JEANS, PARKER, AND CONVECTIVE INSTABILITIES IN A SELF-GRAVITATING MAGNETIZED DISK

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A linear stability analysis has been performed onto a self-gravitating magnetized gas disk bounded by an external pressure. Three kinds of instability operate in the disk: the usual Jeans instability, a Parker type instability that is driven by self-gravity, and the convective instability. By applying either symmetric or anti-symmetric modes of perturbations at the mid-plane, we have carefully differentiated the Jeans instability out of the three.

When a symmetric boundary condition is taken, the resulting dispersion relation shows all the features of the three instabilities. Undular mode of perturbations brings about two peaks in the dispersion relation: one at smaller wavenumber is due to the Jeans instability, and the other at larger wavenumber due to the Parker type instability. For interchange mode of perturbations, the convection dominates the system at large wavenumbers, while the Jeans instability does the same at small wavenumbers.

When an anti-symmetric perturbation is imposed at the mid-plane, the magnetized gas disk, however, doesn't develop the Jeans instability at all. The resulting dispersion relation for the undular mode of perturbations shows a single peak due to the Parker type instability only. For the interchange mode of perturbations, only the convection dominates the system at large wavenumbers.

The Parker type instability of undular mode develops mainly in low density region far from the mid-plane. The convection due to the magnetic Rayleigh-Taylor instability takes place also in the low density region and develops chaotic features to the system.