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Axial Soft X-ray Brightening Associated with Hα Filaments

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Abstract. We have studied coronal soft X-ray (SXR) arcades around filament channels, as observed with the Yohkoh Soft X-ray Telescope (SXT). We have found about a dozen events (1991–1993). Comparisons with Hα filaments have revealed an association between some SXR structures and filaments. These bright thread-like SXR structures (often) appear to be *parallel* to and *co-spatial* with Hα filaments. The SXR structures are occasionally maintained for days, although transient brightening of axial structures is more common.

1. Introduction

Covered here are the events on March 10, 1992 and March 24-26, 1992. Full-disk Hα images are from Big Bear Solar Observatory, and the 868.8 nm FeI magnetograms are from Kitt Peak National Observatory. The Hα images were resized and de-rotated to fit full disk SXT images, spatially (to an accuracy of about one pixel) and temporally. The boxes on the full-disk SXT images indicate the location of the partial images. These have been extracted from full-disk SXT images and are shown with Hα contour overlays in Figures 1 and 2. All SXT images were enhanced using a special sharpening routine (McAllister et al. 1992). The thinnest SXR structures approach the resolution of the SXT images. Higher cadence (~0.5–1 hour) Hα images (recently supplied from Sacramento Peak Observatory by Haosheng Lin) were used to check the stability of the filaments.

2. The Events

- **March 10, 1992** (Figure 1): Located near Sun center, between two active regions. The western active region is an emerging flux region (EFR) which seems to have triggered the event (Note: Hα flaring occurred here at 10:33 UT and 14:50 UT). The overall lifetime of pronounced axial SXR structures was about 6 hours (~14:00 UT to ~20:00 UT). The filament seemed to be fairly undisturbed during the axial X-ray events on the 10th. The filament even grew in size from about 16:00 UT, while there was still high axial SXR activity.

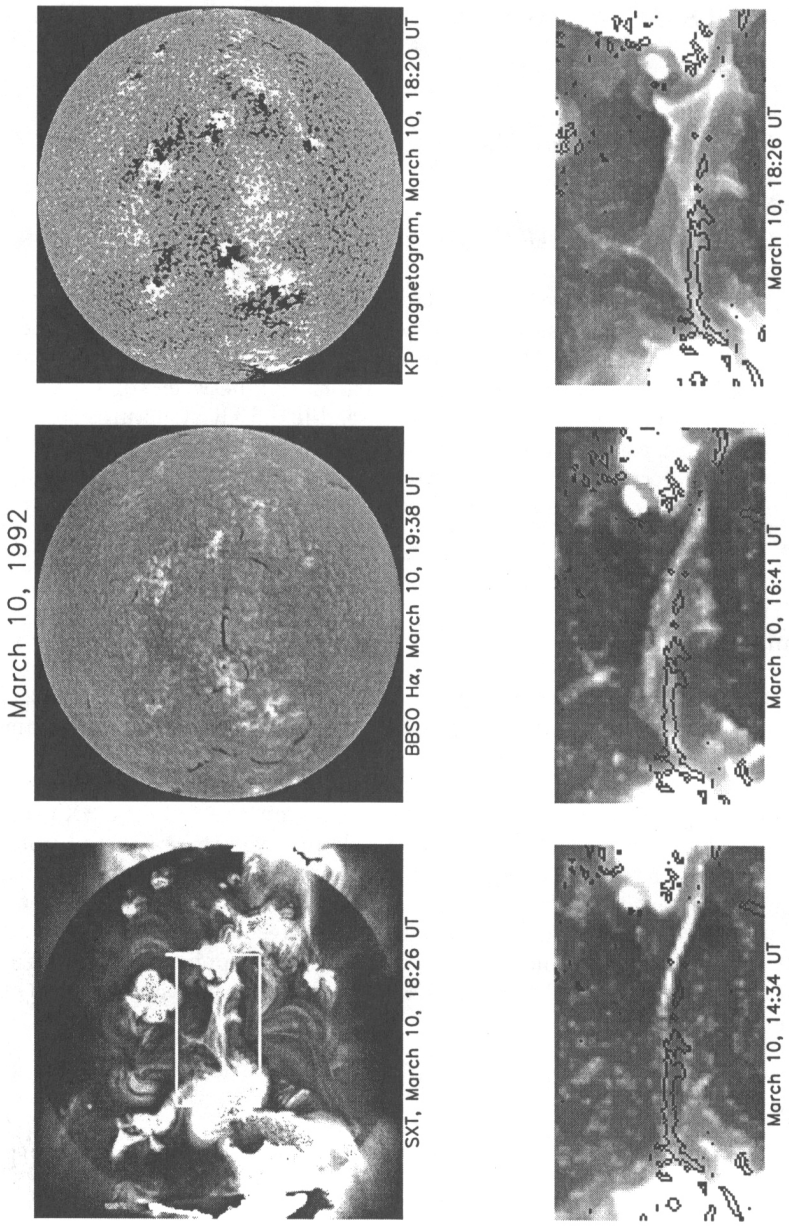

Figure 1.

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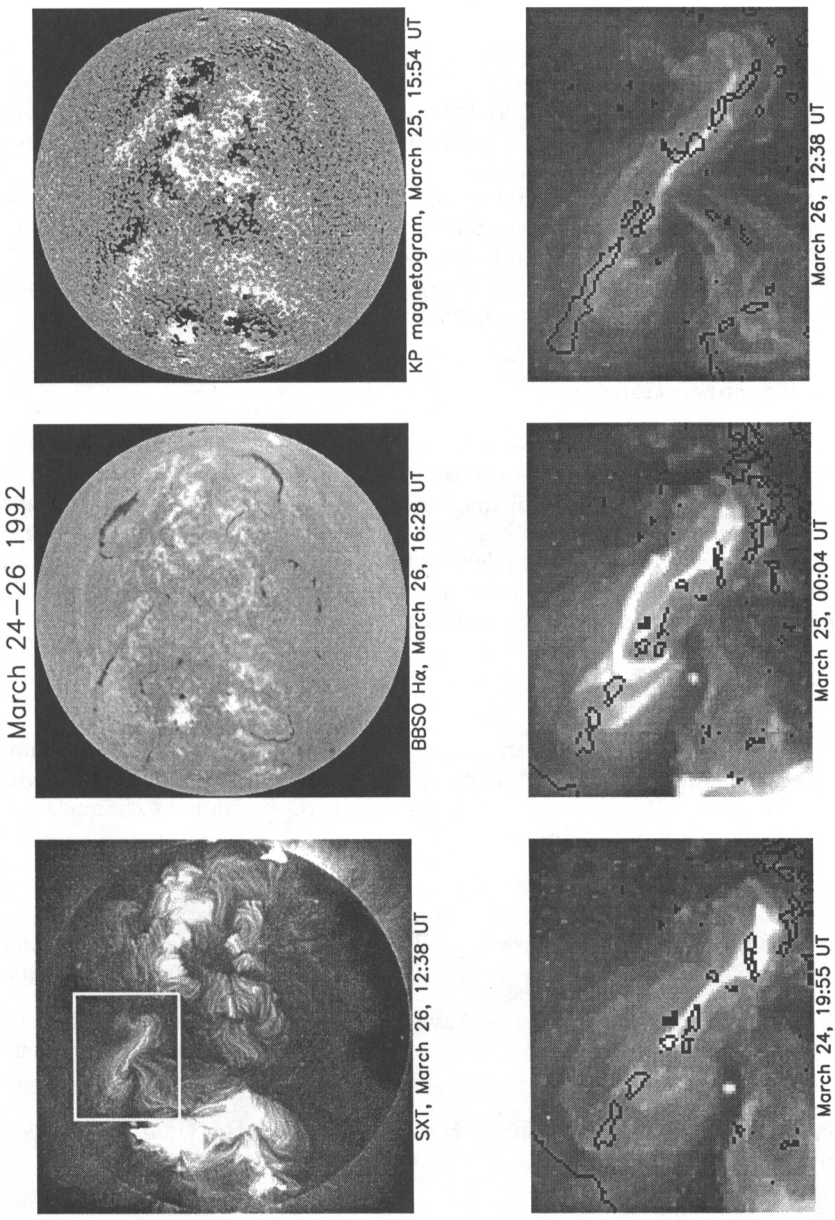

Figure 2.

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This suggests that there is a significant height difference between the Hα filament and the axial X-ray structures. The Hα contours on the partial images are from the 19:38 UT BBSO image.

- **March 24-26, 1992** (Figure 2): Long-lived axial event situated in the northeast quadrant (not an EFR). Locally, the SXR structures showed transient axial activity and flickered with time-scales down to minutes. Pay special attention to the middle partial frame, where both the axial *and* the transverse SXR loops are bright. Higher cadence Hα images show that the filament was not stable throughout the event. The filament did not disappear completely and it more or less resumed its original state after some time. Contours on the first two partial images are from the Hα image taken at 19:03 UT, March 24, whereas the right partial image has contours from the image taken at 16:28 UT, March 26.

3. Interpretation

The axial SXR structures owe their existence to some dynamical energization. In this low-β plasma, the energization must result from a need to readjust the magnetic field. Movement of magnetic anchor points in the photosphere, or emergence of new flux in the region, can then be the driving force. The movements cause loops of the complex system of filament and filament channel to interact, creating stress and pressure gradients to drive sufficient reconnection to produce the observed X-ray emission.

4. Conclusions

- We have found axial soft X-ray signatures associated with Hα filaments and filament channels. They appear to be parallel and co-spatial with the filaments. We also see axial SXR structures in filament channels without observing any Hα filament.
- The Hα filaments appear fairly stable during some periods of axial soft X-ray brightening, but disappear temporarily in others. When the Hα filaments are stable during axial X-ray activity it suggests that the cool filament plasma is separated (and insulated) from the heated X-ray plasma.
- The axial SXR structures have varying lifetimes, from a few hours to several days. On shorter time-scales (minutes), the structures often show a flickering behavior.

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References

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