RUDIMENTARY WARP DRIVE PROPULSION

By John R. Cipolla, Copyright August 29, 2015

Research has shown that an analogy exists between potential vortex flow and the generation of space-time curvature around massive objects as predicted by Einstein's theory of General Relativity (GR). The analogy between GR and potential vortex flow is based on results from potential vortex experimentation, GP-B researcher statements, free-surface shape extracted from Schwarzschild's metric, a unit analysis of the curvature and energy-momentum components of potential vortex flow and the analogous components from Einstein's Field Equations and black hole dynamics compared to potential vortex dynamics. This research indicates that gravity control and rudimentary warp drive is possible if space-time possesses the properties of a superfluid.

An implication for the existence of a superfluid potential vortex substratum is that interesting fluid mechanical characteristics of space-time can be revealed. A superfluid is a state of matter in which matter and therefore space-time behaves like a fluid with zero viscosity. Specifically, an interesting by product of a superfluid substratum is the Magnus effect. The Magnus effect is the force exerted on a rapidly spinning cylinder or sphere moving through air or another fluid in a direction at an angle to the axis of spin. The sideways force is responsible for the swerving of balls when hit or thrown with spin. For example, if an object composed of energy-momentum rotates in the gravitational field of another massive object a Magnus[1] effect based on the superfluid of space-time will impart a sideways force on the object and an associated acceleration in the substratum. In exactly the same way the surrounding fluid is deformed by a spinning object, space-time will be compressed on one side of the object and expanded on the other side of the object generating an imbalance in space-time. The deformed space-time surrounding the spinning object could be called a warp bubble that uses the pressure imbalance within space-time to propel an object perpendicular to the field lines of the surrounding superfluid. Speeds approaching the speed of light are not practical but exotic materials are not required for a device based on this technology. The analogous Magnus effect in General Relativity that uses the principals of fluid mechanics[1] to model space-time

around a circular cylinder with circulation is defined as a **uniform flow** plus a **doublet** plus a **vortex** as follows.

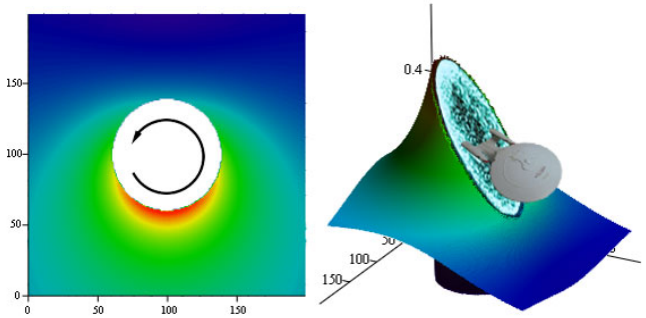
$$v_r = \frac{1}{r}\frac{\partial \psi}{\partial r} = U_\infty \cos\theta \left(1 - \frac{a^2}{r^2}\right). \quad (1)$$

$$v_\theta = \frac{\partial \psi}{\partial r} = -U_\infty \sin\theta \left(1 + \frac{a^2}{r^2}\right) + \frac{K}{r}. \quad (2)$$

$$K = \sqrt{GMr} \text{ And } K = \beta\, U_\infty a \quad (3)$$

$$p = p_\infty + \frac{1}{2}\rho V^2 \quad (4)$$

Where vortex strength, K[2, 3] is defined at the surface $(r = a)$ of the rotating mass-energy.



Space-time around a rotating mass-energy pressure field (p) and the resulting warp bubble

The associated Magnus force acting on a warp bubble and the associated material object within a warp bubble is expressed by the following relationship that finds an exact analogy with inviscid fluid mechanics.

$F = \rho\, U_\infty (2\pi K) L$. Where it can be shown that $K = a^2\omega = \sqrt{GMa}$. (5)

Force F in Eqn. 5 is the resulting **warp drive propulsive force** acting on the material object within the warp bubble. Proof of the hypothesis that space-time can be modeled as a superfluid is provided within General Relativity. Standard textbooks on General Relativity routinely discuss modeling space-time as a perfect fluid[4, 5], a substance exhibiting no heat conduction or viscosity and characterized only by mass density ρ and pressure p. The stress-energy tensor for a perfect fluid in the local frame of reference is.

$$T_{\mu\nu} = \left(\rho + \frac{P}{c^2}\right) U_\mu U_\nu + p\, \eta_{\mu\nu} \quad (6)$$

The stress-energy tensor in matrix form where the diagonal terms represent the characteristics of a perfect fluid or superfluid is.

$$T_{\mu\nu} = \begin{bmatrix} \rho & 0 & 0 & 0 \\ 0 & p & 0 & 0 \\ 0 & 0 & p & 0 \\ 0 & 0 & 0 & p \end{bmatrix} \frac{erg}{cm^3} \tag{7}$$

Finally, according to General Relativity the curvature[5] of space-time due to the presence of a rotating mass-energy field becomes the following.

$$R_{\mu\nu} = 8\pi \frac{G}{c^4} T_{\mu\nu} \tag{8}$$

Where in matrix form, the four-dimensional curvature of space-time for a perfect fluid or in our case a superfluid becomes.

$$R_{\mu\nu} = \begin{bmatrix} R_{1,1} & 0 & 0 & 0 \\ 0 & R_{2,2} & 0 & 0 \\ 0 & 0 & R_{3,3} & 0 \\ 0 & 0 & 0 & R_{4,4} \end{bmatrix} \frac{1}{Tm^2} \tag{9}$$

Equations 6 to 9 indicate there is underlying proof within General Relativity that space-time can be considered a perfect fluid and that gravity control and rudimentary warp drive is possible if space-time possesses the properties of a superfluid.

References

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[5]S. M. Carroll, *SPACETIME AND GEOMETRY* (Addison Wesley, San Francisco, 2004)