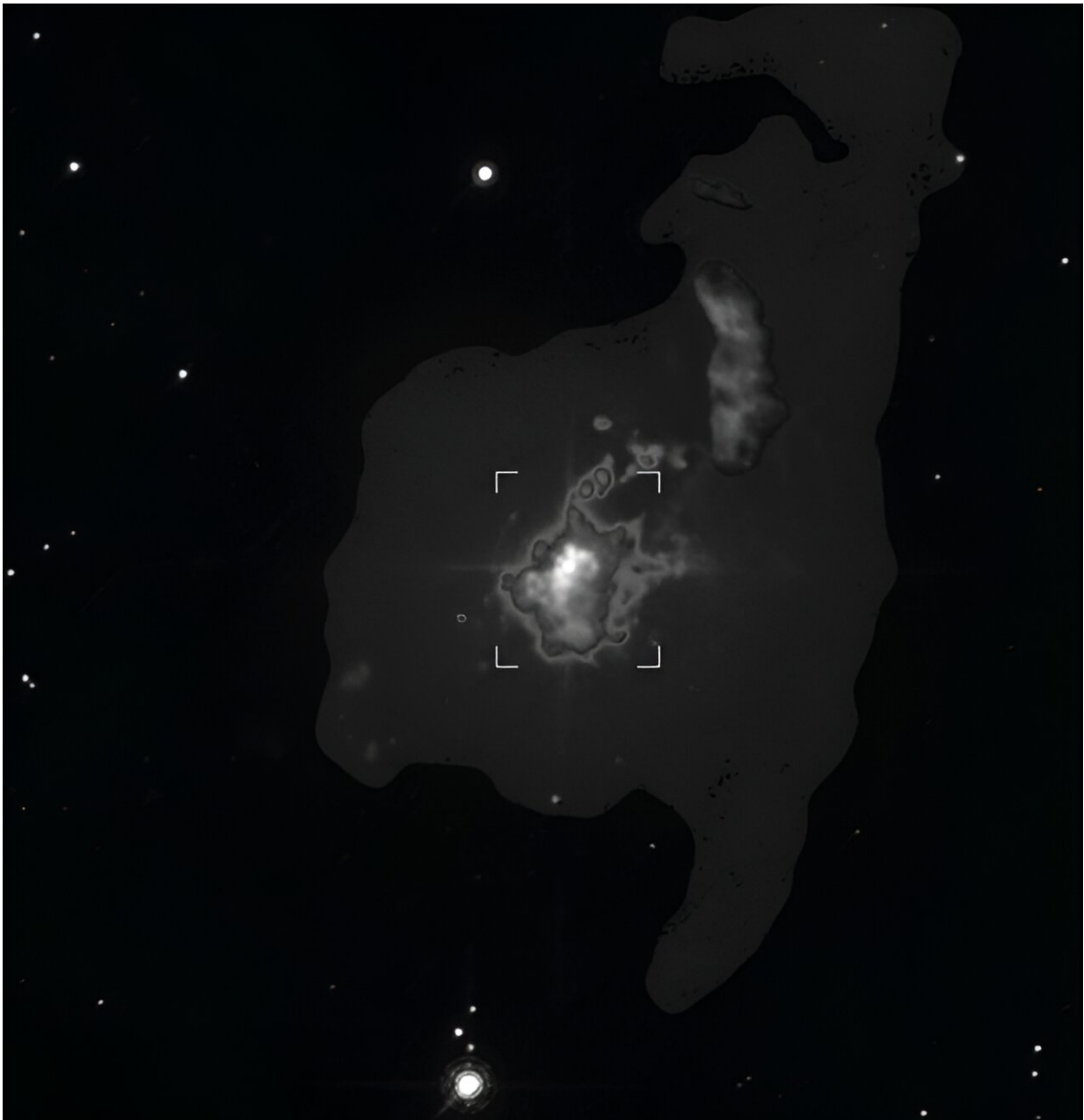


Research investigates evolution of symbiotic binary HM Sagittae

December 14 2023, by Tomasz Nowakowski



HST WFC3 [N II] image of HM Sge and the surrounding nebula enhanced artistically to accentuate the main nebular features of different contrast scales for the large-scale nebular structure and central region. Credit: © 2023 Brittany C. Bennett. All rights reserved. Used with permission.

Using the Hubble Space Telescope (HST) and the Stratospheric Observatory for Infrared Astronomy (SOFIA), astronomers have performed a multiwavelength study of a symbiotic binary known as HM Sagittae. Results of the study, [presented](#) December 4 on the pre-print server *arXiv*, yield crucial insights into the evolution of this system.

Symbiotic stars are interacting binaries showcasing dramatic, episodic changes in the spectra of their light because one of the pair is a very hot, small star (e.g. white dwarf, neutron star), while the other is a cool giant. These systems may deliver crucial information for researchers studying various aspects of stellar evolution.

Located some 3,350 [light years](#) away from the Earth, HM Sagittae (or HM Sge for short) is a symbiotic system composed of a cool highly-evolved oxygen-rich (M-type) [asymptotic giant branch](#) (AGB) star, most likely a Mira variable, accreting material onto a white dwarf (WD). The two stars are separated by 40 AU and the orbital period of the system is estimated to be at least 90 days.

HM Sge experienced a nova-like outburst in 1975 when it brightened six magnitudes in the optical band. However, unlike what is observed in classical novae, the outburst remained near its peak brightness far longer than the expected few days.

Now, a team of [astronomers](#) led by Steven Goldman of the Space

Telescope Science Institute (STScI) in Baltimore, Maryland, has investigated HM Sge in infrared, optical and ultraviolet bands, in order to understand how the system evolved since the 1975 outburst. For this purpose, they analyzed new and archival data from HST and SOFIA.

The study detected water emission lines in HM Sge, most of which show velocity shifts of a couple of kilometers per second. This is the first detection of water emission in a symbiotic system. Moreover, some movement of nebular features in the system has been also observed, corresponding to average outflow velocities of a few dozen kilometers per second.

Goldman's team found that the two components of HM Sge experienced considerable changes over the past few decades. The effective temperature of the white dwarf increased from less than 200,000 K in 1989 to at least 250,000 K. A dimming in the I-band over the past year has been observed, which may be linked to the orbital motion of the system.

Furthermore, infrared photometry and grism spectroscopy of the AGB star show a slightly higher near-infrared flux and fainter far-infrared flux. The researchers assume that this may also be related to the orbital motion, or it may suggest that HM Sge has returned to producing dust at full capacity.

They added that the shape of the AGB star's spectral energy distribution (SED) since the outburst suggests that this star swiftly returned to significant stable dust production.

Based on the collected data, the authors of the paper also found that the AGB star has a luminosity of about 1,500–2,000 solar luminosities and a gas mass-loss rate at a level of 0.000004 [solar masses](#) per year.

More information: Steven Goldman et al, A Multi-Wavelength Study of the Symbiotic Mira HM Sge with SOFIA & HST, *arXiv* (2023). [DOI: 10.48550/arxiv.2312.01984](https://doi.org/10.48550/arxiv.2312.01984)

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