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Electric Fields and Currents of the Sun and Solar Wind[1]
CHARLES DRISCOLL, University of California, San Diego — A simple model of solar electric fields explains the solar wind energetics and coronal "heating", invoking only thermo-electric and photo-electric forces. In the (collisional) solar interior, thermal electron pressure *necessarily* generates a radial electric field, integrating to a surface field $eE_{th}(R_s) \cong 1.4eV/Mm$, comparable to the proton weight $m_p g = 2.8eV/Mm$. In the (less collisional) plasma "sheath" of the photosphere and corona, the outward photon flux $\Gamma_\gamma = 60.MW/m^2$ causes additional electron displacement, giving $eE_\gamma(r) = \sigma_{\gamma e} \Gamma_\gamma / c$. Here, the main uncertainty is the photon cross-section $\sigma_{\gamma e}$ for electrons *correlated* with protons: H-minus and "rydberg" hydrogen states have $\sigma_{\gamma e} \cong 0.5x10\hat{}\text{-}20m^2$, whereas *isolated* electrons have Thompson cross-section $\sigma_{\gamma e} \cong 0.7x10\hat{}\text{-}28m^2$. An average cross-section $\sigma_{\gamma e} \cong 3x10\hat{}\text{-}24m^2$ can generate the observed solar wind, as "collisional runaway" protons accelerate out of the 2.keV gravity well and up to 1.3 keV kinetic energy within several R_s. This coherent proton/electron flow will glow as the K-Corona, obviating the traditional T=100eV hydrostatic models. Fluctuating 3D electric fields and charge currents will arise from convective surface granulation ("roiling") and from "current pinch" propagation dynamics, generating the observed *fluctuating* magnetic fields. Some characteristics of solar wind currents can be ascertained from the extensive databases of satellite magnetic field measurements.

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