NASA approves space mission to unlock the secrets of magnetic reconnection

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NASA has stepped up to the challenge of an NRC study by defining a four-spacecraft constellation that will probe known magnetic reconnection sites with the highest-resolution charged particle, electric field and magnetic field measurements yet performed in space.

Magnetic fields are continuously being generated and annihilated throughout the universe. The generation takes place by the motions of conductive fluids in the interiors of planets, the Sun and stars. Simultaneously, annihilation takes place, often violently, in these and other regions including solar and stellar atmospheres, the boundaries between solar and stellar winds, planetary magnetospheres around strong magnetic stars such as pulsars, and in exploding supernovas.

Energy is transferred to the surrounding gases in these annihilation regions, producing high-energy particles, solar flares, magnetic storms and the aurora. This annihilation process is called magnetic reconnection, and there is mounting evidence that it is one of the most important processes of energy generation throughout the universe.

NASA has recognized that there is an ideal place where magnetic reconnection can be directly probed in space, and that is at the boundary between the solar wind and planetary magnetospheres and within the long drawn-out tails of those magnetospheres. The Earth's magnetosphere is the most accessible of these, leading to the high priority given to the Magnetospheric Multiscale (MMS) mission in the latest decadal survey on Solar and Space Physics published by the

National Research Council (NRC).

Separations among the four spacecraft will be controlled precisely down to distances of 10 kilometers, which will require a novel new system of inter-spacecraft ranging and communication. The extremely high data rates needed to probe magnetic reconnection leads to a burst-mode data acquisition system that relies on the ability of the four spacecraft to communicate their findings to each other in real time so that critical information can be relayed to the ground for analysis while less important data are discarded. Analysis of the data is expected to determine how magnetic field energy is rapidly converted into heat and the kinetic energy of charged particles leading to the understanding of perhaps the most fundamental energy-transfer mechanism in the universe.

The MMS mission is managed by the NASA Goddard Space Flight Center, which will build the four spacecraft and the inter-spacecraft ranging and communication system. Southwest Research Institute leads the science investigation and development of the instrument suite together with numerous partners including the University of New Hampshire, NASA GSFC, Johns Hopkins University Applied Physics Laboratory, University of Colorado, and international partners in Austria, Sweden, France and Japan.

Source: Southwest Research Institute