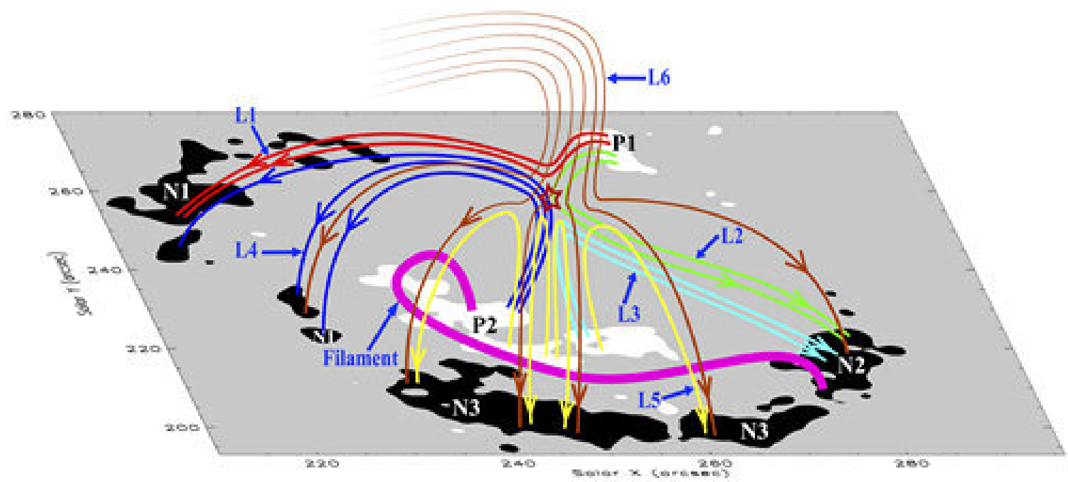
New Vacuum Solar Telescope reveals acceleration of magnetic reconnection

March 11 2021, by Li Yuan



Schematic diagram of magnetic reconnection between loops accelerated by a nearby filament eruption. Two groups of fibrils marked by L2 and L4 converge and reconnect with each other. Two sets of newly formed fibrils marked by L1 and L3 then appear and retract away from the reconnection region. Credit: LI Leping

Magnetic reconnection shows the reconfiguration of magnetic field geometry. It plays an elemental role in the rapid release of magnetic energy and its conversion to other forms of energy in magnetized plasma systems throughout the universe.

Researchers led by Dr. Li Leping from National Astronomical Observatories of Chinese Academy of Sciences (NAOC) analyzed the evolution of magnetic reconnection and its nearby filament. The result suggested that the reconnection is significantly accelerated by the propagating disturbance caused by the adjacent filament eruption.

The study was published in the *Astrophysical Journal* on Feb. 20.

The New Vacuum Solar Telescope (NVST) is a one meter ground-based solar telescope, located in the Fuxian Solar Observatory of Yunnan Astronomical Observatories of Chinese Academy of Sciences (YNAO). It provides observations of the solar fine structures and their evolution in the solar lower atmosphere.

The NVST observed the active region 11696 on March 15, 2013, in the Hα channel, centered at 6562.8 angstrom with a bandwidth of 0.25 angstrom.

Employing the NVST Hα images with higher spatial resolution, the researchers studied the evolution of magnetic loops and their nearby filament in the active region, combining the Atmospheric Imaging Assembly (AIA) extreme ultraviolet (EUV) images and Helioseismic and Magnetic Imager (HMI) line-of-sight magnetograms on board the Solar Dynamic Observatory (SDO).

In NVST Hα images, two groups of fibrils converged and interacted with each other. Two sets of newly formed fibrils then appeared and retracted away from the interaction region.

"The result provides clear evidence of magnetic reconnection," said Prof. Hardi Peter from Max-Planck Institute for Solar System Research (MPS), a co-author of this study. In AIA EUV images, the current sheet formed repeatedly in the reconnection region in the lower-temperature channels, and plasmoids appeared in the current sheet and propagated along it bi-directionally.

A filament was located to the southeast of the reconnection region. It erupted, and pushed away the loops covering the reconnection region. "The filament eruption leads to a disturbance propagating outward across the reconnection region," said Dr. Li Leping, the first author of this study.

Thereafter, the current sheet became shorter and brighter, with a larger reconnection rate. It appeared in the AIA higher-temperature channels. In the current sheet, more and hotter plasmoids formed.

"Comparing with the observations before the filament eruption during the same time intervals, more thermal and kinetic energy is converted through reconnection after the filament eruption," said Dr. LI. "The reconnection is thus significantly accelerated by the propagating disturbance caused by the nearby filament eruption."

More information: Leping Li et al. Magnetic Reconnection between Loops Accelerated By a Nearby Filament Eruption, *The Astrophysical Journal* (2021). DOI: 10.3847/1538-4357/abd47e

Provided by Chinese Academy of Sciences