WHY SYROVATSKII'S MECHANISM OF DYNAMIC DISSIPATION OF MAGNETIC FIELDS DOES NOT WORK*

U. ANZER

Max Planck Institute for Physics and Astrophysics, Munich, G. F. R.

Abstract: Syrovatskii's mechanism of "dynamic dissipation of the magnetic field" is reinvestigated. In order to have this kind of "dynamic dissipation" at a neutral line, the ratio of the current density to particle density must exceed a certain critical value. For conditions in the solar atmosphere near sunspots, this value can only be reached by a mechanism which produces a very large compression of the magnetic field, as well as an extreme rarefaction of the density. Syrovatskii claims that his mechanism provides both these features. His enormous field compression, however, can only be obtained, if one neglects the restoring Lorentz force (e. g., in Syrovatskii's model the compressed field near the neutral line is about one order of magnitude larger than the field of the sunspots which generates it). The second effect, i.e. the large plasma rarefaction is due to the particular flow field of Syrovatskii's model which allows for a free reconnection of the field lines across the neutral line; the magnetic field is treated like a vacuum field, the effects of the field accumulation near the neutral line being neglected. The aim of the present paper is to show how more realistic models modify Syrovatskii's results. Our numerical calculations lead to a maximum current-to-density ratio which is a factor of 10^6 smaller than the one obtained by Syrovatskii. Therefore, one has to conclude that in the solar atmosphere one cannot produce the configurations which are necessary for "dynamic dissipation" in the way, described by Syrovatskii.

* The paper in full extent was published in the Solar Phys., *30*, 1974, 459.