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The Effect of Electron Inertia and Suspended Particles on the Ionosphere of the Earth

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ABSTRACT

We have studied the effect of finite electron inertia on the self-gravitating instability of viscous, uniformly magnetized gaseous plasma in the presence of suspended particles. A general dispersion relation is obtained by using the normal mode analysis with the help of relevant linearized perturbation equations of the problem and a modified Jeans criterion of instability is obtained.

Keywords: Viscosity, Jeans Criterion, Suspended Particles, Magneto hydrodynamics (MHD).

1. INTRODUCTION

Recently, there has been a great deal of interest in investigating various collective processes in gaseous plasma. which are ubiquitous in space, including diffuse and dense interstellar media, circumstellar shells, dark interiors molecular clouds, ionosphere, star envelopes, nova ejecta, accretion disks and the out flow of red giant star. It has been found both theoretically and experimentally that the presence of suspended particles and electron inertia modifies the existing plasma wave spectra[1,2,3].

In addition to this magnetic fields can provide pressure support and inhibit the contraction and fragmentation of interstellar clouds. The magnetic field interacts directly only with The ions, electrons and charged grains in the gas, collisions of the ions with the predominantly neutral gas in clouds are responsible for the indirect coupling of the magnetic fields to the bulk of the gas. The degree to which the magnetic pressure is important and depends upon the field strength and the fractional abundance[5]. Several authors[6,7,13,14] observed that the magnetic ion-neutral slip is characterized by a diffusion time and the neutral gas decouples form the magnetic field if the slip time is short compared to the Jean's time for collapse without a magnetic field.

Along with this the presence of dust in astrophysical environment, has been known since a long time, from different type of remote observations, as for the dust around and between stars. Dust in the solar system, between and around planets and comets, has been detected also in site closer inspections indicates that the transition from goes to large dust particles in astrophysics is almost continuous, from electrons and ions through macromolecules cluster of molecules, very small or sub-micron sized grains, micron-sized grains, larger grains, boulders, asteroid remnants etc. The dust grains in the magnetosphere of the earth may originate from micrometeoroids, space debris, lunar ejecta, terrestrial aerosols, etc. The probable reason of anomalous scattering of radio waves in the ionosphere may be due to the dust grain in that region.

Regarding the size of dust particles, this may vary from $0.05\mu m$ to $10\ \mu m$, when the grain average separation (r_O) is greater in comparison to Plasma Debye Length (λ_D) then we call it "DUST IN PLASMA" otherwise "DUSTY PLASMA" For $r_O < \lambda_D$ in which collective behavior of the neighboring particles play an important role. The charge on dust grains influences the motion of the grain in an electromagnetic field of a planetary magnetosphere and participates in the formation of the spokes in the rings of Saturn and in the erosion of the rings by micrometeorites[4,8,9].

In the past few years, the importance of suspended particles in interstellar gas dynamics has been recognized by many researchers Sharma *et al*.[11] have investigated the effect of suspended particles on the onset of Benard convection in hydromagnetics. They have pointed out that the effect of suspended particles is to destabilize the layer and the magnetic field has a stabilizing influence. In another study[10,12] investigated the effect of suspended particles on the gravitational instability of an infinite homogeneous gas-particle medium.

It is well known that the parameters of electron inertia and electrical resistivity are important in the problems of magnetic reconnection processes, stability of accelerated plasma and in the plasma confinement problem. The presence of electron inertia gives fundamental knowledge about the wave propagation in the system with a finite plasma frequency.

From the above studies, we find that magnetic field, finite electron inertia and suspended particles are the important parameters to discuss the gravitational instability of plasma. Thus, in the present problem, we investigate the finite electron inertia and suspended particles on the self-gravitating gaseous plasma in the presence of uniform transverse magnetic field.

2. LINEARIZED PERTURBATION EQUATION

We consider an infinite homogeneous, viscous, self gravitating gas particle medium including finite electron inertia and suspended particles in the presence of magnetic field $\vec{H}\,(0, 0, H)$. Let $\vec{u},\ \vec{v},\ \rho$ and N be the gas velocity, the particle velocity, the density of gas and the number density of particles. If we assume uniform particle size, spherical shape and small relative velocities between the two phases, then the net effect of particles on the gas is equivalent to extra body force term per unit volume $KN(\vec{v} - \vec{u})$ and is added to the momentum transfer equation for gas, where the constant K is given by Stokes drag formula $K = 6\pi\rho\upsilon r$, where r being the particle radius and υ is the kinetic viscosity of clean gas. Self-gravitational attraction U is added with kinetic viscosity term in equation of motion for gas.

In writing the equation of motion of particles, we neglect the buoyancy force as its stabilizing effect for the case of two free boundaries is extremely small. Inter-particle reactions are also ignored by assuming the distance between particles to be too large compared with their diameters.

The stability of the system is investigated by writing the solutions to the full equations as initial state plus a perturbation. The initial state of the system is taken to be a quiescent layer with a uniform particle distribution. The equations thus obtained are linearized by neglecting the product of two perturbed quantities. Thus the linearized perturbation equations with finite electron inertia, suspended particles governing the motion of hydromagnetic fluid plasmas are given by

$$\frac{\partial \vec{u}}{\partial t} = -\frac{1}{\rho}\vec{\nabla}\delta p + \vec{\nabla}\delta U + \frac{KN}{\rho}(\vec{v}-\vec{u}) + \upsilon\left[\nabla^2\vec{u} + \frac{1}{3}\vec{\nabla}(\vec{\nabla}.\vec{u})\right] + \frac{1}{4\pi\rho}(\vec{\nabla}\times\vec{h})\times\vec{H} \qquad (1)$$

$$\frac{\partial}{\partial t}\delta\rho = -\rho\,\vec{\nabla}.\vec{u} \qquad (2)$$

$$\left(\tau\frac{\partial}{\partial t}+1\right)\vec{v} = \vec{u} \qquad (3)$$

$$\delta p = c^2\delta\rho \qquad (4)$$

$$\nabla^2\delta U = -4\pi G\delta\rho \qquad (5)$$

$$\vec{\nabla}.\vec{h} = 0 \qquad (6)$$

$$\frac{\partial\vec{h}}{\partial t} = \vec{\nabla}\times(\vec{u}\times\vec{H}) + \frac{c^2}{4\pi{\omega_p}^2}\frac{\partial}{\partial t}\nabla^2 h \qquad (7)$$

Where $\delta\rho, \delta p, \delta U$ and h denote respectively, the perturbation in density ρ, pressure p, gravitational potential U and magnetic field H. G is the gravitational constant, C is the velocity of sound. $\tau = \frac{m}{K}$ and mN is the mass of particles per unit volume and $\omega_p =$ is the plasma frequency.

3. DISPERSION RELATION

Let us assume the perturbation of all the quantities vary as

$$\text{Exp}\,[i(k_x x + k_z z + \omega t)] \qquad (8)$$

where ω is the growth rate of the perturbation and k_x, k_z are the wave number of the perturbation along the *x*-and *z*-axes respectively such that

$$k_x{}^2 + k_z{}^2 = k^2 \qquad (9)$$

using expression (8) and (9) Equations (1-7) give

$$\left[-\tau\omega^3 + i\omega^2\left(1+\frac{4}{3}\upsilon k^2\tau + \frac{kN\tau}{\rho}\right) + \frac{4}{3}\upsilon k^2 + \frac{\tau k^2V^2}{\alpha}\omega - \frac{ik^2V^2}{\alpha}\right]u_x z = -\omega\left(\frac{ik_x}{k^2}\right)\Omega_j{}^2(1+i\tau\omega)\,s \qquad (10)$$

$$\left[-\tau\omega^3 + i\omega^2\left(1+\frac{4}{3}\upsilon k^2\tau + \frac{kN\tau}{\rho}\right) + \left(\frac{4}{3}\upsilon k^2 + \frac{\tau k_z^2V^2}{\alpha}\right)\omega - \frac{ik_z{}^2V^2}{\alpha}\right]u_y = 0 \qquad (11)$$

$$\left[-\tau\omega^2 + i\omega\left(1+\frac{4}{3}\upsilon k^2\tau + \frac{kN\tau}{\rho}\right) + \frac{4}{3}\upsilon k^2\right]u_z = -\frac{ik_z\Omega_j^2}{k^2}(1+i\tau\omega)s\Big] \qquad (12)$$

where $\Omega_j{}^2 = C^2k^2 - 4\pi G\rho$, $V^2 = \frac{H^2}{4\pi\rho}$, V is the Alfven velocity, $s = \frac{\delta\rho}{\rho}$ is the condensation of the medium and $c = \left(\frac{\gamma p}{\rho}\right)^{1/2}$ is the adiabatic velocity of sound in the medium.

Now taking the divergence of Equation (1) with the use of Equations (2) - (7) and expressions (8) + (9) we get.

$$\frac{k_x k^2 V^2}{\alpha}(1+i\tau\omega)u_x + \left[i\tau\omega^4 + \left(1+\frac{4}{3}\upsilon k^2\tau + \frac{kN\tau}{\rho}\right)\omega^3 - \left(\frac{4}{3}\upsilon k^2 + \tau\Omega_j^{\,2}\right)i\omega^2 - \Omega_j^{\,2}\omega\right]s = 0 \quad (13)$$

Now Equations (10), (11), (12) and (13) can be written in the matrix form. where $\alpha = 1 + \frac{C^2k^2}{4\pi\omega_p^{\,2}}$

$$\begin{vmatrix} -\tau\omega^3 + i\omega^2\left(1+\frac{4}{3}\upsilon k^2\tau+\frac{kN\tau}{\rho}\right) + \left(\frac{4}{3}\upsilon k^2+\frac{\tau k^2V^2}{\alpha}\right)\omega - \frac{ik^2V^2}{\alpha} & 0 & 0 & \left(\frac{ik_x}{k^2}\right)\Omega_j^{\,2}\omega(1+i\tau\omega) \\ 0 & -\tau\omega^3 + i\omega^2\left(1+\frac{4}{3}\upsilon k^2\tau+\frac{kN\tau}{\rho}\right) + \left(\frac{4}{3}\upsilon k^2+\frac{\tau k^2V^2}{\alpha}\right)\omega - \frac{ik_z^{\,2}V^2}{\alpha} & 0 & 0 \\ 0 & 0 & -\tau\omega^2 + i\omega\left(1+\frac{4}{3}\upsilon k^2\tau+\frac{kN\tau}{\rho}\right)+\frac{4}{3}\upsilon k^2 & \left(\frac{ik_z}{k^2}\right)\Omega_j^{\,2}(1+i\tau\omega) \\ \frac{k_xk^2V^2}{\alpha}(1+i\tau\omega) & 0 & 0 & i\tau\omega^4+\omega^3\left(1+\frac{4}{3}\upsilon k^2\tau+\frac{kN\tau}{\rho}\right) - i\omega^2\left(\frac{4}{3}\upsilon k^2+\tau\Omega_j^{\,2}\right)-\Omega_j^{\,2}\omega \end{vmatrix} \begin{vmatrix} u_x \\ u_y \\ u_z \\ s \end{vmatrix} = 0 \quad (14)$$

From eqn. (14) we obtain the general dispersion relation

$$\omega\left[\left\{-\tau\omega^3 + i\omega^2\left(1+\frac{4}{3}\upsilon k^2\tau+\frac{kN\tau}{\rho}\right)+\omega\left(\frac{4}{3}\upsilon k^2+\frac{k_z^{\,2}V^2}{\alpha}\right)-\frac{ik_z^{\,2}V^2}{\alpha}\right\}\times\left\{\tau\omega^2 - i\omega\left(1+\frac{4}{3}\upsilon k^2\tau+\frac{kN\tau}{\rho}\right)-\frac{4}{3}\upsilon k^2\right\}\times\left\{i\tau^2\omega^6+2\tau\left(1+\frac{4}{3}\upsilon k^2\tau+\frac{kN\tau}{\rho}\right)\omega^5-\tau\left(\tau\Omega_j^{\,2}+\frac{k^2V^2}{\alpha}+\frac{4}{3}\upsilon k^2\right)+\left(1+\frac{4}{3}\upsilon k^2\tau+\frac{kN\tau}{\rho}\right)^2\right\}i\omega^4-\left\{\left(1+\frac{4}{3}\upsilon k^2\tau+\frac{kN\tau}{\rho}\right)\times\left(\tau\Omega_j^{\,2}+\frac{k^2V^2}{\alpha}+\frac{8}{3}\upsilon k^2\right)+\tau\left(\Omega_j^{\,2}+\frac{k^2V^2}{\alpha}\right)\right\}\omega^3+\left\{\frac{4}{3}\upsilon k^2\left(\frac{4}{3}\upsilon k^2+\tau\Omega_j^{\,2}\right)+\frac{4}{3}\frac{\tau k^4V^4\upsilon}{\alpha^2}+\frac{\tau^2k_z^{\,2}V^2\Omega_j^{\,2}}{\alpha}+\left(\frac{k^2V^2}{\alpha}+\Omega_j^{\,2}\right)\left(1+\frac{4}{3}\upsilon k^2\tau+\frac{kN\tau}{\rho}\right)\right\}i\omega^2+\left\{\Omega_j^{\,2}\left(\frac{4}{3}\upsilon k^2+2\tau k_z^{\,2}V^2\right)+\frac{4}{3}\frac{k^4V^4}{\alpha^2}\right\}\omega-\frac{ik_z^{\,2}V^2\Omega_j^{\,2}}{\alpha}\right]=0 \quad (15)$$

Equation (15) gives the general dispersion relation for an infinite homogeneous, self- gravitating, viscous gaseous plasmas medium incorporating finite electron inertia and suspended particles.

4. DISCUSSION

We now, discuss the dispersion relation (15) in two mode of propagation: (i) longitudinal propagation and (ii) Transverse propagation.

4.1 Propagation parallel to the Direction of magnetic field

For this case we take k_x *=0* and k_z*=0* and $i\omega = \sigma$, the perturbation are takes parallel to the magnetic field, The dispersion relation (15) has four independent factors, each represents the mode of propagation incorporating different parameters. The first factor of eqn. (15) for parallel to the direction of magnetic field gives

$$\omega = 0 \qquad (16)$$

which is a neutrally stable mode. The second factor of Equation (15) equating to zero, we get

$$\tau\sigma^3 + \sigma^2\left(1 + \frac{4}{3}\upsilon k^2\tau + \frac{kN\tau}{\rho}\right) + \sigma\left(\frac{4}{3}\upsilon k^2 + \frac{\tau k^2V^2}{\alpha}\right) + \frac{k^2V^2}{\alpha} = 0 \qquad (17)$$

Equation (17) represents the dispersion relation for an infinite homogeneous, viscous magnetized gaseous plasmas medium incorporating suspended particles and finite electron inertia. This mode of propagation is independent of self-gravitation and represents modified Alfven mode due to viscosity, finite electron inertia and suspended particles. Equation (17) does not allow a positive real root or a complex root whose real part is positive and so the system is stable. If σ_1, σ_2 and σ_3 are the three modes of frequencies of propagation, then we have

$$\sigma_1 + \sigma_2 + \sigma_3 = -\left(\frac{1}{\tau} + \frac{4}{3}\upsilon k^2 + \frac{kN}{\rho}\right) \qquad (18)$$

And $$\sigma_1 . \sigma_2 . \sigma_3 = \frac{k^2V^2}{\tau\alpha} \qquad (19)$$

Since for magnetized gaseous plasmas having finite electron inertia the value of $\frac{k^2V^2}{\alpha}$ is positive, then the entire coefficient will be positive and the three principle diagonal minors of Hurwitz matrix will also be positive as follows

$$\Delta_1 = \left(\frac{1}{\tau} + \frac{4}{3}\upsilon k^2 + \frac{kN}{\rho}\right) > 0$$
$$\Delta_2 = \frac{4}{3}\upsilon k^2\left(1 + \frac{4}{3}\upsilon k^2\tau + \frac{kN\tau}{\rho}\right) + \frac{\tau k^2V^2}{\alpha}\left(\frac{4}{3}\upsilon k^2\tau + \frac{kN\tau}{\rho}\right) > 0$$
$$\Delta_3 = \frac{k^2V^2}{\alpha}\,\Delta_2 > 0$$

The third factor of Equation (15) gives

$$\tau\sigma^2 + \left(1 + \frac{4}{3}\upsilon k^2\tau + \frac{kNT}{\rho}\right)\sigma + \frac{4}{3}\upsilon k^2 = 0 \qquad (20)$$

Equation (20) does allow any root whose real part is positive and so that the system is stable.

The last factor of Equation (15) gives

$$\tau^2\sigma^6 + 2\tau\left(1+\frac{4}{3}\upsilon k^2\tau+\frac{kN\tau}{\rho}\right)\sigma^5 + \left\{\tau\left(\tau\Omega_j^{\,2}+\frac{k^2V^2}{\alpha}\right)+\frac{4}{3}\upsilon k^2+\left(1+\frac{4}{3}\upsilon k^2\tau+\frac{kN\tau}{\rho}\right)^2\right\}\sigma^4 + \left[\tau\left(\Omega_j^{\,2}+\frac{k^2V^2}{\alpha}\right)+\left(1+\frac{4}{3}\upsilon k^2\tau+\frac{kN\tau}{\rho}\right)\left\{\frac{8}{3}\upsilon k^2+\tau\left(\Omega_j^{\,2}+\frac{k^2V^2}{\alpha}\right)\right\}\right]\sigma^3 + \left[\left(\frac{k^2V^2}{\alpha}+\Omega_j^{\,2}\right)\left(1+\frac{kN\tau}{\rho}+\frac{4}{3}\upsilon k^2\tau\right)+\frac{4}{3}\upsilon k^2\left(\frac{4}{3}\upsilon k^2+\tau\Omega_j^{\,2}\right)+\frac{4}{3}\frac{\tau k^4V^4\upsilon}{\alpha^2}+\frac{k^2V^2\Omega_j^{\,2}\tau^2}{\alpha}\right]\sigma^2 + \left[\Omega_j^{\,2}\left(\frac{4}{3}\upsilon k^2+\frac{2\tau k^2V^2}{\alpha}\right)+\frac{4}{3}\frac{\upsilon k^4V^2}{\alpha^2}\right]\sigma + \frac{k^2V^2\Omega_j^{\,2}}{\alpha} = 0 \qquad (21)$$

It follows that when $\Omega_j^{\,2} = C^2k^2 - 4\pi G\rho < 0$, then one of the roots of equation (21) is positive, that means instability occurs with condition.

$$k < k_j = \sqrt{\frac{4\pi G\rho}{C^2}} \qquad (22)$$

which is Jeans Criterion. The system is unstable for all wave number when k< k_j. Thus we can say that in the case of longitudinal mode of propagation for an infinite homogeneous, uniformly magnetized, viscous, self gravitating gaseous plasmas medium incorporating finite electron inertia and suspended particle is unstable, when Jeans condition is satisfied. When Jeans condition is not satisfied i.e.

$k > k_j = \sqrt{\frac{4\pi G\rho}{C^2}}$, the system is stable.

4.2 Transverse mode of propagation

For this case we take $k_x = K$ and k_z =0, the Equation (15) will becomes

$$\omega^3\left[\left\{-\tau\omega^2+i\omega\left(1+\frac{4}{3}\upsilon k^2\tau+\frac{kN\tau}{\rho}\right)+\left(\frac{4}{3}\upsilon k^2\right)\times\left\{\tau\omega^2-i\omega\left(1+\frac{4}{3}\upsilon k^2\tau+\frac{kN\tau}{\rho}\right)-\frac{4}{3}\upsilon k^2\right\}\times\left\{iT^2\omega^5+2\tau\left(1+\frac{4}{3}\upsilon k^2\tau+\frac{kN\tau}{\rho}\right)\omega^4-\tau\left(T\Omega_j^{\,2}+\frac{k^2V^2}{\alpha}+\frac{4}{3}\upsilon k^2\right)+\left(1+\frac{4}{3}\upsilon k^2+\frac{kN\tau}{\rho}\right)^2\right\}\omega^3-\left\{\left(1+\frac{4}{3}\upsilon k^2\tau+\frac{kN\tau}{\rho}\right)\times\left(\tau\Omega_j^{\,2}+\frac{k^2V^2}{\alpha}+\frac{8}{3}\upsilon k^2\right)+\tau\left(\Omega_j^{\,2}+\frac{k^2V^2}{\alpha}\right)\right\}\omega^2+\left\{\frac{4}{3}\upsilon k^2\left(\frac{4}{3}\upsilon k^2+\tau\Omega_j^{\,2}\right)+\frac{4}{3}\frac{\upsilon\tau k^4V^4}{\alpha^2}+\left(\frac{k^2V^2}{\alpha}+\Omega_j^{\,2}\right)\left(1+\frac{4}{3}\upsilon k^2\tau+\frac{kN\tau}{\rho}\right)\right\}i\omega+\left\{\Omega_j^{\,2}\left(\frac{4}{3}\upsilon k^2\right)\right\}+\frac{4}{3}\frac{k^4V^4}{\alpha^2}\right]=0 \qquad (23)$$

Equation (21) represents the dispersion relation for an infinite homogeneous, uniformly magnetized, viscous, self-gravitating gaseous plasmas medium incorporating suspended particles and finite electron inertia in the case of propagation perpendicular to the direction of the magnetic field. This relation also have three independent factors, each represents the mode of propagation incorporating different parameters.

The first factor of Eqn. (23) for perpendicular to the direction of magnetic field gives.

$$\omega = 0 \qquad (24)$$

which is a neutrally stable mode. The second factor of Equation (23) equating to zero, we get

$$\tau\sigma^2+\left(1+\frac{4}{3}\upsilon k^2\tau+\frac{kN\tau}{\rho}\right)\sigma+\frac{4}{3}\upsilon k^2 = 0 \qquad (25)$$

Equation (25) represents the dispersion relation for an infinite homogeneous, viscous gaseous plasmas medium will suspended particles. This mode of propagation is independent of self-gravitation, finite electron inertia and magnetic field. Equation (25) does not allow a positive real root or a complex root whose real part is positive and so the system is stable.

If σ_1 and σ_2 are two modes of frequencies of propagation, then we have

$$\sigma_1 + \sigma_2 = -\left(\frac{1}{\tau} + \frac{4}{3}\upsilon k^2 + \frac{kN}{\rho}\right) \qquad (26)$$

and

$$\sigma_1\sigma_2 = \frac{4}{3}\frac{\upsilon k^2}{\tau} \qquad (27)$$

Since for gaseous plasmas medium having finite kinetic viscosity, the value of $\frac{4}{3}\upsilon k^2$ is positive, then all the coefficient will be positive and the two principle diagonal minors of Hurwitz matrix also be positive

$$\Delta_1 = \tau\left(1 + \frac{4}{3}\upsilon k^2\tau + \frac{kN\tau}{\rho}\right) > 0$$

$\Delta_2 = 0$ not negative

The last factor of Equation (23) gives

$$\tau^2\sigma^5 + 2\tau\left(1 + \frac{4}{3}\upsilon k^2\tau + \frac{kN\tau}{\rho}\right)\sigma^4 + \tau\left\{\tau\left({\Omega_j}^2 + k^2V^2\right) + \frac{4}{3}\upsilon k^2\right\} + \left(1 + \frac{4}{3}\upsilon k^2\tau + \frac{kN\tau}{\rho}\right)^2\Big\}\sigma^3 + \left[\tau\left({\Omega_j}^2 + \frac{K^2V^2}{\alpha}\right) + \left(1 + \frac{4}{3}\upsilon k^2\tau + \frac{kN\tau}{\rho}\right)\left\{\frac{8}{3}\upsilon k^2 + \tau\left({\Omega_j}^2 + \frac{k^2V^2}{\alpha}\right)\right\}\right]\sigma^2 + \left[\left(\frac{k^2V^2}{\alpha} + {\Omega_j}^2\right)\left(1 + \frac{kN\tau}{\rho} + \frac{4}{3}\upsilon k^2\tau\right) + \frac{4}{3}\upsilon k^2\left(\frac{4}{3}\upsilon k^2 + \tau{\Omega_j}^2\right) + \frac{4}{3}\frac{k^4V^4}{\alpha^2}\tau\upsilon\right]\sigma + \frac{4}{3}\upsilon k^2\left({\Omega_j}^2 + \frac{k^2V^2}{\alpha}\right) = 0 \qquad (28)$$

The System is unstable when $\left({\Omega_j}^2 + \frac{k^2V^2}{\alpha}\right) < 0$ then one of the root of equation (28) is positive, that means instability occurs with condition

$$k < k_{j2} = \sqrt{\frac{4\pi G\rho}{C^2 + \frac{k^2V^2}{\alpha}}} \qquad (29)$$

It shows that the Jean's Criterion of instability is modified by Alfven velocity and finite electron inertia.

5. CONCLUSION

To summarize, we have dealt with the effect of suspended particles on self-gravitating gaseous uniformly magnetized plasma. The general dispersion relation is obtained, which is modified due to the presences of these parameters .We find that the Jeans condition remains valid but the expression of the critical Jeans wave number is modified. Alfven mode is modified by the presence of finite electron inertia. We also found that viscosity and suspended particles have dissipative effect but do not affect the Jeans expression. In transverse direction, it is found that the magnetic field has stabilizing effect.

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