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Photo release:
A glimpse into the heart of a dying star

18-July-2002 **An image taken with the NASA/ESA Hubble Space Telescope shows one of the most unusually long planetary nebulae found so far. Scientists think planetary nebulae hold the key to understanding how the Universe became enriched with heavier elements so they study them intensively. It is not well-understood how a perfectly round star can turn into such an unusual-looking nebula.**

Planetary nebulae occur in a huge variety of shapes and sizes. They are the final stage of a star's life before it ends its days as a burnt-out white dwarf. When it dies, a star rapidly sheds the outer parts of its atmosphere, creating a planetary nebula that exists only as long as the star has fuel to burn.

Witch's cauldron
Stars are large recycling factories. Over their lifetimes of millions of years they process huge amounts of the lighter elements (mostly hydrogen and helium) into heavier ones (such as carbon, nitrogen and oxygen). These heavier elements are then dispersed into the surrounding space when the stars peel off their atmospheres to form planetary nebulae. In turn, the heavier elements may become part of other stars or end up in planetary systems like our own Solar System. This dispersion process is therefore one of the most important in the Universe and can tell us something about our own origins.

Hubble image of Henize 3-401
This image, taken with the NASA/ESA Hubble Space Telescope, shows the young planetary nebula Henize 3-401. Hubble's extraordinary vision reveals that it is one of the most elongated planetary nebulae found so far. The image shows two very long cylindrical outflows with intricate thread-like structures and tattered ends. In this image, we are seeing the central star responsible for the beautiful display in the nebula for the first time.

Although planetary nebulae exist in many different shapes they are often elongated, or as astronomers call it, 'bipolar'. Although astronomers agree on the terminology, they disagree on how these nebulae become so elongated. Some claim that a second star, a companion orbiting around the central star, is needed to create the jet-like streamers of gas. Others think that strong magnetic fields are capable of funnelling the gas into the long outflows.

Henize 3-401 is an interesting astronomical object since astronomers can peer directly into the brew of different elements created in the witch's cauldron that is a star's core. During this brew, stars form complex organic molecules that may be some of the molecular building blocks of life.

Henize 3-401 is currently passing through a phase that is very short, in astronomical terms, and there are not very many similar objects around for similar study. It will take only a few thousand years for the central star to exhaust its nuclear fuel and become a cooling, fading white dwarf.

Nebula clings to its secrets
European astronomers have combined Hubble images together with observations from several other telescopes, among them ESA's Infrared Space Observatory (ISO) and the International Ultraviolet Explorer (IUE). However, it is proving difficult to unveil the origin of this nebula. As Pedro García-Lario from the ESA ISO Data Centre in Villafranca, Spain, says: *"We are studying stars at a crucial moment in their life – as they die. Our ultimate goal is to find out exactly how the dying stars spread these huge amounts of processed material throughout the Universe. How can a perfectly round star undergo a rapid metamorphosis to become such an elongated object as Henize 3-401? These are key questions to answer if we want to find out how our Milky Way evolves chemically."*

Despite the ongoing efforts of García-Lario and others studying Henize 3-401, the detailed nature and origin of this nebula remain deep mysteries.

Henize 3-401 is located in the constellation of Carina (the Keel) at an approximate distance of 10 000 light-years. This picture is composed of three exposures obtained with Hubble's Wide Field Planetary Camera 2 on 12 June 1997. The three exposures were taken through a wide orange filter (1200 seconds) shown in blue, a hydrogen-alpha filter (400 seconds) shown in red, and a singly ionised sulphur filter (1200 seconds) shown in green.

Image credit: European Space Agency and Pedro García-Lario (ESA ISO Data Centre)

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Notes for editors
The Hubble Space Telescope project is an international cooperation between ESA and NASA.

The original Hubble image was obtained by R. Sahai (Jet Propulsion Laboratory, USA), V. Bujarrabal (Observatorio Astronomico, Spain), J. Trauger (Jet Propulsion Laboratory, USA), A. Zijlstra (University of Manchester Institute of Science and Technology, United Kingdom) and J. Alcolea (Centro Astronomico de Yebes, Spain).

The image processing for this image was done by Richard Hook and the Hubble European Space Agency Information Centre.

IUE
The International Ultraviolet Explorer (IUE) is the world's longest lived one of the most productive satellite ever built. A joint ESA-NASA-UK project, it was launched in January 1978 and worked non-stop until switched off in September 1996.

ISO
The Infrared Space Observatory (ISO) was the most sensitive infrared satellite ever launched. It studied the dusty regions of the Universe, something visible light telescopes are unable to do. Launched in 1995, it operated from November 1995 to May 1998.

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