Dynamical Evolution of X-ray Bright Points with Hinode/XRT

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Summary. We analysed a 7-hour long time sequence of the soft X-ray images obtained on April 14, 2007 in a quiet region from X-Ray Telescope (XRT) on-board the Hinode mission. The aim is to observe the intensity oscillatory phenomena in coronal XBPs of different brightness levels and to bring out the differences, if any, in the period of intensity variations and heating mechanism during their dynamical evolution. We have compared the XRT images with GONG magnetograms using Coronal Modeling Software (CMS) and found that some of the XBPs are located at the magnetic bipoles. The coronal XBPs are highly dynamic and oscillating in nature showing a wide variety of time scales in their intensity variations.

1 Introduction

Coronal X-ray bright points (XBPs) were discovered using a soft X-ray telescope (SXT) on a sounding rocket and the nature of XBPs has been an enigma since their discovery in late 1960's (Vaiana et al., 1978). Later, using Skylab and Yohkoh/SXT X-ray images, the XBPs were studied in detail (Golub et al., 1974; Longcope et al., 2001; Hara & Nakakubo-Morimoto , 2003). The number of XBPs (daily) found on the Sun varies from several hundreds up to a few thousands (Golub et al., 1974). It has been found a density of 800 XBPs for the entire solar surface at any given time (Zhang et al., 2001). The number of coronal bright points varies inversely with the solar activity cycle (Sattarov et al., 2002; Hara & Nakakubo-Morimoto , 2003). It is found that the diameters of the XBPs are around 10-20 arc sec (Golub et al., 1974) and their life time ranges from few hours to few days (Zhang et al., 2001, Kariyappa & Varghese, 2008).

In this contribution we report the analysis of XBPs of soft X-ray images obtained from Hinode/XRT and magnetograms from GONG. We briefly discuss the dynamical evolution of the XBPs in relation to the magnetic field.

2 Results and discussion

We use a 7-hour (17:00 UT - 24:00 UT) time sequence of soft X-ray images obtained on April 14, 2007 from X-Ray Telescope (XRT) on-board the Hinode mission observed with Ti_poly filter near the center of the solar disk in a quiet region. We selected 14 XBPs and 2 background coronal regions in a very quiet dark region for analysis and marked them as XBP1, XBP2,..........., XBP14 and 2 background coronal regions as XBP15 and XBP16. The XRT images have been calibrated using the subroutine xrt_prep.pro in IDL under SSW (Kariyappa & Varghese, 2008). We have selected the full-disk magnetograms obtained from GONG corresponding to the XRT observing period. The magnetograms have been overlyed on XRT soft X-ray images using Coronal Modeling Software (CMS) - developed by Dr. van Ballegooijen.

We derived the cumulative intensity values of the XBPs by placing the rectangular or square boxes on XRT images covering the selected XBPs. We have summed up all the pixel intensity values covered by the box. The light curves of all the XBPs are derived. It is clearly seen from the light curves that the XBPs will show an intensity oscillations. We performed the power spectrum analysis to determine the period of intensity oscillations associated with XBPs and found that the period of intensity oscillations ranges in the time scales of few minutes to hours. The light curves of the 14 XBPs have been

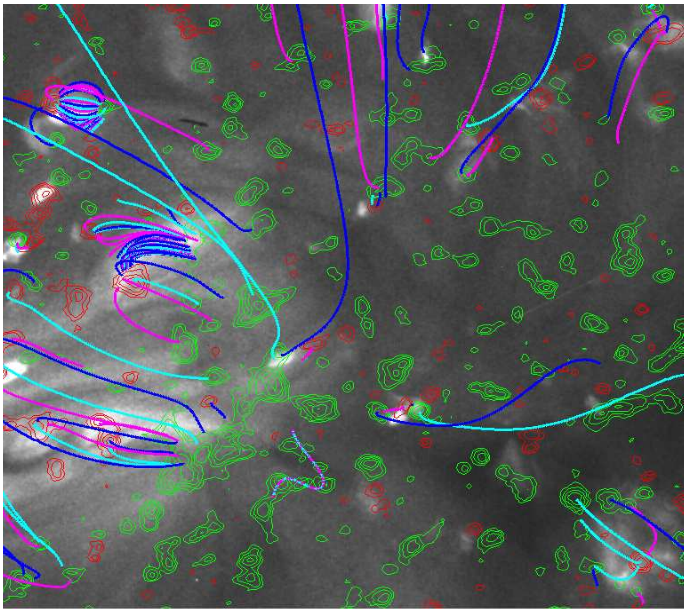

Fig. 1. GONG magnetogram overlyed on XRT image using CMS model. The magnetic field lines are computed from a potential field extrapolation of the magnetogram.

carefully examined and found that the XBPs can be grouped into three classes depending on their emission level. Class I XBPs show a very strong emission level and whereas the Class II XBPs show medium brightness level and the Class III XBPs are weak in their brightness during the dynamical evolution. It is evident from the light curves and power spectra of XBPs (see Kariyappa and Varghese, 2008) that the period of intensity oscillations in the three cases of XBPs seem to be identical and this can be taken as an evidence to argue that heating mechanism in all the three cases of XBPs is similar. The period is almost the same in all the cases of XBPs and thus seems to be independent of the differences in the brightness enhancement. Thus the XBPs are highly dynamic in nature and are the sites where intense brightness enhancement is seen, and the brightness oscillates with a period ranges from few minutes to hours. In Fig.1, we have overlyed the GONG magnetogram on X-ray image using Coronal Modeling Software (CMS). A comparative study suggests that some of the XBPs lie in between positive (red) and negative (green) polarity of the magnetic elements, i.e., the XBPs are located at the magnetic bipoles. The field lines shown in Fig.1 are computed from a potential field extrapolation of the magnetogram. The reason for the existence of different classes of XBPs depending on their brightness enhancement may be related to the different strengths of the magnetic field with which they have been associated. However, a detailed analysis of a large number of XBPs together with magnetograms is needed and it is in progress.

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