P21b Three-dimensional MHD simulations of self-gravitating magnetized gas layers under external pressure

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By three-dimensional magnetohydrodynamic simulations, we studied the evolution of magnetized self-gravitating isothermal gas layers under external pressure. In previous work, we have shown that under high external pressure, incompressible mode of gravitational instability creates spherical clump structures. When magnetic fields exist, we expect the formation of filamentary structures as observed in interstellar clouds.

In this work, we show results of three-dimensional numerical simulations of magnetized gas layers under external pressure. The simulation code is a three-dimensional MHD code with self-gravity. We adopt Cartesian coordinates (x, y, z) where x,y are in the horizontal direction and z is in vertical direction. As the initial model, we adopt a plane-parallel horizontal isothermal self-gravitational gas layer threaded by uniform magnetic field in y-direction. The horizontal boundaries are periodic and we adopt free boundary at $z = z_{max}$. Free parameters are plasma β (ratio of thermal pressure and magnetic pressure) at the mid-plane of the gas layer and the external pressure.

We present the parameter dependence of numerical results and compare them with linear stability analysis.