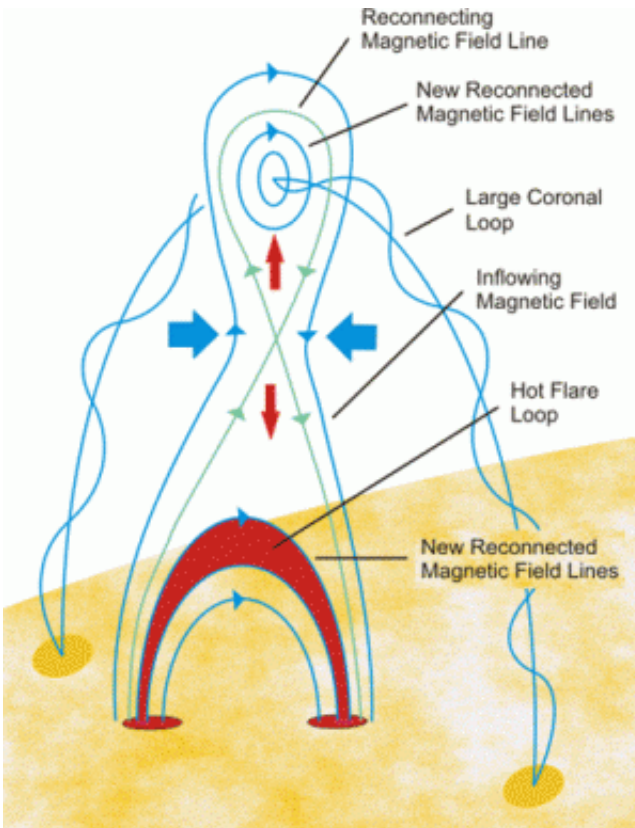


# NASA to investigate magnetic explosions

March 11 2015, by Dr. Tony Phillips

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A cartoon model of magnetic reconnection on the sun.

Magnetic reconnection could be the Universe's favorite 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," says Jim Burch of the Southwest Research Institute.

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 wonderful natural laboratory for studying this phenomenon," says Burch, the MMS Principal Investigator.

Slated for launch on March 12th, 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 meters in diameter and 1 meter 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 meters long," says Craig Tooley, MMS Project Manager at Goddard. "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. "We can maintain formation with an accuracy of only 100 meters," says Tooley. "This is crucial to our measurements."

Any new physics MMS observes 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," says Burch. "One approach, [magnetic confinement fusion](#), has yielded very promising results with devices such as tokamaks. But there have been problems keeping the plasma contained in the chamber."

"One of the main problems is [magnetic reconnection](#)," he continues. "A spectacular result of reconnection is known as the 'sawtooth crash.' As heat in the tokamak builds up, the electron temperature reaches a peak, then 'crashes' to a lower value. Some of the hot plasma escapes. This is caused by reconnection of the containment field."

In light of this, you might suppose that fusion chambers would be a good place to study reconnection. But no, says Burch. Reconnection in tokamaks happens in a tiny volume only a few centimeters wide. It is practically impossible to build sensors small enough to probe the reconnection zone.

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 kilometers across, for instance, when reconnection at the sun propels plasma clouds toward Earth, where additional reconnection events then sparks auroras.

"We can fly spacecraft in and around it and get a good look at what's going on," he says.

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 a full two-year mission of discovery.

Provided by NASA

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