The Electromagnetic Wave Electric Field Force Thruster - Vacuum Tensor Drive

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Abstract

As we know that Newton's law considers vacuum as empty, force between objects passing through action at a distance. But in Electromagnetism, vacuum is not considered as empty but considered as continuum, force between objects passing through vacuum. It means that Newton's law may not work if vacuum must be considered.

We know that on the electromagnetic wave propagation path, the direction of electric field at a point changes periodically. If there is a charged object at the point also changes its charge property periodically with the same frequency, then the electric field force direction on the object will not change. Therefore, the object will do directional movement. Based on this, it is possible to design a spacecraft does not follow Newton's law. And the calculation suggests that the thrust can be much higher than radiation pressure.

With the Electromagnetic Momentum Conservation Equation, this paper proved that in a limited space, Newton's second law may not work although it still work in the whole universe. Also with the Electromagnetic Momentum Conservation Equation, this paper explained why in quantum mechanics at the particle level, particles usually do not follow Newton's second law.

Key words: vacuum propulsion, vacuum propellant, electromagnetic wave propulsion, electromagnetic propulsion, electromagnetic wave force, propulsion, electromagnetic momentum conservation, vtdrive, vacuum tensor

1. Introduction

As we know that Newton's law considers vacuum as empty, force between objects passing through action at a distance. But in Electromagnetism, vacuum is not considered as empty but considered as continuum, force between objects passing through vacuum. It means that Newton's law may not work if vacuum must be considered. It also means that vacuum is just like water can also be pushed [1]. We can push vacuum in vacuum with electromagnetic fields.

2. The Principle of Vacuum Tensor Drive

Figure 1: The Left Half of the Electromagnetic Wave Cycle.

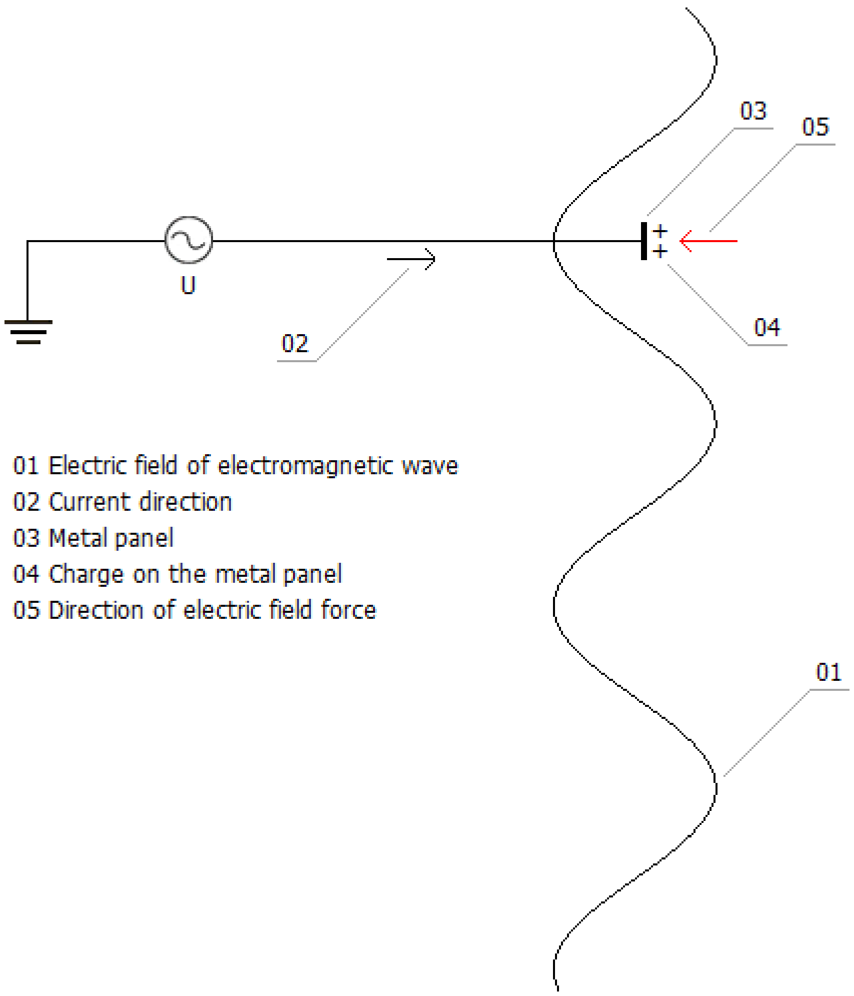
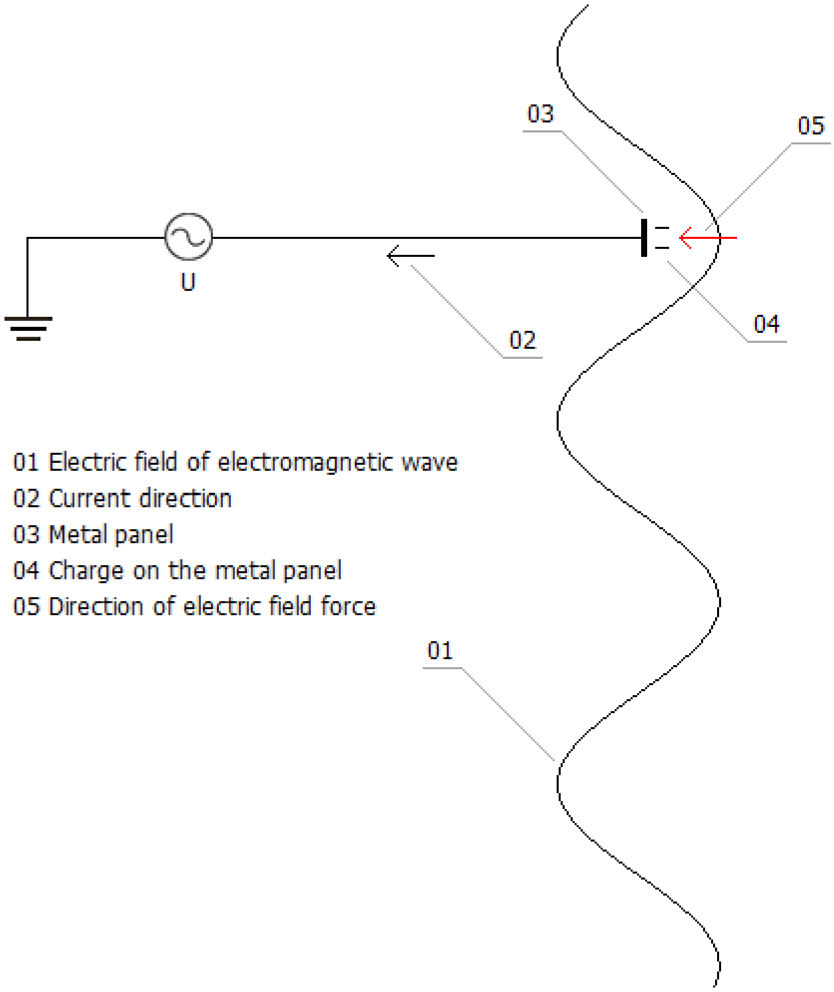


Figure 2: The Right Half of the Electromagnetic Wave Cycle.



We know that on the electromagnetic wave propagation path, the direction of electric field at a point changes periodically. If there is a charged object at the point also changes its charge property periodically with the same frequency, then the electric field force direction on the object will not change. Based on this, I designed the Electromagnetic Wave Electric Field Force Thruster. Essentially it is using vacuum as propellant [2], so I also call it Vacuum Tensor Drive(VtDrive) [3].

We assume that the polarization direction of the electromagnetic wave and the thruster are on the same plane. And the electromagnetic wave is a directional wave. The AC power U has the same frequency with the electromagnetic wave.

From the figure 1 and 2, we can see that the direction of electric field force can keep the same if the charge on the metal panel synchronizes with the electromagnetic wave. Because the direction of electric field force on the metal panel does not change, so the thruster will do directional movement. The electric field force on the metal can be considered as external force, so VtDrive can push itself in vacuum. And electric field force has much higher efficiency than radiation pressure in using the energy of electromagnetic waves, so VtDrive is not a photon thruster.

3. The Force on Vacuum Tensor Drive

We assume that electric field of the electromagnetic wave at the metal panel changes according to the following formula:

$$E(t) = E0 \times \sin(\omega \times t) \qquad (2\text{-}1)$$

$E0$ is the amplitude of E. ω is the angular frequency of the electromagnetic wave. t is the time.

Declare the electromagnetic wave cycle is T, then we have:

$$T = \frac{2 \times \pi}{\omega} \qquad (2\text{-}2)$$

Assume that the current in the inductor L changes according to the following formula:

$$i(t) = I0 \times \sin(\omega \times t + \frac{\pi}{2}) \qquad (2\text{-}3)$$

$I0$ is the amplitude of i. $\frac{\pi}{2}$ is the phase difference for synchronizing $E(t)$ and $C(t)$.

Then quantity of electric charge on the metal panel will be:

$$C(t) = \int i(t)dt \qquad (2\text{-}4)$$

Assume the initial quantity of charge on the metal panel is 0, then we have:

$$C(t) = \frac{I0 \times \sin(\omega \times t)}{\omega} \qquad (2\text{-}5)$$

Then electric field force on the metal panel is:

$$f(t) = C \times E \qquad (2\text{-}6)$$

The average electric field force on the metal panel is:

$$F = \frac{\int_0^T f(t)\,dt}{T} \qquad (2\text{-}7)$$

Solve (2-7), then we have:

$$F = \frac{E0 \times I0}{2 \times \omega} \qquad (2\text{-}8)$$

3. Performance of Vacuum Tensor Drive

If the Poynting's vector of the electromagnetic wave is 1000 W/m2, then $E0$ is 868 V/m. If the wavelength of the electromagnetic wave is 10 m, then ω is 1.884E8. And if $I0$ is 100 A, then we can figure out F is 2.3E-4 N. F can be much higher than radiation pressure if $I0$ is high enough and the wavelength of the electromagnetic wave is long enough.

And there are there ways to increase F without increasing energy consumption:

1) Reduce ω, that is reduce the frequency of the electromagnetic wave.

2) Make the electromagnetic wave beam narrower.

3) Amplify the power of the electromagnetic wave resonance.

4. The New Understanding of Electromagnetic Momentum Conservation Equation

The following equation is the Electromagnetic Momentum Conservation Equation.

$$f = -\nabla \bullet \overleftrightarrow{T} - \frac{\partial g}{\partial t} \qquad (4\text{-}1)$$

$$\overleftrightarrow{T} = -\varepsilon 0 EE - \frac{1}{\mu 0} BB + \frac{1}{2}(\varepsilon 0 E^2 + \frac{1}{\mu 0} B^2)\overleftrightarrow{I} \qquad (4\text{-}2)$$

$$g = \varepsilon 0 E \times B \qquad (4\text{-}3)$$

f is the Lorentz force density.

And we have the Newton's second law:

$$F = \frac{\partial p}{\partial t} \qquad (4\text{-}4)$$

Compare (4-1) with (4-4), if f match F and $-\frac{\partial g}{\partial t}$ match $\frac{\partial p}{\partial t}$, then (4-4) is missing one item to match $-\nabla \bullet \overleftrightarrow{T}$. So (4-4) should be the special case of (4-1) when $-\nabla \bullet \overleftrightarrow{T}$ tends to zero. Why (4-4) is missing one item? Because Newton's law considers vacuum as empty, but Electromagnetism does not consider vacuum as empty, but considers vacuum as continuum [4].

Do integral for (4-1) in region V, then we have its integral form:

$$\int_V fdV = -\int_V \nabla \bullet \overleftrightarrow{T} - \frac{d}{dt}\int_V gdV \qquad (4\text{-}5)$$

$\int_V fdV$ should match F and $-\frac{d}{dt}\int_V gdV$ should match $\frac{\partial p}{\partial t}$. We know that when V is the whole space, $-\int_V \nabla \bullet \overleftrightarrow{T}$ will tend to zero. So when V is a large enough space, $-\int_V \nabla \bullet \overleftrightarrow{T}$ can be considered as zero. That means Newton's second law is the special case of Electromagnetic Momentum Conservation Law when we use a large enough space to contain the system.

But when V is a limited space which is not large enough and it is not in a static field, then $-\int_V \nabla \bullet \overleftrightarrow{T}$ can not be considered as zero, Newton's second law may not work in this case. So in a limited space which is not large enough, Newton's second law may not work. When we enlarge the space to the whole universe, it will always be large enough. So Newton's second law will always work in the whole universe.

Einstein's special theory of relativity proves that Newton's law does not work for high speed object, Electromagnetic Momentum Conservation Equation proves that Newton's law also may not work in a limited space which is not large enough.

In (4-1) we can see that f is composed by $-\nabla \bullet \overleftrightarrow{T}$ and $-\frac{\partial g}{\partial t}$. $-\frac{\partial g}{\partial t}$ is the radiation pressure. So we can understand why the thrust of VtDrive can be much higher than radiation pressure, because its thrust has more $-\nabla \bullet \overleftrightarrow{T}$, but less $-\frac{\partial g}{\partial t}$.

As we know, in quantum mechanics at the particle level, particles usually do not follow Newton's second law. And we know the smaller the volume is, the higher probability that $-\int_V \nabla \bullet \overleftrightarrow{T}$ will not be zero, then the higher probability that particles do not follow Newton's second law. This can explain why in quantum mechanics, particles usually do not follow Newton's second law.

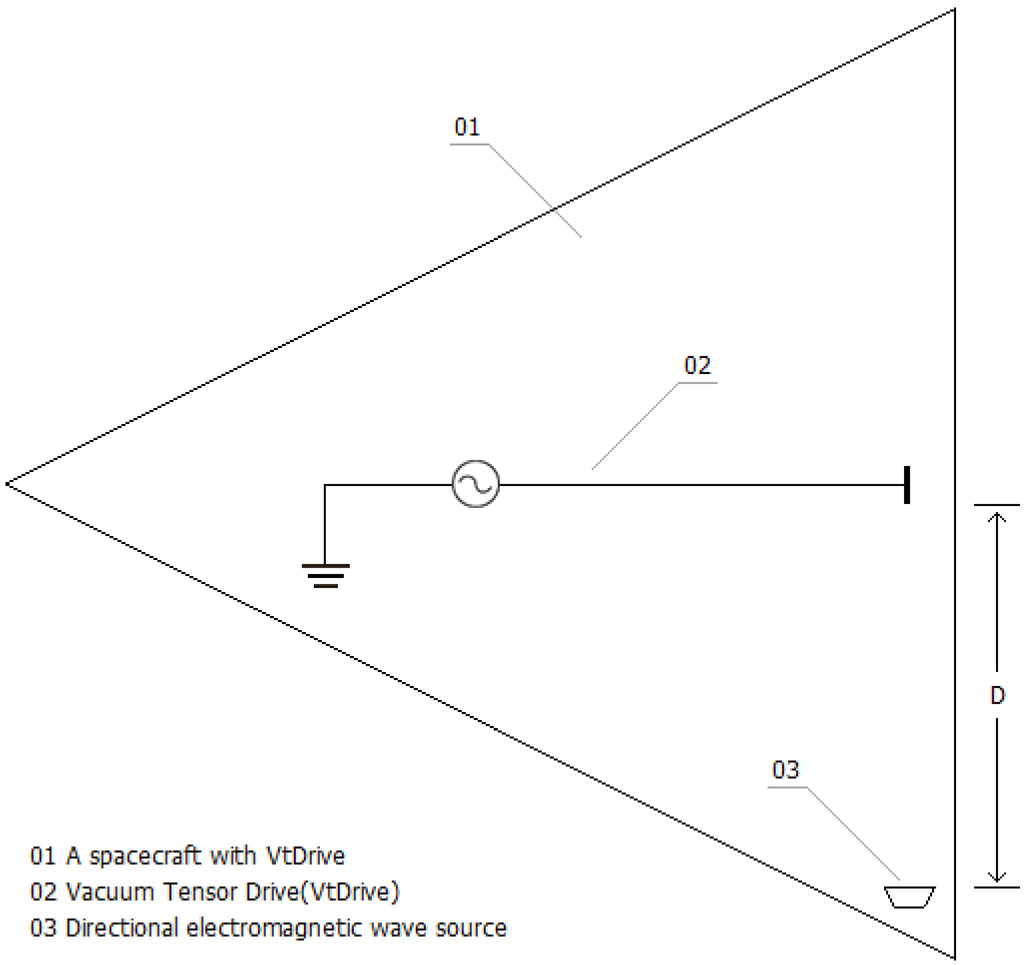
VtDrive does not violate the Electromagnetic Momentum Conservation Law, but it violates Newton's second law in a limited space which is not large enough. But in the whole universe, it still does not violate Newton's second law.

5. Design a Spacecraft with VtDrive

We assume that the distance between the electromagnetic wave source and VtDrive is very long. Because the electromagnetic wave is a directional wave, then the electric field force on VtDrive can be much higher the radiation pressure. Although VtDrive may also generate some electromagnetic wave, but its wave is not directional wave, just need the distance is long enough, the reaction force from VtDrive to the source can be very week, much weaker than the force from the source to VtDrive. So the action force and the reaction force are not the same.

If the distance between the electromagnetic wave source and VtDrive "D" is very long, and because the electromagnetic wave is a directional wave, then the force on VtDrive can be much higher than the reaction force from VtDrive to the source. So we can put VtDrive and the source on the same spacecraft, just need their distance is long enough. And even though there maybe a little reaction force between VtDrive and the wave source, their reaction force can only be perpendicular to the electric field force on the metal panel of VtDrive. So the reaction force from VtDrive to the source will not offset the electric field force on the metal panel of VtDrive.

Figure 3: A Spacecraft with VtDrive.



6. Conclusion

Although VtDrive looks like a violation of Newton's Law, but it does not violate any principle of electromagnetism. And the calculation suggests that the thrust of VtDrive can be much higher than radiation pressure. Based on VtDrive, it is possible to design a spacecraft does not follow Newton's second law. And the Electromagnetic Momentum Conservation Equation proved that in a limited space, Newton's second law may not work although it still work in the whole universe, and it also explained why in quantum mechanics at the particle level, particles usually do not follow Newton's second law.

7. References

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