Laser Propulsion System, Powered by a Supercapacitor System, Along with Time-Independent Communication Protocol

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Abstract/Background:

Long-distance interplanetary, interstellar, and intergalactic travel has long been an unrealized dream of humanity, due to limits in aerospace engineering. Fuel limitations have led to proposals involving a solar sail system which entails transfer of momentum from photons emitted from a nearby star or a satellite laser. Acceleration of a solar sail system would be limited to regions exposed to substantial optical flux. Instead of relying on naturally produced photons, here, a dense powerful laser system(s) is(are) proposed which transfers momentum via emission of exhaust photons. Since the laser systems would require a substantial energy supply to accelerate the inertial mass of the craft to an appropriate speed for interstellar travel, an onboard supercapacitor system is proposed. Due to the traveler being far into the future relative to those at the departure location, a communication protocol independent of time is proposed. Entanglement between two particles exhibiting time dilation yields a system such that transmitting binary data via switching spin of entangled particles against time's arrow becomes theoretically possible, bolstered by the fact that spin exchange increases entropy.

Introduction

The theoretical work of Lorentz, along with the experimental work of Michelson and Morley led Einstein to his famous Gedanken which led to the now well-established theory of special relativity. Extending to general relativity led to the complete quantification of space-time. While Chandrasekar and Thorne contributed greatly to a universal understanding of the limits of space-time with their study of black holes, engineering has struggled to keep pace. For example, only recently has GPS technology included satisfactory relativistic corrections. Furthermore, theorists have long struggled with unifying relativity and quantum mechanics, while overlooking other interesting possibilities. Here, not only is a propulsion system theorized which would allow interstellar travel at near-light speed, but a classical method of powering such propulsion is proposed, along with time-independent communication protocol to combat the time dilation between traveler and observer.

Discussion

It is well-known that the photon is massless yet carries a momentum of

$$p=\frac{h}{\lambda}, \qquad \textbf{(1)}$$

where h is Planck's constant, and λ is the wavelength. As photon flux is emitted from a laser, momentum flux occurs though the cross-sectional area, as well, yielding a transfer of momentum flux

$$\Phi=\frac{1}{A}\frac{dp}{dt}=\frac{h}{\lambda A}\frac{dN}{dt}, \qquad \textbf{(2)}$$

where N is the number of photons emitted along the unit normal vector to the cross-sectional area. By definition,

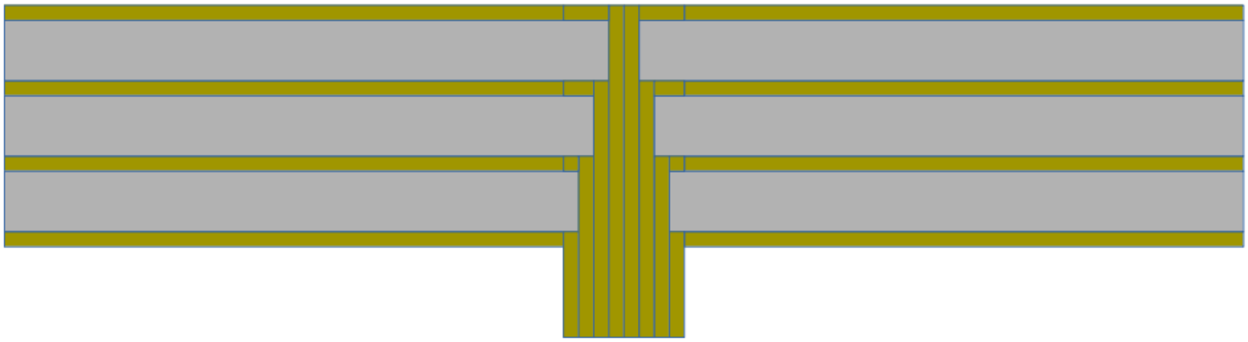

Figure 1. *The colossal dielectric constant materials are shown in grey, while the electrodes and wires are shown in a copper color.*

$$F=\frac{dp}{dt}. \quad \textbf{(3)}$$

By Newton's first law, an equal and opposite normal force is exerted on the cross-sectional area of the laser. Assuming the laser is attached to the craft, this force accelerates the craft. It should be noted that as a photon is emitted, the excited electron decreases in energy state, therefore any reactionary force is not quantum mechanical in nature.

The powering of the laser system on the craft is proposed to be a release of electrical energy from a stack of parallel plate capacitors in a parallel circuit configuration, thus resulting in an increase in stored electrical energy proportional to a summation of the individual capacitance values of each layer. Such power transferred over such a short period of time results in a release of energy equivalent to

$$E=\int P\,dt=\int \boldsymbol{F}\,d\,\boldsymbol{x}, \quad \textbf{(4)}$$

where P is the power released, t is the time period of release of such power, and **F** is the force exerted on the craft during that time period over a distance **x**.

In order to store such electrical energy, a material with a high dielectric constant is not sufficient – a colossal dielectric constant, such as that of LSNO,[1] CCTO, or PZT is necessary for proper engineering of such a system of capacitance. **Figure 1** shows such a configuration where the proposed system of colossal capacitance is shown. Due to the parallel placement of the parallel plate capacitors in the system, the total capacitance is a simple summation of each individual later, such that

$$C_{total}=\sum_i C_i, \quad \textbf{(5)}$$

and the total potential electronic energy stored is

$$U=\frac{1}{2}C_{total}V^2. \quad \textbf{(6)}$$

In theory, capacitors can be added continually such that energy stored has no physical limit. This energy can be released very quickly, according to the time constant of the arrangement, or the current can be reduced appropriately either with current reduction or by releasing each stack, one at a time. In any case, the system of capacitors can power the laser system as quickly as the photons can be excited, and acceleration is achieved much simpler than any propulsion device conceived of to date. The laser-emission system, along with the supercapacitor system has been claimed under USPTO provisional utility patent application #63230785, with confirmation #3211.

In theory, the fundamental limit of such a velocity which could be achieved would be the speed of light, enabling the craft to arrive at its destination instantaneously, according to proper time, while time would pass as normal at the departure location, in accordance to special relativity. Effectively, one

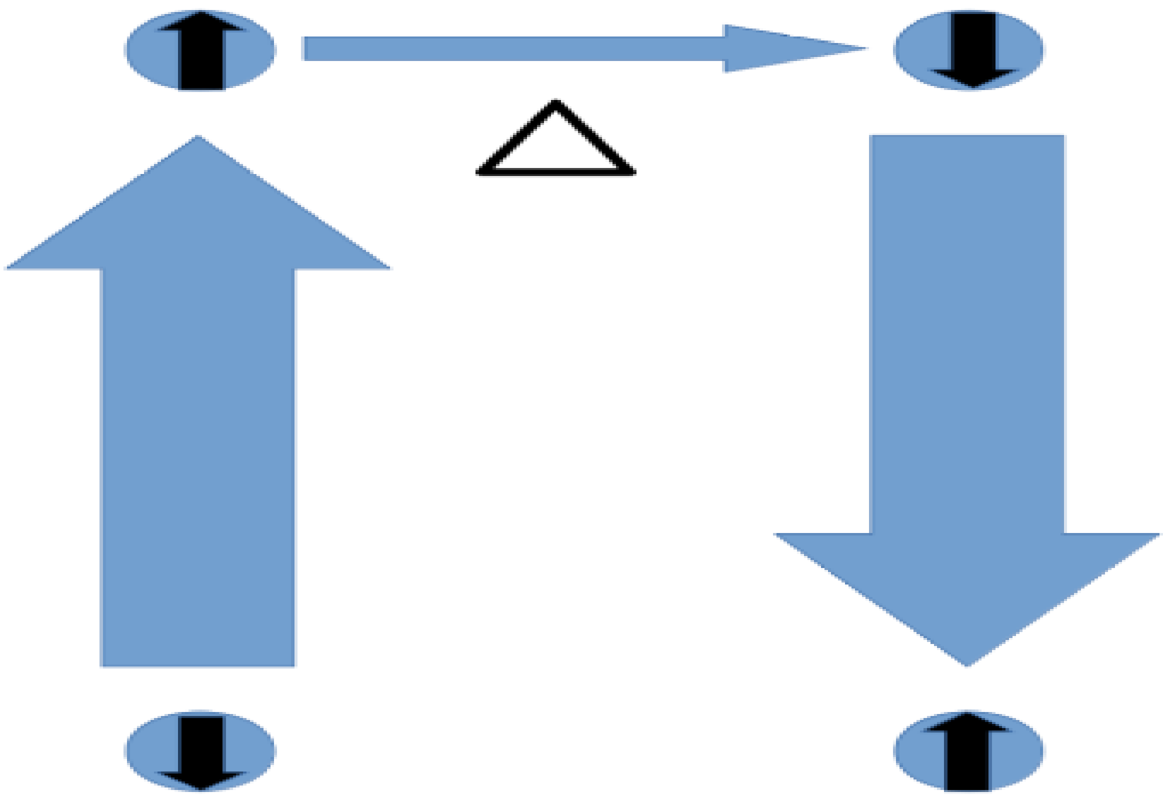

Figure 2: *The figures display a system of transmitting binary data via entangled particles, where the black arrows indicate spin and blue arrows indicate direction of data transfer. The two pairs of entangled particles are shown, and the Δ indicates the electromechanical time delay between the transfer of data from the first pair of entangled particles to the second.*

could travel quasi-infinitely into the future, according to one of the fundamental assumptions of special relativity – time dilation, where the different between the departure time and proper time is equal to

$$\Delta t = \gamma \cdot \boldsymbol{v} \cdot \boldsymbol{d} / c^2 , \quad \textbf{(7)}$$

where the Lorentz factor γ can be described by

$$\gamma = \left(1 - \frac{|\boldsymbol{v}^2|}{c^2}\right)^{-\frac{1}{2}} . \quad \textbf{(8)}$$

Clearly, in the limit where v approaches c, the difference between the two times approaches infinity. It should be noted that at an acceleration of 1g, near-light speed could be reached in under one year. Assuming deceleration at 1g, as well, one could conceivably reach any destination in the known universe in under two years.

Unfortunately, due to special relativistic concerns, even though only about two years would pass in proper time (in situ), observers at the departure location would perceive time elapsed to be much greater. While the traveler would be in the future relative to those at the departure location, communication should still be possible, according to known laws of physics. First, however, some discussion of recent advances in entanglement is warranted.

The most notable advancement in experimental entanglement in recent memory was the skillful reduction of quantum decoherence by Chinese researchers in their famous ground to satellite experiment, where photon pairs were entangled at a distance of approximately 1200 km.[2] However, more cost effective approaches have shown promise in recent years, building on Cramer's recent experiments based on his reformulation of Wheeler-Feynman absorber theory.[3] Specifically, again, Chinese researchers have developed a method of entangling photons along a single mode fiber optic cable over significant distance.[4] These are great achievements in science, yet due to their massless nature, transmitting binary data via the switching of entangled photons, which travel at the speed of light, would lead to a limit such that the data would arrive infinitely before the particles were initially entangled.

Incidentally, it is well known that either two fermions or two bosons are capable of becoming entangled, as well. As Dieks has explicated well recently, an entangled quantum state can be described by the following equation:

$$|\Psi\rangle = \frac{1}{\sqrt{2}}\left\{|\phi_1\rangle|\psi_2\rangle \pm |\psi_2\rangle|\phi_1\rangle\right\}, \quad (9)$$

where the + sign applies to bosons, and the - sign applies to fermions.[5] Having mass, the velocity of fermions or bosons can be controlled, such that time dilation can be engineered appropriately.

Switching spin of a ground particle, which would in turn switch the spin of the entangled particle on an accelerated object such as a space probe or craft, leads to a time-dilated binary message. Returning the message back to ground would require the message to be transferred to either a third entangled particle, or more easily, an electro-mechanical switching system which manipulates the spin of a second pair of entangled particles. In the simpler case, using the electromechanical switching system, a τ term is introduced, which accounts for the electro-mechanical delay and is added to the dilated time. The full dilated time difference becomes

$$t_D = \gamma \cdot \boldsymbol{v} \cdot \boldsymbol{d_a}/c^2 + \gamma \cdot \boldsymbol{v} \cdot \boldsymbol{d_b}/c^2 - \tau. \quad (10)$$

To illustrate such a system, **Figure 1** is provided. The black arrows indicate spin, whereas the blue arrows indicate direction of quantum entanglement exchange. This arrangement has been claimed under USPTO provisional utility patent #63/202,544.

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