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New Magnet Ion (pa-pu-la) Engine (Plasma Propulsion)

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***Abstract*— *The ion space engine, or ion thruster, represents a cutting-edge propulsion technology that employs electrostatic acceleration of ionized fluxes to generate thrust. Unlike conventional chemical rockets which expel combustion gases, ion engines accelerate charged particles to extremely high velocities, achieving specific impulses several times greater than traditional chemical propulsion. This results in highly fuel-efficient propulsion suitable for long-duration deep space missions. This research explores the fundamental principles, technological developments, and applications of ion propulsion systems. Additionally, we introduce a new design, the Ion (pa-pu-la) Engine, with particular emphasis placed on the electrostatic ion thruster design, its operating mechanisms, and performance characteristics. Our research also reviews successful missions utilizing ion engines, their advantages and limitations, and potential future applications, including satellite station-keeping, asteroid exploration, and interplanetary travel. In addition, our research provides innovative ideas in building the new generation of the Magnet Ion (pa-pu-la) Engine. We estimate that this new spaceship engine can provide a speed up to 1/10 of the speed of light.*

***Keywords*— *Magnetic Donut, Pa-pu-la System, Plasma Propulsion, Magnet Ion (pa-pu-la) Engine.*

I. Methodology

This research article is based on a comprehensive systematic review of rigorously peer-reviewed scientific studies sourced from reputable databases such as NASA, Google Scholar, and ResearchGate. The focus is on analyzing various types of space research, including associate studies, case studies, and meta-graphy analyses, all published within the timeframe from 2020 to 2025. The review above can provide strong support for our innovative New Magnet Ion (pa-pu-la) Engine (Plasma Propulsion).

II. Literature review:

The ion engine technology has evolved as a critical component of electric propulsion systems used primarily for spacecraft propulsion. Ion thrusters operate on the principle of ionizing a neutral propellant gas, commonly xenon, and electrostatically accelerating the resulting positive ions through grids with high voltage differences to generate thrust. This electrostatic acceleration method enables velocities of charged particles between 15 to 50 km/s, significantly surpassing the exhaust velocities of traditional chemical rockets and thereby enhancing fuel efficiency and mission duration [1].

Early demonstrations of ion propulsion include NASA's Space Electric Rocket Test (SERT) missions in the 1960s which validated the technology's feasibility in space environments. More recent missions such as Deep Space 1 and Dawn have used ion engines to achieve substantial velocity increments, translating to increased mission flexibility and range without proportional increases in fuel consumption. For example, Dawn's ion propulsion allowed it to orbit two separate celestial bodies—Vesta and Ceres—a feat unattainable with conventional propulsion [2].

The core components of an ion engine include the ionization chamber where plasma is generated, the acceleration grids that impart high kinetic energy to ions, and the neutralizer that releases electrons to maintain spacecraft electrical neutrality and continuous thrust production. Modern systems, such as the microwave discharge ion engine used on Japan's Hayabusa and Hayabusa2 missions, have innovated by removing discharge electrodes to enhance longevity and reduce complexity [3].

III. Discussion and Insight:

In space, the environment is characterized as a near-perfect vacuum, which implies an extremely low density of particles and negligible resistive forces such as drag or friction. Theoretically, this absence of resistive forces suggests that an object in free space can continue its motion indefinitely without energy loss, according to Newtonian mechanics and the principle of inertia. However, to examine the nuances between the equivalence principle—a cornerstone of General Relativity—and the phenomena observed during space travel, it is essential to recognize that space is not an absolute void but a quantum vacuum with subtle fluctuations and fields. Proximity to massive celestial bodies, such as planets, introduces spacetime curvature, which manifests as gravitational attraction and tidal forces. Furthermore, interactions between galaxies involve complex gravitational dynamics governed by Einstein's field equations, resulting in gravitationally bound systems and large-scale structure formation. From a perspective grounded in relativistic acceleration, if an object maintains a constant velocity relative to a distant inertial frame, it must experience continuous proper acceleration to counteract the spacetime curvature effects and to keep its trajectory inertial relative to local spacetime geometry. This acceleration, while maintaining constant speed locally, results in a non-inertial frame characterized by proper acceleration. In essence, absent resistive forces, the propulsion system must supply perpetual energy input to sustain acceleration, which—on a proper time axis—appears as continuous acceleration. Moreover, the vacuum, while nearly empty, exhibits quantum fluctuations—virtual particles and fields—that can produce effective repulsive or attractive interactions at microscopic scales, potentially influencing the dynamics of objects over vast distances. These subtle quantum effects, coupled with gravitational interactions, underpin the complex behavior observed in space environments and inform current models in relativistic physics and astrophysics.

The speed of light, denoted as 'c', is a fundamental constant in the realm of physics, establishing an ultimate speed limit for information and matter within the framework of special relativity. However, there exists a speculative hypothesis within the theoretical physics community regarding particles known as tachyons. Tachyons are hypothetical, faster-than-light (FTL) particles that, if they exist, would possess imaginary rest mass and traverse space at superluminal velocities, exceeding 'c'. The concept of tachyons originates from solutions to certain equations in quantum field theory and special relativity, where their existence implies intriguing yet controversial implications for causality and the structure of spacetime. Mathematically, tachyons are associated with imaginary mass terms, often expressed as the square root of a negative quantity, such as \\sqrt{-1}\\, reflecting their superluminal nature and the complex extensions of relativistic energy-momentum relations.

Let : $F = E$

$$F = MA$$
$$E = MC^2$$
$$MA = MC^2$$
$$A = C^2$$

Innovative Idea with suggestion:

Therefore, the foundational principles underlying these two scenarios—operating an engine in space versus on Earth—are inherently different due to the varying gravitational and environmental conditions. While it is theoretically possible to design an engine compatible with both environments, the operational results and performance metrics will differ substantially when the same engine is utilized in each setting. Under the equivalence principle, the gravitational acceleration (G) and the proper acceleration (A) are indistinguishable locally; hence, in a free-falling reference frame such as an elevator, occupants cannot differentiate whether the acceleration originates from gravity or from an applied force. Consequently, G = A holds true in both outer space and terrestrial environments from a physical law perspective. In practical electromechanical systems, this principle allows the propulsion apparatus to generate a force component aligned horizontally relative to its frame of reference, effectively translating an external rotational torque into an internal reaction torque. This transformation results in a counter-rotation, facilitating propulsive acceleration through torque-induced reaction forces. Specifically, a dynamic propulsion engine operates by converting the external rotational force into a moment that produces internal counter-torques, which collectively contribute to the generation of thrust. This mechanism involves complex interactions between angular momentum transfer, torque modulation, and reaction force management to achieve controlled acceleration, emphasizing the advanced application of rotational dynamics and electromagnetic or mechanical force exchanges in propulsion system design.

$$F = G_{matter}. P.A$$

$$Force = Gravity_{plasma-matter} \times Perturbation \times Accelaration$$

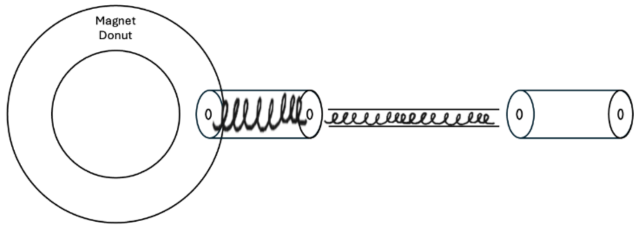

Figure 1: Pa-Pu-la spinning system (Plasma Propulsion)

The Pa-Pu-la system uses magnetic force to generate hydrogen plasma, creating a nuclear fusion reaction in the magnetic donut. Hot plasma flows through, generating ongoing plasma due to the strong magnetic reaction. The hydrogen gas heats up and causes fusion. The plasma then moves through pipelines during the tunneling process, which causes perturbation effects that can boost plasma acceleration, pushing the plasma out of the tunnel. The ejection of hot plasma produces thrust, providing kinetic energy to propel the spaceship.

This Pa-Pu-la system employs a sophisticated magnetic confinement mechanism to generate high-temperature hydrogen plasma, which facilitates controlled nuclear fusion reactions within a toroidal magnetic confinement device, analogous to a tokamak or stellarator. The magnetic fields confine and stabilize the plasma, maintaining the extreme temperatures necessary for fusion. As hydrogen gas is ionized and heated via electromagnetic induction or radiofrequency heating, it reaches conditions conducive to nuclear fusion, primarily deuterium-deuterium or deuterium-tritium reactions, releasing significant energy. This energetic plasma flows through a series of magnetically-actuated pipelines or channels designed to compress flux, that can in-turn accelerate the jet fluxes, during which perturbation modes can be intentionally excited to induce magnetohydrodynamic (MHD) fluxes that enhance plasma acceleration through Lorentz force interactions. The resulting hot plasma is directed through flux tubes during a tunnelling or ejection phase, where magnetic mirror effects and magnetic nozzle configurations modify the plasma dynamics, increasing exhaust velocity. The ejection of the heated plasma produces a reaction thrust via the principle of conservation of momentum, effectively converting the kinetic energy of the plasma into useful propulsion for the spacecraft. This system integrates magnetic confinement fusion, plasma dynamics, and MHD acceleration to achieve efficient, continuous propulsion in space travel.

As illustrated in Figures 1 and 2, the plasma will then experience a perturbation, which we call the spinning in the tunnel, with pa-pu-la. This perturbation process causes the Ion engine to thrust the plasma out with hot steam. Our magnet donut is a strong magnet that can generate a powerful magnetic repulsive force.

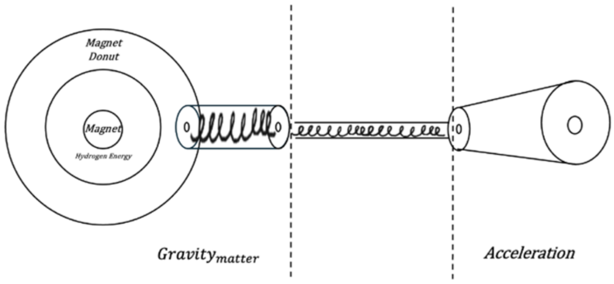

Figure 2: New Ion (pa-pu-la) Engine (Plasma Propulsion)

The repulsive force from the surrounding inner core of the tone will prevent the hot plasma from melting down the entire system. Additionally, the two pipeline tunnels, as shown in Figure 2, have the same repulsive magnetic force in the surrounding area (inner tone) to prevent the plasma from melting down the pa-pu-la pipeline tunnel. Moreover, the pa-pu-la pipeline tunnel can induce spin, which provides an extra push force to boost the plasma's speed. The final part of the cone-shaped side will eject the hot plasma.

IV. Conclusion

This study explores the fundamental principles, technological progress, and applications of ion propulsion systems. We introduce the Ion (pa-pu-la) Engine, a new design centered on the electrostatic ion engine, detailing its operation and mechanism. Additionally, this paper introduce an innovative ideas for developing the next-generation Magnet Ion (pa-pu-la) Engine. Our estimates suggest this new craft could reach speeds up to one-tenth of the speed of light. Hope this paper can benefit the world and mankind.

References

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