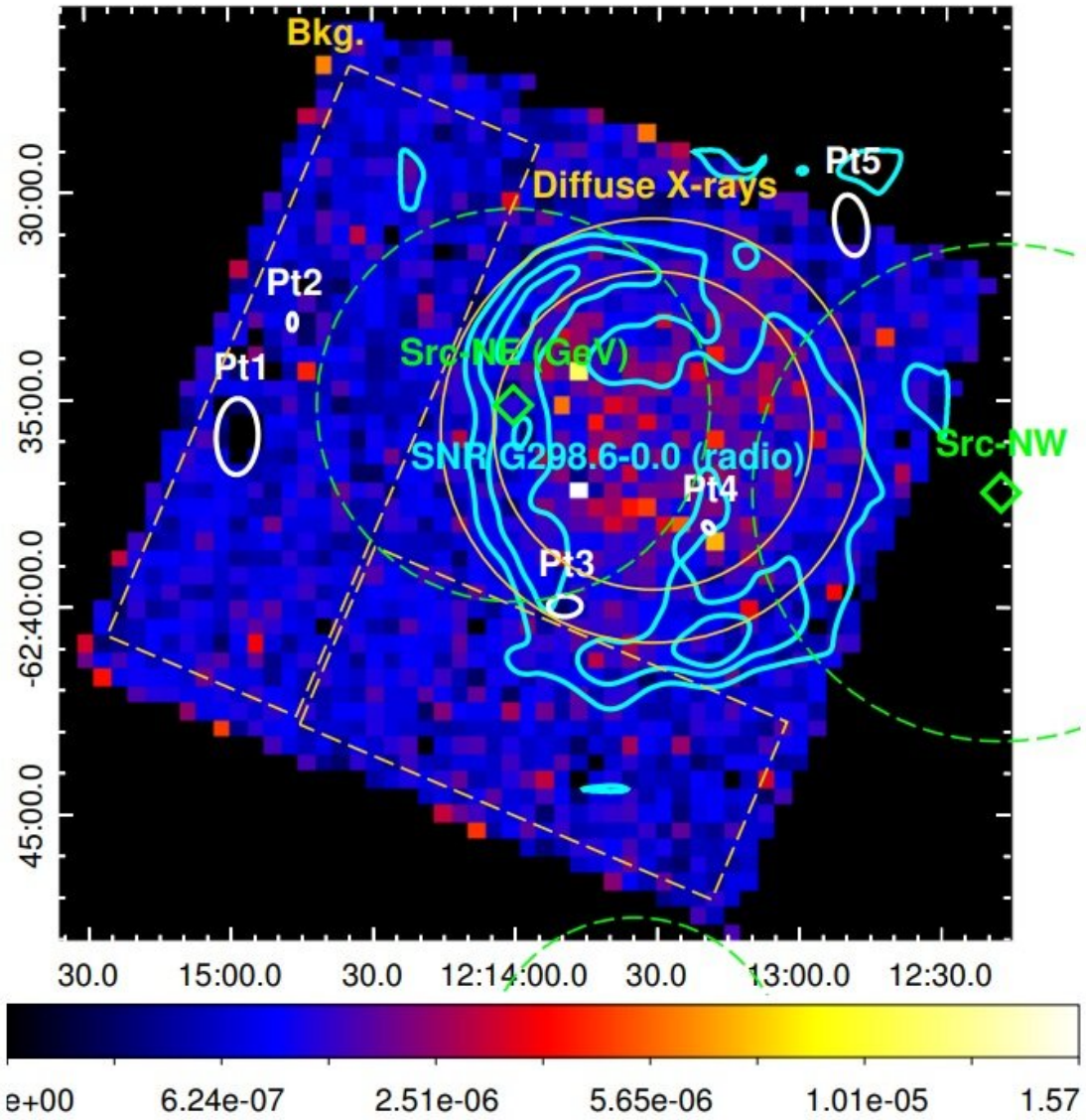
SNR G298.6−0.0 is an old supernova remnant interacting with molecular clouds, study finds

December 13 2022, by Tomasz Nowakowski



Chandra-ACIS flux map (i.e., exposure-corrected map) of the field around SNR G298.6−0. Credit: Yeung et al, 2022

Japanese astronomers have performed long-term multiwavelength observations of a supernova remnant (SNR) designated SNR G298.6−0.0. They found that G298.6−0.0 is an old SNR interacting with molecular clouds. The new findings were detailed in a paper published December 4 on the *arXiv* pre-print server.

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 shockwave from the exploded star.

Studies of supernova remnants are important for astronomers, as they play a key role in the evolution of galaxies, dispersing the heavy elements made in the supernova explosion and providing the energy needed for heating up the interstellar medium. SNRs are also believed to be responsible for the acceleration of galactic cosmic rays.

SNR G298.6−0.0 is a Galactic supernova remnant with a flat radio spectral index of -0.3, located in a complex region near two bright extended regions of ionized atomic hydrogen (H II). Previous observations of SNR G298.6−0.0 have found that the remnant is associated with an extended GeV gamma-ray source, designated 4FGL J1213.3−6240e, and identified a centrally filled X-ray structure inside the radio shell, indicating a mixed morphology.

Now, a group of astronomers led by Paul K. H. Yeung of the University of Tokyo in Japan, presents the results of a long-term monitoring

campaign of SNR G298.6–0.0 that was launched in 2008 and lasted nearly 14 years. The main aim of these observations, utilizing mainly NASA's Fermi spacecraft, was to comprehensively investigate multiwavelength properties of this SNR.

The observations show that 4FGL J1213.3–6240e consists of three point-like components, designated Src-NE, Src-NW and Src-S. Src-NE has a much higher spectral peak energy than Src-S, and the 2–300 GeV photon index of Src-NE is significantly softer than that of Src-S. According to the researchers, such differences in the spectral shape point to different origins of the responsible cosmic rays.

The study found that Src-NE and SrcNW demonstrate spectral breaks at energies of around 1.8 GeV, which suggests that SNR G298.6–0.0 is at least 10,000 years old. The kinematic distance to SNR G298.6–0.0 was estimated to be about 33,000 light years, yielding a physical radius of the remnant of approximately 50.5 light years. Such a large physical size further confirms the old age of this SNR.

Furthermore, the research identified dense molecular clouds in the surroundings of SNR G298.6–0.0. The observations suggest that the remnant is interacting with these clouds. The authors of the paper assume that the molecular clouds could possibly account for the gamma-ray emission of the components Src-NE, Src-NW and Src-S.

More information: Paul K. H. Yeung et al, Multiwavelength studies of G298.6–0.0: An old GeV supernova remnant interacting with molecular clouds, *arXiv* (2022). DOI: 10.48550/arxiv.2212.01851