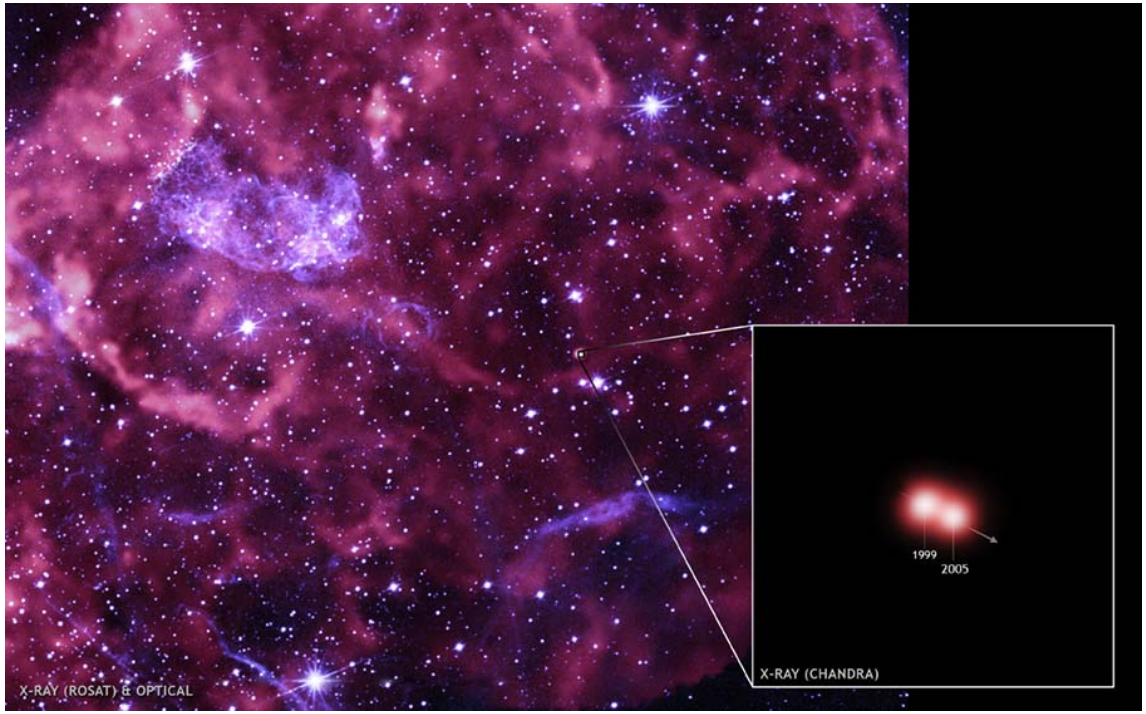
Chandra Science Highlight

RX J0822-4300: Direct Measurement of Neutron Star Recoil in the Oxygen-rich Supernova Remnant Puppis A



Chandra X-ray Observatory HRC image. Scale: Inset is 14.5 arcsec across

The larger field-of-view is a composite of X-ray data from the ROSAT satellite (pink) and optical data (Purple), fro the Cerro Tololo Inter-American Observatory 0.9-meter telescope, which highlights oxygen emission. The inset box shows two observations of this neutron star obtained with the Chandra X-ray Observatory over the span of five years, between December 1999 and April 2005.

Credit: Chandra: NASA/CXC/Middlebury College/F.Winkler et al; ROSAT: NASA/GSFC/S.Snowden et al; Optical: NOAO/AURA/NSF/Middlebury College/F.Winkler

- The observed angular motion of the neutron star RXJ0822-4300, deduced from 3 Chandra images over 5 years, implies a transverse space velocity of 1,600 km/s for an estimated distance of 7,000 light years.
- The unusually large space velocity is consistent with the explosion center inferred from proper motions of the oxygen-rich optical filaments, and confirms the idea that Puppis A resulted from an asymmetric explosion accompanied by the recoil of the neutron star.
- The kinetic energy associated with the transverse motion of the neutron star is only about 3% of the total expected in a typical supernova. Some 2-3 dozen oxygen-rich knots like those now glowing optically are sufficient to balance the momentum of the neutron star.
- The most likely candidate for producing the high neutron star velocity appears to be some mechanism through which hydrodynamic instabilities in the supernova explosion lead to recoil of the compact remnant. However, the most specific such model proposed to date is strained to explain both the high kick velocity and the apparent absence of iron-rich ejecta from the inner core of the Puppis A progenitor.

Reference: F. Winkler & R. Petre, 2007, ApJ, 670, 635

Chandra X-ray Observatory HRC Image

CXC operated for NASA by the Smithsonian Astrophysical Observatory

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