

FOR IMMEDIATE RELEASE

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Creating Solar Arches in Miniature

Laboratory scaled models help reveal the dynamics and structure of solar prominences.

MILWAUKEE, Wis.—Experiments at the California Institute of Technology are recreating solar prominences in the lab to help understand how and why they erupt. Solar prominences are arches of hot ionized gas, “plasma,” which extend from the sun over distances many times the size of Earth. They are characterized by bundles of twisted magnetic fields that resemble ropes when traced. Every couple of days, one or more of these bundles becomes unstable and erupts, sending millions of tons of plasma out into space.

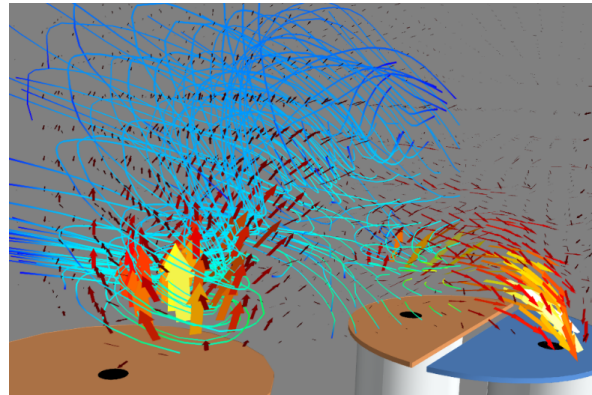


Figure 1: This figure show traces of experimentally measured magnetic field-lines (blue) and the magnitude and direction of the density of electrical current (red vectors).

Graduate student Magnus Haw and Professor Paul Bellan use these laboratory experiments to study solar prominence

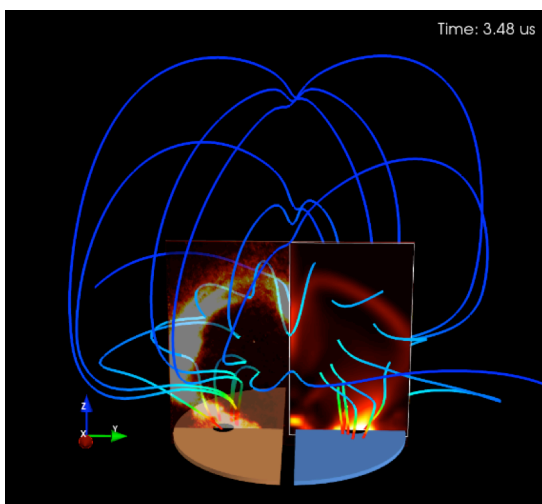


Figure 2: Magnetic field lines from simulated plasma arch with magnetic dip at apex. Experimental (left) and simulated (right) images are juxtaposed above the experimental electrodes.

eruptions in a controlled environment. These laboratory plasmas are created with the same twisted magnetic fields and appropriately scaled density, so that the miniature arches evolve in the same way that the solar versions do (Figure 1). Haw states, “We use the experiments as scale models of solar arches, just like wind tunnels are used to study airplane designs.”

Recent 3D measurements of the internal magnetic fields of these plasma arches demonstrate a collimation mechanism that operates much like squeezing a tube of toothpaste: stronger compressive magnetic forces at the base of the arches push material upwards towards its apex. This mechanism could explain the longstanding mystery of why solar loops tend to be denser and more

collimated than expected. This work has recently been published and highlighted in the journal Geophysical Research Letters.

Variants of these experiments have reproduced a magnetic dip at the arch apex, a feature commonly seen in solar prominences (Figure 2). These dips are thought to be indicative of the prominences' large mass being supported by a magnetic tension force, similar to a tightrope walker at the center of their rope. Computer simulations of this process indicate that these higher density regions can make the arches more stable by inhibiting helical instabilities.

For additional information, see also: <http://dx.doi.org/10.1002/2017GL074505>.

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Abstract

[BO6.00013](#)

Session

[Apex Dips of Experimental Flux Ropes: Helix or Cusp?](#)

[BO6: Reconnection](#)

9:30 AM–12:18 PM, Monday, October 23, 2017

Room: 202C