

ASSA Deep Sky Observing Bulletin

Director: Colin Steyn

Target: The Cosmic Eye of God. **(Helix Nebula. NGC 7293)**

1. Overview

The Helix Nebula (NGC 7293) is one of the finest and most accessible Planetary Nebulae in the Southern sky.

Located in Aquarius, it is particularly rewarding for observers in Southern Africa because it reaches a very useful altitude and is readily visible during the Spring and early Summer season.

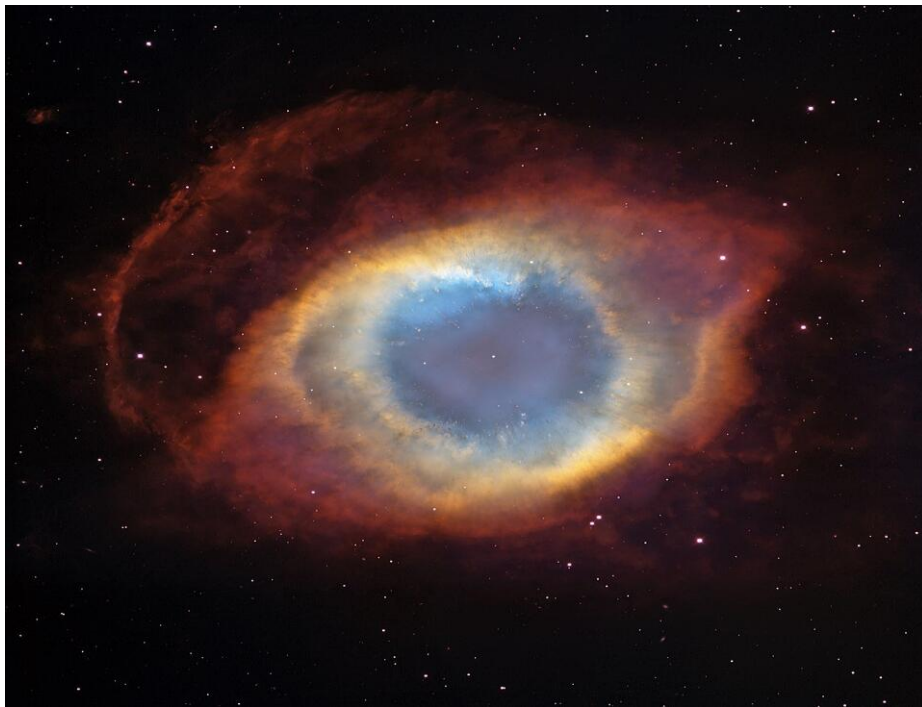
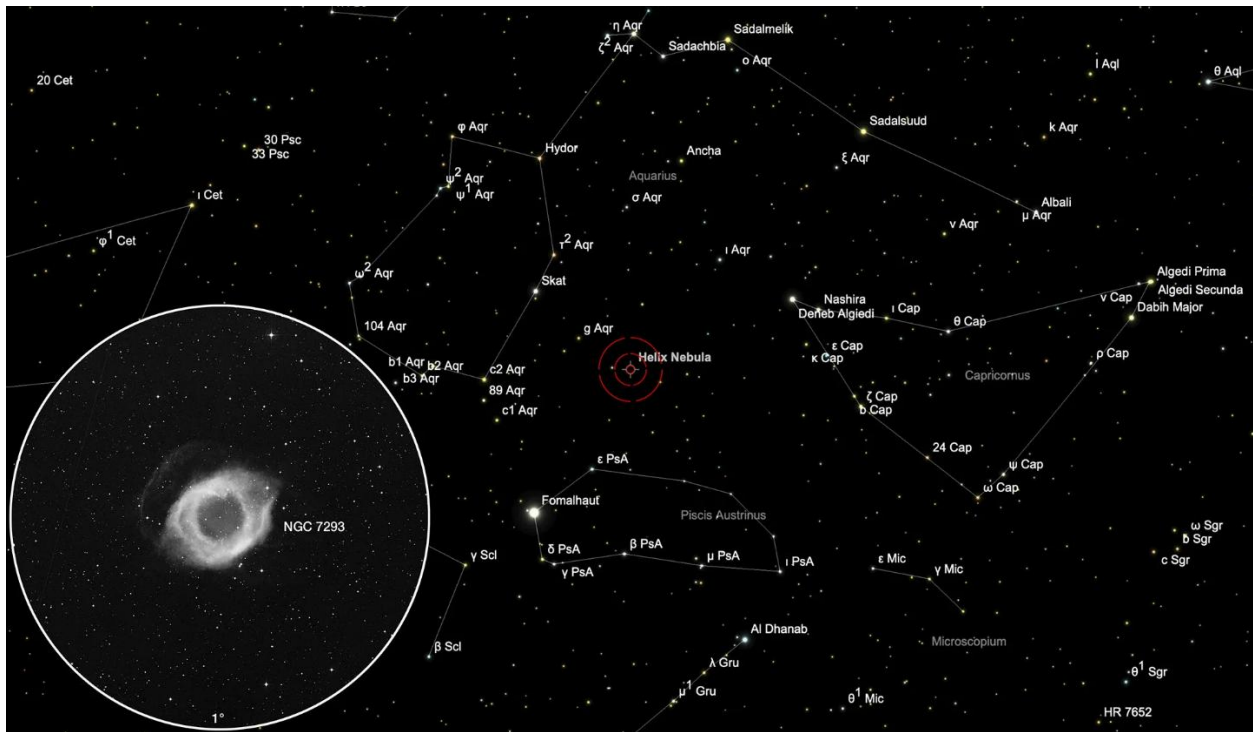
The Helix is a relatively nearby Planetary Nebula at a distance of approximately 650-700 light-years.

It is the expanding envelope of gas expelled by a Sun-like star during the final stages of its evolution.

At the centre is the extremely hot stellar remnant that will ultimately cool into a White Dwarf star.

Unlike many compact Planetary Nebulae, the Helix is very large in apparent size. It's principal nebulae structure covers roughly half the apparent diameter of the Full Moon, making it an excellent object for wide or rich-field telescopes as well as larger instruments.

The object/target is also known as "The Eye of God" because of it's striking visual appearance, although this is a popular rather than an astronomical designation. It's discovery is attributed to Karl Ludwig Harding, probably before 1824.



2. Observational Data:

Object - Helix Nebula

Designation - NGC 7293 / Caldwell 63

Object type - Planetary Nebula

Constellation - Aquarius

RA - 22h 29m 38.5s

Dec - -20° 50' 14"

Distance - 650-700 light-years

Apparent Magnitude - 7.3

Angular Extent - 16-25 arc minutes depending on the component measured

Central star - Hot White Dwarf precursor

Best Southern observing period - August - November

3. Locating NGC 7293

The Helix lies in the Eastern part of Aquarius, approximately 9° South of the bright star Sadalmelik (Alpha Aquarii) and several degrees southwest of the star Fomalhaut in the constellation Piscis Austrinus.

Because the Helix is large but has a relatively low surface brightness, it can be surprisingly difficult to detect from a light-polluted location despite its magnitude of about 7.3.

A useful method is to first locate the general region of Aquarius using binoculars or a finder scope and then work towards the Helix using a detailed star chart or digital setting circles.

4. Physical Nature of the Helix

The Helix is a Planetary Nebula, a term dating from the eighteenth century. The name is misleading: Planetary Nebulae have nothing to do with Planets. Early observers using small telescopes sometimes found these objects sufficiently round and Planet-like in appearance that the terminology became established.

The progenitor star was originally a normal, relatively low-mass star comparable in broad terms to the Sun.

After exhausting the Hydrogen and Helium available for nuclear fusion in its core, the star evolved through the Red-Giant stages and expelled its outer atmosphere into space.

The remaining hot core became the Central Star of the Planetary Nebula. Its intense ultraviolet radiation ionises the previously expelled gas, causing it to glow.

Thus, when we observe NGC 7293, we are witnessing a relatively brief stage in stellar evolution - the transformation of a Sun-like star into a White Dwarf.

NASA observations place the Helix among the closest Planetary Nebulae to Earth.

5. The Structure of the Helix

The familiar "eye" appearance is produced by a complex three-dimensional structure rather than a simple flat ring.

The bright inner region is surrounded by extensive shells of gas and dust. Hubble Space Telescope reveals numerous radial filaments and Comet-like knots around the inner edge of the Nebula. These structures formed as fast-moving material from the hot central star interacted with slower, denser material previously expelled by the progenitor star.

The famous Cometary knots are particularly interesting. Although they resemble Comets visually, they are vastly larger structures and have no direct connection with our Solar System's Comets.

Infrared observations have also revealed dust associated with the central region. NASA's Spitzer Space Telescope observations suggested the presence of a warm dust component around the central star, providing evidence for material remaining in the stellar environment after the Nebula formation.

6. Observing the Helix

6.1 Binoculars

Under a dark rural or exceptionally transparent sky, the Helix can be detected with binoculars, particularly instruments in the 10 x 50 or 15 x 70 class.

The low surface brightness is the principal difficulty. Rather than appearing like a bright, sharply defined Planetary Nebula, it may initially

resemble a very faint, slightly circular patch of nebulosity. Averted vision is extremely useful.

6.2 Small Telescopes

A telescope of approximately 80-100 mm aperture can reveal the Helix as a noticeably elongated or circular patch under good skies.

At low magnification, the large angular size of the Nebula becomes apparent; increasing the magnification too much can actually make the object harder to see because the diffuse light is spread over a larger area.

6.3 Medium and Large Telescopes

Telescopes in the 150-250+ mm provide a much more satisfying view. The characteristic annular form becomes more obvious, with a darker central region surrounded by the brighter nebular shell.

Under excellent conditions, variations in brightness around the ring can be detected. Larger apertures may reveal subtle filamentary detail and irregularities within the Nebula, although the visual appearance will remain considerably less dramatic than long-exposure astrophotography.

7. The Importance of Nebular Filters

The Helix is an excellent object for experimenting with Nebular filters.

An O-III filter can provide a dramatic improvement because much of the Nebula's visible emission is concentrated in strong oxygen emission lines.

A UHC-type filter can also be effective.

The filter may make the difference between a difficult, barely perceptible object and an obvious ring-shaped Nebula.

The observer should not assume that the darkest background always means the best views. Compare the visibility of the Nebula's structure rather than simply the darkness of the surrounding sky.

8. Astrophotography

With astrophotography you will come eye-to-eye with the "Eye of God".

NGC 7293 is an outstanding Astro photographic target.

It's enormous size means that a relatively short-focal length telescope can encompass much of the Nebula.

Narrowband imaging using O-III, H-alpha and related filters can reveal structures that are extremely difficult or impossible to see visually.

Long-exposure images reveal the complex outer shell, radial structures and the striking contrast between the ionised gas and surrounding dust.

The Helix has been imaged extensively by both ground-based and space-based observatories. ESO's field imagery illustrates the extraordinary scale of the object while Hubble observations reveal fine structure within the Nebular shell.

9. Astrophysical Significance

The Helix provides astronomers with an unusually nearby example of the final stages of evolution of a low-to-intermediate-mass star.

It's proximity makes it possible to study it's gas, dust, central star and complex small-scale structures in considerable detail.

ESO describes it as one of the closest bright Planetary Nebulae to Earth.

The Nebula also provides a valuable opportunity to study the interaction between Stellar Winds, ionised gas and dust. The spectacular structures revealed by Hubble demonstrate that Planetary Nebulae are considerably more complex than the simple spherical shells once seen and imagined.

For amateur astronomers the Helix has an additional significance: It offers a visual example of a process that is expected eventually to affect stars of approximately Solar mass. NASA describes Planetary Nebulae as the remnants of stars similar in broad evolutionary terms to our Sun.

10. Conclusion

The Helix Nebula is one of the outstanding Planetary Nebulae for Southern Observers. It's combination of large angular size, relative proximity, unusual structure and astrophysical importance makes it an ideal ASSA Deep Sky target.

For the visual observer, the Helix demonstrates an important lesson: Large apparent size does not necessarily mean easy visibility. It's relatively low surface brightness rewards dark skies, patience, averted vision and the appropriate Nebular Filter.

Once located, however, the sight of the faint elliptical ring surrounding it's central star provides a direct visual connection with one of the final stages in the evolution of a Sun-like star.

May you have clear skies, Moonless nights and Happy Observing!

Colin Steyn

ACKNOWLEDGEMENTS

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