NUMERICAL MODELLING OF FLUX EMERGENCE IN THE SOLAR ATMOSPHERE: EFFECTS OF PARTIAL IONISATION

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We present results from 2.5D numerical simulations of the emergence of magnetic flux from the upper convection zone through the photosphere and chromosphere into the corona. Certain regions of the solar atmosphere are at sufficiently low enough temperatures to be only partially ionised, in particular the lower chromosphere. This leads to Cowling resistivities 10^{12} orders of magnitude larger than the Coulomb values, and thus highly anisotropic diffusion of currents. We find that the rates of emergence of magnetic field are greatly increased by the partially ionised regions of the model atmosphere, and the resultant magnetic field is more diffuse. More importantly, the only currents associated with the magnetic field to emerge into the corona are aligned with the field, and thus the newly formed coronal field is force-free.