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

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.


Chandra X-ray Observatory HRC Image


CXC operated for NASA by the Smithsonian Astrophysical Observatory

December 2007