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How reliable are the large temperature anisotropies in polar coronal holes?

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Abstract. We examine the influence of different electron density stratifications on the coronal LOS-integrated profiles of H I Ly-α and O VI lines at 103nm. We find that the widths of the emitted lines are significantly affected by the details of the adopted electron density profiles. Densities deduced from SOHO data result in O VI profiles whose widths and intensity ratio are relatively close to the values observed by UVCS although only isotropic kinetic temperatures are employed. Hence we expect the magnitude of the anisotropy to depend strongly on the density stratification adopted when analyzing the data.

Keywords. Sun: corona, Sun: solar wind, Sun: UV radiation, Line: formation, Line: profiles, Plasmas

1. Introduction

Large anisotropies in the kinetic temperatures ($10 \leqslant T_\perp/T_\parallel \leqslant 100$) of heavy coronal ions (i.e. O VI) due to ion-cyclotron waves were invoked to reproduce the observed broad lines and intensities emitted by these ions. In the present paper, we consider the influence of the density stratification on the LOS-integrated profiles. We compute the intensity profiles of H I Ly-α and the O VI doublet. We take into account the effect of the solar wind (Doppler dimming and the optical pumping of the O VI λ1037.6 line by the C II doublet). Only *simple Maxwellian velocity distributions* characterized by mean velocity $\boldsymbol{V}$ and width $\boldsymbol{\alpha}_S$ are considered.

2. Density, Magnetic field & Solar Wind

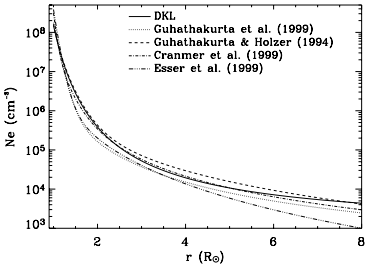

Figure 1. Left: Electron density stratifications for different empirical models.

We consider different empirical density models for the polar coronal holes taken from different sources (figure 1). The large scale coronal magnetic field is given by the model of Banaszkiewicz *et al.* (1998). The solar wind profile is computed using the mass-flux conservation equation

3. Results and Conclusions

Although no anisotropy is considered in the kinetic temperature of coronal species, we find that Ly-α profiles obtained from different density stratifications are comparable and reasonably fit the observed ones (figure 2). O VI profiles depend strongly on the details

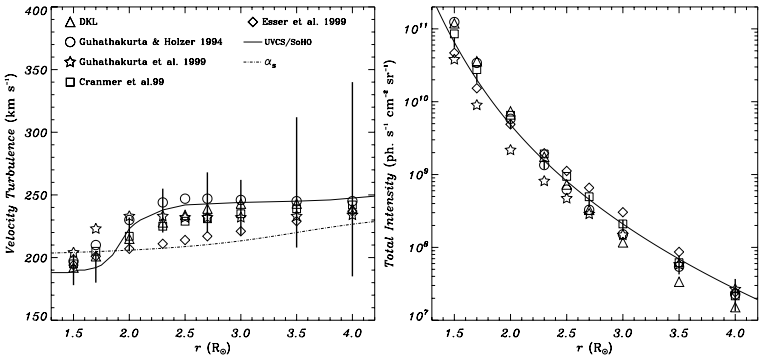

Figure 2. Width (left) and total intensity (right) of the LOS-integrated Ly-α line profile as a function of height. Solid curves and error bars: observations. Symbols: models

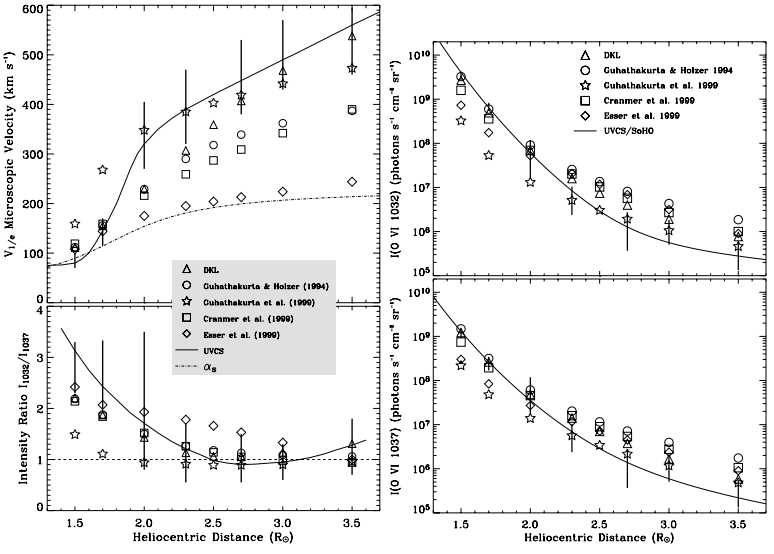

Figure 3. Left: width (top) and intensity ratio (bottom) of the LOS-integrated profiles of O VI as a function of height. The dot-dashed curve in top panel displays the used values of $\boldsymbol{\alpha}_S$. Right: Total intensity of the O VI lines as a function of the projected heliocentric distance.

of the density stratification (figure 3). The O VI widths, total intensities and intensity ratios obtained from the DKL density model (Doyle et al . 1999) are comparable to the observed ones. Differences between the kinetic temperatures of heavy ions and protons found in earlier works are also present in our analysis. This is all the more surprising since we did not in any way optimize the computations with such an aim. Our analysis suggest that the need for coronal kinetic temperature anisotropies may not be so pressing as previously concluded, although we stress that the current results do not rule out such anisotropies.

For more details see Raouafi & Solanki (2004 & 2006a,b).

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