Proceedings of ICRC 2001: 3665 © Copernicus Gesellschaft 2001

ICRC 2001

The validity of the force-field equation to describe modulation

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Abstract. The Force-Field equation is a classical, convenient means to describe modulation effects in the one-dimensional approximation. It serves mainly as a tool for experimentalists to give a concise description of modulation strength. By comparing the Force-Field solution to numerical solutions of the transport equation, however, we show that the Force-Field approximation gets progressively worse with increasing radial distance. The reason is that adiabatic losses in the outer heliosphere become unimportant, and the Force-Field equation can not simulate that. It is shown that the convection-diffusion approximation is more appropriate in the outer heliosphere. This result has consequences for the interpretation of Pioneer/Voyager observations in the outer heliosphere.