MOLECULAR DISSOCIATION DUE TO THE $\underline{B}^{(3)}$ FIELD.

by

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ABSTRACT

The fundamental $\underline{B}^{(3)}$ field of electromagnetic radiation is shown to produce a driving torque by interaction with a molecule or ion, a torque that can be amplified with Euler resonance. The resonance is induced by tuning a frequency of the electromagnetic field to a natural frequency of a catalyst in a nanometric mould. Kurata has developed this into a full scale industrial process producing clean burning fuels of various kinds, and clean water.

Keywords: The $\underline{B}^{(3)}$ field of ECE theory, molecular dissociation by the $\underline{B}^{(3)}$ field, Euler resonance.

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1. INTRODUCTION

Circularly polarized radiation of any frequency is characterized by its fundamental magnetic flux density, the $\underline{B}^{(3)}$ field {1 - 10}. This is a phaseless, radiated field that is observed in the phaseless magnetization known as the inverse Faraday effect {11, 12}. Over the past twenty years, Kurata et al. {13, 14} have developed the use of $\underline{B}^{(3)}$ into a full scale industrial technology. This is a new industrial revolution capable of producing several kinds {15} of clean burning fuel from waste oil, waste polymer, and landfill, capable of producing clean water, and capable of producing fuel from sea water. The Kurata / $\underline{B}^{(3)}$ technology has been used by N.A.S.A. on its space shuttle to produce clean water. In ECE theory {1 - 10} the $\underline{B}^{(3)}$ field is understood straightforwardly as an effect of rotating and translating spacetime described by the Cartan spin connection using a generally covariant unified field theory.

In its natural condition the inverse Faraday effect (IFE) is a tiny magnetization produced by pulsed lasers of high intensity. In Section 2, however, it is shown that the driving torque of the IFE may be amplified by a well known process, Euler resonance {16}. The amplification is brought about by tuning a frequency of the electromagnetic field to a natural frequency of a catalyst in a nanometric mould. Such moulds are described by Kurata et al. {13, 14} in the public domain. The catalysts are carefully designed by Kurata et al. to recombine fragments produced by dissociation. In this way clean burning fuels are synthesized from waste oil, waste polymer and other landfill. A circularly polarized electromagnetic field may interact with and spin a molecule in several ways through various torques. The first molecular dynamics simulation {17} of this process used a permanent electric dipole moment interacting with the electric field strength $\underline{E}^{(1)}$ of a circularly polarized electromagnetic field. This type of simulation is known as "field applied molecular dynamics". It has been animated by Evans and Pelkie {18} from molecular dynamics simulation code, and the animation is available on www.aias.us. The molecules are spun by the circularly polarized electromagnetic field. The first field applied computer simulation of the inverse Faraday effect {19} was carried out by this author using the torque between the magnetic dipole moment induced by the $\underline{B}^{(3)}$ field and the $\underline{B}^{(1)}$ magnetic flux density of the electromagnetic field. Various types of correlation functions were used to analyse the effect {19, 20}.

In Section 2 it is shown how Euler resonance in a catalytic mould may be used to spin the molecules to destruction, so the hydrocarbon bonds break apart, producing spinning fragments {21}. These fragments are recombined in the Kurata process as already described.

2. EULER AMPLIFICATION OF THE DRIVING TORQUE

In the first instance, and for simplicity and clarity of conception, consider the rotational motion in two dimensions of an electric dipole moment $\underline{\mu}$ in a time varying electric field. The motion is described by:

$$I \frac{d^2\theta}{dt^2} + \frac{\partial V}{\partial \theta} = -\left| \underline{\mu} \times \underline{E} \right| \quad -(1)$$

where I is the moment of inertia of the molecule or ion and where V is a potential well of the type generated in a catalyst or molecular liquid. In the linear Hooke's law approximation (the linear oscillator approximation):

$$\frac{\partial V}{\partial \theta} = V^{(0)} \theta \quad -(2)$$

where $V^{(0)}$ is the magnitude of the potential energy of the well. For the sake of analytical simplicity and illustration consider:

$$\left| \underline{\mu} \times \underline{E} \right| = \mu E \sin\left(\theta - n\frac{\pi}{2}\right) = \mu E \cos\theta. \quad -(3)$$

Therefore Eq. (1) becomes:

$$I \frac{d^2\theta}{dt^2} + V^{(0)} \theta = \mu E \cos\theta. \quad -(4)$$

With the definition:

$$\theta = \omega t \qquad -(5)$$

Eq. (4) becomes:

$$\frac{d^2\theta}{dt^2} + \omega_0^2 \theta = A \cos \omega t \qquad -(6)$$

where:

$$\omega_0^2 = \frac{V^{(0)}}{I} , \qquad A = \frac{\mu E}{I} . \qquad -(7)$$

The solution of Eq. (6) {16} is:

$$\theta(t) = \frac{A \cos \omega t}{\omega_0^2 - \omega^2} . \qquad -(8)$$

At resonance:

$$\omega_0 = \omega \qquad -(9)$$

and the angular displacement goes to infinity along with the angular velocity of the molecule or ion:

$$\omega = \frac{d\theta}{dt} \rightarrow \infty . \qquad -(10)$$

So the molecule or ion is spun to destruction and dissociates into fragments.

Now consider a circularly polarized electromagnetic field applied to a molecule such as a heavy hydrocarbon or waste polymer in a nanometric mould. The transverse electric field strength of the plane wave is:

$$\underline{E}^{(1)} = \frac{E^{(0)}}{\sqrt{2}} \left(\underline{i} - i \underline{j} \right) \exp\left(i \left(\omega t - \kappa Z \right) \right) \qquad -(11)$$

where ω is its angular frequency at instant t and κ its wavevector at point Z in the direction of propagation. The strongest torque present is that between $\underline{E}^{(1)}$ and the permanent electric dipole moment $\underline{\mu}$ of the molecule or ion:

$$\underset{(1)}{\underline{Tq}} = -\underline{\mu} \times \underline{E}^{(1)}. \quad -(12)$$

The real and physical part of $\underline{E}$ is:

$$\mathrm{Re}\,\underline{E}^{(1)} = \frac{E^{(0)}}{\sqrt{2}}\left(\underline{i}\cos(\omega t - \kappa Z) + \underline{j}\sin(\omega t - \kappa Z)\right) \quad -(13)$$

and in general:

$$\underline{\mu} = \mu_X \underline{i} + \mu_Y \underline{j} + \mu_Z \underline{k}. \quad -(14)$$

Therefore:

$$\underline{Tq} = \mu_Z E_Y \underline{i} - \mu_Z E_X \underline{j} - (\mu_X E_Y - \mu_Y E_X)\underline{k}. \quad -(15)$$

The torque is defined as the vector product of displacement r and force F:

$$\underline{Tq} = \underline{r} \times \underline{F} \quad -(16)$$

so in general:

$$\underline{Tq} = (r_Y F_Z - r_Z F_Y)\underline{i} - (r_X F_Z - r_Z F_X)\underline{j} + (r_X F_Y - r_Y F_X)\underline{k}. \quad -(17)$$

Therefore:

$$r_Y F_Z - r_Z F_Y = \mu_Z E_Y, \quad -(18)$$

$$r_X F_Z - r_Z F_X = \mu_Z E_X, \quad -(19)$$

$$r_X F_Y - r_Y F_X = -(\mu_X E_Y - \mu_Y E_X). \quad -(20)$$

For a torque in the XY plane, only Eq. (20) need be considered. The angular momentum is:

$$L = |\underline{L}| = I\frac{d\theta}{dt} \quad -(21)$$

where the moment of inertia is:

$$\underline{I} = mr^2 \quad -(22)$$

with m being the mass of the molecule r ion. The magnitude of the torque is therefore:

$$Tq = r_X F_Y - r_Y F_X = I\frac{d^2\theta}{dt^2} \,. \quad -(23)$$

The effect of the catalyst in the nanometric mould is represented by the linear harmonic oscillator which produces a restoring torque. This concept is analogous to the restoring force of the spring in Hooke's law in the linear approximation of force proportional to distance of spring displacement. The restoring torque is proportional to angular displacement. The same type of concept is used in describing the far infra red absorption of a molecular liquid with an itinerant oscillator model {22}. The restoring torque and catalyst produce Euler resonance through the equation:

$$\frac{d^2\theta}{dt^2} + \omega_0^2\theta = -\frac{1}{I}\left(\mu_X E_Y - \mu_Y E_X\right) -(24)$$

where ω_0^2 is defined by Eq. (7) and is a characteristic frequency of the catalyst or mixture of catalysts.

The solution of Eq. (24) is the sum { 16 }:

$$\theta = \theta_c + \theta_p \quad -(25)$$

where θ_c is the complementary function and θ_p the particular solution. The complementary function is defined by:

$$\frac{d^2\theta_c}{dt^2} + \omega_0^2\theta_c = 0 \quad -(26)$$

and is:

$$\theta_c = A_1 e^{i\omega_0 t} + A_2 e^{-i\omega_0 t} \quad -(27)$$

It describes transient effects. By inspection the particular solution is:

$$\theta_p = D\cos\omega t \quad -(28)$$

where:

$$D = -\frac{1}{I}\frac{(\mu_x E_y - \mu_y E_x)}{(\omega_0^2 - \omega^2)\cos\omega t}. \quad -(29)$$

Therefore:

$$\theta_p = \frac{\mu_y E_x - \mu_x E_y}{I(\omega_0^2 - \omega^2)}. \quad -(30)$$

At resonance:

$$\omega_0 = \omega \quad -(31)$$

and

$$\theta_p \to \infty. \quad -(32)$$

So the molecule is spun to destruction and breaks apart into spinning fragments. These are synthesized into clean burning fuels in the Kurata / $\underline{B}^{(3)}$ processes, of which there are many.

For a more accurate description of the process, molecular dynamics and Monte Carlo simulation methods can be used. These have been developed to the point where they can describe nanostructures accurately. It should be possible to animate the dissociation process.

As shown in ref. (19), the torque due to the $\underline{B}^{(3)}$ field is that between the induced magnetic dipole moment due to $\underline{B}^{(3)}$ and the $\underline{B}^{(1)}$ magnetic flux density of the circularly polarized electromagnetic field:

$$\underline{B}^{(1)} = \frac{B^{(0)}}{\sqrt{2}}\left(i\underline{i} + \underline{j}\right)\exp\left(i\left(\omega t - \kappa Z\right)\right). \quad -(33)$$

The B Cyclic Theorem asserts that:

$$\underline{B}^{(1)} \times \underline{B}^{(2)} = iB^{(0)}\underline{B}^{(3)*} \quad -(34)$$

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where:

$$\underline{B}^{(1)} = \underline{B}^{(2)*}, \quad -(35)$$

so the existence of $\underline{B}^{(1)}$ implies that of $\underline{B}^{(3)}$. In the molecule fixed frame (1, 2, 3) the induced magnetic dipole components are {19}:

$$m_1 = -E_0^2 e_{1Z}\left(b''_{123} - b''_{132}\right) \quad -(36)$$
$$m_2 = -E_0^2 e_{2Z}\left(b''_{213} - b''_{231}\right) \quad -(37)$$
$$m_3 = -E_0^2 e_{3Z}\left(b''_{312} - b''_{321}\right) \quad -(38)$$

where b'' is the imaginary part of the electric electric magnetic molecular hyperpolarizability. A particular molecular symmetry {20} was used to deduce Eqs. (36) to (38).

The components of the induced magnetic dipole moment in the laboratory frame are:

$$\begin{bmatrix} m_X \\ m_Y \\ m_Z \end{bmatrix} = \begin{bmatrix} R_{11} & R_{12} & R_{13} \\ R_{21} & R_{22} & R_{23} \\ R_{31} & R_{32} & R_{33} \end{bmatrix} \begin{bmatrix} m_1 \\ m_2 \\ m_3 \end{bmatrix} \quad -(39)$$

so:

$$m_X = R_{11}m_1 + R_{12}m_2 + R_{13}m_3 \quad -(40)$$
$$m_Y = R_{21}m_1 + R_{22}m_2 + R_{23}m_3 \quad -(41)$$
$$m_Z = R_{31}m_1 + R_{32}m_2 + R_{33}m_3 \quad -(42)$$

and the induced magnetic dipole moment is:

$$\underline{m}^{ind} = m_X \underline{i} + m_Y \underline{j} + m_Z \underline{k} . \quad -(43)$$

In ref. (19) the R matrix of Eq. (39) was found by computer simulation. The torque due to the $\underline{B}^{(3)}$ field is therefore:

$$\underline{Tq} = m_Z^{ind} B_Y^{(1)} \underline{i} - m_Z^{ind} B_X^{(1)} \underline{j} - \left(m_X^{ind} B_Y^{(1)} - m_Y^{ind} B_X^{(1)} \right) \underline{k} . \quad -(44)$$

For simplicity consider again:

$$r_X F_Y - r_Y F_X = -\left(m_X^{ind} B_Y^{(1)} - m_Y^{ind} B_X^{(1)} \right) = I \frac{d^2\theta}{dt^2} \quad -(45)$$

so the Euler resonance equation (24) becomes:

$$I \frac{d^2\theta}{dt^2} + V^{(0)}\theta = -\left(m_X^{ind} B_Y^{(1)} - m_Y^{ind} B_X^{(1)} \right) \quad -(46)$$

whose particular solution is:

$$\theta_p = \frac{m_Y^{ind} B_X^{(1)} - m_X^{ind} B_Y^{(1)}}{I\left(\omega_0^2 - \omega^2\right)} . \quad -(47)$$

In order to find an approximate estimate of ω consider the Euler equation:

$$\ddot{\theta} + \omega_0^2 \theta = A \cos \omega t \quad -(48)$$

whose solution is:

$$\theta_p = \frac{A \cos \omega t}{\omega_0^2 - \omega^2} . \quad -(49)$$

It is found that:

$$\cos \omega t = \frac{1}{AI} \left(m_Y^{ind} B_X^{(1)} - m_X^{ind} B_Y^{(1)} \right) \quad -(50)$$

and so ω is of the order of the electromagnetic angular frequency.

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