AN ELECTROMAGNETIC ROCKET HYPER-LIGHT STELLAR DRIVE

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ABSTRACT

Virtues of electromagnetic propulsion are examined in light of recent data published about unusual vehicles. If conditionally treated as credible evidence, enough information exists to develop an electromagnetic rocket and compels reexamining Maxwell's equations indicating:

- **o Electric surface currents exist that may sustain a force,**
- **o An analogue exists regarding electric and magnetic effects to generate axial thrust,**
- **o Maxwell's equations admit a relativistic solution, and**
- **o A cyclonic drive may represent a hyper-light electromagnetic rocket capable of accelerating particles.**

This proposed device replicates a black-hole singularity creating an unconfined plasma toroid that acts as a particle accelerator for a segmented two-stage drive as well as exploits electric and magnetic currents and charges. The plasma sustains fields and generates electron rings which, due to instabilities, leave the toroid and are accelerated in a magnetic vortex. Analytical results suggest electric effects dominate sub-light speeds while magnetic effects dominate light-speed forces. Relativistic effects, magnetic monopoles and ball lightning are discussed. Clearly these devices, if they exist, have capabilities probably beyond our current understanding.

Nomenclature

A	Vector potential
B	Magnetic flux field vector
C	Magnetic source flux vector potential
c	Speed of light
E	Electric field vector
e	Fluid dynamic particle energy per unit mass
F	Force
i	Imaginary number
J	Conduction or surface electric current
m	Instantaneous mass
p	Fluid dynamic pressure
p-ba	Momentum
P	Power
q	Electric or magnetic charge
r	Radius
t	Time
V	Velocity
phi	Potential
r,th,phi	Spherical coordinates
x,y,z	Cartesian coordinates

Subscripts or Superscripts

c	Electric
m	Magnetic
o	Reference

Greek Symbols

gam	Relativity velocity factor
ε	Permitivity
μ	Permeability
rho	Volume charge density or fluid mass density
σ	Conductivity

I. INTRODUCTORY COMMENTS-Basic Rules and Caveats

Man appears content to be bound by his own home planet rather than venture outward toward the stars and an unknown destiny. We need challenges to exercise our imagination. Such endeavors allow the human spirit to soar past the limits of the conventional wisdom setting new technical standards. Understanding a relativistic electromagnetic rocket falls within this challenging realm.

It is not our intention to prove flying saucers exist. Many observers have made credible claims and fragmentary documentation is detailed enough to warrant scientific exploration. Nonetheless there is consistency amongst observers and photographic evidence provides images difficult to fake or artificially reproduce. Some suggest the scientific community has traditionally ignored these events; this paper attempts to respond to these challenges. If we adopt the physicist or engineer's belief that all natural forces are well understood, we can conclude UFOs are not extra-terrestrial but resolvable by conventional wisdom. If anything, we may have misinterpreted explainable phenomenon otherwise scientific principles may exist that are not yet discovered or sufficiently exercised to explain such phenomena. The antithesis may be difficult to accept. There are limitations to conventional thinking. Human logic dictates that we deal with the unknown by making comparisons with the familiar. For example, the critic would look at an observation as a consequence of some 'comfortable' explanation; this is only human nature. Unfortunately, the process may be flawed because some observed event may not fit the accepted notion of reality. It would be tragic if a legitimate event occurred and the masses accepted the belief that this was 'naturally' occurring plasma or 'ball lightning'. Conversely, those accepting the natural phenomena hypothesis are yet to prove and

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find the means to readily reproduce such events in a predictable and scientifically acceptable manner.

Thus an open mind is warranted to seek some understanding and partial resolution. An awareness by the reader is required that permits some leeway regarding certain assumptions. The author will not argue whether there are such things as a UFO which cannot be readily explained by natural phenomenon. Moreover, the author has no additional knowledge other than available references cited in this paper nor has seen a UFO. The growth and numbers of reports from credible witnesses demand reexamining earlier reports to their being extra-terrestrial.

The approach here is very simple. First, some data will be presented. It will be assumed this data represents the 'truth' and may require some explanation. It may be very illusive being neither black nor white; in the broader sense truth may remain undefined. One may argue that the data selection will bias the analysis. This criticism is gladly accepted. New credible data is always needed to improve model fidelity. Second, Maxwell's equations may explain singular and relativistic behavior. These equations are difficult to use due to the lack of basic solutions treating combinations of geometries within a time-varying E-M field. Third and final, a fusion is pursued to discover some partial explanation of the phenomena to synthesize a propulsor drive. No claim is made at having the necessary answers; our pursuit is simply to understand the problem.

The drive of interest employs a rotating sphere constellation. In black holes, gravitational attraction is so great, light cannot escape the remnants of a collapsed dying star. Black holes are unstable, evaporate and eject mass at high speeds. Here, stellar gases rotate about the ejecta axis in cyclone-like motion. These devices may duplicate a black hole singularity, but in lieu of gravity, we are postulating using a toroid plasma to sustain these electric/magnetic fields and provides particles for acceleration.

If these devices are real or not is immaterial. What is important is that the human imagination, once tantalized by a concept or idea, may open closed doors and find keys that turn dreams into concrete realities. Finally, several references[1,2] suggest that long duration high-thrust space flight alter a spacecraft's orbit changing an elliptic into a hyperbolic trajectory. This paper compliments these efforts conceptualizing a high thrust-to-weight device for efficient space travel and draws heavily upon several of the author's earlier references[3,4]. However, some of the more speculative aspects are eliminated to improve focus and better understand some of these intriguing concepts.

II. DISCUSSION- The 'Prima Facia' Evidence

It is difficult to present credible and succinct evidence regarding UFOs. Assume they exist. Quotes are provided for the interested reader as evidence and provide clarity, insights and a concise description of propulsion related phenomenon. No claim is made concerning the truthfulness of these data.

In 1970, Burt[5] sums up a basic understanding of the phenomenon as:

"could explain many of the truly puzzling UFO observations: their silence; the lack of sonic boom; their high accelerations and ability to make sharp changes in direction; clouds which form around them; halos which appear around them; the various colors emitted associated with the type of motion; radiation felt by observers; the disruption of electrical circuits; the spinning of magnetic compasses in their vicinity; their shapes; and the principles by which they could make interstellar trips."

Magnetism as we know it is based upon negative ions or electrons. Burt develops a theory regarding diamagnetism where atoms and molecules, not electrons, achieve higher levels of magnetism by orienting their spin axis in the same direction. He claims a diamagnetic or inverted magnetic field using positive ions will repel magnetic fields created by negative ions. Repulsive forces between these fields are inversely proportional to the cube of the distance between particles.

Burt suggests, for example, noise does not exist whereas other sources[6] suggest just the opposite occurs. One must therefore accept that we are not dealing with 'trained' observers and human frailties alter encounter reports. Samples of the database believed to be insightful are provided in the following sections:

1. Noise emissions

- "Meier[7] held out a tape recorder and captured the sounds made by one of the beamships. The sound, an eerie and grating noise, like a high-pitched cross between a jet engine and a chain saw,"

- "and[8] the Socorro incident: (1) the apparent shape of the object; (2) the silence of the object except during the beginning of ascent; (3) the explosion-like noise during initial liftoff; (4) the vertical liftoff; (5) the sensation of 'heat' during the explosion-like sound; and (6) the independent witnesses to the sound produced at takeoff."

2. Ground residue effects

- "They[7] noticed that the spots marked on the ground were beginning to form roughly the shape of a circle. Inside the circle the radiation level consistently measured .2 roughly 400 percent higher than the background measurements. And the readings inside the circle pulsated. (Gamma radiation levels at the site).... the circle in which the readings pulsated.... roughly 21 feet..... such gamma ray detection--an unnatural source strong enough to change the electromagnetic nature of every molecule where the readings were obtained."

3. Effects implying a strong electric field

- "Beneath the craft[7], the hull, exceedingly old in appearance, seemed to undulate 'as if little waves ran continuously through the lower side of the ship.' The waves radiated downward, creating an aura around the truck (200 feet below the saucer)."

- "Once she[7] was inside, waves again emanated from the craft, distorting the shapes and colors of everything around it. A blue-red corona radiated outward....a beamship rose slowly above the pine trees and drifted to the north."

- "a[8] salesman and his friend experienced a sudden failure of engine and headlights. An electrical sensation was felt in their bodies, then a craft was observed about 150 feet away, off the road."

- "As the F-4 crew[9] were headed north of Teheran toward the unidentified light source,..but as the jet approached within twenty-five nautical miles of the object, all instrumentation and communications, both UHF and intercom, on the plane suddenly went dead. Rendered defenseless, the pilot broke off the intercept and headed back to base. As the plane retreated, all electronic systems were restored...A second F-4 pilot took off to try his luck...As the second jet closed within twenty-five miles of the UFO, it pulled ahead, keeping the pursuer at that constant distance...south of Teheran, the UFO suddenly ejected a smaller object, which came streaking toward the Phantom at a high rate of speed. As the (apparent) projectile came closer, the weapons control panel and all communications on the jet were lost, just as had happened with the first F-4."

Similar points are described by Walters[10] and Durrant[11]. After an evaluation and compilation of data from many sources, trends do emerge that expose basic propulsion characteristics[5-11]:

- Noise: These devices emit noise comparable to the frequencies of rotating turbo-machinery and occasionally change pitch signifying different operation modes. Explosive sounds are sometimes heard before the vehicle accelerates or disappears.

- Color Changes: Unsubstantiated data suggest color changes may reflect differences in operational cycles. White usually infers benign operations whereas colors going from 8 to 4 microns indicate increasing accelerations. Ground-reflections may mirror the ground-plane.

- Effluents: Substances are ejected from these devices. Vehicles may be shrouded by mist due to by-products; however, it is not clear in all of these situations whether these fluids are propulsion related or not. No correlation exists regarding if effluents are necessary for a specific operation phase.

- E-M Fields: Vehicles have strong transient fields and hysteresis may persist at landing sites.

- Propulsion Device: These craft, if they exist, may incorporate more than one drive; a 'cyclonic drive' generates an electromagnetic field as well as gravity waves.

4. Photographic Evidence

What is compelling is not description of events but available photos. Again, this is 'raw' data with no claim regarding truthfulness. A beamship at Haselbol is shown in Figure 1 taken on March 29, 1976. Figure 2 is a picture of a craft, possibly the same one. These craft are comparable in fineness ratio.

Walters[10] presents color photographs taken at Gulf Breeze near Eglin Air Force Base during November 1987 to February 1988 and Walters presently claims sightings still occur. Figure 3 shows a device having a different fineness ratio from Meier. Note the bright portion on the bottom of the vehicle. Figure 4 shows a vehicle hovering over a roadway at night. Reflections beneath the device are comparable in brightness to the source. Figure 5 provides details regarding the bottom of the vehicle, however, other than the ring of light, nothing else could be said.

Story[9] presents historical evidence. Figures 6 and 7 present a photograph and computer enhancement. The first shows two bright objects whereas the second shows that the brightness is due to an intense 'ring' of light. A haze obscuring its 'true' outline surrounds each vehicle. Remarkable consistency exists between this 'older' photograph (circa 1950) and newer data regarding devices using a ring of light propulsor. If genuine, these pictures depict some very interesting phenomenon.

III ANALYSIS AND EXPLANATION OF THE EVIDENCE

Many approaches[12-20] describe propulsion schemes suitable for space flight. A drive using tachyons employs atomic particles that, by definition, move at or greater than light speed. It can not be confirmed that these vehicles move at hyper-light speeds. Devices may emit or become a tachyon, which is not detectable to refute such claims. A detector would sense some property, say radiation emitted during relativistic collisions, with a tachyon. Such detectors would continuously scan the night-time sky to capture such motion or radiation emitted over a small angular cone. Detection occurs if velocity is aligned with a tachyon sensor in orbit or on earth. The probability that an alien pilot would aim a hyper-light vehicle directly at a planet in hope of stopping before a collision makes one susceptible to Murphy's law. Moreover, detection involves delayed field effects. Hyper-light travel claims thus require a leap of faith and should be dealt with carefully from a scientific basis.

A.1 Feasibility of Achieving Light Speeds

If power to accelerate mass to light speed becomes infinite, is this problem tractable? Krause[21], in 1964, opens the door. He defines a general Lorenz transformation between a primed and unprimed coordinate system as:

$$r' = r + v\left((\gamma - 1)\frac{\bar{r}\bullet\bar{v}}{v^2} - \gamma t\right),\ t' = \gamma\left(t - \frac{\bar{r}\bullet\bar{v}}{v^2}\right).$$

where:

$$\gamma = 1 \,/\, \sqrt{1 - \left(\frac{v}{c}\right)^2} = 1 \,/\, \sqrt{1 - \beta^2}\,.$$

Relativistic force becomes:

$$\bar{F} = \frac{d\bar{p}}{dt} = \frac{d}{dt}(m\bar{v}) = \frac{d}{dt}\left[m_o\bar{v} \,/\, \sqrt{1 - \left(\frac{v}{c}\right)^2}\right].$$

The value m_o is in the bracket implying rest mass is not constant but decreasing due to mass expulsion. Power becomes finite for variable mass; force is:

$$\bar{F} = \frac{d}{dt}[\gamma m_o \bar{v}] = \frac{d\,m_o}{d\,t_o}\bar{v} + \frac{1}{\gamma}\bar{F}_o + \left(1 - \frac{1}{\gamma}\right)\left[\frac{\bar{F}_o\bullet\bar{v}}{v^2}\right]\bar{v};$$

$$\text{with: } \bar{F}_0 = m_0\,\bar{a}_0.$$

The first term in the last expression accounts for flowrate changes. For constant rest mass m_o and $v << c$, $F = F_o$ or force at constant rest mass. Krause considers these equations for a relativistic rocket and, clearly, UFOs may be electromagnetic rockets if some effluent is expelled.

A.2 The Light-Speed Singularity

In fluid dynamics a singularity occurs at transonic speeds. Nature circumvents this with additional momentum terms. We have to alter or avoid singular behavior. Petit[22] offers another option. He examines definition of constants such as the gravitational constant; velocity of light, Planck's constant, and mass of electrons, protons, and neutrons. Petit claims the General Theory of Relativity does not require constancy of the universal gravitational constant (mass of the Earth multiplied by the value of gravity at the surface) or the speed of light separately but demands absolute constancy of the ratio G/c^2 or Einstein's constant in the field equation. Thus it may be feasible to change velocity of light and the gravitational constant as a function of time. If so, speed of light may vary within a hyper-light propulsor removing the singularity.

Maxwell's classic 1864 paper, Torrance[23] states:

"The ratio of the electromagnetic and electrostatic units of electricity, ... was in fact equal to the constant of the medium which measured the speed of light... velocity of electromagnetic waves and the velocity of light both have the same value v in a vacuum as the constant ratio of the electromagnetic and electro-static units of electricity, known as c."

If the velocity of light is altered as Petit suggests, this ratio changes according to the conventional wisdom. Is there such a premise found by the 'unwashed' for altering this ratio thereby changing the speed of light?

A.3 Mathematical Realities

If a particle is faster than light speed, mass becomes imaginary in the algebraic sense. Mass is not only imaginary but also negative when moving faster than light. This should not be confused with anti- or negative matter. Energy should be viewed in a similar context. Particle momentum is defined in normal terms at slower velocities but at hyper-light speeds, momentum and energy has a negative imaginary sense:

$$h\,\nu = \frac{1}{2} m\, v^2 = \frac{1}{2} \frac{m_o\, v^2\, c\, i}{\sqrt{v^2 - c^2}} ,$$

thus frequency is imaginary for a hyper-light particle.

If energy is complex, the real component of energy may be a reference quantity. Using temperature as a measure, reference temperature can be absolute zero. A particle with complex energy may have a real component being zero, negative or imaginary. Particle temperature may be near absolute zero. Exhausting such a fluid may explain ejecta, as the working fluid itself or water condensates when it comes in contact with the atmosphere.

A.4 The Relativistic Way Out

Expelling mass may create light-speed travel. Another approach considers ideas[24], Ingarden shows that for a body in a Minkowski space, the first dimension is time and the body's position obeys Lorenz transformations going from one inertial coordinate system to another:

$$\tilde{x}^0 = \frac{x^0}{\sqrt{1-\beta^2}} - \frac{x^1\beta}{\sqrt{1-\beta^2}} , \quad \tilde{x}^1 = \frac{x^1}{\sqrt{1-\beta^2}} - \frac{x^0\beta}{\sqrt{1-\beta^2}} ,$$

$$\tilde{x}^2 = x^2 , \text{ xtildeHk} = x^3 ; \text{ for the Minkowski space } (x^0, x^1, x^2, x^3),$$

$$\text{where } \beta = \frac{\sqrt{(v^1)^2 + (v^2)^2 + (v^3)^2}}{c} ; \; v^j = \dot{x}^j = \frac{d x^j}{dt} .$$

E-M fields change value and sense on passing from one inertial system to another. Horizontal components remain constant with respect to the line of motion of the two systems. In vector notation this is:

$$\tilde{E}_{\_} = \bar{E}_{\_} , \; \tilde{E}_\perp = \gamma(\bar{E} + \bar{v} \times \bar{B})_\perp ;$$

$$\tilde{B}_{\_} = \bar{B}_{\_} , \; \tilde{B}_\perp = \gamma(\bar{B} - \frac{\bar{v} \times \bar{E}}{c^2})_\perp .$$

Components are field segments parallel and perpendicular to the coordinate system's relative velocity. Perpendicular field components increase similar to mass increases. Surface currents and charge density also increase and the covariant form of Ohm's law is:

$$\rho = \frac{\rho_0}{\sqrt{1-\beta^2}} , \; \tilde{J}_1 = \frac{\bar{J}_1 - \rho \bar{v}}{\sqrt{1-\beta^2}} , \; \tilde{J}_2 = \bar{J}_2 , \; \tilde{J}_3 = \bar{J}_3 .$$

Thus an electromagnetic spaceship approaching light speed using these effects is like getting on a 'magic' railroad. As weight becomes infinite, thrust based upon relativity's influence in certain directions becomes infinite.

How do we use these specific field or current components and charge density to provide a meaningful propulsor? We may have entered the realm of `something for nothing' and have to remember several realities. Einstein states mass can be converted to energy and DeBroglie claims the inverse process with matter waves. Capra[25] claims matter may be a condensation in an electromagnetic field. He claims if a particle has no mass or charge undergoes a process that forms two particles, one particle has mass and a charge and the other particle must have a mass and charge of opposite sign. If these devices convert photons into electrons and positrons, a circular magnetic field could expel hyper-light electrons as a propulsive media in the axial direction.

B. E-M Phenomenon and Effects

These devices are a source of electromagnetic emissions. Lack of shock waves are somewhat explained by electrodynamics that would smooth and alter gas dynamic shocks explaining some observations. Moreover, these vehicles require huge amounts of electric energy. Many references[26-28] provide insights into Maxwell's equations which account for electric currents and charges identifying a vector potential and scalar potential satisfying:

$$\Delta^2 \bar{A} - \mu\varepsilon \frac{\partial^2 \bar{A}}{\partial t^2} - \mu\sigma \frac{\partial \bar{A}}{\partial t} = -\mu \bar{J}_c ,$$

$$\Delta^2 \phi_c - \mu\varepsilon \frac{\partial^2 \phi_c}{\partial t^2} - \mu\sigma \frac{\partial \phi_c}{\partial t} = -\frac{\rho_c}{\varepsilon} .$$

where J_c is the surface current source and rho is the density defined as charge per unit volume. Magnetic and electric field vectors related to these potentials are:

$$\bar{B} = \Delta \times \bar{A} , \; \bar{E} = -\Delta \phi_c - \frac{\partial \bar{A}}{\partial t} .$$

Source terms are related by conservation of charge:

$$\frac{\partial \rho_c}{\partial t} + \Delta \bullet \bar{J}_c = 0 .$$

Rate of change of the charge density is a function of the spatial gradient of surface current. The vector and scalar potentials are related through the Lorenz condition:

$$\Delta \bullet \bar{A} = -\mu\varepsilon \frac{\partial \phi_c}{\partial t} .$$

If a particle having a charge q is in an electric and magnetic field, the Lorenz force acting on the particle is:

$$\bar{F} = \frac{d}{dt}[m\,\bar{v}] = q\,[\bar{E} + \bar{V} \times \bar{B}] .$$

There is an implicit assumption in Maxwell's equation that E-M fields are weak and media properties are linear. Electric field, magnetic field intensity coefficients and surface current are not constant but tensors. For weak fields in a vacuum, linearity implies constant values along the main diagonal and tensor off-diagonal components vanish. Main diagonal elements may also vanish[29]. Exotic materials can exhibit physical properties that theoretically amplify E-M field strength instead of attenuate E-M energy contrary to the skin-depth effect in a conductor. Some data[30] suggest vehicles have hulls consisting of a very pure form of magnesium. Magnesium possesses excellent electric conductivity superior to copper but has no magnetic properties. If true, the vehicle may operate solely by electric means. Other data suggest finding traces nickel and cobalt traces which are ferromagnetic suggesting magnetism plays a role in the propulsor.

B.1. E-M Field and Fluid Dynamic Aspects

Off-diagonal tensor elements may, according to Russian efforts[29] for crystals, amplify in lieu of dampen or attenuate fields. Temperature and large field strengths create unusual effects at variance with expected linear behavior. Miller[31] defines gas and liquid properties that change in a lasing medium. Polarization current may be described in a molecular gas as a 'cubic medium' in:

$$P_i^{\omega_1} = P_i^{o} + \varepsilon_0\, \chi_{ij}\, E_j^{\omega_1} + \varepsilon_0\, \chi_{ijlm}\, E_j^{\omega_1}\, E_l^{\omega_2}\, E_m^{\omega_3}\,.$$

This accounts for changes in electric current and the susceptibility tensor includes nonlinear dielectric constant and refractive index effects. Total susceptibility becomes:

$$\chi_T = \chi_{ij} + \chi_{ijlm}\, E_l^{\omega_2}\, E_m^{\omega_3}\,.$$

These effects add to problem complexity. Moder et al[32] examine a two-dimensional MHD generator. They assume a negligible electron pressure gradient in a large electric field. Ignoring thermal diffusion, the conduction current density and conduction heat flux vectors are:

$$\bar{J} = \tilde{\sigma}_e \bullet (\bar{E} + \bar{V}_f \times \bar{B}),\quad \bar{q}_{cond} = -\frac{5}{2}\frac{kT}{e}\bar{J} - \tilde{\lambda} \bullet \Delta T.$$

For example, in a Cartesian coordinate where the z-axis is aligned with the magnetic field B vector, the electron electric thermal conductivity tensor is:

$$\tilde{\lambda} = \begin{vmatrix} \lambda_{e,\perp} & -\lambda_{e,H} & 0 \\ \lambda_{e,H} & \lambda_{e,\perp} & 0 \\ 0 & 0 & \lambda_e \end{vmatrix} + \begin{vmatrix} \lambda_n & 0 & 0 \\ 0 & \lambda_n & 0 \\ 0 & 0 & \lambda_n \end{vmatrix}.$$

Individual components depend upon local magnetic field and gas state. Subscripts are for electron properties and field component variations. High temperatures result in 20% ionization and high electric power levels are attained without seeding. This causes radiative transport to become important for driving up gas convective and radiative heat transfer rates.

If a plasma is not a source of ionized effluents, the plasma would redirect E-M field effects near light speed. If off-diagonal elements are real, E-M components enter the vehicle force equation. Such tensors need experimentally confirmed and depend on plasma composition.

B.2 A Cyclonic Drive for E-M Propulsion

Is Burt's diamagnetism concept viable? For diamagnetism to work, an inverse-cube law between particles may exist that requires inter/intra-molecular particles be as small as an electron or as large as a propulsor component. Is this how a propulsor should work?

Several references[34-35] discuss three or four small spheres rotating underneath these vehicles. Rotation rate is high and different from the main vehicle. The spheres represent glass-like objects suspended by a mechanical arm-like support having a bulging end that can contact a conical surface. A wheel at the end of the support rests on a large liquid-filled circular track. This track is concentric to the conic surface providing support-arm alignment during rotation. Could a 'cyclonic drive' involve a sphere constellation rotating in a downward directed electric and/or microwave field? Reports suggest these spherical objects, spin slowly about the axis of symmetry traveling in a torus-like trajectory scribing the 'ring of light' revealed in photographic data. As angular rate increases colors change and blend together. Sudden explosive sounds may suggest an angular rate shift. At higher rates, the vehicle performs rapid maneuvers and sudden changes in forward speed.

Equations governing sound propagation[33] are similar to scalar and vector potential equations for E-M fields. Hence, sound pitch changes could be related to rotation rate or electric field frequency changes.

The center of the conic surface may contain a propellant injector that fires particles along the rotation axis. Sphere support-arms are banded and may electrically isolate spheres from the rest of the structure; bands can represent an electron or proton gun component where electric magnets align a beam against a target located in the center of each sphere. A beam could cause transients by charging a target plate to create a charge density making the sphere luminesce. Spinning motion may pump and remove gases from the sphere activating some as of yet unknown process.

How much faith can be placed in the cyclonic drive concept? Story[9] provides supporting data previously shown regarding an event during August 1950 at Great Falls, Montana. Pictures show nothing more than two bright white dots near a water tower. Photo analysis during 1950 indicates images on the film are difficult to reconcile with aircraft or other known phenomena. The film was analyzed again in 1955 and the images have a constant elliptical shape without wings. Intensity data reveals two bright spots implying a possible central source of light. Computerized intensity gradation suggests the devices are smaller and surrounded by a halo mist (one object has the mist to one side). Both objects have a dark region inside and outside of a very bright doughnut shaped region. The mist is not bright enough to illuminate these objects. Intensity in and outside the doughnut shape is essentially the same and slightly higher than the background suggesting a negligible contribution to the brightness of the object. The doughnut shaped region is comparable to the plasma toroid seen in Walters[8]. Thus picture from the 1950s may confirm Walters' as well as narrative provided by Andreasson[34-35] in 1988 and 91 respectively.

B.3 The Electric Field Problem

Electric power levels and if the field is transient warrant assessment. Several things happen for electric system disruption from a source about 150 feet away. For radios, in-band interference is achieved with as little as 10 to 100 watts. Radios are, however, broadband. For broadband noise, electric power levels quickly exceed megawatts at these distances. Static fields do not produce interference, thus the electrical field(s) must be transient.

With the exception of a few feet of cable, car ignitions are shielded and power levels at these ranges are equivalent to a lightning strike. Two Iranian F-4 jets lost electric power at large distances, broadband power required would be phenomenal. If the device expends energy over a small angular sector, power levels may be manageable. Vehicle near-field responses involving E-M effects may be only transient upsets that occur if electric power density is less than a watt/cm[3.] The unit operates as if nothing happened once the source is removed. Some data[6]

$$\Delta^2\, \bar{A}_o - \mu\,\alpha(\alpha\varepsilon + \sigma)\,\bar{A}_o = \mu[\gamma_o\, \Delta\hat{\rho} + \alpha\, \bar{J}_c'']\,.$$

suggest batteries and electric components are actually destroyed implying significant power levels.

Biological events reported during alleged abductions[34-35] were ignored. Claims suggest children grown from premature fetuses can no longer survive in an earth environment as human children can and babies are suspended in a bluish gel-like solution in large tubes. A bluish color implies a metal additive. Abductees can stay aboard these craft for, at most, two hours based upon 'missing time' investigations. These findings suggest continual exposure to the interior radiation environ may be fatal to human physiology. If real, propulsor fields may create biological damage. On long journeys, claims imply abductees are in a suit and ingest a breathing liquid to survive hyper-light speeds. These fluids could possess a high metal content to induce a skin-depth effect absorbing radiation to minimize biological damage.

B.4 The 'Missing' Electric Source Solution

Assume surface current is proportional to the gradient of charge density plus a secondary electric surface current. This last current and charge density is to be defined such that:

$$\bar{J}_{c'} = e^{\alpha t}\,[\gamma_o \Delta \hat{\rho}_c + \alpha \bar{J}_c''],\ \rho_{c'} = e^{\alpha t}\,[\hat{\rho}_c - \Delta \bullet \bar{J}_c''],$$

which, when substituted into charge conservation, becomes:

$$\Delta^2 \hat{\rho}_c + \left(\frac{\alpha}{\gamma_o}\right) \hat{\rho}_c = 0 .$$

The J''_c terms identically cancel. Both ρ-hat and Jc" are not functions of time. By separating time, other terms are introduced by superposition. Thus surface current is equal to a transient term multiplied by two additive components; the first accounts for charge density gradient while the second includes steady-state surface current boundary conditions. Charge density includes steady-state boundary conditions and gradients in a steady-state surface current.

If the surface is a conductor or an insulator, electric surface current is either sustained or dissipated. Specifying J" on a boundary defines charge density. Boundary conditions may exist as well as surface currents and neither is equal to each other nor time varying.

Another solution assumes a steady-state term, a gradient of a potential:

$$\bar{J}_{c'} = e^{\alpha t}\,[\gamma_o \Delta \hat{\rho}_c + \alpha \bar{J}_c''] + \Delta \Xi_c .$$

The variable XI depends upon spatial terms and substituted into charge conservation, charge density requires:

$$\Delta^2 \Xi_c = 0 .$$

Surface current allows for electric sources as solutions through boundary conditions although it does not simplify the transient form of the vector potential equation. Charge density is unchanged by these conditions.

B.5 An Electric Current Source Solution

If a cyclonic drive is reasonable, radiation considering electric sources should be examined. New potentials may reside on the spheres and the plasma's exterior boundary, domain singularities include electric monopoles and dipoles. The vector potential is:

where: _(r,t) = _o(r)e$^{\alpha t}$ and the scalar potential satisfies:

$$\Delta^2 \phi_c - \mu \alpha (\alpha \varepsilon + \sigma)\, \phi_c = -\frac{\hat{\rho}_c}{\varepsilon} .$$

Both equations are related to the same charge density and solutions are similar except for boundary conditions. Consider three spheres with electric charges at an equal distance r_o from the origin that rotate in a plane perpendicular to an axis at the center of the constellation. The solution treating only radial effects is:

$$\hat{\rho} = \rho_o\, e^{+\alpha t} \sum_{j=1}^{n=3} \frac{e^{\frac{2\pi (j-1)}{n}}}{(r - r_o)} \cos\beta (r - r_o) .$$

where . The cosine term treats the sphere's surface as a point source simplifying the analysis. Actual sphere geometry effects should be included.

Using the appropriate source term in the vector potential, for the three spheres produces the current:

$$J' = \frac{\gamma_o}{\rho_o} \frac{[1 +\_\ i\beta (r - r_o)]}{(r - r_o)} \hat{\rho} .$$

If a =- s/e , and let _(r,t) = _o(r)e$^{\alpha t}$, then for radial effects in a spherical coordinate system, the potential solution has the form:

$$\bar{A}_o(r) = -\mu\gamma_o \int \sum_{j=1}^{n=3} \frac{e^{\frac{2\pi(j-1)}{n}}}{(r - r_o - \zeta)^2} \frac{e^{+\_ i\beta\zeta}}{\zeta^2} (1 +\_\ i\beta\zeta)\, d\zeta .$$

If we define the scalar potential as:

$$\phi_c(r,t) = \phi_{c'}(r)\, e^{\alpha t}$$

the scalar potential satisfies:

$$\Delta^2 \phi_{c'} - \mu\varepsilon(\alpha\varepsilon - \sigma)\, \phi_{c'} = -\sum_{j=1}^{n=3} \frac{e^{\frac{2\pi(j-1)}{n}}}{\varepsilon (r - r_n)} e^{+\_ i\beta(r - r_n)} .$$

Invoking the Lorenz condition defines a similar time dependency between the vector and scalar potentials. These potentials have an inverse-cubed or 'Burt' behavior.

C. Magnetic Source Terms

It is unknown if the radiation-like field is electric or magnetic or if charge density is created and exists on boundaries of the spheres. Although electric charge density is considered, an analogous equation exists regarding magnetic charge. Here, a vehicle may expel magnetic monopoles assumed to be the end of an infinitely long magnet or discrete particles. A monopole influences particle dynamics and does not appear in momentum conservation for defining thrust.

Consider changes to Maxwell's equation for a magnetic charge density and/or surface current, electric field intensity and magnetic flux density are:

$$\Delta \times \bar{E} = -\frac{\partial \bar{B}}{\partial t} + \bar{J}_m ,\ \Delta \bullet \bar{B} = \rho_m .$$

where J_m is the magnetic surface current, a vector, and ρ_m is a scalar representing magnetic charge density.

In the normal derivation, electric field intensity is a combination of the scalar potential gradient and time derivative of the vector potential. Consequently, the magnetic flux vector is the curl of the same vector potential leading to equations that are decoupled but similar. To treat magnetic surface current, the flux vector is defined as:

$$\bar{B} = \Delta \times \bar{A} + \Delta \phi_m ,\ \text{where: } \Delta^2 \phi_m = \rho_m .$$

The resulting equations to be solved are:

$$\Delta^2 \phi_c - \mu\varepsilon\frac{\partial^2\phi_c}{\partial t^2} = -\frac{\rho_c}{\varepsilon}, \quad \Delta^2 \bar{A} - \mu\varepsilon\frac{\partial^2\bar{A}}{\partial t^2} = -\mu \bar{J}_c ;$$

$$\frac{\partial \rho_m}{\partial t} - \Delta \bullet \bar{J}_m = 0 .$$

Magnetic potential is a transient function if magnetic surface currents exist. A magnetic charge density and surface current is comparable to electric charge and currents. Equations for creating magnetic charge density or surface current have the same form as electric field surface or charge and electric field vector remains unchanged. Existence of a magnetic potential is independent of the existence of magnetic charge density or current. Likewise a magnetic field does not require an electric field if magnetic charge exists. This potential introduces terms that may include monopoles and dipoles.

C.1. A Missing Magnetic Surface Current

A similar derivation, suggests a magnetic surface current exists due to a magnetic charge density. A magnetic source should be separable from field effects created by placing a source in free space in a retarded time sense. Surface current is proportional to the gradient of the magnetic charge density plus a surface current contribution. This current can reside as surface boundary conditions:

$$\bar{J}_m = e^{\alpha t} [\gamma_o \Delta \hat{\rho}_m + \alpha \bar{J}_m'] + \Delta \Xi_m .$$

Magnetic charge density has the form:

$$\rho_m = e^{\alpha t} [\hat{\rho}_m + \Delta \bullet \bar{J}_m'] .$$

For a positive exponent, the potential dampens as the transient continues. To eliminate time, let:

If the gradient does not vanish, magnetic current and singularities are solutions of Poisson's equation. For symmetry, solutions have similar behavior. These equations are similar to Harmuth[35] for defining transient equations on a loss-free medium with magnetic charge density and surface current. Differences are due to definitions (i.e.: signs) and stipulation of a gauge condition between the magnetic vector and static potentials. Ingarden[24] calls these 'anti-potentials'. A steady-state magnetic field exists without an electric field; once a transient electric field occurs, coupling exist between magnetic and electric fields. Even if sources vanish, magnetic scalar and vector potentials and Gauge conditions are still valid.

C.2. Magnetic Monopoles

Many notational definitions exist for magnetic monopoles and dipoles[36-39]. Magnetic currents or charge density are singularities in Maxwell's equations. Harmuth suggests the simplest is a monopole current may be carried by charges such as electrons or ions. A magnetic current flows in a conductor if magnetic charges or monopoles exist.

Conventional wisdom dictates magnetic monopoles are particles with either a 'north' or 'south' charge. If one particle exists, so must the opposite by nature's symmetry. One charge may be generated by negatively charged particles whereas the second is produced by positively charged particles. A monopole may be located at one pole in the near field where the opposite pole is an infinitely long magnet in the far field. While a pole accelerates, the device may accelerate a virtual pole of opposite magnetic charge in the opposite direction. This creates a magnetic current comparable to placing a pole at infinity when, in reality, the virtual pole is absorbed in the device while ejected monopoles include entrained particles.

C.3 Magnetic Source Terms and Symmetry

Many ways exist for treating magnetic source terms. Ramo, et al[27] introduces two vector potentials; Bowman[39] uses polarization vectors. Electric and magnetic Hertz vectors account for these effects. Barret[38] calls the use of free magnetic poles as 'Harmuth's Ansatz'. Harmuth[36,37] resolves this problem by using magnetic monopoles or 'instantons.'

King[26] suggests vector and scalar potentials permit symmetry and symmetric solutions offer advantages. Define the scalar and vector potentials to treat magnetic effects:

$$\bar{E} = -\frac{\partial \bar{A}}{\partial t} - \Delta \phi_c + \varepsilon \mu \alpha \Delta \times \bar{C} ,$$

$$\bar{B} = \Delta \times \bar{A} + \Delta \phi_m + \alpha \frac{\partial \bar{C}}{\partial t} ,$$

where al is arbitrary. Substitution in Maxwell's equations with electric and magnetic charge density requires imposing Lorenz Gauge conditions between these new potentials:

$$\Delta \bullet \bar{A} = -\mu \varepsilon \frac{\partial \phi_c}{\partial t}, \quad \Delta \bullet \bar{C} = -\frac{\mu \varepsilon}{\alpha} \frac{\partial \phi_m}{\partial t} .$$

Subsequent use of these relations results in the following equations for the vector and scalar potentials:

$$\Delta^2 \bar{A} - \varepsilon\mu\frac{\partial^2 \bar{A}}{\partial t^2} = -\mu \bar{J}_c , \quad \Delta^2 \bar{C} - \varepsilon\mu\frac{\partial^2 \bar{C}}{\partial t^2} = -\frac{\varepsilon\mu}{\alpha} \bar{J}_m ,$$

$$\Delta^2 \phi_c - \varepsilon\mu\frac{\partial^2 \phi_c}{\partial t^2} = -\frac{\rho_c}{\varepsilon} , \quad \Delta^2 \phi_m - \varepsilon\mu\frac{\partial^2 \phi_m}{\partial t^2} = \rho_m .$$

By symmetry, solutions have a similar form and behavior.

$$\Delta^2 \Xi_m = 0 .$$

Holt[40-42] mentions an approach that relies upon magnetic effects and claims merging magnetic field lines releases energy creating solar flares and magnetic substorms. Hydromagnetic waves inhibit or enhance magnetic field line merging altering magnitude and frequency. By crossing field lines, Holt claims a craft can travel to any location in space by 'tuning' the craft's magnetic field. Such a region where magnetic field lines cross is the leeward region of a planet's magnetosphere. Field merging may be created if magnetic charges exist.

D. Competing Effects

It is desirable to identify engineering trends and sensitivities for a vehicle that employs a cyclonic drive. We may treat the drive as a toroid continuum ignoring azimuthal coordinate derivatives. Consequently, azimuthal vector components vanish unless they depend upon other coordinates such as the radial direction. Due to the sphere geometry, these arguments may not be true and all terms remain. Consider the problem with a magnetic surface current and charge. Forces acting on a fluid are:

$$\bar{F} = q \left(-\Delta \phi_c - \frac{\partial \bar{A}}{\partial t} + \varepsilon \mu \Delta \times \bar{C} + \ldots\ldots \right.$$

$$\left. + (\bar{v} + \omega \bar{r}_o) \times (\Delta \times \bar{A} + \Delta \phi_m + \frac{\partial \bar{C}}{\partial t}) \right) .$$

Velocity considers rotation and linear components. As craft speed increases, velocity components are included for ionized fluid particles injected into the E-M fields. Particle velocity vector should include high accelerations at light speeds. Taking this analogy further, a medium acted upon by the spheres possesses an axial or a radial velocity, would produce a decaying spiral-like trajectory.

D.1 Toroidal Coordinates

If the cyclonic drive uses a toroid model to describe the ring of light, could a solid toroidal channel perform the same task as a sphere constellation? The subsequent potential in a mu, nu, and phi three-dimensional coordinate system[43] satisfies:

The z axis is at mu = 0. and mu = 1.0 is the outer toroid surface; center of the toroid is at mu equal to infinity. This is difficult to solve in closed-form because of non-separable variables. The coordinate independent variables may be separable in Laplace's equation (i.e.: beta is zero) but are supposedly not separable with regards to the wave equation. Difficulties are discussed[42] for separable variables for either Laplace or wave equation in toroid coordinates:

Complexity becomes worrisome for a far-field solution or a solution derived for an asymptotic coordinate system, say bipolar coordinate(s), to consider near-field intensity. As toroid radius increases compared to thickness, the field behaves as an inverse function of radius. At constant radius and increasing toroid thickness, some mirror image effects may enhance the near field. The sensitivity between the radius of the toroid and toroid thickness suggests a prevalent non-dimensional effect.

$$\text{Let: } \phi_c = \sqrt{\cosh\mu - \cos\eta}\, F(\mu, \eta, \phi);$$

$$\frac{1}{\sinh\mu}\frac{\partial}{\partial\mu}\left(\sinh\mu\frac{\partial F}{\partial\mu}\right) + \frac{\partial^2 F}{\partial\eta^2} + \frac{1}{\sinh^2\mu}\frac{\partial^2 F}{\partial\phi^2} + \frac{1}{4}F = 0.$$

Insights are available from the wave equation:

$$\frac{1}{\sinh\mu}\frac{\partial}{\partial\mu}\left(\sinh\mu\frac{\partial F}{\partial\mu}\right) = \alpha,$$

$$\text{where: } F(\mu) = \alpha\ln(\sinh\mu);\ \alpha = \frac{F_0}{\ln(\sinh\mu_o)}.$$

Constants are for boundary conditions. A Greens' function is not suitable due to singular behavior at the rotation axis. A linearization assumes separable variables and a sinusoidal behavior for the angle variable ignoring azimuth effects (i.e.: toroid thickness is constant and at the same distance to the symmetry axis). The equation is:

$$\frac{1}{\sinh\mu}\frac{\partial}{\partial\mu}\left(\sinh\mu\frac{\partial F}{\partial\mu}\right) + \left(\frac{1}{4} + n^2 + \frac{\beta^2 a^2}{(\cosh\mu + \cos\eta)^2}\right)F = 0.$$

The first term[44] can be simplified:

$$\frac{d^2 F'}{d\mu^2} + \left(n^2 + \frac{1}{4} + \frac{\beta^2 a^2}{(\cosh\mu + \cos\eta)^2} - \frac{1}{4}\coth^2\mu - \frac{1}{2\sinh^2\mu}\right)F' = 0,$$

$$\text{where: } F' = F\, e^{(-\frac{1}{2}\int\coth\mu\, d\mu)} = F\, e^{-\frac{1}{2}\ln(\sinh\mu)}$$

Greens' function is defined for the wave potential:

$$F' = \left(\int_{\mu_o}^{\mu}\left(\frac{\beta^2 a^2}{(\cosh\xi + \cos\eta)^2} - \frac{1}{4}\coth^2\xi - \frac{1}{2\sinh^2\xi}\right) x\right.$$
$$\left.\sin\left(\sqrt{n^2 + \frac{1}{4}}(\mu - \xi)\right)F'\, d\xi\right) + \alpha_0\sin\sqrt{n^2 + \frac{1}{4}}\,\mu + \alpha_1\cos\sqrt{n^2 + \frac{1}{4}}\,\mu,$$

$$\text{for: } \phi_c = \sqrt{\cosh\mu - \cos\eta}\sum_{n=0}^{n=\infty}(A_n\sin n\eta + B_n\cos n\eta)\,F'\, e^{\frac{1}{2}\int\coth\mu\, d\mu}.$$

Constants in this Volterra integral equation satisfy boundary conditions based upon integration direction.

Where derivatives disappear for the toroid, none of these derivatives disappear for the sphere constellation and each makes a contribution to thrust in the vehicle axial direction. A toroid may be valid only for far-field effects.

III. Typical Propulsive Duct Candidates

The first part of a conceptual segmented drive may use electric and magnetic fields based upon Burt and Holt's ideas consist of spheres rotating about a central axis. Since forces due to E-M fields involve charge, the spheres initially rotate as uncharged condensers to build-up a large electric surface charge.

It shall be assumed that the craft interior is insulated

$$\Delta^2\phi_c + \beta^2\phi_c = 0$$

$$\frac{1}{h_\mu^3}\left[\frac{1}{\sinh\mu}\frac{\partial}{\partial\mu}\left(h_\mu\sinh\mu\frac{\partial\phi_c}{\partial\mu}\right) + \frac{\partial}{\partial\eta}\left(h_\eta\frac{\partial\phi_c}{\partial\eta}\right) + \right.$$
$$\left. + \frac{h_\mu}{\sinh^2\mu}\frac{\partial^2\phi_c}{\partial\phi^2}\right] + \beta^2\phi_c = 0$$

$$\text{where: } h_\mu = h_\eta = \frac{a}{\cosh\mu - \cos\eta};$$

$$\text{for}: 0 \le \mu \le \infty;\ 0 \le \eta \le 2\pi;\ 0 \le \phi \le 2\pi.$$

from the structural shell. Exterior surfaces appear metallic. The problem[43] is to compute the potential inside and outside the metallic shell at a voltage with respect to the region at infinity. In two dimensions, the field about two spheres having a different charge is well defined and constant potential lines connect the spheres in a pattern depending upon charge distribution and geometry. For the same charge, high field concentrations occur between spheres. Placing spheres within the shell's field is a problem; an odd number of spheres can not have alternating electric charge or magnetic poles but only the same charge. Moreover, there is mention of a magnetic ring. One may speculate plasma entrained by the spheres is this magnetic ring. If a toroid represents a magnetic element, it generates a force by the right-hand rule in the direction of the vehicle axis suggesting the spheres be of the 'same' kind. The shell is isolated from the toroid with a charge or magnetic pole of opposite sign. Lines of force from spheres within a region along the axis are densely packed comparable to Holt's suggestion of merging lines of force. Particles placed here will be accelerated to light speeds producing the hyper-light drive.

A.1. Electromagnetic Drive Phenomenon

Some evidentiary observations suggest luminous spheres leave the object floating along a trajectory either controlled or random. These objects change color and either fade or disappear. Explosive sounds may accompany these migrating spheres as they touch the ground.

A.2. Ball Lightning

Falling object behavior is reminiscent of ball lightning[45-49]. Koloc[46] states:

"commonly observed that Ball Lightning terminates explosively perhaps fifty percent of the time, and in some cases the explosion has caused considerable physical damage."

Roth[47] states:

"Ball lightning can have a diameter up to several meters, a lifetime of over 100 seconds, an energy content in excess of 10 megajoules, and an energy density and a kinetic pressure greater than that of a reacting DT plasma."

Ohtsuki and Ofuruton[48] make similar claims and photographic evidence resembles what other observers claim. Koloc suggests two plausible types of internal structure for ball lightning; the first contains a torus shaped current filament while the second is a toroid filament perpendicular to the axis of two smaller toroid filaments.

A hypothetical propulsor injects ball lightning into each sphere in a controlled and continuous fashion. Electric continuity/isolation from the rest of the craft is provided by the rotating motion, which stabilizes the ball lightning. Translucent spheres change colors due to creating electric or magnetic charge from ball lightning in the spheres. Ball lightning may become unstable exiting the sphere constraint in a direction dictated by existing fields. As steady-state equilibrium is reached, new ball lightning is inserted into the empty sphere. If unstable, the recharging process provides a plausible explanation for observed in-flight wobble.

A.3. Particle Accelerator Relevant Effects

The hull may be a very-high power electric conduction medium isolated from the cyclonic drive. A report claims the vehicle hull is hot to the touch. The vehicle could heat during reentry but it was hovering prior to landing and reentry heating is not a valid explanation. The hull may have gained thermal energy through ohmic heating while acting as a conduit for large electric currents. This assumes a magnesium and aluminum hull and spheres that contains nickel and cobalt. The former has excellent electrical properties while the latter excellent magnetic properties.

What about separate fields and eddy currents generated by the spheres and subsequent electron bunching within the plasma? For particles on a ring in a traverse magnetic field, unusual particle resonance occurs when a flux is varied and particles may produce self-contained magnetic field effects[50]. A large accelerating field in the axial direction could trap and accelerate ions in a controlled manner with ever increasing phase velocity. A particle beam can be kept together for accelerators by:

- Inverse coherent drag: refers to a process where an intense beam literally 'drags' along a stationary ion from rest and accelerates it due to friction forces,
- Net space charge: an electric field is created by the space charge of a bunch of electrons, which are partially charge-neutralized, accelerate a cluster of ions,
- Induced electric fields: a time-varying beam current or inductance collectively accelerates ions.

Power expended gives beam particles kinetic energy to generate a beam's self-magnetic field to compensate for particle energy dissipated on accelerator walls. Schumacher[49] discusses a ring-like accelerator where the particle accelerator requires E-M field magnitudes to be given by assuming current density and charge density vanish within the volume moved by the accelerating particles.

A.4. 'Confined' Accelerator Problems

Electron ring accelerators (ERA) use a cluster of charges to generate a collective field forming a ring of relativistic electrons. An intense relativistic electron beam injected into a strong magnetic field can form a ring. Some ERA concepts use an unneutralized electron beam injected into a slightly focusing magnetic field (magnetic mirror) forming the ring. To increase ring electric field strength, it is compressed in the major and minor dimensions by raising magnetic field strength with time. Since electron energy increases, differences between electrostatic repulsion and magnetic field attraction decreases. To compensate for these fields, ions created by collisional ionization of the residual gas partially neutralize the ring providing the missing focusing and become the accelerated particles; the electron ring gets polarized by the inertial forces acting on the ions when an accelerating field is applied.

If the magnetic guide field expands along the axis, a relativistic electron ring accelerates along magnetic field lines due to externally applied electric fields and Lorenz force. An external electric field is parallel to the magnetic field of an ion loaded electron ring with high holding power. Holding power keeps ions in the ring and is high as possible for ring integrity limiting acceleration rate due to applied electrical field. The electron ring expands during acceleration and holding power drops; magnetic field strength drops as ring radius grows.

Static magnetic fields generated by hollow beam injection through a cusp allows the electron ring axial velocity to be converted into angular velocity. In a static magnetic field, electron energy is conserved and velocity cross product with the magnetic field accelerates the ring along its axial direction. This increases electron angular velocity in the ring. Vector field potential strength acting in the azimuthal direction to focus and accelerates the ring. If the ring defocuses and expands, these effects diminish.

Flux reversal uses a cusp in the magnetic field by using two solenoidal magnetic fields equal in magnitude but opposite in direction to each other. Electrons created and accelerated to high energy levels in one solenoid travels initially along the magnetic field lines parallel to the z-axis with a velocity near light speed. Passing through the cusp region the Lorenz force turns electrons into a circular path in the opposite direction. Particles may be influenced the same way in a cyclonic drive.

Devices[49] with circular particle beams contain a high number of unstable particles. Collective fields produced by a large number of particles and adjacent boundaries drive particle motion enhancing field amplitudes; instabilities grow to a saturation value due to nonlinearities leading to beam destruction. In intense electron rings with a high number of particles and strong fields, suppression of collective instabilities is a major problem. Longitudinal instabilities occur by electromagnetic bunching forces (negative mass instability), in the transverse direction by eddy current forces generated in resistive surfaces (resistive wall instability) or by attractive ionic forces (electron-ion instability).

Schumacher states negative mass instability is due to space charge acting on azimuthal forces in circulating electron beams. An electron in front of an extra charge gains energy from the repulsive forces acting upon it. Since electron speed is near c, angular frequency decreases with momentum and the particle goes to a higher orbital radius. If behind the density distribution, a particle losses energy from space charge repulsion dropping to a lower orbit increasing frequency revolution and the electron nears the excess space charge. Azimuthal density distribution leads to electron bunching and effects similar to those predicted by using negative inertia in the wave equation.

Resistive wall instabilities suggest an accelerator's highly conductive side plates suppress negative mass instability. With high electric conductivity, surfaces prevent penetration of pulsed magnetic fields for electron ring compression. Poor conduction materials are combined with negative mass coupling impedance reduction to compensate for these effects. Ion-electron transverse instability occurs when Lorenz forces are generated by the magnetic field of currents created by the resistive wall instability.

The point is that all of these features are relevant within the evidentiary database. Fields may accelerate particles. Moreover, these devices eliminate a majority of particle instabilities by using an unconfined plasma. With 'unstable' plasmas and using highly conductive metals, effects that dominate particle accelerators are not prevalent in our propulsor. Plasma particles leaving the toroid accelerate within a magnetic vortex to generate thrust.

A.5. Microwave Effects

Mueller and Micci[52] examine microwave energy absorption by a gas in a waveguide. A dielectric bluff body is placed directly in the gas flow acting as a flameholder. Recirculation and drag around the bluff body stabilize the plasma. Plasma is heated to high temperatures due to contact with the waveguide walls; gases cool the walls and feed the plasma. High-energy coupling efficiencies were achieved as a function of plasma stability with minimal radiation losses using magnetrons to provide the microwave energy. Plasma waveguide position and field distribution is important for microwave energy coupling. Plasma remains stabilized in the absorption chamber over a range of power densities, propellant gas pressures and flowrates. These effects can influence a drive which ignites the plasma.

B. A Candidate Propulsor Drive Plasma Effects

It is uncertain if the plasma is optically thin or opaque based upon photography. The toroid is visible or optically smeared at night making features indistinguishable. During daytime, a toroid may not be visible but the vehicle appears optically distorted. If the underside has a different appearance from the top, one may conclude the plasma is optically thin with few particles and low pressure. At night, an equally valid conclusion is the plasma is optically thick implying just the opposite. Photographic data as well as verbal 'Oral History' are useful to evaluate aspects of a propulsor. Motion of a cyclonic drive may entrap a pseudo-atmosphere in wakes of the spheres that trace toroid and a downward directed microwave field ignites the plasma. Ball lightning may produce, sustain, alter magnetic and/or electric charges or ignite the plasma. Plasma ions sustain surface currents and charge density; the spheres may contain electric or magnetic charges developing a force. If spheres act like electric space charges, injected particles form an electron ring satisfying criteria for negative mass instability. By lagging spheres, particles receive energy from space charges and follow an orbit with a lower radius forming a ring near the innermost orbit of the spheres. Particle orbits degenerate falling closer to the vehicle centerline due to fields based upon charge differences between the hull and spheres. Particles from plasma instabilities accelerate to hyper-light speeds by an induced axial field created by the spheres and hull in a downward decaying spiral trajectory; this converts angular and radial momentum into axial momentum for thrust to compliment electric and magnetic forces.

With the hull's high electrical conductivity, resistive wall instabilities do not occur and eddy currents form near and particles bunch directly behind the spheres. A static electric field propels particles toward the centerline. Transient sphere rotation induces a magnetic field which, with the electric field, accelerate these particles as discrete ions or as ionic rings. The cross product of the toroid magnetic field and rotation velocity of the plasma should generate enough thrust to satisfy sub-light needs. For hyper-light acceleration, the vehicle concentrates field lines of force to create large E-M field gradients. Spheres should have the same charge and the inter-sphere geometry generate an increase in field intensity along the axis.

D. Fluid Dynamic Processes

The problem is to find specific E-M field components to accelerate particles. In a portion of the device the field may accelerate particles to sub-light speeds followed by a region where the field drastically changes to accelerate particles to hyper-light speeds. Several observations imply expelling a working fluid from these devices, fluid effects warrant examination. Durrant[11] provides evidence of a working fluid:

"appearance of smoke (condensation) left behind the UFO at that moment of its ultra-rapid acceleration before its disappearance."

Thrust generation uses some form of MHD. Gas could be exhausted for main thrust or control thrust; the effluent could reproduce tentacle-like phenomenon such as 'angel hair'. The problem is how to treat the working fluid. If a small number of particles per unit of time are expelled, a LaGrange formulation suffices for speeds far below light. At light speeds or above, a cone of influence due to retarded E-M potentials make a LaGrange formulation impractical. If ejected at a reasonable flowrate, the gas as a continuum warrants an Eulerian formulation.

D.2. Relativistic Aspects of Plasma

A high-current machine accelerates particles moving near or faster than light speed[53]. Maxwell's equations that account for plasma particle distributions and include hydrodynamic effects for a moving plasma in a magnetic field are:

$$\rho = -q \int f\, d^3p, \quad \bar{j} = -q \int \bar{v} f\, d^3p, \quad \bar{p} = \frac{m\bar{v}}{\sqrt{1 - [\frac{v}{c}]^2}},$$

where f represents the relativistic electron distribution having charge q and the current considers electrons with velocity v, and particle momenta p.

Is this viable for defining plasma fluid dynamics considering strong E-M fields? One needs to explore E-M singularities using quantum mechanics[53-58] where potentials rather than fields are fundamental quantities; this is not true for classical mechanics. Particle motion is described by a complex wave function which is the probability amplitude that the particle will be at a point r at a given time t. Absolute value of the wave function squared times a volume element is the probability of finding the particle at time t in the volume element about t. The wave function in the absence of any fields satisfies a Schrodinger equation:

probability as a function of momentum, energy and time is:

$$\psi(r,\theta) = e^{iK\bullet\bar{r}} + e^{-iK\bullet\bar{r}} + [f(\theta) + f(\pi - \theta)]\frac{e^{ikr}}{r}.$$

The problem is to find solutions that sustain anti-particles or singularities with electric effects. A correspondence exists for inducing magnetic charge or current. If particle energy is described in energy distributions, large particles have a slightly altered distribution and remain in a normal distribution due to E-M effects. Ionized particles with large mass will see some altered energy content under these conditions. Charged particles such as protons and lightweight electrons due to E-M fields have the greatest altered energy distributions. Thus heavy particles are held in the plasma in contrast to electron and ionized particles.

The Klein-Gordon equation describes the probability for a relativistic particle and its anti-particle to be at a certain coordinate at a given time based upon initial conditions. There are additional terms in the energy expression for a relativistic particle compared to the Schrodinger wave equation for non-relativistic particles.

In the absence of an E-M field, the wave function satisfies a Gordon-Klein equation for a particular state:

$$\left[\frac{1}{c^2}\frac{\partial^2}{\partial t^2} - \Delta^2 + \left(\frac{mc}{h}\right)^2\right]\psi(r,t) = 0.$$

Wave function and conjugate satisfy:

$$\tilde{\psi}\left[\frac{1}{c^2}\frac{\partial^2}{\partial t^2} - \Delta^2 + \left(\frac{mc}{h}\right)^2\right]\psi - \psi\left[\frac{1}{c^2}\frac{\partial^2}{\partial t^2} - \Delta^2 + \left(\frac{mc}{h}\right)^2\right]\tilde{\psi} = 0.$$

which is equivalent to the charge conservation equation:

$$\frac{\partial \rho(r,t)}{\partial t} + \Delta \bullet \bar{j}(r,t) = 0.$$

Using these equations, electric current and charge density in terms of the wave functions and its conjugate:

$$\bar{j}(r,t) = \frac{h}{2im}[\tilde{\psi}\Delta\psi - \psi\Delta\tilde{\psi}],$$

$$\rho(r,t) = \frac{ih}{2mc^2}\left[\tilde{\psi}\frac{\partial\psi}{\partial t} - \psi\frac{\partial\tilde{\psi}}{\partial t}\right].$$

Positive eigenvalue solutions represent positive energy states for 'real' particles. Negative eigenvalues describe anti-particles (i.e.: charge density is negative). Current and charge density for E-M fields become:

$$\bar{j} = \frac{1}{2m}\left[\tilde{\psi}\left(\frac{h}{i}\Delta - \frac{e}{c}\bar{A}\right)\psi + \psi\left(-\frac{h}{i}\Delta - \frac{e}{c}\bar{A}\right)\tilde{\psi}\right],$$

$$\rho = \frac{1}{2mc^2}\left[\tilde{\psi}\left(ih\frac{\partial}{\partial t} - e\phi_c\right)\psi + \psi\left(-ih\frac{\partial}{\partial t} - e\phi_c\right)\tilde{\psi}\right].$$

Vector potentials influence currents while scalar potentials influence charge based upon the conventional wisdom. Differences are due to field and particle interactions.

The Hamiltonian resembles:

$$H = \frac{1}{2m}\left[\bar{p} - \frac{e}{c}\bar{A}\right]^2 + e\phi_c + V(r,t).$$

The last term includes coulomb attraction between particles. A more correct expression for relativistic effects is:

$$H = \bar{p}\bullet\bar{v} - \frac{1}{\gamma}\left[-mc^2 + \frac{e}{mc}(\bar{p}\bullet\bar{A}) - mc^2\sqrt{1-\left(\frac{v}{c}\right)^2} + \frac{e}{c}\bar{v}\bullet\bar{A} - e\phi_c\right].$$

D.3. Magnetic Currents and Charges

If a particle has a magnetic charge and mass, the equation of motion, ignoring electric fields, would look like:

$$\frac{1}{m}\frac{d\bar{p}}{dt} = e_m\bar{B} = e_m\left(\alpha\frac{\partial\bar{C}}{\partial t} + \Delta\phi_c + \Delta\,x\,\bar{A}\right).$$

which includes a magnetic scalar potential. Two ways can describe the probability that magnetic particles exist. The first uses a wave function that includes all terms in a force balance.

$$ih\frac{\partial\psi(r,t)}{\partial t} = \left[-\frac{h^2}{2m}\Delta^2 + v(r,t)\right]\psi(r,t),$$

$$\text{where: } \psi(r,t) = e^{i(\bar{p}\bullet\bar{r} - Et)/h}, \text{ for: } \int|\psi(r,t)|^2\, d^3r = 1.$$

This probability may be partitioned to separate magnetic effects. A second may assume a magnetic particle as a separate entity not having an electric charge that is influenced by an electric current. The first is treated here.

The wave-function describes the probability a magnetic particle is at a given location in time is:

$$ih\frac{\partial\psi_m}{\partial t} = \left[\frac{1}{2m}\left(\frac{h}{i}\Delta - \alpha e_m\bar{C}\right)^2 + \bar{A}\bullet\frac{h}{i}\Delta + e_m\phi_m + V\right]\psi_m.$$

An analogous magnetic wave function is defined as:

$$\bar{j}_m = \frac{h}{2im}(\tilde{\psi}_m\Delta\psi_m - \psi_m\Delta\tilde{\psi}_m) - \frac{\alpha e_m}{mc}\bar{C}\tilde{\psi}_m\psi_m - \frac{e_m}{mc}\bar{A}\tilde{\psi}_m\psi_m,$$

$$\rho_m = \frac{ih}{2mc^2}\left(\tilde{\psi}_m\frac{\partial\psi_m}{\partial t} - \frac{\partial\tilde{\psi}_m}{\partial t}\psi_m\right) - \frac{e_m}{mc^2}\tilde{\psi}_m\phi_m\psi_m.$$

If terms disappear, magnetic charges or currents are not present. They may exist if the scalar and vector potentials exist. Such particles are yet to be discovered although quantum electromagnetics from the above logic argue for their existence. This magnetic charge has inertial mass.

Let the Hamiltonian represent the force equation considering electric and magnetic charges. The wave function solution is a function of four potentials in lieu of two; scalar effects amplify the electric and magnetic fields. The Hamiltonian is:

$$H = \left[\bar{p} - \frac{e}{c}\bar{A}\right]^2 - e\phi_c + e\bar{r}\bullet[\varepsilon\mu\alpha\Delta x\bar{C} + \frac{1}{m}\bar{p}x[\Delta\phi_m + \ldots$$

$$+ \alpha\frac{\partial\bar{C}}{\partial t}] - \frac{1}{m}\frac{\partial\bar{p}}{\partial p}x\,\bar{J}_m].$$

The last term represents a magnetic current. At sub-light speeds, the wave function is:

$$ih\frac{\partial\psi}{\text{partial } t} = H\psi, \quad \text{where: } \psi = \psi_o\, e^{-(iHt)/h},$$

while the wave function for relativistic effects is:

$$\frac{1}{c^2}\frac{\partial^2\psi}{\partial t^2} = H\psi, \text{ where: } \psi = \psi_o \sinh[c\sqrt{H}\,t)].$$

This Hamiltonian includes a rest mass correction. A magnetic scalar field influences the wave function producing alternating signs or imaginary values allowing anti-poles and magnetic charges. These results are circumstantial. If the potentials exist, then one may claim such particles exist representative of an odd probability function for a monopole with a unity eigenvalue. Dipoles would have an eigenvalue of two and so on. Monopoles have not been observed and magnetism, with few exceptions needs an even number of poles, nothing can be said about their existence.

E.3. Speed of Light Particle Trajectories

Examine a trajectory where a relativistic particle is ionized within a field containing E-M sources. The Lorenz forces acting upon the momentum of a particle having a charge q and mass m is:

$$\frac{\partial \bar{p}}{\partial t} = q(\bar{E} + \frac{1}{c}\bar{v} \times \bar{B})$$

$$\text{where: } \bar{E} = -\frac{1}{c}\frac{\partial \bar{A}}{\partial t} - \Delta \phi_c + \varepsilon \mu \alpha \Delta \times \bar{C};$$

$$\bar{B} = \Delta \times \bar{A} + \Delta \phi_m + \alpha \frac{\partial \bar{c}}{\partial t}.$$

Expanding these terms in cylindrical coordinates yields:

$$\frac{d}{dt}\left[\frac{m}{\sqrt{1-(\frac{v}{c})^2}}\right]\begin{bmatrix} v_r \\ v_\theta \\ v_z \end{bmatrix} = +\frac{q}{c}\begin{bmatrix} \alpha_2 v_\theta - \alpha_1 v_z \\ \alpha_0 v_z - \alpha_2 v_r \\ \alpha_1 v_r - \alpha_0 v_\theta \end{bmatrix} + q\begin{bmatrix} -\frac{1}{c}\frac{\partial A_r}{\partial t} - \phi_{c_r} + \varepsilon\mu\alpha[\frac{1}{r}\frac{\partial C_z}{\partial \theta} - \frac{\partial c_\theta}{\partial z}] \\ -\frac{1}{c}\frac{\partial A_\theta}{\partial t} - \frac{1}{r}\phi_{c\theta} + \varepsilon\mu\alpha[\frac{\partial C_r}{\partial z} - \frac{\partial C_z}{\partial r}] \\ -\frac{1}{c}\frac{\partial A_z}{\partial t} - \phi_{c_z} + \varepsilon\mu\alpha[\frac{1}{r}\frac{\partial}{\partial r}(r C_\theta) - \frac{\partial C_r}{\partial \theta}] \end{bmatrix},$$

where:

$$\alpha_0 = \frac{1}{r} + \phi_{m_r} + \alpha\frac{\partial C_r}{\partial t}$$

$$\alpha_1 = \frac{\partial A_r}{\partial z} + \frac{1}{r}\phi_{m_\theta} + \alpha\frac{\partial C\theta}{\partial t}$$

$$\alpha_2 = \frac{1}{r} + \phi_{m_z} + \alpha\frac{\partial C_z}{\partial t}$$

If a particle moves along the z axis close to light speed, field components parallel to the trajectory are unchanged where components perpendicular increase by the relativity factor. Considering vector potential cross product and satisfying gauge conditions, vector potential components cannot increase. If they did, they counteract the right components providing contributions to the field parallel to the velocity vector. If allowed to increase, components in either the A or C vector potentials would have to cancel these effects. Thus the scalar potential should increase by the relativity factor. Considering axisymmetric effects where the z axis velocity is predominant yields:

$$(1-(\frac{v_z}{c})^2)\frac{d}{dt}\begin{bmatrix} v_r \\ v_\theta \\ v_z \end{bmatrix} + \frac{v_z}{c^2}\begin{bmatrix} v_r \\ v_\theta \\ v_z \end{bmatrix}\frac{d v_z}{dt} = \frac{q}{m}\begin{bmatrix} -\phi_{c_r} + \frac{1}{c}[v_\theta \phi_{m_r} - v_z \frac{\phi_{m\theta}}{r}] \\ -\frac{\phi_{c\theta}}{r} + \frac{1}{c} v_z \phi_{m_r} \\ +\frac{1}{c}[v_r \frac{\phi_{m\theta}}{r} - v_\theta \phi_{m_r}] \end{bmatrix}.$$

Components that influence axial velocity reduce the equation to:

$$\frac{\partial v_z}{\partial t} = \frac{q}{m c}(1 - (\frac{v_z}{c})^2)[v_r \frac{\phi_{m_\theta}}{r} - v_\theta \phi_{m_r}].$$

with the solution:

$$v_z = v_{z_o} + \tanh[\frac{q}{m c^2}\int_0^t [v_r \frac{\phi_{m_\theta}}{r} - v_\theta \phi_{m_r}] dt].$$

The first term in the integrand may vanish due to symmetry and constant angular velocity. Only magnetic field components enter this equation at light speed whereas electric field components influence non-axial components at lower than light speed. Although not obvious, it is an important conclusion. Other solutions include separation of variables for the scalar potentials or auxiliary potentials that include relativity effects with a spatial dependency.

F.1. Eulerian Representation

Many references[59-60] describe perturbations to the governing equations. The equations of motion[60] for a non-relativistic plasma may be recast for both transient flow in two-dimensions with viscous and heat transfer components:

$$\frac{d}{dt}\int_{\nu} \bar{f}\, d\nu = -\int_s [\bar{F}^x + \bar{G}^y] \bullet \hat{n} ds + \int_s [\bar{H}^x + \bar{H}^y] \bullet \hat{n} ds + \int_{\nu} \bar{R} d\nu.$$

The governing vector-matrix equation for symmetric flows including dissipation terms, is:

$$\frac{\partial \bar{f}}{\partial t} + \frac{\partial \bar{F}^z}{\partial z} + \frac{1}{r}\frac{\partial}{\partial r}(r\,\bar{G}^r) = \frac{\partial \bar{H}^z}{\partial z} + \frac{1}{r}\frac{\partial}{\partial r}(r\,\bar{H}^r) + \bar{R},$$

where vectors consider radial effects about a symmetric z-axis. Using definitions for Harmonic and wave-flux potentials[61], the method suggests that the conservation equations for a high-speed plasma clearly demonstrate the wave-like nature of supersonic flow. Introducing the potential function and integration factor:

$$\text{let: } \phi_z = \mu\bar{F},\ \phi_r = -\mu\bar{G};\ \text{where: } \mu = -\frac{\bar{F}\frac{\partial\mu}{\partial r} + \bar{G}\frac{\partial\mu}{\partial z}}{[\frac{\partial\bar{F}}{\partial r} + \frac{\partial\bar{G}}{\partial z}]}.$$

then the governing equations have the form:

$$\frac{\partial \bar{f}}{\partial t} + \frac{1}{\mu}[\phi_{rr} + \frac{\phi_r}{r} - \phi_{zz}] - \frac{1}{\mu^2}[\mu_r\ \phi_r - \mu_z\ \phi_z] = \Delta \bullet \bar{H}.$$

Here, eta represents an integration factor and phi is a potential; both have the same number of vector spaces as the original equations. The second term dominates steady-state conditions for two-dimensional axisymmetric flow. There is additional pseudo-wave like functions defined based upon this potential.

For this fluid problem, consider a swirling flow, which rotates about the z-axis achieving near light speed along the z direction. If a rotating fluid is accelerated to light speed, the integration factor is singular at the origin to account for vortex-like flow. A solution considers vehicle forward motion and a doublet located at r = a to treat the toroidal plasma. Recent comments[59,62-64] suggest E-M wakes exist analogous to hydrodynamic wakes. The means for generating solenoidal eddies are available in Maxwell's equations for large-scale eddies. Finally, a term would be required to consider induced vorticity due to rotation of the cyclonic drive resulting in:

$$\phi(r,z) = w_0 z - \frac{w_1}{\sqrt{[z^2 - \frac{1}{\gamma^2}(r-a)^2]}} - \frac{z}{(r-a)}\frac{w_2}{\sqrt{[z^2 - \frac{1}{\gamma^2}(r-a)^2]}}.$$

This approximate solution for the conserved fluxes describes the vehicle wake. A more detailed flow field solution requires a suitable integration factor to determine fluxes.

The situation for Maxwell's equation is quite different because these equations are in a similar form. Including electric and magnetic source terms, the vector-matrix version of Maxwell's equations becomes:

$$\varepsilon\mu\frac{\partial^2 \bar{\Phi}}{\partial t^2} = (\frac{\partial^2 \bar{\Phi}}{\partial z^2} + \frac{1}{r}\frac{\partial}{\partial r}(r\frac{\partial \bar{\Phi}}{\partial r})) + \bar{Q},$$

where: $\bar{\Phi}^t = [\bar{A}, \quad \bar{C}, \quad \phi_c, \quad \phi_m]$

$$\bar{Q}^t = [\frac{1}{\mu}\bar{J}_c, \quad \bar{J}_m, \quad \frac{\rho_c}{\varepsilon}, \quad -\rho_m]$$

Relations between vector and scalar potentials satisfy Gauge conditions. Solutions depend upon sign of permitivity and permeability or whether they are real or imaginary. If these are tensors, off-diagonal elements may provide amplification in lieu of dissipation or damping.

F. Relativistic Eulerian Fluid Dynamics

If the control volume is relative to the vehicle and velocity in the z direction is close to light speed, the transformed coordinates for time dilation and length contraction occurs along the z-axis according to:

$$\tilde{t} = \gamma(t - \frac{\beta}{c}z), \ \tilde{z} = \gamma(z - u\,t), \ \tilde{r} = r, \ \tilde{\theta} = \theta.$$

These equations in the transformed coordinate system for a relativistic fluid are:

$$\gamma[\frac{\partial \bar{f}}{\partial \tilde{t}} - \frac{\beta}{c}(\frac{\partial \bar{F}^r}{\partial \tilde{t}} - \frac{\partial \bar{H}^z}{\partial \tilde{t}})] + \gamma[\frac{\partial \bar{F}^z}{\partial \tilde{z}} - \beta c\frac{\partial \bar{f}}{\partial \tilde{z}}] +$$

$$+ \frac{1}{\tilde{r}}\frac{\partial}{\partial \tilde{r}}(r\,\bar{G}^r) = + \gamma\frac{\partial \bar{H}^z}{\partial \tilde{z}} + \frac{1}{\tilde{r}}\frac{\partial}{\partial \tilde{r}}(\tilde{r}\,\bar{H}^r) + \bar{R}.$$

The transpose of these vectors are:

$$\bar{f}^T = [\rho, \ \gamma\rho u, \ \rho v, \ \rho e]$$

$$\bar{F}^{z^T} = [\gamma\rho u, \gamma\rho u\,u + p, \gamma\rho u\,v, \gamma\rho u(e + \frac{p}{\rho})]$$

$$\bar{G}^{r^T} = [\rho v, \gamma\rho u\,v, \rho v\,v + p, \rho v(e + \frac{p}{\rho})]$$

$$\bar{H}^{z^T} = [0, \ \tau_{zz}, \ \tau_{rz}, q_z - u \bullet \tau_{zz} - v \bullet \tau_{zr}]$$

$$\bar{H}^{r^T} = [0, \ \tau_{rz}, \ \tau_{rr}, q_r - u \bullet \tau_{rz} - v \bullet \tau_{rr}]$$

$$\bar{R} = [0, \ \frac{1}{c}q\,E_z + ., \ \frac{1}{c}q\,E_r + ., \ ..].$$

Depending upon shear stress definition using kinematic viscosity, additional gam terms may be required. It shall be assumed shear effects can be ignored.

Using definitions for the wave-flux potential, the vector equation is recast for very high-speed flow:

Including electric and magnetic source terms, the vector-matrix version of Maxwell's equation becomes:

Assumption of pseudo-steady-state flow is made:

If the relativity factor is unity at slow speeds, electric fields dominate. At higher speeds, both magnetic field and radial effects dominate the flowfield. Assuming the vehicle will reach hyper-light speeds travelling in the direction of the vehicle centerline, off-axis sphere rotation, if they contain electric or magnetic charges, will emit radiation although the device itself travels in a linear line. The radiation sustains the plasma maintaining E-M fields and none of the derivatives or cross-product terms vanish. At or near light speed, these equations simplify to:

where the RHS terms vanish when beta is unity but are kept because other terms may cancel out this factor. E-M field effects drive fluid dynamics through these source terms and both of these partial differential equations are wave-like. If a pseudo steady-state assumption is invoked, the fields and fluid variables are predominantly linear functions of the spatial variable parallel to the velocity vector:

$$\frac{\partial}{\partial \tilde{z}}(\eta\frac{\partial \phi}{\partial \tilde{z}}) = (1 - \beta^2)[\bar{R} + \frac{1}{\tilde{r}}\frac{\partial \bar{H}^r}{\partial \tilde{r}}] = 0.$$

$$-\beta^2[1 - \varepsilon\mu\,c^2]\frac{\partial^2 \bar{\Phi}}{\partial \tilde{z}^2} = + (1 - \beta^2)\bar{Q} = 0.$$

V. CONCLUDING THOUGHTS

Several things were identified based upon evaluating the evidentiary data. These include an additional current(s) identified in the conservation of charge expression and the influence of magnetic surface and charges that enter the equations of motion. How to realistically produce these quantities from a qualitative or engineering design perspective is beyond the realm of technical feasibility. If not, all of this is nothing more than smoke, glass and mirrors. Finally, a premise was made that 'new' physical principles may be at play here. Based upon some of the findings, this appears not to be the case at sub-light speeds.

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[illegible]

$$+ (1 - \beta^2)\bar{Q} = 0.$$

$$-\gamma\beta c\frac{\partial f}{\partial \tilde{z}} - \frac{1}{\eta}[\gamma^2 \ \phi_{\tilde{z}\tilde{z}} - \frac{1}{\tilde{r}}\frac{\partial}{\partial \tilde{r}}(\tilde{r}\,\phi_{\tilde{r}})] + \ldots$$

$$-\frac{1}{\eta^2}[\gamma^2 \ \phi_{\tilde{z}} \ \eta_{\tilde{z}} - \phi_{\tilde{r}} \ \eta_{\tilde{r}}] = + \gamma\frac{\partial \bar{H}^z}{\partial \tilde{z}} + \frac{1}{\tilde{r}}\frac{\partial}{\partial \tilde{r}}\bar{H}^r + \bar{R},$$

$$\gamma^2 \ \beta^2 [1 - \varepsilon\mu\,c^2]\frac{\partial^2 \bar{\Phi}}{\partial \tilde{z}^2} + \frac{1}{\tilde{r}}\frac{\partial}{\partial \tilde{r}}(\tilde{r}\frac{\partial \bar{\Phi}}{\partial \tilde{r}}) = -\bar{Q}.$$

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