PRESS RELEASE

Astronomers try to catch runaway star

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Astronomers are using an unusual technique to measure the speed of an equally unusual star in our galaxy, which might be traveling through space at 10 million miles per hour.

If they succeed, the star's velocity would make it about the fastest moving object of its kind. If they don't, a theory is going to need rewriting, said research physicist Kevin Hurley of the Space Sciences Laboratory at the University of California, Berkeley.

Chandra x-ray picture of the magnetar SGR1900+14 (to the lower left of the center of the cross) and its neighboring sources (indicated by green circles). The neighboring sources must be identified, and their positions measured, to determine whether the magnetar has moved. The size of this image on the sky is roughly half the size of the full moon.
Kevin Hurley, UC Berkeley

A progress report was presented Jan. 9 at the meeting of the American Astronomical Society by Hurley and a team of scientists from NASA's Marshall Space Flight Center, the University of Texas at Austin, the United States Naval Observatory and Pennsylvania State University.

The star, which goes by the name SGR1900+14, is located in the constellation of Aquila about 20,000 light-years away. It is an example of an intensely magnetic star, known as a magnetar, which is thought to arise from a fairly recent supernova explosion. Only four are known to exist for certain within our Milky Way Galaxy.

Although many stars have come to an end in supernova explosions over the eons, in most cases the result is a dense object known as a neutron star, which has about the same diameter as the Washington D.C. beltway, but contains as much matter as the sun. Neutron stars are observed by radio astronomers as pulsars. A supernova remnant, the cosmic debris of a supernova explosion, on the other hand, can be observed by optical and radio astronomers as a slowly expanding, diffuse glow for up to 10 or 20 thousand years. After that, it fades into complete obscurity.

For reasons which are not entirely understood, Hurley said, in very rare cases a supernova explosion may produce an intensely magnetized neutron star or magnetar. A magnetar at the distance of the moon, for example, would exert a stronger pull on metallic objects than a refrigerator magnet, erasing credit cards and subway tickets, and pulling keys from pockets everywhere.

Although SGR1900+14 is at a "safe" distance of 20,000 light years, it still has an effect on the Earth, Hurley said. It emits short pulses of gamma-rays, an energetic type of x-ray, which are easily measured by orbiting satellites. Several years ago, it unleashed a torrent of radiation so intense that it produced a major disturbance in the Earth's upper atmosphere. Scientists are understandably interested in finding out when and where stars like this are born, and why.

"Normally, when you discover a magnetar, you look for the nearest supernova remnant and assume that is its birthplace," Hurley said. "In this case, though, we have a problem — the nearest remnant is very far away. If it really was born there, it must hold some sort of speed record, because it got out in a big hurry. And if it wasn't, then we have another problem, because we don't know where it came from."

The distance between the magnetar and the nearest supernova remnant is at least 15 light years. The nearest supernova remnant is probably 10,000 years old at most, or it would have faded to the point of being invisible. So the velocity of the magnetar can be estimated on paper, and it turns out to be at least 10 million miles an hour.

Still, astronomers can't actually perceive its motion, because it is so distant. The idea is to take "snapshots" of it at intervals of several years and compare them to one another. But even this is not an easy matter. The snapshots must be exceedingly accurate if the motion is to become at all apparent. Until a few years ago, there were just two ways to achieve this. One is with optical pictures, which astronomers routinely use to measure stellar velocities. The other is with radio pictures.

Unfortunately, the magnetar does not emit enough optical light to pose for a portrait, Hurley said. That leaves radio pictures, but the magnetar is not very photogenic in the radio either. It emitted a large blast of radio waves several years ago, during its last giant outburst, but it has been radio quiet ever since. So astronomers know where it was a few years ago, and would like to know where it is today.

Enter the Chandra x-ray Observatory, one of NASA's "great observatories" in space, launched two and a half years ago. Chandra takes the most accurate x-ray pictures ever achieved, and fortunately, SGR1900+14 is a bright x-ray source. Chandra took an x-ray picture of the magnetar last June. Now the trick will be to compare the x-ray picture with the earlier radio picture to see if the magnetar has moved.

To do this, the positions of all the other x-ray sources in the Chandra picture will have to be measured very accurately, so that a fixed background can be established against which the motion of the magnetar will be apparent. The required accuracy is about one tenth of one arcsecond, which is the size of a dime at a distance of 12 miles. The first results are just starting to emerge, but several more months of work will be needed to draw any firm conclusion.

If the large velocity is confirmed, a new speed record will be established. If it is not, astronomers will have to examine the relation between supernova explosions and magnetar births with a more critical eye.

The final results are expected to become available by the time of the next AAS meeting at Albuquerque in June.

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