Astronomers take a closer look at emission from the supernova remnant MSH 15−56

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By analyzing archival data from the Suzaku X-ray satellite, astronomers have learned important information regarding thermal and non-thermal emission from the composite supernova remnant (SNR) designated MSH 15-56. Results of the study, available in a paper published May 29 on arXiv.org, could be helpful in advancing the knowledge about composite SNRs residing in the Milky Way galaxy.

Supernova remnants (SNRs) are diffuse, expanding structures resulting from a supernova explosion. They contain ejected material expanding from the explosion and other interstellar material that has been swept up by the passage of the shock wave from the exploded star.

When SNRs consist of an expanding shell into a surrounding medium and a pulsar wind nebula (PWN), they are called composite supernova remnants. This subclass represents a unique evolutionary phase of SNRs, where X-ray, gamma-ray and radio observations allow astronomers to study of the co-evolution of the emission from the shell-like shock front and from the PWN.

Located some 13,400 light years away, MSH 15-56 (other designations: G326.3−1.8 and Kes 25) is a composite SNR containing a remnant shell and a displaced PWN with a comet-like morphology. Previous observations have revealed that the PWN resides in the southwest rim of MSH 15-56 and has a radius about 3.6 times smaller than that of the whole SNR.

Given that X-ray observations have the potential to reveal detailed information about composite SNRs, a team of astronomers led by Nergis Cesur of Radboud University in Nijmegen, the Netherlands, decided to conduct a study of MSH 15-56 using data provided by the Suzaku X-ray astronomy spacecraft. An analysis of the data allowed them to investigate the nature of the emission and spectral parameters of this remnant.

"Although the X-ray properties of the thermal and non-thermal emission were studied in detail by Yatsu et al. (2013) and Temim et al. (2013), we study this SNR using more recent atomic database (AtomDB) version 3.0.9 and give a comparison of metal abundances with xspec and spex software packages, which provide almost consistent results with each other except a few parameters," the astronomers wrote in the paper.

According to the paper, thermal and non-thermal emission from the southwest rim of MSH 15-56 were also found during the analysis of Suzaku data. The results are indicative of the interactive relation between the PWN and the thermal emission. pointing out the material in the remnant interior and an interaction of the SNR reverse shock with the pulsar wind nebula.

"It is therefore likely that the thermal component integrated with the PWN spectrum may be explained by the morphological relation between the PWN and the shell region," the paper reads.

The astronomers added that the thermal component, with an electron temperature of around 0.64 keV and ionization timescale of approximately 100 billion cm^3/s, dominates nearly half of the X-ray spectrum, accounting for about 54 percent of the total unabsorbed flux.

Moreover, the researchers found slightly enhanced abundances of neon (Ne), magnesium (Mg), sulfur (S) and an enhanced abundance of silicon

(Si) in the spectrum of MSH 15-56. These findings, according to the study, support evidence of ejecta heated by the reverse shock.

"This result together with the small X-ray-emitting mass suggests that its emission arises from the shock heated ejecta," the authors of the paper concluded.

More information: Nergis Cesur et al. A study of the composite supernova remnant MSH 15-56 with Suzaku, 2019. arXiv:1905.12473v1 [astro-ph.HE]. arxiv.org/abs/1905.12473