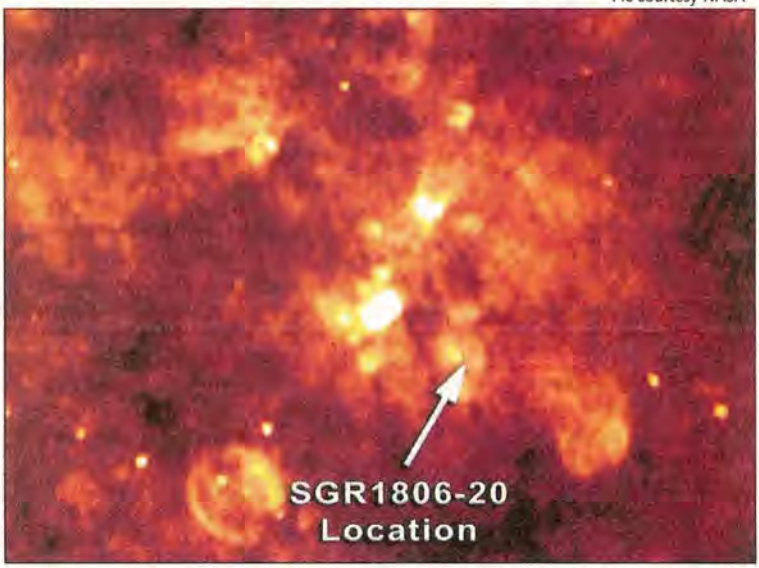
Magnetic showers in space

With magnetic fields over a hundred trillion times that of the earth, magnetars are capable of shredding an approaching astronaut to pieces.

Pic courtesy NASA



On December 27, 2004, a day after the devastating Indian Ocean tsunami, a spectacular burst of gamma ray radiation hit the earth's ionosphere, changing its properties and disturbing radio communication. The amazing thing about this was that the object causing this was at the other end of the galaxy! This object, dubbed a magnetar, belongs to an exclusive class of objects having a magnetic field more than hundred trillion times that of the earth.

That the earth has a magnetic field has been known since antiquity. Apart from their entertainment aspects, compasses pointing to the north, magnetic pole played a key role in navigation during long marine voyages of adventurous seafarers across vast oceans. Many birds navigate from pole to pole sensing the magnetic field. The earth's magnetic field is less than a gauss, a unit to measure the field intensity. Many other celestial objects have magnetic fields.

Sunspots are regions on the sun's surface having large magnetic fields of several thousand gauss. Dissipation of this magnetic energy (the energy per unit volume going as the square of the magnetic field strength) leads to several high energy phenomena on the sun such as solar flares, coronal mass ejections etc. Many stars are known to have surface magnetic fields of several thousand gauss. About forty years ago, astronomers found a new class of objects called pulsars, which emit intense pulses of radio radiation at very regular intervals. These objects, most of them spinning several times a second, were identified as neutron stars, which are the end products of the supernova explosion of massive stars about more than ten times the sun's mass. Neutron stars span about ten kilometres but weigh as much as the sun.

These objects have very large magnetic fields, around a trillion gauss, that is, a million million times the strength of the earth's field. Their magnetic axis is inclined with respect to their rotational axis, and they lose their stored rotational energy through magnetic dipole radiation. The rate of the slow down (one part in a million per year) of their radiation is consistent with such large fields. Despite their intense radio emission, the flux of radiation falling on the earth from the pulsars is negligible.

Magnetars

In the past ten years or so, astronomers have become aware of a special kind of neutron star called a magnetar, with magnetic fields typically hundred times or more than a pulsar. These have magnetic fields a hundred trillion times stronger than that of the earth and every now and then give out flashes of high energy gamma and x-rays, lasting just a second or so.

An early evidence for such an exotic object came on March 5, 1979, when a torrential burst of gamma rays swept through the solar system knocking off radiation monitors on spacecraft near Earth and near Venus. The burst lasted just a fifth of a second. But in this split second, it had emitted more gamma rays than the energy emitted by the sun in twenty thousand years! The culprit was later identified as a neutron star (invisible in optical radiation) in a neighbouring galaxy.

On 27 December 2004, gamma radiation hit the earth's ionosphere, changing its properties from night to day, causing significant drop in ham radio signals and other radio disturbances including sighting of aurorae. The object was identified as SGR 1806-20, a magnetar, SGR standing for Soft Gamma Ray repeater. In this fraction of a second, the flare produced more energy in gamma rays than the entire radiation output of the sun in a hundred thousand years!

Magnetar flares are not as energetic as gamma ray bursts but they occur more frequently and are more likely to happen closer to earth. More than a million magnetars are expected to loiter unseen in the dusty lanes and bylanes of our galaxy. Magnetars have a unique source of power. The energy released by a magnetar comes from the gradual loss of its magnetic field. Thus, magnetars are the most magnetised objects in the universe. To get some idea about the strength of the magnetic field, imagine an astronaut approaching them, the intense magnetic field would pull all atoms of the astronaut's body into long thin needle formations, completely shredding him. Fatal are the ways of the Universe.

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