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Effective Calculation of Power, Direction and Angle of Lightning using Wiedemann-Franz Law

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Abstract- In an electrical circuit ,voltage and current can be calculated when the circuit is closed and proper ground connection is given. In this paper earth is consider as closed circuit and this concept is related to lightning power. When lightning starts at the point of the sky, it comes to the ground at the fraction of seconds. In order to effectively calculate the power that enters the ground and the direction, angle and temperature of the lightning, we proposed WIEDMANN-FRANZ law, from the Quantum Theory.

Keywords: Quantum Theory, WIEDMANN-FRANZ LAW, Lightning , Closed circuit.

I. INTRODUCTION

Quantum theory is that the electron in the metal freely moves like the practices of a gas and is called free electron gas. Quantum theory is the theoretical basis of modern physics that explains the nature and behavior of matter and energy on the atomic and subatomic level. In 1900, physicist Max Planck presented his quantum theory to the German Physical Society. Planck had sought to discover the reason that radiation from a glowing body changes in color from red, to orange, and, finally, to blue as its temperature rises. He found that by making the assumption that energy existed in individual units in the same way that matter does, rather than just as a constant electromagnetic wave as had been formerly assumed - and was therefore quantifiable, he could find the answer to his question. The existence of these units became the first assumption of quantum theory.

Planck wrote a mathematical equation involving a figure to represent these individual units of energy, which he called quanta. The equation explained the phenomenon very well, Planck found that at certain discrete temperature levels, energy from a glowing body will occupy different areas of the color spectrum. Planck assumed there was a theory yet to emerge from the discovery of quanta, but, in fact, their very existence implied a completely new and fundamental understanding of the laws of nature. Planck won the Nobel Prize in Physics for his theory in 1918, but developments by various scientists over a thirty-year period all contributed to the modern understanding of quantum theory.

WIEDEMANN-FRANZ LAW ,The law that the ratio of the thermal conductivity of a metal to its electrical conductivity is a constant, independent of the metal, times the absolute temperature.

Lightning: There are roughly thousand thunder storms in progress around the world at any one time, producing about 3200 clouds to ground flash each second are about 5 million flashes a day. Lightning occurs in four ways. Lightning can travel between points within a cloud, from a cloud to clear air, from cloud to an adjacent cloud and from a cloud to ground. The flashes are referred to intra cloud, cloud to air, cloud to cloud and cloud to ground. Intra cloud flashes, redistributing the charge with the cloud, account for over half the lightning flashes in Northern latitude. Cloud to cloud and cloud to air flashes are less common. Aside from aviation these three types of flashes have little effect on people. The cloud to ground lightning flash can lower positive or negative charge, depending on the source of the flash. This can be determined by the polarity of the strokes current.

II. PROPOSED SYSTEM

In an electrical circuit ,voltage and current can be calculated when the circuit is closed and proper ground connection is given. In this paper earth is consider as closed circuit and this concept is related to lightning power. When lightning starts at the point of the sky, it comes to the ground at the fraction of seconds. In order to effectively calculate the power that enters the ground and the direction, angle and temperature of the lightning, we proposed WIEDMANN-FRANZ law, from the Quantum Theory.

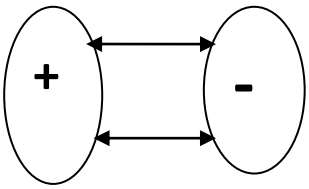

Fig.1 Charge Collision Timing

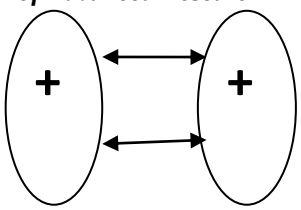

Fig .2 Charge Repelling Timing

Fig 1and 2 shows that, when the two opposite charges are colliding, the colliding time is equal to releasing energy at that timeCollision Time = Energy releasing time.

$W=F*S$ (1)

W=Work, F=Force, S=Displacement.

F is considered as $F=q_1q_2t_c^2 / 4\pi\mathcal{E}r^2$

$r = x+y+z$

$r^2 =x^2+y^2+z^2$

$S=S_1 *S_2$ where $S_1 =[h_1 + \cos\theta\ h_2]$,$S_2 = 1/k_m$

forming the equation ,

$W= (q_1q_2t_c^2 / 4\pi\mathcal{E} [x^2+y^2+z^2]) * (S_1 * S_2)$

$W= (q_1q_2t_c^2 / 4\pi\mathcal{E} [x^2+y^2+z^2]) * ([h_1 + \cos\theta\ h_2] * S_2)$

Work is done by power and time

$W= P* t$

$P* t = (q_1q_2t_c^2 / 4\pi\mathcal{E} [x^2+y^2+z^2]) * ([h_1 + \cos\theta\ h_2] * S_2)$

$P = (q_1q_2t_c^2 / 4\pi\mathcal{E}\ t_1[x^2+y^2+z^2]) * ([h_1 + \cos\theta\ h_2] / t_2)* S_2$

$P = (q_1q_2t_c^2 / 4\pi\mathcal{E}\ t_1[x^2+y^2+z^2]) * (([h_1 + \cos\theta\ h_2] / t_2)* (1/k_m))$ (2)

$(x^2+y^2+z^2)$ direction

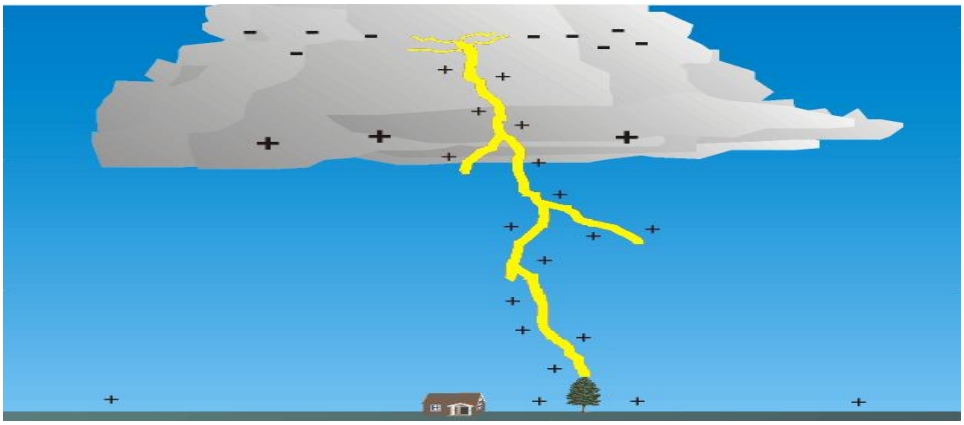

Fig.3 Direction of lightning

h_1 - Initial position of the sky

$\cos\theta\ h_2$ - Angle of lightning

we choosing when lighting in z-direction at the angle 90°, time taken for lightning

(time $=0.2*10^{-6}$ s).

when lightning hits the ground surface , the ground surface constant is $E_g =\pi/12$,

By using Wiedemann-Franz law ,we can obtain the temperature , when lightning pass in one direction

Z-direction (1_z)) remaining direction become zero.

Consider a one kilometer has one lakh centimeter (1km =100000cm) .take one centimeter of the sky while solving.

According to Wiedemann –Franz law :

$k/\sigma=(\pi^2/3)*(k_B/e)^2T$ (3)

while solving k_B^2 act as a constant term ,while lightning pass into the ground we can measure the value of power .

Divide earth surface into 12 parts .There are 12 possibilities for lightning to reach the ground surface .

$\mathcal{E}=8.85*10^{-12}$

$K_B=1.38*10^{-23}$

E_g = Earth constsnt = $\pi/12$,

$q_{1=}$ Charge in the sky=$6353.3*10^{-2}$,

q_2= Charge in the surface=$6353.3*10^{-2}$.

$e=1.6021*10^{-19.}$

While measuring the power K_B^2 acts as a constant.

$P = (q_1q_2t_c^2 / 4\pi\mathcal{E}\ t_1[x^2+y^2+z^2]) * (([h_1 + \cos\theta\ h_2] / t_2)* (1/k_m)) *((\pi^2/3)*(k_B/e)^2T)$ (4)

When the collision time and discharging time are equal, the equation (4) can also be written as

$P=((q_1q_2t_c/4\pi\mathcal{E})/E_g)*(1/1_Z)*((h_1+\cos 90 h_2)/t)*(1/10*10^5)_{km}*((3.14)^2/3)*(1/1.6021*10^{-19})^2*(K_B^2)\,T$ (5)

On Substituting the above values and the distance between the surface and the sky is assumed as 10Km in the equation (5) and it is given as,

In the cloud ordinary temperature is 50^0C and it is changed into Kelvin,

C=K - 273.15, K=323.15 where T =323.15 K

On solving ,equation (5) becomes

$P_1= (355.036*10^{37})*(1/1_Z)*([h_1+(-0.448)h_2]/0.2*10^{-6})*(323.15)*K_B^2$ W

Where, $355.036*10^{37}$ =Power.

$1/1_Z$ = Direction.

$[h_1+(-0.448)h_2]/0.2*10^{-6}$ =Angle at the time.

323.15 =Temperature.

This process is calculated for different values ,such as 11km, 12 km, 13 km and 14 km and table is formed.

III. RESULTS AND GRAPHS

TABLE I

Calculation of Power

Power (Watts)	*Kilometer*	*Temperature (Kelvin)*	*Temperature (Degree Celsius)*
$355.03*10^{37}$	10	$323^{0.}15$	50
$322.74*10^{37}$	11	$328^{0.}15$	55
$295.85*10^{37}$	12	$333^{0.}15$	60
$273.09*10^{37}$	13	$338^{0.}15$	65
$253.55*10^{37}$	14	$343^{0.}15$	70

This table shows that ,when the distance and the temperature increases ,the power will be reduced.

Result.1 Power Versus Kilometer

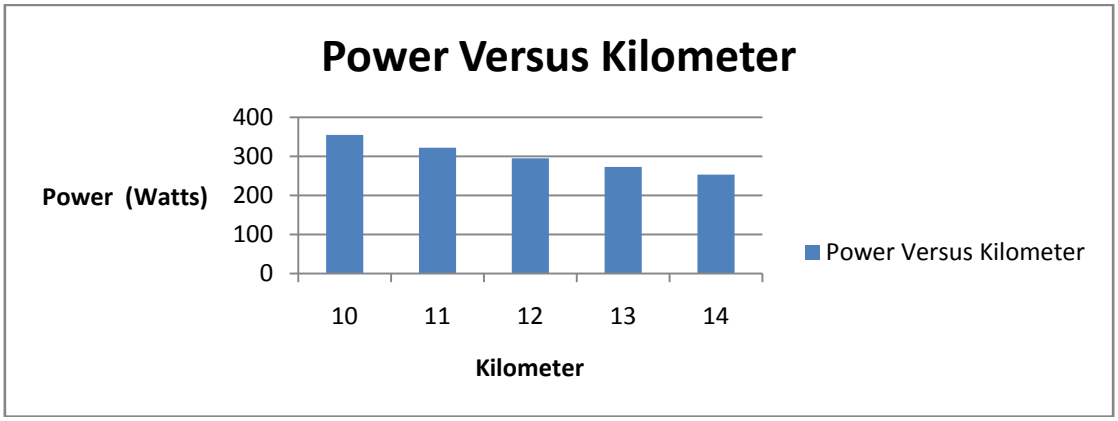

Fig.4 Power Vs Kilometer

Fig 4 shows that as the kilometer increases the power decreases.

To find the Voltage and Current

By using $V_T = K_B T / q$ (6)

where q = magnitude of electric charge

V_T = Thermal Voltage,

T = Temperature,

K_B= Boltzmann Constant.

This formula is used in semiconductor material to find the thermal voltage.This equation (6) is rewritten according to to calculate the Voltage and Current for lightning.

Here ,q is changed as power => q=P and $K_B = K_B^2$, where $K_B \neq$ Constant.

To find the voltage,the equation (6) is written as $V_T = K_B^2 T / P$ (7)

$K_B= 1.38*10^{-23}$,from the table.1 ,the temperature and the power values are substituted in the equation (7)

$V_T = ((1.38*10^{-23})^2 (323.15)) / (355.07*10^{37})$

$V_{T1}=1.7331*10^{-83}$ V

To find the current $P=V_T*I$ (8)

$I= P / V_T$

$I= 204.8718*10^{120}$ A ,This process is repeated for power and temperature values ,which is given in the table .1

Result.2 Voltage Versus Current

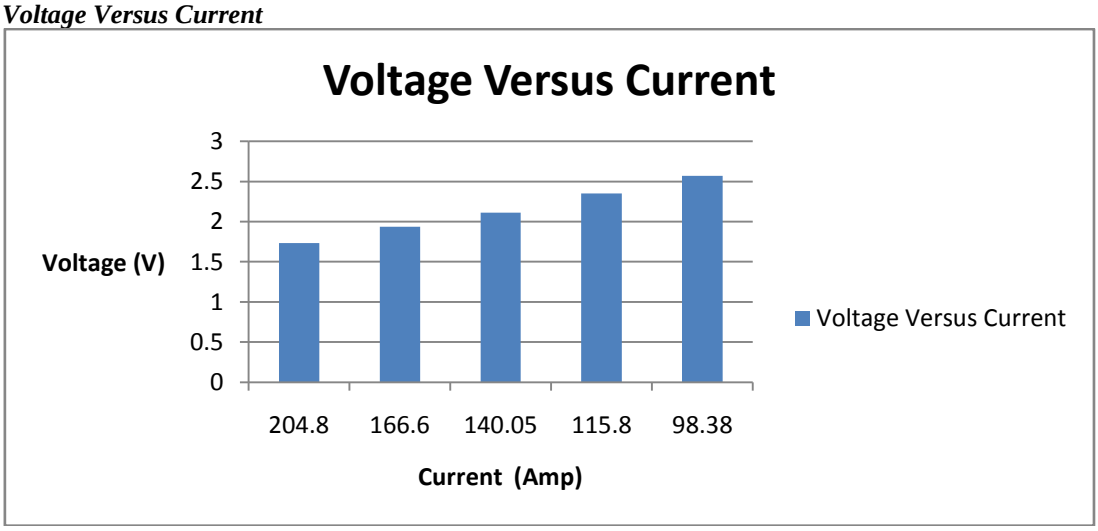

Fig.5 Voltage Vs Current

This graph shows that ,when current increases voltage decreases and vice versa.

IV. CONCLUSION

In this paper earth is consider as closed circuit and this concept is related to lightning power. When lightning starts at the point of the sky, it comes to the ground at the fraction of seconds. WIEDMANN-FRANZ law, from the Quantum Theory is used and power ,voltage ,current ,angle ,direction and temperature is calculated and the graph is plotted. It shows that as the kilometer increases the power decreases and when current increases voltage decreases and vice versa.

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