

A Mechanism of Action for Shawyer emdrive Propulsion System

by John Newell..
35 Neighbour Avenue
Goolwa Beach 5214
South Australia

Email: spupeng7@gmail.com

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Successful repeats of Roger Shawyer's emdrive experiment, originally conducted at SPR Ltd. in the UK, present General Relativity with a paradox of action without equal and opposite reaction. The results from this experiment will find their simplest explanation in Mach's Principal if we can resolve the interaction between electrical conduction in its reflectors and acceleration of remote charges. Special Relativity establishes that the emission and absorption of a photon occurs when those events are synchronous in complex time. Photons exist as independent entities from a point perspective in real time but from the covariant perspective they are not separate from the matter emitting and absorbing their energy. This allows the possibility that Shawyer's emdrive may be gaining traction from the remote universe by induction.

Electrical current has inertia relative to its conductor. When microwave energy is resonant between the ends of a waveguide the mechanism of reflection is, absorption which induces current in the absorber and then emission when that current is deflected by a boundary or discontinuity within the conductor causing the current to change direction. When a waveguide has different sized reflectors at either end and contains resonant electromagnetic energy reflecting between those reflectors, then the inertia of the electron motion within the conductors has a longer duration in the more extensive conductor surface.

The propulsive force demonstrated by Shawyer [9] and others [7], [10] is a consequence of that inertia having some value on a vector normal to the surface of the reflector in the direction from which the transmission was received [6]. When electromagnetic energy is resonant within the asymmetric waveguide, the difference between the duration of its inertia in the more extensive reflector and the duration of its inertia in the less extensive reflector, compounds with the amount of contained radiation producing a continuous unidirectional force.

This would contravene the established law of equal and opposite reaction unless that force is an interaction with distant matter so it is necessary to re-examine the mechanism of inertia. Within mass negative charges are more widely dispersed than positive charges. In MKS units and in the simplest available terms, all forces between separate objects, including free atoms and individual charges, are equal to the sum of attractive and repulsive forces between individual charges [2] positive + and negative -

$$F = \sum_0^n kq^2/r_{n+}^{-2} - \sum_0^n kq^2/r_{n++}^2 - \sum_0^n kq^2/r_{n-}^{-2} \dots \textcircled{1}$$

where n includes all electrostatic interactions between the charges of separate atoms, q is the individual charge in Coulomb and k is the electromagnetic constant. This is a covariant formulation [1] which can be solved within complex time where in all electromagnetic interactions, involving an emission₁ and an absorption₂,

$$ict_2 = ict_1$$

Inertia could be a consequence of the wider distribution, within matter, of negative charges with respect to positive charges if; acceleration of charge or mass causes acceleration of remote charge or mass. In a universe with roughly constant density at large scales there is an exponential increase of mass with distance from a point, which is balanced by the exponential decrease of electromagnetic force with distance between any pair of charges. Induction of current or acceleration of mass in the remote universe is an unavoidable consequence of the generation of current or motion locally if the distributions of opposite charges are not the same.

All electromagnetic interactions can be accounted for by this method. Magnetism is completely accounted for by electrical interaction. Gravity can be included as an electromagnetic interaction as well because the difference in distribution of opposite charges need be no greater than that due to the orbital radii of electrons, to account for it completely. Gravity being a weak force due to the almost but not quite perfect balance between attractive

and repulsive electromagnetic interactions due to the wider distribution of negative charges with respect to positive chargers.

This imbalance arises because the attractive electrical forces between opposite charges have a range of action, between any two atoms, which is not completely balanced by the sum of electron-electron repulsive forces which have a greater range of action, plus the sum of proton-proton repulsion which have smaller range of action. The assumption that these forces sum to zero over distances greater than a few millimetres, does not seem to have been tested and it would be extremely difficult to do so. An argument can be made that they cannot sum to zero unless their respective distributions are more similar that they actually are. If the geometry of range and distribution of charges could be confidently charted for any two atoms, the greater distribution of the negative charges, including their lateral displacement, is within the range required to fully account for gravitational and Machian inertial interactions.

In the case of gravity the approximate net gravitational force between orbiting bodies,

$$F_g = \sum_0^n kq^2/r_{n+}^{-2} - \sum_0^n kq^2/r_{n++}^{-2} - \sum_0^n kq^2/r_{n-}^{-2} = G m_2 m_1 / r^2 \quad \dots \textcircled{2}$$

where G is the gravitational constant, m₁ and m₂ are the gravitating bodies and F_g is the force of attraction between them.

The relevance of the difference of distribution between positive and negative charges is that all net force is either a direct consequence of that difference or a consequence of charge imbalance. If opposite charges had a perfectly homogeneous distribution with respect to each-other there would be complete neutrality within matter and no forces would act without the presence of current. The varying distribution of opposite charges is only part of the solution, a mechanism of interaction between charges is also necessary and that can be shown to be the dilation of time.

A re-examination the role of time dilation, extended to incorporate electromagnetism, is necessary. Gravity and electrostatic force have identical behaviours, as demonstrated unequivocally by Milliken's oil drop experiment. That they should share time dilation as their mechanism of action constitutes such a simple method of unification that it should be considered.

Llewellyn Thomas resolved the conservation of energy in the mechanism of capture of electrons into atomic orbitals. He also explained the splitting of Fraunhofer lines of radiation produced when electrons rise into higher orbitals while influenced by magnetic fields. His solutions allowed conservation of energy within these mechanisms but that logic was not followed through to the insight which it reveals. If the capture of an electron into an atomic orbital requires it to move into a field of time dilation then the incorporation of time dilation into all electromagnetic interaction has already been proven. To state the case any less bluntly disregards the need for conservation of energy as well as disregarding the necessity of a covariant resolution.

This is in harmony with quantum mechanics because there is no energy in electromagnetic fields from the covariant perspective, the apparent paradox arises only when interactions are considered from the point perspective. That point perspective is necessarily distorted by reduction of time to a constant passage in a universe where the reality of differing passage of time in different locations invalidates the energy conservation of that point

perspective. General relativity solved this problem by incorporation of time dilation as a mechanism of action for gravity but the complexity introduced by general relativity is not necessary. Electrical interaction can account for gravitational interaction more simply provided that the dilation of time inherent in change of separation between charges is appreciated. The benefit of this approach is that both gravity and inertia can be recognised as electromagnetic effects and the paradox presented by Rodger Shawyer's experiments can be resolved.

Inertial and electromagnetic forces have been interpreted as different by nature to gravity because electrical forces were not understood when gravity was first analysed mathematically. Reverence for Galileo, Kepler and Newton have caused us to miss the obvious, that gravity behaves in the same way as electrical attraction. Gravity is described as a monopole but acceleration into a gravitational field at a higher rate than the acceleration due to that gravity, will require an energy input against inertia. Gravity can be seen to invert as your own acceleration changes, when it is considered as just one aspect of all electromagnetic interaction this conundrum falls away.

Whether or not the results of Shawyer's experiments are found feasible by these arguments, it is necessary to repeat them and refine them until emdrive can be demonstrated to be a functional propulsion technology. To do this requires funding which is unlikely to be available until its propulsion production is either considered feasible or demonstrated undeniably. The notions expressed here are incomplete and lack mathematical development, they are an attempt to start the conversation addressing the need for a theoretical explanation to support funding submissions for this dynamic field of experimentation.

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