MAGNETIC RECONNECTION

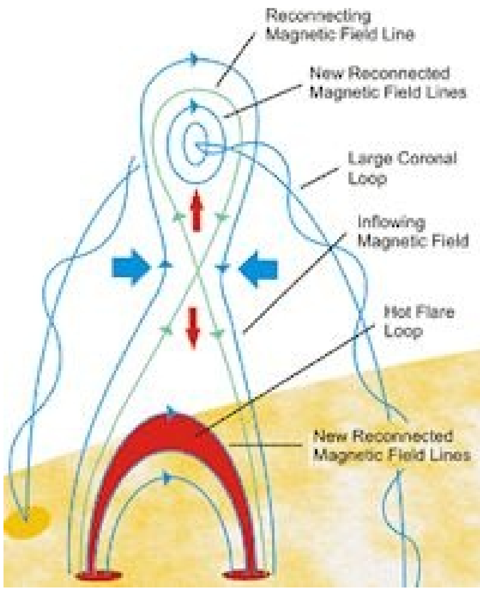
It could be the Universe's favourite way to make things explode

It operates anywhere magnetic fields pervade space--which is to say almost everywhere. In the cores of galaxies, magnetic reconnection sparks explosions visible billions of light-years away. On the sun, it causes solar flares as powerful as a million atomic bombs. At Earth, it powers magnetic storms and auroras. It's ubiquitous.

The problem is, researchers can't explain it.

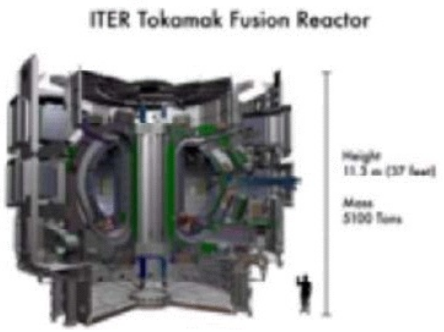
The basics are clear enough. Magnetic lines of force cross, cancel, reconnect and—Bang! Magnetic energy is unleashed, with charged-particles flying off near the speed of light. But how? **How does the simple act of crisscrossing magnetic field lines trigger such a ferocious explosion?** Something very interesting and fundamental is going on that we don't fully understand.

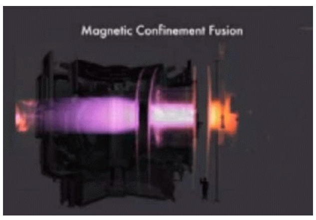
NASA is about to launch a mission to get to the bottom of the mystery. It's called MMS, short for **"Magnetospheric Multiscale"** and it consists of four spacecraft that will fly through Earth's magnetic field, or "magnetosphere," to study reconnection in action. Earth's magnetosphere is a ready-made natural laboratory for studying this phenomenon. Slated for launch on 12 March, the four spacecraft were designed, built and tested at NASA's Goddard Space Flight Center. Each one is shaped like a giant hockey puck, about 4 metres in diameter and 1 metre in height. In space, however, they are much larger. After launch, the spinning spacecraft will unfurl their electromagnetic sensors, which are at the end of wire booms as much as 60 metres long, When fully extended, the sensors are as wide as a baseball field. These sprawling, spinning probes will fly in precise formation, as close as 10 km apart and are guided by GPS satellites orbiting Earth far below them. Maintaining formation with is crucial to the measurements.

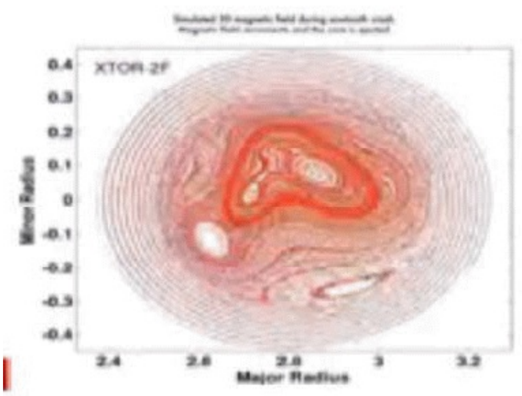


Model of magnetic reconnection

A practical spin-off from the project could help provide clean energy on Earth. For many years, researchers have looked to fusion as a clean and abundant source of energy for our planet and one approach is magnetic confinement. But there have been problems with magnetic containment in the plasma chamber. The main problems is exactly the magnetic reconnection. As heat in the tokamak builds up, the electron temperature reaches a peak, then a reconnection of the containment field causes a 'crash' and some of the hot plasma escapes. It is virtually impossible to study this process at the microscopic dimension of the containment chamber of the reactor. Earth's magnetosphere is much better. In the expansive magnetic bubble that surrounds our planet, the process plays out over volumes as large as tens of kilometres across, when magnetic reconnections sparks aurora displays. Spacecrafts can fly in and around it and get a good look at what's going on. That is what MMS will do: fly directly into the reconnection zone. The spacecraft are sturdy enough to withstand the energetics of reconnection events known to occur in Earth's magnetosphere, so there is nothing standing in the way of the full two-year mission of discovery







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