Pulsed EM Propulsion of Unconventional Flying Objects

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Abstract— Specific properties of Unconventional Flying Objects of unknown origin were widely documentated in the past, but they seemed to be too mysterious for scientific studies. Indeed, the *propulsion system* of these objects is radically different from those that are familiar to us, since they have neither wings, nor propellers or jet engines. However, we can deduce from observed facts and known physical laws that they ionize the surrounding air and exert forces on the resulting charged particles by means of adequate EM fields. Lift and propulsion result then from the reaction force, but this requires *very intense magnetic fields, oscillating at low frequencies.* Having shown that they can be produced when the surface of the object is superconducting, we explain here *why these fields are needed and how they act.* This model is confirmed by observations of interactions with water. Observational evidence concerning these fields will follow.

1. INTRODUCTION

There are numerous observations of “Unconventional Flying Objects” and their effects, as shown by Richard Hall [1, 2], the astronomer Allen Hynek [3, 4] and the physicist Peter Sturrock [5]. Actually, these objects can be *identified* by their form and behavior, since they have no wings to provide aerodynamic lift, nor visible means for propulsion. Nevertheless, they are able to remain motionless and to move at low or even extremely high velocities in complete or nearly complete silence. Usually, they don’t create any air motions. Their origin is unknown, but this is irrelevant when we *try to understand their propulsion system in terms of observed facts and known physical laws.* Our objective is to show that this seems to be possible. We have shown already that they could produce *low frequency EM surface waves,* if their surface were superconducting [6]. A current density **J**, oscillating around a given axis, would then be associated with an oscillating magnetic field **B** and an induced electric field **E** (Figure 1).

For disc-like or long cylindrical, but axially symmetric objects, the magnetic field lines are somewhat different, but they are situated in meridional planes and the electric field lines are still circular and parallel to the equatorial plane. The fields **E** and **B** are thus orthogonal to one another. The intensity of the magnetic field decreases rapidly below the surface of the superconductor and the magnetic field lines are there nearly parallel to the surface. However, they are refracted when they emerge, since the normal component of **B** has to be continuous, while the tangential component is not. In polar coordinates (r, θ, φ), the electric field $\mathbf{E} = (0, 0, E)$ and the magnetic field $\mathbf{B} = (B_r, B_\theta, 0)$. Outside a superconducting sphere

$$E = \frac{\omega M}{r^2} \sin\theta \sin\omega t, \quad B_r = \frac{2M}{r^3} \cos\theta \cos\omega t \quad \text{and} \quad B_\theta = \frac{M}{r^3} \sin\theta \cos\omega t \tag{1}$$

This stationary oscillation is possible for any low frequency ω and any magnetic dipole moment M, as long as superconductivity is not destroyed. Objects that are topologically similar to a sphere will behave in an analoguous way. In regard to their propulsion, our initial reasoning [7] was that

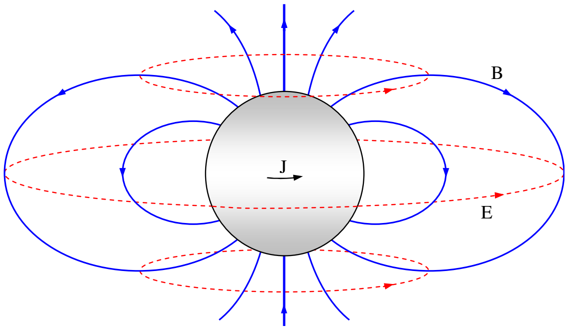

Figure 1: Configuration of the magnetic and electric field lines for a superconducting spherical shell.

any autonomous system has to apply forces on something else to be submitted itself to the reaction force. The luminosity, which was often seen to surround UFOs, sugested that they *ionize* the ambiant air. They could thus exert forces on the resulting charged particles by means of adequate *EM fields.* Actually, the intensity and color of the surrounding luminsity was sometimes seen to depend on the state of motion or to pulsate. We had thus to explore possible effects of pulsed ionization and low frequency EM fields.

2. FORCED MOTIONS OF ANY CHARGED PARTICLE

Let's consider a particle of charge q and mass m that is suddenly created by ionization at the instant $t = 0$ at a given point P. It defines the origin of a right-handed Cartesian frame, where $\mathbf{B}$ is oriented along the z-axis and $\mathbf{E}$ along the y-axis. These fields are oscillating at a sufficiently low frequency to consider their values as being *practically constant during the lifetime T of the charged particle.* Its initial velocity $\mathbf{v}$ is negligible, but it is immediately accelerated by the electric field $\mathbf{E}$ and as soon as it has aquired some velocity $\mathbf{v}$, it is pushed sideways by the magnetic field $\mathbf{B}$. Since the average effect of elastic collisions is equivalent to viscous friction, characterized by the relaxation time τ, we get the equation of motion

$$m\mathbf{a} = q(\mathbf{E} + \mathbf{v} \times \mathbf{B}) - \frac{m}{\tau}\mathbf{v} \tag{2}$$

Diffusion is negligible when ionization is homogeneous at the scale where the charged particle is moving. The velocity components v_x and v_y are thus determined by

$$\tau\dot{v}_x + v_x = \mu B v_y \quad \text{and} \quad \tau\dot{v}_y + v_y = \mu(E - Bv_x) \tag{3}$$

where $\mu = q\tau/m$ is the *mobility* of the particle. Since $\omega_c = \mathrm{qB/m}$ is the cyclotron frequency of this particle, $\mu B = \omega_c\tau$ is a numerical parameter. The general solution of (3) is

$$v_x = V_x + A\cos(\omega_c t + \phi)e^{-t/\tau} \quad \text{and} \quad v_y = V_y - A\sin(\omega_c t + \phi)e^{-t/\tau}$$

where V_x and V_y are the velocity components that subsist when the stationary state has been reached. The first terms in (3) are then negligible. Thus,

$$V_y = \frac{\mu E}{1 + (\mu B)^2} \quad \text{and} \quad V_x = \frac{\mu^2 EB}{1 + (\mu B)^2} \tag{4}$$

The constants A and ϕ are determined by the initial condition ($v_x = v_y = 0$ for $t = 0$), but the velocity vector $\mathbf{v}(t)$ varies in such a way that its tip describes a spiral (Figure 2). The particle reaches its stationary state very rapidly ($\tau \ll T$) and is then moving at the velocity $\mathbf{V}$. The transverse component V_x reaches a maximum when $\mu B = 1$ (Figure 3).

Because of (4), $(V_y - u)^2 + V_x^2 = u^2$, when $u = \mu E/2$. The components of the velocity vector $\mathbf{V}$ are such that the tip of $\mathbf{V}$ touches a half-circle of radius u (Figure 4). Θ is the Hall angle and the values of E and B are both proportional to M. Equation (2) is equivalent to $m\mathbf{a} = \mathbf{F} + \mathbf{f}$, where $\mathbf{F}$ is the EM force exerted on the charged particle. In the stationary regime $\mathbf{a} = 0$, and the applied force $\mathbf{F} = -\mathbf{f} = (m/\tau)\mathbf{V}$ is oriented like $\mathbf{V}$ and proportional to its magnitude (Figure 5). This is even valid during practically the whole lifetime of the charged particle.

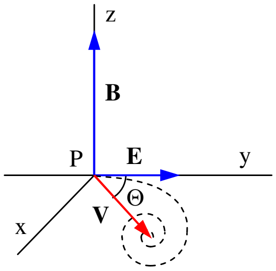

Figure 2: The fields $\mathbf{E}$ and $\mathbf{B}$ with the resulting drift velocity $\mathbf{V}$.

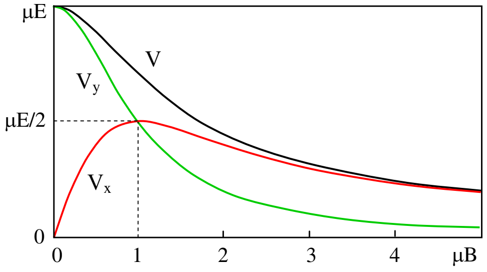

Figure 3: Variations of the magnitude of the velocity vector $\mathbf{V}$ and its components for increasing values of μB.

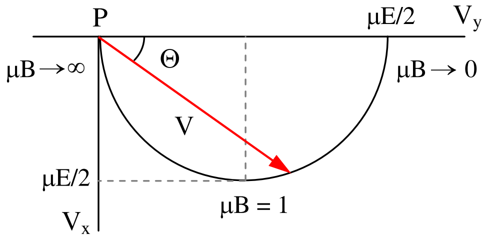

Figure 4: The magnitude and orientation of the drift velocity **V** depend on the fields **E** and **B**.

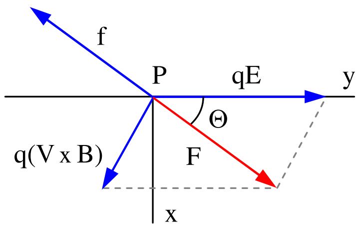

Figure 5: In the stationnary regime, the applied force **F** compensates the frictional force **f**.

An electric field alone would imply that $\mathbf{F} = q\mathbf{E}$. Since ionization produces two particles of opposite charge, the average force would be zero, while a strong magnetic field **B** deviates the force **F** with respect to the induced electric field **E**. Since the transverse force F_x is proportional to q^2, positive and negative particles will be pushed in the same direction.

3. PULSED IONIZATION IN AIR AND WATER

Atmospheric air can be ionized by microwaves. This yields *free electrons* and positive ions, while electron attachment will produce negative ions. All these particles could be set in motion, but electrons have a much higher mobility $\mu = q\tau/m$ than ions, because of their small mass and their larger relaxation time (Ramsauer effect). Usually, it is thus sufficient to consider only the momentum confered by the object to free electrons. Although they collide with ions or neutral molecules, they leave them pratically motionless. *This explains the absence of sound and air turbulence,* in contrast to what happens for helicopters. Moreover, the progressive action on the ambient air accounts for the *absence of a sonic boom* when the object passes the sound barrier. Because of (4), the magnitude of the transverse force F_x is proportional to the product EB and thus to $2\sin\omega t\cos\omega t = \sin 2\omega t = \pm 1$, when the ionization is adequately pulsed. This is very advantageous, since the driving force **F** can be reversed.

Figure 1 shows that the magnetic field **B** is horizontal at some places (when $\theta \approx 55^\circ$ for a dipolar field). However, the orientation of **B** is opposite above and below the equatorial plane, while the perpendicular electric field **E** has there the same orientation. Since the orientation of the applied force **F** is defined by the local vector product $\mathbf{E} \times \mathbf{B}$, the resulting vertical forces would be opposite if ionization did occur there at the same instant. *By simply alternating the ionization above and below the equator*, we get equally oriented forces. The object would attract free electrons above its equatorial plane and push them downward below it, but *not* at the same instant. This doubles the average value of the reaction force acting on the object.

Ionization can even occur at instants where **E** changes sign, while **B** has a given sign, as well above as below the equator. This produces forces that are symmetrical with respect to the x-axis (Figure 5). The average transverse force **F** is then doubled and *situated in meridional planes for steady oscillations.* During sudden departures, where the intensity of the fields varies within a single period, forces oriented towards the left or right side of meridional planes will not be perfectly symmetric. Physical traces, where vegetation was laid down in clockwise or anti-clockwise spiraling patterns confirm this possibility. Lateral motions of the object can be obtained by attracting charged particles in front of the object and repelling them behind it. This requires only a modification of the distribution of the ionization density. The resulting propulsion sytem is *extremely flexible.* It allows not only for sudden changes of the direction of motion, but can even account for actually observed propulsion inside water.

Ionization produces there H^+ ions instead of free electrons. These protons have a greater mobility than other ions, because of their smaller mass and the Grotthuss mechanism. Propulsion in water is thus usually based on setting only protons in motion, but they can transfer momentum to water molecules. This should result in *visible actions on water!* Because of (1) and (4), we get as well for protons in water as for free electrons in air the same expressions for the components of the velocity vector **V** of these particles in meridional planes. When ionization occurs at optimal instants,

$$V_r = \frac{-V_0 C\rho^{-5}\sin^2\theta}{1 + C\rho^{-6}\sin^2\theta} \quad \text{and} \quad V_\theta = \frac{V_0 C\rho^{-5}\sin 2\theta}{1 + 4C\rho^{-6}\cos^2\theta} \tag{5}$$

The reduced distance $\rho = r/a$, where a is the radius of the sphere. The velocity $V_o = \omega a$ and the constant $C = \mu^2 B_o^2/2$ where $B_o = M/a^3$ is the magnetic field intensity at the surface of the sphere in its equatorial plane. The vertical and horizontal velocity components $V_v = V_r \cos\theta - V_\theta \sin\theta$ and $V_h = V_r \sin\theta + V_\theta \cos\theta$. For moderate magnetic fields ($C \ll 1$), we get

$$V_v = -V_o C\rho^{-5} 3\sin^2\theta\cos\theta \quad \text{and} \quad V_h = V_o C\rho^{-5}\left(3\cos^2\theta - 1\right)\sin\theta \tag{6}$$

The vertical velocity and the resulting force are nearly maximal when $\theta \approx 55°$ (where $V_h \approx 0$). They vanish close to the symmetry axis (where $\sin\theta \approx 0$). The global vertical propulsive force F_p is opposed to the integral of all vertical forces $(e/\mu)V_v$, multiplied by $2\pi r^2 dr \sin\theta d\theta$ above the equator and doubled by alternate ionizations above and below the equator. We assume that the ionization density decreases like $I(a/r)^2$ outside a sphere of radius a, where I is a fraction of the normal particle density. Actually, the ionization is limited to a sphere of radius R, because of threshold effects, but $R \gg a$. We have also to take into account the relative time $\bar{t}$ (lifetime/period), where the EM field can act on the charged particles. For moderate magnetic fields and optimal ionizations, the total vertical propulsive force

$$F_p = \bar{t} I\omega a^4 e\mu B_o^2 \int_1^\infty \int_0^{\pi/2} 4\pi\rho^{-5} d\rho 3\sin^3\theta\cos\theta d\theta = \bar{t} I\omega a^4 \frac{3\pi}{4} e\mu B_o^2$$

To estimate the *minimal* magnetic field B_o, we assume that up to 1% of neutral particles can be ionized and that $a \approx 5\,\text{m}$, $\omega \approx 10\,\pi/\text{s}$ at 5 Hz and $\bar{t} \approx 1\%$. *For electrons in atmospheric air at NTP,* we get then $I < 2.7 \cdot 10^{23}$ electrons/m^3 air, while their mobility $\mu \approx 1\,\text{m}^2/\text{Vs}$ or smaller [8] when $E > 10^4\,\text{V/m}$. Simple hovering of an object of 10^3 kg would require a magnetic field $B_o > 0.02\,\text{T}$. *For protons in water,* the same assumptions would yield $I < 3.3 \times 10^{28}/\text{m}^3$, but their mobility [9] $\mu \approx 3.6 \times 10^{-7}\,\text{m}^2/\text{Vs}$. The same effective weight (beyond buancy) would require $B_o > 0.1\,\text{T}$. Since the degree of ionization is probably weaker and since very rapid motions were also observed, possible magnetic fields have to be very great.

4. OBSERATIONAL CONFIRMATIONS

On March 29, 1974, a couple was sitting on a beach in Togo at about 50 m from the water, when a dark object approached at low altitude above the sea. It stoped at 200 to 300 m from the witnesses and hovered about 10 m over the sea. However, it generated powerful concentric waves, pushing the water up to their feet [10, 11] (Figure 6). This object had thus to exert very strong, low frequency forces on ionized water, in agreement with the model of *Pulsed EM Propulsion.* It created also a 5 to 6 m deep and 25 to 30 m large central depression. Carl Feindt, who collected numerous observations of interactions with water [12], proposed *a phenomenological model*, where a UFO surrounded by water would induce motions along flow lines that are similar to field lines of a magnetic dipole (interrupted lines in Figure 7).

It has actually been observed that before UFOs emerged from water, they produced large hemispherical swellings. After they rose above the water, there remained at first a central water column, but when they came from above the water, they created a cup-like depression (Figure 6). This confirms our theory, which has the advantage of correcting the phenomenological model by predicting *two separate circulations above and below the object.* The ionization range is limited and the

Figure 6: Water waves and central depression observed in Togo [10, 11].

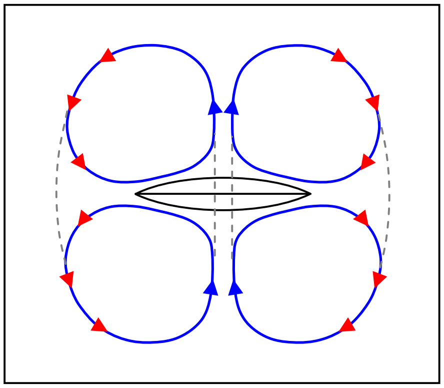

Figure 7: Predicted lines of flux.

applied forces are indicated by red arrows in Figure 7, while the flux lines are represented in blue. Agreement between observational evidence and the theoretical model is quite remarkable.

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