Unlinked Electromagnetic Fields Thrusters.
A novel approach to electric propulsion in aerospace applications.

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Abstract:

The aerospace industry is undergoing a transformative phase, necessitating innovative solutions to overcome the limitations of traditional propulsion systems. This document introduces the concept of **Unlinked Electromagnetic Field Thrusters**, a groundbreaking technology that promises to revolutionize electric propulsion in aerospace applications.

Unlinked Electromagnetic Field Thrusters operates on the principle of electromagnetic force fields, leveraging electromagnetic pulses to generate impulse forces without the need for propellants or fuels. Theoretical foundations, technological developments, feasibility assessments, and comparisons with existing propulsion technologies are discussed, highlighting the potential or **unlinked electromagnetic fields thrusters** to significantly enhance the efficiency, cost-effectiveness, and performance of propulsion systems in space exploration and satellite missions.

1. Introduction:
The propulsion systems utilized in the aerospace industry are approaching their inherent limitations, necessitating the exploration of alternative technologies to propel spacecraft and satellites more efficiently and sustainably. Traditionally propulsion systems, such as chemical engines, ion thrusters, and Hall effect thrusters, rely on the expulsion of mass to generate thrust, resulting in significant limitations in terms of efficiency and payload capacity. In response to these challenges, there has been growing interest in electric propulsion systems that utilize electrical energy to generate thrust without the need for propellants or fuels.

2. Background:

The concept of **unlinked electromagnetic fields thrusters** emerged from the need for a propulsion system that transcends the constraints of conventional propulsion technologies.

Unlinked electromagnetic fields thrusters operate on the principle of **unlinked electromagnetic fields**, wherein electromagnetic pulses are used to induce impulse forces on susceptible objects, thereby enabling propulsion without the expulsion of mass. This technology represents a paradigm shift in aerospace propulsion, offering numerous advantages over traditional propulsion systems.

3. Technological foundations.

Basic concepts of **Unlinked Electromagnetic Fields Thruster** technology.

a.An electromagnetic field such as a train of electromagnetic pulses can change the dynamic state of a susceptible object without requiring a traditional balance of momentum

$$\frac{d}{dt}(m_1\vec{\mathbf{v}}_1) = -\frac{d}{dt}(m_2\vec{\mathbf{v}}_2)$$

between the object and the element that originated the field pulses.

b.An electromagnetic field can change the dynamic state of a susceptible object even after the element that created the electromagnetic field has ceased to exist.

a. ***An electromagnetic field such as a train of electromagnetic pulses can change the dynamic state of a susceptible object without requiring a balance of momentum between the object and the element of origin of the field pulses.***

If we take into account the so-called electromagnetic spectrum that includes radio waves, microwaves and light, we can take the reference of the impulse that is generated in the so-called solar sails or laser sails, where a susceptible surface in this case a reflective surface such as Metallized Mylar is deployed like a sail and a laser beam is directed onto it generating an impulse that has already been verified on different occasions, such as on the Japanese satellite “IKARUS”. In this case light with its wave-particle duality impacts the sail and the photons carry out an energy exchange with respect to the sail even though a photon in its basic nature has no mass, however a loss of energy is generated on the photons since its length wave changes becoming a longer wavelength which represents a decrease in its energy at the moment of impact. The physicist Arthur Compton proved the capacity of electromagnetic waves to change the dynamic state of electrons using X-rays for this, these studies that led him to win the Nobel Prize in Physics, were complemented by other investigations developed by Max Planck and Albert Einstein which led to the formulation of a concept of momentum for the photon that would allow to handle momentum balance equations although the photon and electromagnetic waves lack mass, it is also important to remember that the concept of photon is not exclusive to the portion of the electromagnetic spectrum corresponding to visible light but extends to the entire electromagnetic spectrum.

Starting from Einstein's equation:

$$\boldsymbol{E = mc^2}$$

In addition, considering that each photon has, according to Max Planck's equation, the energy given by:

$$\boldsymbol{E = hv}$$

Where ***h*** is Planck's constant, and ***v*** is the frequency of the electromagnetic wave

$$\boldsymbol{hv = mc^2}$$

$$\boldsymbol{h = mc^2/v}$$

Using the wavelength equation:

$$\lambda = \frac{\boldsymbol{c}}{\boldsymbol{v}}$$

$$\boldsymbol{h = mc}\,\lambda$$

Using these two equations we obtain that the momentum of the photon is equal to:

$$\boldsymbol{p = \frac{hv}{c}}$$

Where ***c*** is the speed of light and substituting ***c*** in the previous equation:

$$\boldsymbol{c = \lambda v}$$

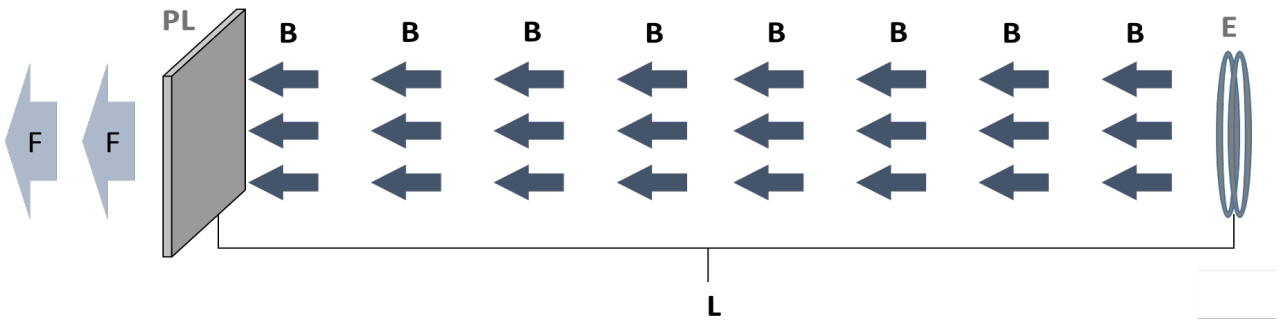
It results in a value for the equivalent momentum of the photon equal to:

$$\boldsymbol{p = \frac{h}{\lambda}}$$

This last expression shows that when a photon hits the surface of the sail, if it is reflected with a longer wavelength it is this energy loss of each photon upon impacting the sail's surface that allows an increase in sail's momentum, photons are not exclusive to the region of the electromagnetic spectrum that encompasses light. In this way, the laser beam generates a change in the momentum of the sail without there having to be a balance of momentum with the source that generated the laser beam, which is an electromagnetic wave that travels through space once it has been generated to subsequently generate an interaction of the wave with the surface of the sail.

Let us consider, on the other hand, a plate of conductive material on which a series of magnetic field pulses generated by an emitter are applied. These pulses, upon impact on the plate, generate induced currents that in turn oppose the magnetic field that created them generating a repulsion effect; this action can generate a change in the momentum of the plate due to the action of the repulsion force that the magnetic field pulses originate ***diag. 1***

In order to facilitate the explanation of the operation of the concepts related to the design of unlinked force field thrusters, we are going to use diagrams that illustrate the movement of the fields in the direction of the susceptible object or target starting from an emitting element towards the target using rectilinear displacement arrows, although we know that electromagnetic fields propagate in a much more complex and almost omnidirectional way, we are only taking into account the displacement trajectories between the emitter and what we call the target.



E *magnetic field pulses emitter*
PL ***c****onductive plate target*
L *distance between emitter and target*
B *magnetic field pulses*
F *resulting force*

diag. 1

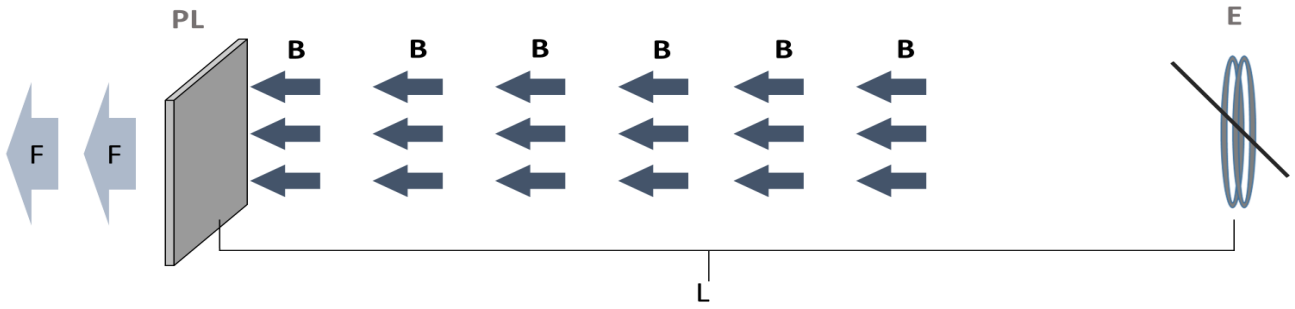
Maxwell's equations for electromagnetism allow determining the magnitude of the induced currents and the forces resulting from the interaction of variable or pulsed magnetic fields acting on a plate of conductive material:

$$\nabla \cdot \boldsymbol{E} = \frac{\rho}{\varepsilon_0}$$
$$\nabla \cdot \boldsymbol{B} = \mathbf{0}$$
$$\nabla \times \boldsymbol{E} = -\frac{\partial \boldsymbol{B}}{\partial t}$$
$$\nabla \times \boldsymbol{B} = \mu_0 \boldsymbol{J} + \mu_0 \varepsilon_0 \frac{\partial \boldsymbol{E}}{\boldsymbol{J}t}$$

Through the action of electromagnetic fields, as we will see later, it is possible to generate an impulse force through mechanisms unrelated to the Newtonian principles of conservation of the momentum balance but maintaining the principles of conservation of energy. Several researchers have already been able to demonstrate in the laboratory that this is possible.

b. An electromagnetic field can change the dynamic state of a susceptible body even after the element creating the electromagnetic field has ceased to exist.

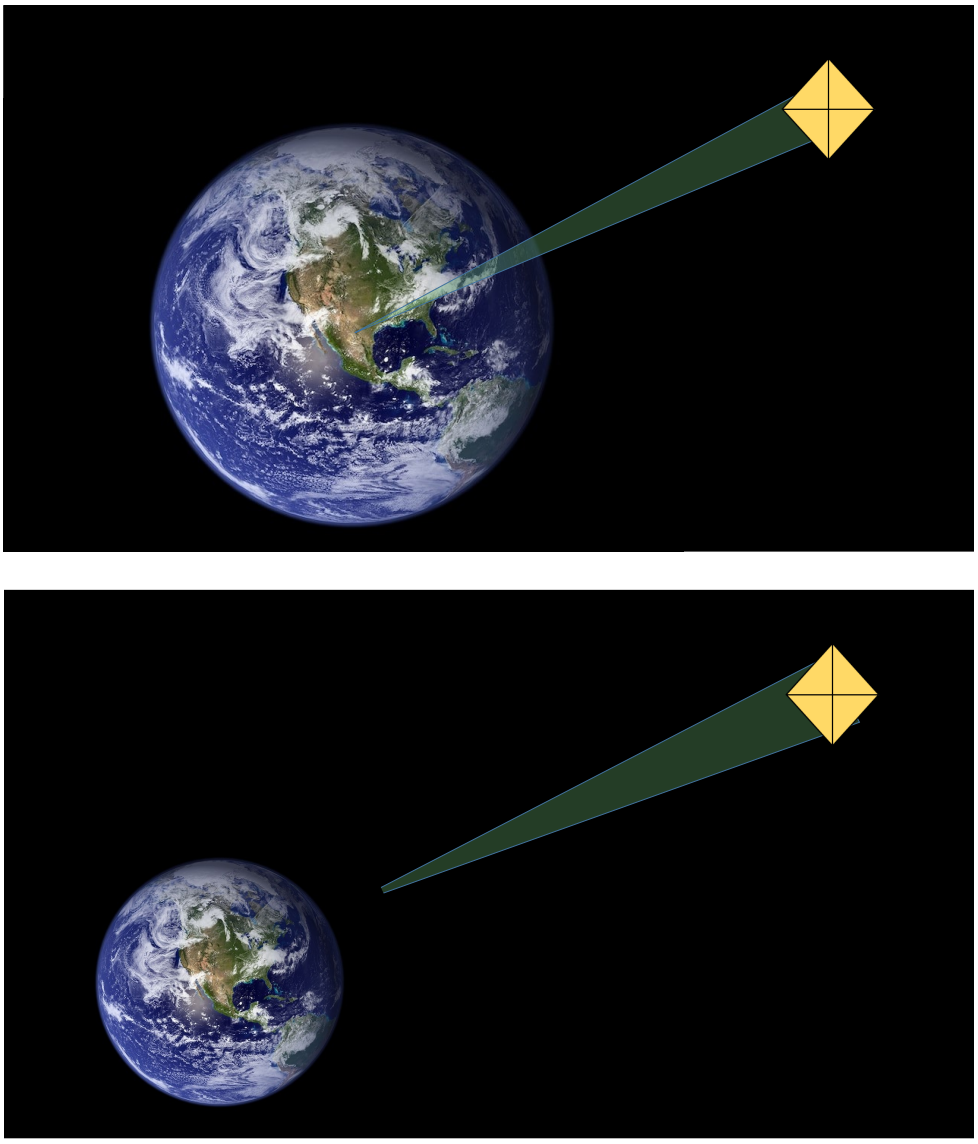
If the emitter in ***diag. 1*** ceases to exist as in ***diag. 2***, the target plate will be receiving the impact of the remaining magnetic field pulses that are traveling through the space between the disappear emitter and the plate until the last one pulse impacts the target.



E *magnetic field pulses emitter*
PL ***c****onductive plate target*
L *distance between emitter and target*
B *magnetic field pulses*
F *resulting force*

diag. 2

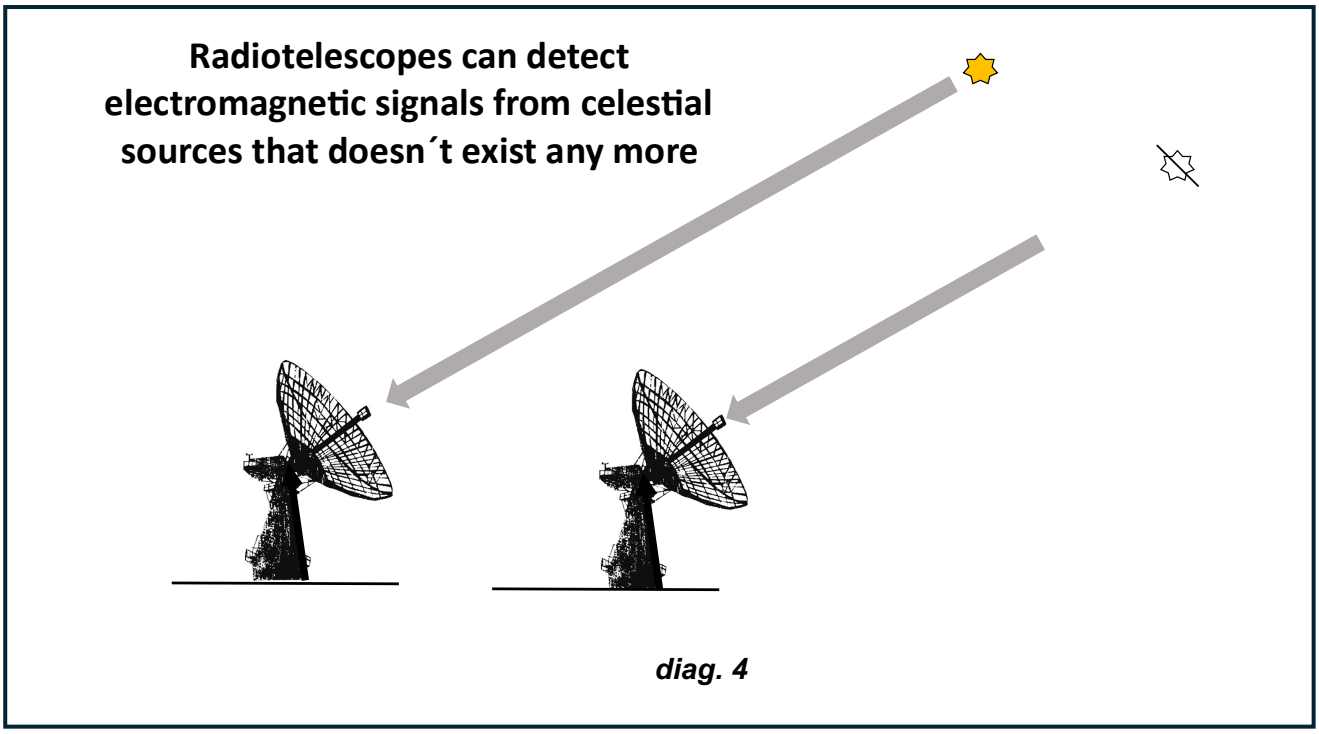
We can also consider the case of a light sail that is at a great distance from the origin of a light beam directed to it, if at a given moment this light beam stops transmitting the sail may still experience acceleration due to the remaining radiation that travels through the space from the original source to the light sail.
Here the important thing to note is that the light sail can acquire an increase in its momentum directly from the electromagnetic radiation which in this case is light, without a balance of momentum of the sail with respect to the emitter, in such a way that the remnant of the electromagnetic wave that continues its journey between its point of origin and the sail can continue to increase the speed of the sail even if the laser emitter is turned off as long as there is still an amount of this laser light (electromagnetic radiation) traveling through space after its emission has been interrupted and until the last portion of this electromagnetic radiation arrives to impact the light sail. (***diag. 3***)



diag. 3

We can easily appreciate this concept by observing radio telescopes that can capture the energy of electromagnetic waves generated by stellar bodies that have long since ceased to exist.

Some sources of electromagnetic radiation in the universe cease to exist, but the electromagnetic energy they have generated continues to travel through space for up to millions of years and that electromagnetic energy can be captured by radio telescopes because its sensors are susceptible to these types of radiation and can continue to do so regardless of whether its source no longer exists. (***diag. 4***)



diag. 4

The concept that a susceptible object can be affected in its dynamic state by electromagnetic fields whether modulated or pulsed for a certain time after its source of origin has ceased to exist is what we call "unlinked electromagnetic field effect." And is the basis of our 100% electric thruster's design.

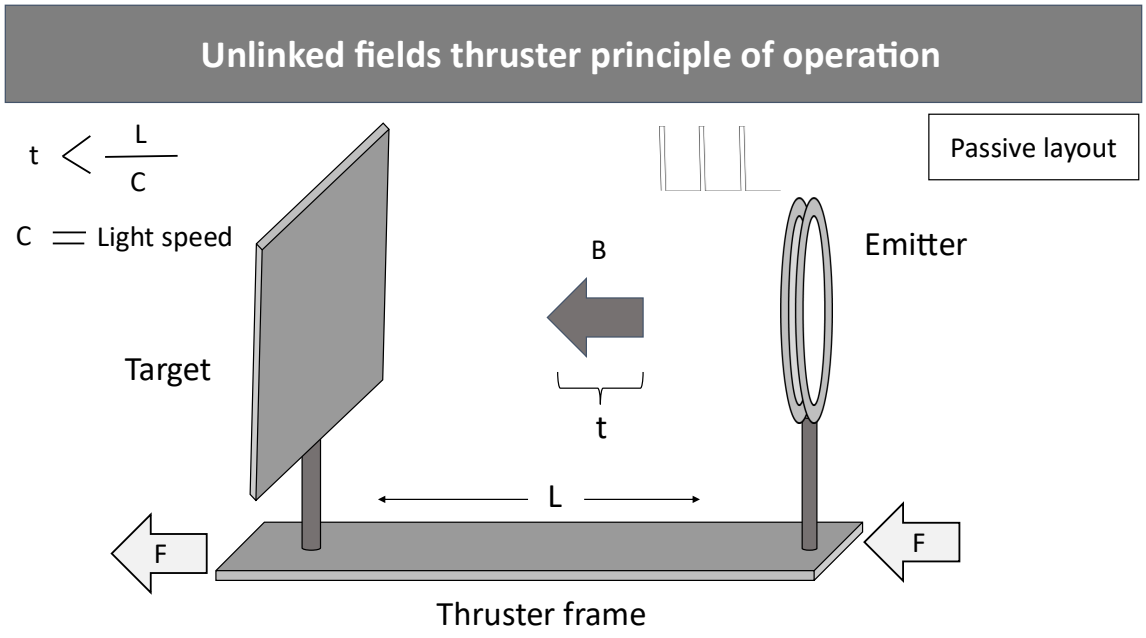
4. Technology development.
Unlinked Electromagnetic Field Thruster.

How to apply the above to the development of a 100% electric impulse engine for space use that does not use propellant or fuel.

Understanding the principle of **unlinked electromagnetic field thrusters** might seem complicated, but it can be simplified with a straightforward analogy. Imagine a plate made of conductive material suspended in space. Now, imagine a pulse emitter that sends out

magnetic field pulses. Every time a pulse hits the plate, it generates an induced current. This current, in turn, creates a magnetic field that opposes the one that caused it, generating a force, now, if the pulse emitter suddenly stops or disappears, the magnetic field pulses it had emitted continue to travel through space until they reach the plate and generate force pulses due to the repulsion between the fields created on the plate and the incoming field pulses.
This is similar to how radio telescopes in astronomy can detect electromagnetic signals from cosmic sources that no longer exist. This process of generating induced currents and resulting forces can be deduced directly from Maxwell's equations and electromagnetic theory.

Applying this principle to the design of an **unlinked electromagnetic field thruster**, consider this assembly that we call “passive layout” (***diag. 5***):

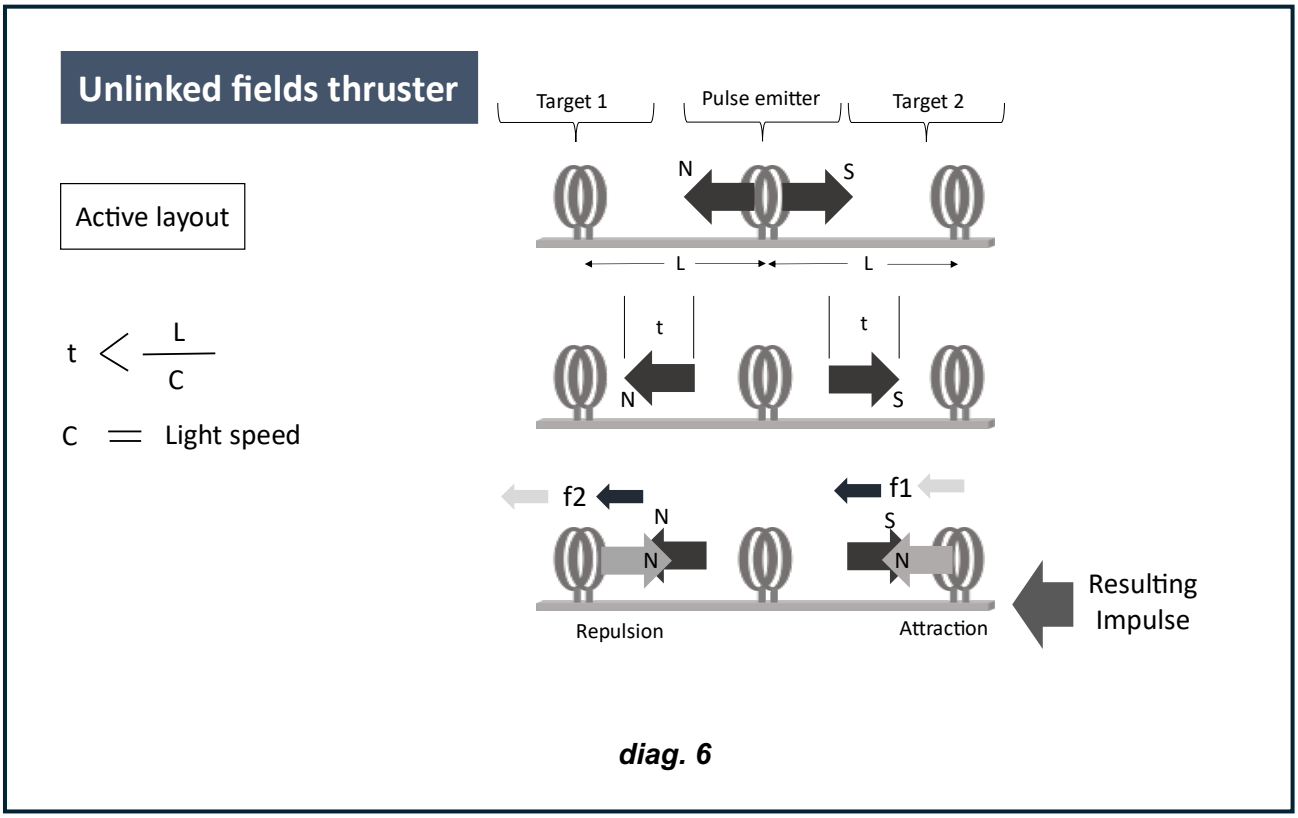


diag. 5

A pulse emitter and a plate, both on the same frame, the emitter is activated by an electronic circuit and sends out intense magnetic field pulses, the duration of these pulses is shorter than the distance between the emitter and the plate divided by the speed of light which is the propagation speed of the magnetic field pulses, this allows each pulse to detach or unlink from the emitter before reaching the conductive plate.
The emitter generates a large number of pulses per second, each time that an unlinked pulse impacts the plate, induced currents are generated, producing a repulsion force against the magnetic field pulses that created them. This force lasts a very short time but results in a micro-impulse. When multiplied by the number of pulses produced by the emitter in one

second, this micro-impulse determines the final impulse and consequently, the movement of the structure containing the emitter and the plate.

The operation principle can also be applied using an array with a primary magnetic field pulse generator and two secondary emitters; we call this array “active layout”. (***diag. 6***)
A primary emitter generates intense magnetic field pulses, each shorter in duration than the distance between the secondary emitters and the primary emitter divided by the speed of light. The secondary emitters then emit synchronized pulses, one of attraction and one of repulsion, which generate micro-impulses that finally consolidates in a final impulse.

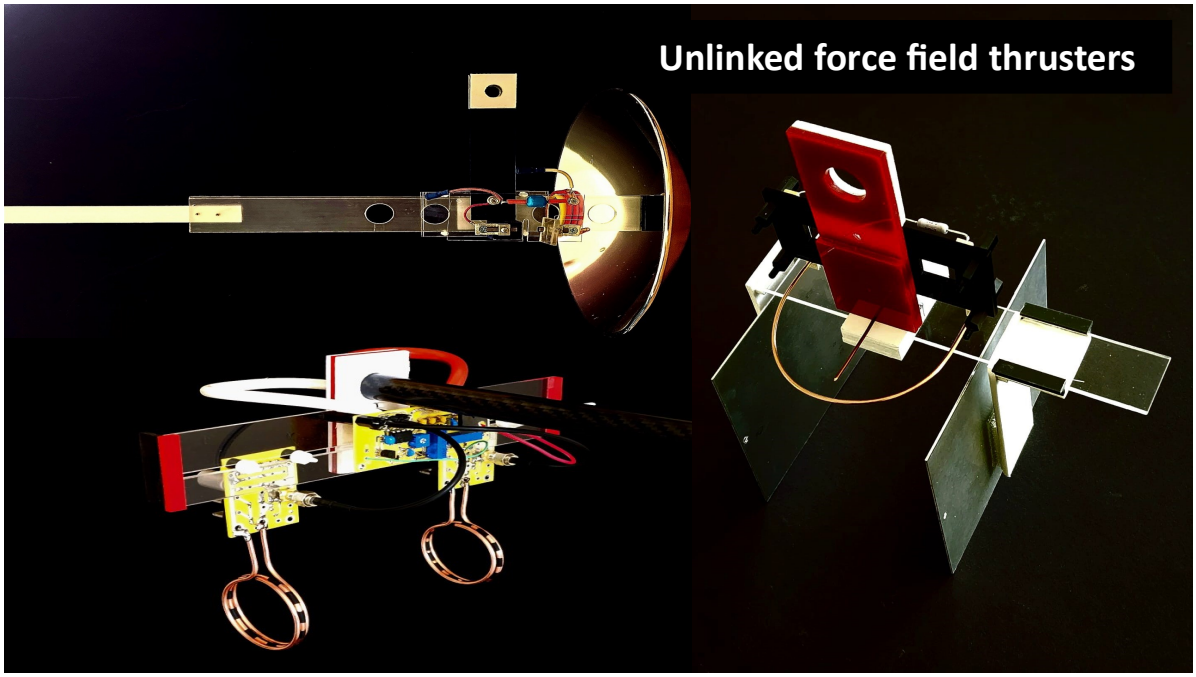


diag. 6

5. Experimental Validation:

So far we have carried out feasibility tests using torsion balance and various assemblies that allow us to measure, evaluate and calibrate various thrusters based on the principle of **unlinked electromagnetic fields**, due to the extreme complexity of the mathematics related to this area of science, we have seen that the best option to advance rapidly in the processes of debugging and perfecting this technology is computer simulation which will allow us to obtain the best relationship of parameters as well as being able to estimate the maximum

scope of this technology being one of the most important issue the maximum speed that could be achieved with an **unlinked electromagnetic field motor or thruster.**
As we have being obtaining good results in terms of validation and impulse, we have high expectations regarding this technology, the theoretical analysis allows us to anticipate that the thrust forces and maximum speed far exceed those of current ion engines and although it is possible that the **unlinked electromagnetic fields technology** will not be able to exceed the maximum thrust force of the most powerful chemical engines, we anticipated that can far exceed their maximum speed.
Currently we are carrying out laboratory tests with different variants of the **unlinked electromagnetic fields thrusters,** firstly with magnetic field pulses in the active and passive layouts, that is, using plates of conductive material as targets both isotropic and anisotropic in the case of the passive layout and using secondary emitters as targets in the active layout versions, we are also carrying out tests with versions focused on the use of primarily electrical field pulses using plates as electric field emitting elements and feeding them with high voltage electronic circuits (20,000 to 40,000 Volts).
Actually, we are reaching the limit of our installed laboratory capacity so we are looking for partners that will allow us to advance both in computer simulation development and testing using better materials and testing facilities to reach functional and commercially ready designs to go out into the market and into space.

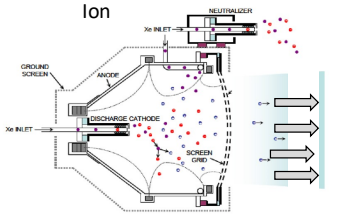
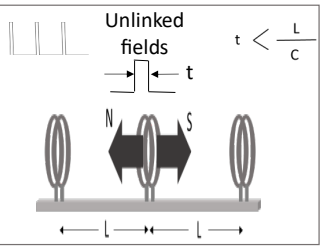


6. Comparative Analysis:

Comparisons with existing propulsion technologies, such as ion thrusters and chemical engines, reveal the unique advantages of **unlinked electromagnetic fields thrusters.**

Notably, **unlinked electromagnetic fields thrusters** offer independence from propellants or fuels, cost-effectiveness in manufacturing and potentially superior thrust and speed characteristics compared to traditional propulsion systems. **(*diag. 7*)**

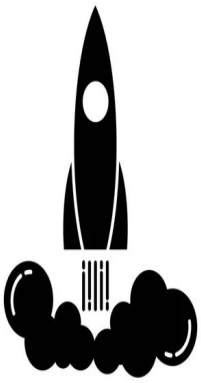
Thruster technologies for space use comparison

Thrusters	Chemical	Ion	Unlinked fields
			
Required to operate	Tanks for fuel and oxidants , electric energy , electric valves and servomechanisms	Electric energy , propellant and storage tanks for it , electric valves , high voltage electronics ,exotic materials	Electric energy , high frequency electronics
Cost	Very high	Very high	Low
Remarks	High thrust , terminal performance limited by the rocket equation	Very low thrust , cannot operate if propellant tank is empty , requires exotic materials	High thrust , 100% electric , low cost No fuel, no propellant

diag. 7

chemical thrusters. (*diag. 8*)

Limitations of chemical thrusters



Requires large amounts of fuel

Each kilogram of fuel represents almost 20000 dollars extra in the budget

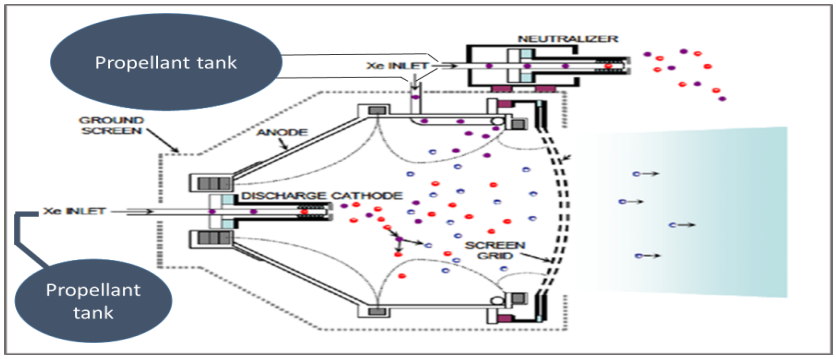
Chemical thrusters are very expensive and complex

Tsiolkovsky's rocket equation shows that chemical rockets are reaching its limits in performance

diag. 8

Ion Thruster. (daig. 9)

Ion Thruster



Ion thrusters try to overcome Tsiolkowsky equation´s limitations by increasing exhaust velocity but relies in the use of gas propellants that requires storage , add mass to the system and stops operating when propellant tank is empty

daig. 9

The main characteristics and qualities of **unlinked electromagnetic fields thrusters** are first of all, their independence from fuels or propellants. This type of engine is very easy to manufacture and has a very low cost since it does not require exotic materials.
The most delicate aspect in the manufacture of these thrusters, is the very high frequency and power electronics required and that in some of its modalities it is necessary the handling of high voltage (20,000 to 40,000 Volts). We still do not know what is the maximum speed that could be achieved with this type of thrusters, because the handling of mathematics related to electromagnetic theory in three dimensions is very complicated but with the use of computational simulation we will know.

7. Expected impulse.

Regarding the amount of thrust that this type of motor can generate, let's think for a moment that the primary magnetic pulse emitter and the target are two parallel conductors placed at a distance ***d***, each having a total length equal to ***L***.
If we consider the equation for calculating the force between both conductors:

$$F = \frac{u_0}{2\pi d}\left(I_1 \quad I_2 \right) L$$

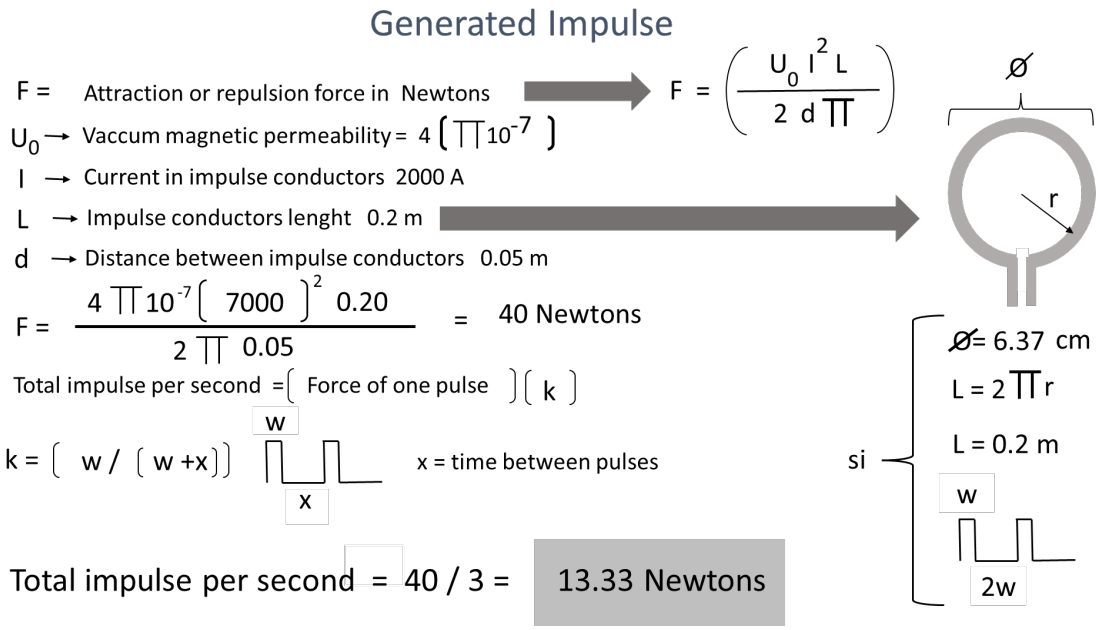
This equation is obtained directly from the manipulation of the equations of electromagnetic theory and is the basis for the definition of the unit of electric current (the ampere).

We can see that the smaller the distance between conductors, the greater the force created by the magnetic field between both conductors. The currents I_1, I_2 can reach values of several hundred amperes during the execution of very short pulses. It is easy to determine that it is feasible to generate high levels of attraction or repulsion force between both conductors (depending on the direction of the currents) although as the distance between both conductors decreases the force increases linearly, the smaller the distance between both, the shorter must be the duration of the pulses to achieve their unlinking, so a calculation will have to be reached where the force is maximized based on the ability to produce the most intense and brief pulses that are possible.

It is general knowledge that in the past, accidents have occurred in electric power plants because high currents in parallel steel connecting bars have caused these bars (up to half an inch thick), to bend and generate short circuits.

8. Numerical calculation of impulse.

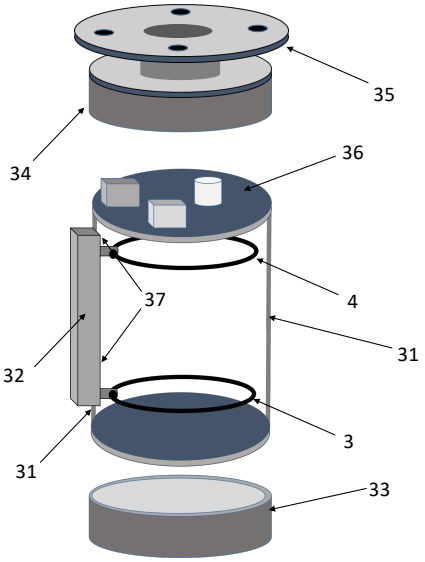
Considering the two impulse currents equal and with a magnitude of 7000 amperes, the distance between conductors equal to 5 cm. And the length of the conductors equal to 20 cm. arranged in a circumference of 6.37 cm. In diameter, as well as a ratio of the pulse width and the time between each pulse of 1 to 2, that is, if the pulse width is equal to w, the pulses will be spaced by a time equal to 2w, then we can do the following calculation:

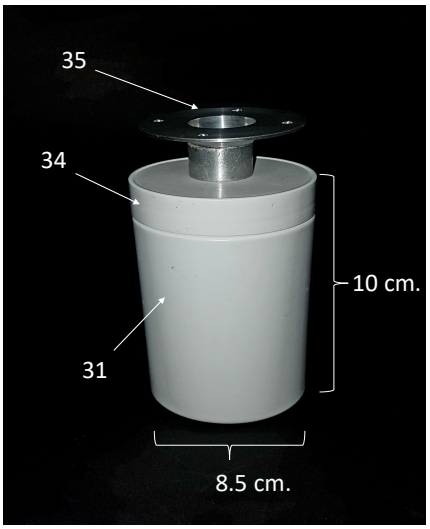


As can be seen in this 100% electric motor, the impulse per second can be extraordinarily high. We have calculated these approximations through computer simulations and the performance can be greatly improved by using more specific components such as metals and very low resistivity compounds, capacitors with ultra-low inductance discharge and optimal transmission lines, according to our calculations it is possible to manufacture low-cost, low-weight thrusters with reduced volumetric dimensions that can provide good levels of impulse without using propellants or fuel.

Thrust forces on the order of 1 to 20 newtons may seem small compared to what a chemical motor can offer, however, the force in the unlinked field motor, can be applied to the satellite or space ship by long periods of time, producing final velocities much greater than those produced by chemical motors, an unlinked field thruster can generate thrust for months or years without ceasing to produce acceleration and operate as long as they have a supply of electrical energy, while chemicals motors can only work for a few minutes.

The equation of impulse and momentum: $\boldsymbol{Ft = m\,(\Delta v)}$ allows to easily appreciate this.





9. Patents:

In parallel with the development in laboratory, we have proceeded to prepare invention patents for the protection of the technology of **unlinked electromagnetic fields thrusters.** We have patents granted in several countries such as United States of America, China, Russia, Japan, Israel, Eurasia etc…

The patent priority of **unlinked electromagnetic fields thrusters'** technology is:
Sept. 30, 2016

10. Conclusion:

In conclusion, **Unlinked Electromagnetic Fields Thrusters** represent a transformative technology with the potential to revolutionize electric propulsion in aerospace applications. By harnessing electromagnetic force field, **unlinked electromagnetic fields thrusters** offer a sustainable, cost-effective, and high-performance alternative to traditional propulsion systems.

The concept that a susceptible object can be affected in its dynamic state by electromagnetic fields whether modulated or pulsed for a certain time after its source of origin has ceased to exist is what we call "unlinked electromagnetic fields effect." And is the basis of our 100% electric thruster's design.

11. Acknowledgments:

The authors acknowledge the support and contributions of colleagues, partners and collaborators involved in the research and development of **unlinked electromagnetic fields thrusters.**