Bigger Picture 2

I recently read an article that was published in 2003 and which I thought you may find of interest. The title of the paper was **"Solar Flares on Steroids"**

It was August 24th 1998, around solar maximum, so flare activity was not unusual. That day there was an X class flare, quite a powerful one as there had been some radio interference, but not unexpected.

There was no surprise, when three days later a second mighty flare swept past the earth. Satellites recorded massive bursts of x-rays and gamma rays and radio hams experienced yet another blackout. Astronomers thought it was another X class flare, but no, this one did not originate from the sun.

It came from outer space!!

Using various satellites of the Interplanetary Network (IPN), such as Ulysses, 2001 Mars Odyssey, RHESSI and others, all considerable distances apart, accurate location was achieved by triangulation. (Although it is not the primary mission of these spacecraft, their instrumentation, namely x-ray and gamma ray, does record these radiation bursts) The source of the blast was SGR 1900+14, a Magnetar some 45,000 light years from earth. Incredible stuff.

Magnetars have the strongest magnetic fields known, possibly a million, million gauss. The sun can only average 10 gauss and possibly up to 1000 gauss near sunspots. On the sun, flares happen when magnetic fields become stretched and twisted, they snap, and recoil with explosive results. Physicists call this "magnetic reconnection". Maxim Lyutikov of McGill University thinks something similar takes place on magnetars. *"I imagine that the atmosphere of a magnetar is similar to the solar corona-filled with plasma and complicated magnetic fields*" he says.

Reconnections on the sun emit as much as10^{32} ergs of energy. Flares on magnetars are a million, million times stronger.

"They're solar flares on steroids" says Pete Woods of NASA.

When SGR 1900+14 arrived on the 27th August 1998 it hit the nightside of the earth, something solar flares never do. The radiation of charged ions hit our radio signals, either absorbing or reflecting them, so radio listeners knew something had happened.

A registered nurse in Seattle was driving home from work at 2.30am, listening to a local radio station. The station faded-a blackout-and was replaced by country music from Omaha, Nebraska.

On the east coast, hams chatting locally suddenly picked up voice transmissions from distant parts of Canada. These propagation effects, like those experienced during solar flare activity, quickly subsided and no harm was done, but the event left a deep impression on astronomers. From halfway across the galaxy, SGR 1900+14 had "touched" our planet.

It happens more often than most people know. Since 1998, earth has experienced about "*10 similar ionization events."* says Umran Inan of Stanford University. *"Five of them were caused by SRG 1900+14 and the rest from unknown sources"*.

Inan leads the Very Low Frequency Research Group at Stanford University. They have a network of radio stations in North America and Antarctica. When earth is hit by ionizing radiation the network records the telltale changes in radio propagation. Solar flares are global, ionizing the top of Earth's dayside atmosphere. Flares from magnetars can ionize the nightside too. These signatures-dayside vs nightside, help Inan identify the source of ionization.

His *"unknown sources"* are probably magnetars not yet identified by astronomers.

"The best way to pinpoint a magnetar" says Woods (one of the unknown resources) *"is to catch it when it's bursting-but that's not easy because the bursts are unpredictable and brief. Oftentimes they come and go in less than one-tenth of a second"*. Many more await discovery, he believes.

Triangulation works in this manner: When a wave of radiation sweeps through the solar system, it hits different spacecraft at slightly different times. Astronomers can figure out where the burst came from by comparing the arrival times. *"Its simple triangulation,"* says Kevin Hurley of UC Berkeley who leads the effort. *"The Ulysses spacecraft is particularly important because of its long looping orbit around the sun. Ulysses' great distance from other spacecraft makes the triangulation precise."*

"Each year we pinpoint dozens of magnetar outbursts this way" he says. The majority of bursts detected by the IPN are faint, only the strongest few ionize the earth's atmosphere.

As soon as the Interplanetary Network locate a burster, astronomers worldwide are alerted with its coordinates and ground based telescopes are brought to bear on the location. Magnetar candidates receive the attention of many national observatories.

"From a physics point of view," notes Woods, *"the energy reservoir in the magnetosphere and crusts of magnetars is 10 to 100 times bigger than the energy released during the August 27th 1998, outburst. So there is the potential for much higher energy events. It's a good idea to keep an eye on these things."*

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Of the little I know of solar astronomy, this event is not one. I find it incredibly difficult to believe that a burst of radiation, as mighty as it is, can travel such a vast distance and still be able to be recorded here. This is not the light of the star we are talking about, but the impact we feel as the radiation hits the earth.

The average time for a solar storm to reach us from the sun is about 45 hours, equating to about 1000km/s.(though the record for speed goes to a CME with a solar wind speed of 2700km/s back in November, but those sort of speeds are very rare). So, just how long ago did that burst of radiation leave SRG 1900+14?

I guess the journey took approximately 13,500,000 years for the flare to reach Earth if it traveled at or around 1000km/s.

But, a massive ejection of plasma, from a star with the amounts of magnetic energy as described in this article, is not going to be able to escape the pull of gravity at 1000km/s. But, increased 100,000 fold and we are still talking about 1,350,000 years to get here!

Of course, to reach earth in 45,000 years at the speed of light the escape velocity from SRG 1900+14 would have to be 300,000km/s, and that I can't imagine.

In an attempt to clarify the question of time taken, for my own interest as well as for anyone else who may be interested, I have asked several institutions for their opinions and will keep you up to date with their replies.

What do you think the time taken might be?

Alan Buck
30th Sept 2006

Note: If the solar scientists can locate the source of the flare by triangulation, using time differences between satellites, I would have thought using those time differences and knowing the distance of SRG 1900+14 they could work backwards to obtain a fair guess of the speed of the flare.

Addendum

The November issue of the American magazine "Astronomy" is now on sale, and, low and behold, it has an article on Magnetars in it.

As the article says, they are a very new discovery. In 1987 two astronomers, Robert Duncan and Christopher Thompson suggested the possible existence of highly magnetized types of neutron stars. They gave such a star the name "magnetar", but their theories were viewed by the establishment with considerable scepticism.

In fact, they had to wait until 2004 for their theories to become fact, and that was with the arrival of SGR1900+14's flare in August of that year.

The paper from which I took my last article quoted SGR1900+14 as being 45,000 light years away. The magazine article says it came from within the constellation Aquila and about 20,000 light years distant. So, on the strength of that, my suggestions of various amounts of travel time are obviously incorrect.

The magazine article goes on to say that magnetars are being identified on a regular basis and they now form a new avenue of research. To the present, 5 Soft Gamma ray Repeaters have been positively identified, along with 9 possibles that have the title AXP (Anomalous X-ray Pulsar).

Alan Buck
19th October 2006