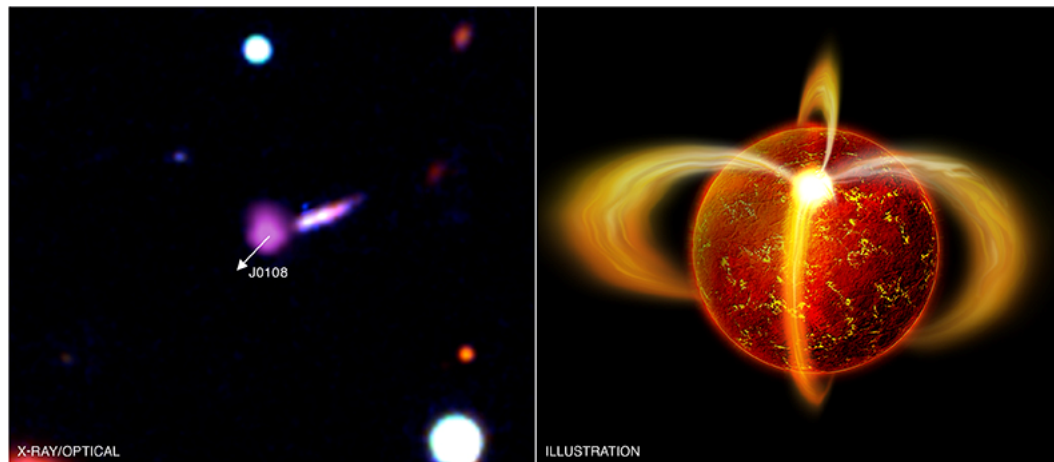




# Chandra Science Highlight

## PSR J0108-1431: Geriatric Pulsar Still Kicking



The composite image on the left shows an image from NASA's Chandra X-ray Observatory in purple and an optical image from the European Southern Observatory's Very Large Telescope in red, blue and white. The Chandra source in the center of the image is the ancient pulsar PSR J0108-1431 (J0108 for short), located only 770 light years from us. The elongated object immediately to its upper right is a background galaxy that is unrelated to the pulsar.

Credit: X-ray: NASA/CXC/Penn State/G.Pavlov et al.; Optical: ESO/VLT/UCL/R.Mignani et al.; Illustration: NASA/CXC/M.Weiss

Scale: Image is 1.3 arcmin across. Estimated Distance: About 770 light years

- With an age of about 200 million years this is the oldest isolated pulsar ever detected in X-rays. Among pulsars that have not been spun-up in a binary system, it is over 10 times older than the previous record holder with an X-ray detection. At a distance of 770 light years, it is one of the nearest pulsars known.
- Some of the energy that J0108 is losing as it spins more slowly is converted into X-ray radiation. The efficiency of this conversion process for J0108 (1.7%) is found to be higher than for any other known pulsar. An accurate distance for the pulsar from very recent VLBI work, obtained independently, increased the efficiency from the published value of 0.4%.
- A proper motion corresponding to a velocity of 130 km/s was measured for J0108 by comparing with a radio position obtained in 2001. This enabled a likely optical identification of the pulsar to be made by several members of the Chandra team, in a separate paper. The proper motion and optical identification were confirmed by the VLBI work.
- Two forms of X-ray emission are likely produced in J0108: emission from particles spiraling around magnetic fields, and emission from heated areas around the neutron star's magnetic poles. Measuring the temperature and size of these heated regions can provide valuable insight into the extraordinary properties of the neutron star surface and the process by which charged particles are accelerated by the pulsar.

Reference: Pavlov, G., et al., 2009, *Astrophysical Journal*, 691,458

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