Recent Insights into the Physics of the Sun and Heliosphere:
Highlights from SOHO and Other Space Missions
IAU Symposium, Vol. 203, 2001
P. Brekke, B. Fleck, and J. B. Gurman eds.

The Temperature of the Extended Solar Corona

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Abstract. We use the Coronal Diagnostic Spectrometer instrument on board the Solar and Heliospheric Observatory to analyse coronal helmet streamer structures observed close to the solar minimum / maximum on the 1996 July 8 / 1999 August 4-5th. The radial variation of peak electron temperature is extracted out to 2 solar radii. These are found to agree well with Yohkoh observations close to the solar maximum, but are found to be reduced by around half a million close to the solar minimum.

1. Introduction

Knowledge of the electron temperature in the corona and its variation with height in different regions form an integral part of our understanding of coronal heating and solar wind acceleration. Recently its knowledge has been successfully probed at great heights in the corona using the broadband filter ratio technique (*see Foley et al., 1996; Sturrock Wheatland and Acton, 1996a, 1996b; Wheatland, Sturrock & Acton 1997; Foley, 1998, Priest et al., 1998, 2000*). In these works the vertical temperature structure, $T_e(h)$, has been used to attempt to determine the vertical heating function of the sun's Corona. This work has often found that the temperature is an increasing function of height, and has subsequently been used to demonstrate a requirement for heating upto and including the maximum observed height range of almost 2 solar radii. The analyses on the broadband data obtained with the *Yohkoh Soft X-ray Telescope*, has required simplifying assumptions to be made as regards to both the geometry and distribution of plasma with respect to temperature and density. Positive temperature gradients have been consistently reported for quiescent regions, overlying neutral lines in the high latitude regions, up to over 0.5 R_s above the solar limb.

The SOHO *Coronal Diagnostic Spectrometer*, CDS, now allows us to view the relative distribution of individual ions as function of height. Consequently, we now have the ability to examine the true distribution of plasma in many regions of the corona. In this work we evaluated the temperature structure determined for two observations obtained close to solar minimum and maximum of the current cycle 23, on July 8 1996 and 4-5th August 1999 respectfully. The rel-

ative abundance of each ion in the region observed was used to determine which line ratio would provide the best representation of the true radial temperature stucture.

2. Results and Discussion

We find that the peak temperature obtained close to the maximum is reminiscent to the values determined using the Yohkoh SXT, with the exception that the temperature maximum is located closer to the coronal base (*see figure*). At solar minimum this behaviour is repeated with the temperature maximum located in a similar location, with the absolute values being subdued by around half a million Kelvin. The implications that these results have for the coronal heating debate are two fold - these observations suggest that heating in the first few scale heights could reproduce the observed emission, there is not a requirememnt for sustained heating at great heights. The fact that the solar minimum corona is greatly reduced in temperature with respect to the solar maximum may suggest the energy budget is similarly reduced. However, care must be taken since it is possible the temperature reduction is attributed to the mechanical flux entering through the coronal base being distributed in a greater volumn at the solar minimum.

Acknoledgements

CRF would like to thank PPARC for funding through a postdoctorial research associateship.

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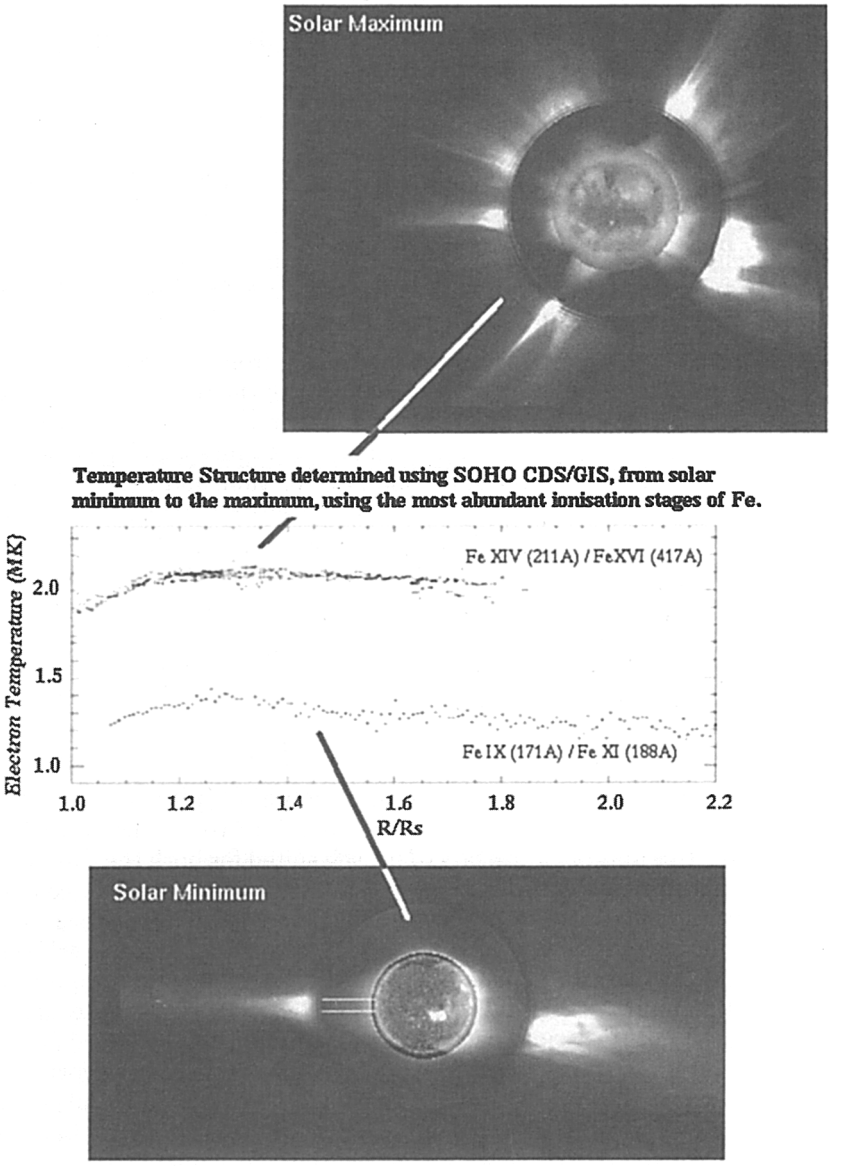

Figure 1. The peak temperatures as a function of height in the corona. These values were determined using line ratio's of the most abundant Fe ions. The composite images were generated from Lasco C2, Mauna Loa MK3 Coronagraph, EIT 284 data.

https://doi.org/10.1017/S0074180900219876 Published online by Cambridge University Press