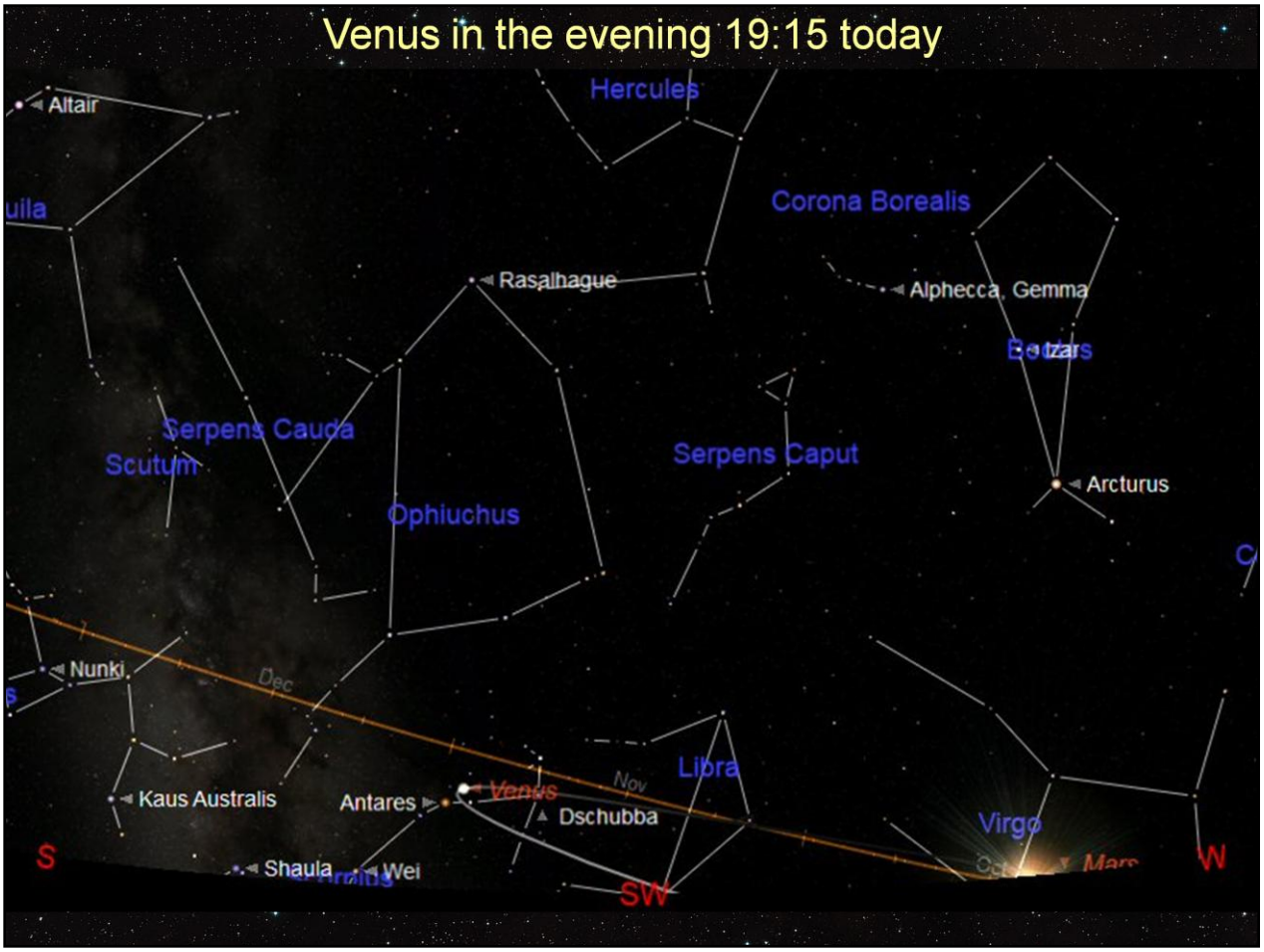
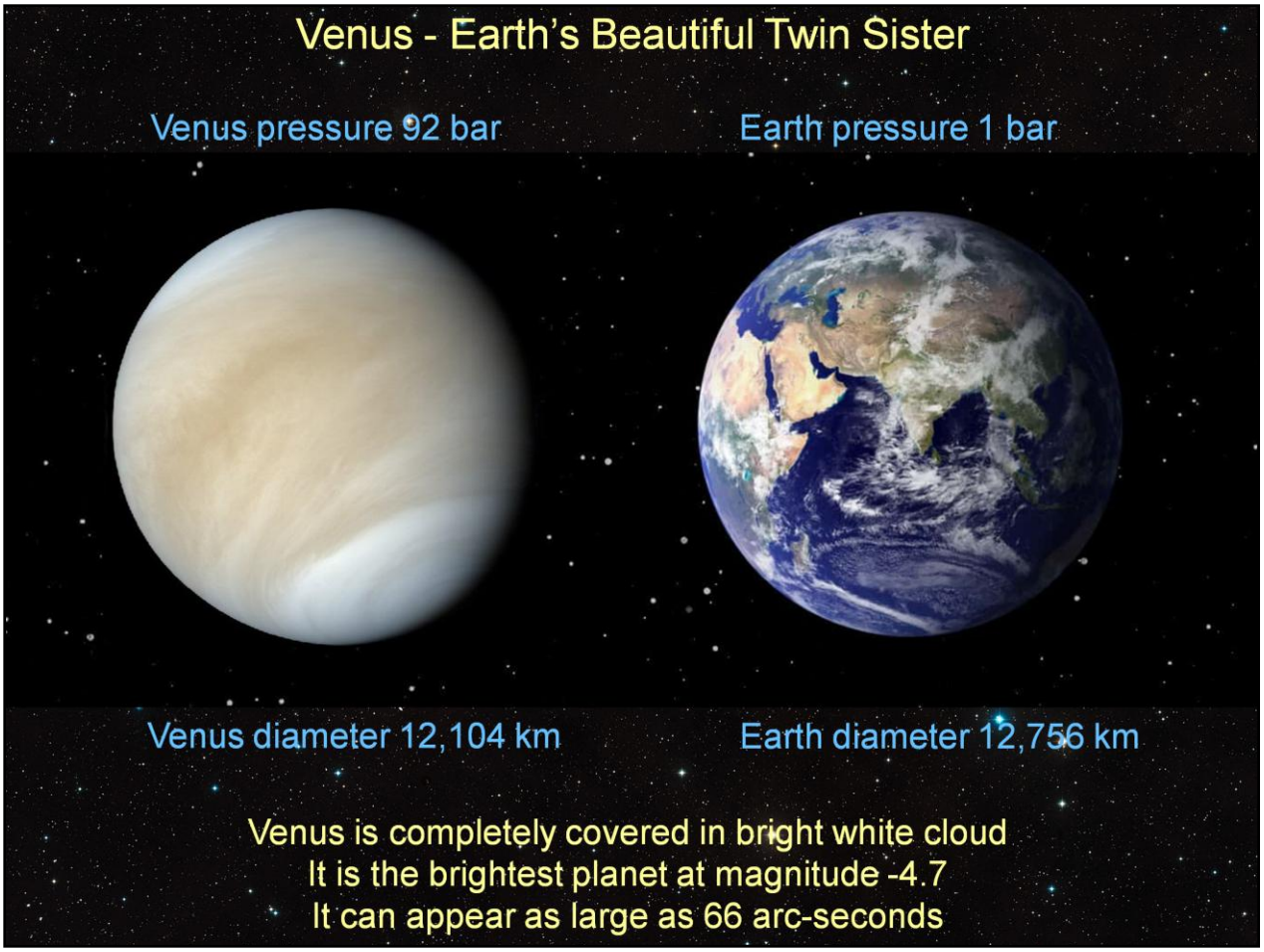
This presentation was given to the Newbury Astronomical Society Beginners Meeting on 15th September 2021.



The chart above shows the position of Venus at the of the September 2021 meeting and as it will be seen at 19:15 as the Sun is setting over the western horizon.

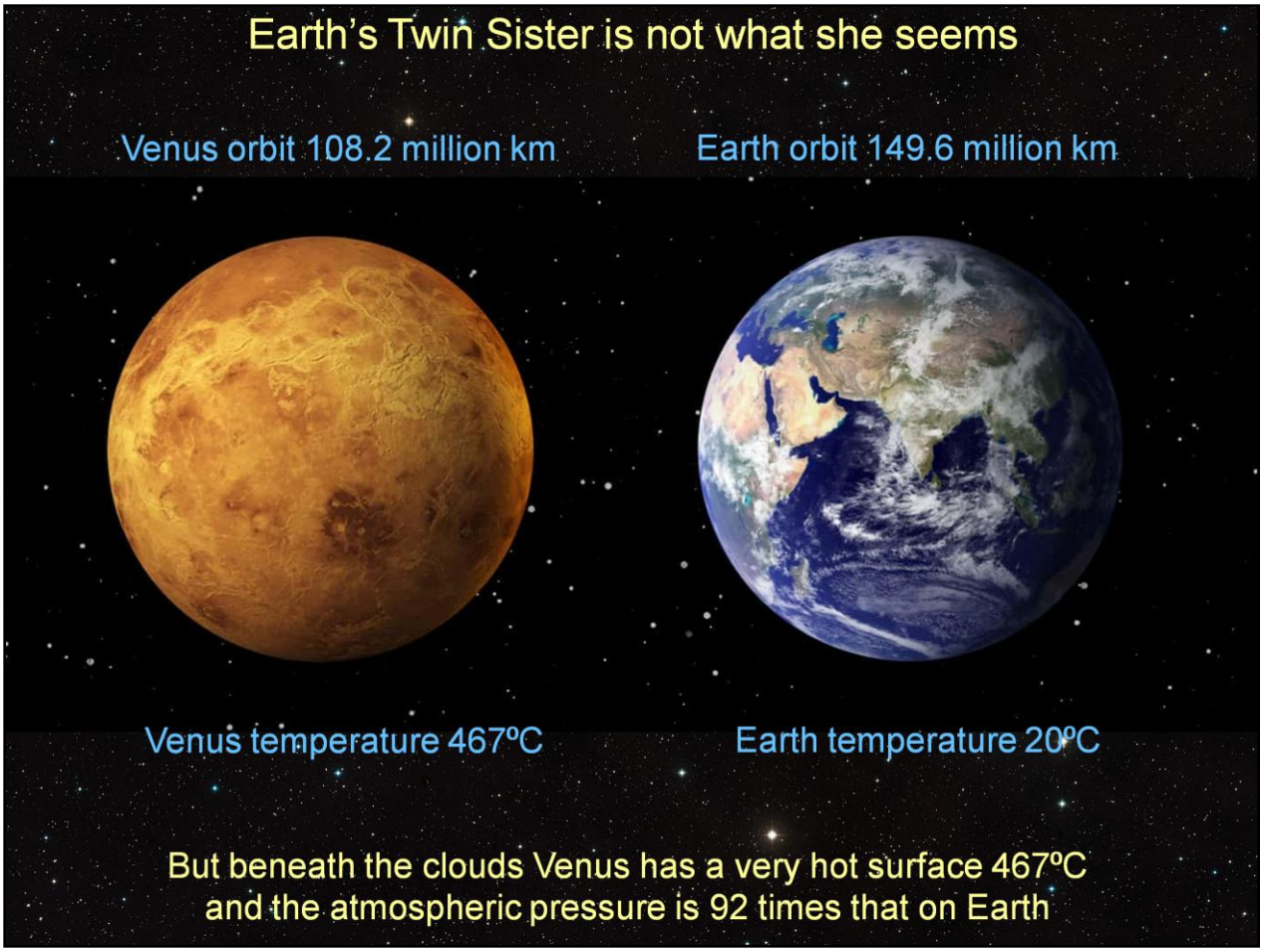
This means Venus is best seen early in the evening after the Sun has set. A clear view to the western horizon is required to see Venus.



Venus is the second planet out from the Sun and in many ways it is the twin of our planet Earth. Venus is 12,104 kilometres in diameter so it is slightly smaller than Earth that is 12,756 kilometres in diameter.

Venus orbits 108.2 million kilometres from the Sun compared to Earth's orbit of 149.6 million kilometres from the Sun. It is thought that the two planets have similar composition with one exception being the amount of water they have. The amount of water may have been similar in the past but Venus appears to have lost the majority of its water.

Venus is completely covered with a thick white atmosphere of Carbon dioxide gas (CO_2) that completely obscures the surface. The white cloud also reflects the sunlight and causes the planet to shine very brightly.

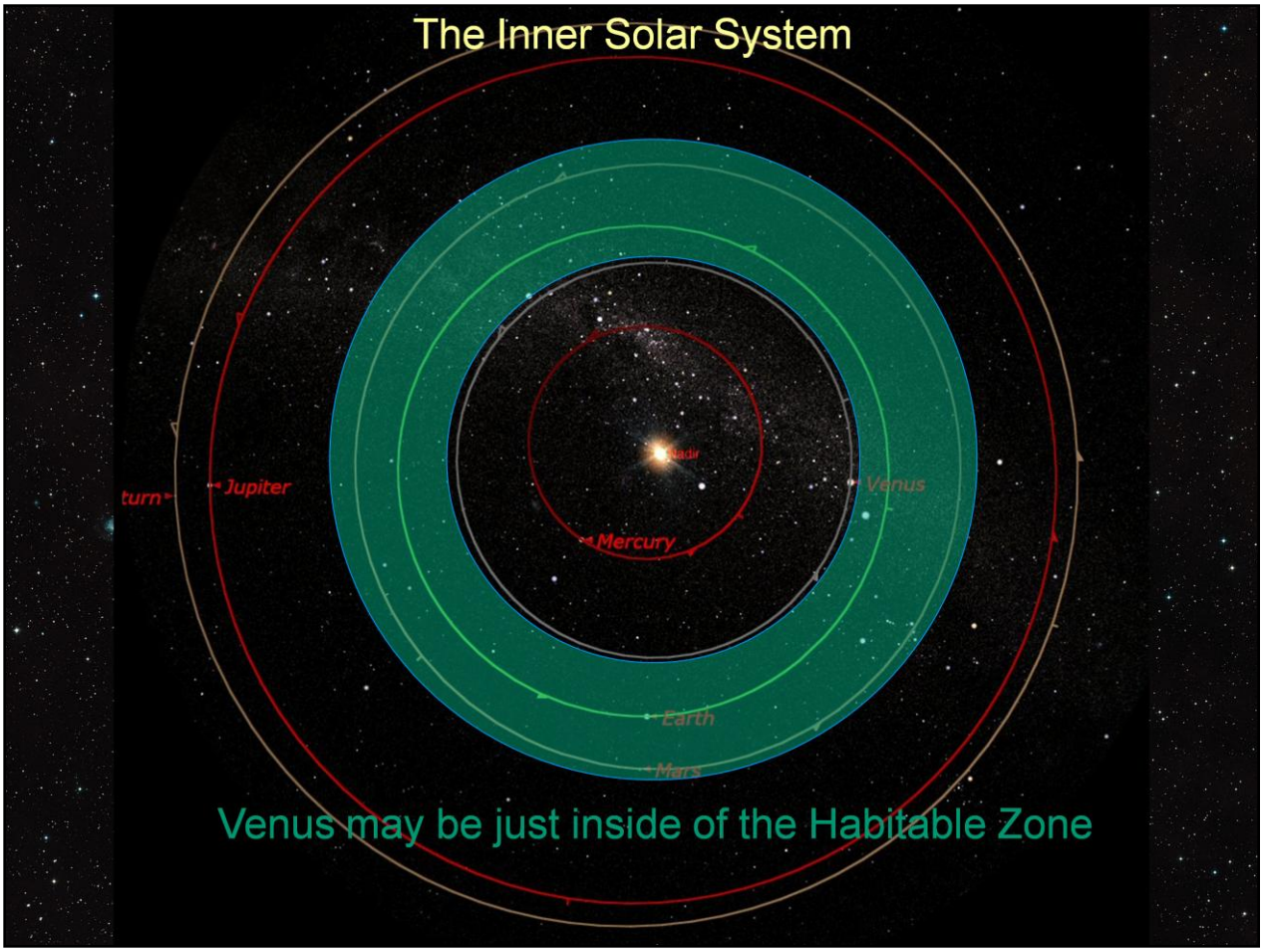


Venus is closer to the Sun and appears to have suffered a 'runaway greenhouse effect'. The additional heat from the Sun may have caused the surface temperature to rise and the Carbon that is trapped in the rocks on Earth was released into the atmosphere on Venus to form Carbon Dioxide (CO_2). The Carbon Dioxide allows the heat from the Sun to reach the surface but prevents it from being radiated back into space. The temperature then steadily increased in a runaway manner until it reached the 467°C surface temperature we see on Venus today.

The Carbon Dioxide (CO_2) atmosphere on Venus is not only hot but is very thick as well. The atmospheric pressure at the planet's surface is 92 times that on Earth, or roughly the pressure found 900m (3,000ft) underwater on Earth. If it was possible to stand on the surface of Venus (which it is not, it is far too hot) the view would be very odd because the refraction of light would cause large distortions compared to our atmosphere.

Venus is also thought to have Sulphuric Acid rain.

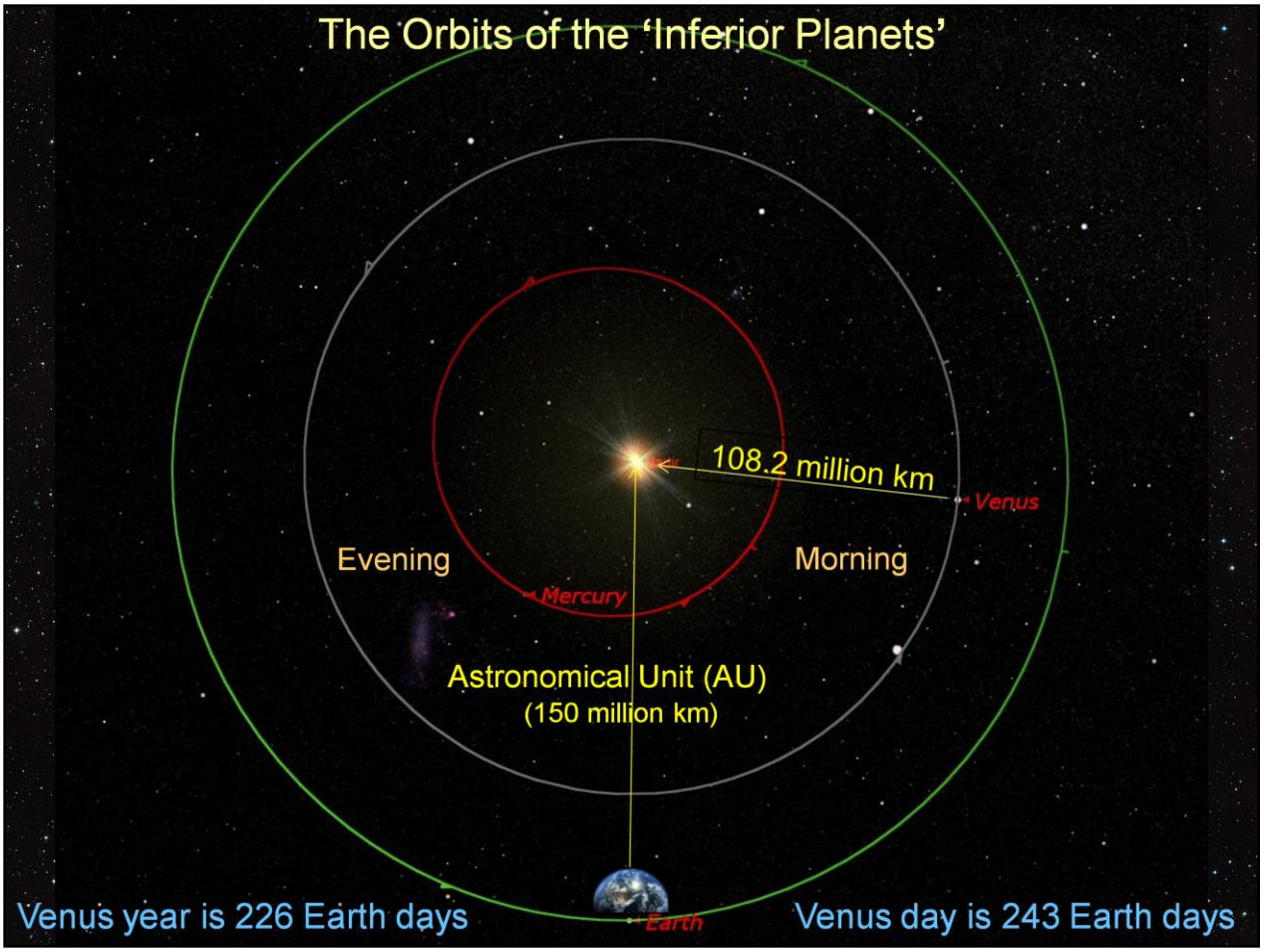
It is thought that Venus may have had water oceans on its surface and an atmosphere that recycled water until about 2½ billion years ago.



Venus has an orbital period (year) equivalent to 226.5 Earth days but its axial rotation (day) is equivalent to 243 Earth days. This means a day on Venus is longer than its year. Not that this makes any difference on the surface because the Sun is never visible due to the very thick Carbon Dioxide (CO_2) clouds.

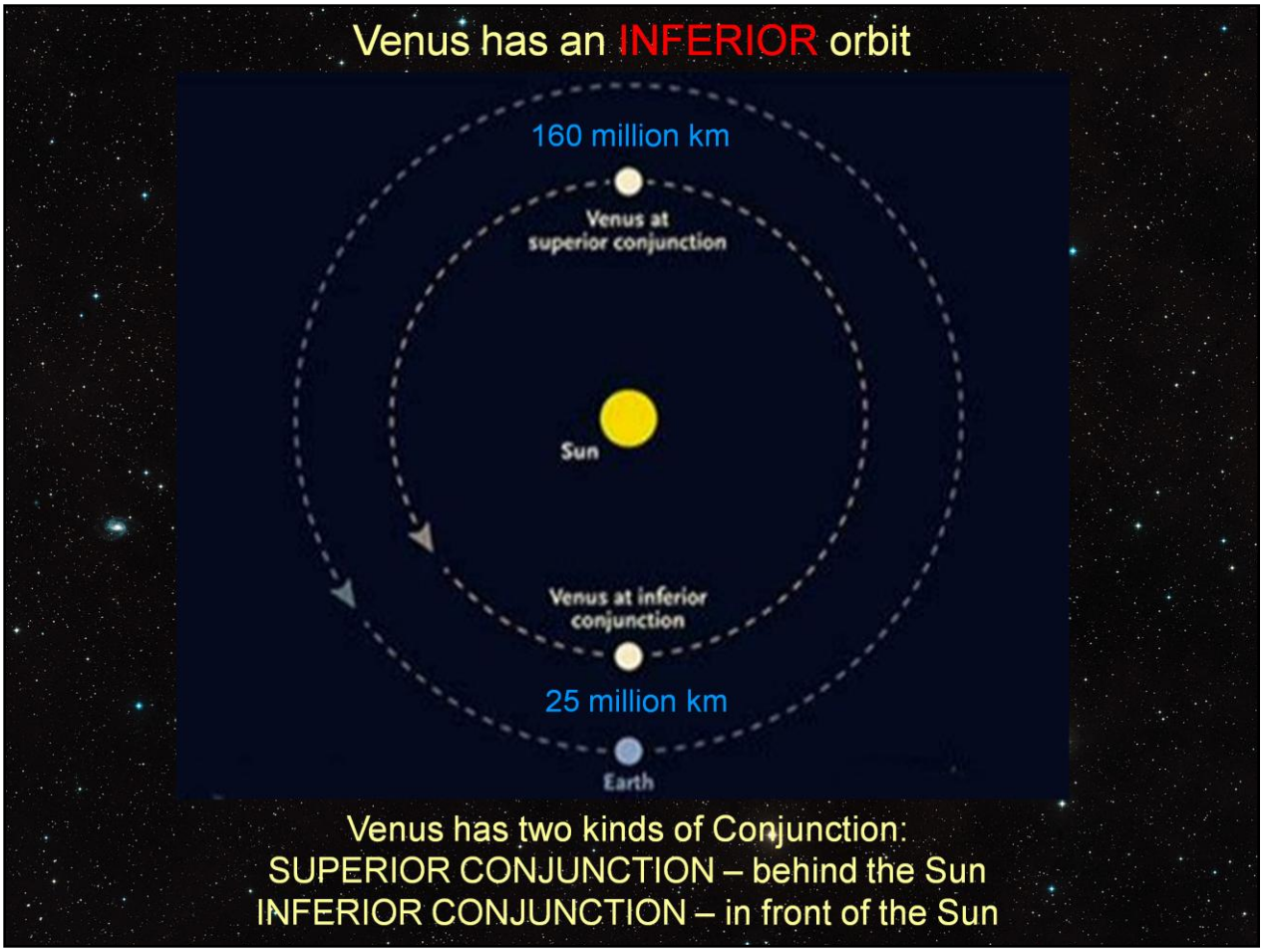
Venus orbits at 108.2 million kilometres from the Sun compared to Earth's orbit of 149.6 million kilometres from the Sun.

It is thought that Venus may have its orbit just a little bit closer to the Sun that the inner edge of the Habitable Zone. This is the zone that is far enough from a star to provide the right temperature range for water to be liquid and for life (as we know it) to develop. It is also called the 'Goldilocks Zone' because it is "not too hot and not too cold but just right" [for liquid water to exist].



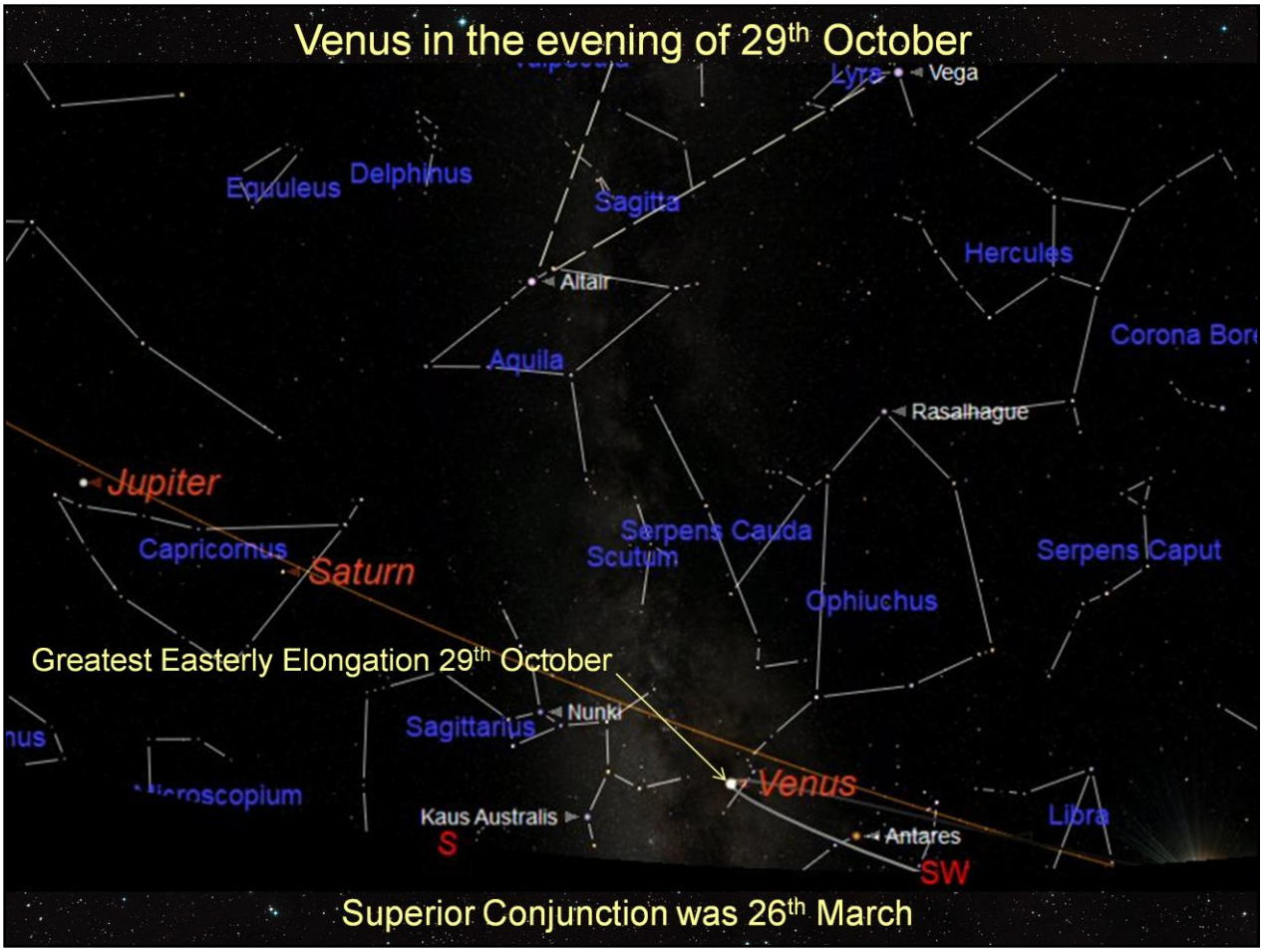
The two innermost planets: Mercury and Venus are called the Inferior Planets not because they are less important but because their orbits are inside the orbit of Earth. Therefore they always appear towards the Sun and are the only planets that pass between Earth and the Sun.

Venus is a little weird because its day (rotation period) is longer than its year (orbital period).

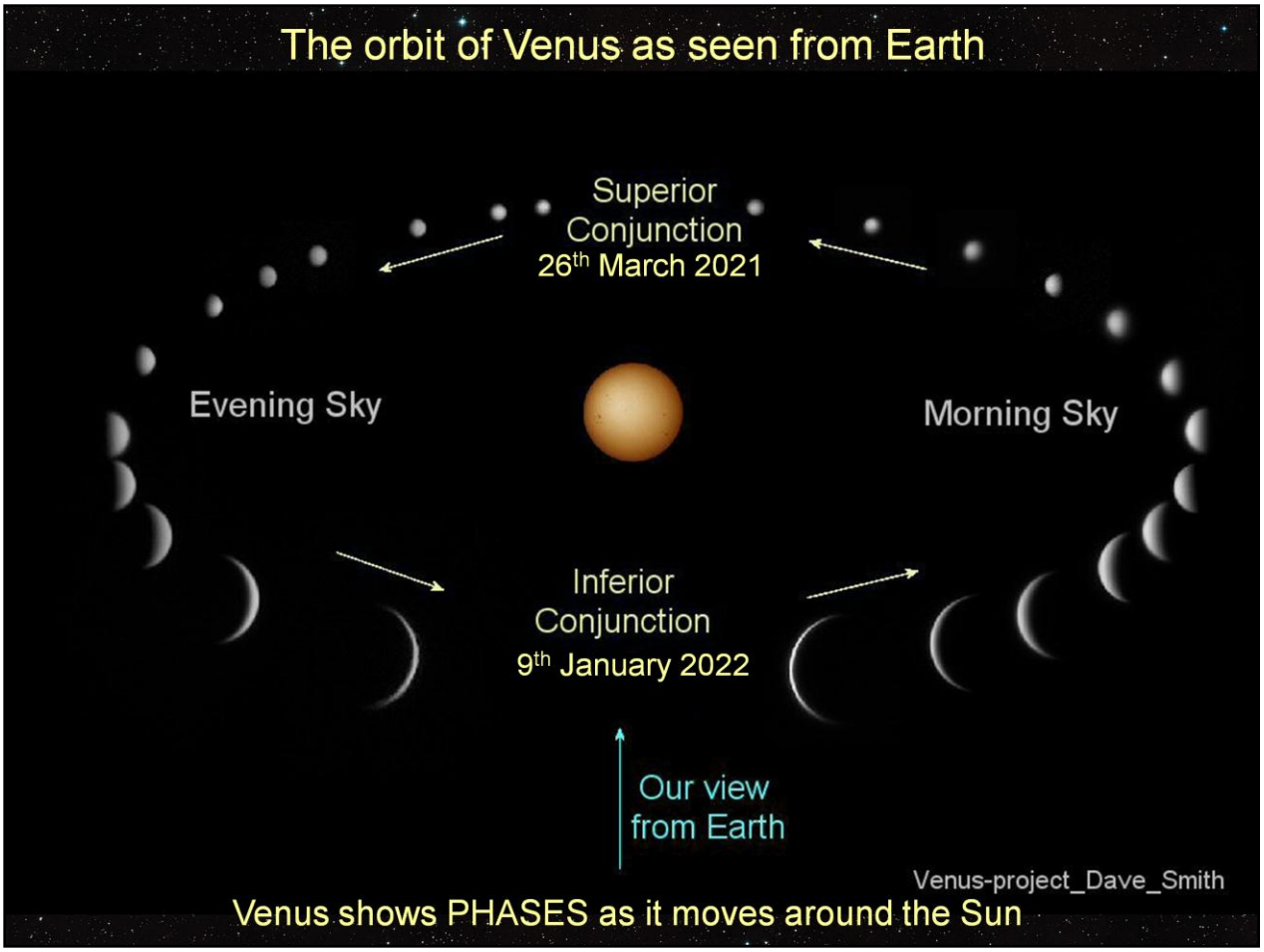


It can be seen from the diagram above why Venus appears smaller when it is close to Superior Conjunction and smaller when close to Inferior Conjunction.

When the Sun is on the opposite side of the Sun to Earth it is about 160 million kilometres away from us. However at Inferior Conjunction it can be as close as just 25 million kilometres from us at its closest approach.



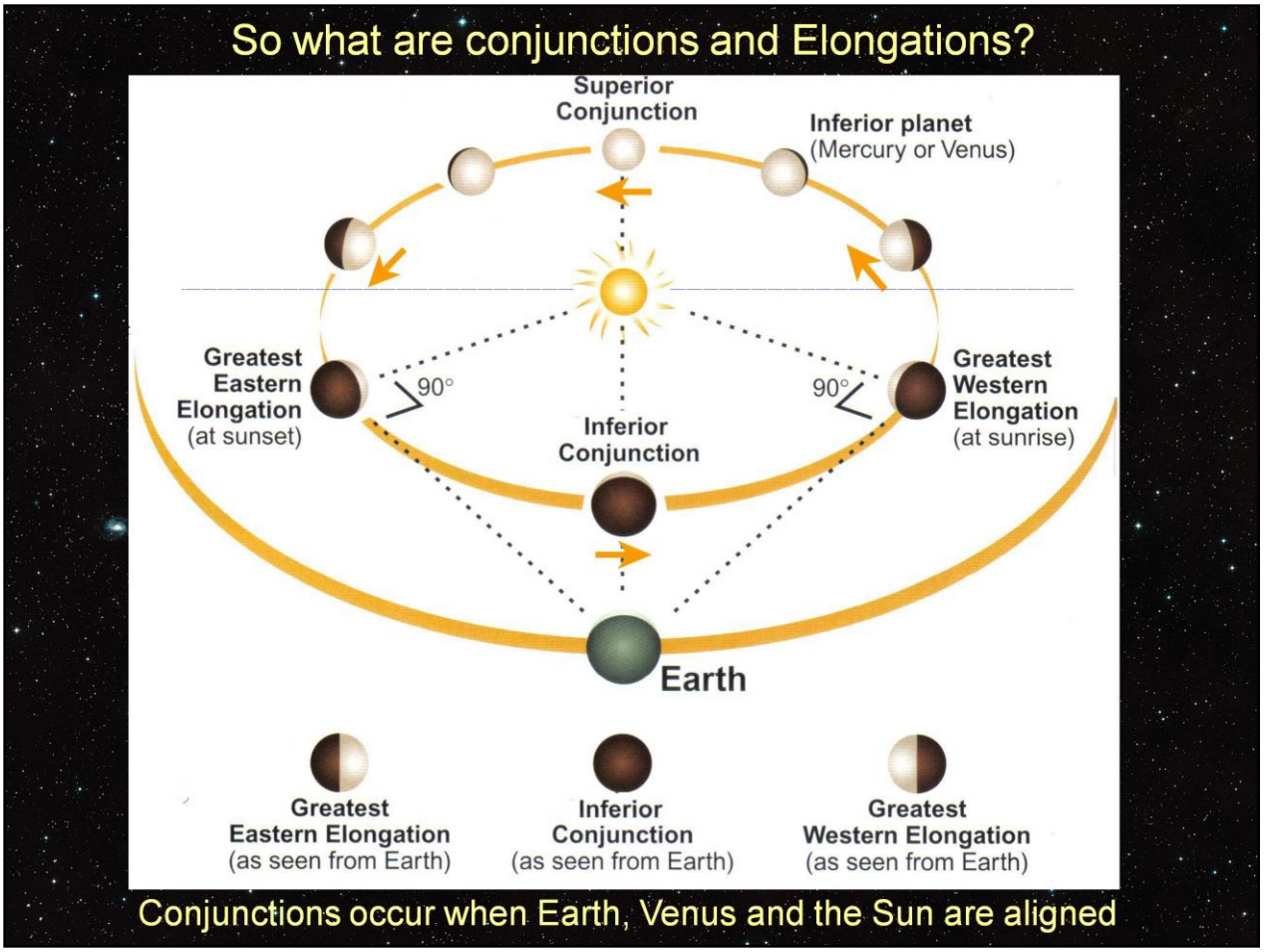
The chart above shows the orbital path of Venus in the evening sky. It passed behind the Sun on 26th March 2021 and then appeared over the western horizon and into the early evening sky. It has climbed higher in the evening sky following the thicker part of the orbital path shown on the chart. It will reach its apparent furthest position from the Sun on 29th October this is called: Greatest Easterly Elongation.



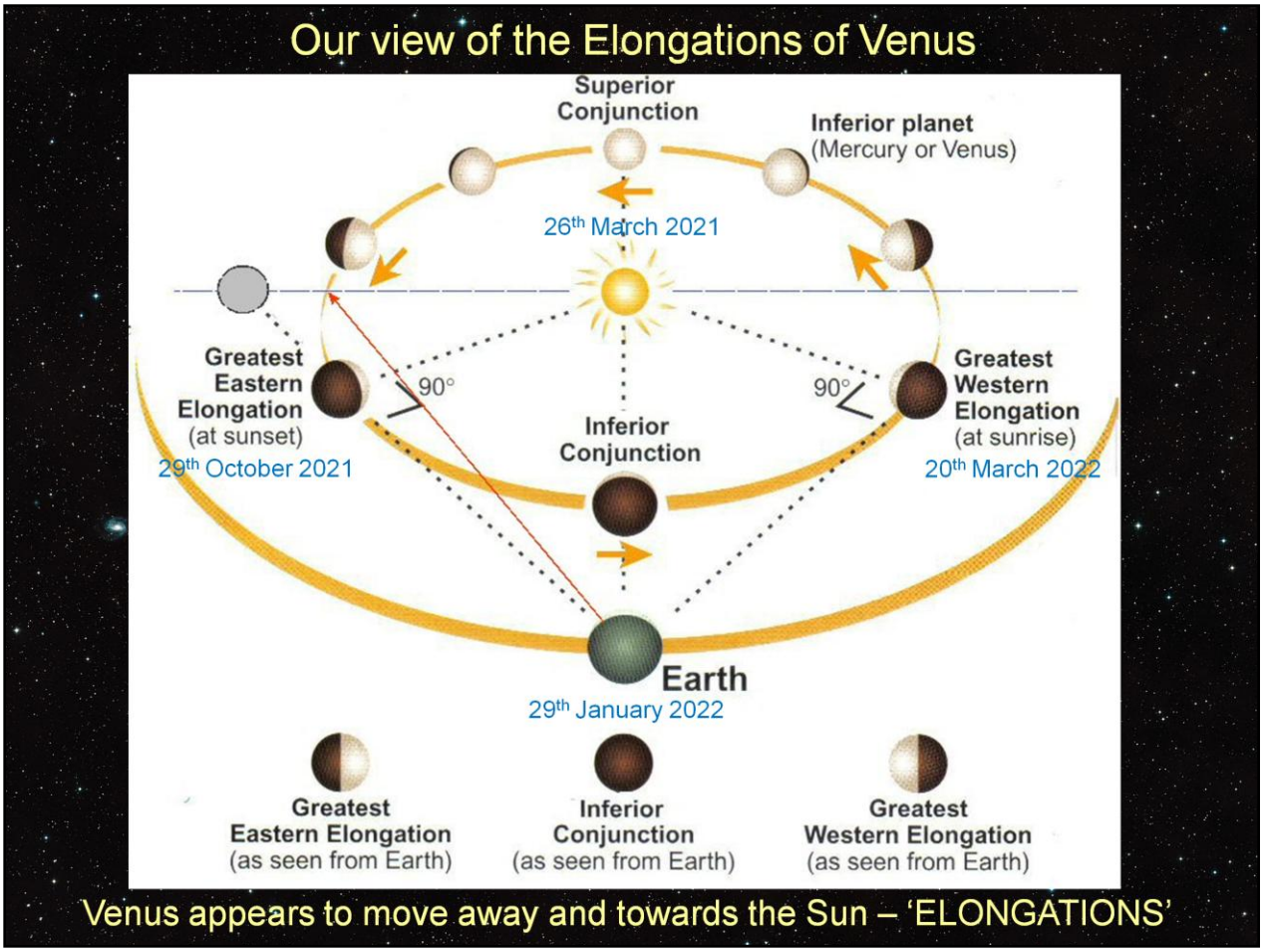
The chart above shows how the appearance of Venus changes as it orbits the Sun. In the evening sky it first appears small and full as it climbs over the western horizon after passing behind the Sun at its Superior Conjunction. As it moves around its orbit it moves closer to Earth and appears to become larger.

It initially appears 'full' because the illuminated face of Venus is towards us. When Venus reaches about half way towards us just the side facing the Sun is illuminated and we see half of Venus illuminated (like the Half Moon). As Venus moves even closer towards Earth it continues to appear larger but as a narrowing crescent.

As Venus approaches the Sun and Inferior Conjunction it will appear larger in diameter and as a very thin crescent before it disappears into the bright sky close to the Sun to enter its Inferior Conjunction. It will then emerge from Inferior Conjunction to reappear in the early morning sky before sunrise in the east. It will initially appear large and as a thin crescent but will become smaller and wider as it loops out from the Sun and back again in the early morning sky for the next Superior.

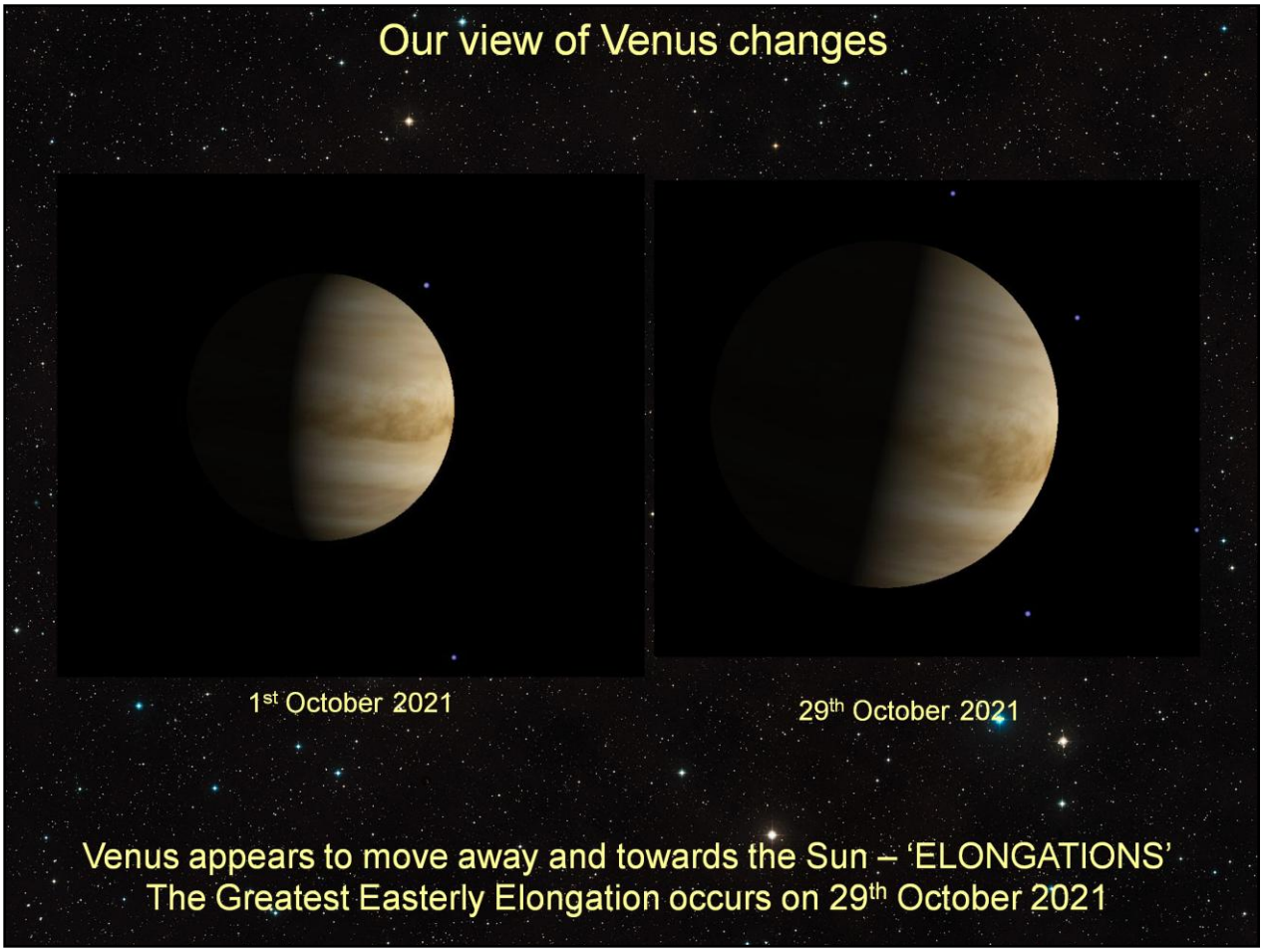


Greatest Elongation does not actually occur when Venus is at the same distance away from us as the Sun. Greatest Elongation occurs when the angle subtended between Earth, Venus and the Sun as shown on the diagram above is 90º. So Venus develops into a crescent rather than Half Moon shape at Greatest Elongation.



Greatest Elongation occurs when the angle subtended between Earth, Venus and the Sun as shown on the diagram above is 90º. After this point Venus appears a crescent rather than Half Moon shaped at Greatest Elongation.

The red arrow on the diagram shows the direction of our view when Venus is at the same distance as the Sun. When Venus reaches the point labelled Greatest Eastern Elongation the angle subtended by Earth, Venus and the Sun is 90º. Our view towards Venus at this point is marked by the dotted line. Venus appears to us to be at the position marked by the gray circle which appears to be further east than the point marked by the red arrow. So the is the most easterly point that Venus appears to us. The same applies to the position of Greatest Western Elongation in the morning sky.



Greatest Easterly Elongation will occur on the 29th October this year.

It is the point where Venus will appear to be at its furthest distance from the Sun.

So Venus will start to appear as a crescent rather than Gibbous shape before Greatest Elongation.

Sidereal and Synodic (orbital) Periods

PLANET	SIDERIAL PERIOD	SYNODIC PERIOD
Mercury	88 days	116 days
Venus	225 days	584 days (1.5 y)
Earth	1.0 year	--
Mars	1.9 years	780 days (2.14 y)
Jupiter	11.9 years	399 days (y + 34d)
Saturn	29.5 years	378 days (y + 13d)
Uranus	84.0 years	270 days (y + 6d)
Neptune	164.8 years	268 days (y + 3d)

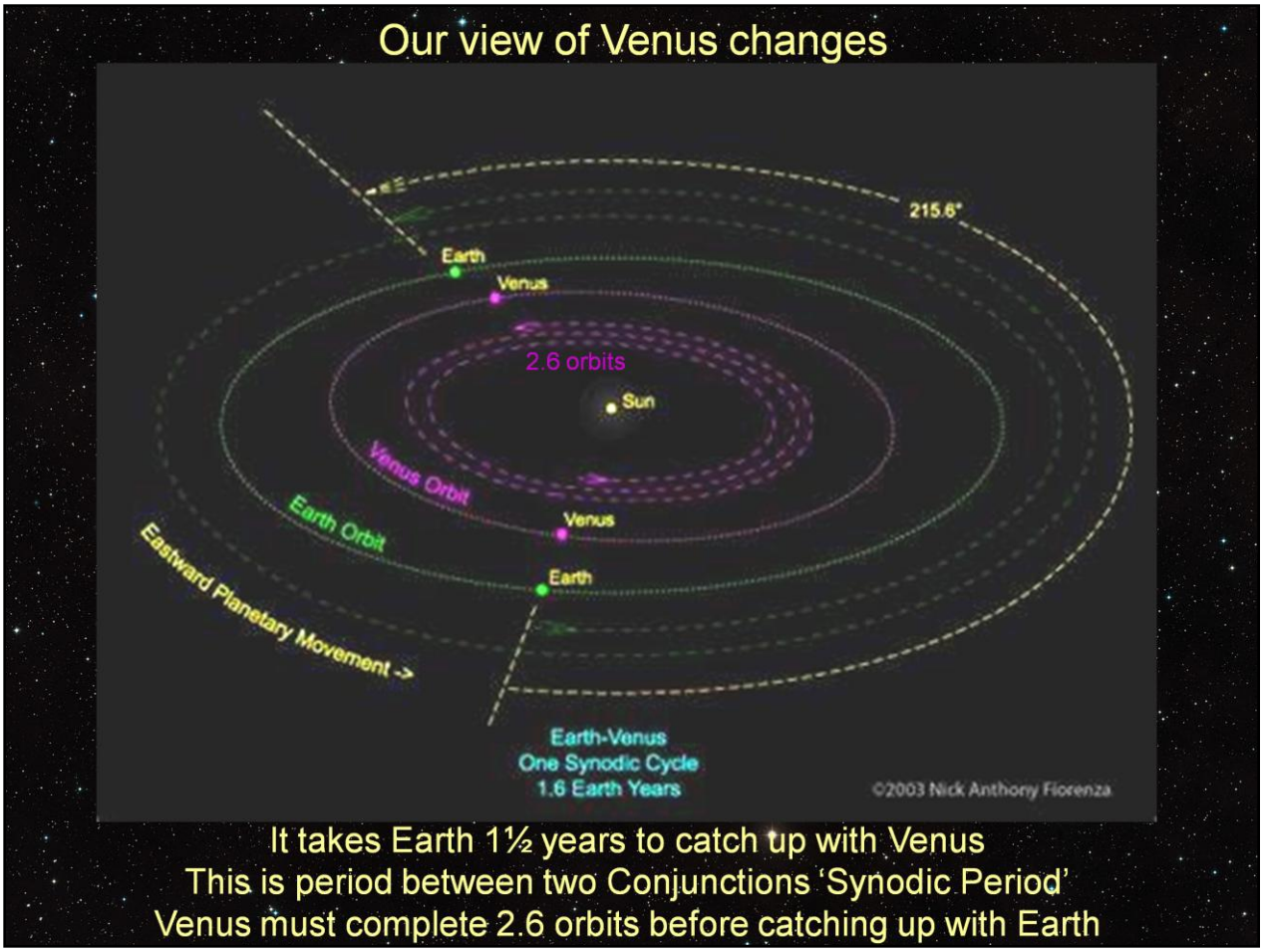
SIDEREAL PERIOD – Time taken to orbit the Sun

SYNODIC PERIOD – Time taken to catch up with Venus

We have a Venus conjunction every 292 days (1 Inf & 1 Sup)

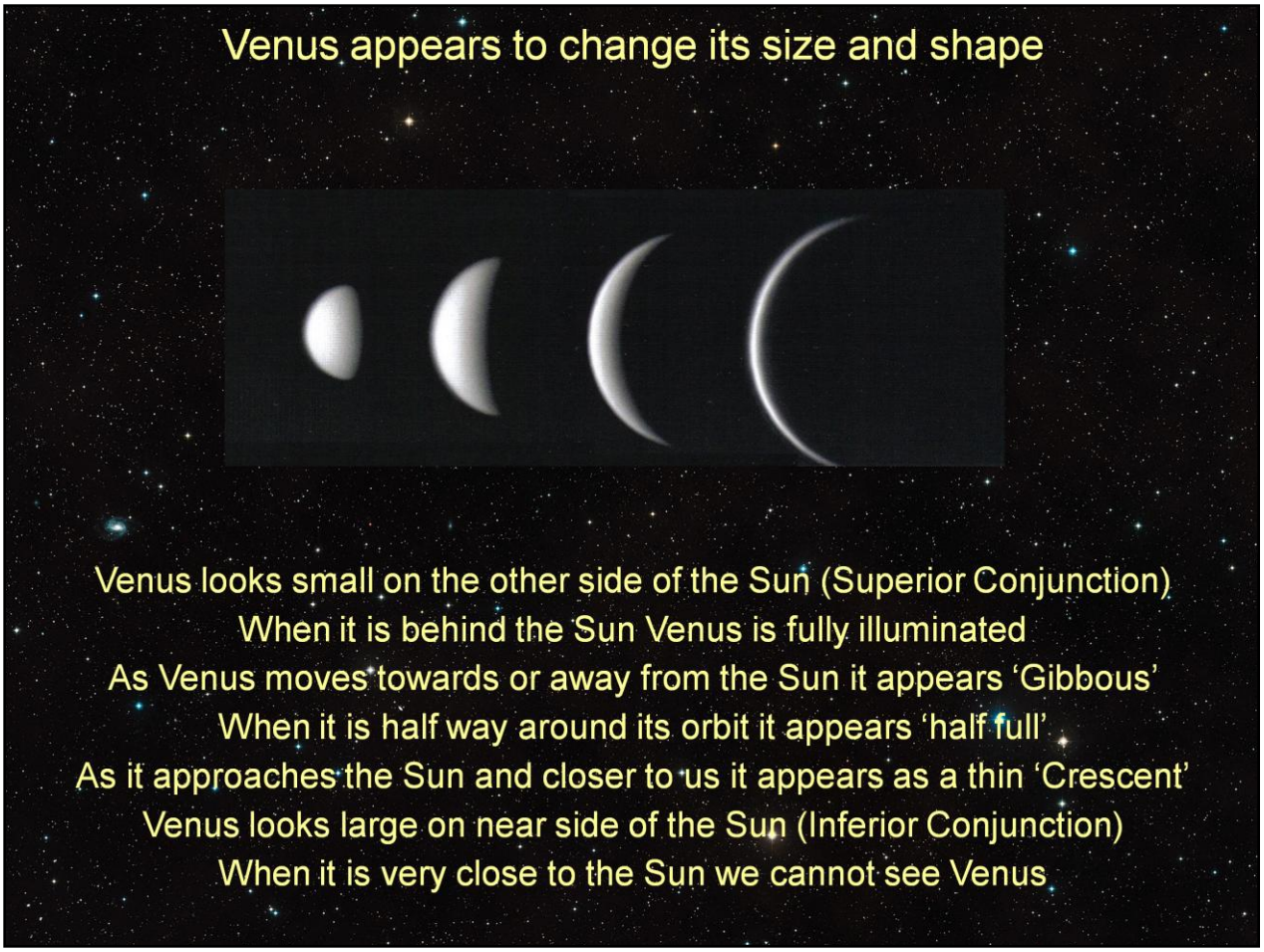
The Inferior and Superior Oppositions of Venus repeat every 584 Earth days (about 1½ Earth years). This may seem a little odd as the time taken for Venus to complete one orbit of the Sun is only 225 Earth days called its SIDEREAL PERIOD.

The reason for this is when Earth returns to the location of the previous opposition, Venus will have passed the location (in 225 days) and moved on around its orbit. It takes Venus 584 Earth days (2.6 Venus years) to catch up with Earth for its next similar opposition [Superior or Inferior]. This period is called the Venus / Earth SYNODIC PERIOD.



The last Superior Conjunction occurred on 26th March 2021. The next Superior Conjunction will occur on 22nd October 2022 this is about 584 days later (about 1.6 Earth years).

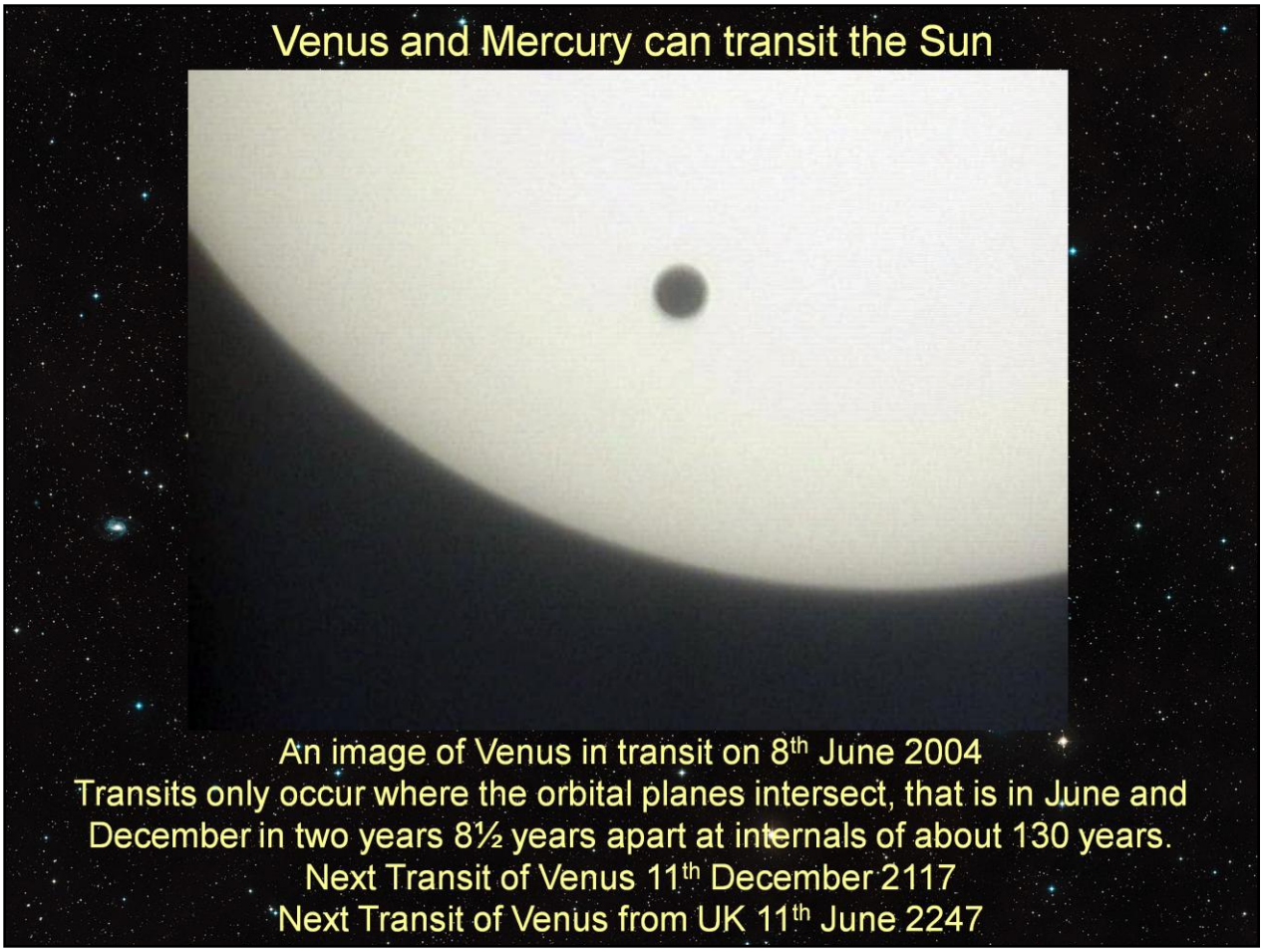
The pink dotted line on the diagram above shows the distance needed to be travelled by Venus to reach the next Inferior Conjunction. The green dotted line shows the distance to be travelled by Earth. Earth and Venus will need to travel for about 1.6 years (about 1 year and 6½ months or 548 days) to reach this conjunction. This is called the Venus / Earth SYNODIC PERIOD.



Venus has a very thick and clouded atmosphere that covers the whole surface. Consequently there are no surface features to see. All that is visible on Venus is the top of the thick white clouds. Some faint features can be seen in the clouds but special filters are required to see them.

The main interest for amateur astronomers when observing Venus is to follow the progress of the phases. The two inner planets Mercury and Venus (known as Inferior Planets) are the only planets to show phases. Phases occur when these planets (and our Moon) are partially illuminated by the Sun. The phases change as the planets move around the Sun on their orbits.

Only the two Inferior Planets can pass in front of the Sun to produce a 'Transit'.



The last transit of Venus occurred on the morning of Tuesday 8th June.

A transit occurs when one of the two planets orbiting the Sun, inside the orbit of Earth, appears to pass in front of the Sun.

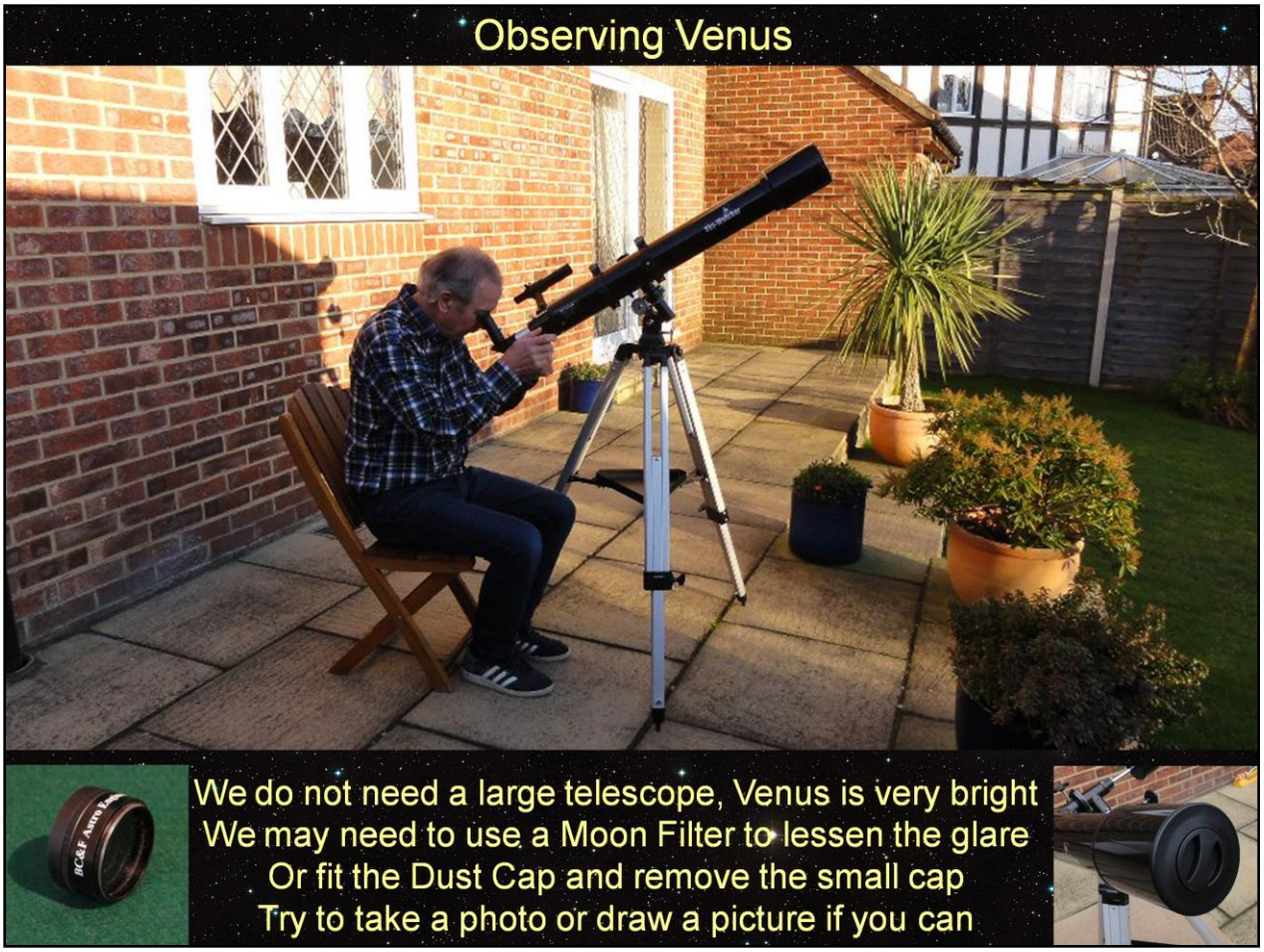
Mercury and Venus are the only two of the seven other planets that can appear to pass between Earth and the Sun to create a transit.

The transit on 8th June 2004 began at 6:20 BST when the Sun was about 12 degrees above the north eastern horizon.

The silhouette of Venus took about six hours to track across the southern quarter of the Sun's disc.

The second transit of this pair occurred on 5th/6th June 2012 but just the very end was visible from some parts of Europe but not the UK.

The next transit that can be seen from the UK will be on 11th June 2247.



A telescope is needed to see Venus as a disc and the larger the telescope the bigger Venus will appear. Venus often appears low in sky and in the murky and turbulent air close to horizon. It is best to start with a low power eyepiece (25mm) when observing Venus then use a higher power (magnification) eyepiece (10x) to have a good look.

If the image is too bright then a Moon filter can be used or the Dust cap can be fitted to the telescope and the small 'Moon' cap removed to reduce the glare. A card 'mask' with a ~50mm hole cut in it can also be used to reduce the glare.

If the image looks good then a Barlow Lens can be used to effectively double the magnification of the 10mm eyepiece.

When Venus is low in the sky and we are looking through more of the atmosphere some colour distortion can be seen as red and blue fringes . This is caused by the refraction of the light as it passes through our atmosphere.

This year Venus will be low in the sky and appear unstable in the thick and turbulent atmosphere.


This presentation is on the Beginner's Website:
(with notations)
naasbeginners.co.uk