Parker Instability under External and Self Gravities: II. An MHD Simulation

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A linear stability analysis of the Parker instability has been performed onto an isothermal magnetized gas disk, which is under the influence of self and external gravities simultaneously. For the external gravity we choose tanh z/H to describe its acceleration as a function of vertical distance z from mid-plane of the disk with density scale height H. The choice of tanh-function simplifies the analysis greatly, because the resulting density structure sech^2 z/H yields the same form of tanh z/H for the self gravity. On the basis of resulting dispersion relation, we will discuss how the Jeans, Parker and convective instabilities would interact with each other in the Galactic ISM disk, if the disk is approximated by an isothermal magnetized gas layer. A particular emphasis will be given to the question whether large-scale strucutres resulting from the Jeans-Parker instability place their central cores north and south of the mid-plane alternatively or in the mid-plane. Nonlinear evolution of the Jeans-Parker instability has been traced on coarse grids of 64^3 and the result will be compared with the corresponding case of a disk under self gravity only.