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News & Comments

The Strongest Magnetic Field Ever Measured in the Universe

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The cyclotron absorption lines in their X-ray energy spectra are the only way to measure neutron stars' surface magnetic fields directly because they have the strongest magnetic fields in the universe. A cyclotron absorption line was recently discovered by the Insight-HXMT team in the neutron star X-ray binary Swift J0243.6+6124, which corresponds to a surface magnetic field of more than 1.6 billion Tesla. Direct measurement of the strongest magnetic field in the universe at about 1 billion Tesla was made in 2020. This broke all previous records for cyclotron absorption lines and magnetic fields. Swift J0243.6+6124 was already considered a star to watch. An ultra-luminous source of X-rays in our galaxy, it is a super-compact cosmic heavyweight known as a pulsar. interestingly it is the only X-ray pulsar with a Be-type companion star in the Milky Way. An outburst of activity in Swift J0243.6+6124 following X-ray observatory Insight-HXMT's launch also provided a glimpse into its high-strength magnetic field, with a cyclotron resonance scattering feature buried within its X-ray spectrum. In an analysis of its features, its electrons had 146 kiloelectron volts, breaking the previous record of 90-100 kiloelectron volts. Only one ultra-luminescent X-ray pulsar in the Milky way has a precise magnetic field measurement. By using the cyclotron absorption line, Insight-HXMT was able to determine the direct magnetic field much more precisely than by using indirect means. It is the first direct evidence that a neutron star's magnetic field structure is more complex than a traditional symmetric dipole field. In addition, it provides the first measurement of a neutron star's nonsymmetric magnetic field component.

KEYWORDS

Magnetic field, Milky way, Neutron star, J0243.6+6124, X-ray binary Swift J0243.6+6124, X-ray observatory Insight-HXMT, X-ray observatory Insight