

Electromagnetic Mirror Nuclear Reaction Controller

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Abstract: A particle can be trapped inside such a mirror field (electric and magnetic field) and its velocity, acceleration and all other type of kinematic movement can be controlled.

Keywords: Nuclear reaction controller, electric field sensor, electromagnetic mirror, energy source

I. Introduction

Electromagnetic mirror is a type of mirror in which particles having a magnetic and electric field will be reflected back from the boundary with almost negligible loss of energy. A particle can be trapped inside such a mirror field and its velocity, acceleration and all other type of kinematic movement can be controlled (using varying electric and magnetic field) Main principle behind such mirror will be electromagnetism. Electromagnetism explains why when a charged particle is placed in magnetic field experience a force and also the amount of force experienced by the particle present in the field system. This will help us to control the magnitude of electric field and magnetic field at the boundary to control the particles kinematics.

II. Question Is Why We Need To Control The Kinematics Of A Particle?

Considering a situation of nuclear fusion reaction where the reaction doesn't occur because of repulsion between charged particle. By controlling the movement of such type of particles, we can bring the particle enough closer so that the nuclear force overcomes the electromagnetic force and reaction might be possible. Although the strength of magnetic field to control the particles in such type of reaction will be very high but the energy consumed to produce such field will be nothing in comparison to the energy which will be produce in case of nuclear fusion reaction.

III. Nuclear Fusion Reaction

Nuclear fusion reaction is a type of reaction in which two atomic nuclei collides to form a new atomic nucleus and subsequently releasing very large amount of energy. It is the process which powers the stars. During this process matter is not conserved because some of the masses of fusion nuclei are converted in photons. Fusion of two nucleus having masses less than iron releases high amount of energy while fusion of two electron having masses more than iron absorbs energy. Energy released during the process of nuclear fusion reaction is much greater than Energy released during the process of chemical reaction .This is because the energy which holds the photons in the nucleus is much greater than energy present in chemical bonds.

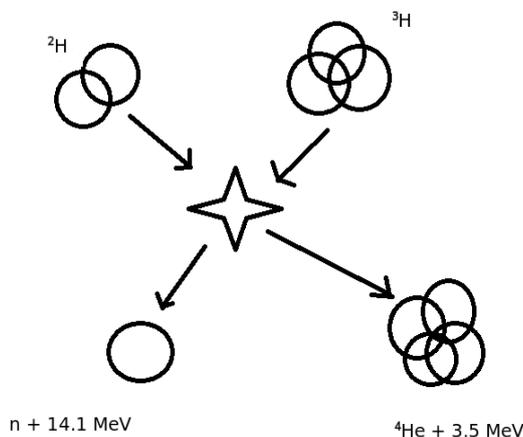


Figure 1 Nuclear fusion reaction

Due to electrostatic force the particle cannot come close to each other. The energy barrier must be overcome before the fusion reaction can occur. At larger distance the atomic nuclei repels each other with the electrostatic forces originating due to charges of proton. But if the two atomic nuclei are brought close enough

then the attractive nuclear force can overcome the substantial energy barrier of electrostatic forces. This is where the electromagnetic mirror plays its role.

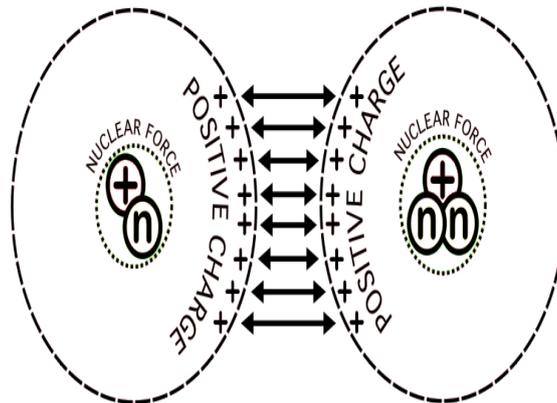


Figure 2 : Strong electrostatic force between nucleus

So what we have to do is to force these atomic nuclei to a point so that they can fuse with one another. Energy required to force these atomic nuclei at a definite point is going to be very high. This can be done by putting the particles inside the mirror field and forcing them to fuse with one another. Inside the mirror field the nucleus entire kinematics motion can be studied. Results can be used to force the particle to the centre using definite amount of electric and magnetic field. As all the particles will have the tendency to move at the centre of the virtual sphere (defined below) maximum probability to find a nuclei will be the origin of the sphere.

IV. ELECTRONIC CONFIGURATION

Electron in its non excited state is motionless that is it does not alters its position with time. Considering the space inside the atom (which is not empty but filled with space matter), it exerts a buoyant force on the electron. It is one of the factors which determine the electronic configuration. The other factors are attraction from the nucleus of the atom because of which electron are revolving around the nucleus and repulsion between electron in a shell and between electron in inner and outer shell. Shells are different energy levels which are assumed to be present in an atom. Electrons are distributed in various shells according to atomic structures. An atom has two type of shell. Electron shells are regions where the electrons are configured in an atom (when the electron is in its non excited state) and transitory shells are possible regions where the electron can jump from their electron shells when being excited.

V. Generation Of Electric And Magnetic Field

Electron has a standing electric and magnetic field at right angle to each other which doesn't alters with the motion, presence of charge and position of electron in shell of atom. This is the reason why an electron acts like a small bar magnet with a negative charge. In an atom electric field will be directed towards the nucleus and the magnetic field will horizontal to the nucleus. When the charged particles will be aligned in a single way in a material, a magnetic field will be produced in the material.

VI. Electric Field Controller

Using electric field controller particles speed and acceleration can be controlled. Electric field sensor is a type of sensor which calculates the strength of electric field. Suppose a particle having a charge Q , is confined in a space where electric field sensor are existing. Electric field sensor will have a very small test charge suppose q ($Q \gg q$). Force experienced by the charge will be

$$F = \frac{qQ}{4\pi\epsilon r^2} \quad (\text{coulombs' law})$$

So the electric field intensity will be

$$E = \frac{Q}{4\pi\epsilon r^2}$$

So the electric field intensity of the charged particle will be inversely proportional to the distance between the charged particle and the sensor. Since the charge particle is accelerating its displacement with respect to the sensor is also changing. From this it can be inferred that, when a particle will approach the sensor its field intensity will increase and vice-versa.

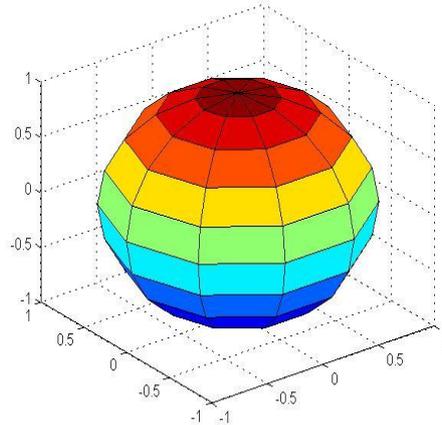


Figure 3 virtual electric field of the sensor

Suppose six sensors are present in the co-ordinate system as $(0, 0, 0)$, $(0,0,1)$, $(1,0,0)$, $(-1,0,0)$, $(0,1,0)$, $(0,-1,0)$, $(0,0,1)$, $(0,0,-1)$. These six sensors will try to concentrate the particle present inside the sphere at the center of the virtual sphere. A detailed explanation has been illustrated in table 1 about the effect of electric field on charged particle. Boundary of such sphere will be made up of magnetic field.

MAGNETIC FIELD CONTROLLER

Magnetic field will give a specific boundary domain to the particles. Due to electric field the particles will accumulate at the center of the virtual sphere.

The boundary of the virtual sphere will be made up of magnetic field. It will allow the desired particle to enter the virtual sphere but not allow it to exit.

A detailed explanation has been illustrated in table 1 about the effect of magnetic field on charged particle

Table 1 Effect of electric and magnetic field on charged particle

S No.	Kinematics	Effect on electric field	Effect on magnetic field
1.	When charged particle is at rest.	The force on positively charged particle acts in the direction of motion.	No force act.
2.	When the charged particle is moving along the direction of field.	The positively charged particle is accelerated along the direction of electric field and negatively charged particle is retarded along the direction of electric field.	No force acts.
3.	When the charged particle is moving perpendicular to the field.	Force acts on the charged particle which is perpendicular to the initial direction of motion of charged particle.	Maximum force $(B \times q \times v)$ acts on the charged particle which is perpendicular to B vector and v vector.
4.	Path of moving charged particle in a perpendicular field.	Parabolic path.	Circular path.
5.	Path of the charged particle while moving at an angle θ with the direction of field.	Parabolic path.	Helical path.
6.	Momentum of the charged particle moving in a perpendicular field.	Momentum of the particle changes in magnitude as well as direction.	Momentum of the particle do not changes in magnitude but the direction changes continuously.
7.	Kinetic energy of the charged particle in a perpendicular field.	Kinetic energy of the particle changes.	Kinetic energy of the particle remains constant.

VII. Mathematical Modeling

Motion of a charged particle (a non relativistic) can be modeled by Maxwell's and Lorentz force equation. Using these equations and modifying it according to the requirement we can design a mirror field such that the particle can never escape from that region. By creating this field we can concentrate the particle at the centre (so the particle interacts with one another and fusion reaction triggers).

$$\epsilon_0 \mu_0 \frac{\partial E}{\partial t} = \nabla B, \text{ in } \Omega$$

$$\frac{\partial B}{\partial t} = -\nabla \times E, \text{ in } \Omega$$

$$\nabla \cdot E = \nabla \cdot B = 0, \text{ in } \Omega$$

$$\frac{d^2 p}{dt^2} = \frac{q}{m} E|_p + \frac{q}{m} \frac{dp}{dt} \times B|_p$$

$$E \times n|_{\partial\Omega} = F_1, B|_{\partial\Omega} = F_2$$

Where Ω a bounded domain in R^3 is, $\partial\Omega$ is the boundary of Ω , n is the outward unit normal. On the boundary, the vector E is the electric intensity, B is the magnetic intensity, q is the charge, p is the position vector of the charge, ϵ_0 is the permittivity of free space, μ_0 is the Permeability of free space, m is the mass of the charge, $\nabla \times$ is the curl operator, $\nabla \cdot$ is the Divergence operator. F_1 and F_2 is boundary feedback controllers which have to be designed to drive the charge p to a desired position such as the origin.

VIII. Conclusion

Feedback controller can be designed using the above formulated theory, though it needs various aspects of nuclear science which is yet too designed. Main purpose of this paper is to give a general way to control the nuclear reaction. Introducing new concept like electromagnetic mirror and way it works.

IX. Advantage

This type of mirror can effectively control the kinematics of particle. Using strong and also calculated amount of field strength we can harness the energy of nuclear fusion. Nuclear fusion energy is a clean and green source of energy causing almost no environmental issues.

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