Simultaneous Observations of p-mode Light Walls and Magnetic Reconnection Ejections above Sunspot Light Bridges

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Introduction

Due to the divergence between the magnetic fields of light bridges and those of ambient sunspot umbra, some dynamic phenomena have been observed above light bridges. In Hα channel, jets, surges, and ejections were often detected above light bridges and explained by magnetic reconnection. Recent high-resolution observations from the Interface Region Imaging Spectrograph (*IRIS*) reveal bright wall-shaped structures in active regions (ARs), especially above sunspot light bridges. Their most prominent feature is the bright oscillating front in *IRIS* 1400/1330 Å channel. These structures are named ***light walls*** and are often interpreted to be driven by p-mode waves and associated shocks.

Observations

Our study mainly reports two events where the light walls and ejections were simultaneously observed above light bridges. Above the light bridge of AR 12222 on 2014 December 06, we observed intermittent ejections superimposed on an oscillating light wall in the IRIS 1400 Å passband. At the base location of each ejection, the emission enhancement was detected in the Solar Dynamics Observatory 1600 Å channel. Similarly, in the second event occurring in AR 12371 on 2015 June 16, a jet was simultaneously detected in addition to the light wall with a wave-shaped bright front above the light bridge. At the footpoint of this jet, lasting brightening was observed, implying magnetic reconnection at the base.

Results & Discussion

➢ *Intermittent ejections superimposed on an oscillating light wall in the first event*

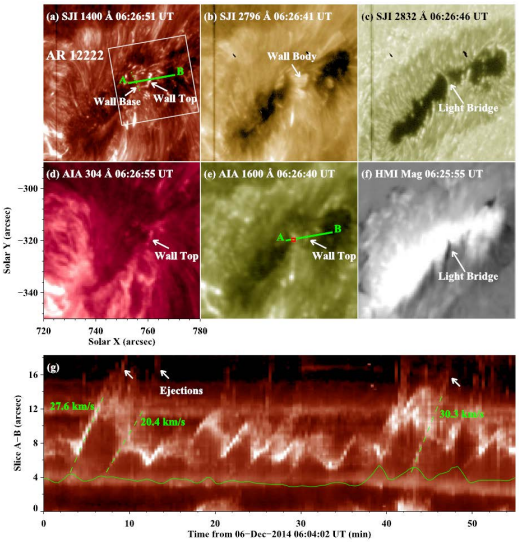

Fig.1 (a)-(f): multi-wavelength (E)UV observations and a LOS magnetogram displaying the targeted region in AR 12222 on 2014 December 06; (g): time–space plot along slice "A–B" in the 1400 Å channel. The green solid curve delineates the variation of mean emission strength in the 1600 Å passband within the region outlined by the small red square in panel (e), where the slice and the wall base intersect.

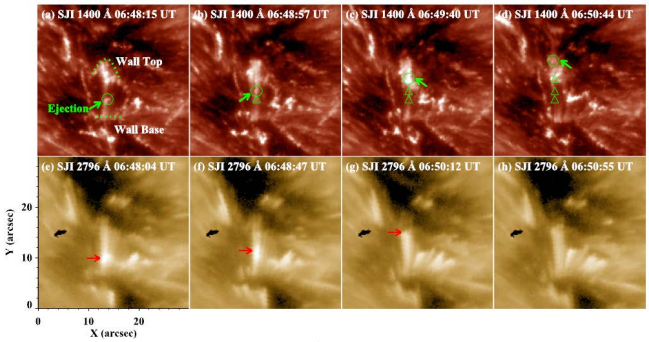

Fig.2 (a)-(d): sequence of IRIS 1400 Å SJIs showing one process of the ejection moving upward from the wall base until escaping from the wall top; (e)-(h): corresponding 2796 Å SJIs exhibiting the ejection motion in a cooler channel.

➢ *A jet rooted at the base of a light wall in the second event*

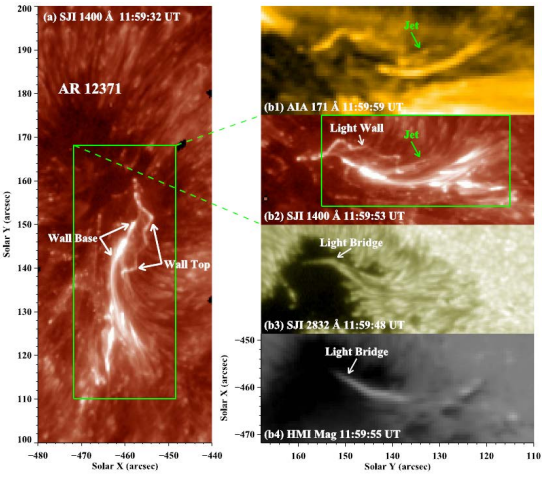

Fig.3 (a): IRIS 1400 Å SJI displaying the overview of the second event of interest in AR 12371 on 2015 June 19; (b1)-(b4): AIA 171 Å image, IRIS SJIs of 1400 and 2832 Å, and HMI LOS magnetogram exhibiting the jet, light wall, and light bridge, as well as their underlying magnetic fields.

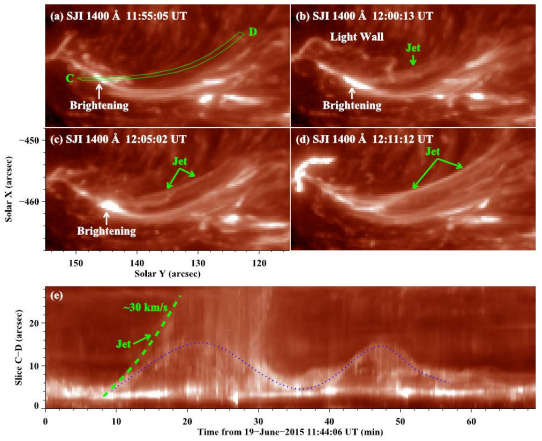

Fig.4 (a)-(d): time sequence of IRIS 1400 Å images showing the evolution of the jet; (e): time–space plot along the arc-sector domain "C–D" of panel (a) in the 1400 Å channel.

Summary & Publication

- Employing high-resolution observations from the IRIS and the SDO, we detect two events tracking the coexistence between light walls and ejection-like activities above the light bridge. We propose that in these events, two mechanisms of p-mode waves and magnetic reconnection simultaneously played roles in the light bridge, resulting in distinct kinetic features of the light walls and the ejection-like activities, respectively. We come to this conclusion based on the following different points between light walls and ejections/jets: **(1)** rising projected velocity: 10 km/s vs 30 km/s; **(2)** typical heights: several Mm vs tens of Mm; **(3)** lifetime: several hours vs 10 minutes; **(4)** 1600 Å intensity at the base location: I_0 vs $3*I_0$; **(5)** typical base widths: tens of Mm vs 1.5 Mm.

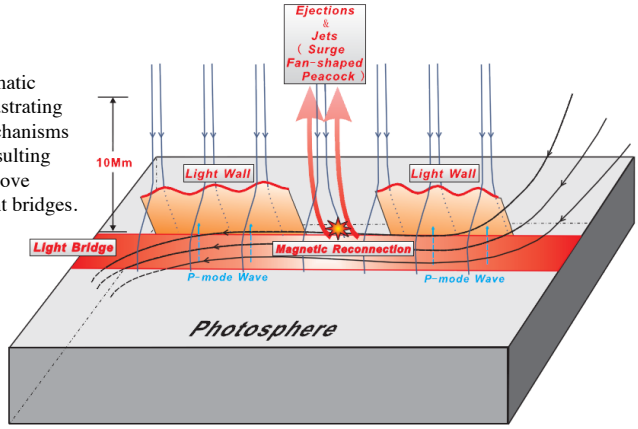

Fig.5 Schematic diagram illustrating the two mechanisms and their resulting activities above sunspot light bridges.

- Ejection-like activities caused by magnetic reconnection have been observed with heights of tens of Mm above light bridges in many works. Although we speculate that beside these jets, light walls with typical heights of several Mm triggered by the p-mode waves usually coexist, these light walls could be easily overlooked due to their much smaller scales compared to the jets and the constraints of previous observations.

- *"Simultaneous Observations of p-mode Light Walls and Magnetic Reconnection Ejections above Sunspot Light Bridges"*
  Yijun Hou, Jun Zhang, Ting Li, Shuhong Yang, and Xiaohong Li **ApJL 848, L9 (2017)**

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Poster

4. Eruptions in the solar atmosphere

Simultaneous Observations of p-mode Light Walls and Magnetic Reconnection Ejections above Sunspot Light Bridges

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Recent high-resolution observations from the Interface Region Imaging Spectrograph reveal bright wall-shaped structures in active regions (ARs), especially above sunspot light bridges. Their most prominent feature is the bright oscillating front in the 1400/1330 Å channel. These structures are named light walls and are often interpreted to be driven by p-mode waves. Above the light bridge of AR 12222 on 2014 December 06, we observed intermittent ejections superimposed on an oscillating light wall in the 1400 Å passband. At the base location of each ejection, the emission enhancement was detected in the Solar Dynamics Observatory 1600 Å channel. Thus, we suggest that in wall bases (light bridges), in addition to the leaked p-mode waves consistently driving the oscillating light wall, magnetic reconnection could happen intermittently at some locations and eject the heated plasma upward. Similarly, in the second event occurring in AR 12371 on 2015 June 16, a jet was simultaneously detected in addition to the light wall with a wave-shaped bright front above the light bridge. At the footpoint of this jet, lasting brightening was observed, implying magnetic reconnection at the base. We propose that in these events, two mechanisms, p-mode waves and magnetic reconnection, simultaneously play roles in the light bridge, and lead to the distinct kinetic features of the light walls and the ejection-like activities, respectively. To illustrate the two mechanisms and their resulting activities above light bridges, in this study we present a cartoon model.