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Two Types of Magnetic Reconnection in Coronal Bright Points and the Corresponding Magnetic Configuration

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Coronal bright points (CBPs) are long-lived small-scale brightenings in the solar corona. They are generally explained by magnetic reconnection. However, the corresponding magnetic configurations are not well understood. We carry out a detailed multi-wavelength analysis of two neighboring CBPs on 2007 March 16, observed in soft X-ray (SXR) and EUV channels. It is seen that the SXR light curves present quasi-periodic flashes with an interval of ˜1 hr superposed over the long-lived mild brightenings, suggesting that the SXR brightenings of this type of CBPs might consist of two components: one is the gentle brightenings and the other is the CBP flashes. It is found that the strong flashes of the bigger CBP are always accompanied by SXR jets. The potential field extrapolation indicates that both CBPs are covered by a dome-like separatrix surface, with a magnetic null point above. We propose that the repetitive CBP flashes, as well as the recurrent SXR jets, result from the impulsive null-point reconnection, while the long-lived brightenings are due to the interchange reconnection along the separatrix surface. Although the EUV images at high-temperature lines resemble the SXR appearance, the 171 Å and 195 Å channels reveal that the blurry CBP in SXR consists of a cusp-shaped loop and several separate bright patches, which are explained to be due to the null-point reconnection and the separatrix reconnection, respectively.

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In this paper, we carried out a detailed multi-wavelength analysis of two neighboring CBPs captured by Hinode/XRT and STEREO-B/EUVI on 2007 March 16. During the 5 hr observations, the newly formed northern CBP was dynamic, with strong flashes accompanied by SXR jets. The spot-like feature in SXR can be resolved into a cusp-shaped loop under the jet and several discrete kernels in 171Å and 195 Å. The preexisting CBP, i.e., BP2, however, presented gentler variations, probably due to the fact that it was in the late phase of its lifetime, and no jets were found during the observations. The potential field extrapolation revealed that the two bright points are located above "embedded bipolar fields," where one polarity is surrounded by the opposite polarity. Both of them are covered by a dome-like separatrix surface with a magnetic null point above. The height of null points, which characterizes the height of reconnection, is found to correlate with the magnetic flux of the embedded polarities under the null points.We suggest that the SXR light curves of the bright points of this type present two components: quasi-periodic recurrent flashes with a period of ~1 hr and long-lived brightenings with small-amplitude fluctuations. The CBP flashes result from the impulsive null-point reconnection between the small-scale loops and the unipolar field, which leads to the cusp-shaped structure and jets guided by the spine field lines, whereas the long-lived brightenings are due to the gentle interchange reconnection along the separatrix surface between the anemone-like loops and the unipolar field, which gives rise to bright kernels around the cusp. The two types of reconnection in a single event might be responsible for those CBPs associated with recurrent jets.

According to the 3D magnetic configuration of the CBPs, we infer that the quasi-periodic CBP flashes might be caused by the magnetic reconnection modulated by slow-mode wave along the spine field lines or be due to the recycling of continuous pumping of magnetic energy via the localized rotating motions of the photosphere and the sporadic releasing of the magnetic free energy. Further investigations are required in order to find out how often the CBPs are associated with the "embedded bipolar field."

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