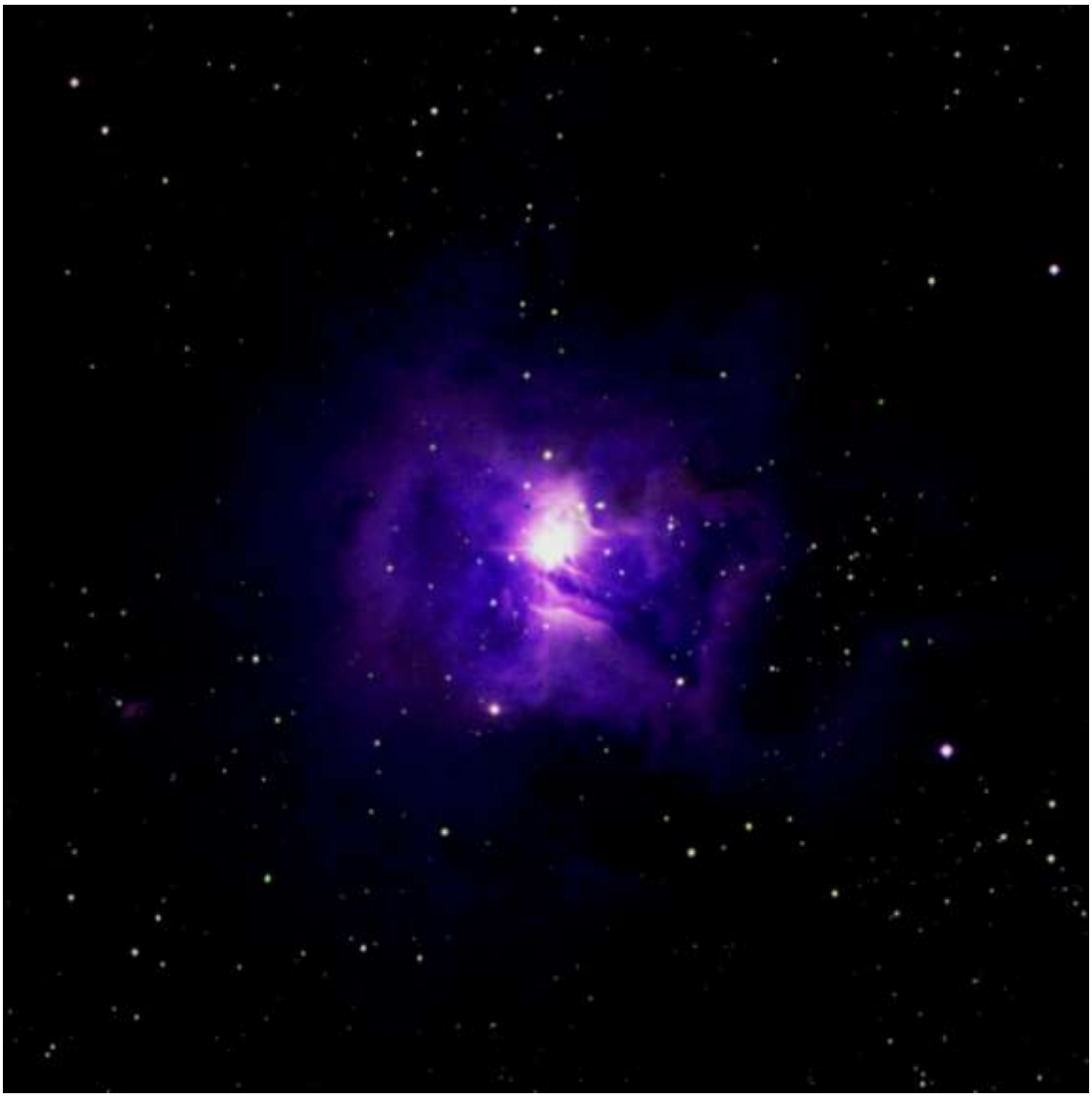
R Monoceros varies by over four magnitudes ,and Magnitude of nebula varies on time-scale of months

Nebula discovered over 150 years ago (Sir William Herschel)

Distance of 2500 light years

Iris Nebula NGC7023 (Cepheus)

(DSS composite)



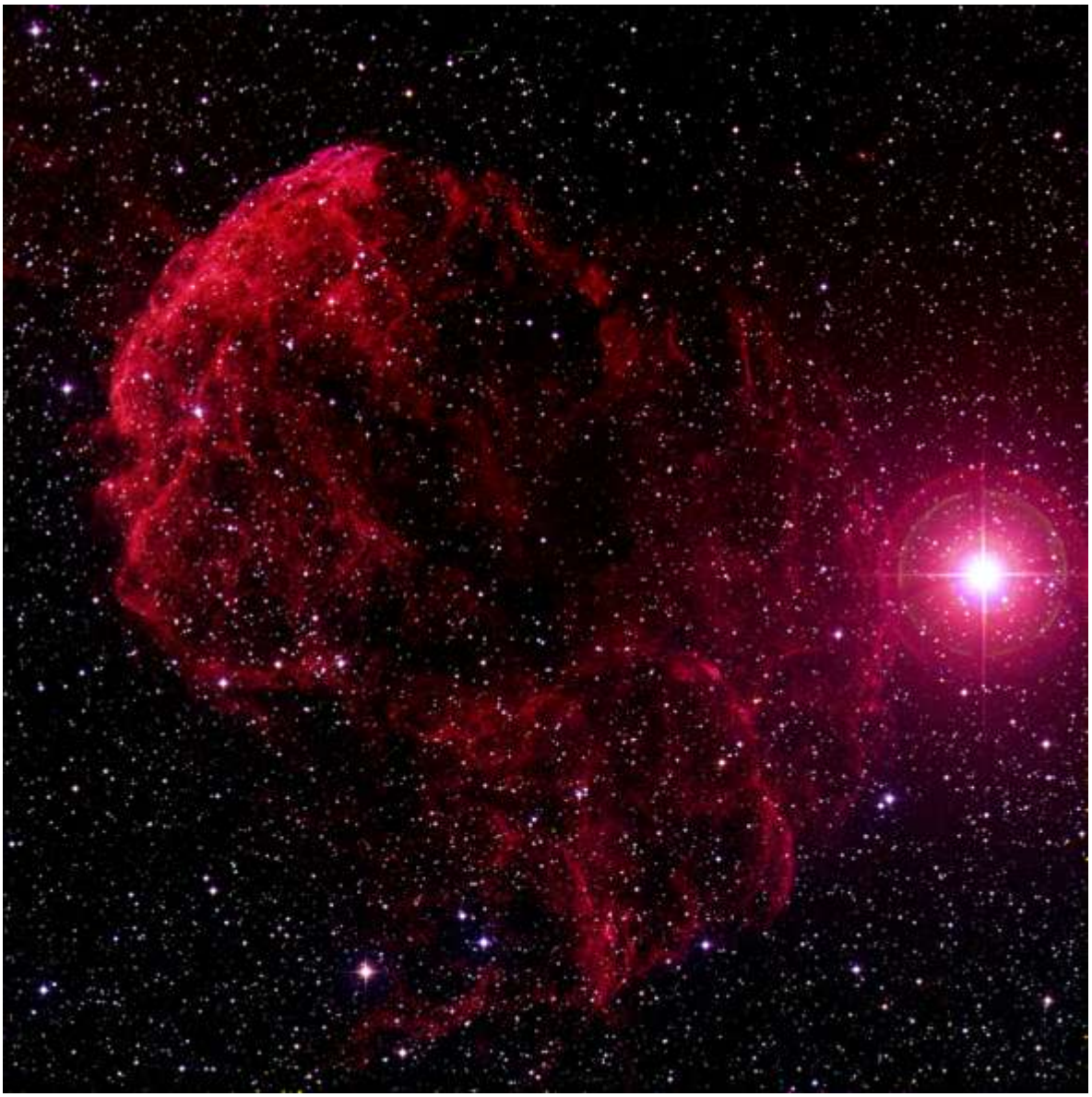
Bright star shines through Iris nebula . **Illuminating star** is In region cloaked by thick obscuring dust clouds

Blue starlight reflects from surface of minute dust particles

Nebula emits radiation from dust particles – **in infra-red and low Level red light** from dark dust clouds surrounding nebula

Iris nebula located at end of optically invisible molecular cloud **(distance of 1400 light years)**

Jellyfish Nebula IC443 (Gemini)



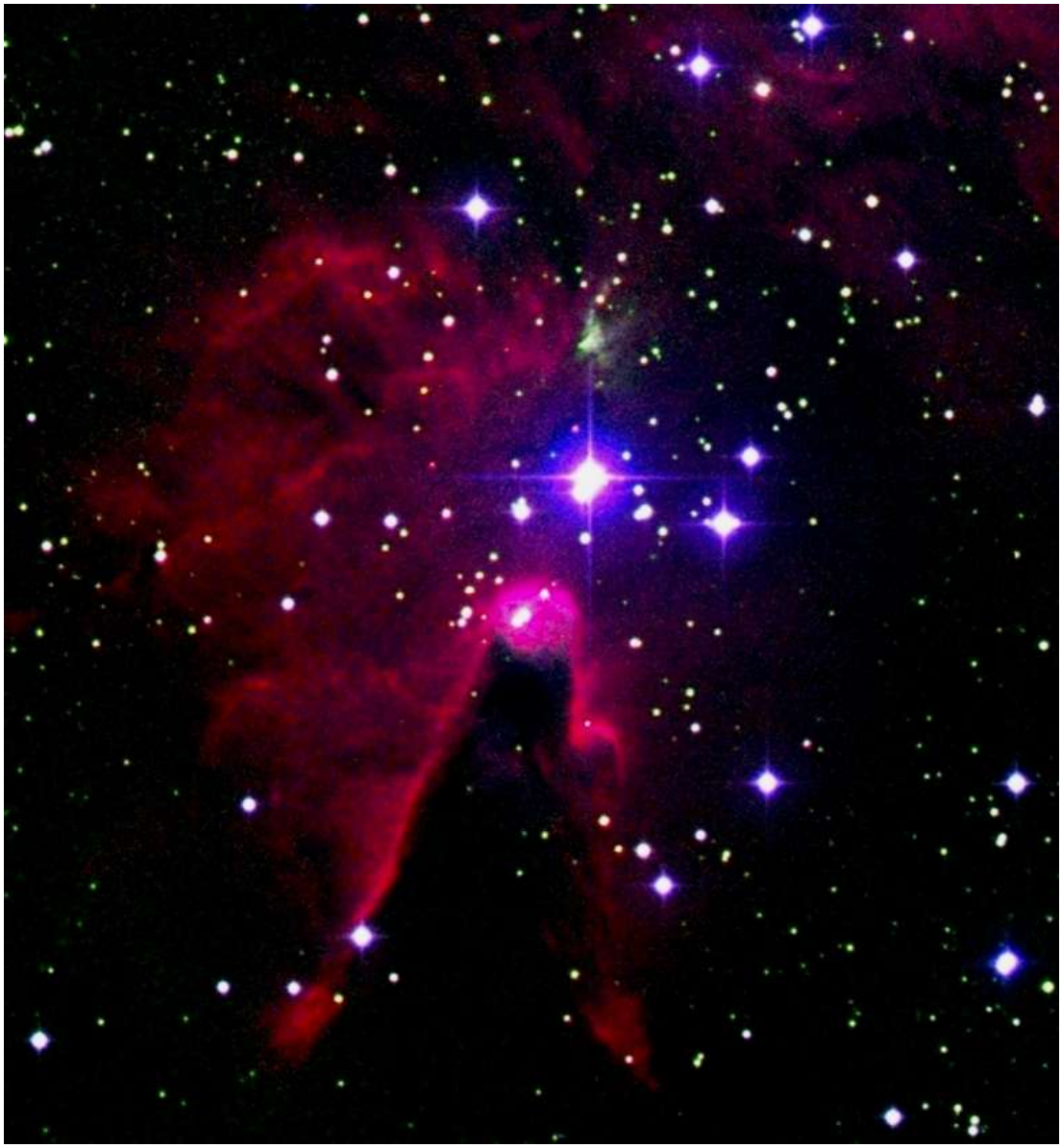
IC443 (Jellyfish nebula) –
Supernova remnant interacting with molecular cloud

Shell of gas expanding into and heating interstellar medium

Red light – ionization of gas in molecular cloud

Neutron star at centre of IC443
(distance of 5000 light years)

Cone Nebula (Monoceros)



DSS composite

Cone Nebula – conical pillar of gas and dust (7 light years)
Surrounded by open cluster NGC2264(600 members)

S Monocerotis (O- type supergiant & 8000 times more massive
Than sun) provides ionizing source for Cone Nebula

(distance of 2600 light years)

Flaming Star Nebula IC405 (auriga)

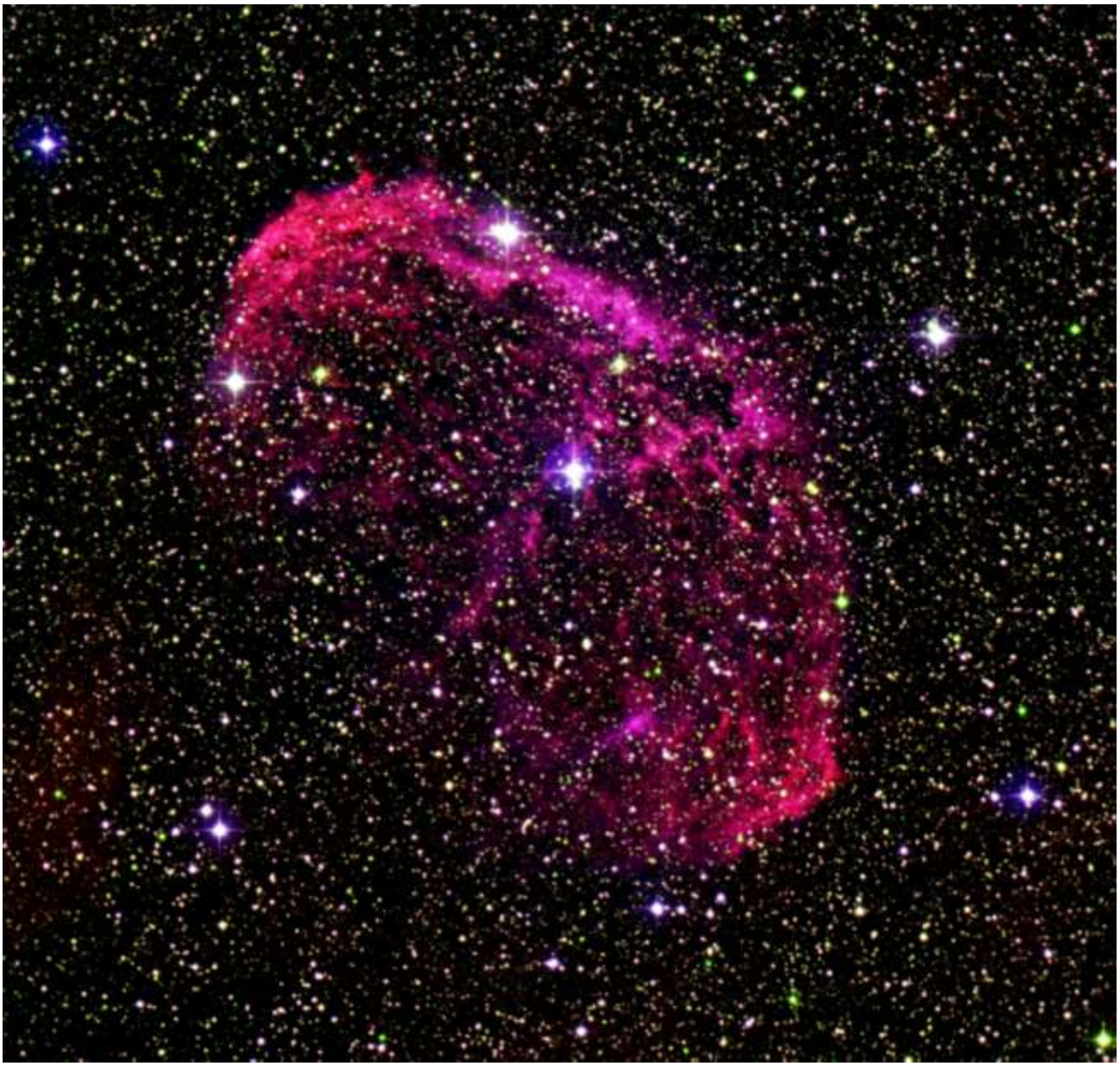
Flaming star Nebula (IC405) :
Energized by brilliant star O-type AE Aurigae

AE Aurigae – ejected from Trapezium cluster (2.5 million yrs ago)

Encountered interstellar cloud / dust in Flame nebula

Several bright flame-like prominences in nebula
(distance of 1500 light years)

Crescent Nebula NGC688 (Cygnus)

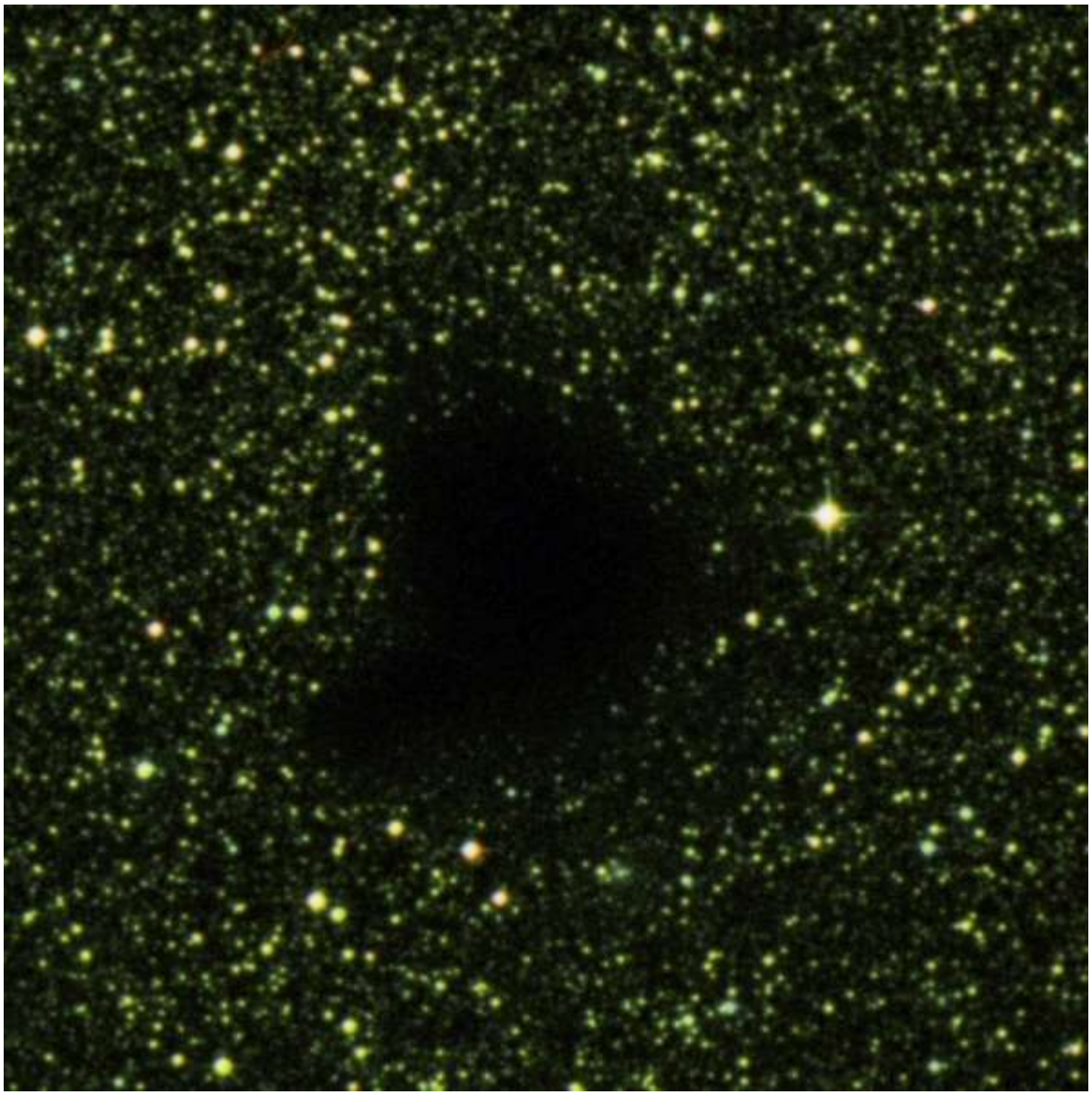


Crescent Nebula (NGC6888) :
Powerful blue Wolf-Rayet star energizes Crescent Nebula

Wolf Rayet star
– luminous / hot 0-type supergiant star – ejected material
-Material dispersed by stellar winds from Wolf Rayet star
-Shell of material ionized by uv radiation from star

(distance of 4700 light years)

Barnard 68(Ophiuchius)



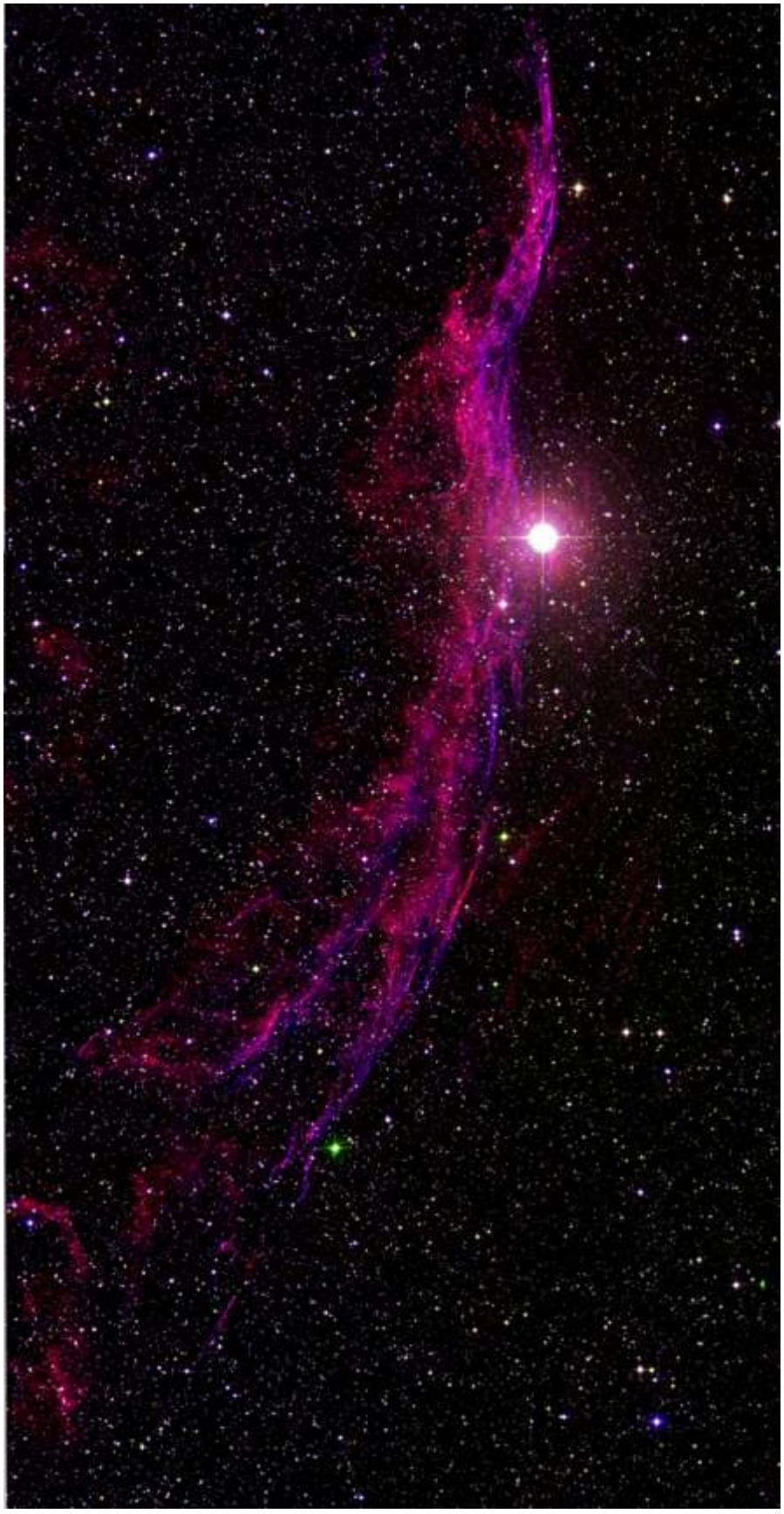
Barnard 68 –
Dark absortion nebula – Bok globule –only 500 lt yrs away

Blocking visible light from 3700 background stars

Interior of nebula – temp only 16K – 2x mass of sun - .5 lt yr across

Gravitational Collapse in 100,000 years to form star

NGC6960 – Part of Cygnus Loop



Cygnus Loop :

Supernova remnant

80 light years across

5000 light years away

Features of nebula :

Delicate tendrils of Glowing gas

Material in remnant :

Collides with inter-Stellar medium

Material heated and Glowing at visible and In high energy X-rays

NGC2359 (Thor`s Helmet) – Canis Major

Distance of 15,000 light years

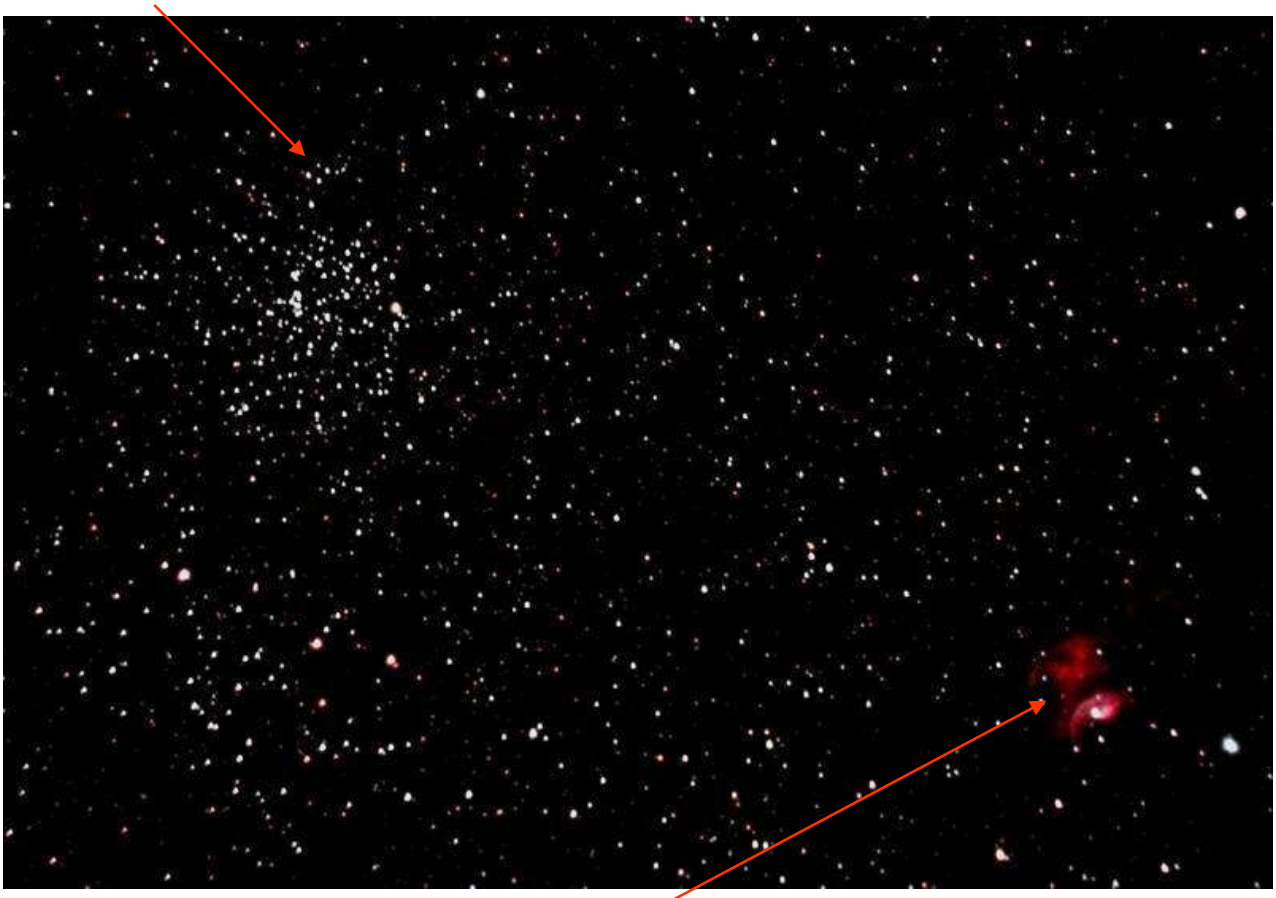
Example of bubble shaped filamentary nebula

Created by fierce stellar winds from unstable star (Wolf-Rayet)

Bubble Nebula NGC 7635

Open Cluster M52

– 5000 light years away (magn 5) – 15 light years across



Bubble Nebula NGC7635 :

Energized by Wolf_Rayet Star –

100,000x more powerful Than Sun(40x solar mass)

Powerful stellar winds

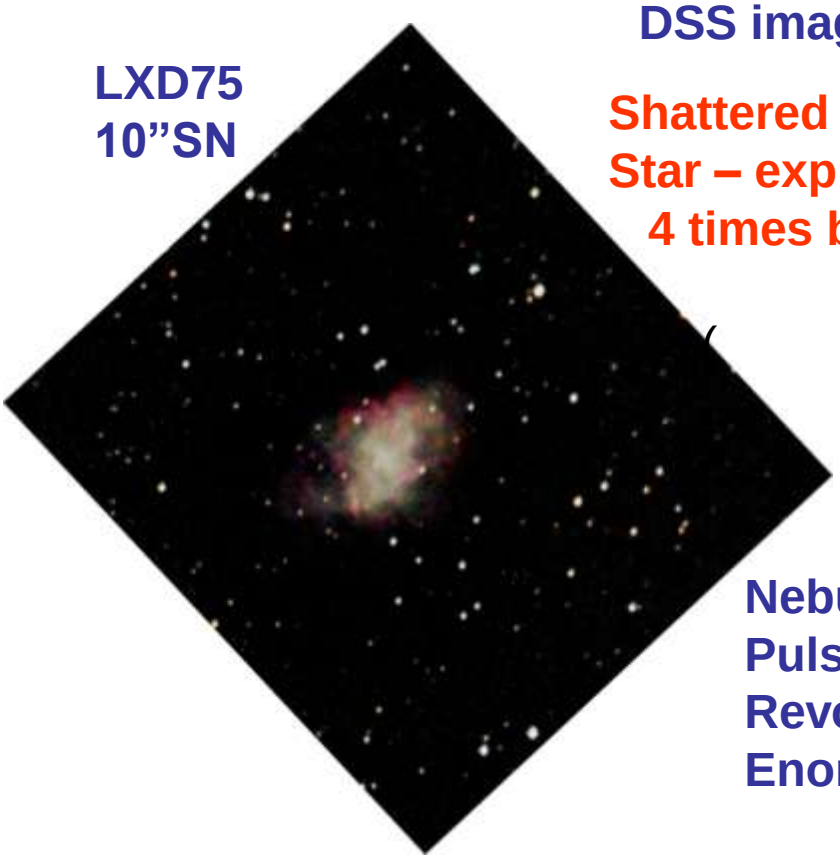
Distance of 7800 light years

Crab Nebula Supernova Remnant (M1) - Taurus

Distance :
6300 light years

DSS image

LXD75
10”SN



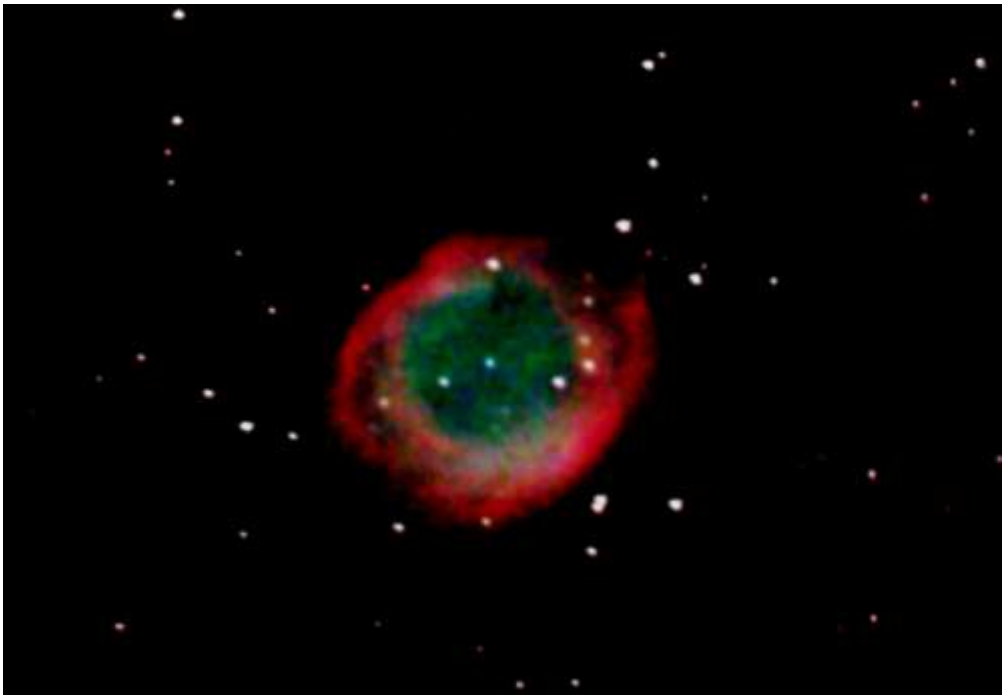
Shattered remnant of supergiant Star – exploded in 1054 and was 4 times brighter than Venus

Nebula is energized by Pulsar – spinning at 30 Revolutions / sec and Enormos density

Helix Planetary Nebula NGC7293

D.Malin

Nearest Planetary Nebula – 694 light years



LXD75 image

Remnant of a
Dying star

Series of ring-
Like structures
-Different gases
-Expelled from
-Star

-Cometary knots
-In inner ring

Further Planetary Nebula Examples

Dumbell Planetary Nebula M27 (Vulpecula)

Ring Planetary Nebula M57 (Lyra)