NEW PERSPECTIVES IN FUNDAMENTAL PHYSICS

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CHANGING THE WAY WE LOOK AT GRAVITY HAS ENORMOUS ADVANTAGES

- Mass is stored energy[1]
- Gravitational attraction is because the same matter cannot hold as much energy when closer to the mass of other matter
- Photons do not lose energy (get redshifted) in escaping a gravitational field[2,3]
- The same matter (i.e. atoms) holds more energy higher in a gravitational field
- The frequency of oscillation of all matter and waves is proportional to energy
- $\Delta\omega/\omega = \Delta\Phi/c^2$ - the change in energy causes the change in clock-rate
- Atoms are blue-shifted but photons have unchanged energy[4]

- A background field/medium, due to massive objects, is essential[5]
- Massive objects are sensitive to speed relative to this background field
- **BUT** the speed of massless light is insensitive to speed relative to the field
- The speed of light is constant within a constant field from mass (no gravity)
- There is no requirement that light-speed be independent of the field strength
- If $E = mc^2$ holds for all backgrounds, then mass decreases with increasing c
- There is no need for a contraction of "space" (the distance between objects)

Gravitational acceleration arises from stored energy (mass) being converted into kinetic energy

The gain in stored energy per unit of mass, in raising an object distance dr against F, is: $\int_{r_1}^{r_2}(F/m)dr = \Delta E/m = \Delta mc^2/m = -G_N M(1/r_2 - 1/r_1) = \Delta\Phi$

The work done per unit mass = the change in gravitational potential $\Delta\Phi$ (energy per unit mass) with distance r from a point source of mass M.

Combining Einstein's equation with Newton's gravitational equation and his 2nd law, has gravitational attraction arising from a decrease in mass/energy.

The fractional change in energy is independent of the size of mass m and of the nature of the matter: $\Delta m/m = \Delta E/E = G_N M/Rc^2 = \Delta\Phi/c^2 = -\Phi_R/c^2$

The mass per unit matter decreases as the magnitude of the background and the speed of light increase.

General relativity keeps mass and light-speed locally invariant by distorting both space and time by relative potential, based on the belief that gravity is transformed away by free-fall. This is a misunderstanding; the force remains but is exactly balanced by inertial resistance to acceleration as the object moves into a region of reduced gravitational potential. The Equivalence Principle does not hold – mass reduces during free-fall.

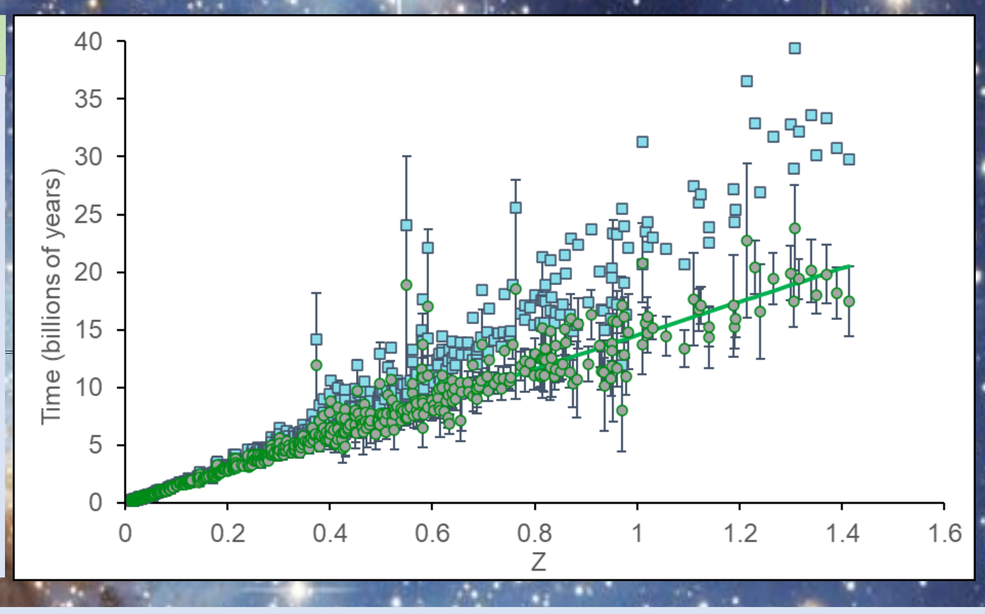
The new perspective has time and energy varying with the background via c so that a 4-vector formulation is retained while 'space' is fixed.

OBSERVATIONAL EVIDENCE

The new and old perspectives can be compared using the data from distant type 1a supernovae, which act as standard candles because they explode with nearly the same energy. Under the revised understanding, the distance data has to be corrected for the cumulative increase in the speed of light, going back in time. The time should be corrected by dividing by the integral of the received to emitted wavelength, i.e. by $\lambda_{rec}/\lambda_{em} = 1+Z$ where Z is the redshift.

The publicly available Union 2.1 data[6] is plotted with and without correction.

The raw data (blue squares) has light from distant supernovae taking longer than expected. The corrected data (green circles) removes any evidence for an accelerating expansion and hence for dark energy. It also removes the need for any (Hubble) expansion at all; changes in emitted energy can account for all the apparent expansion.



MASS ACCORDING TO THE STANDARD MODEL OF PARTICLE PHYSICS

The SM of particle physics has the Higgs mechanism, a spontaneous breaking of gauge invariance associated with handedness (chirality), as the source of mass.

An unopposed flux must fall off as $1/R^2$, so components from opposite handedness (matter and antimatter) must partially resist changes in each other.

Thus, it is proposed that trapping of momentum (mass) arises from chirality (handedness), consistent with gravitational & electromagnetic potentials falling off as $1/R$.

CONSEQUENCES of new perspectives and new proposals

COSMOLOGY

- The singularities inside black holes and their event horizons are removed[7]
- The speed of light was faster going back in time[8]
- No need for dark energy, a big bang or cosmic inflation (see Figure)
- Overcomes the horizon and flatness problems[9]
- Preserves key current predictions of general relativity[10]
- Gravitational "waves" are travelling variations in gravitational potential that alter the time for light to travel and so will be seen by LIGO
- Gravitational waves do not carry energy[11]
- The value of inertia will vary within an isolated galaxy
- Dark matter is not needed[12]

- The total potential from matter and antimatter determines c
- The asymmetry between the matter & antimatter fields determines inertia

QUANTUM MECHANICS

- Energy is continuous. Quanta arise from the allowed transitions between confined but continuously oscillating 'particle' states i.e. cyclic standing-wave states
- A quantum gravity is not needed

THE STANDARD MODEL OF PARTICLE PHYSICS

- The changed understanding links electroweak and QCD interactions, and suggests the source of gauge invariance is continuous local conservation of momentum
- Appears able to remove all evidence for physics beyond the SM[13]

EXPERIMENTAL & OBSERVATIONAL TESTS

- The gravitational perspectives differ in the apparent versus real distortion of distance. This could be tested by examining timing signals (using on-board clocks) and returned (re-emitted) signals to Earth from spacecraft with increasing measured distance from the Sun (but potentially confounded by the change in light-speed).
- Establish whether it is movement relative to the observer or movement of the observer relative to the background that slows time. This could be done by comparing accurate clocks moving linearly towards each other and to a central clock (or spaced pair of clocks) at very high, but constant, velocity and compare all clock-rates.
- A test for asymmetry of matter/antimatter as the source of inertia is the dependence of inertia on position within galaxies. It should be visible in the expansion rates of the matter in type 1a supernovae explosions. The expansion rate should reflect the inertia seen in the galaxy rotation curve at the supernova location.

NOTES

1. In deducing $m = E/c^2$, Einstein realised that: "the mass of a body is a measure of its energy content". Einstein A. 1905. Does the inertia of a body depend on its energy content? *Annalen Der Physik*. 18, 639-641
2. The standards of time change: Schwinger, J.S., 1986. *Einstein's legacy: the unity of space and time*. (Scientific American, New York), p. 142.
3. Energy change is real but due to the change in time. Okun, L.B., Selivanov, K.G. and Telegdi, V.L. 2000. On the interpretation of the redshift in a static gravitational field. *Am. J. Phys. 68*(2) 115. Cheng, T.P. 2009. *Relativity, gravitation and cosmology: a basic introduction*. Oxford University Press, 2nd ed. pp.77-79.
4. As expected for $F = (G_N Mm)/r^2$ with $m = 0$
5. Einstein A. 1920. Ether and the Theory of Relativity, an address on 5 May 1920 at the University of Leiden, published 1922 in *Sidelights on Relativity*, Methuen, London, pp. 3-24.
6. N. Suzuki et al. 2012. *Ap. J.* 746, 85.
7. The negative feedback of a decrease in mass per unit matter as density increases is the opposite of general relativity's positive feedback of energy increasing with distortion that demands singularities inside black holes.
8. Clumping of like-matter increases local asymmetry but reduces the total background field and light-speed. Inertia increases within galaxies which contract over time, while the energy held by matter increases in proportion to the decrease in light-speed.
9. The 'horizon' problem is that the observed uniformity of the large-scale distribution of distant galaxies and of the cosmic microwave background seem to require that all parts of the early universe were in contact and in thermal equilibrium. However, galaxies in opposite directions are now so far apart, that for the current speed of light, they could not have interacted in the lifetime of the universe (calculated from the supposed rate of expansion seen in the redshift). The 'flatness' problem is that: if the geometry of space had deviated ever so slightly from being undistorted (flat), then the distortion (curvature) would have been rapidly amplified over time by gravity (and dark energy). Yet, it is currently observed to be flat.
10. The predictions can be the same but the explanations differ, e.g. gravitational redshift is a blueshift; perihelion advance is due to change in momentum which is equivalent to a change in time, while the change in distance scale is ignored; Shapiro delay fits data for logarithmic increase in path length due to bending.
11. Forbidden by the 1/R dependence of potential. The apparent loss of energy of pulsars is because the comparison is with circular orbits with no relativistic effects included e.g. retarded potentials.
12. Changes in asymmetry and light-speed in isolated galaxies (like-matter) appear able to explain their flat rotation curves and increased bending of light; removing the need for dark matter.
13. Approx. equal quantities of matter and antimatter except within galaxy clusters, but separated regions no longer interact. Massless (inertia-free) neutrino states that transport different energies and so have different oscillation frequencies appear possible and would change state via interactions with matter.