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The light controlled fusion

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ABSTRACT

This is a new technique for controlled fusion. When two nuclei are colliding with each other, light, whose the frequency is higher than the minimal threshold frequency of lithium, will be aimed directly at the two nuclei, the two nuclei will perform the simple harmonic oscillation, the charged particle's simple harmonic oscillation can be considered as an oscillating electric dipole, and the two oscillating nuclei will radiate the electromagnetic wave. Either of the two oscillating electric dipoles will attract each other, or they will repulse each other. There will be an attraction force between the two oscillating nuclei. When the attraction force is greater than the Coulomb repulsion between the two nuclei, the two nuclei will fuse together. Where the kinetic energy and the density of the two nuclei can be controlled, the electric vector and the frequency of the light can be controlled also and, therefore, the fusion can be controlled.

1. Introduction

If the light is directed at the nuclei like ^{2}H and ^{6}Li, the ^{2}H and the ^{6}Li will perform a simple harmonic oscillation and will then radiate the electromagnetic wave.

The charged particle's simple harmonic oscillation can be considered as an oscillating electric dipole.

As the ^{2}H and the ^{6}Li have a positive charge, when the ^{2}H and the ^{6}Li are travelling in the same direction along the line, there will be an attraction force between the ^{2}H and the ^{6}Li.

The attraction force is inversely proportional to the 4th power of the distance between the two nuclei that perform a simple harmonic oscillation; the repulsion force is inversely proportional to the 2nd power of this distance, the attraction force will be greater than that of the repulsion force.

When the attraction force is greater than that of the Coulomb repulsion between ^{2}H and ^{6}Li, the ^{2}H and the ^{6}Li will fuse together.

An example shows that if the kinetic energy of the ^{2}H and the ^{6}Li are greater than 2.15 keV, and the distance between them is shorter than 10^{-12} m, and the frequency of the light is $\omega \geqslant 5.14 \times 10^{17}$ Hz, the ^{2}H and the ^{6}Li will fuse together.

2. The principle of light controlled fusion

Light controlled fusion is based on the following principle:

When a light directs at a charged particle, the charged particle will perform a simple harmonic oscillation and will radiate an electromagnetic wave.

The charged particle's simple harmonic oscillation can be considered as an oscillating electric dipole.

When two oscillating electric dipoles are in the same direction along the line, there will be an attraction force between the two oscillating electric dipoles.

Suppose the distance between two oscillating nuclei is r, r is also the distance between two oscillating nuclei when they are colliding.

Suppose the light which is directed at the nuclei is produced by the oscillating electric dipole.

In the far-zone fields of the oscillating electric dipole which has charge Q and amplitude a, the electric field intensity $\vec{E}(t)$ is proportional to the 2nd power of the angular frequency ω (Cheng, 1989a),

$$\overrightarrow{E(t)} = \frac{Qa}{4\pi\varepsilon_0 c^2 R}\omega^2 \cos \omega t \tag{1}$$

where ε_0 is the dielectric constant, c is the speed of light, and R is the distance between the point of observation and the centre of the oscillating electric dipole.

Let

$$A = \frac{Qa}{4\pi\varepsilon_0 c^2 R} \tag{2}$$

The Eq. (1) can then be changed into

$$\overrightarrow{E(t)} = A\omega^2 \cos \omega t \tag{3}$$

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This electric field intensity $\overrightarrow{E(t)}$ will cause the nuclei to perform a simple harmonic oscillation.

The nucleon 1's simple harmonic oscillation can be considered as an oscillating electric dipole.

Suppose the nucleon 1 has a charge of q_1, its angular frequency of the simple harmonic oscillation is ω, and its amplitude is l_1.

In the near-zone fields of the oscillating nucleon 1, the electric field intensity components in spherical coordinate are $\overrightarrow{E_r(t)}$ and $\overrightarrow{E_\theta(t)}$, the magnetic field intensity component in spherical coordinate is $\overrightarrow{H_\phi(t)}$ (Cheng, 1989b),

$$\overrightarrow{E_r(t)} = \frac{q_1 l_1 \cos\theta}{2\pi\varepsilon_0 r^3}\cos\omega t\,\vec{r} \tag{4}$$

$$\overrightarrow{E_\theta(t)} = \frac{q_1 l_1 \sin\theta}{4\pi\varepsilon_0 r^3}\cos\omega t\,\vec{\theta} \tag{5}$$

$$\overrightarrow{H_\phi(t)} = \frac{\omega q_1 l_1 \sin\theta}{4\pi r^2}\cos\left(\omega t + \frac{\pi}{2}\right)\vec{\phi} \tag{6}$$

where r is the distance between the point of observation and the centre of the oscillating nucleon 1, $r \gg l_1$, $r \ll \lambda$, and where λ is the wavelength of the incident light.

Suppose the oscillating nucleon 2 lies at the point of observation, which is in the near-zone fields of the oscillating nucleon 1. r is then the distance between the two oscillating nuclei when they are colliding.

When the electric field intensity $\vec{E_r(t)}$ is in the direction along $\vec{r}$, $\theta = 0$, therefore

$$\overrightarrow{E_r(t)} = \frac{q_1 l_1}{2\pi\varepsilon_0 r^3}\cos\omega t\,\vec{r} \tag{7}$$

$$\overrightarrow{E_\theta(t)} = 0 \tag{8}$$

$$\overrightarrow{H_\phi(t)} = 0 \tag{9}$$

The electric field intensity $\overrightarrow{E(t)}$ and $\overrightarrow{E_r(t)}$ will also cause the nucleon 2 to perform a simple harmonic oscillation, so the nucleon 2 can be considered as a bound oscillator of mass m_2 and charge q_2, its angular frequency of the simple harmonic oscillation is ω, and its amplitude is l_2.

The nucleon 2 will oscillate in the direction of $\vec{r}$, according to the equation of motion

$$\ddot{x} + \gamma\dot{x} + \omega_0^2 x = q_2 A\omega^2 \cos\omega t\,\vec{r} + \frac{q_2 q_1 l_1}{2\pi\varepsilon_0 r^3}\cos\omega t\,\vec{r} \tag{10}$$

and where ω_0 is the natural frequency of the nucleon 2, and γ is the coefficient of damping (Panofsky and Phillips, 1962), for convenience one can set

$$\gamma = \frac{q_2^2\omega^2}{6\pi\varepsilon_0 m_2 c^3} \tag{11}$$

Because $\gamma \ll \omega$, one can obtain

$$\begin{aligned} x &= \frac{q_2}{m_2}\frac{1}{\sqrt{(\omega_0^2-\omega^2)^2+\omega^2\gamma^2}}\left(A\omega^2 + \frac{q_1 l_1}{2\pi\varepsilon_0 r^3}\right)\cos\omega t\,\vec{r} \\ &= l_2\cos\omega t\,\vec{r} \end{aligned} \tag{12}$$

$$l_2 = \frac{q_2}{m_2}\frac{1}{\sqrt{(\omega_0^2-\omega^2)^2+\omega^2\gamma^2}}\left(A\omega^2 + \frac{q_1 l_1}{2\pi\varepsilon_0 r^3}\right) \tag{13}$$

The nucleon 2's simple harmonic oscillation can be considered also as an oscillating electric dipole.

By defining $\vec{P_2}$ as the nucleon 2's dipole moment vector with magnitude $q_2 l_2 \cos\omega t$ and direction along $\vec{r}$ such that

$$\begin{aligned} \vec{P}_2 &= q_2 l_2 \cos\omega t\,\vec{r} \\ &= \frac{q_2^2}{m_2}\frac{1}{\sqrt{(\omega_0^2-\omega^2)^2+\omega^2\gamma^2}}\left(A\omega^2 + \frac{q_1 l_1}{2\pi\varepsilon_0 r^3}\right)\cos\omega t\,\vec{r} \end{aligned} \tag{14}$$

The electric field intensity $\overrightarrow{E(t)}$ has nothing to do with the distance of r, as it will not give the oscillating nucleon 2 the force which moves along the direction of $\vec{r}$.

The near-zone electric field intensity $\overrightarrow{E_r(t)}$ of the oscillating nucleon 1 will give the oscillating nucleon 2 a force F which moves along the direction of $\vec{r}$.

When two oscillating nuclei are going in the same direction along $\vec{r}$, as shown in Fig. 1. P_1 and P_2 are in the same direction along $\vec{r}$,

$$F = q_2 l_2 \cos\omega t(\vec{r}\cdot\nabla\vec{E_r(t)} = \vec{P_2}\cdot\nabla\vec{E_r(t)} \tag{15}$$

and $\nabla = \vec{r}\,\frac{\partial}{\partial r}$,

$$F = -\frac{1}{\sqrt{(\omega_0^2-\omega^2)^2+\omega^2\gamma^2}}\left(\frac{3Aq_2^2 q_1 l_1\omega^2\cos^2\omega t}{4m_2\pi\varepsilon_0 r^4} + \frac{3q_2^2}{8m_2}\frac{q_1^2 l_1^2\cos^2\omega t}{\pi^2\varepsilon_0^2 r^7}\right) \tag{16}$$

which shows that F is the attraction force.

The Coulomb repulsion between two oscillating nuclei is F_f

$$F_f = \frac{q_1 q_2}{4\pi\varepsilon_0 R_f^2} \tag{17}$$

To fuse together, it needs

$$R_f \leqslant 10^{-15}\ \text{m} \tag{18}$$

The interaction energy between the oscillating nucleon 1 and the oscillating nucleon 2 is W (Jackson, 1998)

$$\begin{aligned} W &= \vec{P_2}\cdot\vec{E_r(t)} \\ &= \frac{1}{\sqrt{(\omega_0^2-\omega^2)^2+\omega^2\gamma^2}}\left(\frac{Aq_2^2 q_1 l_1\omega^2\cos^2\omega t}{2m_2\pi\varepsilon_0 r^3} + \frac{q_2^2}{4m_2}\frac{q_1^2 l_1^2\cos^2\omega t}{\pi^2\varepsilon_0^2 r^6}\right) \end{aligned} \tag{19}$$

The Coulomb barrier between two oscillating nuclei is W_f

$$W_f = \frac{q_1 q_2}{4\pi\varepsilon_0 R_f} \tag{20}$$

When W is greater than the Coulomb barrier W_f between two oscillating nuclei, the two oscillating nuclei will fuse together.

Suppose an electron lies at the point of observation, which is in the near-zone fields of the oscillating nucleon 1.

For the electron of mass m_e and negative charge of q_e, the Eq. (13) will be changed into

$$l_e = \frac{q_e}{m_e}\frac{1}{\sqrt{(\omega_0^2-\omega^2)^2+\omega^2\gamma^2}}\left(A\omega^2 + \frac{q_1 l_1}{2\pi\varepsilon_0 r^3}\right) \tag{21}$$

and where l_e is the amplitude of the oscillating electron.

By defining $\vec{P_e}$ as the oscillating electron's dipole moment vector with magnitude $q_e l_e \cos\omega t$ and direction along $\vec{r}$ such as

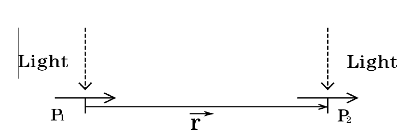

Fig. 1. P_1 and P_2 are in the same direction along $\vec{r}$.