Novelty Journals

ISSN 2394-9651

International Journal of Novel Research in Physics Chemistry & Mathematics
Vol. 7, Issue 3, pp: (5-8), Month: September - December 2020, Available at: www.noveltyjournals.com

# Mass Stopping Powers of Alpha particles in eye lens and its compositions (H,C,N,O,Na,P,S,Cl))

Khalda T. Osman

Physics Department, College of Science and Art, Qassim, University, Buraydah, Saudi Arabia

Author email id: Khaldateosman@gmail.com

***Abstract:*** **In this work we present a simple relation for mass stopping power (in MeVcm$^2$/g) of alpha particles in energy range 10-100MeV in eye Lens and its compositions (H, C, N, O, Na, S, Cl). The proposed relations have been described in terms of alpha particle energy only. The data for mass stopping powers are fitted to a suitable module.**

***Keywords:*** **mass stopping power, Alpha particle energy, eye Lens.**

## 1. INTRODUCTION

The stopping power of the matter resulting from the passage of charged particles through it is an important topic not only in the field of physics but also includes large areas of science, such as ion implantation, fundamental particle physics, nuclear physics, radiation damage, radiology [1-6].

Stopping Power is defined as the amount of energy that a particle loses in every unit of length from its path through the materials. Therefore, the process of energy loss of the charged particle passing through the target material must be very accurate through direct practical measurement or through theoretical calculation and study The property of the target material and how it responds to the interaction with the charged particles. The charged particle when it travels through the material is that its interaction with the target atoms is caused by electrostatic forces between the charged particles and that reaction is divided into two elastic collisions with all the atoms and inelastic collisions with the target material electrons. As we Know that the electron Cloud occupies more space than the nuclei of atoms, so the loss of energy caused by the non-elastic collisions are expected to be greater than the loss of energy by elastic collisions.

In this paper, the stopping powers of alpha particles in eye lens and its composition (P,S) are calculated using Bethe-Bloch formula [1-6]. The other composition of eye lens (H,C,N,O,Na,Cl) calculated by ASTAR code [2].

## 2. THEORY AND CALCULATION METHOD

The following Bethe stopping power equation [1-6] has been used for energy range 1-200MeV:

$$-\frac{dE}{dx} = \frac{5.08 \times 10^{-31} z^2 n}{\beta^2}[F(\beta) - ln(I)] \qquad (1)$$

Where β is V/c where v is the alpha particle velocity and c is light velocity, z is atomic number of alpha particle, I is the excitation energy and F(β) is given by

$$F(\beta) = ln\frac{1.02\times10^6\beta^2}{1-\beta^2} - \beta^2$$

n is calculated using the following relation:

$$n = \frac{N_a \rho Z}{A} \qquad (2)$$

Novelty Journals

ISSN 2394-9651

International Journal of Novel Research in Physics Chemistry & Mathematics
Vol. 7, Issue 3, pp: (5-8), Month: September - December 2020, Available at: www.noveltyjournals.com

Where $N_a$ Avogadro number, ρ is the density of substances and $\frac{Z}{A}$ is the ratio of atomic number to the mass number of substances.

The basic data for eye lens and its compositions (P,S) are given in Table (1).

The equations for calculated mass stopping power for eye lens and its composition (P,S) are given by equations (3-5) respectively based on Bethe equations after substituting the constants from table (1)

For calculation mass stopping power for alpha particles in eye lens the following equation is used:

$$-\frac{dE}{\rho dx} = \frac{0.669}{\beta^2}[F(\beta) - 4.31] \qquad (3)$$

For mass stopping power of alpha particle in ($_{15}$p) the following equation is used:

$$-\frac{dE}{\rho dx} = \frac{0.592}{\beta^2}[F(\beta) - 5.21] \qquad (4)$$

For mass stopping power of alpha particles in ($_{16}$S) the following equation is used:

$$-\frac{dE}{\rho dx} = \frac{0.611}{\beta^2}[F(\beta) - 5.26] \qquad (5)$$

For mass stopping power for other compositions of eye lens is calculated using ASTAR code (H,C,N,O,Na,Cl) [2]

## 3. RESULTS

The results for mass stopping powers for the present work with other data avalible in ASTAR code are given in Table (2). We have plotted graphs between available mass stopping powers versus alpha particle energy. We observed that the mass stopping powers are decreasing with increasing alpha particle energy which are presented in fiq 1. Using the fitted graph of eye lens we have been able to find a simple empirical relation for mass stopping power of alpha particles in energy range 10-100MeV by the following relation:

$$Y = a\,X^b \qquad (6)$$

Where Y is the mass stopping power in MeVcm$^2$/g , X is the alpha particles energy in MeV, **a = 3534.5 and b =-0.813**

**Table (1): Basic Data for calculating mass stopping powers**

| Substances | Density(ρ) g/cm$^3$ | $\langle Z\|A\rangle$ | N (Electrons/m$^3$) | I(eV) |
|---|---|---|---|---|
| Eye lens | 1.070 | 0.54709 | $3.53\times10^{29}$ | 74.3 |
| P | 1.8219 | 0.4843 | $5.31\times 10^{29}$ | 183.45 |
| S | 2.0686 | 0.4989 | $6.22\times 10^{29}$ | 192.16 |

**Table (2): Compositions of eye Lens**

| Substance | Composition Z fraction by weight |
|---|---|
| H | 0.096000 |
| C | 0.195000 |
| N | 0.057000 |
| O | 0.646000 |
| Na | 0.001000 |
| P | 0.001000 |
| S | 0.003000 |
| Cl | 0.001000 |

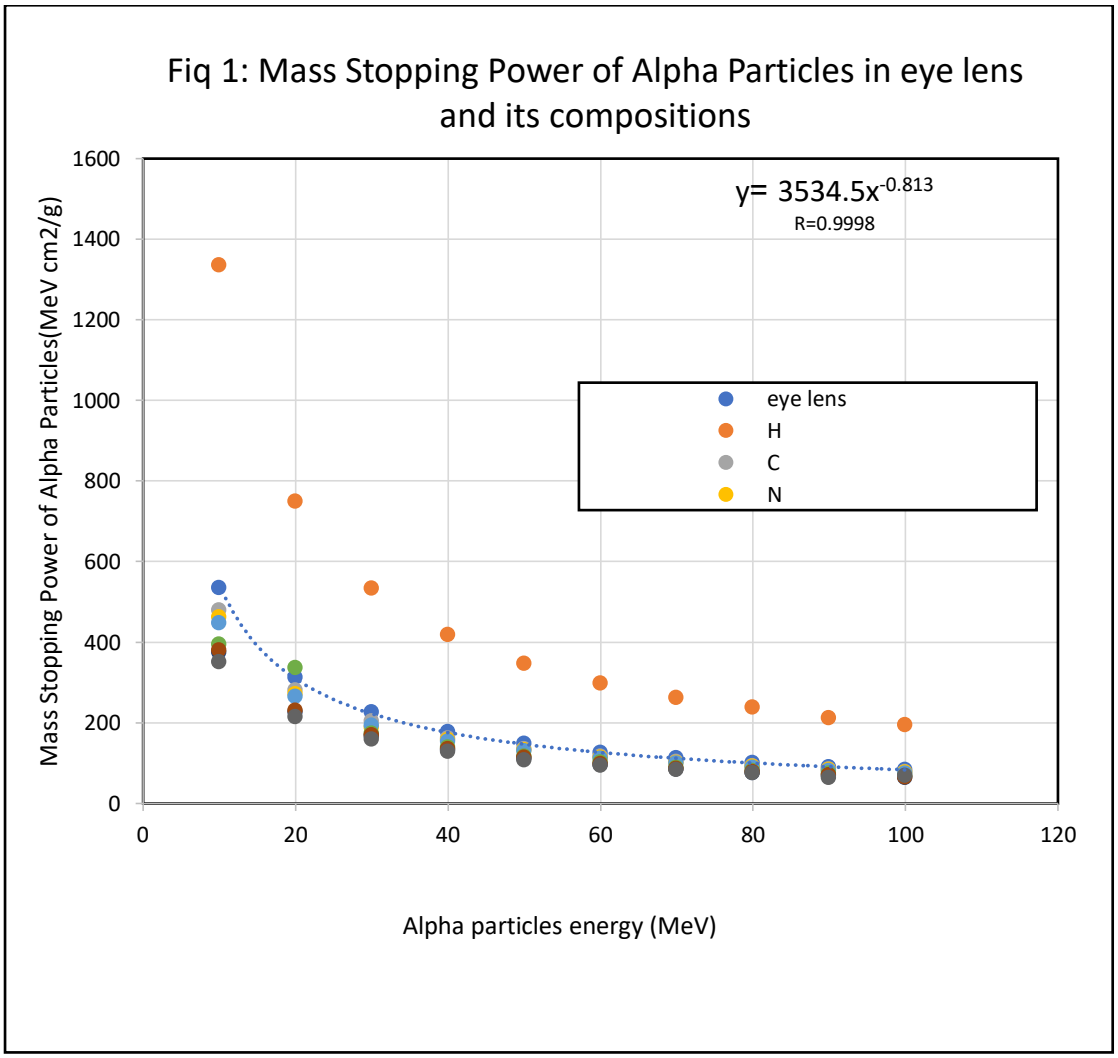
Novelty Journals

ISSN 2394-9651

International Journal of Novel Research in Physics Chemistry & Mathematics
Vol. 7, Issue 3, pp: (5-8), Month: September - December 2020, Available at: www.noveltyjournals.com

**Table (3); mass stopping power of alpha particles in eye and its compositions**

| Alpha particle energy (MeV) | Mass Stopping Power ($MeVcm^2/g$) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | H | C | N | O | Na | P | S | Cl | Eye Lens |
| 10 | 1335 | 478.6 | 461.8 | 447.3 | 394.6 | 374.1 | 380.2 | 350.1 | 534.8 |
| 20 | 749.2 | 280.1 | 271.7 | 264.4 | 236.2 | 225.8 | 229.9 | 314.0 | 311.4 |
| 30 | 532.8 | 303.3 | 187.6 | 192.8 | 173.2 | 166.2 | 169.4 | 158.4 | 225.4 |
| 40 | 418.3 | 161.6 | 157.4 | 153.8 | 138.7 | 131.6 | 134.3 | 127.5 | 176.8 |
| 50 | 346.7 | 135.3 | 131.9 | 128.9 | 116.6 | 110.9 | 113.2 | 107.6 | 147.9 |
| 60 | 297.6 | 116.9 | 114.1 | 111.6 | 101.1 | 95.0 | 97.1 | 93.7 | 125.9 |
| 70 | 261.5 | 103.4 | 100.9 | 98.9 | 89.7 | 84.5 | 86. | 83.2 | 111.7 |
| 80 | 237.9 | 92.9 | 90.8 | 88.9 | 80.8 | 75.9 | 77.50 | 75.1 | 99.8 |
| 90 | 212.0 | 84.6 | 82.7 | 81.0 | 73.7 | 68.5 | 70.0 | 63.3 | 89.9 |
| 100 | 194.7 | 77.7 | 76.0 | 74.5 | 67.9 | 63.69 | 65.1 | 68.6 | 83.4 |



## 4. CONCLUSIONS

From the above results obtained using the proposed relations for mass stopping power calculations of alpha particle in eye lens and its compositions the following conclusions are drown:

1-It observed that the mass stopping power can be expressed in term of alpha particle energy only.

2- It is also noteworthy that the proposed relation is simpler, widely applicable

3- Also we notice that the mass stopping power decreasing with increasing the alpha particle energy

4- The present proposed equations for mass stopping power are simple and are applied to a large range of alpha particle energy up to 100MeV

**5-** The equations proposed in the current study give important information for those interested in charged particles radio therapy and radiation hazard.

## ACKNOWLEDGEMENT

The author thank Department of physics - Qassim University for supporting this work.

## REFERENCES

[1] J.F. Ziegler at el ,2010,SRIM " The stopping and range of Ions in matter " Nuclear instruments ad method in physics Research B,268,page1818-1823,2010.

[2] Berger, M.J, ESTAR, PSTAR, ASTAR ,A Pc package for calculating stopping powers and ranges of electron, protos and helium ions, version 2, International Atomic Energy Agency, nuclear data services, documentation series of the IAEA nuclear data section, (1993)

[3] National Research Council, Committee " On the biological Effects of Ionizing Radiation, Health Effect of Exposure to low levels of Ionizing Radiation, BEIR V, National Academy Press, Washington, D.C,1990..

[4] Hamalata Singh , S. K. Rathi, A. S. Verma " stopping powers of protons in biological human body substances", universal Journal of Medical Science I(2):17-22,2013.

[5] Mukherjee B. "Mass stopping powers of protons up to 200MeV in some biological important materials", Nucl.Inst. Meth.1983;1983,211:235-237.

[6] M.O.El-Ghossain "Calculations of stopping power, and range of ions radiation(alpha particles) interaction with different materials and human body part", International Journal of Physics,2017,vol5,No.3,92-98,science @Education Publishing.