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EFFECT OF PARALLEL ELECTRIC FIELD ON KINETIC ALFVEN WAVE

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ABSTRACT

Dispersion relation and growth rate of the kinetic Alfven wave in the presence of parallel electric field have been obtained by investigating the trajectories of the charged particles. The effect of parallel electric field is included with the zeroth-order distribution function. The whole plasma is considered to consist of resonant and non-resonant particles. It is assumed that non-resonant particles support the oscillatory motion of kinetic Alfven wave while the resonant particles participate in the energy exchange with the wave. The plasma under consideration which assumed to be anisotropic with low β. It is found that parallel electric field controls the wave damping in the magnetosphere. The results are interpreted for the space plasma parameters appropriate to the auroral acceleration region of the earth's magnetoplasma.

KEYWORDS: Kinetic Alfven Wave (KAW), Parallel Electric Field, Auroral Phenomena, Magnetosphere-ionosphere Coupling

During the last decade observation of electric field in the ionosphere and the magnetosphere using various techniques have led to important advances in the understanding of magnetospehere-ionosphere coupling. Electric field of the order of hundreds of millivolts per meter have been predicted in the high latitude ionosphere, the auroral zone, magentotail and the plasma sheet (Cattell et.al., 1986; Mauk and Zanetti, 1987).

Small scale intense disturbance of the electric field are constantly measured by polar-orbiting and Freja satellites in the altitude range from 900 km. to $2R_E$ above the auroral ionosphere (Louaran et. al., 1994) . Direct measurements from FAST satellites (Bennett et. al., 1983) and rockets (Boehm et.al.,1990) have shown that the discrete flux of keV electrons registered at auroral zone are often correlated with small-scale, localized electromagnetic disturbance sometimes interpreted as kinetic Alfve's waves (KAW).

It has been shown explicitly that finite-ion-gyroradius and electron-inertia effects produces parallel electric filed in kinetic Alfve'n waves, which brings about collisionelss wave-particle resonant interaction, resulting in enhanced plasma heating and anomalous transport.

There is such observational evidence for parallel electric field as large as 100 mV/m along auroral field lines (Mozer et. al., 1985; Mauk and Zenetti, 1987). The variety of theories have been proposed to explain the development of parallel electric fields on the auroral field lines (Tiwari and Rostoker, 1984) , such as double layer process, electrostatic shock model and others (Mozer et. al., 1980). The purpose of this paper is to investigate the effect of such a static parallel electric field on kinetic Alfv'n wave attributed to the auroral acceleration region.

We have considered a kinetic Alfve'n wave propagating obliquely to the constant magnetic field, and two different potentials in the x-z plane for the evaluation of the charges particle trajectories.

The organization of the paper is as follows. In section 2; basic trajectories are presented. In section 3 the density perturbation is considered. The dispersion relation is derived in section 4. Energy balance and growth rate is considered in section 5 while Results and discussion are presented in section 6.

BASIC TRAJECTORIES

In the mathematical analysis we follow the procedure considered in (Terashima, 1967; Tiwari and Varma, 1991, 1993; Varma and Tiwari, 1992; Tiwari et. al., 1985 and Baronia and Tiwari, 2000). The kinetic Alfve's wave is assumed to start at t=0 when the resonant particles are undisturbed. The main interest lies in the behavior of those kinetic Alfven waves which satisfy the conditions.

$$V_{T||i} << \frac{\omega}{K_{||}} << V_{T||e}, \omega << \Omega_i, \Omega_e; k_\perp^2\rho_e^2 << k_\perp^2\rho_i^2 < 1 \quad (1)$$

Where $V_{T||i}$ and $V_{T||e}$ are the mean velocities of ions and electrons along the magnetic field, $\Omega_{i,e}$ are gyration frequencies and $\rho_{i,e}$ the mean gyroradii of the respective species. $k_\perp$ and

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$k_{\parallel}$ are the components of real wave vector k perpendicular and parallel to the magnetic field.

We begin with the two potential representation of wave electric field of form (Hasegawa 1975; Baronia and tiwrari, 2000).

$E_{\perp} = -\nabla_{\perp}\phi$ and $E_{\parallel} = -\nabla_{\perp}\psi$

to decouple the compressional mode and the wave electric field.

$$\overline{E} = \overline{E}_{\perp} + \overline{E}_{\parallel}$$

$$\phi = \phi_1 \mathrm{Cos}(k_{\perp}x + k_{\parallel}z - \omega t)$$

$$\psi = \psi_1 \mathrm{Cos}(k_{\perp}x + k_{\parallel}z - \omega t) \qquad (2)$$

where ϕ_1 and ψ_1 are assumed to be slowly varying function of time t, and ω is the wave frequency which is assumed as real.

The equation of motion of particle is:

$$m\frac{dv}{dt} = q(\overline{E} + \frac{1}{c}\overline{v} \times \overline{B}) \qquad (3)$$

Where the collision between particles are neglected. q is charge and m is the mass of the particle and c represents the velocity of light. The velocity v can be expressed as a sum of the unperturbed velocity V and the perturbed velocity u i.e. v=V + u. u is determined by following set of the equations (Baronia and Tiwari, 2000).

$$\frac{du_+}{dt} + i\Omega u_+ = \frac{q}{m}[\phi_1 k_{\perp} - \frac{V_{\parallel}k_{\perp}k_{\parallel}}{\omega}(\phi_1 - \psi_1)]Sin(k_{\perp}x + k_{\parallel}z - \omega t)$$

$$\frac{du_{\parallel}}{dt} = \frac{q}{m}[\psi_1 k_{\parallel} - \frac{V_{\parallel}k_{\perp}k_{\parallel}}{\omega}(\phi_1 - \psi_1)\mathrm{Sin}(\Omega t - \theta]\mathrm{Sin}(k_{\perp}x + k_{\parallel}z - \omega t) \qquad (4)$$

Where $u_+ = u_x + iu_y$, θ is the initial phase if velocity, $\Omega = \frac{qB_0}{mc}$, u_x and u_y are the perturbed velocities in the x and y directions respectively. The slowly varying quantities ϕ_1 and ψ_1 are treated as a constant. We start by taking the trajectories of free gyration as (Tiwari and Varma, 1991; Tiwari et.al., 1985).

$$x(t) = x_0 + \frac{V_{\perp}}{\Omega}[\mathrm{Cos}(\Omega t - \theta) + \mathrm{Cos}\theta]$$

$$y(t) = y_0 + \frac{V_{\perp}}{\Omega}[\mathrm{Sin}(\Omega t - \theta) + \mathrm{Sin}\theta]$$

$$z(t) = z_0 + V_{\parallel}t \qquad (5)$$

$\bar{r}_0 = (x_0, y_0, z_0)$ is the initial position of the particles at t=0, where the wave is assumed to start.

Equation (4) is solved by replacing the coordinates of charged particles to that of free gyration, which provides the perturbed velocity u(t), and can be further transformed to u (r, t) by the use of eq. (5) once again.

Thus,

$$u_x(r,t) = -\frac{q}{m}[\phi_1 k_{\perp} - \frac{V_{\parallel}k_{\perp}k_{\parallel}}{\omega}(\phi_1 - \psi_1)]\sum_{-\infty}^{+\infty} J_n(\alpha)\sum_{-\infty}^{+\infty} J_1(\alpha)[\frac{\Lambda_n}{a_n^2}\mathrm{Cos}\xi_{nl}$$

$$-\frac{\delta}{2\Lambda_{n+1}}\mathrm{Cos}(\xi_{nl} - \Lambda_{n+1}t) - \frac{\delta}{2\Lambda_{n-1}}\mathrm{Cos}(\xi_{nl} - \Lambda_{n-1}t)$$

$$u_y(r,t) = -\frac{q}{m}[\phi_1 k_{\perp} - \frac{V_{\parallel}k_{\perp}k_{\parallel}}{\omega}(\phi_1 - \psi_1)]\sum_{-\infty}^{+\infty} J_n(\alpha)\sum_{-\infty}^{+\infty} J_1(\alpha)[\frac{\Lambda_n}{a_n^2}\mathrm{Sin}\xi_{nl}$$

$$-\frac{\delta}{2\Lambda_{n+1}}\mathrm{Sin}(\xi_{nl} - \Lambda_{n+1}t) - \frac{\delta}{2\Lambda_{n-1}}\mathrm{Sin}(\xi_{nl} - \Lambda_{n-1}t)$$

$$u_z(r,t) = -\frac{q}{m}[\Psi_1 k_{\|} - \frac{V_{\perp}k_{\|}k_{\perp}}{\omega}(\phi_1 - \psi_1)\frac{n}{\alpha}]\sum_{-\infty}^{+\infty} J_n(\alpha)\sum_{-\infty}^{+\infty} J_1(\alpha)$$

$$\frac{1}{\Lambda_n}[\mathrm{Cos}\xi_{nl} - \delta\mathrm{Cos}(\xi_{nl} - \Lambda_n t)] \tag{6}$$

Where $\delta = 0$ for non resonant particles and $\delta = 1$ for resonant particles

and $\alpha = \frac{k_{\perp}V_{\perp}}{\Omega}$,

$$\Lambda_n = V_{\|}k_{\|} - \omega - n\Omega$$

$$a_n^2 = \Lambda_n^2 - \Omega^2$$

$$\xi_{nl} = k_{\perp}x + k_{\|}z - \omega t + (1-n)(\theta - \omega) \tag{7}$$

Also we use the equation as follows –

exp

$$[-i\alpha \mathrm{Sin}(\theta - \Omega t)] = \sum_{-\infty}^{+\infty} J_n(\alpha)\mathrm{Exp}.-[-in(\theta - \Omega t)]$$

$$\mathrm{Cos}\theta \exp[-i\alpha \mathrm{Sin}\theta] = \frac{n}{\mu}\sum_{-\infty}^{+\infty} J_n(\alpha)\exp[-in\theta]$$

Integration of eq (6) gives the perturbed coordinates of the particles x,y,z which in addition to trajectories of free gyration exhibits the true path of the particles. In view of the approximation introduced in the beginning, the dominant contribution comes from the n = 0. The resonant criterion is given by $k_{\|}V_{\|} - \omega = 0$. The particles satisfying the above condition are called resonant. J_s are Bessel's functions which arise from the diffrenet periodical variation of charges particles trajectories. The term represented by Bessel's functions shows the reduction of the field intensities due to finite gyroradius effect.

DENSITY PERTURBATION

In order to fig out the density perturbation associated with the velocity perturbation, u (r, t, V), we consider the equation (Baronia and Tiwari, 2000; Terashima, 1967).

$$\frac{dn_1(\bar{r},t,V)}{dt} = -\{\nabla.\bar{u}(\bar{r},t,V)\}.N - u_y(\bar{r},t,V)\frac{dN\ (y,V)}{dy} \tag{8}$$

Where N(V) represents the zeroth-order distribution function. The equation (8) is derived by the conservation of particle numbers (Terashima, 1967) and perturbed quantities n_1 (r,t,V) and u (r, t,V) depend on instantaneous velocity V. Since the density n_1 (r, t, V) and velocity u (r, t, V) are depending on velocity the average value of density is obtained as the integrated perturbed density in equation (12). Expressing the right-hand-side of the equation (8) as a function of t (Tiwari and Varma, 1993) and after integration, we obtain the perturbed density for non-resonant and resonant particles in the presence of the kinetic Alfve'n wave as

$$n_1(\bar{r},t) = N(\overline{V})\sum_{-\infty}^{+\infty} J_n(\alpha)\sum_{-\infty}^{+\infty} J_1(\alpha)\frac{q}{m}[\{\phi_1 - \frac{V_{\|}k_{\|}}{\omega}(\phi_1 - \psi_1)\}$$

$$\{\frac{k_{\perp}^2}{a_n^2} + \frac{\Omega^2 v_d k_{\perp} m}{A_n a_n^2 T_1}\} + \frac{k_{\|}^2}{A_n^2}\{\Psi_1 - \frac{n}{\alpha}\frac{V_{\perp}k_{\perp}}{\omega}(\phi_1 - \psi_1)\}]\mathrm{Cos}\xi_{nl}$$

(9)

and for resonant particles

$$n_1(\bar{r},t) = N(\overline{V})\sum_{-\infty}^{+\infty} J_n(\alpha)\sum_{-\infty}^{+\infty} J_1(\alpha)\frac{q}{m}[\{\phi_1 - \frac{V_{\|}k_{\|}}{\omega}(\phi_1 - \psi_1)\}\{\frac{k_{\perp}^2}{a_n^2} + \frac{\Omega^2 v_d k_{\perp} m}{A_n a_n^2 T_{\perp}}\}\mathrm{Cos}\xi_{nl}$$

$$+\frac{1}{2\Omega\Lambda_{n+1}}Cos(\xi_{nl}-\Lambda_{n+1}t)(\frac{k_\perp^2}{}-\frac{\Omega v_d k_\perp m}{T_\perp})+\frac{v_d k_\perp m}{\Lambda_n T_\perp}Cos(\xi_{nl}-\Lambda_n t)$$

$$-\frac{1}{2\Omega\Lambda_{n-1}}Cos(\xi_{nl}-\Lambda_{n-1}t)(\frac{k_\perp^2}{}+\frac{\Omega v_d k_\perp m}{T_\perp})\}+\frac{k_\parallel^2}{\Lambda_n^2}\{\Psi_1-\frac{n}{\alpha}\frac{V_\perp k_\perp}{\omega}(\phi_1-\psi_1)\}$$

$$\{Cos\xi_{nl}+\Lambda_n tSin(\xi_{nl}-\Lambda_n t)-Cos(\xi_{nl}-\Lambda_n t)\}] \tag{10}$$

Where V_d is the diamagnetic drift velocity which is defined by

$$V_d=\frac{T_\perp}{m\Omega}\frac{1}{N}\frac{dN}{dy}=\frac{T_\perp}{m\Omega}\varepsilon_N;\varepsilon_N=\frac{1}{N}\frac{dN}{dy}$$

To determine the dispersion relation and the growth rate, we use the bi-Maxwellian plasma with density distribution (Tiwari and Varma, 1993).

$$N(y,v)=N_0[1-\varepsilon(y+\frac{v_x}{\Omega})]f_\perp(V_\perp)f_\parallel(V_\parallel)$$

Where

$$f_\perp(V_\perp)=\frac{m}{2\pi T_\perp}\exp[-\frac{mV_\perp^2}{2T_\perp}]$$

$$f_\parallel(V_\parallel)=(\frac{m}{2\pi T_{\parallel c}})^{1/2}\exp[-\frac{mV_\parallel^2}{2T_{\parallel c}}]$$

$$T_{\parallel ce}=T_\parallel[1+i\frac{qE_0.\bar{k}}{k^2T_\parallel}]$$

Where

$$k=(k_\perp^2+k_\parallel^2)^{1/2}$$

Here $T_\perp$ and $T_\parallel$ are the perpendicular and parallel temperatures (in energy units) and $\in$ is a small parameter of the order of inverse of the density gradient scale length. The expression for $T_{\parallel C}$ is originally derived (Pines and Schreiffer, 1961) by adopting the rigorous treatment of kinetic approach for collective behavior of solid state plasma. They have arrived at the results where the parallel electric field E_0 is eliminated by adopting the expression for $T_{\parallel C}$ expressed as above. There work also describes that the wave vector k at an angle to the E0. They have clearly mentioned that the sign of the effect depends upon both the charge of the particle and the angle between E_0 and k . Thus it is true for the finite $k_\perp$ also. In this description the parallel electric field E_0 is sufficiently weak that the drift velocity of the charged particles is much smaller than the phase velocity of the wave, $\frac{e\psi}{T_e}<1$ and time scaled are such that the relaxation are nearly Maxwellian and the runway conditions of the electrons are excluded by the same reasoning as discussed by Tiwari and Varma (1991). Here we follow the technique of (Pines and Schrienffer, 1961) and Bers and Brueck, 1968), where a change in the zeroth-order distribution function is due to the result of change in the temperature parallel to the parallel electric field E_0. This method was further considered by Mishra et.al. (1979) for the investigation of whistler mode instability and (Tiwari and Varma, 1991) for the investigation of drift instability. The existences of parallel static electric fields in the presence of KAW on auroral field lines may be the matter of further debate.

DISPERSION RELATION

To evaluate the dispersion relation we calculate the integrated perturbed density for non-resonant particles as

$$\bar{n}_{i,e}=\int_0^\infty 2\pi V_\perp dV_\perp\int_{-\infty}^\infty dV_\parallel n_1(r,t) \tag{12}$$

With the help of eqs (9) and (11) we find the average densities for inhomogeneous plasma as

$$n_i=-\frac{\omega_{pi}^2}{4\pi e}[-\frac{k_\perp^2\phi}{\Omega_i^2}+\frac{k_\parallel^2\psi}{\omega^2}+\frac{V_d^i k_\perp m_i\phi}{T_{\perp i}\omega}](1-\frac{1}{2}k_\perp^2\rho_i^2) \tag{13a}$$

$$\bar{n}_e=-\frac{\omega_{pe}^2}{4\pi eV_{T\parallel Ce}^2}\psi$$

Taking a complex $V_{T||Ce}$ of the form

$$V_{T||Ce} = V_{T||e}[1 + i\frac{eE_0}{mkV_{T||e}^2}]^{1/2}$$

$$\bar{n}_e = -\frac{\omega_{pe}^2}{4\pi e V_{T||e}^2[1 + \frac{e^2E_0^2}{m_e^2k^2V_{T||e}^4}]}\psi$$

(13b)

In this model the evaluation of dispersion relation and growth rate is based upon the real quantities and concept of imaginary quantity in various parameter has not been adopted. Therefore, in density also only real term has been considered otherwise the dispersion relation would have been complex due to this imaginary term which violates the basic principle. It is observed that essential feature if the kinetic Alfve'n wave is retained even in this ideal case. For Maxwell's equation we use the quasi-neutrality condition (Hasegawa 1977).

$n_i = n_e$

to we get the relation between ϕ and ψ as

$$\phi = -\frac{\Omega_i^2}{k_\perp^2}[\frac{\omega_{pe}^2}{\omega_{pi}^2V_{T||Ce}^2} - \frac{k_\parallel^2}{\omega^2}](1 - \frac{1}{2}k_\perp^2\rho_i^2) \quad (14)$$

Using perturbed ion and electron densities n_i and n_e And Ampere's law in the parallel direction (Hasegwa 1977), we obtained the equation

$$\frac{\partial}{\partial z}\nabla_\perp^2(\phi - \psi) = \frac{4\pi}{c^2}\frac{\partial}{\partial t}J_z \quad (15)$$

Where

$$J_z = e\int_0^\infty 2\pi V_\perp dV_\perp \int_{-\infty}^\infty dV_\parallel[\{N(V)u_z(r,t) + V_\parallel n_1(r,t)\}$$
$$- \{N(V)u_z(r,t) + V_\parallel n_1(r,t)\}_e]$$

Jz is the current density which is contributed by first-order perturbations of density and velocity. With the help of eqs (14) and 15) we obtain the dispersion relation for the kinetic Alfve's wave as

$$(1 - \frac{\omega^2}{k_\parallel^2C_s^2A[1 + \frac{e^2E_0^2}{m_e^2k^2V_{T||e}^4}]})(1 - \frac{\omega^2}{V_A^2k_\parallel^2}D_A) = \frac{k_\perp^2\omega^2D_A}{k_\parallel^2\Omega_i^2A} - \frac{\omega_{pi}^2\omega^2A}{c^2k_\parallel^2\Omega_i^2}(\frac{T_{||i}}{m_i})$$
$$(\frac{\omega_{pe}^2}{\omega_{pi}^2V_{T||e}^2A[1 + \frac{e^2E_0^2}{m_e^2k^2V_{T||e}^4}]} - \frac{k_\parallel^2}{\omega^2})$$

(16)

Where

$$D_d = (1 - \frac{V_d^ik_\perp\Omega_i^2m_i}{T_{\perp i}k_{\perp i}^2\omega})A$$

$$A = (1 - \frac{1}{2}k_\perp^2\rho_i^2)$$

$$D_A = [D_d(1 - \frac{1}{2}k_\perp^2\rho_i^2)]$$

Where

$$c_s^2 = \frac{\omega_{pi}^2V_{T||e}^2}{\omega_{pe}^2})$$

is the square of ion-acoustic speed and

$$V_A^2 = \frac{c^2\Omega_i^2}{\omega_{pi}^2}$$

is the square of Alfve'n speed. The dispersion relation of the kinetic Alfve'n wave reduces to that derived by (Hasegawa and Chen, 1976) under the approximation, $I_0(\lambda_i)$ exp $(-\lambda_i) \sim 1 - \lambda_i$, for $\lambda_i = \frac{1}{2}k_\perp^2\rho_i^2 < 1$ as we have applied $I_0(\lambda_i)$ is the modified Bessel function.

ENERGY BALANCE AND GROWTH RATE

The oscillatory motion of non-resonant electrons carries the major part of energy (Tiwari and Varma, 1993; Terashima, 1967). The wave energy density per unit wavelength Ww is the sum of pure field energy and the changes in energy of the non-resonant particles $W_{i,e}$. It is observed that the wave energy is contained in the form of the oscillatory motion of the non- resonant electrons (Tiwari and Varma 1993; Terashima, 1967). Thus

$$W_w = W_e = \frac{\lambda k_{\|}^2 \psi_1^2}{16\pi} \frac{\omega_{pe}^2}{k_{\|}^2 (\frac{T_{\|e}}{m_e})} \qquad (17)$$

Now we calculate the resonance energy W_r of the electrons per unit wavelength, that is

$$W_r = \int_0^{\lambda} ds \int_0^{\infty} 2\pi V_{\perp} dV_{\perp} \int_{(\omega/k_{\|})-\Delta V_{\|}}^{(\omega/k_{\|})+\Delta V_{\|}} (-\frac{1}{2} N m_e u_z^2 + n_1 m_e u_z V_{\|}) dV_{\|} \qquad (18)$$

With the help of eqs (6), (10) (11) and (18) expanding the integrand around $V_{\|} = \omega / k_{\|}$ and following the procedure as discussed in (Tiwari and Varma 1993; Terashima, 1967) , in the limiting case of $k_{\perp}\rho_e << 1$ we obtain.

$$W_r = -\frac{1}{4} \lambda \psi_1^2 t \omega_{pe}^2 k_{\|} f_{\|} (\frac{\omega}{k_{\|}}) \frac{\omega^2}{k_{\|}^2 V_{T\|Ce}^2} (1 - \frac{k_{\perp} V_d^e}{\omega}) \qquad (19)$$

Where $k.s = \vec{k}.\vec{r}$ and $k = 2\pi / \lambda$

And $\omega_{pi.e}^2 = \dfrac{4\pi N_0 e^2}{m_{i,e}}$

Using the law of conservation of energy, we calculate the growth rate of the drift kinetic Alfven wave by

$$\frac{d}{dt}(W_w + W_r) = 0 \qquad (20)$$

With the help of (17) and (19) we have found the growth rate of the drift kinetic Alfven wave as

$$\frac{\gamma}{\omega} = \frac{\pi^{1/2}\omega}{k_{\|} V_{T\|e} [1 + \frac{e^2 E_0^2}{m_e^2 k^2 V_{T\|e}^4}]^{1/2}} [(1 + \frac{e^2 E_0^2}{8 m_e^2 k^2 V_{T\|e}^4})(\frac{k_{\perp} V_d^e}{\omega} - 1)]$$

$$\exp\left[-\frac{\omega^2}{k_{\|}^2 V_{T\|e}^2 [1 + \frac{e^2 E_0^2}{m_e^2 k^2 V_{T\|e}^4}]}\right] \qquad (21)$$

Where $V_{T\|.\perp}^2 = \dfrac{2T_{T\|.\perp}}{m}; V_d^e$ represents electron diamagnetic drift velocity and the value of ω for the drift kinetic Alfve'n wave has to substituted. The kinetic Alfve'n waves are generated by density inhomogeneity if the magnetic field inhomogeneity is absent. However, due to magnetic field inhomogeneity the condition is altered.

RESULTS AND DISCUSSION

We have evaluate dispersion relation and growth rate of the kinetic Alfven wave in the presence of parallel electric field using the following parameters for auroral acceleration region (Tiwari and Rsostker , 1984; Tiwari and Varma, 1991; Baronia and Tiwari, 1999, 2000).

B_0=4300nT, n=10/cm^3

$$kT_{\|e} = 10\text{keV}$$

$$\frac{\omega_{pi}}{\Omega_i} = 10$$

Fig. 1 shows the relation between wave frequency ω versus $k_{\perp}\rho_i$ at the different values of parallel electric field E_0. it is observed that the parallel electric field slightly enhanced the wave frequency with $k_{\perp}\rho_i$. The increased phase velocity from the particle velocity may cause the acceleration of the charged particles by the wave particle interaction mechanism. Therefore, the parallel electric field may contribute to acceleration of charged particles through the wave.

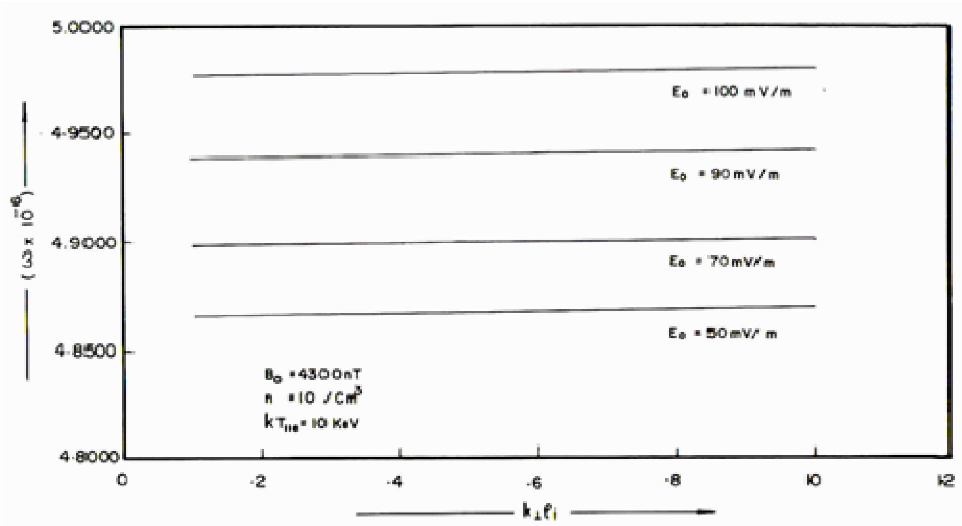

Figure 1: Frequency Vs parallel wave number for different value of E_0

Fig. 2 predict the variation of normalized growth rate γ / ω with $k_{\perp}\rho_i$ at different values of parallel electric field E_0 .it is notice that the parallel electric field E_0 is to reduces the growth rate. The parallel electric field controls the wave damping in the magnetosphere and transfers the energy into the particle due to Landau damping.

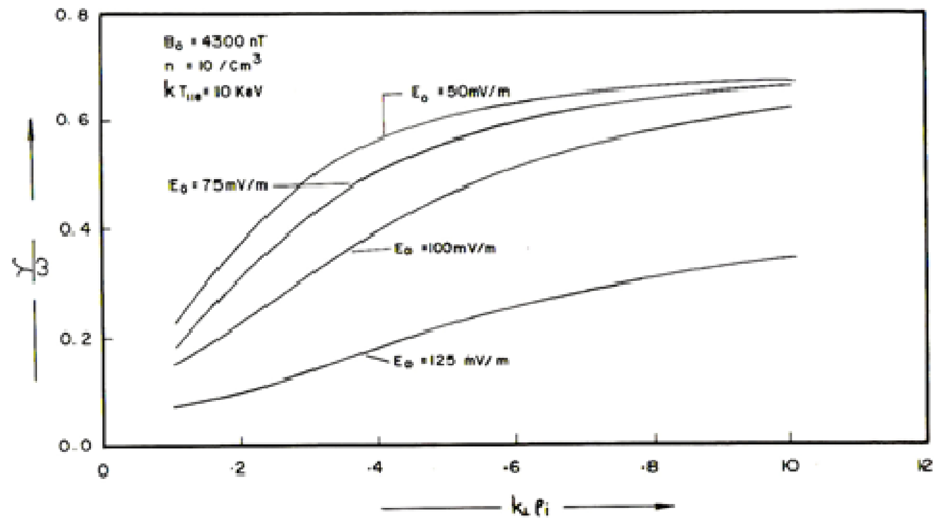

Figure 2: Growth rate Vs parallel wave number for different value of E_0

Here we may conclude that the parallel electric field can influence the growth rate because the wave has been generated by the diamagnetic drift. It follows that convection charges in the equatorial plane of the magnetosphere in a manner that produces an east-west density gradient Alfve'n disturbance will be setup that propagate to the ionosphere leading to the subauroral region II field-aligned current system and the acceleration of charged particles which one influenced by parallel electric field (Baronia and Tiwari, 1999).

Our aim in this paper is that to examine the effect of parallel electric field on KAW. The kinetic Alfven wave may be generated in the distant magnetosphere and bounce between ionosphere and magnetosphere setting a standing wave pattern .The field –aligned current and closer currents may be the effect of such a pattern which are effected by parallel electric field . This study may be of importance in the experiment plasma (Baronia and Tiwari, 2000).

The polar satellite launched on February 24, 1996, into an elliptical polar orbit with apogee of~9 Earth radii geocentric over the North pole and a perigee of ~2 Earth radii . Through rotation of its line apsides with time. Polar has traversed auroral zone magnetic field in the premidnight meridian at all altitudes between perigee and near apogee. As part of the payload, Polar carries a three-axis electric field instrument (Harvey et. al., 1995). A magnetometer and the HDRA plasma instrument (Scudder et, al., 1995). The data from these instruments are used in this paper to discuss the auroral acceleration pattern.

The present model is based upon (Dowson's, 1961) approach to the Landau damping which was further extended by (Tiwari et, al., 1985; Varma and Tiwari , 1992,93 ; Baoania and Tiwari , 1999 and Dwivedi et, al., 2001, 2002) in which the wave frequency ω and wave vector k are assumed to the real. The dispersion relation contains no imaginary part and the evaluation of growth rate is done by energy exchange approach between wave and particles.

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