The Parker-Jeans Instability in the Galactic Gas Disk

S. M. Lee[1], J. Kim[2], S. S. Hong[3]. & J. Franco[4]

[1]*Supercomputing Center, KISTI, Daejeon, KOREA*
[2]*Korea Astronomy Observatory, Daejeon, KOREA*
[3]*Astronomy Program, SEES, Seoul National University, Seoul, KOREA*
[4]*Instituto de Astronomia, Universidad Nacional Autonoma de Mexico, MEXICO*

Here we present a three-dimensional MHD model for the Parker-Jeans instability in the Galactic gas disk. The magnetic field is assumed to be parallel to a Galactic spiral arm. The Galactic ISM disk is modeled by a multicomponent, magnetized, isothermal gas layer. This model employs the observed vertical stratifications for the gas density and the gravitational acceleration in the solar neighborhood. In the sense of the stratifications the ISM disk model is a realistic one, but the isothermal assumption makes it still idealistic.

The sum of gas and magnetic pressures at arbitrary height z should balance the weight of the gas-column extending from z to an upper boundary z_max. This condition automatically fixes the vertical stratification for the magnetic field. By solving Poisson equation with the density stratification, we determine the vertical acceleration due to the self gravity as a function of z. By subtracting it from the observed gravitational acceleration, we separate components of the self and external gravities from each other. Onto the resulting equilibrium disk we perform a linear stability analysis and obtain dispersion relations for the Galactic ISM disk under various conditions. The mid-plane value of the gas density, the disk thickness z_max, and the isothermal sound speed are important parameters for the disk model. We will discuss how these parameters might affect the fastest growing time and the maximum length scales of the Parker-Jeans instability. Also addressed will be the question on whether large scale structures brought by the instability have their cores right in the mid-plane or on the northern and southern sides of the plane alternatively.