*Available online a*t www.scientiaresearchlibrary.com

Scientia Research Library **ISSN 2348-0416**
USA CODEN: JASRHB

Journal of Applied Science And Research, 2014, 2 (2):136-141

(*http://www.scientiaresearchlibrary.com/arhcive.php*)

Determination of The Velocity of Cosmic Ray Proton Within The Atmosphere

Akande P. I
Department of Industrial Physics, Ebonyi State University Abakaliki

ABSTRACT

The velocity of cosmic ray particle is examined within the atmosphere. Since cosmic ray has high percentage of proton, i will restrict my study to a cosmic ray proton. A high energy governing equation is used. This equation is simplied. With the use of the high equation, the velocity of cosmic ray proton in the atmosphere was examined. This was done by using a steady state assumption to determining the density of the atmosphere in which the particle travels, and then obtain its velocity. And this velocity is affected by some parameters such as density of the atmosphere and pressure.

INTRODUCTION

Cosmic rays are the major role players in the electrical properties of the atmosphere and the global electric circuit by manipulating atmospheric conductivity (Markson, 1981; Harrison, 2004). Cosmic that enter the atmosphere are being affected by atmospheric particles (or constituents of the atmosphere). As cosmic ray enters the atmosphere, there exist a physical relationship between its particles and that of the atmosphere. And this relationship is due to a physical mechanism such as ionization of the lower atmosphere by cosmic rays (Yu, 2002, Mash and Svensmark, 2003). Cosmic rays being high energy changed particles penetrate into the lower atmosphere and are also filtered by the geomagnetic field. The filtering effect becomes variable in time with magnetospheric currents that grow during the periods of magnetic activity allowing particles of a given energy to penetrate to lower latitudes, where there particles produce ionization (Stozhkov, 2002). For high energy particles, an electric current of such particles amplifies magnetic field upstream via a non-resonant streaming instability (Bell, 2004). The generated magnetic fields are almost purely growing magnetic disturbances. This amplified field plays the role of the regular field for low-energy particles (Zirakashvili & Ptuskin, 2008). The amplified magnetic field is almost isotrophi

So, the velocity for highest energy particles is close tot the plasma velocity in contrast to low-energy particles (Vadimi *et al*, 2010).

In this work, we are going to use a high energy equation to achieve an aim. Using steady state assumption, we are going to examine the effect of particle density and radial distance on the velocity of atmospheric particles. Also, we will examine the field due to cosmic ray proton and then, finally, obtain the velocity of cosmic ray proton.

RESULT AND DISCUSSION

Cosmic rays are the major role players in the electrical properties of the atmosphere and the global electric circuit by manipulating atmospheric conductivity (Markson, 1981; Harrison, 2004). Cosmic that enter the atmosphere are being affected by atmospheric particles (or constituents of the atmosphere). As cosmic ray enters the atmosphere, there exist a physical relationship between its particles and that of the atmosphere. And this relationship is due to a physical mechanism such as ionization of the lower atmosphere by cosmic rays (Yu, 2002, Mash and Svensmark, 2003).

Cosmic rays being high energy changed particles penetrate into the lower atmosphere and are also filtered by the geomagnetic field. The filtering effect becomes variable in time with magnetospheric currents that grow during the periods of magnetic activity allowing particles of a given energy to penetrate to lower latitudes, where there particles produce ionization (Stozhkov, 2002).

For high energy particles, an electric current of such particles amplifies magnetic field upstream via a non-resonant streaming instability (Bell, 2004). The generated magnetic fields are almost purely growing magnetic disturbances. This amplified field plays the role of the regular field for low-energy particles (Zirakashvili & Ptuskin, 2008). The amplified magnetic field is almost isotrophic.

So, the velocity for highest energy particles is close tot the plasma velocity in contrast to low-energy particles (Vadimi *et al*, 2010).

In this work, we are going to use a high energy equation to achieve an aim. Using steady state assumption, we are going to examine the effect of particle density and radial distance on the velocity of atmospheric particles. Also, we will examine the field due to cosmic ray proton and then, finally, obtain the velocity of cosmic ray proton.

$$\frac{\partial \rho}{\partial t} = -\frac{1}{r^2}\frac{\partial}{\partial r}r^2 u\rho \qquad (1)$$

From the relation governing equation (1), we assume a steady state condition:

$$\frac{\partial \rho}{\partial t} = 0 \qquad (2)$$

So that equation (1) becomes:

$$0 = -\frac{1}{r^2}\frac{\partial}{\partial r}r^2 u\rho \qquad (3)$$

Then,

$$0 = \frac{\partial}{\partial r}r^2 u\rho \qquad (4)$$

Since u and ρ are not function of r^2, we have;

$$constant = u\rho \int \frac{\partial}{\partial r}r^2 . dv$$

$$constant = u\rho \int 2r . dv$$

$$constant = r^2 u\rho \qquad (5)$$

Equation (5) is the steady state solution of equation (1). Therefore,

$$r^2 = \frac{constant}{\rho u} \tag{6}$$

$$\rho = \frac{constant}{r^2 u} \tag{7}$$

Equation (7) is shown in the diagrame below;

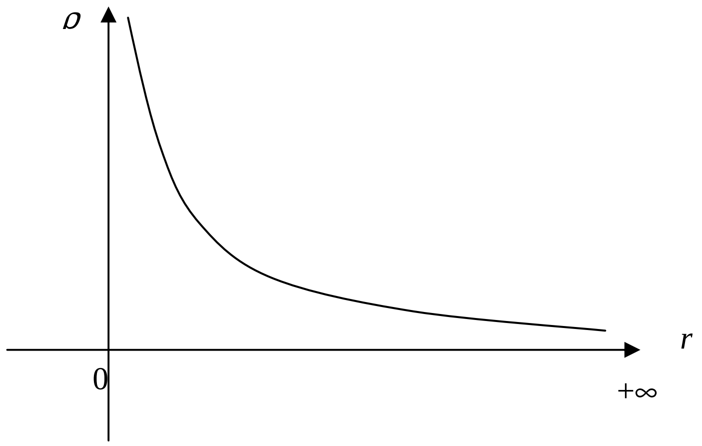

Figure 1: A Graph showing the Effect of Density on the Internal Heat Energy of a Particle and its Radial Distance.

Field E due to the Cosmic Ray Proton

Field due to cosmic ray proton is given as;

$$E = \frac{q_p}{4\pi\varepsilon_o r} \tag{8}$$

and the potential $P.E$, which is equal to the work done in moving a unit q_p from one position to another in the atmosphere becomes:

$$P.E = \frac{q_p}{4\pi\varepsilon_o r} = \frac{Kq_p}{r} \tag{9}$$

$$r = \frac{Kq_p}{P.E}$$

where $K\ and\ q_p$ are constants. Therefore,

$$r = \frac{constant}{PE}$$

Squaring both sides, we have,

$$r^2 = \left(\frac{constant}{P.E}\right)^2$$

$$r^2 = \frac{constant^2}{P.E^2}$$

$$r^2 = \frac{constant}{P.E^2} \tag{10}$$

Equating equation (6) to equation (10), we have,

$$\frac{constant}{P.E^2} = \frac{constant}{\rho u}$$

$$P.E^2 = \rho u \qquad (11)$$

If energy is conserved, then $P.E = K.E = \frac{1}{2} m_p v^2{}_p$, that is, the potential energy of the cosmic ray proton is equal to the kinetic energy acquired by the proton. Hence equation (11) becomes;

$$\left[\frac{1}{2} m_p v^2{}_p\right]^2 = \rho u$$

$$\left[\frac{m_p v^2{}_p}{2}\right] = \sqrt{\rho u}$$

$$m_p v^2{}_p = 2\sqrt{\rho u}$$

$$v^2{}_p = \frac{2\sqrt{\rho u}}{m_p}$$

$$v^2{}_p = \left[\frac{2}{m_p}\right] . \sqrt{\rho u}$$

$$v_p = \left[\frac{2}{m_p}\right]^{1/2} . \rho u \qquad (12)$$

Substituting equation (7) into equation (12), we have;

$$v_p = \left[\frac{2}{m_p}\right]^{1/2} . \frac{constant}{r^2 u} . u$$

$$v_p = \left[\frac{2}{m_p}\right]^{1/2} . \frac{constant}{r^2}$$

$$v_p = \left[\left[\frac{2}{m_p}\right]^{1/2} . constant\right] . \frac{1}{r^2}$$

$$v_p = J . \frac{1}{r^2},$$

where J is $\left[\left[\frac{2}{m_p}\right]^{1/2} . constant\right]$ which is equal to constant.

$$v_p \propto \frac{1}{r^2} \qquad (13)$$

Equation (13) shows that the velocity of the cosmic ray proton v_p is inversely proportional to the separation or distance r between the cosmic ray proton and the atmospheric electron. This can be seen the figure below;

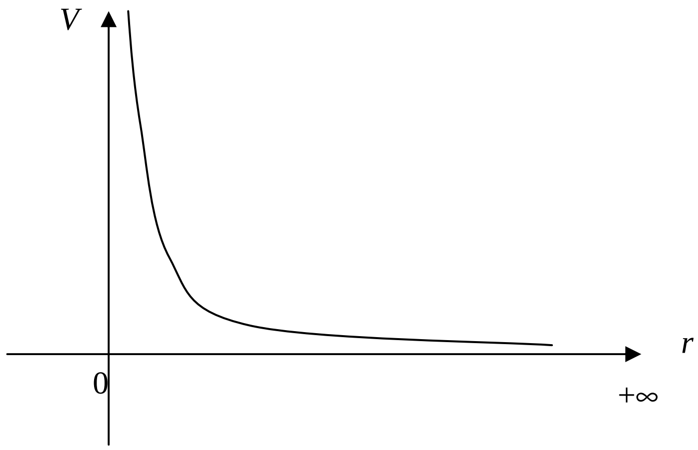

Figure 2: A Graph Showing the Relationship Between the Velocity of Cosmic Ray Proton and its Distance with Atmospheric Electron.

Assuming a steady state conditionin equation (1) reveals that at any girent, the density of the particles does not change.this means that, within a certain volume, if there is no force applied to the particles. Its state remains unchanged. Hence. The density of the particles will remain the same, which means that at steady state pressure is constant.

In equation (5), it can be seen that the gas density remains constant as long as the radial distance of cosmic ray proton and the atmospheric velocity is constant, and also, it is inversely proportional to the gas velocity. This reveals that if the density of the atmosphere increases the gas velocity will increase.

With the application of equation (4b) and (5) into equation (41), the velocity of cosmic ray proton in relation to its redial distance was determined. Equation (42) shows clearly how the cosmic ray proton relates with its redial distance. It reveals that the velocity of the cosmic ray proton v_p is inversely proportional to the separation, or distance r between the cosmic ray proton and atmospheric particles. That is , when cosmic ray proton moves with a high velocity, the separation or distance between the cosmic ray proton and atmospheric particles will reduce.

In general,this work confirms the statement made by Vladimir et al (2010), "More work is needed to understand how robust our results are". This implies that, to understand the behavour of cosmic ray involves lots of research work. Therefore I decided to use theoritical view to examin the velocity of cosmic ray proton in the atmosphere.

CONCLUSION

Conclusively, considering the field in which the particles operates, a relationship guiding the density of the gas particles of the atmophere and the distance r from the cosmic ray proton was obtained. Further consideration of the steady state assumed, revealed that the density of the particles can remain stable only if the pressure on the particles is constant. This implies that, the velocity of cosmic ray proton in ralation to the atmopheric particles are being affected by the state of the particles.

REFERENCES

[1]. Harrison, R. G. (**2004**). The Global Atmospheric Electrical Circuit and climate
Surveys in Geophysics, 25 (5-6). pp. 441-484.
[2]. Markson, R. (**1981**). Modulation of The Earth's Electric Field by Cosmic Radiation.
304 -308 02139, USA, Vol. 291, PP Center for Space Research, Massachusetts Institute of 308.Technology, Cambridge, Massachusetts
[3]. Marsh, N. and Svensmark, H. (**2003**). Solar Influence on Earth's
Climate. Space Science Review, vol. 107, p. 317.
[4]. Stozhkov, Y. I. (**2002**). Nuclear and Particle Physics. J. Geo.Phys. Vol. 29, pp. 913.
[5]. Vladimir, P., Vladimir, Z. and Eun-Suk, S. *(***2010**) .Spectrum of Galactic Accelerated in
journal *vol.* 718, pp 1-8. Supernova Remnants Astrophysical
[6]. Yu, F. (**2002**). Altitude Variations of Cosmic Ray-induced Production of Aerosols.Implication for Global cloudiness and climate Journal of Geophysical Research. vol. 107, p.8-1.