

# Speed of Light in Rotating Frames

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In a rotating non-inertial frame the speed of light does shift analogous to a pseudo-scalar increasing in one sense of rotation and decreasing in the opposite sense of rotation. This is in contrast to a spherically symmetric compact source that is not rotating where the speed of light remains at  $c$  for the fixed non-inertial observer although its direction changes (bending of light – gravity lens). Gravimagnetic Lense-Thirring frame drag, therefore, will be expected to shift the speed of light for the non-inertial observers.

On Feb 14, 2005, at 3:04 PM, Jack Sarfatti wrote:

Metric engineering is the artificial warping of the fabric of space-time using SMALL amounts of electrical power on board the "flying saucers" – as small as a single AAA battery perhaps? ;–)

[http://www.streetpeddler.com/cgi-bin/street/dynam.html?prod\\_group=toys&category=over\\_10&type=Energetic%20B](http://www.streetpeddler.com/cgi-bin/street/dynam.html?prod_group=toys&category=over_10&type=Energetic%20B)

<http://stardrive.org/cartoon/dan.html>

<http://stardrive.org/cartoon/coffee.html>

<http://stardrive.org/cartoon/Saturn.html>

The context here are Russian claims for torsion field-based advanced weapons systems combined with a seeming glimmer of a confirmation from an American physicist on a US Navy contract that subsequently went "black" as well as <http://americanantigravity.com/eric-davis.shtml> for the Rube Goldberg/Polish Joke version of metric engineering. :–)

When one reads Nick Cook's book "The Hunt For Zero Point" re:

Podkletnov, Ning Li and previous alleged Nazi experiments

[http://www.findarticles.com/p/articles/mi\\_m2843/is\\_6\\_26/ai\\_94044223](http://www.findarticles.com/p/articles/mi_m2843/is_6_26/ai_94044223)

rotation of a macro-quantum object seems to be important. Now we have "supersolids" as well as superconductors. Is the flying saucer shell a high  $T_c$  nano-smart super solid? (e.g. my 1969 paper "Destruction of superflow in unsaturated 4He films and the prediction of a new crystalline phase of 4He with Bose-Einstein condensation." Physics Letters, Vol 30A, no 5 3 November 1969 pp 300–1).

Let's look at rotating frames in Einstein's theory. Start with a non-rotating inertial frame  $K$  in Einstein's 1905 special relativity.

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Direct warping of spacetime by real matter or by the virtual matter of dark energy and dark matter will be neglected. Think of a Merry Go Round!

The space–time geometry in the global inertial frame K has the metric form

$$ds^2 - c^2dT^2 - dX^2 - dY^2 - dZ^2$$

Since kids are playing on the Merry Go Round we take it real slow and gentle with a Galilean transformation to the rotating non–inertial frame K about z axis at  $w$  RPM.

$T = t$  i.e. ABSOLUTE COORDINATE TIME in this slow rotation limiting case.

$$X = x\cos wt - y\sin wt$$

$$Y = x\sin wt + y\cos wt$$

$$Z = z$$

Therefore, from Newton's calculus, the first–order differentials are

$$dX = dx\cos wt - xw\sin wt - dy\sin wt - yw\cos wt$$

$$dY = dx\sin wt + xw\cos wt + dy\cos wt - yw\sin wt$$

Substitute  $dX$  &  $dY$  into INVARIANT  $ds^2$  to get

$$ds^2 = [c^2 - w^2(x^2 + y^2)]dt^2 + 2wydxdt - 2wx dydt - dx^2 - dy^2 - dz^2$$

There is no real event horizon here like in a black hole because the Galilean approximation here is

$$(w/c)^2(x^2 + y^2) \ll 1$$

The dimensionless gravimagnetic field is

$$B_i = g_{0i}$$

$$B_x = 2wy/c, B_y = 2wx/c, B_z = 0$$

What is the speed of light measured by an non–inertial observer fixed in the rotating frame?

$$ds = 0 \text{ for a ray of light.}$$

Therefore

$$0 = [1 - (wr/c)^2](cdt)^2 - dL^2 - (B_x dx + B_y dy)(cdt)$$

$$r^2 = x^2 + y^2 = \text{distance from axis of rotation in cylindrical coordinates}$$

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$$dL^2 = dx^2 + dy^2 + dz^2$$

The physical time measured by a clock fixed to the rotating frame at  $r$  will be, according to Einstein's SR time dilation and the GR principle of equivalence

$$dT = [1 - (wr/c)^2]^{1/2} dt$$

The metric equation for the ray of light is then

$$0 = (cdT)^2 - dL^2 - (B.dr)(cdt) = (cdT)^2 - dL^2 - (B.dr)(cdT)(1 - (wr/c)^2)^{-1/2}$$

Divide by  $dT^2$

$$c^2 - (dL/dT)^2 - B.(dr/dT)c(1 - (wr/c)^2)^{-1/2}$$

$$dL/dT = c[1 - (B/c).(dr/dT)(1 - (wr/c)^2)^{-1/2}]^{1/2}$$

Obviously  $dL/dt = c$  is the speed of light in vacuum for the non-rotating inertial frame. The rotation has changed the physical speed of light. Note however that the speed of light does not change in a the vacuum surrounding a nonrotating spherically symmetric mass.

$$\text{Note that } dr/dT = wr[1 - (wr/c)^2]^{1/2}$$

therefore, the vacuum speed of light in the rotating non-inertial frame is

$$dL/dT = c[1 - (B/c).(dr/dT)(1 - (wr/c)^2)^{-1/2}]^{1/2}$$

$$dL/dt = c[1 - Bwr/c]^{1/2}$$

where  $Bwr/c \ll 1$

$$dL/dt \sim c(1 \pm B|w|r/2c)$$

Note that when we change the sense of rotation  $w \rightarrow -w$ , the shift in the speed of light reverses as well analogous to a pseudo-scalar violating parity in the weak force of beta decay radioactivity.

The effective gravity here does not decay to zero at infinity like a real gravity field from a compact source. See Landau & Lifshitz "Classical Theory of Fields" Ch 10.

On Feb 14, 2005, at 2:01 PM, Jack Sarfatti wrote:

On Feb 14, 2005, at 1:14 PM, iksnileiz@earthlink.net wrote:

When I wrote "speed of light propagation", I meant the speed of light propagation.

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When O&R wrote "speed of light propagation", they meant the speed of light propagation.

I am talking about the speed of light propagation.

It's a tricky question in GR.

The time of delay in propagation of light in the Shapiro effect is not due to a change in the physical speed of light in vacuum. It is due to an INCREASE in the proper space length of the photon's path from the Sun's curvature field. Wheeler & Ciufolini explain it in detail in 'Gravitation and Inertia'. You do seem to get speed of light effects in rotating frames like Sagnac effect and also gravimagnetism with rotating sources, but you do not get it in Schwarzschild case where

$$ds^2 = c^2dT^2 - dR^2 - dL^2$$

$$ds = 0$$

$(dR^2 + dL^2)^{1/2}/dT = c$  measured both by rest LNIF and coincident LIF observers at same event P

$dR = (1 - 2GM/c^2r)^{-1/2}dr$  = physically measured radial interval by LNIF rods at rest relative to M source.

$dT = (1 - 2GM/c^2r)^{1/2}dt$  = physically measured time interval by LNIF clocks at rest relative to M source.

$$dL^2 = r^2(d\theta^2 + \sin^2\theta d\phi^2)$$

Bending of light by gravity is

$$\tan(\chi) \sim dL/dR$$

gravity red shift is from

$$dt = dt'$$

i.e.

$$dT/(1 - 2GM/c^2r)^{1/2} = dT'/(1 - 2GM/c^2r')^{1/2}$$

You do not understand elementary measurement theory in GR.

With gravimagnetism you do get new effect

$$ds^2 = c^2dT^2 - dR^2 - dL^2 - g_{oi}(cdt)dx^i = c^2dT^2 - dR^2 - dL^2 - Bidx^i(cdt)$$

$$i = 1,2,3$$

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$B_i$  is the gravimagnetic field used by Ray Chiao in "gravity radio" for submarine  $C^3$ .

$$B_i = g_{0i}$$

for a light ray  $ds = 0$

Therefore, I get the interesting formula (will work for Sagnac effect also!)

$$c^2 = (dR/dT)^2 + (dL/dT)^2 + cB_i(dx^i/dT)(dt/dT)$$

$$dt/dT = 1/g_{00}$$

Suspend summation convention

$$dX^i = (g_{ii})^{1/2} dx^i$$

$$c^2 = (dR/dT)^2 + (dL/dT)^2 + c(g_{ii})^{-1} B_i (dX^i/dT) g_{00}^{-1}$$

$$\text{i.e. } (g_{ii})^{-1} B_i (dX^i/dT) = (g_{11})^{-1} B_1 (dX^1/dT) + (g_{22})^{-1} B_2 (dX^2/dT) + (g_{33})^{-1} B_3 (dX^3/dT)$$

Therefore, the measured speed of light for rotating sources and frames is

$$d(R^2 + L^2)^{1/2}/dT = c[1 - (g_{ii})^{-1} (B_i/c) (dX^i/dT) g_{00}^{-1}]^{1/2}$$

Eq 36 p. 17 of Brazilian paper mentions Moller's solution of this problem using the Cartan tetrads that are a bridge between the two complementary local gauge connection and tensor geometrodynamical formulations of Einstein's 1916 GR before generalizations to additional Shipov-type torsion dynamical compensating field and possibly others from the hyperbolic boosts and the dilation parts of the Conformal Group's Lie algebra.

Decoding The Cipher of Genesis

Cartan Form GR

Let  $A^a{}^b{}_c$  be the Ricci rotation coefficients in the tangent space

$$A^a{}^b{}_c = e^a{}_\alpha A^{\alpha}{}^b{}_c$$

$e^a{}_\alpha$  = Locally gauged T4 Cartan tetrad of Einstein's torsion-free 1916 GR.

$$e^a{}_\alpha = \&u^a{}_\alpha + B^a{}_\alpha$$

$\&u^a{}_\alpha$  = trivial globally flat Minkowski holonomic tetrad where the tangent space and the base space are degenerate identical i.e. no gravity, no inertia of the unstable Dirac Sea pre-inflationary false warplless vacuum "before" the BIG BANG.

Casting "Oil" on the Stormy Waters of The Dirac Sea to create The Big Bang from the binding energy of virtual electron–positron pairs in the Vacuum Condensate of the Cosmic "multi–layered multi–colored" (Wilczek) cosmic superconducting field.

$Bu^a$  is the non–trivial part of the Cartan tetrad encoding the post–inflationary emergent warps of gravity, inertia, dark energy and dark matter in the Pacific Higgs Ocean. The anti–gravity dark energy residual micro–quantum zero point fluctuations is the "fuel" of globally superluminal weightless warp controlled geodesic drive and time travel to the past through Star Gates.

The warp drive gauge potential field is

$$Bu = Bu^a Pa/h = (\text{Higgs Ocean Goldstone World Hologram Macro–Quantum Phase}), u$$

$h$  = Planck's constant

$\{Pa\}$  = Lie algebra of the translation group  $T_4$  generated by John Wheeler's total "mom–energy",

The Cartan 1–form for the connection of parallel transport in warped spacetime is

$$A = Au^b{}^c S_{bcd} x^u$$

$\{S_{ab}\}$  is the Lie algebra of the  $O(1,3)$  local Lorentz group in the tangent space of Einstein's GR

The covariant exterior Cartan derivative  $D$  is then

$$D = d + A$$

$d$  = ordinary flat space–time exterior derivative

$d^2 = 0$  in flat space–time sans gravity sans inertia (massless lepto–quarks)

$D^2 = 0$  in warped space–time with gravity and inertia as well as exotic vacua domains.

The tidal stretch–squeeze curvature 2–form  $R$  is simply

$$R = DA = dA + AA$$

The tetrad 1–form is

$$e = eu^a(Pa/h)dx^u$$

The Gennady Shipov torsion 2–form  $T$  is then simply

$$T = De = de + Ae$$

On Feb 12, 2005, at 1:10 PM, Jack Sarfatti wrote:

Decoding The Cipher of Genesis

"quasi-local approach" ... "super-potential, which is a Hamiltonian boundary term" "screen" of World Hologram i.e. local horizon on (anti) De Sitter space-time with Hawking radiation? That is the gravity energy only depends on the horizon surface not on local space volume elements! 3D Space is a holographic image! See p. 16 section E of Brazilian paper. They go on to get a local representation in the complementary or dual gauge-force picture that is physically equivalent to the nonlocal geometrodynamical picture.

The Brazilians Arcos & Pereira (2005) discuss the nonlocality of the gravity energy in Einstein's geometrodynamical representation with curvature and no torsion that is Bohr complementary to the gauge force representation with torsion and no curvature. However the Brazilian "torsion" should not be confused with Gennady Shipov's torsion. They are entirely different and different words should be used.

My own macro-quantum theory, for the emergence of Einstein's curvature in the post-inflationary "Higgs Ocean" (Brian Greene) AKA "multi-layered multi-colored" cosmic superconducting field (Frank Wilczek) AKA partial cohering of the pre-inflationary random micro-quantum zero point false vacuum fluctuations, is more naturally set in the Brazilian gauge force representation initially although I immediately transform to Einstein's orthodox geometrodynamical representation as more heuristic for getting new insights.

Recall that the pre-inflationary unstable false vacuum is a conformal vacuum without gravitation or inertia admitting only massless lepto-quark and boson gauge force special relativistic quantum fields.  $U(1)SU(2)SU(3)$  is locally gauged in the false vacuum. No part of the 15 parameter conformal group is locally gauged pre-inflation.

Conformal Group  $C(4)$

= Dilation\*(Conformal Boosts to Uniformly Accelerating Hyperbolic Motion)\*(Translations)\*(Space-Rotations)\*(Inertial Frame Lorentz Boosts)

$T_4$  = normal subgroup of translations generated by Wheeler's "mom-energy"  
= Lie algebra  $\{P_\alpha\}$

$O(1,3)$  = (Space-Rotations)\*(Inertial Frame Lorentz Boosts) = Lorentz Group

Lorentz Boost = space-time rotation

real angles of rotation of an extended rigid body have imaginary extensions that are equivalent to the "rapidities" of the Lorentz boosts.

Spontaneous breaking of O(3) rotation group symmetry in the ground state of many spinning electrons is ferromagnetism. Ferromagnetism is a preferred frame of orientation in space without explicit O(3) breaking terms in the dynamical action.

Similarly, data like Cahill's and Consoli's claiming a preferred Lorentz inertial frame would, if corroborated, merely mean spontaneous breakdown of the O(1,3) group in the physical vacuum, particularly its boost sector. The preferred frame of absolute rest means a set of rapidities are chosen in a finite region of vacuum just like a set of rotation angles (only latitude and longitude on the celestial sphere, twist rotation (torsion field?) about the preferred space direction is another issue using ALL THREE Euler angles, is chosen in a finite domain of the ferromagnetic ground state.

Einstein, not knowing about spontaneous symmetry breakdown in 1905, thought of the space of global inertial frames (pre-GR 1916) as an affine space without a preferred origin. Lorentz thought of this space of frames as a vector space with an origin. This is a real experimental difference, but it is contingent not fundamental. The way the symmetry breaks in a ferromagnetic domain is contingent like a pimple on one's nose. Similarly, for Cahill's claim – a small blemish on Einstein's nose for The Truth! :-)

All dynamics comes from the minimal coupling local gauge principle of different symmetry groups both internal and external in 4D space-time. Roger Penrose says extra space dimensions are unstable so let's see if we can do without them. No supersymmetry needed as yet either since I predict supersymmetry will not be found in the LHC and also that dark matter detectors will never click with the right stuff, e.g. on-mass-shell neutralinos et-al do not exist. These are falsifiable predictions.

From Stormy Dirac Sea to Calm Higgs Ocean (Oil upon The Waters of Creation)

Looking only, for now, at the low-energy tail of the false pre-inflationary conformal vacuum sans gravity and inertia, both emergent properties, the Dirac negative energy virtual Fermi energy is  $E = 0$  and the zero point PV virtual electron-positron pairs in a small thickness of the Fermi surface form virtual bound states fusing into the zero entropy BEC vacuum condensate "Higgs Ocean" that trigger the inflation and the emergence of Einstein's gravity along with all rest masses  $m$  and both dark energy and dark matter.

Post-inflation, the Cartan tetrad encoding the important part of the equivalence principle (EEP) is

$$e^a_\mu = (\text{Kronecker Delta})u^a_\mu + B u^a_\mu$$

$$B u^a_\mu = B u^a_\mu P a / h = (\text{Higgs Ocean Goldstone Phase}), u$$

{Pa} is Lie algebra of T4

i.e. the non-trivial curved intrinsic part – the actual or "real" gravitational field that is locally equivalent to an inertial field in a local non-inertial frame of reference, AKA "LNIF"

This is a spontaneous broken locally-gauged U(1)em vacuum symmetry exactly like in the BCS superconductor where, instead of on-mass-shell charged  $2e$  electron pairs, we have neutral virtual electron-positron pairs in an off-mass-shell "bound state". The result is a locally-gauged T4 dynamical non-trivial tetrad field  $eu^a$  emergent from the spontaneous broken U(1)em vacuum symmetry. The release of binding energy of the virtual electron-positron pairs powers the Big Bang.