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The Influence of Suspended Particles on Jeans Instability in Magneto Quantum Plasma with Thermal Conductivity

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Authors' contributions

This work was carried out in collaboration between both authors. Author DLS designed the study, performed the mathematical analysis and wrote the first draft of the manuscript. Author DLS discussed and analyzed the results obtained in the manuscript. The all work was done under the guidance and supervision of author RKP. Both authors read and approved the final manuscript.

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ABSTRACT

The Jeans instability in magnetized quantum plasma is investigated by taking into account the thermal conductivity and suspended particles. The general dispersion relation is derived with the help of linearized perturbation equation using the normal mode analysis technique, which is reduced for both the transverse and the longitudinal mode of propagation. In the case of longitudinal propagation, the Jeans criterion of instability is affected by the thermal conductivity and quantum effect but the transverse mode of propagation, the Jeans condition is modified by the thermal conductivity, magnetic field, and quantum parameter. It is observed from curves that, thermal conductivity is destabilizing effect while magnetic field, suspended particles, Stoke drag parameter and quantum parameter have stabilized influence on the growth rate of gravitational instability.

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1. INTRODUCTION

The quantum plasma is a more interesting field in a recent year, many researchers have analyzed its important applications in dense astrophysical environments, ultrasmall electronic devices, and high-intensity laser systems. The quantum plasma has received great attention due to their theoretical relevance in many astrophysical plasmas. The effect of quantum parameter played an important role in plasma when De Broglie wavelength associated with the particles is comparable to the dimension of the system.

The hydrodynamic instabilities in quantum plasma have been an important subject of research in the last a few years, the quantum effects play an important role in the behavior of the ionized plasma particles when the de-Broglie wavelength of the ionized carriers becomes greater than or equal to the dimension of the quantum plasma system. The quantum hydrodynamics (QHD) model has been introduced by Gardner [1] for semiconductor physics to describe the transport of change momentum and energy in plasma. The quantum magneto-hydrodynamic (QMHD) model was described by Hass [2] with the help of QHD model with magnetic field based on the Wigner-Maxwell equations. The influence of quantum parameter on the internal waves and Jeans instability in plasma by Pines [3,4]. The study of gravitational instability of an infinite homogeneous medium has been first analyzed by Jeans [5]. He obtained that an infinite external homogeneous self-gravitating medium is unstable when wave number $k < k_j = \frac{\sqrt{4\pi G\rho}}{c_s}$, where, $k_j, G, \rho\ and\ c_s$, are the Jeans wave number, universal gravitational constant, fluid density and sound speed. In next step to this, the gravitational instability of ideal plasma has been defined by Chandrashekhar [6]. He has analyzed the hydromagnetic stability of self-gravitating, unbounded, homogeneous, rotating plasma of infinite conductivity. Recently, many authors [7-11] have studied the problem of Jeans instability in different astrophysical environments. Sharma et al. [12] studied the effect of spin induced magnetization on Jeans instability of viscous and resistive quantum plasma. Ren et al. [13] have discussed using the QMHD model considering resistive effect. Wu et al. [14] have analyzed the effect of hall terms on Jeans instability in quantum magnetoplasma with resistive effects. Shukla and Stenflo [15] investigated the Jeans instability of self-gravitating astrophysical quantum dusty plasma. Prajapati et al. [16] have discussed the effect of hall current on the Jeans instability of magnetized viscous quantum plasma. Propagation of TE surface waves on semi-Bounded quantum plasma was analyzed by Mohamed et al. [17]. Jeans self-gravitational instability of strongly coupled quantum plasma was discussed by Sharma et al. [18]. Effect of thermal conductivity on the gravitational instability of quantum plasma having fine dust particles have studies by Shrivastava et al. [19]. In this direction, Hoshoudy [20] was pointed out quantum effect on the Rayleigh-Taylor instability of viscoelastic plasma model through a porous medium. Effect of quantum correction on Jeans instability of magnetized radiative plasma has discussed by Patidar et al. [21]. Sharma [22] was pointed out the modified Jeans instability of magnetized viscous spin ½ quantum plasma with resistive effects and Hall current. Recently, Jain et al. [23] have studied the Jeans instability of magnetized quantum plasma: Effect of viscosity, rotation and FLR corrections.

In this paper, we investigate the QMHD model on self-gravitating and thermally conducting plasma having fine dust particles. The purpose of this work is to examine theoretically the effect of the fine dust particles on Jeans instability in magnetized quantum plasma with thermal conductivity. The dispersion properties of this work would provide a useful information to understand the astrophysical problems for star formation and interstellar medium structure.

2. LINEARIZED PERTURBATION EQUATIONS

Let us consider an infinitely conducting self gravitating homogeneously magnetized quantum plasma including thermal conductivity and suspended particles. The magnetic field is assumed in z-directions (0,0,H). The suspended dust particles are assumed to be of uniform size, spherical shape and have small relative velocities between the two phases, and then the extra body force per unit volume $k_s N(v-u)$ is added to the momentum transfer equation for gas, where k_s the constant given by Stoke's drag formula $k_s = 6\pi\rho v r$. The quantities $r, v, \rho\ and\ N$ denote the particle radius, kinetic viscosity of the gas, density of gas and the number density of particles, respectively. $u\,(u_x, u_y, u_z)$ and $v\,(v_x, v_y, v_z)$ denote the particle and gas velocity. Self-gravitational attraction *U* is added along with the kinetic viscosity term in the equation of motion for gas. The quantum effects are introduced through the Bohm potential term in the momentum transfer equation. The QMHD model is considered as given by Hass [2]. The momentum transfer equation for magnetized quantum plasma is given by

$$\rho\frac{\partial u}{\partial t} = -\nabla\delta p + \rho\nabla\delta U + k_s N(v-u) + \frac{1}{4\pi}(\nabla\times h)\times H + \rho\vartheta(\nabla^2 v) + \frac{\hbar^2}{4m_e m_i}\nabla(\nabla^2\delta\rho) \quad (1)$$

$$\left(\tau\frac{\partial}{\partial t}+1\right)v = \mathrm{u} \quad (2)$$

The equation of continuity is given by

$$\frac{\partial\delta\rho}{\partial t} + \rho\nabla.\mathrm{u} = 0 \quad (3)$$

Poisson's equation for gravitational potential is given by

$$\nabla^2\delta U + 4\pi G\delta\rho = 0 \quad (4)$$

The equation of thermal conductivity is given by

$$\rho C_p\frac{\partial}{\partial \mathrm{t}}\delta T - \frac{\partial}{\partial t}\delta p = \lambda\nabla^2\delta T \quad (5)$$

The equation of state is given by

$$\frac{\delta T}{T} + \frac{\delta\rho}{\rho} = \frac{\delta p}{p} \quad (6)$$

The idealized Ohm's law is given by

$$\frac{\delta h}{\delta t} = \nabla\times(u\times H) \quad (7)$$

The Gauss's law for magnetism is given by

$$\nabla.h = 0 \quad (8)$$

Where, $\tau = m/k_s$ and the parameters *G, p, T,* C_p, λ, *R,* $\hbar = h/2\pi$, respectively denotes the gravitational constant, pressure, temperature, specific heat at constant pressure, the coefficient of thermal conductivity, gas constant, and Planck constant divided by 2π.

3. DISPERSION RELATION

Let us consider plane waves propagated in the X and Z-direction so that all perturbed quantities vary as

$$\exp\{i(k_x x + k_z z + \omega t)\} \quad (9)$$

Where ω is the frequency of harmonic disturbances, k_x and k_z are wave numbers in X and Z direction, respectively, such that $k_x^2 + k_z^2 = k^2$. For perturbation of the form (9), using (2) to (8) the algebraic amplitude of equations (1) can be written as,

$$\left(\sigma + \vartheta_k + \frac{A\sigma\tau}{\sigma\tau+1} + \frac{k^2V^2}{\sigma}\right)v_x + \frac{ik_x}{k^2}\left(\frac{\sigma\Omega_J^2+\Omega_k\Omega_I^2}{\sigma+\Omega_k}\right)s = 0 \quad (10)$$

$$\left(\sigma + \vartheta_k + \frac{A\sigma\tau}{\sigma\tau+1} + \frac{k_z^2V^2}{\sigma}\right)v_y = 0 \quad (11)$$

$$\left(\sigma + \vartheta_k + \frac{A\sigma\tau}{\sigma\tau+1}\right)v_z + \frac{ik_z}{k^2}\left(\frac{\sigma\Omega_J^2+\Omega_k\Omega_I^2}{\sigma+\Omega_k}\right)s = 0 \quad (12)$$

Now taking the divergence of equation (1) using (2) to (8) we get as

$$\frac{ik_x k^2V^2}{\sigma}v_x - \left\{\sigma\left(\sigma + \vartheta_k + \frac{A\sigma\tau}{\sigma\tau+1}\right) + \frac{\sigma\Omega_J^2+\Omega_k\Omega_I^2}{\sigma+\Omega_k}\right\}s = 0. \quad (13)$$

Equations (10)-(13) can be written in the matrix form as

$$X_{ij}Y_j = 0 \text{ and } i,j = 1,2,3,4 \quad (14)$$

Where Y_j is a single column matrix with elements (v_x, v_y, v_z, s), and X_{ij} is fourth ordered square matrix whose elements are

$$X_{11} = \xi_1 \qquad X_{12} = X_{13} = 0 \qquad X_{14} = \frac{ik_x}{k^2}\Omega_T^2$$
$$X_{21} = X_{23} = X_{24} = 0, \qquad X_{22} = \xi_2 \qquad X_{31} = X_{32} = 0 \qquad X_{33} = d_1, \qquad X_{34} = \frac{ik_z}{k^2}\Omega_T^2$$
$$X_{41} = \frac{ik_x k^2V^2}{\sigma}, \qquad X_{42} = X_{43} = 0 \qquad X_{44} = \left\{\sigma\left(\sigma + \vartheta_k + \frac{A\sigma\tau}{\sigma\tau+1}\right) + \Omega_T^2\right\}$$
$$\Omega_I^2 = \left(k^2c'^2 - 4\pi G\rho + \frac{\hbar^2k^4}{4m_em_i}\right),\ \Omega_T^2 = \left(\frac{\sigma\Omega_J^2+\Omega_k\Omega_I^2}{\sigma+\Omega_k}\right),\ \Omega_J^2 = \left(k^2c^2 - 4\pi G\rho + \frac{\hbar^2k^4}{4m_em_i}\right),\ \Omega_k = \left(\lambda\gamma k^2/\rho c_p\right),$$
$$d_1 = \left(\sigma + \vartheta_k + \frac{A\sigma\tau}{\sigma\tau+1}\right).\ \ \xi_1 = \left(\sigma + \vartheta_k + \frac{A\sigma\tau}{\sigma\tau+1} + \frac{k^2V^2}{\sigma}\right)\quad \xi_2 = \left(\sigma + \vartheta_k + \frac{A\sigma\tau}{\sigma\tau+1} + \frac{k_z^2V^2}{\sigma}\right)$$

Where, $c^2 = \gamma c'^2$, is the adiabatic velocity of sound, $c' = \sqrt{p/\rho}$, is the isothermal velocity of the sound, c_p is the specific heat at constant pressure and $s = \delta\rho/\rho$ is the condensation of the medium, $A = \frac{k_s N}{\rho}$ has a dimension of frequency, $\tau = \frac{m}{k_s}$ is relaxation time, $\sigma = i\omega$ is the growth rate of perturbation. For a nontrivial solution of equation (14) the determinant of the square matrix on the left-hand side should vanish, leading to the dispersion relation.

$$\xi_1 \xi_2 d_1 \left(-\sigma d_1 - \Omega_T^2\right) + \frac{k_x^2 V^2}{\sigma} d_1 \xi_2 \Omega_T^2 = 0 \qquad (15)$$

Equation (15) represents the general dispersion relation for an infinitely extending, self-gravitating magnetized quantum plasma having suspended particles under the influence of thermal conductivity. We find that in this dispersion relation the term due to the thermal conductivity has entered through the factor Ω_k and the term due to the quantum correction have entered through the factor$(\hbar^2 k^4/4m_e m_i)$. If we ignore the effects of magnetic field then (15) reduces to Shrivastava [19]. If we ignore the effects of quantum correction and thermal conductivity then (15) reduces to Sharma [9] and also reduces to Chhajlani and Sanghavi [11] obtained for non-rotating unmagnetized plasma. Again in the absence of thermal conductivity, viscosity and fine dust particle the preceding dispersion relation reduces to Ren et al. [13] on ignoring the effects of magnetic field and electrical resistivity in their case.

4. ANALYSIS OF THE DISPERSION RELATION

Now we shall discuss the dispersion relation given by equation (15) for the following modes, longitudinal propagation i.e. $k_x = 0$, $k_z = k$ and transverse propagation i.e. $k_x = k,\ \ k_z = 0$.

4.1 Longitudinal Mode of Propagation $(\boldsymbol{K} \parallel \boldsymbol{B})$

In this case, we assume that all the perturbation are longitudinal to the direction of the magnetic field $(i.e., k_x = 0 \ and \ k_z = k)$. The dispersion relation (15) reduced to this form.

$$d_1\, \xi_1^2 \left(-\sigma d_1 - \Omega_T^2\right) = 0 \qquad (16)$$

The equation (16) represent the general dispersion relation for an infinite homogeneous magnetized quantum plasma having suspended particle and thermal conductivity. From (16), it is shown that there are three factors of the dispersion relation of the system, which can propagate longitudinally to the direction of the magnetic field in the medium. The first factor of (16) equated to zero, which represents a natural stability of the system. The second factor equated to zero we gate,

$$\begin{aligned}\sigma^6\tau^2 + \sigma^5 2\tau\{1+\tau(A+\vartheta_k)\} + \sigma^4[\{1+\tau(A+\vartheta_k)\}^2 + 2\tau(\vartheta_k + \tau k^2V^2)] \\ + \sigma^3[2(\vartheta_k + \tau k^2V^2)\{1+\tau(A+\vartheta_k)\} + 2\tau k^2V^2] \\ + \sigma^2[(\vartheta_k + \tau k^2V^2)^2 + 2k^2V^2\{1+\tau(A+\vartheta_k)\}] + \sigma(\vartheta_k k^2V^2 + \tau k^4V^4) + k^4V^4 \\ = 0 \qquad (17)\end{aligned}$$

The relation (17) represents a gravitating mode due to modified the presence of magnetic field, suspended particles and viscosity. Now we can write (17) in non-dimensional form, for showing the effects of different parameter on growth rate of instability, as

$$\begin{aligned}\sigma^{*6}\tau^{*2} + 2\sigma^{*5}\tau^*\left[1+\tau^*\left\{k_s^* + \upsilon^*\left(k^{*2} - \frac{1}{k_1^*}\right)\right\}\right] \\ + \sigma^{*4}\left[\left\{1+\tau^*k_s^* + \tau^*\upsilon^*\left(k^{*2} - \frac{1}{k_1^*}\right)\right\}^2 + 2\tau^*\left\{\upsilon^*\left(k^{*2} - \frac{1}{k_1^*}\right) + \tau^*k^{*2}V^{*2}\right\}\right] \\ + \sigma^{*3}\left[2\left\{\upsilon^*\left(k^{*2} - \frac{1}{k_1^*}\right) + \tau^*k^{*2}V^{*2}\right\}\left\{1+\tau^*k_s^* + \tau^*\upsilon^*\left(k^{*2} - \frac{1}{k_1^*}\right)\right\} + 2\tau^*k^{*2}V^{*2}\right] \\ + \sigma^{*2}\left[\left\{\upsilon^*\left(k^{*2} - \frac{1}{k_1^*}\right) + \tau^*k^{*2}V^{*2}\right\}^2 + 2k^{*2}V^{*2}\left\{1+\tau^*k_s^* + \tau^*\upsilon^*\left(k^{*2} - \frac{1}{k_1^*}\right)\right\}\right] \\ + \sigma^*\left\{\upsilon^*\left(k^{*2} - \frac{1}{k_1^*}\right)k^{*2}V^{*2} + \tau^*k^{*4}V^{*4}\right\} + k^{*4}V^{*4} = 0 \qquad (18)\end{aligned}$$

Where the various nondimensional parameters are defined as,

$$\sigma^* = \frac{\sigma}{\sqrt{4\pi G\rho}},\ k_s^* = \frac{k_s N}{\rho\sqrt{4\pi G\rho}},\ k^* = \frac{kC}{\sqrt{4\pi G\rho}},\ \upsilon^* = \frac{\vartheta\sqrt{4\pi G\rho}}{C^2},\ k_1^* = \frac{k_1\sqrt{4\pi G\rho}}{C^2},\ \tau^* = \tau\sqrt{4\pi G\rho},\ V^* = \frac{V\sqrt{4\pi G\rho}}{C}, \quad (19)$$

The variation of the growth rate σ^* with wave number k^* is shown in Figs. 1- 3.

The Fig. 1 curves indicate that when magnetic field increases, the growth rate of instability decreases. Thus we conclude that the magnetic field parameter has a stabilizing influence on the growth rate of the instability in the longitudinal mode of propagation.

The Fig. 2 curves indicate that when the values of Stoke drag Parameter increases, the growth rate of instability is decreasing. Thus we conclude that the Stoke drag Parameter has a stabilizing influence on the growth rate of the system.

The Fig. 3 curves indicate that when the value of suspended particle τ^* increases, the growth rate of instability is decreased. Thus we conclude that the suspended particle τ^* has to stabilize effect on the growth rate of the system.

The third factor equated to zero we gate,

$$\sigma^4\tau + \sigma^3\{1 + \tau(A + \vartheta_k + \Omega_k)\} + \sigma^2\left[(\vartheta_k + \Omega_k) + \tau\{\Omega_J^2 + \Omega_k(A + \vartheta_k)\}\right] + \sigma\left[\Omega_J^2 + \vartheta_k\Omega_k + \tau\Omega_k\Omega_I^2\right] + \Omega_k\Omega_I^2 = 0 \quad (20)$$

Equation (20) shows dispersion relation for an infinite homogeneous magnetized quantum plasma having a kinematic viscosity, thermal conductivity and fine dust particles. The constant term is modified by thermal conductivity but not affected by viscosity and fine dust particles.

4.2 Transverse Mode of Propagation $(\boldsymbol{K \perp B})$

In this case, we assume all the perturbations are transverse to the direction of the magnetic field, $(i.e. k_x = k,\ \ k_z = 0)$. Thus the dispersion relation (eq. 15) reduces to the simple form to gives,

$$d_1^2\left\{\left(d_1 + \frac{k^2V^2}{\sigma}\right)(\sigma d_1 + \Omega_T^2) - \frac{k^2V^2}{\sigma}\Omega_T^2\right\} = 0 \quad (21)$$

It is clear from the above dispersion relation that when the propagation is in the transverse direction it has two factors in equation (21), the first factor of the equation (21) equating to zero and it shows the natural stability of the system. The second factor of the dispersion relation (21) equated to zero gives,

$$\sigma^4\tau + \sigma^3\{1 + \tau(A + \Omega_k)\} + \sigma^2\{\Omega_k + \vartheta_k + \tau(\vartheta_k + \vartheta_k\Omega_k + A\Omega_k + k^2V^2 + \Omega_j^2)\} + \sigma\{\vartheta_k\Omega_k + k^2V^2 + \Omega_j^2 + \tau\Omega_k(k^2V^2 + \Omega_I^2)\} + \Omega_k(k^2V^2 + \Omega_I^2) = 0 \quad (22)$$

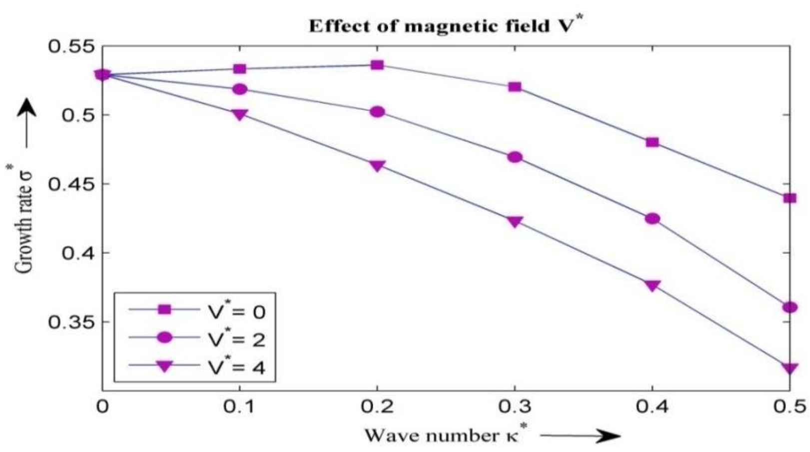

Fig. 1. The growth rate σ^*, in the longitudinal mode, is plotted against wavenumber k^* with variation in the magnetic field V^*= 0, 2, 4, keeping the values of other parameters are unity

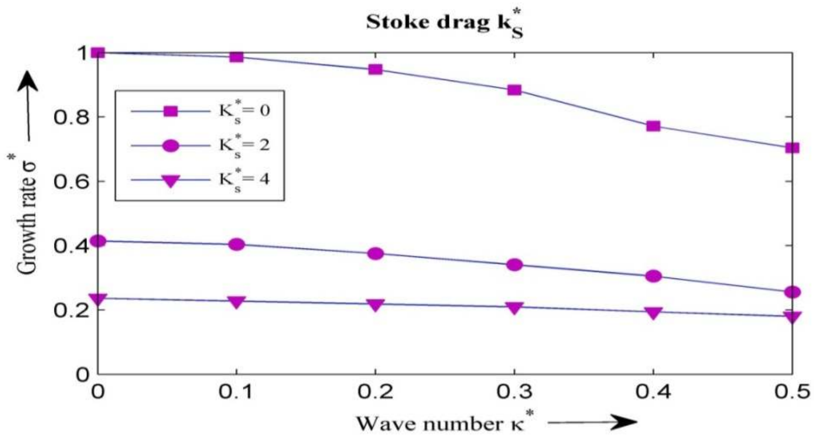

Fig. 2. The growth rate σ^* in the longitudinal mode is plotted against wavenumber k^* with variation in the Stoke drag k_s^* keeping the values of other parameters are unity

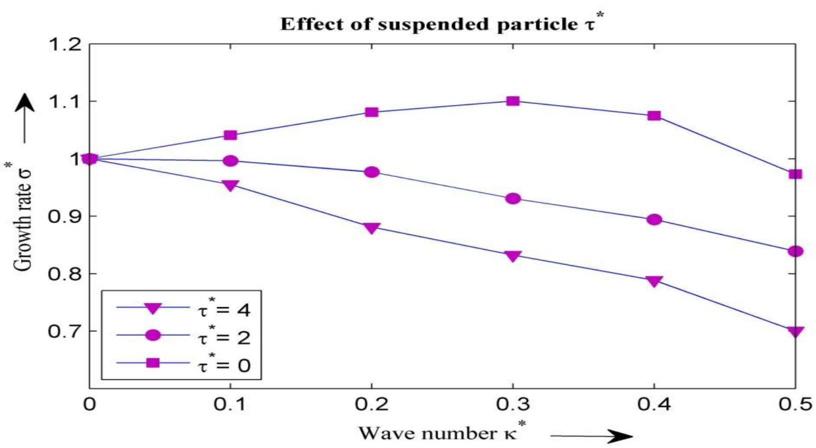

Fig. 3. The growth rate σ^* in the longitudinal mode is plotted against wavenumber k^* with variation in the suspended particle τ^* keeping the values of other parameters are unity

From equation (22) noted that Jeans condition is modified by thermal conductivity, magnetic field and quantum correction, from the constant term of equation (22) the condition of instability can easily be obtained as

$$\Omega_k \left(k^2 V^2 + k^2 c'^2 - 4\pi G\rho + \frac{\hbar^2 k^4}{4 m_e m_i} \right) < 0 \qquad (23)$$

The modified Jeans wave number is

$$k_{j_1} = k_j \left(1 + \frac{V^2}{c'^2} + \frac{\hbar^2 k^2}{4 m_e m_i c'^2} \right)^{\frac{-1}{2}} \qquad (24)$$

Thus the system will be unstable for all wave numbers $k < k_{j_1}$ (where k_{j_1} is modified Jean's wave number) given by equation (24).

The dispersion relation (22) shows a gravitating mode modified due to the presence of magnetized quantum plasma having combined effect of thermal conductivity, viscosity and suspended particles. To discuss the effect of each parameter on the growth rate of instability we solve (22) numerically by introducing the following dimensionless quantities in terms of self-gravitation. Now we can write (22) in non-dimensional form, for showing the effects of different parameter on growth rate of instability, as

$$\sigma^{*4}\tau^{*}+\sigma^{*3}\{1+\tau^{*}(k_s^{*}+\lambda^{*})\} + \sigma^{*2}\left[\lambda^{*}+\upsilon^{*}\left(k^{*2}-\frac{1}{k_1^{*}}\right)+\tau^{*}\left\{\upsilon^{*}\left(k^{*2}-\frac{1}{k_1^{*}}\right)+\lambda^{*}\upsilon^{*}\left(k^{*2}-\frac{1}{k_1^{*}}\right)+k_s^{*}\lambda^{*}+k^{*2}V^{*2}+k^{*2}-1\right\}\right] + \sigma^{*}\left\{\lambda^{*}\upsilon^{*}\left(k^{*2}-\frac{1}{k_1^{*}}\right)+k^{*2}V^{*2}+k^{*2}-1+\tau^{*}\lambda^{*}(k^{*2}V^{*2}+k^{*2}-1)\right\}+\lambda^{*}(k^{*2}V^{*2}+k^{*2}-1) = 0 \tag{25}$$

Where the various nondimensional parameters are defined as,

$$\sigma^{*}=\frac{\sigma}{\sqrt{4\pi G\rho}},\quad k_s^{*}=\frac{K_sN}{\rho\sqrt{4\pi G\rho}},\ \lambda^{*}=\frac{\lambda}{\rho C_p\sqrt{4\pi G\rho}},\quad k^{*}=\frac{KC}{\sqrt{4\pi G\rho}},\quad \upsilon^{*}=\frac{\upsilon\sqrt{4\pi G\rho}}{C^2},\quad k_1^{*}=\frac{K_1\sqrt{4\pi G\rho}}{C^2},\quad \tau^{*}=\tau\sqrt{4\pi G\rho},\ V^{*}=\frac{V\sqrt{4\pi G\rho}}{C} \tag{26}$$

Numerical calculations were performed to determine the roots of σ^{*} from dispersion relation (25), as a function of wave number $k^{*}$for different values of the various parameters.

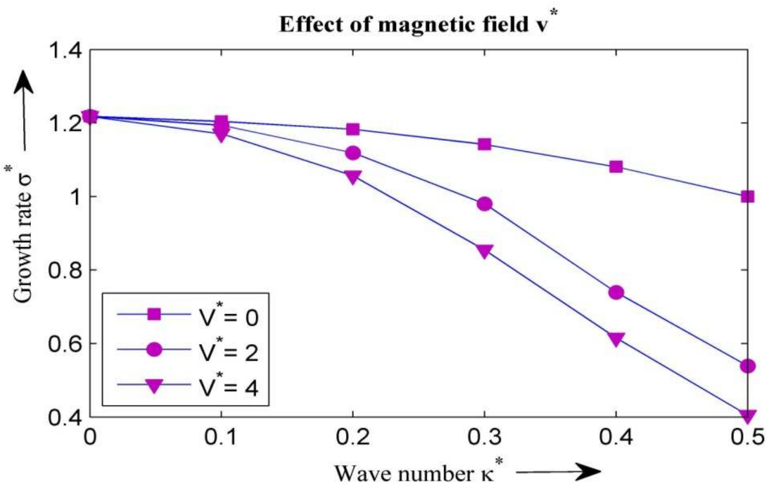

Fig. 4. The growth rate in the transverse mode against wave number with variation in magnetic field $V^{*}=0,2,4$ the values of the other parameters is taken as unity

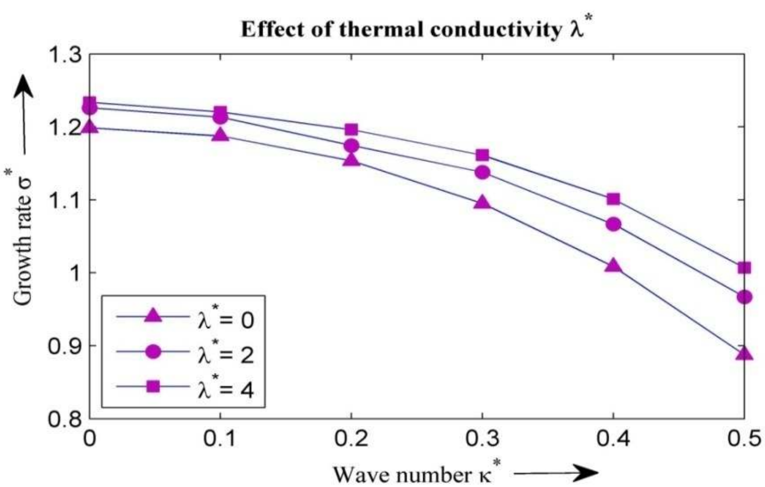

Fig. 5. The growth rate in the transverse mode against wave number with variation in thermal conductivity $\lambda^{*}=0,2,4$ the values of the other parameters is taken as unity

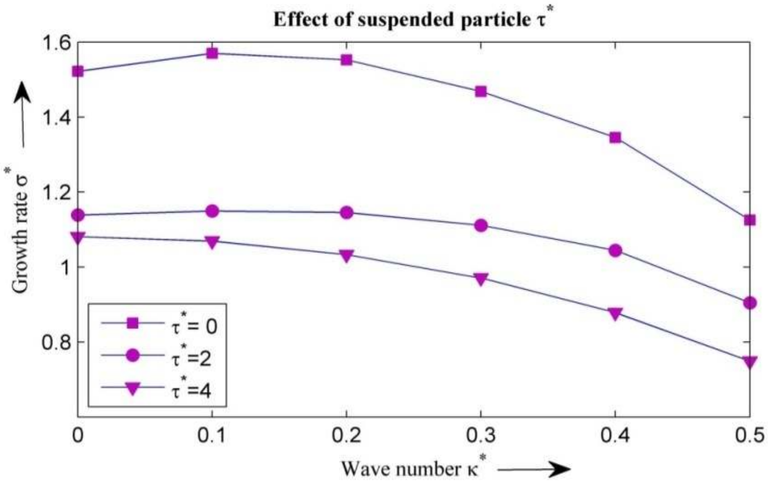

Fig. 6. The growth rate in the transverse mode against wave number with variation in the suspended particles $\tau^* = 0, 2, 4$ the values of the other parameters are taken unity

In Figs. 4, 5 and 6, where the growth rate σ^* (positive real value of σ^*) has been plotted against the wave number k^* to show the dependence of the growth rate on the different physical parameters such magnetic field, thermal conductivity and suspended particles.

From Fig. 4 we observed that increasing value of magnetic field V^* then decreases the growth rate of instability. Thus we can say that magnetic field V^* stabilizes the system.

From Fig. 5 we infer that the growth rate increases with increasing thermal conductivity. Thus the thermal conductivity has a destabilizing effect on the growth rate of self-gravitational instability.

From Fig. 6 we infer that the growth rate decrease with increasing suspended particles τ^*. Thus, the suspended particles τ^* have a stabilizing influence on the growth rate of self-gravitational instability.

5. CONCLUSION

In the present paper, we have analyzed the effect of thermal conductivity and suspended particles on the uniformly magnetized quantum plasma. The linear dispersion relation using QMHD equations in quantum plasma including Bohm potential, thermal conductivity and fine dust particles. The dispersion relation is obtained which is modified due to the presence of considered physical parameters which is discussed for the longitudinal and transverse mode of propagation to the direction of magnetic field and modified Jeans instability results. In the case of the longitudinal mode of propagation along the magnetic field, it is found that the condition of Jeans instability is modified due to thermal conductivity and quantum parameter. The effect of suspended particles does not affect the Jeans condition of the system but they stabilize the system.

In the case of the transverse mode of propagation, we found that the condition of Jeans instability is modified by the presence of magnetic field, thermal conductivity and quantum correction. It is apparent from the curves that magnetic field and suspended particles have a stabilizing influence by decreasing the growth rate of unstable mode both longitudinal and transverse mode of propagation but thermal conductivity is destabilizing the systems in the transverse mode of propagation and Stoke drag parameter is stabilizing the system in a longitudinal mode of propagation. The result of the presence analysis may be useful to understand the problem of wave propagation and Jean's instability self gravitating magnetized quantum plasma. The result of the present work is helpful to an understanding of the astrophysical (star formation and white dwarf star etc.) problems.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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