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THE mystery of what powers some of the universe's strangest objects has deepened with the discovery that "magnetars" emit even more energy than previously thought.

Magnetars are a type of rotating neutron star, immensely dense objects only a few kilometres across. Neutron stars form from compacted debris left over when stars up to 40 times the size of the sun explode in a supernova.

Astrophysicists first noticed something unusual in 1981, when they became puzzled by the powerful bursts of low energy X-rays, visible light and infrared that some neutron stars emit as they rotate. Such pulses are usually powered by matter heating up as it spirals in towards a neutron star or by gradual deceleration of the star's spin, but observations ruled out both these explanations. Astronomers dubbed them anomalous X-ray pulsars or AXPs, and later found six others in the Milky Way and a satellite galaxy called the Large Magellanic Cloud.

Just how AXPs could produce all this energy remained a mystery until 1992, when Christopher Thompson, now at the Canadian Institute for Theoretical Astrophysics in Toronto, and Robert Duncan, now at the University of Texas at Austin, suggested that powerful magnetic fields could generate this radiation. Their idea is that the magnetic field of the progenitor star is locked into the collapsing matter as the neutron star forms, vastly increasing its strength. That would make AXPs the strongest magnets in the galaxy, with fields upwards of 100 trillion times as strong as Earth's - powerful enough to wipe a credit card from the distance of the moon. Hence Thompson coined the name magnetar.

However, it now appears magnetars emit even more energy than the model accounted for. Lucien Kuiper of the Space Research Organization of the Netherlands in Utrecht and four colleagues examined AXPs at higher energies and found to their surprise that they are bright sources of high-energy X-rays. Their results will appear in *The Astrophysical Journal* later this year.

"It was really shocking," says Victoria Kaspi of McGill University in Montreal, Canada. "There had been all this theoretical work on magnetars, but nobody had predicted this."

["It was really shocking. There had been all this work on magnetars but nobody predicted this"](#)

All hope is not lost for the magnetar theory, though. Thompson and Andrei Beloborodov of Columbia University in

New York say that with a few adjustments, the model can explain the high-energy X-rays too (www.arxiv.org/astro-ph/0602417). They believe the magnetar's field becomes twisted as it rotates and this rips electrons from the star's surface, producing an avalanche of positron and electron pairs. These particles then emit the high-energy X-rays as

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they accelerate in the magnetic field. "Beloborodov and I are both convinced that the model of a twisted magnetosphere is the basic explanation," says Thompson.

by Mark Anderson

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