Galactic X-ray emissions originate from stars

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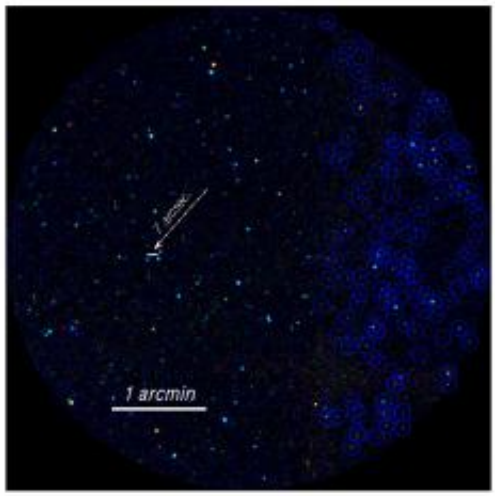

The plane of the Milky Way, recorded with the Chandra satellite in three colours: Photons with energies between 0.5 and 1keV appear red, those between 1 and 3keV green, and those between 3 and 7keV blue. Discrete sources are indicated by circles. Image: Mikhail Revnivtsev

(PhysOrg.com) -- A 25-year old astronomical mystery has been solved: Most of the diffuse X-ray emissions in the Milky Way do not originate from one single source but from so-called white dwarfs and from stars with active outer gas layers. Mikhail Revnivtsev from the Excellence Cluster Universe at the TU Munich and his colleagues at the Max Planck Institute for Astrophysics in Garching, the Space Research Institute in Moscow and the Harvard-Smithsonian Center for Astrophysics in Cambridge have now succeeded in proving this.

It is now 25 years since scientists discovered diffuse X-ray emissions from the vicinity of the Milky Way plane. Since then, a whole generation of astronomers has been racking its brains as to their origin. Energetic X-ray emissions usually originate from very hot gases in a temperature range between 10 and 100 million degrees Celsius. And this "Galactic Ridge X-ray Emission" (GRXE) is also typical for very hot, optically thin plasma.

A gas with these thermal properties would, however, immediately escape from our galaxy - the Milky Way would continuously lose colossal amounts of energy and finally collapse as the existing energy sources, such as stars and supernovae, would not be sufficient to replenish such a loss. Cosmic particles colliding with the interstellar medium could also be ruled out as an explanation for the GRXE.

It is only recently that observations with the RXTE and Integral satellites have shown that the X-ray emissions of the Milky Way exhibit the same distribution pattern as the stars. Since then, it has been assumed that a large portion of the GRXE originates from individual stars. These findings motivated the international team to carry out more precise measurements with the Chandra X-ray telescope. The test area chosen was a small celestial region near the centre of the Milky Way.

The region chosen, about half as big as a full moon, lent itself to the observations for two reasons: On the one hand because of the high GRXE intensity, which minimized the "interfering radiation" from extra-galactic X-ray sources; and on the other hand because the interstellar matter at this position absorbs only small amounts of radiation so that it was even possible to detect weak discrete sources with Chandra.

Chandra actually managed to identify 473 point sources of X-rays in a sector of the search field covering only 2.6 arcminutes. In a further step, the group used measurements from the Spitzer satellite observatory to

prove that the results of the sector observed could be applied to the whole galaxy.

Most of the 473 X-ray sources are probably white dwarfs, which accrete matter from their surroundings, as well as stars with high activity in their outermost gas layer, the corona. White dwarfs are the remnants of extinct, low-mass suns. These cooling dead stars frequently orbit a partner, and in such a binary star system the white dwarf extracts matter from its larger partner until it becomes a Type Ia supernova.

The resolution of the diffuse X-ray emissions in our galaxy into discrete sources has far-reaching consequences for our understanding of a number of astrophysical phenomena. Astronomers can use the GRX emission as a calibration for the spatial distribution of star populations within the Milky Way, for example. The results were also relevant for research into other galaxies: It now seems clear that the diffuse X-ray radiation from these objects originates from white dwarfs and active stars.
Original work:

More information: Mikhail Revnivtsev, Sergey Sazonov, Eugene Churazov, William Forman, Alexey Vikhlinin and Rashid Sunyaev, Discrete sources as the origin of the Galactic X-ray ridge emission, *Nature*, Vol. 458, No. 7242, April 30, 2009

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