Interstellar Travel by Means of Wormhole Induction Propulsion (WHIP)

Eric W. Davis, Ph.D.
National Institute for Discovery Science
1515 E. Tropicana Ave., Suite 400
Las Vegas, Nevada
Voice (702) 798-1700, FAX (702) 798-1970
E-mail: nids@anv.net

Abstract

➤Space flight by means of wormholes is described whereby the traditional rocket propulsion approach can be abandoned in favor of a new paradigm involving the manipulation of spacetime. Maccone (1995) extended Levi-Civita's 1917 magnetic gravity solution to the Morris and Thorne (1988) wormhole solution and claimed that static homogeneous magnetic/electric fields can create spacetime curvature manifesting itself as a traversable wormhole. Furthermore, Maccone showed that the speed of light through this curvature region is slowed by the magnetic (or electric) induced gravitational field there. Maccone's analysis immediately suggests a way to perform laboratory experiments whereby one could apply a powerful static homogeneous magnetic field in a vacuum, thereby creating spacetime curvature, and measure the speed of a light beam through it. Magnetic fields employed in this scenario must achieve magnitudes > 10^{10} *Tesla* in order for measurable effects to appear. Current magnetic induction technology is limited to static fields of ~ *several* x 10^3 *Tesla*. However, destructive chemical (implosive/explosive) magnetic field generation technology has reached peak rate-of-rise field strengths of ~ 10^9 *Tesla/sec*. It is proposed that this technology be exploited to take advantage of the high rate-of-rise field strengths to create and measure spacetime curvature in the lab.

Introduction

- Conventional rocket propulsion is constrained by limiting specific impulse, speed, energy conversion & large fuel mass fractions.
- Rapid interplanetary and interstellar flight by means of wormholes is possible, in principle, via spacetime manipulation.
- Speed of light is circumvented, spacecraft no longer carry large propellant mass, travel time over large distances reduced by orders of magnitude.
- Spacetime manipulation accomplished by linking magnetic fields & gravity thru general relativity.
- Einstein published General Relativity Theory (GTR) in 1915.
- Levi-Civita (1917) introduces creation of artificial gravity field (spacetime curvature) by virtue of static homogeneous magnetic/ electric fields as a GTR solution.
- Morris & Thorne (1988) derive GTR solution for spacetime wormholes.
- Maccone (1995) extended Levi-Civita's magnetic gravity metric to Morris & Thorne's metric and claimed that static homogeneous magnetic fields can induce wormhole effect in spacetime.

Theoretical Brief

- **Levi-Civita's spacetime metric in cylindrically symmetric magnetic field:**

$$ds^2 = (dx^1)^2 + (dx^2)^2 + (dx^3)^2 + \frac{(x^1dx^1 + x^2dx^2)^2}{a^2 - \left[(x^1)^2 + (x^2)^2\right]} - \left[c_1 \exp\left(\frac{x^3}{a}\right) + c_2 \exp\left(\frac{-x^3}{a}\right)\right]^2 (dx^4)^2$$

where c_1 & c_2 are integration constants determined by boundary conditions and $x^1 \ldots x^4$ are Cartesian coordinates with orthographic projection, and

$$a = \frac{c^2}{\sqrt{\frac{4\pi G}{\mu_0}} B} = 3.4840 x 10^{+18} \frac{1}{B} \quad meters$$

is the radius of spacetime curvature {*G = gravitational constant, c = speed of light, B = magnetic field strength in Tesla,* μ_0 *= vacuum permeability* - all in mks units}

- **Maccone derived the "speed of light function" from coefficient of dx^4 term:**

$$v(z) = c \frac{2\exp\left(\frac{L}{2a}\right)}{\exp\left(\frac{L}{a}\right)+1} \cosh\left(\frac{z}{a}\right) \quad m/\sec$$

where *L* is assumed to be length of a long magnetic solenoid, centered around $x^3 = z$ axis.

- **Wormhole is created by the solenoid, and at center of its throat *v(z=0)* is:**

$$v(0) = c \frac{2\exp\left(\frac{L}{2a}\right)}{\exp\left(\frac{L}{a}\right)+1} = 2c \frac{\exp\left(\frac{LB}{2K}\right)}{\exp\left(\frac{LB}{K}\right)+1} \quad m/\sec \qquad 0 < L << a, \quad K = \frac{c^2}{\sqrt{\frac{4\pi G}{\mu_0}}} = 3.4840 x 10^{+18} \; Tesla \bullet meter$$

- **Invert *v(0)* and solve for *B*:** $B = \frac{2K}{L} \ln\left[\frac{c \pm \sqrt{c^2 - v^2(0)}}{v(0)}\right] \quad Tesla$

Levi-Civita's Metric Does Not Give A Wormhole!

$$ds^2 = -\left[c_1 \exp\left(\tfrac{z}{a}\right) + c_2 \exp\left(\tfrac{-z}{a}\right)\right]^2 dt^2 + \left(1 - \tfrac{r^2}{a^2}\right)^{-1} dr^2 + r^2 d\boldsymbol{j}^{\,2} + dz^2$$

$$ds^2 = -\left[c_1 \exp\left(\tfrac{z}{a}\right) + c_2 \exp\left(\tfrac{-z}{a}\right)\right]^2 dt^2 + a^2\left[d\boldsymbol{q}^{\,2} + \sin^2\boldsymbol{q}\, d\boldsymbol{j}^{\,2}\right] + dz^2$$

$$a = \frac{c^2}{B}\left(\frac{4\boldsymbol{p}G}{\boldsymbol{m}_0}\right)^{-1/2} = 3.4840\ x10^{18}\ B^{-1}$$ **is the radius of curvature**

$$d\boldsymbol{s}^{\,2} = a^2\left[d\boldsymbol{q}^{\,2} + \sin^2\boldsymbol{q}\, d\boldsymbol{j}^{\,2}\right] + dz^2$$ **is the hypercylinder 3-metric** $S^2\ x\hat{\boldsymbol{A}}$

Radius of Spacetime Curvature Induced by B-Field

B (x 3.484 Tesla)	*a (meters)*
1	10^{18} (105.7 *ly*)
10^{2}	10^{16} (1.06 *ly*)
10^{3}	10^{15} (0.11 *ly*)
10^{5}	10^{13} (66.7 *AU*)
10^{7}	10^{11} (0.67 *AU*)
10^{9}	10^{9} (1.44 *Solar Radii)*
10^{12}	10^{6} (0.16 *Earth Radii*)
10^{15}	10^{3}
10^{18}	1

B = magnetic field strength
a = radius of spacetime curvature
ly = light-year
AU = Astronomical Unit

Wormhole Throat Size (*b*) *Induced* by Applied Tension (t)

b (m)	*t (x 5.0 N/m^2)*
10^{18} (105.7 *ly*)	10^{6}
10^{16} (1.06 *ly*)	10^{10}
10^{15} (0.11 *ly*)	10^{12}
10^{13} (66.7 *AU*)	10^{16}
10^{11} (0.67 *AU*)	10^{20}
10^{9} (1.44 *Solar Radii*)	10^{24}
10^{6} (0.16 *Earth Radii*)	10^{30}
10^{3}	10^{36}
1	10^{42}

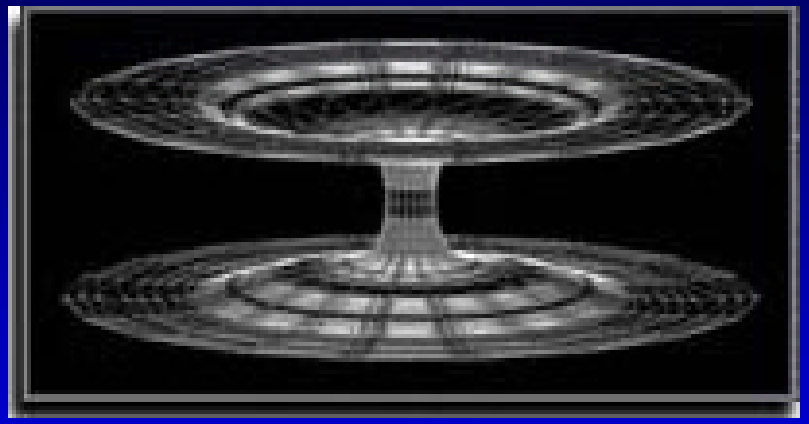
Experimental Approach

- *v(0)* indicates that light speed slows down in localized region because of artificially induced gravity (space curvature) there.
- Maccone suggests measuring the slowing of light speed inside a large magnetic solenoid; achievable precision in measuring this would be $c - v(0)$ or $c^2 - v^2(0)$.
- Experiments will need B-fields ³ 10^{10} *Tesla* to produce measurable effects. (Electric field intensity will be 17 times larger to produce the same radius of curvature).
- Experiments using chemical explosive/implosive magnetic technologies look promising.
- Russian designed MC-1 generator produces 10^3 *Tesla* with very good homogeneity and reliability, ISTC grant to build 2,000 *Tesla* generator.
- LANL/NHMFL/SNL high B-field generators (ATLAS, SATURN).
- Length of homogeneous field is ~ 10 cm, peak rate-of-rise of field is ~ 10^9 *Tesla/sec*, only a few nanosecs is spent at 10^3 *Tesla* which is long enough for good measurement of *c* (to a part in 10^2 or 10^3 with picosecond pulses).
- Exploit peak rate-of-rise of field? Experiments using nuclear explosives/implosives to generate ultrahigh B-fields (~ 10^9 *Tesla*)?

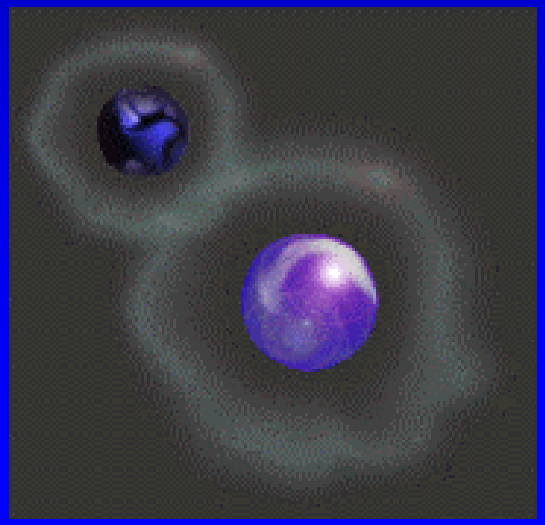
Magnetic Field Generation Technologies

Magnetic Field Strength (Tesla)	*Field Generation Technology*
10 - 300	Superconductivity, Hybrid Magnets and Pulsed Magnets
360	Magnetic flux compression by electromagnetic force
400	One-turn coil connected to strong laser produced plasma
~ 10^3	High powered pulsed lasers
1000 - 3000	Magnetic flux compression by chemical explosion/implosion
10^2 - 10^5	White Dwarf stars
10^7 - 10^9	Neutron stars
³ 10^9	Magnetic flux compression by nuclear explosion/implosion

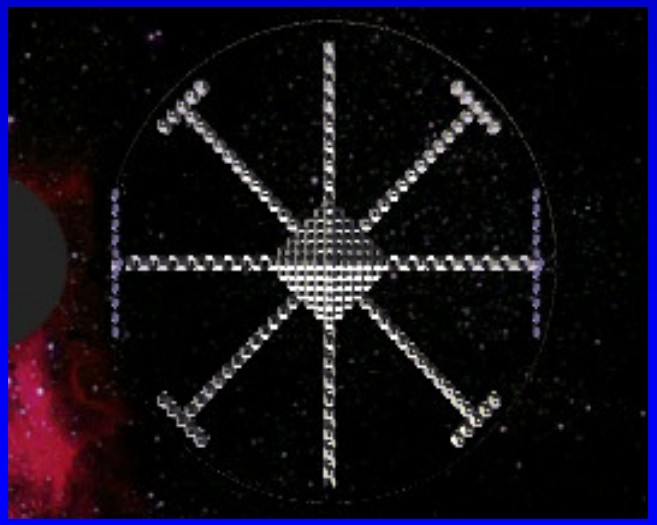
WHIP Spacecraft Concept



Left **and** ***right*** **figures depict the Morris & Thorne wormhole which uses exotic matter-energy.**



WHIP spacecraft (*r*) deploys ultrahigh B-field to generate hypercylinder curvature envelope to stress space into wormhole configuration. Exotic matter-energy field is applied in small region to create the traversable throat which is patched to the hypercylinder space (*l*).



Conclusion

- Maccone's analysis is correct with respect to inducing space-time curvature and slowing of light via ultrahigh magnetic or electric fields.
- Maccone's interpretation of Levi-Civita's metric is incorrect as this really describes a hyper-cylinder with a position depen-dent gravitational potential.
- There is no asymptotically flat external space, no flared-out wormhole mouth and no throat.
- Radial magnetic or electric fields are borderline exotic, but create wormholes in different geometry.
- There are other exotic matter-energy fields to choose from!
- A lab experiment whereby a hypercylinder curvature effect is created by virtue of ultrahigh B-fields has excellent potential for breakthrough propulsion.
- A measure of the slowing of light speed (*c*) in this scenario would verify this effect.
- Recommend using chemical explosive/implosive B-field tech-nologies, exploit ultrahigh peak rate-of-rise of field (10^9 *Tesla/s*).
- Fields > 10^9 - 10^{10} *Tesla* needed to affect measurable slowing of *c*.
- B-field technologies based on nuclear explosives/implosives need to be considered to achieve large magnitude results.