Effect of Radiating Partially Ionized Plasma and Wave Evolution in the Photosphere

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***Abstract*— This paper investigate the effect of a radiating partially-ionized plasma and wave evolution. The presence of upstream and downstream magnetic field is studied with the influence of collision and interaction frequency in radiative flow field. A modified chandrasekher, Drazin and Ried method is used in solving the charateristics value problem with two-dimensional disturbances for the case of equilibrium free convection. Radiation present on the onset of partially ionized plasma and wave evolution is found to have periodic steady state, unsteady with differential gradient on the raleigh number. It effect on wave evolution is small on the radiation parameters of the order wave number 1x10-1 concentration gradient. A steady state effect on the system Graphs were pictorialy displayed, evaluated and the results shows with remarkable good agreement on various figures on decrease points or decline points, steady state points, inclinepoints and also their characteristic behaviour of the Rayleigh number and wave evolutionin in the region. The effect of collision on the onset of static cells diminishes for optical thin non-grey plasma-near periodic steady state. This is of relevant and very important in cosmic ray physics as the interaction between the ionized and neutral gas component represents a state which often exists in the Astrophysics space.**

***Index Terms*— Rayleigh number, Ionized plasma, neutral, wave propagation, wave numbers.**

I. INTRODUCTION

It is curently known that the characteristics behaviour of radiating ionized plasma and wave propagation in the photosphere interstellar medium and the involving hydro magnetic forces is of immense important in connection with meteorologists, space science, engineer, industrialist, environmentalist and in astrophysical phenomena, geophysical Scientist, ionized gas behaviour, and plasma jets. Also equipments in the area such as nuclear power plants, gas turbines and the various propulsion devices for air craft's, missiles satellite and Space vehicles (Sutton, 1959; Shil-Pai, 1965). Besides it has a variety of application in MHD Power generator and Hall accelerators(Ram, et.al;1990), in re-entry problems (Bestman et.al; 1992), in geophysical fluid dynamics, meteorology and engineering. (Chamkha et. Al; 2001) studied the Radiation effects on the free convection flow past a semi-finite vertical plate with mass transfer. Muthucumaraswamy and Senthil (2004) investigated the heat and mass transfer effects on the moving vertical plate in the presence of thermal radiation. Prasad et.al; (2007) considered the radiation and mass transfer effects on a two -dimensional flow past an impulsively started isothermal vertical plate. The interaction of radiation with hydro magnetic flow has become industrially more prominent in the processes wherever high temperatures occur. Takhar et.al; (1996) analyzed the radiation effect on MHD free convection flow past a semi-infinite vertical plate using Runge-kutta Merson quadrature. Abd-EL-Naby et. Al; (2003) Studied the radiation effect on MHD unsteady free convection flow over a vertical plate with variable surface temperature. Chaudhary et.al; (2006) studied the radiation effect with simultaneous thermal and mass diffusion in MHD mixed convection flow from a vertical surface. Ramachandra et.al; (2006) Studied the transient radiative hydro magnetic free convection flow past an impulsively started vertical plate with uniform heat and mass flux

The problem of studying the complex occurrence of neutral and ionized species of those particles accelerated at astrophysical sources and those particles produced in interaction and collisions with those on interstellar gas are relevant to Geophysics, Astrophysical flow, Solar power technology, space vehicle re-entry, also relevant to environmental scientist and engineers. Naturally occurrence and the existence of extraterrestrial and terrestrial atmosphere are cause by the variation in solar radiation amount-solar out put (Ayoade, 1993), variation in the absorption of solar radiation outside the earth atmosphere since atmosphere and weather are guided and governed by dynamics of fluid (William and John, 1999; Gaisser and Stanev, 2000). Analytical study of Galactic cosmic rays which are fully ionized; the accelerated mechanism fully strip the ions with antimatter component, as measured in the space shuttle, extra galactic origin transport in the cloudy interstellar medium containing randomly distributed giant molecular clouds have been considered in the works of Cowsik and Wilson, 1973; Dogiel et.al; 1987; Osborne et.al; 1987 and Ptuskin et.al;1990. The latter two papers theory of diffusion in the cloudy medium which takes into account the cloud's finite transparency for diffusion particles. Due to the high temperature involved, its application in space science Management, Astrophysics, Meteorites meteorology and in Agricultural industries cannot be overemphasised. Alabraba et.al; (2008) Study the field structure and the heat transfer at the walls of two-component plasma. The flow is induced by two horizontal walls moving relative to each other along their common axis in the presence of a uniformly applied transverse magnetic field and the analysis made under the following assumptions

(i) The flow is viscous and incompressible (ii) The flow is fully developed (iii) The temperature varies linearly along the

Manuscript received April 23, 2016

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wall (iv) The temperature difference between the walls is not large enough to cause free convection current to flow. Exact solution for the velocities and temperature for the ionized and neutral particles and the induced magnetic field are derived. These together with the heat transfer are discussed quantitatively Pekene and Ekpe (2015). Investigated unsteady state of radiating partially-ionized plasma in the galactic centre in the presence of incline magnetic field is investigated with the influence of collision frequency and radiative flow. The modified chandrasekher, Drazin and Ried method is used in solving the eigenvalue problem with two-dimensional disturbances for the case of stationary convection. Radiation present on the onset of thermal unsteadying is found to have an unsteady state effect for even a very small radiation parameter of the order $\alpha(0.1)$concentration gradient, on the other hand has a steady state effect on the system. The effect of collision on the onset of stationary cells diminishes for optical thin non-grey plasma-near Steady state. This is of relevant and very important in cosmic ray physics as the interaction between the ionized and neutral gas component represents a state which often exists in the universe. In all these investigation the problem on the effect of radiating partially ionized plasma and wave evolution in the photosphere has been ignored where charged energized particles diffuses in random magnetic field that account for their high isotropy and relatively long confinements time in the photosphere region outer suface of the interstellar medium. Previous studies in this review of the related literature have not considered due to the complexity and the intricate of the mathematical abstractions which are valid only along the path of inertial of the local inertial besides, MHD equations and fluid equations are general, non-linear this means that the solutions are interesting and complex but also difficult to evaluate; thus keeping in view the wide range of applications, relevant to astrophysics problems in various design in the Agricultural industries, relevant for researchers for space scientist, relevant to scientific workers, relevant to geophysicist, relevant to engineers, relevant to curriculum designers (Education) and in the aviation industries. First we formulate Mathematical formulation of the problem of the Physics, Method of solution and analyzed the results from the graphs

II. MATHEMATICAL FORMULATION

In the analysis of exact consequence of radiative transfer in a fluid requires a formulation in terms of integro-differential equations. Solution of equations is complex(Spiegel, 1965; Opara and Bestman, 1988). Approximation theories have been developed that permit a formulation involving only differential equations. One such theory expresses radiation for optically thin non grey gas a differential approximation of variable space co-ordinate (Cogley, et.al;1968). These theories where originally developed for astrophysical studies and where later employed in neutron transport theory. Although the usual formulation of the problem is well known, its modification for radiative terms is not. We therefore consider the flow of a two-component plasma model, using the subscripts i and n to designate ion and neutral particles. The problem as formulated by Sharman and Sunil (1992), is then modified by the radiative term thus.

$$\nabla . q = (\theta - \theta_\infty)\alpha^2$$

$$\delta = 4 \int_0^\infty (\alpha_k . \frac{\partial B}{\partial \theta})\, dk^*$$

B is the Planck's function, δ is the radiation absorption coefficient and k^* is the frequency of radiation, and θ is the temperature. The equations expressing the continuity, momentum, heat and solute mass concentration acted on by a uniform vertical magnetic field $\mathrm{H}(0,0,\mathrm{H})$ and gravity g(0,0,-g) are

$$\nabla . V_i = 0$$

$$\nabla . H_i = 0 \quad (1)$$

$$\left(\frac{\partial w_i}{\partial t} + u_i \frac{\partial w_i}{\partial x} + v_i \frac{\partial w_i}{\partial y} + w_i \frac{\partial w_i}{\partial z}\right) - \frac{\mu}{4\pi\rho_i}\left(H_x \frac{\partial H_z}{\partial x} + H_y \frac{\partial H_z}{\partial y} + H_z \frac{\partial H_z}{\partial z}\right)$$

$$= \frac{\partial}{\partial z}\frac{(\rho - \rho_0)}{\rho_0} + \frac{\mu}{\rho_0}(\nabla^2 w_i)$$

$$-g\beta(\theta - \theta_0) - \frac{\mu}{\rho_0}\kappa\,(w_i) - g\,\alpha'\,(C - C_0) + \frac{fc}{v}(w_n - w_i). \quad (2)$$

$$\left(\frac{\partial H_z}{\partial t} + u_i \frac{\partial H_z}{\partial x} + v_i \frac{\partial H_z}{\partial y} + w_i \frac{\partial H_z}{\partial z}\right) = \left(H_x \frac{\partial w_i}{\partial x} + H_y \frac{\partial w_i}{\partial y} + H_z \frac{\partial w_i}{\partial z}\right) + \eta\nabla^2 H_z \quad (3)$$

$$\left(\frac{\partial \theta}{\partial t} + u_i \frac{\partial \theta}{\partial x} + v_i \frac{\partial \theta}{\partial y} + w_i \frac{\partial \theta}{\partial z}\right) = \kappa\nabla^2\theta - q\alpha\nabla . q \quad (4)$$

and

$$\left(\frac{\partial C}{\partial t} + u_i \frac{\partial C}{\partial x} + v_i \frac{\partial C}{\partial y} + w_i \frac{\partial C}{\partial z}\right) = D_m \nabla^2 C \quad (5)$$

for ionized components

In consequence to the writing of equations 1, 2, 3, 4 and 5 above the Boussinesq approximation has been used. Similarly, for the neutral components we have

$$V_{n\alpha}\nabla . V_n = 0 \quad (6)$$

$$\left(\frac{\partial w_n}{\partial t} + u_n \frac{\partial w_n}{\partial x} + v_n \frac{\partial w_n}{\partial y} + w_n \frac{\partial w_n}{\partial z}\right) = -\frac{\partial}{\partial z}\frac{(p \;\; p_0)}{\rho_0} + \frac{\mu}{\rho_0}(\nabla_n^2)$$

$$-g\beta(\theta - \theta_0) - \frac{\mu}{\rho_n}\kappa\,(w_n) - g\alpha'(C - C_0) + \frac{fc}{v}(w_n - w_i), \quad (7)$$

$$\left(\frac{\partial \theta}{\partial t} + u_n \frac{\partial \theta}{\partial x} + v_n \frac{\partial \theta}{\partial y} + w_n \frac{\partial \theta}{\partial z}\right) = \kappa\nabla^2\theta - q\alpha\nabla . q \quad (8)$$

and

$$\left(\frac{\partial C}{\partial t} + u_n\frac{\partial C}{\partial x} + v_n\frac{\partial C}{\partial y} + w_n\frac{\partial C}{\partial z}\right) = D_m\nabla^2 C \qquad (9)$$

$$\rho = \rho_0[1-\beta(\theta-\theta_0)+\alpha'(C-C_0)], \qquad (10)$$

On the condition where the suffix zero refers to values at the reference level $z = 0$. The temperatures and solute concentration at the bottom surface $z = 0$ are θ_0, C_0 and at the upper surface $z = d$ are C, θ. We have also taken the Cartesian coordinates(x, y, z) with the origin on the lower boundary $z = 0$ and the z-axis perpendicular to it along the vertical (a) In the equation of motion for the neutral component, there will be an equal and opposite motion. (b) for the ionized component, the steady state solution is

$$v(x, y.z) = 0 \qquad (11)$$

$$\theta = \theta_0 - \beta z \qquad (11a)$$

$C = C_0 - \beta' z$ and

$$\rho = \rho_0(1+\beta z - \beta' z)$$

where β and β' are the adverse temperature and concentration gradient considering a small perturbation on the steady state. Under the argument of Chandrasekhar (1981); Drazin and Reid (2004); Pekene and Ekpe (2015); Bestman and Opara (1990) the liberalized perturbation equation become

$$\frac{\partial\theta}{\partial t} = \kappa\nabla^2\theta_i + \beta w_i - \delta^2 \qquad (12)$$

$$\frac{\partial hz_i}{\partial t} = \eta\nabla^2 hz_i + H_0\frac{\partial w'_i}{\partial z} \qquad (13)$$

$$\frac{\partial\xi_i}{\partial t} = \eta\nabla^2\xi_i + H_0\frac{\partial\xi_i}{\partial z} \qquad (14)$$

$$\frac{\partial\xi_i}{\partial t} = v_i(\nabla^2) - \frac{1}{\kappa}) \qquad \xi_i + \frac{\mu}{4\pi\rho_i}H_0\frac{\partial\xi_i}{\partial z} \qquad (15)$$

and

$$\frac{\partial}{\partial t}(\nabla^2 w'_i) = v_i(\nabla^4) - \frac{1}{\kappa})w'_i + \frac{\mu_i}{4\pi\rho_i}H_0\frac{\partial}{\partial z}(\nabla^2 hz_i)$$

$$+g\alpha'\left(\frac{\partial^2 c_i}{\partial x^2} + \frac{\partial^2 c'_i}{\partial y^2}\right) + g\beta\left(\frac{\partial^2\theta_i}{\partial x^2} + \frac{\partial^2\theta}{\partial y^2}\right) - \frac{fc}{v_i}(\nabla^2 w'_n - \nabla^2 w_i), \qquad (16)$$

where w'_i is the z-component of the velocity of ionized particles ξ_i is the component of vorticity and $\bar{\xi}_i$ is a factor representing the current density.

III. DISPERSION RELATION

Analyzing dispersion in terms of normal modes and assuming that the perturbation quantities are of the form

$$W'_i = W_i z e^{[i(k_x X + k_y Y) + nt]}$$

$$\theta_i = \theta_i(z) e^{[i(k_x X + k_y Y) + nt]}$$

$$\bar{\xi}_i = Z_n(z) e^{[i(k_x X + k_y Y) + nt]} \qquad (17)$$

$$\xi_i = X_n(z) e[e^{[i(k_x X + k_y Y) + nt]}$$

$$hZ_i = K(z) e^{[i(k_x X + k_y Y) + nt]}$$

where

$$\bar{\xi}_i = \left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right) \qquad (18)$$

and

$$\xi_i = \left(\frac{\partial hy}{\partial x} - \frac{\delta hx}{\partial y}\right) \qquad (19)$$

denote respectively the z-components of vorticity and current density; κ_x and κ_y are the wave number in the x-and y-directions, $\kappa = (\kappa_x^2 + \kappa_y^2)^{\frac{1}{2}}$ is the resultant wave number and the growth rate. Expressing the coordinate x, y, z in the new unit length d and putting

$$\alpha = \kappa d, \sigma = \frac{nd^2}{v}, \varrho_1 = \frac{v}{k}, \varrho_2 = x = dk^{-\frac{1}{2}}, = \frac{\mu}{\rho}, \xi_c = \frac{fcd}{v}, R = g\beta\beta\frac{d^4}{\kappa v}$$

is the thermal Rayleigh number and the time constant $n = \frac{\partial}{\delta t}$, where $D = \frac{d}{dz}$ while M is the non-dimensional magnetic number, Equations 12,13,14,15, and 16 under usual stability analysis Drazin and Ried (2004) and Chandrasekhar (1981) was modelled to be written.

$$(D^2 - a^2 - \varrho\sigma - R_1\alpha)\theta_i = -\left(\frac{\beta d^2}{\kappa}\right)W_i \qquad (20)$$

$$(D^2 - a^2 - \varrho_2\sigma)K_i = -\left(\frac{H_0 d}{\eta}\right)D X_i \qquad (21)$$

($D^2 - a^2 - \varrho_2\sigma)X_i = -\left(\frac{H_0 d}{\eta}\right) DZ_i$
(22)

$(D^2 - a^2 - X^2 - \sigma)Z_i$=($\frac{\mu}{4\pi\rho v} H_0$d)D$X_i$ ×

$(D^2 - a^2)(D^2 - a^2 - x^2 - \xi_i^2 - \sigma)W_i +$

$+\xi^2(D^2 - a^2)^2 W_n$
(23)

($\frac{H_0 d}{\rho v}$) D(D $-a^2$) k_i =(g $\frac{\beta d^2}{v}$) $a^2\theta_i$
(24)

for ionized components, and

$(D^2 - a^2 - \varrho_i\sigma - \varrho_i\alpha)\theta_n = -(\frac{\beta d^2}{\kappa})W_n$
(25)

$(D^2 - a^2 - \sigma)X_i = 0$
(26)

and

$(D^2 - a^2)^2$ ($D^2 - a^2 - x^2 - \xi^2)W_n + \xi_n^2$ ($D^2 - a^2)^2 W_i = (g\frac{\beta d^2}{v})a^2\theta_n$ (27)

for neutral components.

if we eliminate θ, k, X and Z between equations (20-23),assuming the time constant to be zero we get

$Ra^2 W_i = (D^2 - a^2 - \varrho_i\alpha)(D^2 - a^2)(D^2 - a^2 - x^2 - \xi^2$
$)W_i$

$-MD^2 W_i + \xi_i^2$ ($D^2 - a^2)^2 W_n$
(28)

for ions and

$Ra^2 W_n = (D^2 - a^2 - \varrho_i\alpha)(D^2 - a^2)(D^2 - a^2 - x^2 - \xi_n^2)W_n$

$+\xi_i^2(D^2 - a^2)^2 W_n$
(29)

for neutrals

Now we consider and assummed, the case in which the both boundaries are free on adjoining medium is electrically non-conducting on. The boundaries are assumed to be perfect conductors of both heat and solute concentrations. The boundary conditions appropriate to the problem, by use of equation (17), are

$W = D^2W = X = DZ = \theta = \xi = 0$
(30)

and hx, hy, hz are continuous.

The component of magnetic field strength depends only on moving charges and is independent of the medium also the tangential components is zero outside the fluid, we get

$DK = 0$
(31)

on the boundaries. With the boundary condition on equations (30) and (31) it can be shown that all the even-order derivative of (W) must vanish for Z= 0 and $Z = 1.$

Hence the proper solution of (28) and (29) characterised the lowest mode is

$W = W_0 sin\pi Z$
(32)

where W_0 is constant.

If we substitute equation (32) in to equation (28) and (29) and letting $R_i \approx R_n \approx R$ for two species plasma .we obtain the distribution/dispesion relation.

$\{[Ra^2 - (\pi^2 + a^2 + \varrho_1\alpha)(\pi^2 + a^2 + x^2 + \xi^2)] \times$

$\times [Ra^2 - (\pi^2 + a^2 + \varrho_1\alpha)(\pi^2 + a^2)(\pi^2 + a^2 + x^2 + \xi^2) +$

$+(\pi^2 + a^2 + \varrho_1\alpha)\pi^2 M] - \xi^4(\pi^2 + a^2)^4$ }
(33)

To evaluate the effects of radiative term wave number α and coupling frequency ξ also we investigated the behaviour of the numerical solution (33) on the critical Rayleigh number dimensionless wave number at a given magnetic field profile as shown in the table1 fig.1; table 2 fig. 2 and table 3 fig. 3. Also evaluate the various benchmark of fig. 1, fig 2 and fig. 3 respectively.

TABLE 1: Variation of dimensional wave number(a) with modified R at varying magnetic field M.
X=0.5, π=3.142, α=0.1, ϱ=1, ξ=1.5

A	R at (M=0) X10³	R at(M=25) X10³	R at(M=75) X10³	R at(M=100) X10³
0.20	4.126	12.127	29.605	88.223
0.30	1.506	5.477	12.044	49.236
0.40	1.445	2.354	4.937	26.128

0.50	1.401	1.472	4.757	3.617
0.60	1.456	1.822	2.101	8.344
0.70	1.613	1.721	1.432	3.879
0.80	1.971	1.815	2.244	2.414
0.90	1.556	1.783	1.959	0.208
1.00	2.783	1.881	1.846	1.811

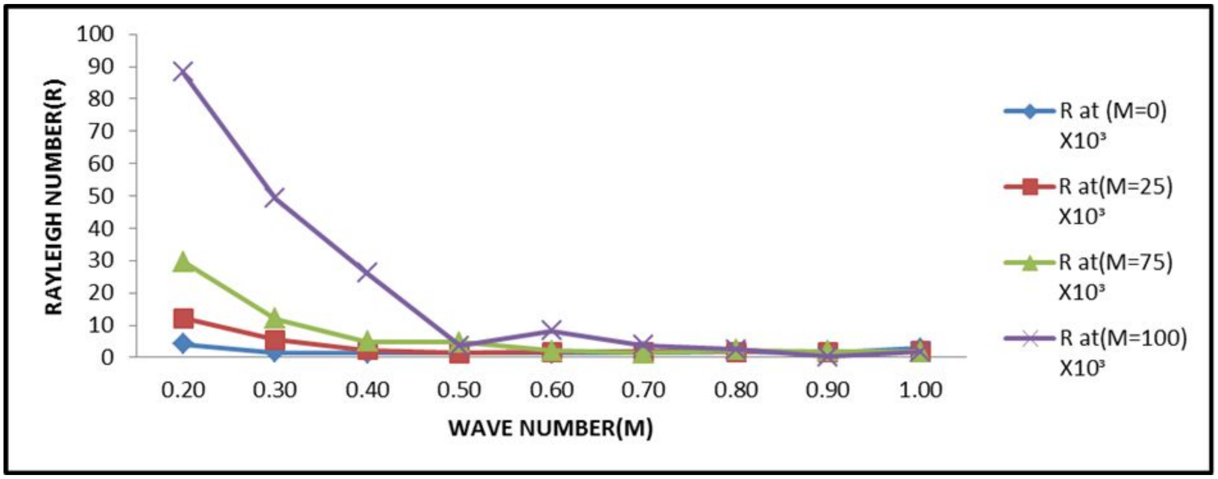

Fig. 1:

TABLE 2: Variation of dimensional wave number(a) with modified R at varying magnetic field M

X=0.5, π=3.142, α=0.1, ϱ=1, ξ=1.5

B	R at (M=0) X10³	R at(M=25) X10³	R at(M=75) X10³	R at(M=100) X10³
0.20	3.377	11.45	28.87	71.26
0.30	0.907	5.148	11.124	46.838
0.40	1.264	1.707	3.469	24.291
0.50	1.317	0.909	4.584	3.652
0.60	1.377	1.661	1.342	6.832
0.70	1.496	1.578	0.77	2.423
0.80	1.842	1.685	1.434	1.963
0.90	0.457	1.521	-2.818	0.106
1.00	2.461	1.478	-4.873	1.617

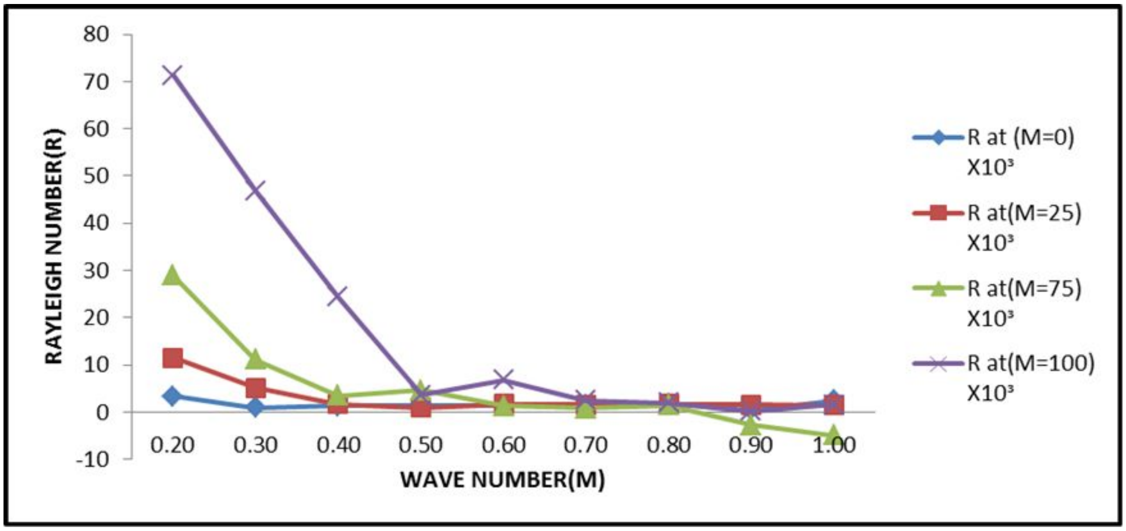

Fig. 2:

TABLE 3: COMPARATIVE PLOT

	R at (M=0) X10³	R at(M=25) X10³	R at(M=75) X10³	R at(M=100) X10³	R at (M=0) X10³	R at(M=25) X10³	R at(M=75) X10³	R at(M=100) X10³
0.20	4.126	12.127	29.605	88.223	3.377	11.45	28.87	71.26
0.30	1.506	5.477	12.044	49.236	0.907	5.148	11.124	46.838
0.40	1.445	2.354	4.937	26.128	1.264	1.707	3.469	24.291
0.50	1.401	1.472	4.757	3.617	1.317	0.909	4.584	3.652
0.60	1.456	1.822	2.101	8.344	1.377	1.661	1.342	6.832
0.70	1.613	1.721	1.432	3.879	1.496	1.578	0.77	2.423
0.80	1.971	1.815	2.244	2.414	1.842	1.685	1.434	1.963
0.90	1.556	1.783	1.959	0.208	0.457	1.521	-2.818	0.106
1.00	2.783	1.881	1.846	1.811	2.461	1.478	-4.873	1.617

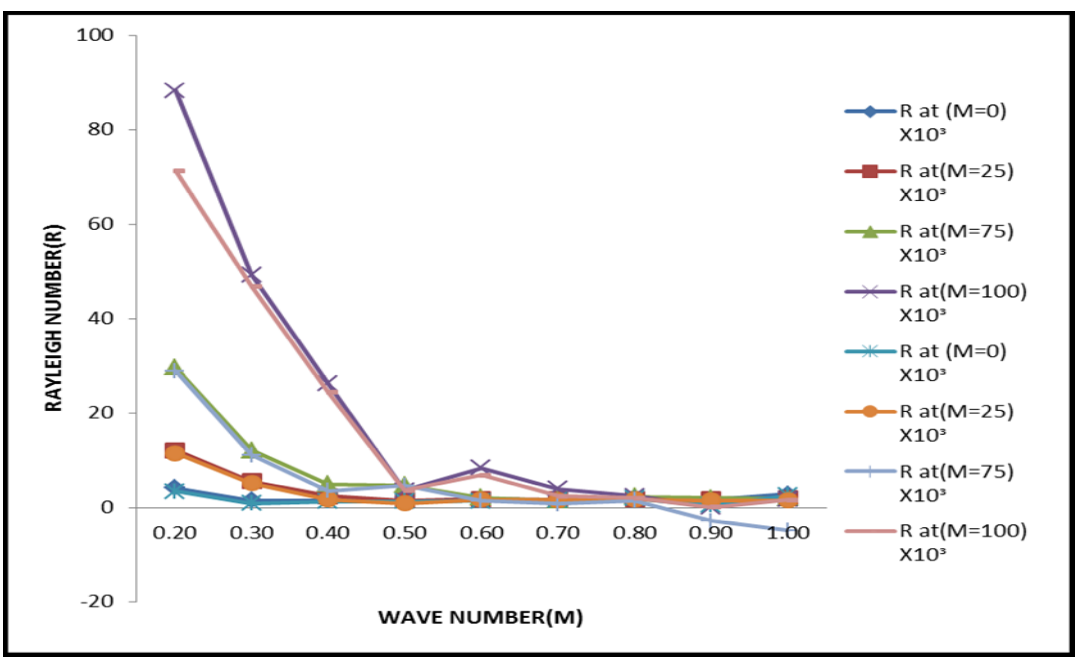

Fig. 3:

RESULT AND DISCUSION

In the fore going, the formulation and the numerical solution for the effect of radiative and coupling frequency of the problem of characteristics value with two dimensional evolution for the case of stable and natural convection were presented. By invoking, characteristic value were solved. To comprehend fully the effects of the dependent parameter, the flow state parameters use is made of the following in the numerical computation; on the above {[Table 1 fig. 1(M=100, 75, 25 and 0)]; [Table 2 fig. 2 (M=100, 75, 25 and 0)]; [Table 3 fig. 3 comparative of fig. 1 and 2].

Graphs were plotted and pictorially displayed from fig.1 (M=100x10^3) Rayleigh number decrease at decline point value 39, 25, 23, 3, and 1 and incline point value 3,1 and 1 with increase in wave number assymtoticaly to 0.8 with sharp decrease in gradient 0.9 and small increase shows unsteady respectively; (M=75x10^3) Rayleigh number at decline point value (20, 4 & 6) steady state value 6, 00, 00, 00 and incline value value 2; fig. 1 (M=25x10^3) Rayleigh numberer decline decrease in gradient value 5 and 4, and steadystate value 1 at some point 0.7 and become steady with increase in wave number were intercept at 0.8 along the wave line; fig.1(M=0x10^3) Rayleigh number declinepoint value 4, 1 and steady state value 1.

Also Table 2 and fig. 2 (M=100x10^3) Raleigh number decline point value (27,20,23,3,1, and 1; incline point 3,1); fig 2 (M=75 x10^3) Rayleigh number decline point 20,6 and 4, steadystate space value 1, incline space value 1, increase negative -5 and -5); fig. 2 (M=25x10^3) Rayleigh number decline point value 10 and 3, steady space value 2; fig. 2 (M=0x10^3) Rayleigh number decline point 4,1; incline point space value 1, 3; all terminate at 1.0.

Table 3 fig. 3(M=100x10^3) Rayleigh number declinepoint space value 40, 20, 25, 5, and 2; steady space value 3 and incline space value 5; fig. 3(M=100x10^3) Rayleigh number decline 67, 5 and 3; steady space value 2, and incline space 2; fig. 3(M= 75x10^3) Rayleigh number declinepoint value4, 2, 2 and incline space value 1; fig. 3(M= 25x10^3) Rayleigh number point space decline 4, 4, 2 and steady space value 2- and incline space value 2; fig. 3(M=0x10^3) Rayleigh number decline space value 3, steady space value 2, 2 and 2; and increasing but negative space value -3, -5 on the double single line graghs (in all wave number increase steadyly with 1x10^{-1}) where displayed Rayleigh number decrease, steady and incline in wave number increase with 1x10^{-1} all terminate at 1.0. When a steady state set in as stationary convection $\alpha = 0$ the equation which expresses the modified Rayliegh number R as a function of dimensionless wave number (α) may be shown analyticaly. But in this study, the numerical solution shows that for very small radiation parameter α of order (10^{-1}) in the presence of magnetic field (M) unsteady State set, thus in Table 1 from the graph M=0 it shows more steady state effect than does M>0. Further more, when the coupling frequency ξ is 1.5 and 1.0 the critical value of the modified Rayliegh number(R_c) change substantially while the critical wave number(α_c) is between 0.7, 0.8 and 0.8 to 0.9. Fig.1 is steady respectively as the magnetic field (M) varies. The coupling frequency therefore, has unsteady effect the themo plasma in the photosphere .When comparing fig. 1and 2, we observed that for $\alpha \leq 0$ there abouts unsteady state is notable as it is in the presence of radiation term but fig. 2 at M=75 and fig. 3 at M=0 are in similar occurence. Table 3 and fig. 3 at M=100 shows 5 decrease point, 3 steady value, 5 inclinepoint; fig. 3 at M=100 shows 3 decline points, 2 steady value and 2 incline value which shows that fig. 3(M=100) under fig. 1 has more interuption of particle at the down stream than fig. 3 (M=100) the results checkmate, examined the behaviour of Rayleigh number and wave number in ionized and neutral species in the photophere medium.

NOMACLATURE

M=magnetic field
$\beta =$ Thermal coefficient of expansion for temperature
$\nu =$ kinematic coefficient
$\kappa =$ thermal diffusivity.
$\eta =$ electrical resistivity
α'=solute concentration
$\delta =$ radiation absorption coefficient
x, y, z=cartesian co -ordinate
g=gravity.
u, v, w= velocity component.
i= ionized species
n=neutral species
$\theta_0 =$ undisturbed temperature.
B=Planck's function
$\xi_i =$ frequency of ionize species
$\bar{\xi_i}$=average frequency
α=wave number
$\varrho =$ density variation
$d =$ unit length.
c = velocity of light
R_c =Modified critical Rayliegh number
$a =$ Radiation
ξ_n =frequency of neutral species
$\beta =$ Thermal coefficient of expansion for temperature
$H_i =$ magnetic field on the ionic field
$H_n =$ magnetic field strength.
p =pressure
α_k – absorbption coefficient.
$k^* =$ frequency of the radiation equation
θ =temperature
C= solute concentration
$\rho =$ fluid density
$\mu =$ coefficient of viscosity.
$D_m =$ solute diffusion coefficient
$\beta =$ Thermal coefficient of expansion for temperature
$\nu =$ kinematic coefficient
$\kappa =$ thermal diffusivity.
$\eta =$ electrical resistivity
α'=solute concentration
$\delta =$ radiation absorption coefficient
x, y, z=cartesian co -ordinate
g=gravity.

u, v, w= velocity component.
i= ionized species
n=neutral species
θ_0 = undisturbed temperature.
B=Planck's function
ξ_i = frequency of ionize species
$\bar{\xi}_i$=average frequency
a=wave number
ϱ = density variation
d = unit length.
c = velocity of light
R_c =Modified critical Rayliegh number
α = Radiation
ξ_n −frequency of neutral species

REFERENCES

[1] Abd-EL-Naby, M .A., Elasayed, M. E., Elbarbary, Naber, Y.&Abdelzem, (2003). Finite Difference solution of radiation Effects on MHD free convection flow over a vertical with variable surface temperature. *J. Appl. Math, vol 2*, 65-86.doi;10.1155/S1110757X0320509X
[2] Alabraba M.A, Warmate, A,R.C. Amakiri & Amonieah J,(2008) Heat Transfer in Magneto Hydrodynamic (MHD) Couette flow of a two-component plasma with Variable wall Temperature Global journal of pure and applied Sciences Vol 14 No 4 2008,439-449 Copy right Bachudo Science co ltd printed in Nigeria
[3] Ayoade J.O (1993) Introduction to Climatology for the Tropics Published John Wiley& spectrum books sunshine house ISBN 978 246 015 X ,167 Cowsik,R. and Wilson, L.W.(1973).ICRE 1,500.
[4] Bestman, A. R.Alabraba M.A Ogulu A. (1992). Radiative heat transfer to Hydro magnetic flow of a slightly rarefied binary gas in a vertical channel Astrophysics Space Sci.189, 303-308.
[5] Bestman, A. R.& Opara F. E. (1990). Proc. Edward Bouchet Institute, Legon .Ghana p 195.
[6] Chandrasehker S. (1961). Hydrodynamic and Hydro magnetic Stability Claredon press oxford
[7] Chamkha, A. J., Takhar, H. S. & Soundalgekar V. M. (2001). Radiation Effects on free convection flow past A Semi-Infinite Vertical plate with Mass Transfer, Chem.Engg. *J Vol.84*, 335-342 doi:10.1016/S1385-8947(00)00378-8
[8] Chaudhary, R. C., .Bhupendra Kumar Sharma & Abhay kumar Jha (2006):Radiation effect with Simultaneous Thermal and mass Diffusion in MHD M ixed convection Flow from a vertical surface with Ohmic Heating. *Romanian Journal of physics, Vol 51.No 7-8*, 715-727.
[9] Cogley, A. C., Vincenti, W. G. & Giles E. S. (1968). Differential approximation of a Radiative heat transfer.ATAA Int. *Journal.6*, 551-4.
[10] Cowsik,R. and Wilson, L.W.(1973).ICRE 1,500.Drazin, P. G. & Ried W.H (2004). Hydrodynamic Stability .Cambridge University press pp 155
[11] Dogiel., V.A ., Gurevich,A. V. .and Istomin, Ya M.(1987).MNRAS 228,843
[12] Gaisser., T K &Stanev T ,(2000).Bartol Research Inst, University of Deleware Joaquin Zueco Jordan, (2007). Network simulation Method Applied to Radiation and Dispersion effect on MHD Unsteady Free Convection Over Vertical Porous Plate, Appl Math. Modelling, *Vol.31*, 2019-2033.doi;10,1016/j,apm.2006.08.004.
[13] Mahajan, R. L. & Gebhart B. B. (1989).Viscous. Dissipation Effects In Buoyancy-Induced Flows, *Int .J. Heat Mass Transfer,Vol.32*, No.7, 1380-1382.doi;10.1016/0017-9310(89)90038-0.
[14] Muthucumarswamy, R. & Senthil Kumar (2004). Heat and Mass Transfer Effects On Moving Vertical Plate, In the presence of Thermal Radiation, Theoretical Applied Mechanics, *Vol.31*, 35-46 doi;10,2298/TAM0401035M
[15] Osborne., and Ptuskin, V.S. (1987) soviet astron. Letter 13, 413
[16] Pai S, I. (1965). MHD and Plasma Dynamic Mc Graw-Hill New York, 21Pekene D.B.J & Ekpe O.E (2015) unsteady state of Radiating partially Ionized Plasma in the Galactic Centre International journal of Scientific Research volume 4| Issue 12| December 2015.ISSN No 2277-8179, 194-200.
[17] Post, R. F. (1956) Controlled of fusion Research ,An Application of the physics of high temperature Plasma Rev. of mod. *Physics .Vol .28* No 3, 338-362
[18] Ptuskin, V.S. & Soutoul,A.(1990).Astr.Ap. 237 pp 445.
[19] Ram, P. C., Singh S. S. & Jain R. K. (1990); Heat and Mass transfer of a viscous heat generating fluid with hall curent .Astrophysics. Space Sci. 168, 209-216.
[20] Ramachandra Prasad V., Bhaskar Reddy, N. & Muthucumarswamy R. (2006). Finite Difference Analysis of Radiative Free convection Flow Past An Impulsively Started Vertical Plate with Variable Heat & Mass Flux, *J. Appl. Theoretical Mechanics, Vol 33*, 31-63.doi;10.2298/TAM0601031P.
[21] Ramachandra Prasad V., Bhaskar Reddy N. & Muthucumarswamy, R. (2007). Radiation and Mass Transfer Effects On Two-Dimensional Flow Past An Impulsively Started Isothermal Vertical Plate *Int.Journal of Thermal Sciences.Vol.46* No 12.,1251-1258.doi;10.1016/j.ijthermalsci 2007.01.004 Spiegel, E .A .(1965). Astrophysics Journal 141 1068..
[22] Sutton, G. W. (1959). Design Consideration of a steady D.C Magneto-hydrodynamic Electric Power generator Tech Inf.ser R.59 D .432 Aero Space Lab. Missile and Space Vehicle Dept Generator Electrical co .
[23] Takhar, H. S; Gorla, R. S. R. & Soundalgekar, V. M. (1996). Radiation Effect On MHD Free Convection Flow of A Radiating Fluid Past A Semi-Infinite Vertical Plat, *Int. J Numerical Methods for Heat and Fluid Flow.Vol.6*., 77-83.

ACKNOWLEDGEMENT

The author is so greatfull to Hon John I Pekene my brother, Mrs. Precious Doumokuma Pekene, Prof K.D Alagoa of Niger Delta university Department of physics Wilberforce Island Bayelsa state of Nigeria. My Menthors Alabraba M.A of RSUST Dept. of Physics Faculty of Science. RSUST Prof F.E Opara of Space Centre of Research University of Nigeria E.U Akpan of Niger Delta University Dept. of Mathematics Faculty of Science William Wilberforce Island Bayelsa State.Nigeria

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