Annotated Bibliography

What does the paper say about your phenomenon?

How are the theoretical models constructed?

What assumptions and approximations are being made?

What are the predictions and implications?

What more do you need to know to understand this article?

Magnetars - solomon.as.utexas.edu/sciam.pdf

This article serves as a great overview of what magnetars are, some of their features, how and when they were discovered, and to a lesser extent, what is being done with them today. Magnetars were first conceived of in the early 70’s after a giant pulse of gamma radiation far too powerful to be from an ordinary star sent several satellites and sensors radiation levels off the charts. Theorists and observers soon leaped at the idea that this phenomenon could’ve originated from one of the two most extreme objects in the universe, and after black holes were decided incapable of this dead, they began looking at neutron stars.

The search into gamma ray bursts (GRB), soft gamma repeaters (SGR), and anomalous x-ray pulsars (AXP) led scientists to a handful of discoveries. For one, magnetars are a very particular form of neutron star. If a star had a large enough magnetic field and the fast enough internal gas currents, after a supernova, a neutron star could perhaps spin so incredibly fast (more so than a pulsar) that it matched the rotation speed of the now-condensed internal solar fluid, creating a dynamo, and allowing for the magnetic field to stabilize and dominate the star. These magnetic fields are usually between 10^14 and 10^15 gauss and are capable of changing fundamental physics. These magnetic fields are also powerful enough to cause damage to the crust of the magnetar, allowing for a release of energy that comes in two forms: a general expulsion of soft gamma rays, typical of a SGR, or occasionally a large-scale event causes a magnetic field rearrangement that releases a violent burst of energy (similar to solar flares). The fact that their magnetic and electric fields in these burst first produce a giant fireball that decays before producing other electromagnetic radiation is worth looking into.

Formation of Very Strongly Magnetized Neutron Stars: Implications For Gamma-Ray Bursts - <http://articles.adsabs.harvard.edu/full/1992ApJ...392L...9D/L000009.000.html>

This article strongly mirrors the one above – I believe it was a heavy influence. It was a fairly easy read from 1992 detailing some characteristics about magnetars and offering multiple solutions for a few theories. They explain that pulsars often differ from magnetars in that their slower rotation speed is caused by either their internal convection not being united enough, but rather spotty and broken, or that the ratio between these internal ionized gas currents and the outer rotation speed was now enough to align the magnetic fields in magnetar fashion. When these celestial beasts are formed, it seems that they are often kicked away from the origin of the supernova that created the as well, with several possible theories. The main theory is that neutron star equivalents to sunspots, caused by contained neutrinos can cause a massive recoil on the neutron-star.

There is also evidence shown that strengthens the argument for a massive slowing down of magnetars due to their large magnetic field, as well as they’re involvement with soft gamma repeaters. Over many years, observations of gamma and x-ray pulses from these magnetars has allowed people to track their locations, spin frequencies, emissions. The consensus is that these neutron stars spin down far faster than their pulsar brethren due to their massive magnetic fields pressing against the ionized convection currents (and thus electric fields) from within them, allowing them a relatively short life. It is discussed that these objects not only have links to SGR, but also possibly to gamma ray bursts as discussed in the article above.