TEMPERATURE DEPENDENT PLASMA UPFLOWS IN THE SOLAR ATMOSPHERE AND THE CORONAL TEMPERATURE

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Soft X-ray observations of the solar corona by XRT/Hinode showed steady plasma upflows in an open magnetic field region. This flow was confirmed by Doppler measurement by EIS/Hinode. EIS/Hinode also found a clear temperature dependent plasma upflows in a unipolar magnetic field region following a big flare, but somewhat away from the flare site. Temperature dependent plasma flows are also reported by SUMER/SoHO in various conditions such as active regions, quiet sun and coronal holes. In this paper, we propose a very simple mechanism of temperature dependent plasma upflows in open magnetic field regions and discuss relationship between the critical temperature which divides up and down flows in the solar atmosphere and the temperature of the solar corona. We try to answer the question why the solar corona is kept to million degree. However, heating mechanisms of the corona is not discussed, only a regulation mechanism of the coronal temperature is discussed here. Charged particles moving in magnetic field have magnetic moments. In case of thermal plasma, the magnetic moment is proportional to temperature and is inversely proportional to magnetic field strength. It is directed anti-parallel to the surrounding magnetic field direction, hence plasma is a diamagnetic media. Generally, magnetic field strength decreases upwards and plasma is pushed upwards due to this diamagnetic force (or mirror force) against the strong gravity force. The critical temperature which divides up and down flows depends on magnetic scale length. In the case of solar atmosphere, higher than million degree plasma is pushed upwards. Around the critical temperature, downward gravity force and upward diamagnetic force balance and the plasma with this temperature occupy wide height range. This critical temperature must be the temperature of the upper atmosphere or the corona.

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