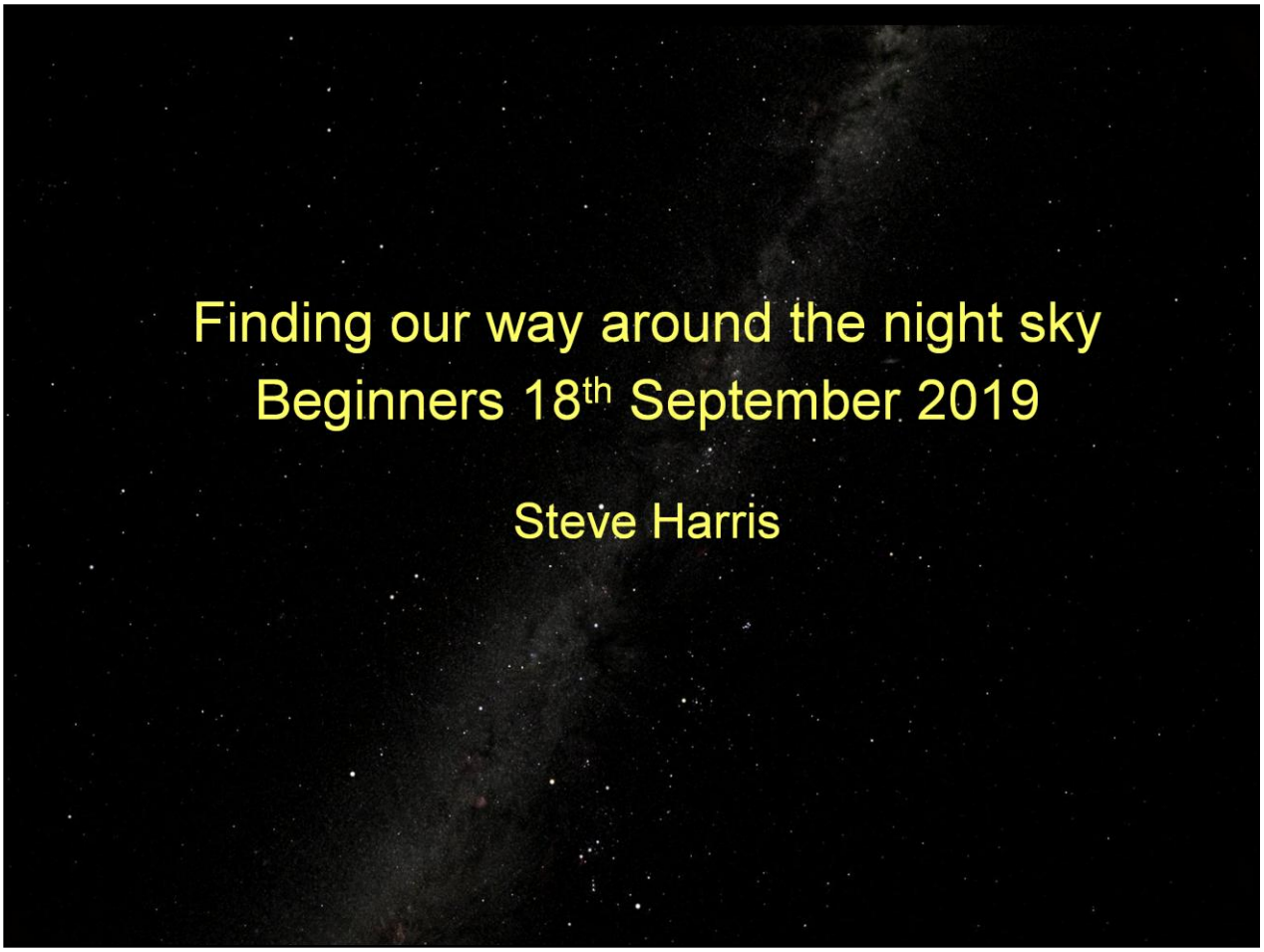
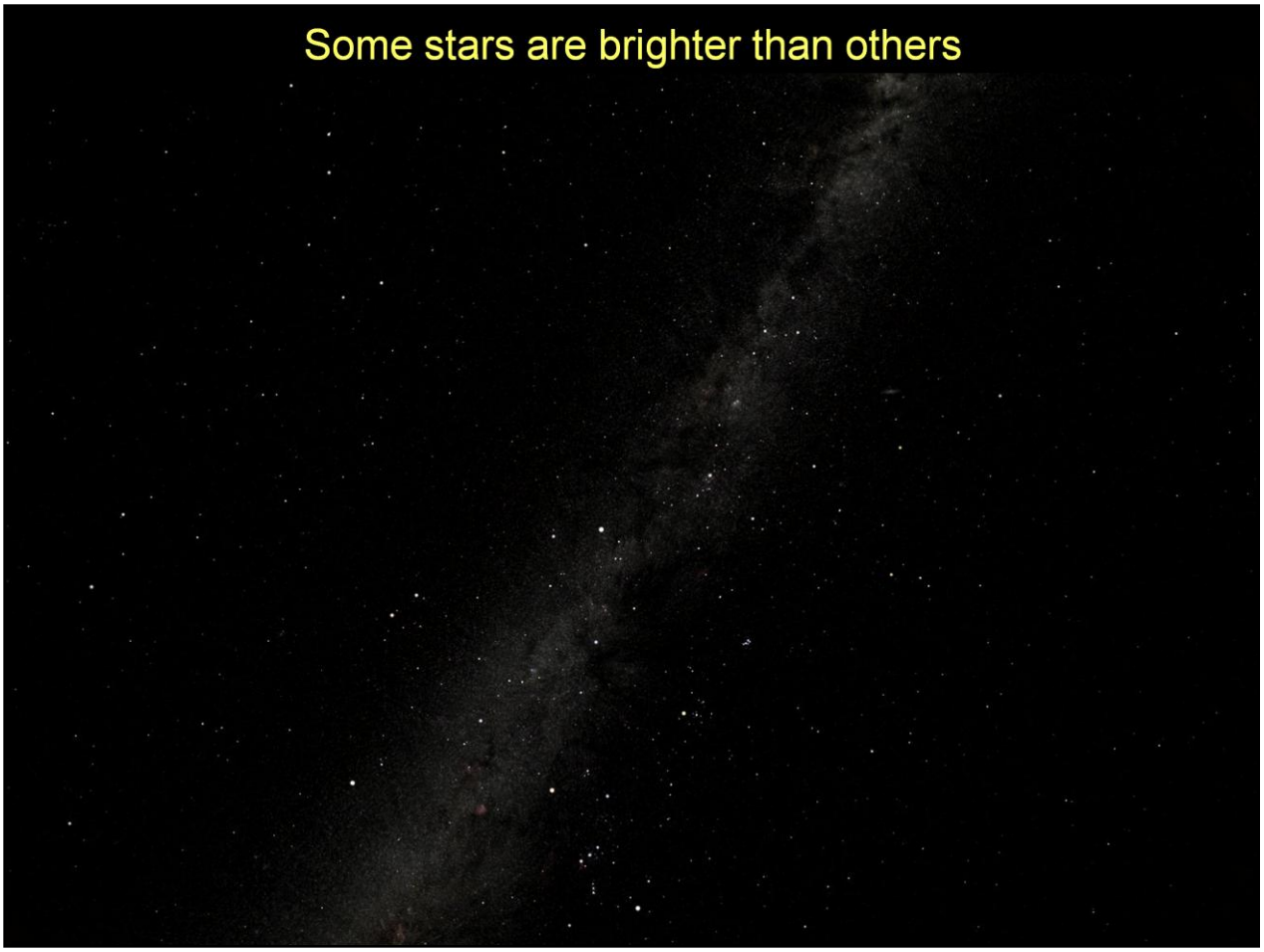


This session 2019 -2020 we intend to present talks designed to provide an introduction to some of the skills that are needed when starting astronomy as a hobby. We start the September presentation with a beginner's guide to exploring the night sky. There are no signposts or directions in the sky the only things that do not change their position in the sky are the stars. Although the stars are in fixed positions in the sky, the sky does change slightly from night to night due to the movement of Earth as it orbits the Sun once a year.

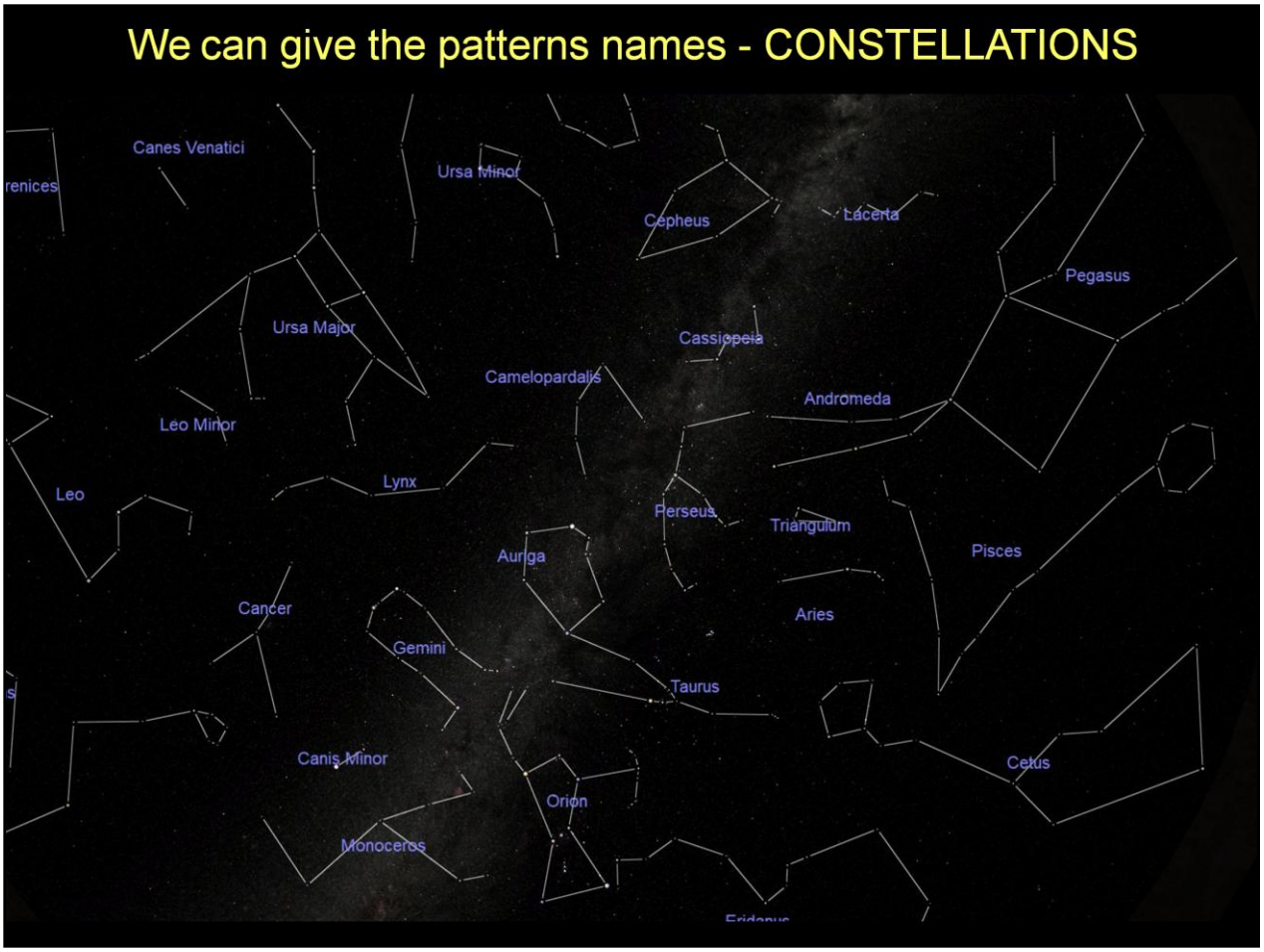


To the naked eye (the astronomical term for look without optical aid) all the stars look very similar. Some do look brighter than others and some of the brighter stars may show a hint of colour but it is very subtle.

One thing we will notice is some stars appear to form a loose pattern or group. We as humans do have an ability to make patterns, groups or shapes out as we look around us. Some examples are seeing rocks that look like an animal or a human head or face. We also see the shapes of animals in the clouds on a bright day. So it is not surprising that we see patterns in the night sky. The picture above shows the winter night sky with the 'naked eye' stars in their relative positions.

The misty band that stretches diagonally across the sky is the Galaxy that our star the Sun resides in and we call the Milky Way. Our Sun is just one of between 200 and 300 billion stars that comprise the Milky Way which is classified as a Giant Spiral Galaxy.

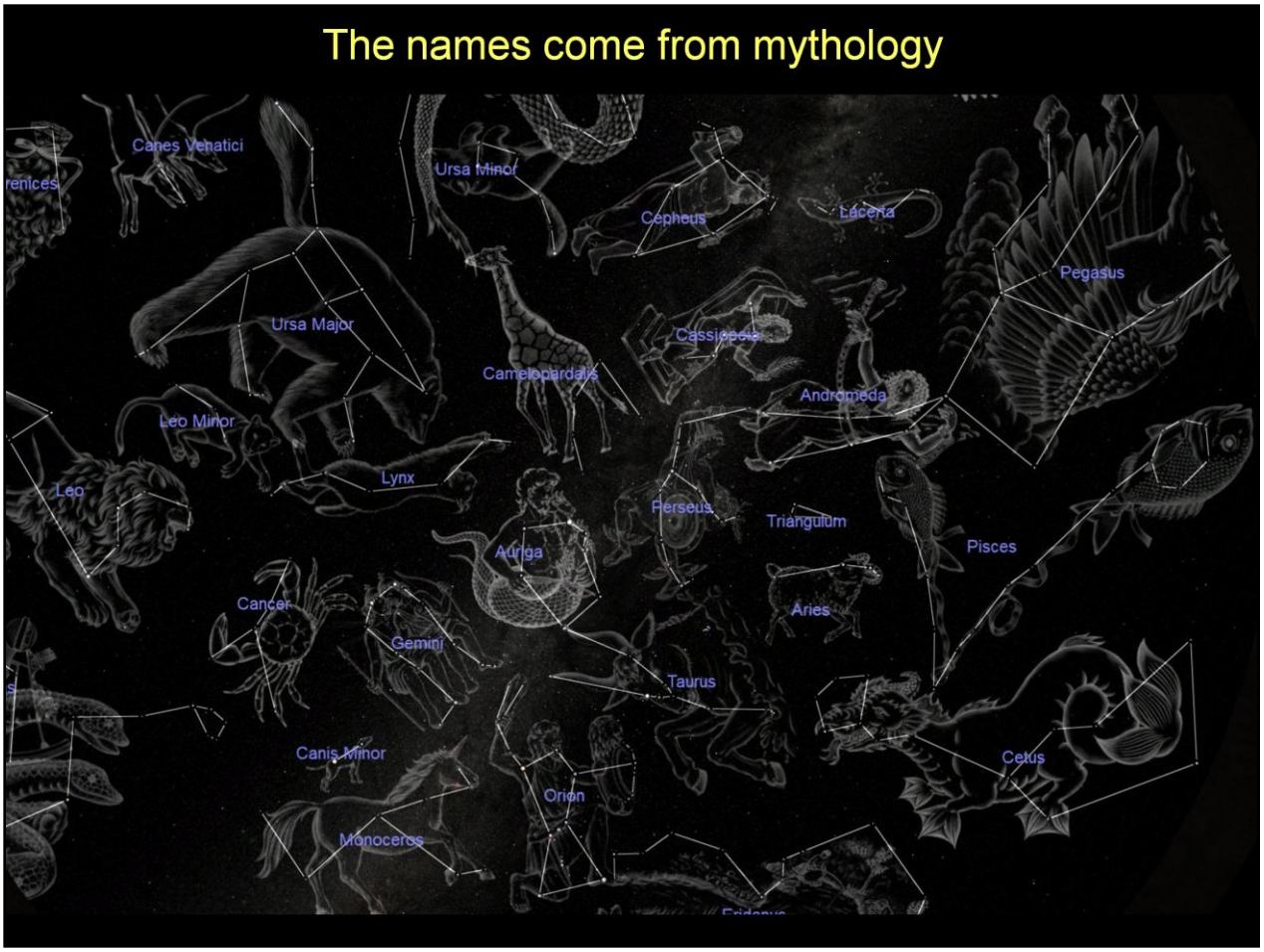
If we join up the stars that appear to form a group with ‘dot to dot’ lines we can make out 88 internationally accepted patterns that we call ‘CONSTELLATIONS’.



So we can talk to each other about these 88 internationally accepted Constellations we give them names. These names are generally taken from mythology so many have existed since ancient times. Some constellations are well known and easy to recognise. Ursa Major, shown at the top left of the chart above is one of the most well known. It is also called the 'Plough' or the 'Big Dipper' by the Americans. The main shape (asterism) does look remarkably like a Saucepan.

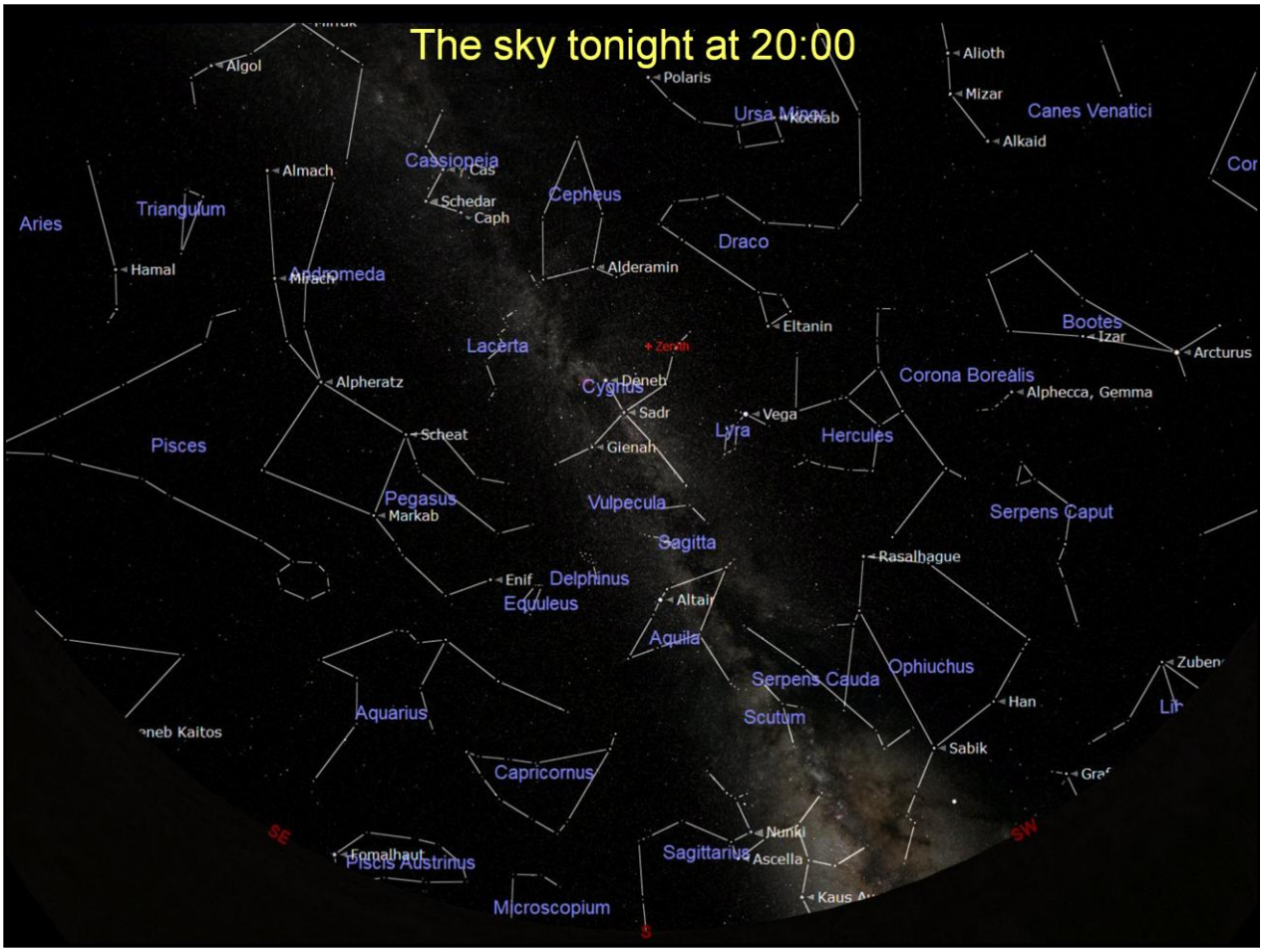
Another well known constellation with a recognisable shape is Orion shown at the centre bottom of the chart. With a little imagination it does look like a man with a belt around the waist of his tunic. He has one of his arms holding a club above his head and with the other arm he is holding a shield out in front of him.

So these are the winter constellations, seen looking towards the south.



In the past, star charts were very artistically drawn. They were lovely to look at but scientifically they were not much use. Some artists even moved the position of the stars to fit better into their elaborately drawn chart. The chart above has illustrations superimposed on the modern stick-man constellation figures. It can be seen that very few illustrations look anything like the star patter it is supposed to represent. Having said that, it can also be seen that the stick figures are not much better.

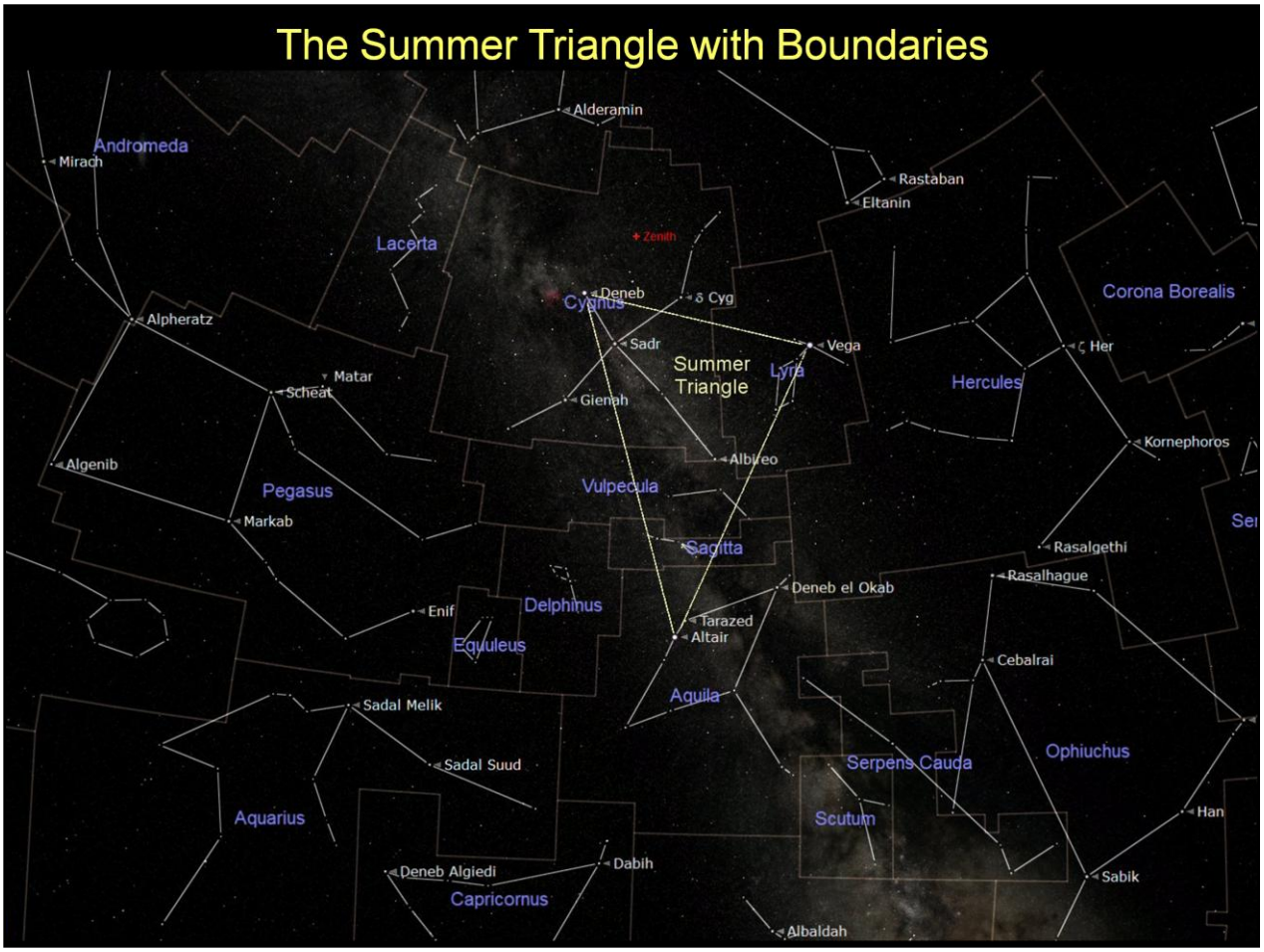
However the stars on modern charts are in the proper position relative to all the other stars. The stick figures just join the brighter stars to make the recognised grouping easier to remember and do not necessarily resemble the mythological character that they represent.



The chart above is a computer planetarium application (Starrynight) generated chart of the sky at 20:00 BST (8 o'clock) on the 18th September 2019, the evening of the September Beginners meeting. The chart shows the sky as we would see it looking towards the south. Of course the constellation figures and names are added and do not appear in the sky.

At this time of the year we have three bright stars that we can quickly recognise to begin our first exploration of the night sky. Just above the centre of this chart is a red mark and the word 'Zenith'. This is the point in the sky directly above the observer. If we look directly overhead we will see a bright star called Deneb. It is the brightest star in the Constellation of Cygnus (the Swan). The name Cygnus can be seen on the chart close to the star Deneb.

To the west (right) of Deneb is an even brighter star, this Vega in the constellation of Lyra (the 'small' Harp). To the south of Deneb and Vega is another fairly bright star with a fainter star to each side of it. This star is called Altair and is the only bright star in the constellation of Aquila (the Eagle). These three stars are quite distinctive and can be used to trace out an imaginary triangle that we call 'The Summer Triangle'.

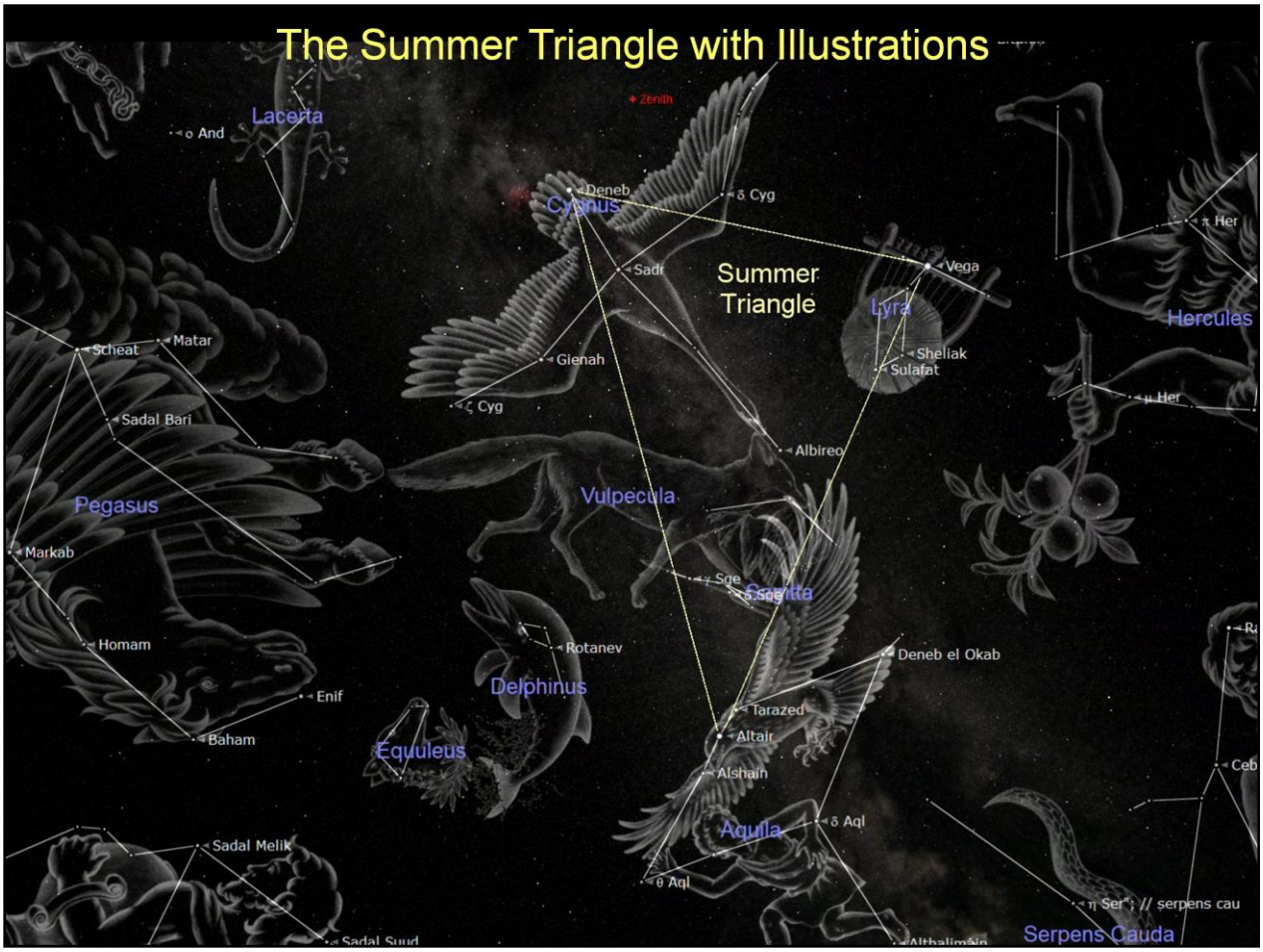


The term ‘Summer Triangle’ was suggested by the famous astronomer Sir Patrick Moore and is now accepted as this very distinctive feature of the Autumn and early Winter sky.

The chart above shows the Summer Triangle with the internationally recognised boundaries of the constellations included. We do not normally use the boundaries because they are very difficult to relate to the real sky and equally difficult to remember.

Astronomers generally use one the stars in a constellation to begin giving directions to a point of interest in the sky. Using directions to other stars in sequence we describe a trail leading to that point of interest. We call this ‘Star Hopping’.

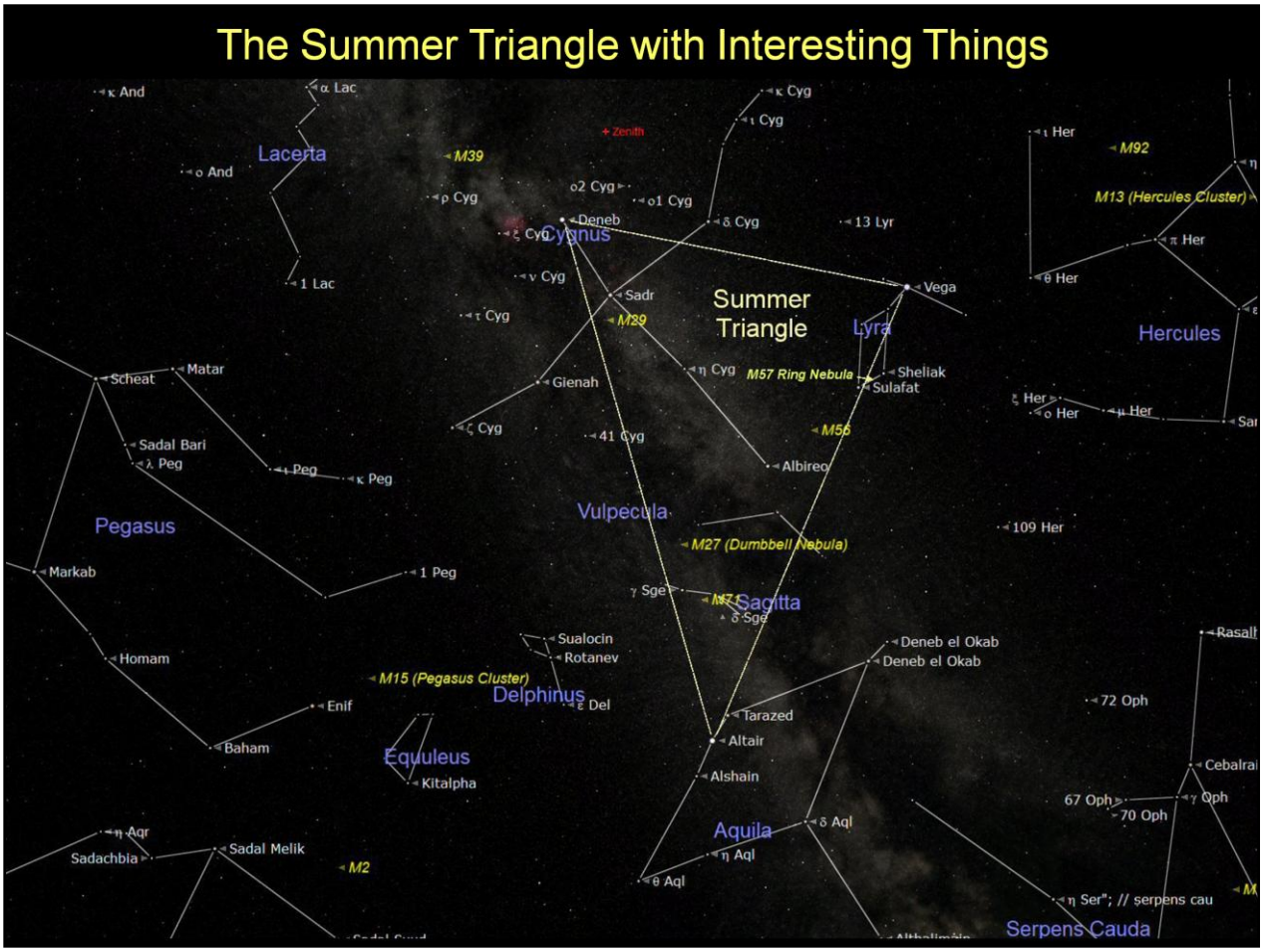
Altair is the faintest star of the Summer Triangle but the two stars on either side of Altair make it quite distinctive. Unfortunately the stick figure of Aquila has no resemblance to an Eagle what so ever.



Cygnus is one of the few constellations that does actually look like what is named after, a Swan. The brightest stars in Cygnus form a quite distinctive cross shape that does, with a little imagination, look like a Swan. There is a line of stars that run from Deneb to Albireo that represent the body and outstretched neck of the swan. To either side of the star Sadr lines of stars appear to represent the outstretched wings of the swan.

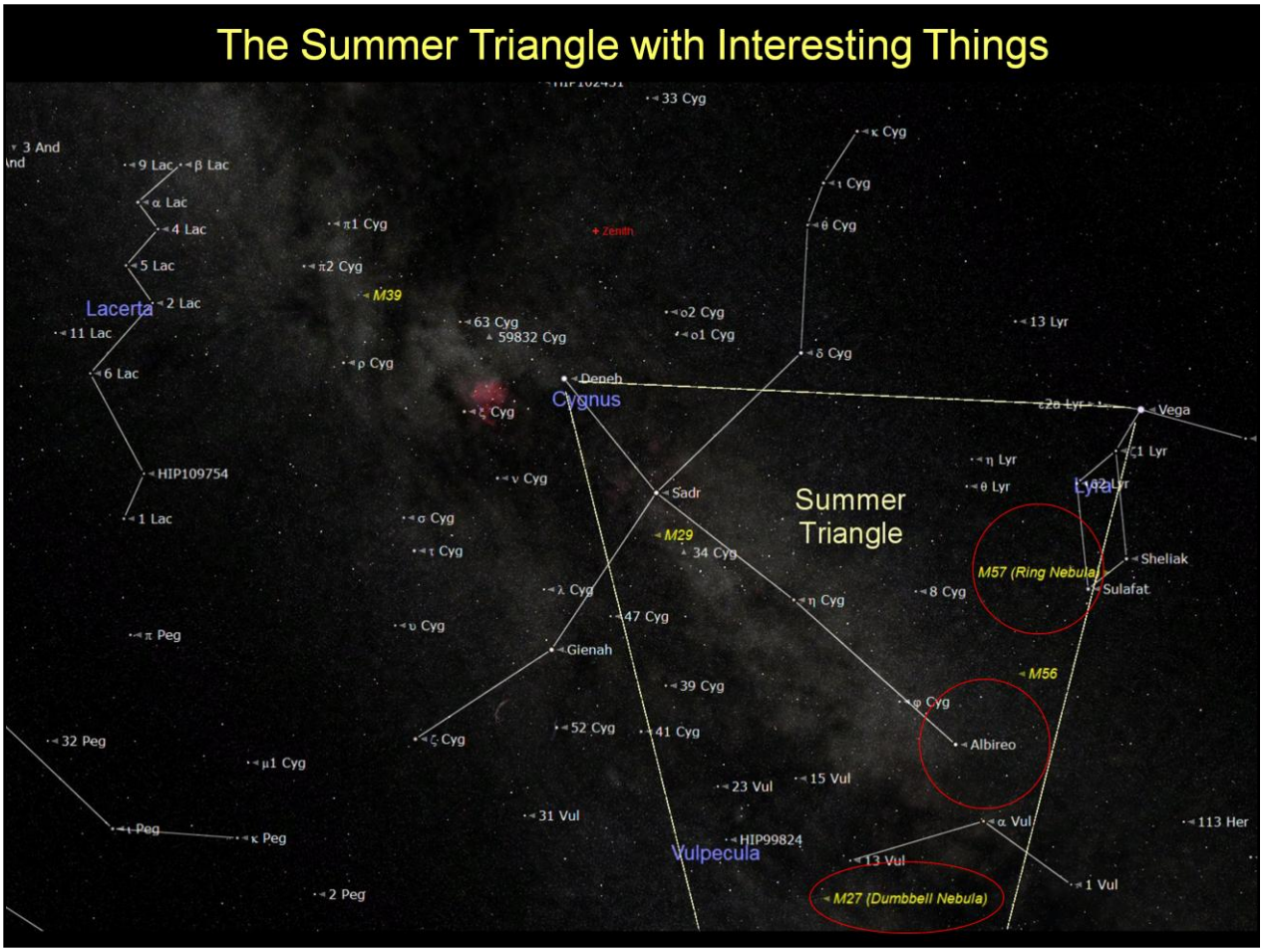
Vega has a fainter star to either side of it that follow the cross bar that supports the strings of the Lyre shown in the illustration above to represent Lyra. Below Vega are four fainter stars that make a diamond or parallelogram shape that represent the resonance box of the lyre as shown above.

Although the two stars on either side of Altair make it quite distinctive, the stick figure of Aquila has no resemblance to an Eagle at all.

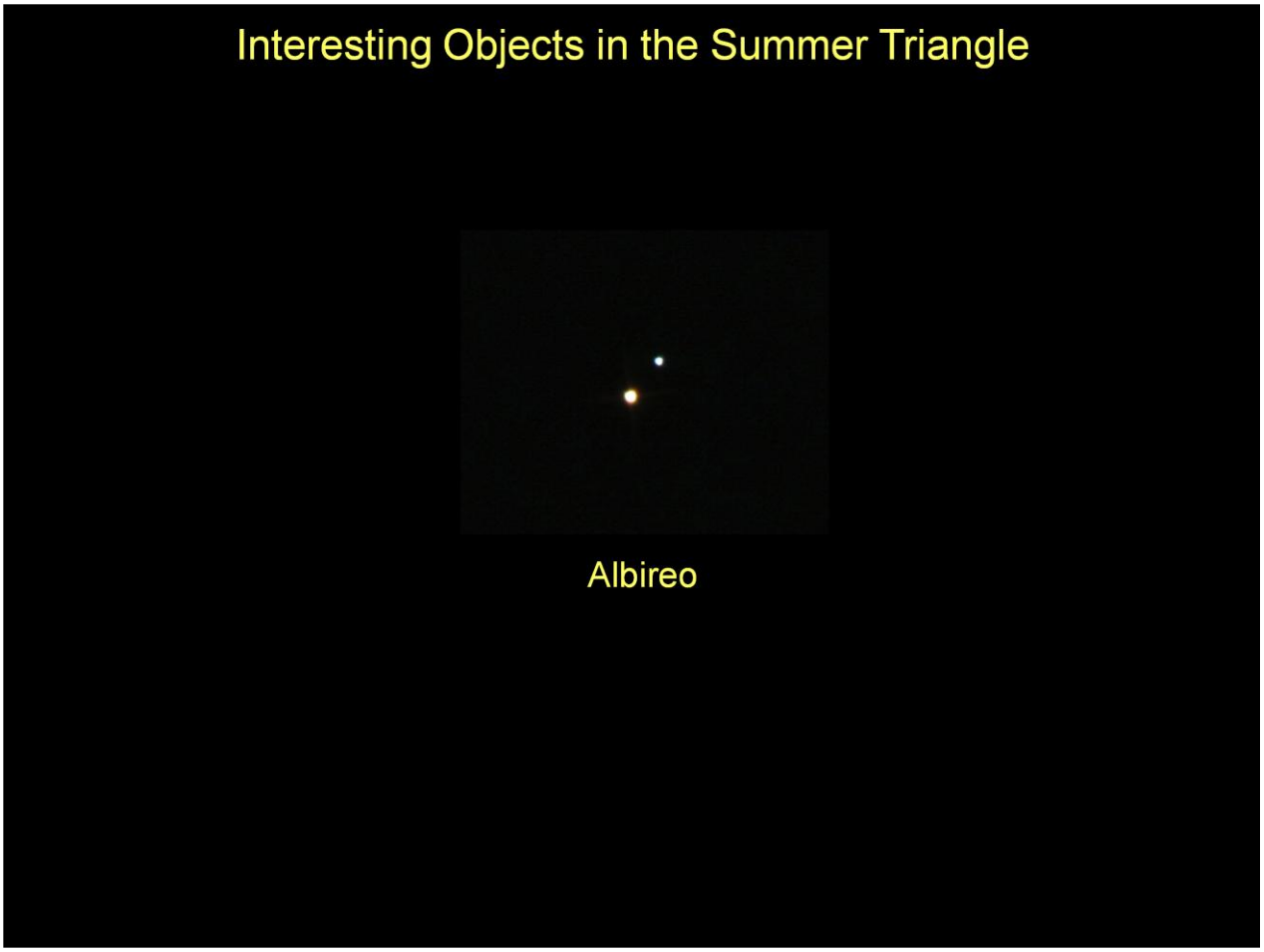


Now we have identified the Summer Triangle we can look at the things of interest in and around the Summer Triangle. There are things of interest that we can see with just our eyes (astronomers call 'Naked eyes') on a clear Moonless night. Other things might be difficult to see clearly and will need binoculars. Fainter objects will need a small telescope to fully appreciate.

The objects marked in yellow print on the chart above are 'Deep Sky Objects' this means they are located outside our Solar System. These generally require a telescope to see clearly.



The chart above identifies three objects in the upper part of the Summer Triangle that are well worth looking for. These are the star Albireo in the 'head' of Cygnus the swan. Messier 57 (M57) in Lyra and Messier 27 (M27) in the constellation Vulpecula (the Fox) a small constellation within the Summer Triangle.

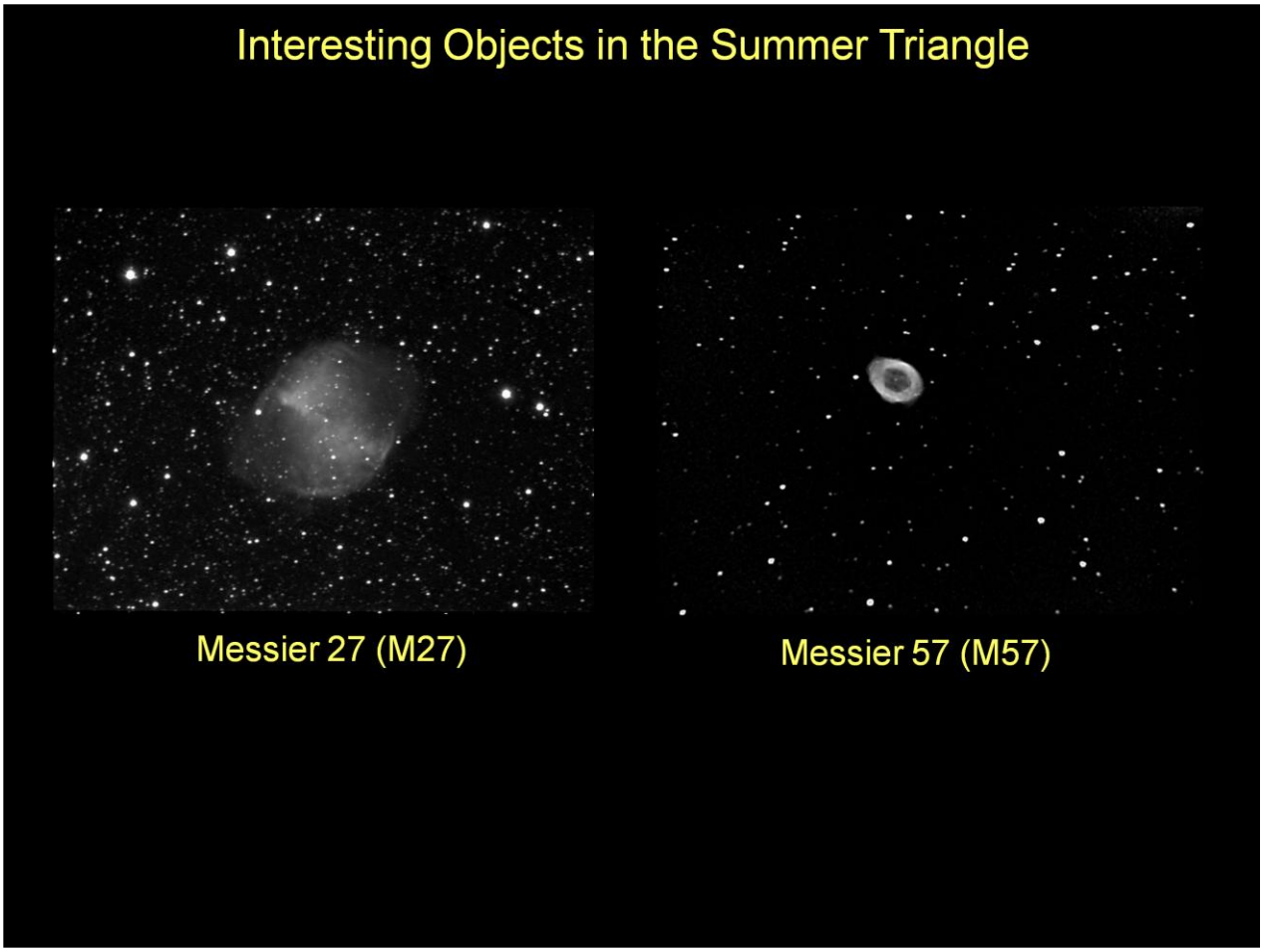


Albireo is the fainter star that denotes the head of the Swan in the constellation of Cygnus. When viewed with the 'naked eye' it appears like any other star but when viewed using a telescope it is seen as a beautiful 'Double Star'. The majority of stars (about 60%) are thought to be double or multiple star systems.

There a two types of double star. The first is a true Binary Star System where the pair (or less common triple or more) are gravitationally associated. This means the stars orbit each other or more precisely orbit a point in space between them called the Common Centre of Gravity. This is rather like a pair of skaters holding hands and spinning around a point that is located at or near their clasped hands.

The second type of binary star is much less common. This is where two stars appear very close together but are in fact just located in the same place in the sky. We call this a 'Line of Sight Double'. Albireo is this type of double star and its appearance is quite deceptive. One star is brighter and golden yellow in colour while the other is fainter and distinctively blue in colour.

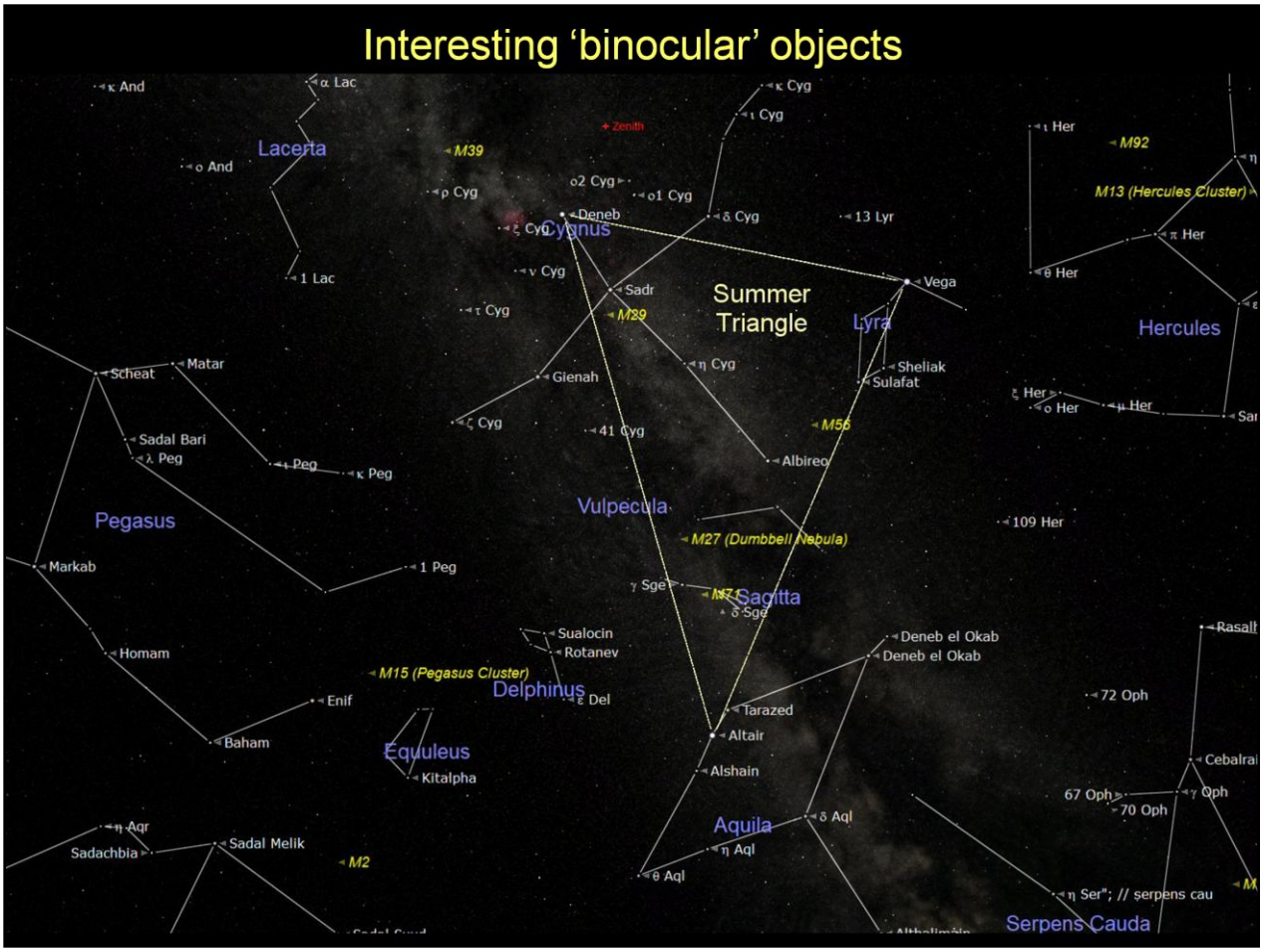
We know that blue stars are very large and extremely hot but yellow or orange stars are much cooler. Therefore we can tell the fainter looking blue star is much further away and the smaller yellow star is closer so it is a 'Line of Sight' double star.



Messier Objects are Deep Sky Objects that are located far outside our Solar System. There are 110 deep sky objects listed in the Messier Catalogue produced by Charles Messier in the 18th century. Messier was a comet hunter who also found comet like objects that proved not to be comets so he listed these as objects to be ignored. These are now the interesting objects that astronomy beginners seek out.

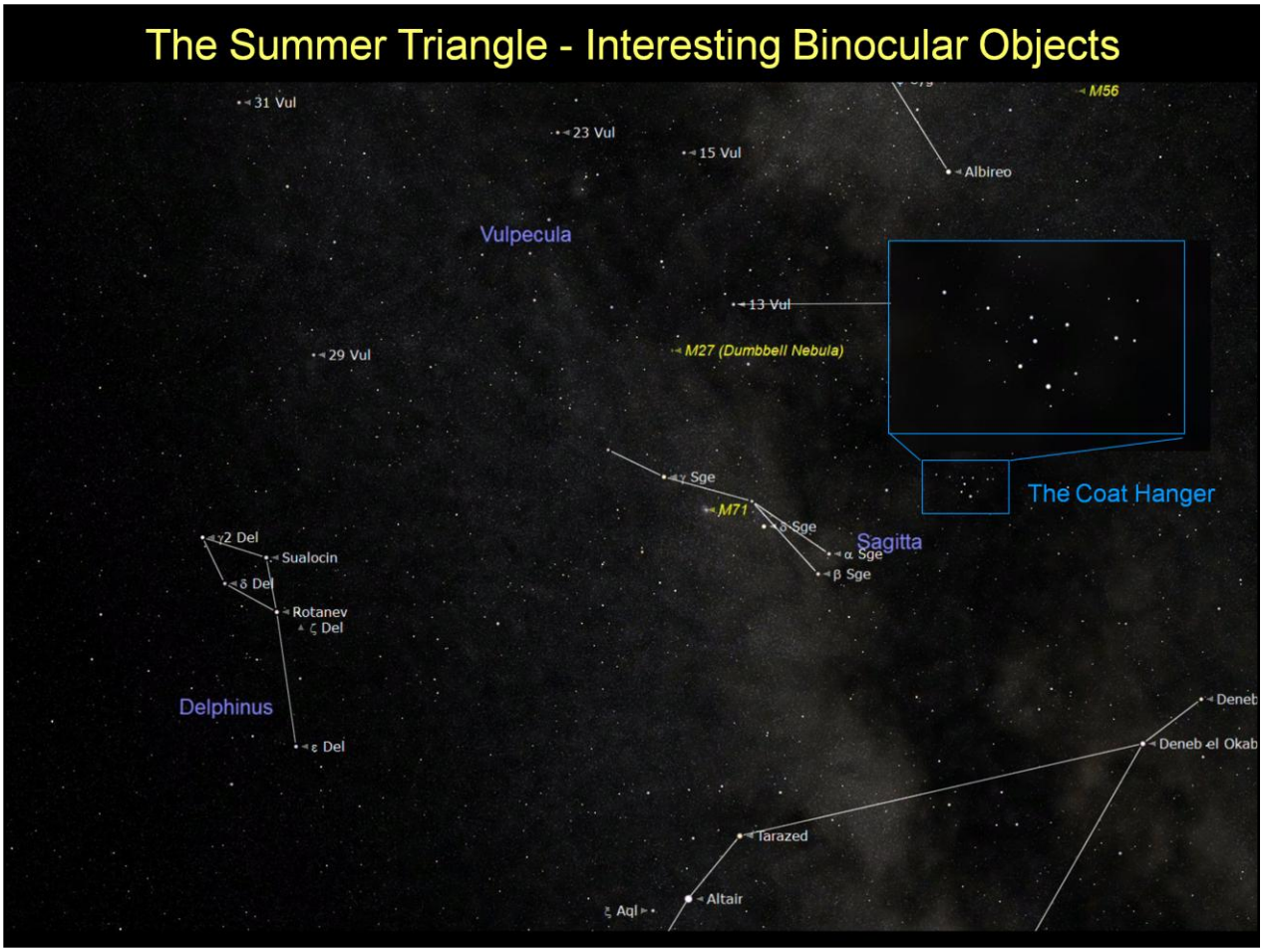
Number 57 (M57) in Messier's Catalogue is a object known as a Planetary Nebular. This is nothing to do with a planet, it just looked like a planet when viewed through the relatively primitive telescopes in the time of Messier. We now know it is a star much like our Sun that has exhausted its fuel supply. As its fuel began to run out it expanded to become a Red Giant Star. When its fuel was completely exhausted it could no longer produce the energy to push out against the inward force of its own gravity. The star slowly collapsed under its gravity and became compressed into a tiny White Dwarf Star. The outer layers of the Red Giant were left behind to drift away and produce a giant bubble surrounding the remains of the dying star.

We see the bubble of gas surrounding M57 as a ring because we see more material through the outer part of the bubble and see less material when we look straight through the side of the bubble. M27 is similar but something has distorted the bubble to produce denser lobes. M27 can be seen using binoculars but M57 cannot.



There are also some interesting small constellations in and around the Summer Triangle. These small constellations are Vulpecula (the Fox), Sagitta (the Arrow) and Delphinus (the Dolphin). These can be found in the bottom half of the Summer Triangle on the chart above and to the lower east (left).

Vulpecula (the Fox) has been discussed in the previous slides but the constellation shape is uninteresting. However within the boundary of Vulpecula the Planetary Nebula Messier 27 (M27) is just visible using binoculars on a clear dark night. It is best seen using telescope fitted a low power eyepiece.

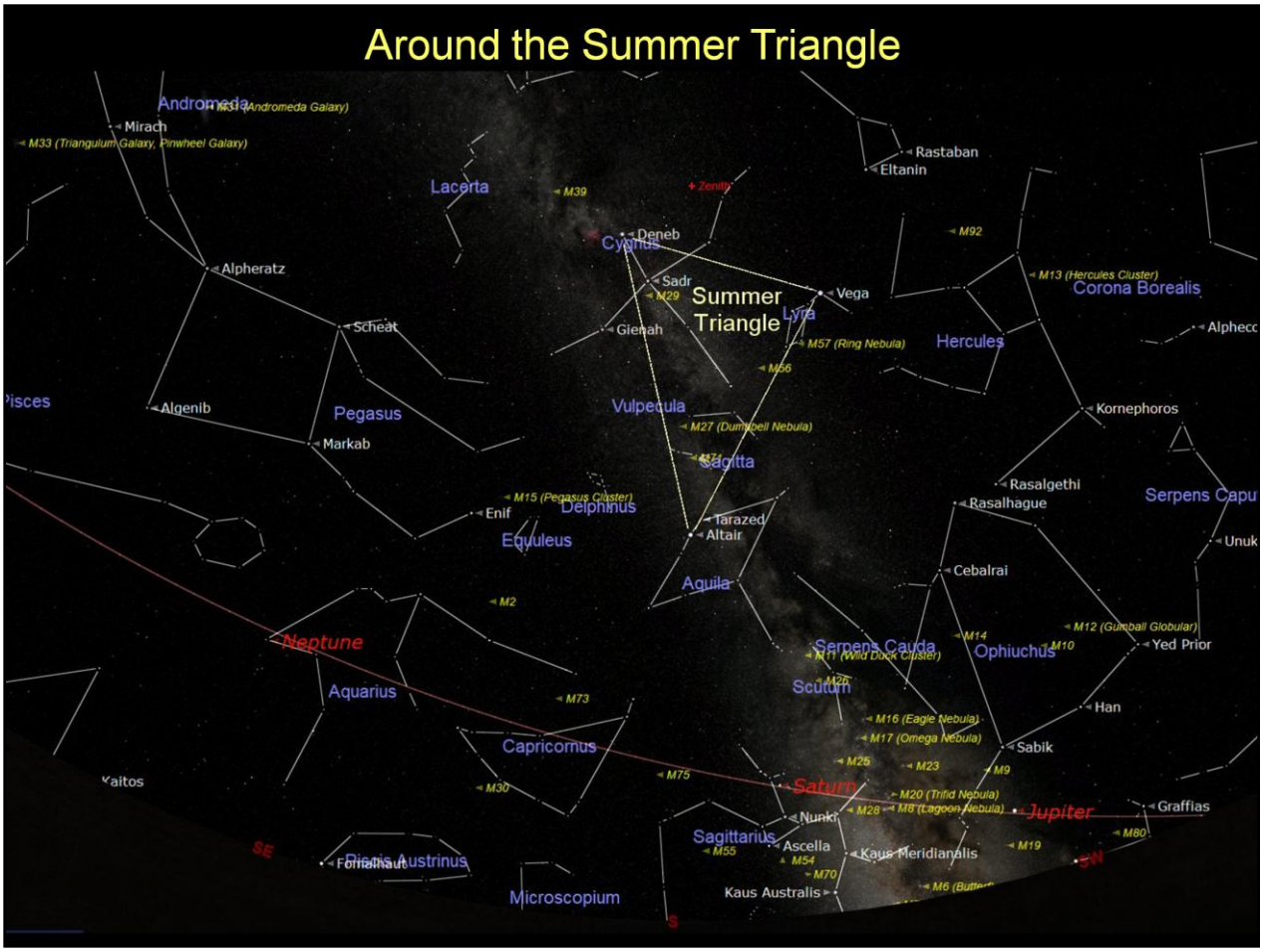


There are two small constellations that are interesting to look for, just because they do remotely resemble what they are named after. Sagitta (the Arrow) is interesting because it does look like an arrow. It can be seen with the naked eye on a dark, clear and not too light polluted sky. There is a line of three stars to represent the arrow shaft and two stars that, with imagination, look like the flight feathers.

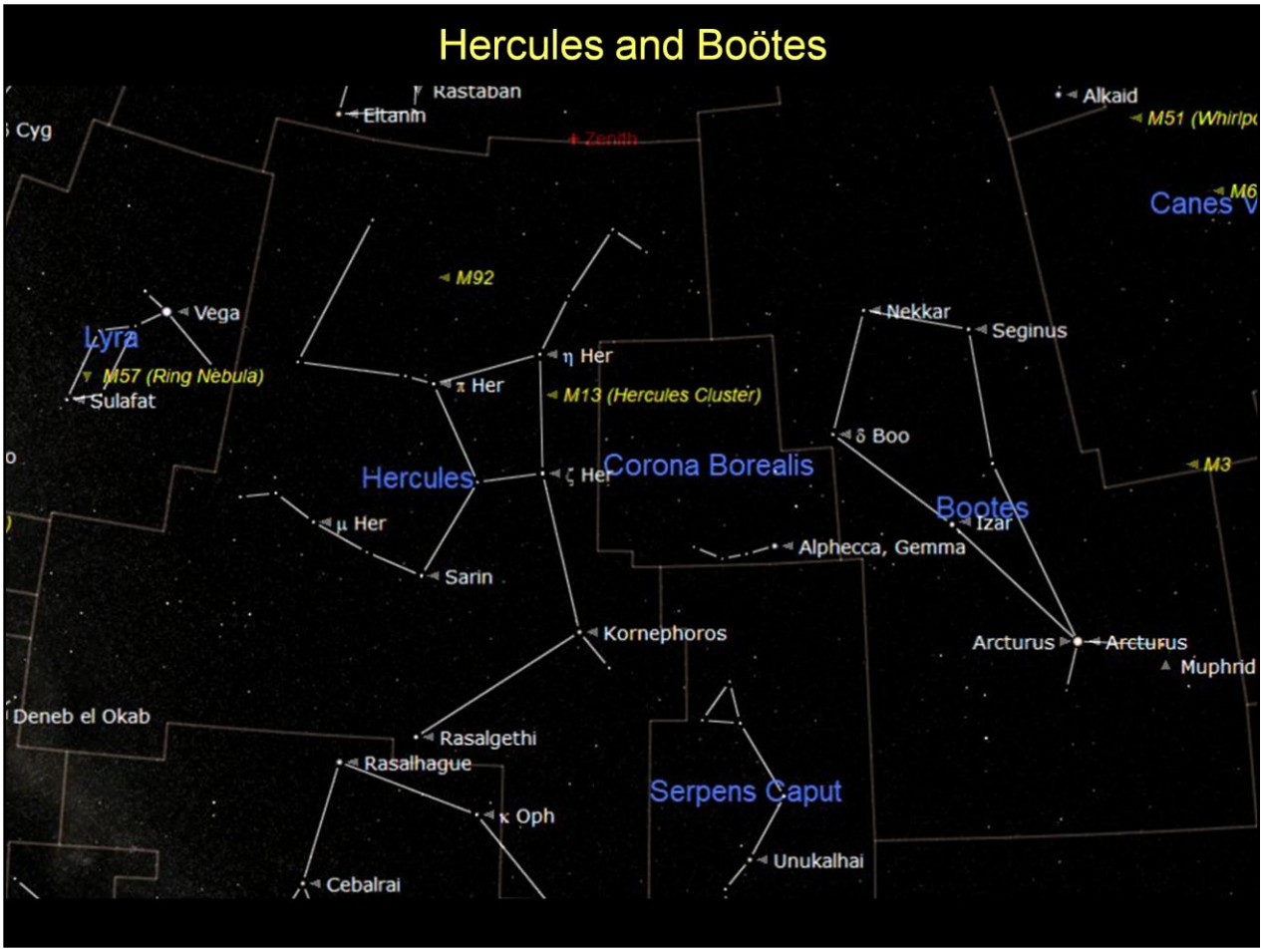
Sagitta does host a Messier object M71 which is a small Globular Cluster. It is sparse, faint and requires a telescope to see.

There is a very interesting binocular object in Sagitta. It is a small asterism (group of stars) that looks remarkably like an up-side-down coat hanger. To find the Coat Hanger first find the arrow flight feathers using binoculars then slowly sweep up and right until the amazing shape of the Coat Hanger should come into view.

Finally to the south east (lower left) of the lower part of the Summer Triangle is the rather cute small constellation of Delphinus (the Dolphin). It can be seen well with the naked eye on a dark, clear and not too light polluted sky but is too big for binoculars. Delphinus has four stars in a diamond shape that represent the body of a dolphin and another star to represent the lower body. It is strange but it does look remarkably like a dolphin leaping out of the water to our imaginative human brain.

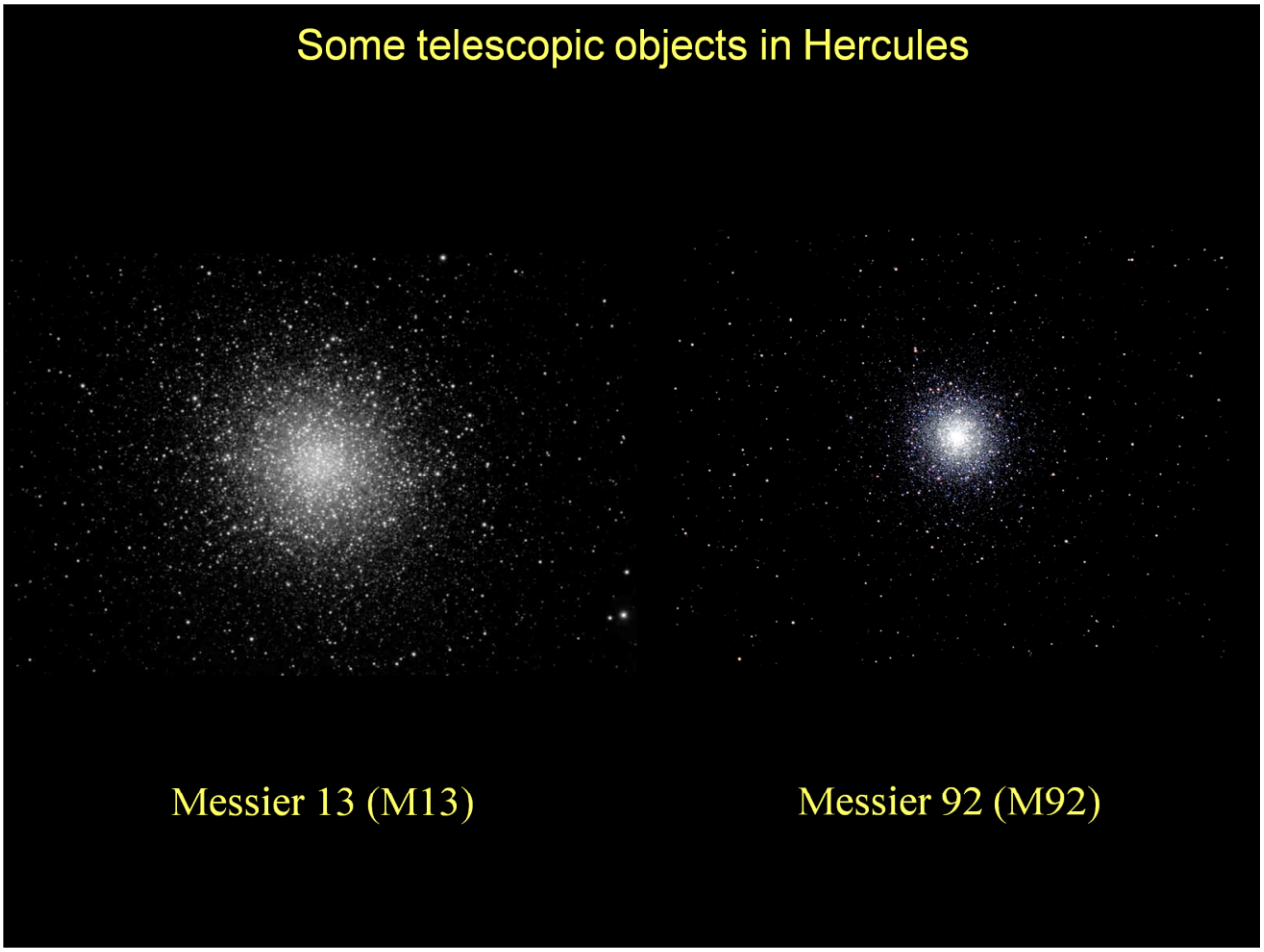


To explore a little further out into the night sky we can use the Summer Triangle as our starting point. First look to the west (right) of the Summer Triangle.



To the far right of the Summer Triangle there is a bright star that stands out amongst the fainter stars around it, this is Arcturus in the constellation of Boötes (the Herdsman). Arcturus looks slightly orange even to the naked eye but even more so using binoculars or a telescope. It is a star that is bigger than our Sun and is approaching the end of its life as a normal star. As its Hydrogen fuel is running out it has expanded to become a Red Giant Star. When its fuel is completely exhausted it will slowly collapsed under its gravity and became compressed into a tiny White Dwarf Star.

Closer to the Summer Triangle and just to the west (right) of the bright star Vega is the Constellation of Hercules (the Strong Man). The main feature of Hercules is the misshapen square at its centre. It is called the 'Keystone' due to its resemblance to the central stone of a stone arch. In the western (right) vertical side of the Keystone is a very beautiful Messier deep sky object known as Messier 13 (M13). This is the biggest and brightest Globular Cluster to be found in our night sky. It can be seen as a patch of light using binoculars. There is another smaller Globular Cluster known a Messier 92 (M92) in the upper part of Hercules.

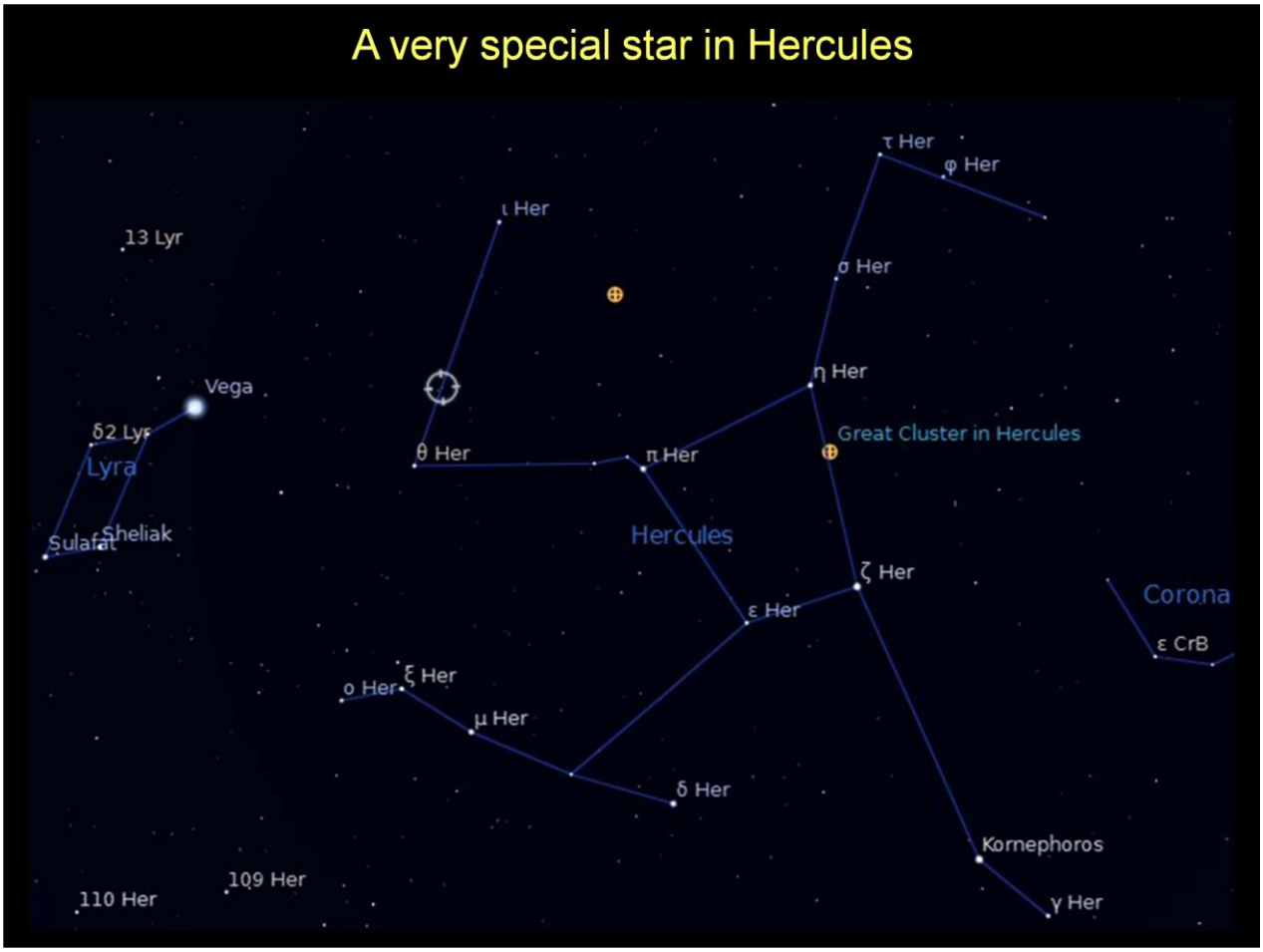


Globular Clusters are thought to be the remnants of smaller galaxies that have ventured too close to our Giant Spiral Galaxy that we call the Milky Way. Our Milky Way Galaxy can be seen on the first slide in this presentation (page 2).

Our Galaxy is thought to have about 100 Globular Clusters that orbit the centre of the Milky Way in random trajectories and may even pass through the Spiral Arms. They typically contain between 10,000 to 1,000,000 stars that appear to be very old like the stars at the centre of most galaxies.

Messier 13 (M13) can be seen using binoculars on a clear dark night and appears as a small 'fuzzy' patch of light. A small telescope will show the outer stars as individual stars but the central stars will not be resolved. A larger telescope will show individual stars further in towards the centre. M13 is the closest and therefore appears as the largest and brightest Globular Cluster visible from the UK.

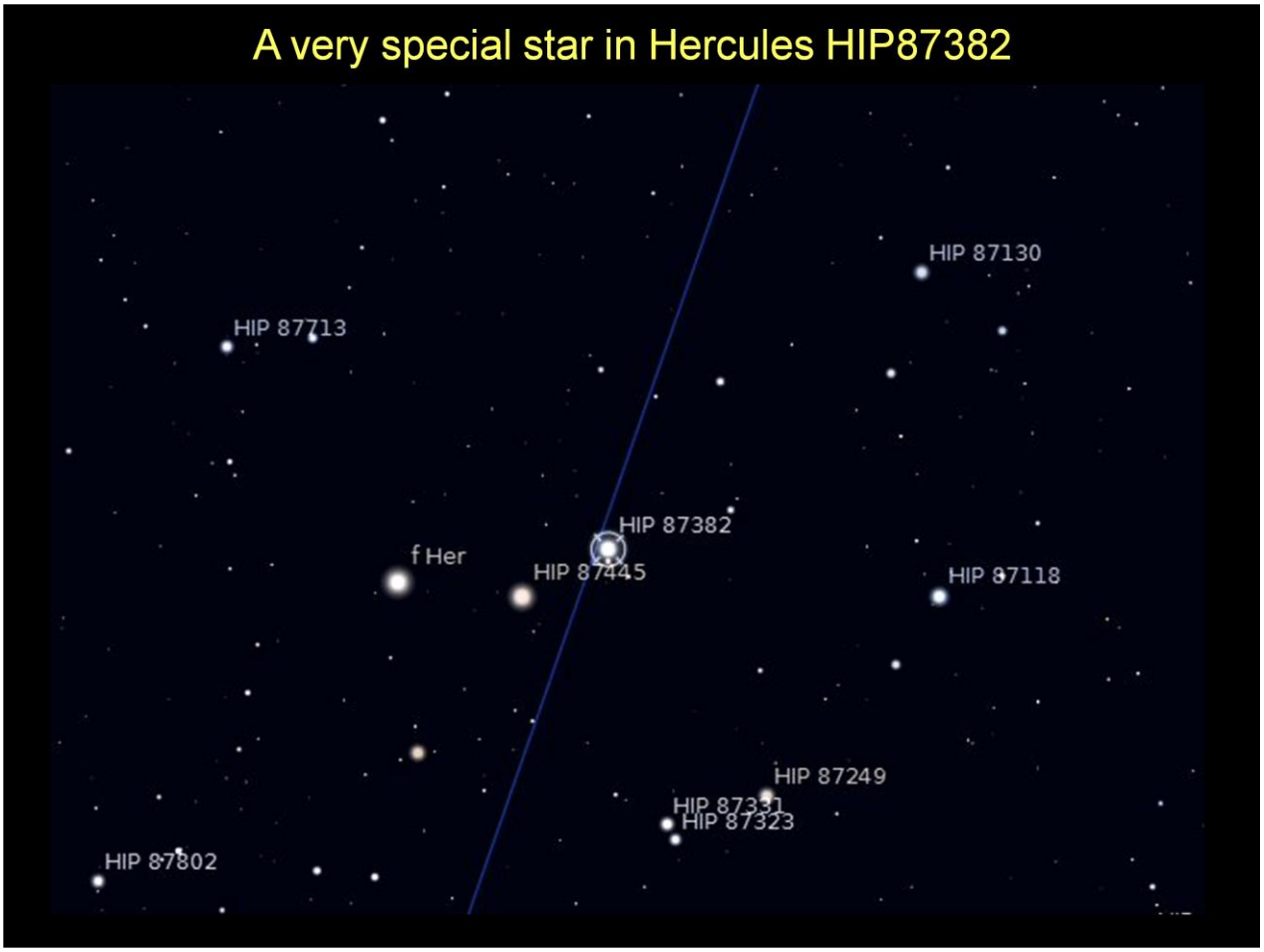
Messier 92 (M92) is further away from us and therefore appears smaller, fainter and needs a telescope to see clearly. However its lack of size is made up for by its appearance through a larger telescope. It displays a lovely symmetrical tighter ball of stars and looks a little 'more tidy' than M13.



There is a very special star in the constellation of Hercules known as HIP 87382 not a very interesting name but it is a very interesting star for us on Earth. HIP 87382 is quite easy to find but does need a telescope to identify it.

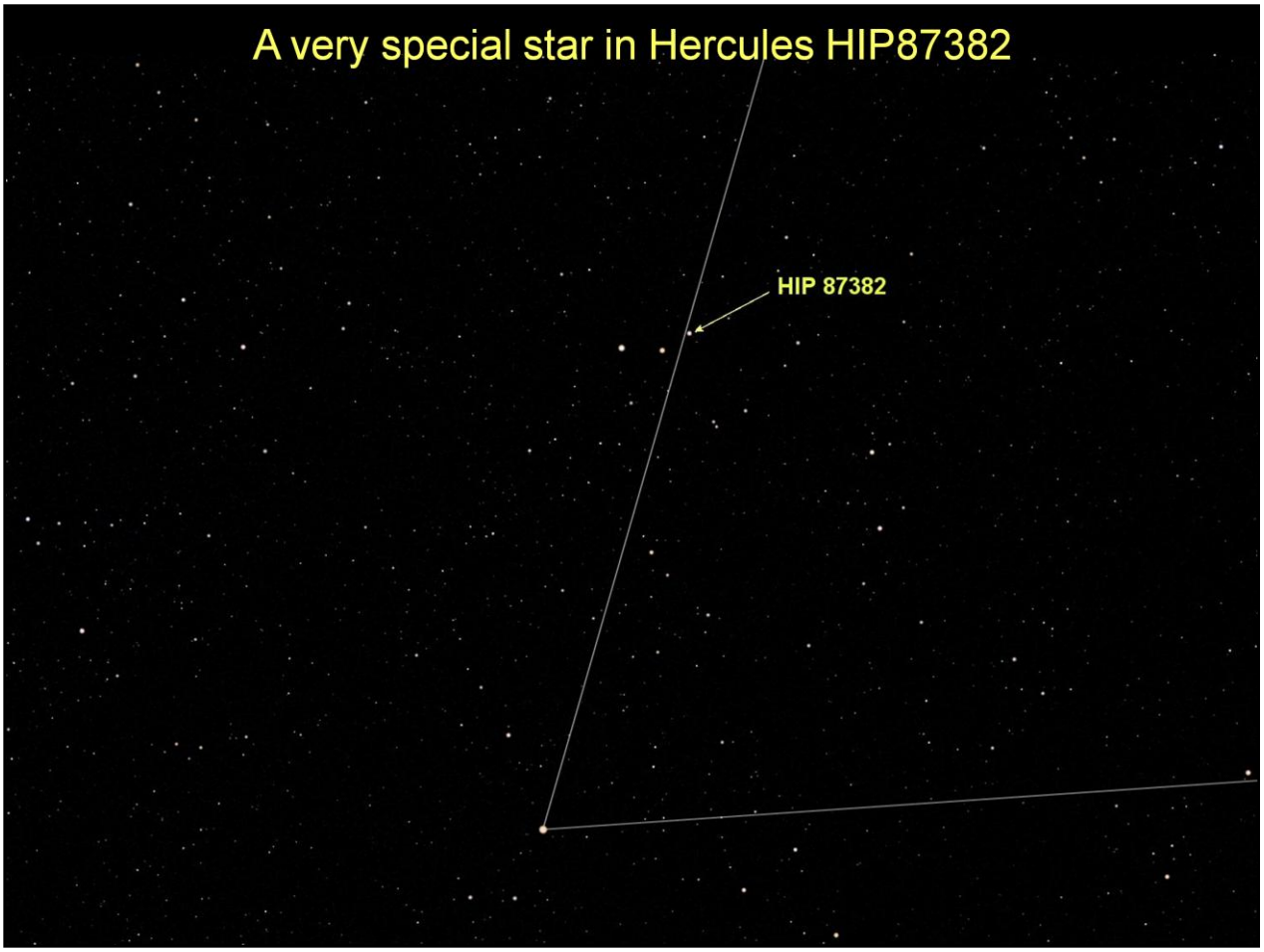
If we try to think of the asterism (shape) of the stick figure representing Hercules the Strong Man, the ‘Keystone’ could be his body and the lines of stars emanating from the corner stars would be his arms and legs. The left arm has an elbow at the star called θ Her and just above the elbow a circle in marked, on the chart above, to indicate the location of HIP 87382.

The next slide shows the location of HIP 87382 magnified.



The chart above shows the star HIP 87382 with two adjacent stars named HIP 87445 and f Her. To identify HIP 87382 we also need to look for the triangle of three stars below HIP 87382 [HIP 87249, HIP 87337 and HIP 87323]. The view through a telescope may be flipped Vertically or Horizontally by the telescope optics. So the small triangle of stars may appear above HIP 87382 or the whole might be flipped sideways and appear like the mirror image of the view shown above. The triangle of stars will always appear above or below HIP 87382 so the star above or the triangle will be HIP 87382. The author's telescope showed the mirror image of the chart above with the triangle below HIP 87382 with HIP 87445 and f Her to its right.

So what is so special about HIP 87382?

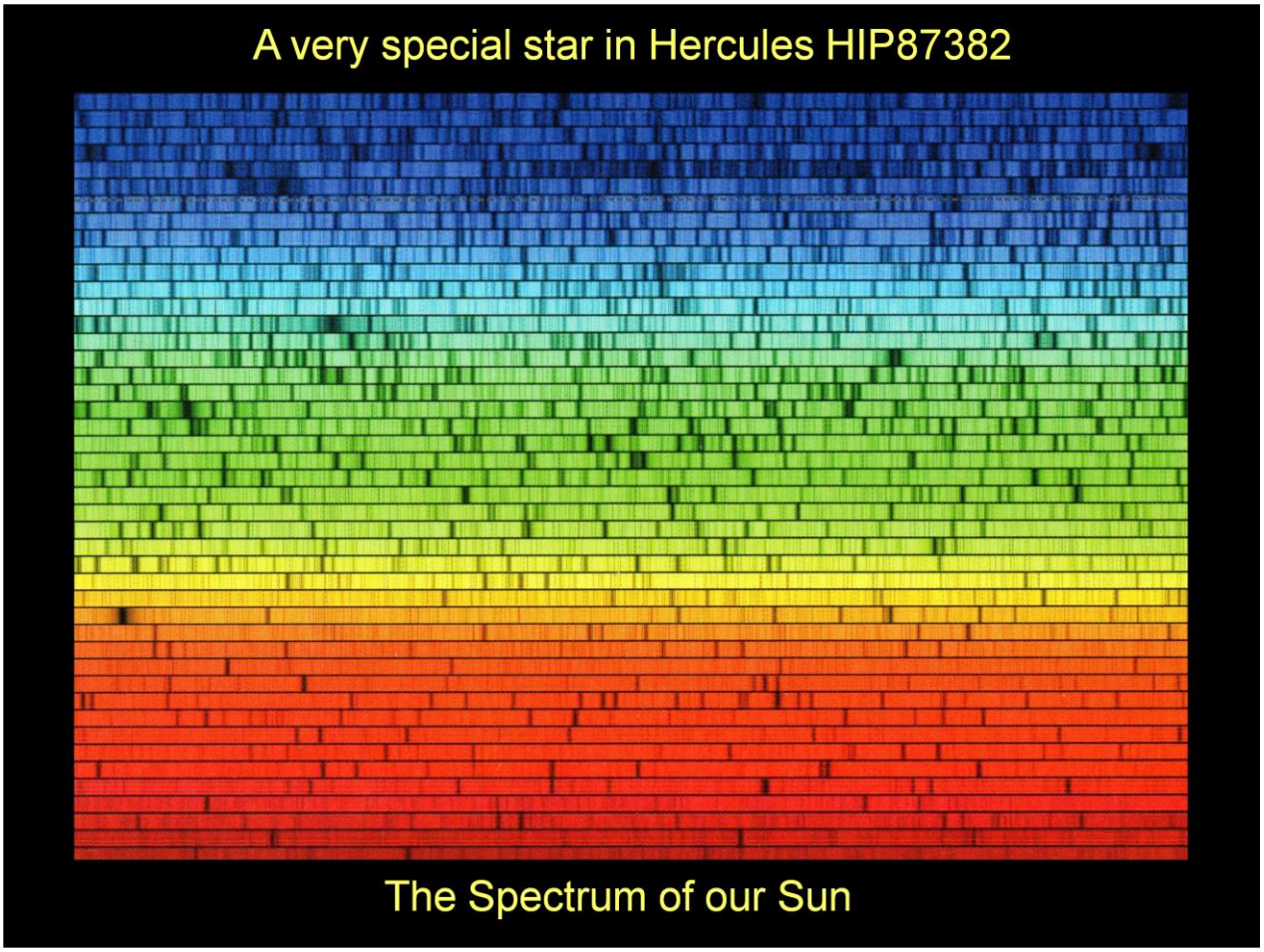


HIP 87382 may be our Sun's sister.

Stars are created (born) in vast clouds of gas and dust in the spiral arms of galaxies like our Milky Way Galaxy. The gas is primarily Hydrogen that was created in the 'Big Bang' the moment when the Universe was created.

Gas and dust in the vast clouds , known as a 'Nebula', is drawn into dense clumps of gas by gravity that then grow ever larger and denser as they pull in more gas and dust. Eventually they are pulled inwards and compressed to form into extremely dense spheres. The cores of these spheres become so compressed and hot that the Hydrogen atoms fuse together to produce atoms of the gas Helium. This 'Fusion' process produces enormous amounts of energy in the form of X Rays that heat the sphere and it begins to shine as a new star.

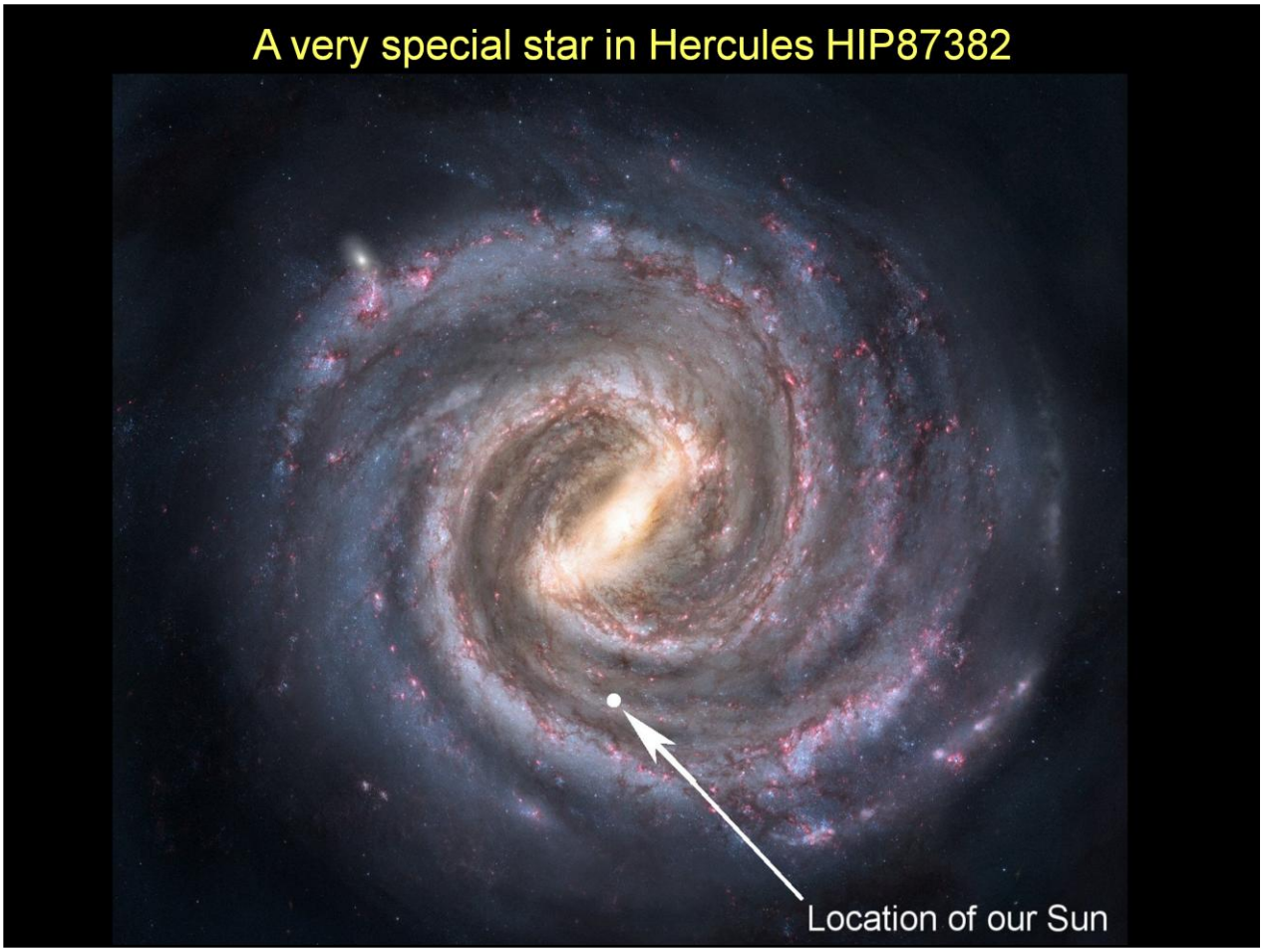
As the stars form in the Nebula, the radiation from the new stars drive away the unused gas of the Nebula to reveal a cluster of new stars called an 'Open Cluster'. These stars will have slightly different motions in space and will gradually move further apart and begin their own journey around the Galaxy. Of all the stars around our Sun HIP 87382 appears to have the same chemical make up as our Sun.



So how do we know what stars are made of?

The light from a star appears more or less white although some are redder and others may shine with a blue hue. However the 'Continuum' of the light from the star is comprised of all the different wavelengths of light. The image above shows the continuum of light from our Sun split into the different wavelengths (colours) to show a 'Spectrum' of the colours. Blue light has the shortest wavelength so the shortest blue wavelength is positioned at the top left of the 'Spectrum' above. Longer wavelengths are shown along the top row and continue from left to right down the diagram in rows and from left to right. The colour we perceive with our eyes changes on the spectrum from blue, to green, yellow, orange and red.

Across the horizontal rows of the spectrum we can see dark vertical lines. These show where the light from the star has been absorbed by material between the star and us. Atoms of every element absorb different wavelengths of light and produce a different pattern of vertical lines on the spectrum. We can identify the different elements and their proportions in the composition of the star by identifying their unique line patterns on the spectrum from the star. HIP87382 appears to have the same pattern of lines indicating it has the same elementary composition of the as our Sun. So it may have been created from the same nebula and be from the same Open Cluster as our Sun.



So why is this star so interesting?

Our Sun was created about 4.3 billion years ago from a nebula in the Milky Way Galaxy and became a member of an Open Cluster most likely of between 30 and 300 stars.

The stars of our Sun's cluster began their trek around the galaxy in different directions about a million years after they formed. They have now been travelling at about 22,000 km/sec for 4.3 billion years. The stars have each completed about 20 circuits of the Galaxy in this time.

There are thought to be between 200 and 300 billion stars in our Galaxy. So as the stars from our open cluster set of in different directions 4.5 billion years ago it has always seemed impossible that we could ever find one of these stars. Now it is thought possible that HIP87382 may be one of our Sun's siblings and is only about 11 light years away. That would be quite some coincidence if it is proved to be true.

Beginner's Website:

naasbeginners.co.uk