Velocity of the solar wind from coronal holes

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The coronal hole is regarded as a source of the fast-speed component of the solar wind. While the acceleration mechanism of the solar wind in the coronal hole has not been fully understood yet, some physical properties of the magnetic field in the coronal hole are considered to play an important role to control the solar wind speed. A simple theoretical relation between the photospheric magnetic field and the solar wind speed has been proposed by Fisk et al. (1998). According to the model of Fisk et al., the solar wind speed is determined by the field strength and time scale of the emerging magnetic loop in the photosphere. Fisk et al. have shown that the fast solar wind originates from the coronal hole, by using typical values for the field strength and the time scale of the emerging loop. Recently, it has been found from interplanetary scintillation measurements of the solar wind (Ohmi et al., 2001) that the low-speed component of the solar wind originates from a certain class of the coronal hole. This fact cannot be explained by the Fisk et al.'s model, and further development of the model is needed. It has been reported by Hakamada et al. (2001) that the solar wind speed is inversely correlated with the expansion rate of the coronal magnetic field; That is, a large (small) expansion rate of the magnetic field is closely associated with high (low)-speed solar wind. This effect is not included in the Fisk et al.'s model. In this study, we have developed a new formula to describe the relation between the photospheric magnetic field and the solar wind speed, by adding the effect of the expansion rate to the Fisk et al.'s model. We have compared the model calculation by this formula with observations of solar wind speed and magnetic field for coronal holes. As result, those observations for the coronal hole are found to be basically consistent with the model calculation with the emerging flux time scale of 0.5-3 days.