ON THE CONCEPTS WHICH LIE AT THE FOUNDATION OF FIELD FLOW MECHANICS

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Abstract

Fluid Flow Mechanics deals with flows which move due to internal particle pressure and pressure gradients. This paper attempts to derive a roughly parallel although an entirely different concept of a relatively unknown mathematical and yet potential physical process which the author refers to simply as Field Flow Mechanics and which deals with pressure gradients of a field created by a macroscopic and as yet unknown 'generator'. The development of Field Flow Mechanics finds a natural exposition in transportation of the 'generator' across, for example, interstellar distances, i.e. space travel. These fields are obviously not yet in existence, but if they were, they and their gradients would be presumed to be macroscopic variables. This paper tries to anticipate their existence by predicting what would happen if they were in existence and even to use dimensional analysis in order to get some kind of grip on the possible reality of such fields. The approach is to try and derive from a set of geometric assumptions a Lagrangian structure such that the Euler-Lagrange equations of motion can be invoked. In the course of attempting to derive a geometric Lagrangian structure, several surprising results occur such as the derivation of an antisymmetric tensor which finds a convenient interpretation as a new type of 'electromagnetic' field which yields a 'magnetic' monopole feature in addition to a rotational feature. This paper also attempts to show how Field Flow Mechanics admits a non-linear partial differential equation of the Hamilton-Jacobi type which allows velocities in excess of the speed of light while allowing a parametric time interval on the 'generator' to equate with the coordinate time interval of the source planet in order to make interstellar travel a viable process.

1 Introduction

The approach will be to use a complex vector velocity over the usual and real four dimensional space-time manifold domain. This complex vector velocity is considered to be a function of the underlying four dimensional coordinates of this manifold domain. The space-time metric $g_{\mu\nu}$ is the one used in general relativity with a signature in a Lorentzian space of (-1 -1 -1 +1) and is not considered changed or modified by any of the above considerations, however, $g_{\alpha\beta}\, u^{\alpha}\, u^{\beta}$ is no longer constrained to be equal to unity since the arc length ds will no longer be used in the denominator, e.g. $u^{\alpha} = dx^{\alpha} / dq$ is the four velocity vector using an arbitrary curve parameter dq other than ds, allowing the four velocity to be defined for velocities equal to and in excess of the speed of light; dx^{α} are the real differential coordinates within the usual space-time manifold domain.

$$d\,\xi_{(1)}{}^{\mu} = (\,\mathbf{a}\, u^{\mu} + i\,\phi^{/\mu}\,)\,dq \qquad (1)$$

This equation represents a complex vector velocity along the curve parameter dq. All indices are 1, 2, 3, 4.

It is assumed that there exists a variable macroscopic physical process or 'generator' which we can use to directly or indirectly manipulate the scalars **a** and ϕ, which are yet to be determined. The gradient of ϕ is given by $\phi^{/\alpha} = g^{\alpha\beta}\,\phi_{/\beta} = g^{\alpha\beta}\,\partial\phi/\partial x^{\beta}$ and is dimension-less as is **a**, which means that ϕ has the dimensions of a length. Normally, $\phi = \phi_o$ is considered constant in all frames of reference, so that we usually never see its gradient across the space-time hyper surface manifold. ϕ may be considered complex in order to allow for macroscopic wavelike variations.

$i = (-1)^{1/2}$ is considered to be a mathematical separator between essentially different yet related potential physical processes, not exactly, but somewhat similar to the roles played by the real and imaginary parts of the Fourier transform of complex response functions, i.e. the dispersion relations. Both the real and imaginary parts of the dispersion relations are generally susceptible to different physical interpretations.

In order to better deal with time averaged quantities we create another complex velocity differential

$d\,\xi_{(2)}{}^{\nu} = (\mathbf{a}\,u^{\nu} + i\,\phi^{*\,/\nu})\,dq$ .... (2)

where $\phi^{*\,/\nu}$ is the complex conjugate of $\phi^{\,/\nu}$ but with a different vector index from (1).

Since we are seeking time averaged equations, we must also allow the complex velocity differentials

$d\,\xi_{(3)}{}^{\mu} = (\mathbf{a}\,u^{\mu} - i\,\phi^{*\,/\mu})\,dq$ .... (3)

and

$d\,\xi_{(4)}{}^{\nu} = (\mathbf{a}\,u^{\nu} - i\,\phi^{\,/\nu})\,dq$ .... (4)

We now form the following asymmetric tensor along q

$\tfrac{1}{2}[(d\,\xi_{(1)}{}^{\mu}/dq)(d\,\xi_{(2)}{}^{\nu}/dq) + (d\,\xi_{(3)}{}^{\mu}/dq)(d\,\xi_{(4)}{}^{\nu}/dq)] =$

$\tfrac{1}{2}[(\mathbf{a}\,u^{\mu} + i\,\phi^{\,/\mu})(\mathbf{a}\,u^{\nu} + i\,\phi^{*\,/\nu}) + (\mathbf{a}\,u^{\mu} - i\,\phi^{*\,/\mu})(\mathbf{a}\,u^{\nu} - i\,\phi^{\,/\nu})]$

$= \mathbf{a}^2\,u^{\mu}u^{\nu} - \tfrac{1}{2}(\phi^{\,/\mu}\phi^{*\,/\nu} + \phi^{*\,/\mu}\phi^{\,/\nu}) +$

$i\,\tfrac{1}{2}\mathbf{a}\,[(\phi^{\,/\mu}u^{\nu} - \phi^{\,/\nu}u^{\mu}) - (\phi^{*\,/\mu}u^{\nu} - \phi^{*\,/\nu}u^{\mu})]$

Letting $\mathbf{a}^2 = \tfrac{1}{2}|\theta|$ then $\mathbf{a} = (2^{1/2}/2)|\theta|^{1/2}$ and $\mathbf{a}/2 = (2^{1/2}/4)|\theta|^{1/2}$ where $|\theta|$ represents a real positive quantity, hence its representation as an absolute magnitude.

$\tfrac{1}{2}[(d\,\xi_{(1)}{}^{\mu}/dq)(d\,\xi_{(2)}{}^{\nu}/dq) + (d\,\xi_{(3)}{}^{\mu}/dq)(d\,\xi_{(4)}{}^{\nu}/dq)] = T^{\mu\nu} - V^{\mu\nu} + i\,L^{\mu\nu}$ (5)

$T^{\mu\nu} = \tfrac{1}{2}|\theta|\,u^{\mu}u^{\nu}$ .... (5a)

$V^{\mu\nu} = \tfrac{1}{2}(\phi^{\,/\mu}\phi^{*\,/\nu} + \phi^{*\,/\mu}\phi^{\,/\nu})$ .... (5b)

$V^{\mu\nu}$ is Hermitian, symmetric and dimension-less.

$L^{\mu\nu} = (2^{1/2}/4)|\theta|^{1/2}[(\phi^{\,/\mu}u^{\nu} - \phi^{\,/\nu}u^{\mu}) - (\phi^{*\,/\mu}u^{\nu} - \phi^{*\,/\nu}u^{\mu})]$ ..... (5c)

$L^{\mu\nu}$ is Hermitian, antisymmetric and dimension-less.

We note that $L^{\mu\nu *} = -L^{\mu\nu} = L^{\nu\mu}$

2 A Structural Lagrangian

Thus we see that the asymmetric complex tensor in (5) naturally breaks up into two parts, a symmetric part to the left of **i** and an antisymmetric part to the right of **i** indicating, according to our previous prescription, the presence of two separate and distinct yet related potential physical processes.

The contraction of (5) with the metric tensor $g_{\mu\nu}$ yields the inner product

$\tfrac{1}{2}[(d\,\xi_{(1)}{}^{\mu}/dq)(d\,\xi_{(2)}{}^{\nu}/dq) + (d\,\xi_{(3)}{}^{\mu}/dq)(d\,\xi_{(4)}{}^{\nu}/dq)]g_{\mu\nu} \equiv$

$\mathcal{L} = T - V + i\,L^{\alpha}{}_{\alpha}$ .... (6)

where

$L^{\alpha}{}_{\alpha} = 0$ due to its antisymmetry

$T = \frac{1}{2}|\theta| u^{\alpha} u_{\alpha} = \frac{1}{2}|\theta| g_{\alpha\beta} u^{\alpha} u^{\beta}$

$V = V^{\alpha\beta} g_{\alpha\beta} = \phi_{/\alpha} \phi^{*/\alpha}$

$\mathcal{L} = T - V$ is similar in mathematical structure to a Lagrangian, with T the 'kinetic energy' and V the 'potential energy.' It therefore seems appropriate to utilize the Euler-Lagrange equations:

$d(\partial L / \partial u^i)/dq = \partial L / \partial x^i \quad \text{for } i = 1,2,3,4$

$\partial L / \partial u^i = \partial T / \partial u^i = |\theta| g_{\alpha i} u^{\alpha}$

$d(\partial L / \partial u^i)/dq = |\theta|_{/\beta} u^{\beta} g_{\alpha i} u^{\alpha} + |\theta| g_{\alpha i/\beta} u^{\beta} u^{\alpha} + |\theta| g_{\alpha i} du^{\alpha}/dq$

$\partial L / \partial x^i = \frac{1}{2}|\theta|_{/i} u^{\alpha} u_{\alpha} + \frac{1}{2}|\theta| g_{\alpha\beta/i} u^{\alpha} u^{\beta} - V_{/i}$

$|\theta|_{/\beta} u^{\beta} g_{\alpha i} u^{\alpha} + |\theta| g_{\alpha i/\beta} u^{\beta} u^{\alpha} + |\theta| g_{\alpha i} du^{\alpha}/dq =$
$\frac{1}{2}|\theta|_{/i} u^{\alpha} u_{\alpha} + \frac{1}{2}|\theta| g_{\alpha\beta/i} u^{\alpha} u^{\beta} - V_{/i}$

$g^{i\lambda} |\theta| g_{\alpha i} du^{\alpha}/dq + \frac{1}{2} |\theta| g^{i\lambda} [g_{\alpha i/\beta} u^{\beta} u^{\alpha} + g_{\beta i/\alpha} u^{\alpha} u^{\beta} - g_{\alpha\beta/i} u^{\alpha} u^{\beta}] +$
$|\theta|_{/\beta} u^{\beta} g_{\alpha i} u^{\alpha} g^{i\lambda} = \frac{1}{2}|\theta|_{/i} u^{\alpha} u_{\alpha} g^{i\lambda} - V_{/i} g^{i\lambda}$

$|\theta| du^{\lambda}/dq + |\theta| \{_{\alpha}{}^{\lambda}{}_{\beta}\} u^{\alpha} u^{\beta} + d|\theta|/dq\, u^{\lambda} = \frac{1}{2}|\theta|^{/\lambda} u^{\alpha} u_{\alpha} - V^{/\lambda}$

$|\theta| Du^{\alpha}/Dq + d|\theta|/dq\, u^{\alpha} = \frac{1}{2}|\theta|^{/\alpha} u^{\beta} u_{\beta} - V^{/\alpha}$ . . . . (7)

where D/Dq is the absolute derivative and $\{_{\alpha}{}^{\lambda}{}_{\beta}\}$ are the Christoffel symbols.

3 A Constant of the Motion

Contracting (7) with u_{α}

$|\theta| u_{\alpha} Du^{\alpha}/Dq + d|\theta|/dq\, u^{\alpha} u_{\alpha} = \frac{1}{2}|\theta|^{/\alpha} u_{\alpha} u^{\beta} u_{\beta} - V^{/\alpha} u_{\alpha}$

$|\theta| u_{\alpha} Du^{\alpha}/Dq + d|\theta|/dq\, u^{\alpha} u_{\alpha} = \frac{1}{2} d|\theta|/dq\, u^{\beta} u_{\beta} - dV/dq$ . . . . (8)

The 'kinetic energy' term is

$T = \frac{1}{2}|\theta| g_{\alpha\beta} u^{\alpha} u^{\beta}$ or

$2T = |\theta| u^{\alpha} u_{\alpha}$

$2dT/dq = D|\theta|/Dq\, (u^{\alpha} u_{\alpha}) + 2|\theta| u_{\alpha} Du^{\alpha}/Dq$ or

$|\theta| u_{\alpha} Du^{\alpha}/Dq = dT/dq - \frac{1}{2} d|\theta|/dq\, (u^{\alpha} u_{\alpha})$ . . . . (9)

Substituting (9) into (8)

$dT/dq - \frac{1}{2} d|\theta|/dq\, (u^{\alpha} u_{\alpha}) + d|\theta|/dq\, u^{\alpha} u_{\alpha} = \frac{1}{2} d|\theta|/dq\, u^{\beta} u_{\beta} - dV/dq$

$dT/dq + dV/dq = 0$

$d(T + V)/dq = d\hat{H}/dq = 0$

$T + V = \hat{H} =$ constant (a maximum or a minimum) . . . . (10)

$\hat{H} = T + V = \frac{1}{2}|\theta| g_{\alpha\beta} u^{\alpha} u^{\beta} + \phi_{/\alpha} \phi^{*/\alpha}$ . . . . (10a)

4 Field Requirements Due to the Imposition of Equality of Parametric Time and Coordinate Time Intervals

Rearranging and expanding (10a)

$\hat{H} = T + V = ½ |\theta| g_{\alpha\beta} u^{\alpha} u^{\beta} + \phi_{/\alpha} \phi^{*/\alpha}$

$\hat{H} = ½ |\theta| (dt/d\tau_q)^2(1 - v^2/c^2) + \phi_{/\alpha} \phi^{*/\alpha}$, where we have introduced $dq = c\, d\tau_q$ where $d\tau_q$ is now to be interpreted as a parametric time interval aboard the 'generator' to distinguish it from proper time which may not be defined.

$\hat{H} - \phi_{/\alpha} \phi^{*/\alpha} = ½ |\theta| (dt/d\tau_q)^2(1 - v^2/c^2)$

$2[\hat{H} - \phi_{/\alpha} \phi^{*/\alpha}]/ [|\theta| (1 - v^2/c^2)] = (dt/d\tau_q)^2$

$(2\hat{H} / |\theta|) [1 - \{\phi_{/\alpha} \phi^{*/\alpha}/\hat{H}\}] / [1 - v^2/c^2] = (dt/d\tau_q)^2$

By hypothesis, ϕ and its gradients are assumed to be macroscopic variables. If we require $dt/d\tau_q = 1$ for a viable method of space travel, so that the differential coordinate time interval at the source planet is the same as the differential parametric time interval on the 'generator' for all velocities, then we can choose $\phi_{/\alpha} \phi^{*/\alpha}$ and $|\theta|$ in order to make

$(2\hat{H} / |\theta|) [1 - \{\phi_{/\alpha} \phi^{*/\alpha}/\hat{H}\}] / [1 - v^2/c^2] = 1.$

By invoking this macroscopic variable process, we form a partial differential equation such that

$\phi_{/\alpha} \phi^{*/\alpha}/ \hat{H} = v^2/c^2$, where v is the instantaneous relative velocity between the source planet and the 'generator' which is moving under the spatial gradients in

$V = \phi_{/\alpha} \phi^{*/\alpha}$, or

$$V = \phi_{/\alpha} \phi^{*/\alpha} = \hat{H} v^2/c^2 \quad \text{......} \quad (11)$$

which is a non-linear partial differential equation of the Hamilton-Jacobi type for a family of fields ϕ for each instantaneous value of the relative velocity v. It is important to realize that (11) is not implying that ϕ is an actual functional of v, as (11) does not have to be true since $\phi_{/\alpha}$ is a variable, but in such other case, the parametric time and the coordinate time would not be equal.

We also observe that in view of (11) that we can finally determine $|\theta|$ in this instance by choosing $|\theta| = 2\hat{H}$. Since $|\theta|$ is positive and real we can assume that $\hat{H}$ is positive definite.

$$\begin{aligned} V = \hat{H} v^2/c^2 &< \hat{H} \text{ for } v < c \\ &= \hat{H} \text{ for } v = c \\ &> \hat{H} \text{ for } v > c \\ &= 0 \text{ for } v = 0 \end{aligned}$$

$$T = \hat{H}\,(1 - v^2/c^2) > 0 \quad \text{for } v < c$$
$$= 0 \quad \text{for } v = c$$
$$< 0 \quad \text{for } v > c$$
$$= \hat{H} \quad \text{for } v = 0$$

5 Recasting Fields in Terms of Pressure or Energy Density

Since $|\Theta| = 2\hat{H}$ is a constant of the motion, the acceleration equation (7) becomes
$|\Theta|\, Du^\alpha/Dq = ½\,|\Theta|^{/\alpha}\, u^\beta\, u_\beta \ - V^{/\alpha}$ or
$2\hat{H}\, Du^\alpha/Dq = \ \hat{H}^{/\alpha}\, u^\beta\, u_\beta \ - V^{/\alpha}$ .... (12)
$\hat{H}$ is a constant of the motion along q .
Now here we are faced with some interpretation, viz. is $\hat{H}$ a 'hard' or a 'soft' constant of the motion. By 'hard' is meant that not only is d $\hat{H}/dq = 0$ but $\hat{H}_{/\alpha} = 0$ as well. By 'soft' is meant that not only is $d\hat{H}/dq = 0$ but $\hat{H}_{/\alpha}\, u^\alpha = 0$, somewhat reminiscent of the Liouville theorem in statistical mechanics. There, the ensemble density P in phase space is an example of such a 'soft' constant in that $dP/dt = 0$ but the gradients of P exist with respect to the canonically conjugate momenta and coordinates in phase space.

For purposes of this paper, $\hat{H}$ will be assumed to be a 'hard' constant in that $\hat{H}_{/\alpha} = 0 = T_{/\alpha} + V_{/\alpha}$ with $T = ½\,|\Theta|\, g_{\alpha\beta}\, u^\alpha\, u^\beta = \hat{H}\, g_{\alpha\beta}\, u^\alpha\, u^\beta$, therefore $T_{/\alpha}$ would imply gradients in the metric. We assume that the metric itself can still be represented by a Lorentz approximation, however any space-time gradients in the metric represent the generation of an artificial gravitational field as a result of space-time gradients in V. Therefore (12) becomes
$\hat{H}\, Du^\alpha/Dq \ = \ - ½\, V^{/\alpha} = - ½\, [\phi_{/\beta}\, \phi^{*\,/\beta}]^{/\alpha}$ .... (12a)
'Pressure gradients' for $\alpha = 1,2,3$ produce accelerations. These accelerations, based upon the previous discussion leading up to (12a) regarding artificial gravitational fields, imply that inertia-less acceleration is possible.

Even though dimension-less, it would be natural to suppose that V should be proportional to a quantity that has the dimensions of a pressure or an energy density, e.g. ergs/cm^3 in view of the fact that pressure gradients give rise to forces.
Let $\phi = R\, \eta/\eta_o$, where R has the dimensions of length thereby making $\phi_o = R$

and

$V = \phi_{/\alpha}\, \phi^{*\,/\alpha} = (R^2/\eta_o^2)\, \eta^{/\alpha}\, \eta^{*}_{/\alpha}$ .... (13)

$V(\eta_o^2/R^2) = \eta^{/\alpha}\, \eta^{*}_{/\alpha} = \hat{H}\, (\eta_o v / Rc)^2$

which we require have the dimensions of an energy density. R will be considered as a 'characteristic length' associated with this macroscopic field. Since we have required that η_o^2/R^2 and $\eta^{/\alpha}\, \eta^{*}_{/\alpha}$ have the dimensions of an energy density in order to represent a pressure, this means that η must have the dimensions of $(\text{energy/Length})^{1/2}$.

If we can represent energy per length as a square of something then we can take the square root of it. One obvious possibility is that if we take energy = β^2/Length, then the square root is β/Length.

If we look hard at this we see a similarity to β having charge-like dimensions such as in ergs= esu^2/cm.

6 A New Type of 'Electromagnetic' Field with a 'Magnetic' Monopole Feature

If we continue with this line of reasoning, we can conclude that η_o/R has the dimensions of charge/length^2 e.g. esu/cm^2. Then if we consider $(\eta_o/R)\, L^{\alpha\beta}$, and, since $L^{\alpha\beta}$ is antisymmetric, then we come to the conclusion that equation (5c) may represent a new type of 'electromagnetic' field phenomena associated with Field Flow Mechanics. We can now justify the reasoning used at the beginning in equation (5)

$T^{\mu\nu} - V^{\mu\nu} + i\, L^{\mu\nu}$

namely, that the $i = (-1)^{1/2}$ is considered to be merely a mathematical separator between essentially different yet related potential physical processes: $L^{\mu\nu}$, a new type of 'electromagnetic' field process to the right of **i** and $V^{\mu\nu}$ a symmetric stress tensor type process to the left of **i**, both being distinct yet related processes. Since a pressure seems to be derivable from $V^{\mu\nu}$, this seems to provide the justification for viewing it as some type of space-time stress tensor.

Equation (5c) becomes

$(\eta_o/R)\, L_{\mu\nu} = (2^{1/2}/4)\, |\theta|^{1/2}\, [(\eta_{/\mu}\, u_\nu - \eta_{/\nu}\, u_\mu) - (\eta^{*}_{/\mu}\, u_\nu - \eta^{*}_{/\nu}\, u_\mu)]$

$= \frac{1}{2}\, \hat{H}^{1/2}\, [\, f_{\mu\nu} - f^{*}_{\mu\nu}]$ where $f_{\mu\nu} = (\eta_{/\mu}\, u_\nu - \eta_{/\nu}\, u_\mu)$ and $f^{*}_{\mu\nu}$ is just the complex conjugate of $f_{\mu\nu}$.

Now let us calculate the antisymmetrized sum of $L_{\alpha\beta/\lambda}$.

$\{f_{\mu\nu/\lambda}\}_{(\mu\nu\lambda)} \equiv (1/3!)\,(f_{\mu\nu/\lambda} - f_{\mu\lambda/\nu} + f_{\nu\lambda/\mu} - f_{\nu\mu/\lambda} + f_{\lambda\mu/\nu} - f_{\lambda\nu/\mu})$
where $_{(\mu\nu\lambda)}$ indicates the variables that this sum is to be over,
but since $f_{\mu\nu} = - f_{\nu\mu}$ this reduces to
$\{f_{\mu\nu/\lambda}\}_{(\mu\nu\lambda)} = ⅓\,(f_{\mu\nu/\lambda} + f_{\nu\lambda/\mu} + f_{\lambda\mu/\nu})$

$$(\eta_o/R)\{L_{\mu\nu/\lambda}\}_{(\mu\nu\lambda)} = ½\, \hat{H}^{½}\,[\{f_{\mu\nu/\lambda}\}_{(\mu\nu\lambda)} - \{f^*_{\mu\nu/\lambda}\}_{(\mu\nu\lambda)}] \quad \text{.......... (17)}$$

$\{f_{\mu\nu/\lambda}\}_{(\mu\nu\lambda)} = \{(\eta_{/\mu}\, u_\nu - \eta_{/\nu}\, u_\mu)_{/\lambda}\}_{(\mu\nu\lambda)}$

$$\{f_{\mu\nu/\lambda}\}_{(\mu\nu\lambda)} = \{(\eta_{/\mu}\, u_\nu - \eta_{/\nu}\, u_\mu)_{/\lambda}\}_{(\mu\nu\lambda)} = ⅓\,[\eta_{/\mu}\,(u_{\nu/\lambda} - u_{\lambda/\nu}) + \eta_{/\nu}\,(u_{\lambda/\mu} - u_{\mu/\lambda}) + \eta_{/\lambda}\,(u_{\mu/\nu} - u_{\nu/\mu})] \quad \text{......... (18)}$$

$\{f^*_{\mu\nu/\lambda}\}_{(\mu\nu\lambda)}$ is just the complex conjugate of equation (18).

$$(\eta_o/R)\{L_{\mu\nu/\lambda}\}_{(\mu\nu\lambda)} = (1/6)\, \hat{H}^{½}\, [(\eta_{/\mu} - \eta^*_{/\mu})(u_{\nu/\lambda} - u_{\lambda/\nu}) + (\eta_{/\nu} - \eta^*_{/\nu})(u_{\lambda/\mu} - u_{\mu/\lambda}) + (\eta_{/\lambda} - \eta^*_{/\lambda})(u_{\mu/\nu} - u_{\nu/\mu})]$$

We know from Maxwellian electromagnetic theory that the usual Maxwell tensor $F^{\mu\nu}$ can be represented as $F^{\mu\nu} = A^{\mu/\nu} - A^{\nu/\mu}$ where A^μ is the Maxwell four potential.
Further, $\{F_{\mu\nu/\beta}\}_{(\mu\nu\beta)} = 0$ means that the antisymmetrized sum is zero which means that there are no magnetic monopoles in Maxwellian electromagnetic theory, as is well known. In startling contrast, however, we immediately notice that $(\eta_o/R)\{L_{\mu\nu/\lambda}\}_{(\mu\nu\lambda)} \neq 0$ implying that there is a'magnetic'monopole type feature associated with Field Flow Mechanics.

7 The 'Magnetic' Monopole's Rotational Feature

Another startling observation is that in the calculation of $\{L_{\mu\nu/\lambda}\}_{(\mu\nu\lambda)}$ the tensor $u_{\lambda/\beta} - u_{\beta/\lambda}$ appears. The presence of the tensor $u_{\lambda/\beta} - u_{\beta/\lambda}$ means that the velocity field $u_\alpha = dx^\alpha / dq$ is not entirely translational and that this tensor selects out those places in the velocity field u_α which have a vortex motion, i.e. a circulation or rotation. It is not proper to split u_α into a translational part and a rotational part since u_α is a true vector and rotational velocity is an axial or pseudo vector as its direction changes with the handedness of the coordinate system. The tensor $u_{\lambda/\beta} - u_{\beta/\lambda}$ is the only proper way to handle rotation in a true tensorial way. Thus, when the tensor $u_{\lambda/\beta} - u_{\beta/\lambda}$ is evaluated for $\nu,\alpha = 1,2,3$, we obtain the components of the well known three dimensional **rot** or **curl** or $\nabla \times$ operator in vector analysis. Further, we know from the theory of ordinary fluid flow that such a three dimensional rotation can be expressed by the following equation
$\omega/c = ½\, \nabla \times \mathbf{u}$.

Therefore, the tensor $u_{\lambda/\beta} - u_{\beta/\lambda}$ indicates that this'magnetic'monopole feature has a rotational aspect associated with it.

8 Dimensional Analysis

It is only natural to try and use dimensional analysis to help determine what physical quantities might make up ϕ. First of all, note from equation (1) that since u^{α} is dimension-less, that ϕ has the dimensions of length. Since we are dealing with a supposed macroscopic field, Planck's constant must not show up. Since we require that ϕ be a space-time scalar in that it is normally constant in all frames of reference, we will try and find the simplest possible representation involving space-time constants. The most obvious space-time constants are the speed of light c and the gravitational constant, so we set
$\eta_o = (\text{energy/Length})^{1/2} = c^A\, G_o^{\,B}\, D$, where D is still unknown and will be used to balance the units of the equation.
Using E = energy, F = force, A = acceleration, M = mass, L = length, T = time we have

$E = FL = MA\,L = ML^2\,T^{-2}$

$E/L = ML\,T^{-2}$

$(E/L)^{1/2} = (ML\,T^{-2})^{1/2} = c^A\,G_o^{\,B}\,D = (L^A\,T^{-A})(F\,L^2\,M^{-2})^B\,D$

$(E/L)^{1/2} = (L^A\,T^{-A})\,(MA\,L^2\,M^{-2})^B\,D$

$(ML\,T^{-2})^{1/2} = (L^A\,T^{-A})\,(M\,L\,T^{-2}\,L^2\,M^{-2})^B\,D = (L^A\,T^{-A})\,(L^3\,M^{-1}\,T^{-2})^B\,D$

$M^{1/2}\,L^{1/2}\,T^{-1} = L^{A+3B}\,T^{-A-2B}\,M^{-B}\,D$

Forgetting about D for the moment, let us write
$1/2 = -B$ $1/2 = A + 3B$ $-1 = -A-2B$ Or $B = -1/2$ $A = 2$ Thus all three equations are satisfied and D is therefore dimension-less and is not needed to balance the units.
If we take $\eta_o = (\text{energy/Length})^{1/2} = c^2\,G_o^{-1/2} = (c^4/G_o)^{1/2}$. The question arises, do we have the correct parameters? There is really no way of knowing, since we still do not know the exact physical generating process which is assumed at the beginning for causing gradients in η.

What exactly is η? If what we have chosen is the correct representation, then we cannot choose a variation in c as being what we are after, since c changes in magnitude whenever it enters a dielectric medium in accordance with c/n , where n is the index of refraction and is equal to the square root of the product of the

dielectric constant and the relative permeability, and, in addition, the derivation of volume forces in the electrostatic field in the presence of dielectrics specifically involves spatial gradients in the dielectric constant which amounts to gradients in the speed of light and these gradients do not produce the kind of acceleration noted in equation (12a). Thus one is led to assume that perhaps gradients in the gravitational 'constant' may produce the kind of acceleration noted in equation (12a). Thus can we take $(c^4/G)^{½}$ as the correct representation for η? Another representation that would be a variable with these same dimensions would be $\eta = (c^4G/G_o^2)^{½}$ or
$(c^4G_o/G^2)^{½}$ What about $\eta = (c^4G^2/G_o^3)^{½}$ or $\eta = (c^4G/G_o^2)^{½}\, e^{(G - Go)/Go}$? It is clear that dimensional analysis offers a limited and very skeletal solution but, as we have seen, there are other solutions with these same dimensions.

9 Conclusion

Field Flow Mechanics may provide a practical method for interstellar space travel if the 'generator' for the fields talked about in this paper can be found. These fields provide the means for inertia-less acceleration and for what looks like a new type of 'electromagnetic' field with its associated 'magnetic' monopole. One obvious danger of a macroscopic 'magnetic' monopole field is due to the fact that currents come to a halt near a 'magnetic' monopole, per Ampere's law. Since biological life forms have currents running through their nerve fibers, there would be a very high danger of paralysis near such a macroscopic field due to the cessation of these biologically generated currents. As everyone knows, Faraday cages defeat Maxwellian electromagnetic fields. Examples of common Faraday cages or good approximations thereto are airplanes, school buses, cars and hoods on cars. The new type of 'electromagnetic' field derived in this paper has greater penetrating power than Maxwellian fields and would be able to defeat the purpose of a Faraday cage and affect the flow of currents inside which are protected by the cage. This is due to the mathematical fact that this new type of 'electromagnetic' field depends on the supposed gradient in the 'gravitational constant', such gradient being unaffected by the presence of the Faraday cage, occurring both externally and internally to the cage.

Rotation is also associated with this 'magnetic' monopole. It is unclear whether the rotation is generated automatically or whether the rotation is an independent variable which can be utilized by the postulated 'generator' to further manipulate the fields. Since the parametric time interval in the frame of reference of the 'generator' and the coordinate time interval in the reference frame of the source planet remain the same, there is an implied certainty that significant space travel over interstellar distances may occur during the lifetime of an explorer for sufficiently high velocities in excess of the speed of light, with the added bonus being that the explorer would be able to return to the same civilization that he left on the source planet. Such extremely high velocities in excess of the speed of light may give pause for concern in deep space where interaction with particles of rock and dust would occur. An obvious answer to this problem would be to take note from the Dimensional Analysis part of this paper, that it may be a blessing in disguise that η is proportional to c^2 . This would suggest that the fields surrounding the 'generator' are extremely powerful and could possibly provide excellent shielding at such extreme velocities.

Throughout this paper, the term 'generator' has been used, but it is clear that such can also be interpreted as a space craft. The presumption is that the space craft would be operating in the environment of outer space which provides an airless vacuum. However, there does not seem to be any reason why such a craft would not be able to operate within a gaseous or liquid medium as well, taking note of the possibility that particles of the gaseous or liquid medium near the crafts accelerating field may themselves be accelerated along with the craft. This may mean that each time such a craft leaves the atmosphere of a planet, that the accelerating field tears away a small amount of the atmosphere which is never to be replaced.