7th January 2024

Shift-symmetry in Einstein's universe: Part A: The Doppler equations

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Part of a series. In Einstein's universe, the basic Doppler relationships are symmetrical with respect to velocity. This behaviour is incompatible with gravitomagnetism and gravitational waves. It is also incompatible with relativistic gravitation and the general principle of relativity, as these require gravitomagnetism.

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doi: 10.13140/RG.2.2.22102.01602

1. Introduction

This is the second of a series of papers [1] [2] [3] [4] [5] [6] exploring Einstein's concept of shift-symmetry.

The introductory paper [1] introduced the interlinked ideas of **Doppler shift symmetry**, **gravitational shift symmetry** and **time-symmetry**, and pointed out that we can define and derive special relativity's equations from just the conditions of symmetry and relativity. In *this* paper we look at how the concepts of relativistic gravitation and the general principle of relativity, and gravitational waves, each make the symmetrical equations of special relativity impossible to implement.

2. Shift symmetry in brief

The relativistic Doppler relationship of Lorentz aether theory (LET) and special relativity, $E'/E = \sqrt{(c-v)/(c+v)}$, [7] is symmetrical with regard to velocity: the change in frequency and energy of a signal from a body *approaching* at *v*, expressed as a ratio, is the inverse of the change if the body is *receding* at *v*.

This has some far-reaching consequences. If we aim a signal across a room, with the emitter and receiver fixed to the room's opposite walls, then when we place a transponder in the beam, and move the transponder *along* the beam, the two Doppler shifts, emitter-to-transponder, and transponder-to receiver, cancel perfectly. [1]

$$E'/E = \sqrt{\frac{c-v}{c+v}} \times \sqrt{\frac{c+v}{c-v}} = 1$$

This cancellation illustrates that (in an LET/SR universe) the light-geometry of the region is utterly unaffected by the presence and motion of the transponder, and that light-dragging effects (which would change the lightbeam geometry as a function of bodies' relative velocities) do not exist. Cancellation lets us *prove*, *geometrically*, that velocity-dependent gravitomagnetism does not exist, and that therefore accelerative and rotational gravitomagnetism do not exist either.

This give a very geometrically simple system that works without our having to understand spacetime curvature, as, move a body however we wish, the body's motion never affects the region's initial intrinsically-flat lightbeam geometry. [8] The cancellation gives us flat, "absolute" (Einstein 1921 [9]) Minkowski spacetime, perfect energy-conservation, and, indirectly, the Schwarzschild solution under general relativity, absolute event horizons and "Wheeler" black holes (Part "B" [3]), and also perfect time-reversibility (Part "C" [4]).

Einstein's system is arguably the simplest [i] possible solution to the problem of reconciling the restricted relativity principle with the behaviour of light. Unfortunately, it is also something of a "dead end" – it is not extensible to cope with gravitation or gravitational behaviours, and the relativity principle applied to bodies with gravitational fields demands a more dynamic spacetime than Minkowski's, generating different Doppler equations. [19]

Special relativity is a unique fit to empty flat spacetime, and presumes that Maxwell's equations for empty space apply even when a region is no longer empty ("*flat spacetime everywhere*" [13]). Shift symmetry *only* works under these conditions. The following pages show that in a universe that applies the relativity principle to gravity, supports the general principle of relativity, and/or supports gravitational waves, we cannot use shift-symmetrical equations. In such a universe, special relativity is not correct foundation theory.

i … or crudest!

3. Relativistic Gravitation ("RG")

3.1 Relativistic gravitation requires finite c, $c_g=c$

Relativistic Gravitation ("RG") [10] is the result of the (reasonable) supposition that the laws of gravity should obey the relativity principle – after all, it would be difficult for the behaviour of stars and planets to obey the relativity principle if their fields did not.

As Einstein pointed out in 1911 [11] relativity requires the speed of gravity, c_g, to be finite. If the speed of gravity was *infinite*, we could use gravitational signals to communicate instantaneously over vast regions. "Instant signalling" would mean that we could then establish for a fact that a set of extremely distant events *really were* instantaneous, giving us an absolute reference frame for judging the behaviour of light. [11]

The 1905 theory allows different observers to each believe that the speed of light is globally fixed in their own frame, partly by allowing different opinions on remote simultaneity, with no way of telling who is really correct. A way of establishing absolute agreed distant simultaneity would wreck this. [i]

3.2 Finite c_g gives gravitomagnetic (GM) side-effects

A finite speed of gravitational signal-propagation generates **gravitomagnetism**:

- **When a star approaches us**, our detectors will measure a "old", outdated value for its field influence at our position, corresponding to the star's previous position, further away, and the star's pull at its *current*, *instantaneous* position, will then be weaker than expected if c_g=*infinity*.
- **When a star recedes from us**, we will still be experiencing its field as it was at an earlier time when it was closer to us, and our detectors should show it to have a pull that is stronger than we'd expect if c_g=*infinity*.

This difference between the expected and actual gravitational effects can be described as a "gravitomagnetic" correction to the rest field that is repulsive for approaching bodies and attractive for receding bodies. [ii] This effect ("pulling" when the star recedes and "pushing" when it approaches) deflects nearby light and matter in the direction of the star's motion, and has an effect similar to the dragging effects of some archaic aether theories. Under general relativity this is "the inductive effect of mass-flow", [12] or "the dragging of inertial frames".

GM causes a rotating star to exert a rotational drag on its environment, and with a forcibly-accelerated mass, a higher-order effect causes a drag in the direction of acceleration.

3.3 Gravitomagnetism destroys special relativity

A velocity-dependent drag on light by moving matter means that a region's lightbeam geometry must change when bodies pass though it, violating the 1905 assumption that the lightbeam geometry of a region populated by moving masses is identical to the geometry of an empty space. [13] It also undermines the 1938 conclusion that the properties of moving bodies can be properly calculated from the field equations for empty space. [14]

Einstein's 1905 math and Minkowski's 1909 spacetime [15] only work with the assumption that spacetime has a fixed geometry. [9] If this is wrong, then "all bets are off", and we need a new theory of inertial physics that incorporates the missing dynamic geometrical elements, using a dynamic **acoustic metric** [16] rather than the usual fixed Minkowski metric.

i It is difficult to have a geometrical physics if different signals propagate according to their own rules.

ii The negative gravitomagnetic field associated with an approaching mass is not an isolated negative field, but represents a reduction in the pre-existing positive field.

3.4 Gravitomagnetic shifts destroy SR as a low-gravity limit

If a receding star pulls *more* strongly, and an approaching star pulls *less* strongly, then we expect the gravitomagnetic field, deflecting light in the same direction as the star, to cause a corresponding redshift or blueshift. Calculated *in addition* to the SR predictions, the GM shift would mean that SR-without-GM no longer has the correct Doppler relationships. Calculated *as a replacement* for the SR predictions, the new motion-shifted wavelengths have to fit a dynamic geometry that is no longer Minkowski's … and again, the shift relationships must be different to those of SR. SR and GM are *mutually exclusive* – gravitomagnetism cannot exist in an SR universe, and SR cannot apply in a universe that supports gravitomagnetism.

Theorists using the current system console themselves with the thought that these disruptive non-SR effects must only be significant for "strong gravity" physics, and that elsewhere SR still operates. But the idea of GM shifts makes this impossible: if GM dragging modifies the shift relationships for moving strong-gravity bodies, then, since a metric theory only allows a single Doppler relationship that must apply *everywhere*, the "worst-case" deviation from "SR Doppler" that must happen for a moving horizon-bounded collapsed star (whose horizon is expected to drag light *totally*), must also be valid for the smallest massed particle possible. [i] [ii]

Special relativity is what Feynman referred to as "a perfect system" that cannot be adjusted. [17] If the SR Doppler predictions are wrong *anywhere*, they must be wrong *everywhere*.

3.5 Relativistic gravitation destroys Einstein's system

Relativistic gravitation invalidates SR's assumptions, geometry and equations for inertial physics. They require us to derive a new set of equations for inertial physics that incorporate curvature, and since SR has the only symmetrical relativistic equations, [1][][] the new equation-set, if it is still to support the relativity principle, needs to be *asymmetrical* with regards to Doppler shifts, gravitational shifts, and time.

3.6 Could relativistic gravitation be wrong?

It is difficult for the concept of "relativistic gravitation" to be wrong, as it is merely the result of applying the relativity principle to moving bodies that have gravitational fields. If it is wrong, then the relativity principle does not apply to stars and planets – a more restricted scenario than even Galileo's and Newton's. [10]

Worse, since the **principle of equivalence of inertia and gravitation** ("**PoE**") insists that inertia and gravitation are two aspects of the same underlying property, [iii] [18] and that it is *impossible in principle* to have an inertial mass without an associated gravitational field, *all* masses become "gravitational" masses. If we dismiss RG to save SR, the resulting restricted relativity principle no longer works in the presence of real matter or real observer-objects.

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i If we idealise a fundamental passed particle as being pointlike(ish), we will expect an enclosing horizon some small distance from the particle's centre, and if the horizon moves, we expect it to drag light totally.

A gravitational model is by default a *fully dragged-light* model, and cannot use flat-spacetime equations for inertial physics (except, perhaps, as a low-velocity approximation).

ii Even without metric theory, if "weak-gravity" and "strong-gravity" objects obeyed different Doppler relationships, we would have to ask which equations applied when a "weak-gravity" and a "strong-gravity" body with significant relative motion exchanged signals, as this would seem to allow the pair to measure the Doppler relationship and identify who was "really" moving the fastest, breaking even "simple" relativity.

Whatever the strength of gravitomagnetism is, and what its effect must be on the motion-shift relationships, it has to apply identically to everyone. We are not allowed to have a distinction between "strong-gravity" physics and an SR "weak-gravity" range, with different equations applying in each. If *some* physics is "strong-gravity" then *all* physics is "strong-gravity". [19]

iii **Einstein (1923):** [18] " *… general relativity, … eliminates the separation between inertial and gravitational effects.* "

4. General Relativity and the General Principle of Relativity

4.1 A general theory requires gravitomagnetism

A general theory of relativity is built on **the general *principle* of relativity** (**GPoR**), which treats *all* motion as relative ... not just the simple motion of bodies at constant speeds in straight lines, but also systems with rotation and acceleration. A general theory complies with the GPoR by saying that when a spaceship spins or accelerates, its occupants feel "geeforces" due to their ship's spin or acceleration, referenced not to some notional "absolute space", but to other environmental matter (*e.g.* the surrounding shell of background stars).

The general principle then requires that these effects be *universal*, and that when the spaceship's *own* mass spins or accelerates with respect to the background, a background onlooker will experience a similar (smaller!) rotational and accelerative field due to the relative motion of the ship's hull and its contents. [9]

The GPoR therefore gives us the same classes of accelerative and rotational gravitomagnetic effect that we encountered in section 3.2 .

4.2 A valid general theory cannot be built on SR equations

Accelerative and rotational dragging effects cannot exist unless there is also an underlying velocity-dependent gravitomagnetic effect, and this then inevitably invalidates the flat foundations of special relativity's assumed geometry.

GR textbooks are keen to tell us that if SR is correct for simply-moving objects in an assumed flat spacetime, that it is also *provably* correct for forcibly-accelerated objects. According to standard arguments, [8] [20] the path of an accelerated mass can be broken down into an arbitrarily-large number of arbitrarily-small velocity-differentials, with the total curvature for the accelerated body being the combined curvature of all the individual velocity stages ... and since the curvature associated with relative velocity of masses under SR is *zero*, the spacetime distortion associated with physical acceleration under an SR-based system is *also* zero. If valid, the SR Doppler relationships then allow us to *prove*, *geometrically*, that there can be no such thing as accelerative gravitomagnetism. [21] At this point, the GPoR is invalidated, and we lose the possibility of ever having a general theory of relativity.

Since a working general theory *<u>needs</u>* a forcibly-accelerated body to warp spacetime as a back-reaction, it also needs this more basic velocity-dependent distortion effect to exist. The geometry of inertial physics under a general theory then no longer fits flat spacetime, and the velocity-dependent curvature gives us a *dynamic*, *acoustic* metric [16] rather than the fixed flat Minkowski geometry. Since Minkowski spacetime is simply the geometrical expression of the equations of special relativity, it is impossible for our basic equations, in the context of a gravitomagnetic universe, to be those of special relativity.

The relativity principle forces us to choose between SR and GR: If we believe that the "symmetrical" SR relationships are correct, we must dismiss the GPoR as wrong, and reject the idea of a general theory. If we want relativistic gravitation, and a general theory, we cannot build them on a foundation of flat-spacetime physics. [i]

i Some results of SR that depend on the relativity principle and do not depend on which *implementation* of the principle we use ... such as the $E=mc^2$ result for rest mass ... will still be correct.

4.3 Einstein's 1916 general theory is impossible

It may seem bizarre to say that a valid general theory cannot be based on SR equations, since SR-compliance is such a key part of Einstein's 1915/1916 general theory, and since Einstein went to great effort to stress that SR lives on as a subset of GR. [22]

The answer is to recognise that Einstein's 1916 theory is not a valid general theory of relativity, and that GR1916 is logically and geometrically incoherent, and built on mutually-contradictory assumptions.

Einstein's aesthetic sense of the rules that he believed his general theory *ought* to conform to resulted in a specification for the theory that was geometrically impossible to implement:

- **SR is a theory of inertia without gravity**. The GPoR tells us that we *cannot have* inertia without gravity. The **relativity of inertia** requires inertia to be field-mediated, with the field-connection between a body and its background provided by the gravitational field: [9] remove the gravitational field (or flatten it), and inertial mass disappears.
- **SR is a theory of the behaviour of matter in flat spacetime**. The PoE tells us that we *cannot have* matter in flat spacetime. Introducing matter introduces curvature.
- **SR is a theory of moving matter without gravitomagnetism**. Relativistic gravitation, and the GPoR, both tell us that we *cannot have* moving matter without gravitomagnetism.
- **SR is presented as a "weak-gravity" limit of GR1916**. Gravitomagnetic theory tells us that there is *no such thing* as "weak-gravity" physics: there is only *zero*-gravity physics or *full*-gravity physics. [19] [24]

Geometrical physics is normally supposed to be exact, and Newtonian theory and special relativity both honorably generate exact answers to exact questions. GR1916 and "modern GR" often cannot manage this, as exactness highlights the theory's ability to produce *conflicting* exact answers. [i] [ii] Modern GR survives on its ability to be *in*exact ("fudging"), and a common feature of many modern GR derivations is talk of first-order approximations and Newtonian approximations.

Some modern theorists will agree that SR-centric "textbook GR" violates the GPoR. But rather than agree that this counts as failure under Einstein's original criteria [25] (being incompatible with the "general" principle that gave the theory its name), they will say that we now appreciate with the wisdom of hindsight that the GPoR was only ever a useful but disposable *heuristic guideline*, that we now appreciate that acceleration is *absolute*, and that "modern textbook GR" *transcends* the original specifications and has now instead become a **general theory of covariance**. [26]

As a result, we do not currently have a working general theory of relativity.

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i The architecture of GR1916 is **pathological**. The difficulty with "pathological" systems is not so much that they cannot produce exact answers, but that they can generate *t*oo many *different*, *contradictory* exact answers to the same question. This quality makes a pathological theory attractive to an unsuspecting theorist, as the "bad" theory will let them select whichever possible answer conforms best to their prejudices and expectations, prove it, and then reject the other answers as "disproved" for conflicting with the first, arbitrarily-selected answer. Pathological theories encourage a sense of loyalty, as they allow the theorist latitude to do almost whatever they want, while thinking that what they are doing is rigorous – they give the theorist a pleasing sense of having derivational "superpowers".

ii Since pathological theories twist logic, making them difficult to recognise, it is important to avoid creating them. Physical theories normally avoid pathologicity by carefully assessing each small component that is to be added to a theory for compatibility with the new theory's principles, before including it. Since Einstein's GR project always *presumed* that a general theory should be built on an SR foundation, this safety-checking stage seems to have been missed.

4.4 Could the GPoR be wrong?

Theoretical physics is partly the search for universal laws. It is difficult for the GPoR and the PoE to be wrong, as any *truly* universal laws of physics need to be able to describe how the universe appears to *everyone*, including rotating and accelerated systems, without deferring to some other external preferred onlooker's point of view.

Local physics implies the GPoR

The idea that physics should be capable of functioning locally using just local data is important, as atoms need to be capable of reacting to the signals presented to them without stopping to wonder whether an apparent field is "real" or "imaginary", or asking themselves whether a different atom with a different state of motion might have a different opinion.

Atoms should not be expected to understand philosophy. In order for the laws of physics to be so computationally simple that atoms are able to carry them out without interpretation, we need physics, to the greatest extent possible, to be locally self-sufficient. An atom, photon, or system needs to be able to respond to an apparent gravitational field by treating it literally, without worrying about how the field originates. The requirement that fictitious fields experienced in rotating and accelerated frames can be considered "real" for local physics then gives us the PoE and points us towards the general principle of relativity.

Local physics suggests that the GPoR is correct, in which case we need gravitomagnetic effects to be real, we need the relative velocities of masses to be associated with physical spacetime curvature, we need different equations to those of special relativity.

Since losing SR means losing symmetry, the requirement of a simple and consistent local physics leads to the loss of shift-symmetry, *gravitational* shift symmetry, and time-symmetry.

5. Gravitational waves

5.1 Unavoidability of gravitational waves

Every time a system changes its mass-energy distribution, it changes how it interacts with and presents itself to the outside universe. [27] [28] It has to communicate this change in its circumstances to the outside universe by changing its exterior field geometry, and since the speed of gravitational signals needs to be finite, the change-of-shape of its exterior field propagates as a spacetime distortion signal, or **gravitational wave** ("*g*-wave"). [i]

5.2 Gravitational waves need energy

Since the transfer of information requires the transfer of energy, any interaction that results in a change of energy-distribution between two particles, and a change in field geometry, must result in an outgoing **micro-gravitational** ("**μg**") wave. [ii] [28] If one atom emits a photon and another atom receives it, then the first atom's curvature decreases, the second atom's curvature increases, and the system's distribution of massenergy changes.

The change in the system's external field does not affect distant matter instantaneously … the geometrical change in the shape of the field propagates outwards, as an associated μ*g* wave that carries information, and if information-transfer is associated with energy-transfer, these propagating kinks in spacetime need to carry energy out of the system.

5.3 Energy-conservation in Einstein's system

As already mentioned in Section 2, and in the introductory paper, one of the more compelling aspects of the shift-symmetric Doppler equations used by Lorentz aether theory and special relativity is their immediate compatibility with conventional energy-conservation.

Taking the SR recession Doppler equation, $E'/E = \sqrt{(c-v)/(c+v)}$, we can immediately see that if we send a signal across a room, and an intermediate transponder or speck of dust enters the signal path, moving along it, that the successive recession redshift (for $+v$) and approach blueshift (for $-v$) exactly cancel, [1] so that the beam is received back in the room frame with precisely the same energy that it started with. But this outcome does not take gravitational waves into account.

5.4 Gravitational waves break Einstein's system

Gravitational waves have energy-requirements that have to be accounted for somewhere, and Einstein's perfectly-balanced system, which *does not take into account* the energy required for gravitational waves, breaks energy-conservation laws as soon as μ*g* wave behaviour is acknowledged. [27]

Where the original thought-experiment ("intro" paper, [1] section A) suggests that the SR equations are unavoidable because the system *cannot* be gaining or losing energy, [1] in the "μ*g* wave"-inclusive description, this "proof" of SR turns into a disproof – we know that the prematurely-balanced SR equations cannot be *right*, because the system *needs* to be losing energy. [iii]

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i "Gravitational wave" is a rather cumbersome term. Unfortunately, we cannot say, "gravity-wave", since this term has already been used in fluid dynamics for something else. "***g*-wave**" seems a reasonable abbreviation

ii The term "micro gravitational" ("**μg**") is used here to stress that these are vastly smaller in amplitude than the "usual" gravitational waves that we associate with catastrophic astronomical events, such as supernovae or the collapse of binary star systems.

iii See "*On Microgravitational Waves*", [28] and the subsequent **Paper C** in this series (time-symmetry). [4]

6. Summary

While Einstein's worldview works perfectly in a "pure SR" context, it does not survive the transition to a more advanced, gravitational physics:

- **Relativistic Gravitation ("RG").** If the principle of relativity applies to objects with gravitational fields, then the speed of gravity needs to be finite, any moving body's rest field must be gravitomagnetically distorted, and the geometry of inertial physics must be dynamic rather than static. The Doppler law then no longer fits fixed, flat, Minkowski spacetime, or special relativity: "Gravitation plus relativity" requires different relationships.

> ⚠ *If Newton and Galileo were right, that "simple" relativity applies to stars and planets, then SR has the wrong relationships.*

- **General Relativity ("GR").** If the principle of relativity applies to acceleration and rotation, then gravitomagnetic effects must apply when *any* mass has a relative acceleration or rotation to other masses. A general theory does not work without gravitomagnetism, and accelerative and rotational GM in turn do not work without *velocity-dependent* GM. We then have a dynamic metric.
  The general principle's need for gravitomagnetism translates into a requirement for non-SR relationships, that are then both shift-asymmetrical and time-asymmetrical.

> ⚠ *If the GPoR is correct, then GM is real, and SR has the wrong relationships.*
> *If the outcome of the Gravity Probe B experiment* [29] *is valid, then GM is real, and SR has the wrong relationships.*

- **Gravitational waves.** Information theory and gravitational wave behaviour require that state-changes in a system generate outgoing μg waves, which involves an energy-loss specific to forward time. If gravitational and μg waves exist, then special relativity's "lossless" equations are wrong, shift-symmetry is wrong, and physics looks different in forward and reversed time.

> ⚠ *If gravitational waves exist, special relativity has the wrong relationships.*
> *If the LIGO results are valid, g-waves exist, and special relativity has the wrong relationships.*

- **Energy-conservation.** In special relativity's "restricted" universe, energy-conservation arguments seem to make the SR equations and Einstein's worldview unavoidably correct. However, in a universe that includes gravitational waves, energy-conservation *rules out* special relativity as a potential solution, as inertial physics needs to be "lossy" in order to pay for the "energy-tax" associated with state-changes and their associated μg waves.

> ⚠ *If gravitational waves don't violate energy-conservation, then SR has the wrong relationships.*

7. Conclusions

Part of special relativity's claim to fundamental correctness is that its equations represent the only possible relativistic solution that shows shift-symmetry with respect to velocity. If **(a)** the equations of motion can be calculated from the simple fixed geometry of flat, empty space, if **(b)** the energy of a system is precisely the same after a state-change as before it, and/or if **(c)** the basic equations of physics need to be identical in forward and reversed time, then shift-symmetry is an absolute necessity, and there is no chance of SR being wrong.

However, the converse is also true. If any *one* of these conditions are violated, then shift-symmetry is merely an interesting mathematical concept and not a law of Nature in real life, and there is no chance of SR being *right*.

When we study gravitational physics, we find that *all* of these conditions are violated:

1. Einstein's shift-symmetric worldview, formulated within flat spacetime, *only works* in a hypothetical flat-spacetime universe, and is not directly relevant to a universe in which mass has associated curvature.

   If we wish to apply the relativity principle to moving gravitational bodies, or apply it to acceleration or rotation (to get general relativity), then there must always be complicating gravitomagnetic effects, and the equations of motion cannot then be calculated from the geometry of simple flat Minkowski spacetime and the equations of SR. Some other set of equations must hold, and these must then necessarily *not* conserve energy in the usual way, or be symmetrical with respect to time.

2. If gravitational waves exist, then the energy of a system must be less after a state-change, and Einstein's "naive" version of energy-conservation, that does not include the cost of *g*-wave generation is wrong.

3. The energetics of systems are then different in forward and reversed time, and Einstein's entire neat-and-tidy worldview of an immortal, unchanging universe becomes a mathematical fantasy.

Einstein's system is like a child's dollhouse, which has all the necessary rooms, and allows the owner to experiment with arranging furniture, but has no connecting doorways between adjacent rooms, and also no stairs connecting the different floors. It is an interesting plaything, and allows us to do certain things, but should not be mistaken as the credible blueprint for the layout of a real, functioning house.

Shift-symmetry is a perfect fit for flat spacetime and a "toy" universe devoid of gravitational effects – a *kindergarten world* – but does not carry over to a more realistic universe that supports gravitation, or problems involving variable spacetime geometry, such as moving gravitational sources, gravitational waves and gravitomagnetism.

If we wish to do "grown up" physics, gravitational effects need to be built-in from the start and we must set aside Einstein's aesthetic legacy and start over, with new equations and new rules based around the asymmetries that are logically unavoidable in any workable gravitational description of reality.

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In **Paper B** we will look at the issue of shift-symmetry under gravitational theory.

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" *No fairer destiny could be allotted to any physical theory, than that it should of itself point out the way to the introduction of a more comprehensive theory, in which it lives on as a limiting case.* "

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