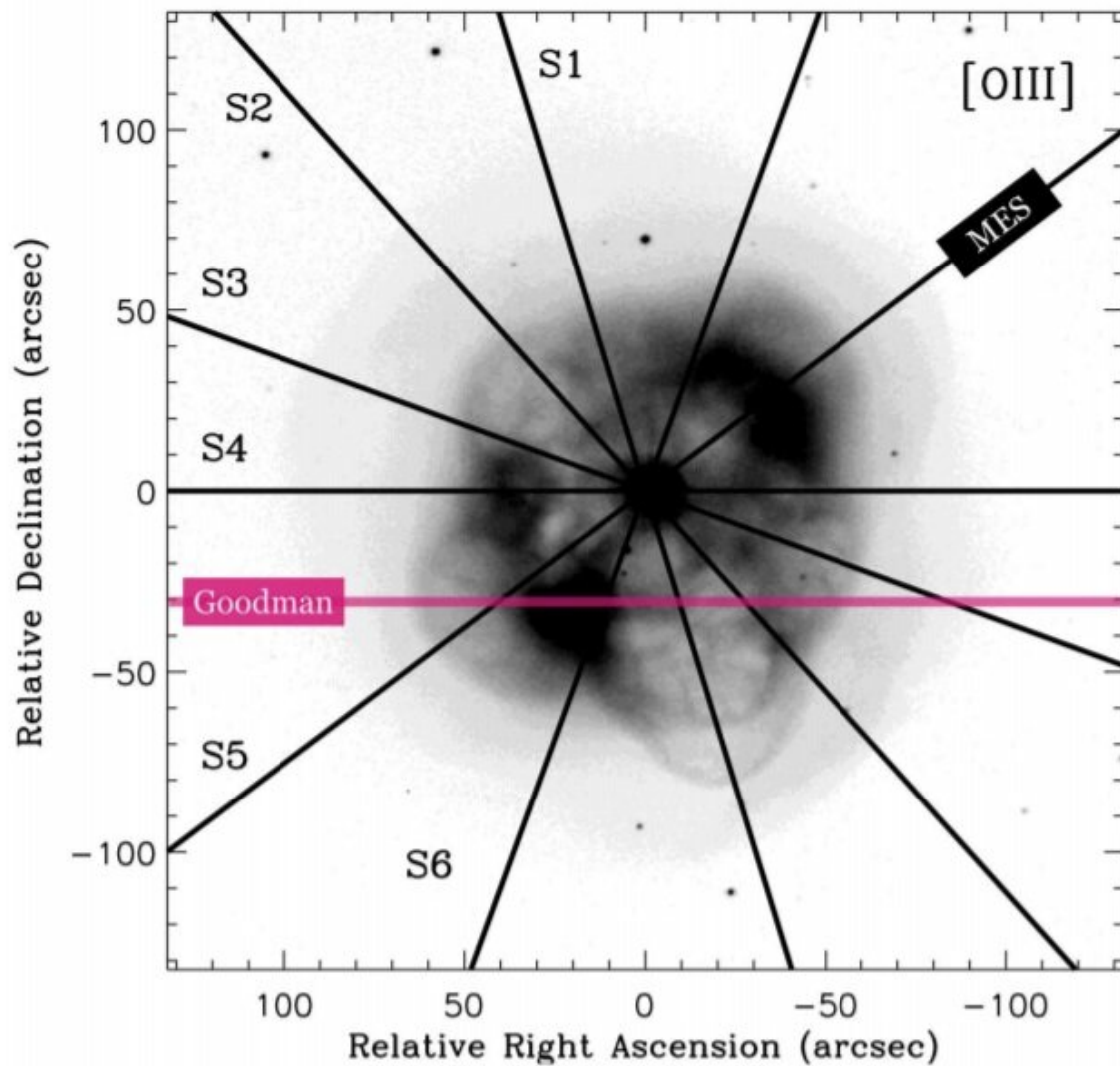


Research sheds more light on the nature of a complex planetary nebula

May 11 2021, by Tomasz Nowakowski



Gray-scale image of NGC 1514 in the [O iii] filter. Credit: Aller et al., 2021.

Astronomers have performed high-resolution observations of a complex planetary nebula known as NGC 1514. Results of the study provide essential information about morpho-kinematical structure and chemical composition of this nebula, which could help researchers to better understand its nature. The research was published May 4 on arXiv.org.

Planetary nebulae (PNe) are expanding shells of gas and dust that have been ejected from a star during the process of its evolution from a [main sequence star](#) into a red giant or white dwarf. They are relatively rare, but are important for astronomers studying the chemical evolution of stars and galaxies.

NGC 1514 is a PN in the Taurus constellation discovered by William Herschel in 1790, located most likely between 650 and 980 light years away. It showcases a complex morphology that does not clearly fit in the defined morphological types. Moreover, it hosts a peculiar central star, designated BD+30°623, that turned out to be a binary system with an orbital period of about 3,300 days—the widest binary central star so far detected.

A team of astronomers led by Alba Aller of the Spanish Astrobiology Center in Madrid, Spain, took a closer look at NGC 1514 in order to investigate its properties. They obtained high-resolution, long-slit optical spectra and images of this object using the Calar Alto Faint Object Spectrograph (CAFOS) at the 2.2-m telescope on Calar Alto Observatory, the Manchester Echelle Spectrometer at the 2.1 m telescope on San Pedro Martir Observatory, and the Goodman High Throughput Spectrograph on the 4.1m Southern Astrophysical Research (SOAR) telescope.

"In this work, we present high-resolution, long-slit spectra and images of NGC 1514 which allow us to describe in detail the internal kinematics and morphology of the nebula. In addition, we also present intermediate-

resolution, long-slit spectra with the aim of deriving their physical conditions and chemical abundances," the researchers wrote in the paper.

Based on the collected data, the astronomers generated a 3D model of NGC 1514 that delivered essential information regarding the main structural components of this PN as well as their kinematics. The model suggests that NGC 1514 consists of an inner distorted shell (that was originally spherical) with some additional and well-defined bubbles and an outer spherical attached shell.

The astronomers noted that NGC 1514 has also two well-defined, mid-infrared rings, what may indicate that this nebula has a barrel-like structure. By comparing these rings to similar features in few other PNe, they found that the barrel-like structure in NGC 1514 has an inclination of approximately 28 degrees.

The chemical analysis of NGC 1514 has revealed that it is a moderate-excitation nebula with emission lines of ionized argon, neon and helium. It was found that the PN has an electron temperature of about 15,000 K and an electron density between 2,000 and 4,000 cm^{-3} .

Further deeper and higher resolution spectroscopic observations of NGC 1514 are required in order to obtain a more comprehensive view of the chemical composition of this object.

More information: The morpho-kinematical structure and chemical abundances of the complex planetary nebula NGC 1514, arXiv:2105.01495 [astro-ph.SR] arxiv.org/abs/2105.01495

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