A search for the origin of very low electron temperatures

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Abstract

VLET's (Very Low Electron Temperature) are regions in the solar wind (lasting 12–30 h) in which the electron temperature is abnormally low. Because it is generally believed that the thermal conductivity parallel to the interplanetary magnetic field lines is high for electrons, i.e. the contact with the Sun should be ideal, VLET's are surprising observations. In this work a statistical analysis of many of these events is made with respect to the dependence of this phenomenon on interplanetary plasma and field parameters. In contrast with earlier work it was found that VLET's exist not only after a shock front. The statistical analysis showed further that a VLET is always associated with a VLPT (Very Low Proton Temperature) event and that, whilst on average the temperature of the electrons and protons outside the low temperature regions is about the same, the mean proton temperature inside is three times lower than that of the electrons.

A particular model for VLET's is investigated in detail; the closed magnetic loop or "blob" model. By assuming: (a) pure adiabatic expansion in a radially streaming solar wind without pressure equalization across the "blob" boundary, and (b) rapid pressure equalization across the boundary, an attempt was made to quantitatively investigate the feasibility of the "blob" model in the light of plasma and field data. It can be shown that the closed magnetic loop model is unlikely to be the major cause of VLET's.

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