# Making Sense of Gravity

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A fully relative theory of gravity (FRT) is outlined that reproduces all the standard, observationally confirmed, predictions of general relativity theory (GRT). However, it avoids the need to hypothesise dark energy, dark matter and cosmic inflation; explains the apparent absence of antimatter; and is consistent with quantum mechanics and the Standard Model of particle physics. Gravity still arises from a distortion of space-time by the energy stored in matter as mass. However, these are matching expansions or contractions of space (*dx*) and time (*dt*) intervals and not a hidden curvature in the underlying geometry. The size of the distortions depends on the background, not the gradient, so that magnitudes of physical laws must be normalised by the relevant background energy density, but space is always flat. The theory and observational consequences are set out more fully elsewhere but give equivalent results when examining small changes in a large background [1]. One consequence is that the energy stored by particles, oscillating states, decreases as the surrounding energy density of like matter increases. This leads to the beautiful understanding that when an object falls in a gravitational field some of its stored energy (mass) is converted into the kinetic energy of motion. In contrast, GRT hypothesises that the mass stays constant but the kinetic energy comes from the surrounding field which is then stronger, because all energy contributes to the field. Under the rubber sheet analogy, in which masses distort space-time leading to the apparent bending of light, GRT has it that a surrounding uniform distribution of matter has no effect on the distortion. It makes more sense to have a central mass producing less distortion when there is more surrounding matter. This is what is observed with a real rubber sheet and, moreover, the speed of a wave propagating on the sheet increases. FRT similarly has the wave speed *c* increasing, but the energy stored as mass obeying $m = E/c^2$ , with mass reducing as *c* increases. Under GRT, the speed of light is constant and distortions from matter in opposite directions in space cancel. This cannot happen unless an expansion is matched by a contraction, which is denied by symmetry. Under FRT, the stored energy, length scale and clock-rate depend on the excess matter density, while the speed of light depends on the total stored energy density. Thus, going back in time, when the density of matter was larger because the universe had expanded less, the clock-rate was slower and the speed of light higher. The amount is just right to explain the apparent faintness of distant supernovae without the need to postulate dark energy (Figure 1). It also allows now distant parts of the universe to have been previously in equilibrium without hypothesising (faster than the speed of light) inflation. The rotation curves of spiral galaxies are also explained without the need for dark matter if the excess energy density tends to zero far from the centre of spiral galaxies. This is possible if there is an approximately uniform distribution of antimatter galaxies and is allowed because FRT has it that matter and antimatter, but not light, would be deflected from, and unable to cross, such boundaries so that no annihilation signal would be seen. It would be desirable to confirm that the gravitational lensing of like-matter galaxy clusters can be fitted without the need for dark matter. The equality of antimatter allows the underlying physical laws to be symmetric with the apparent asymmetry arising from the local excess of matter. There are many other implications of FRT including that the event horizons and singularities of dense concentrations of matter (supposed black holes) cannot exist. This should already have been appreciated, as it has been pointed out that the idea that a photon loses energy in escaping a gravitational field is mistaken [2-4]. The energy is unchanged, it is the space-time of massive objects that is altered, and so light cannot be trapped by gravity. Another implication is that clock-rate and distance scale must be changing as the universe expands. The change in distance with density seen in the corrected supernovae data accurately predicts the value of the Gravitational constant (G) and the current rate of expansion produces a slowing in clock-rate that predicts the downward drift in frequency of the Pioneer anomaly. The implications for particle physics are profound and appear to support the Standard Model with three flavour families and massless neutrinos that can nevertheless oscillate, while yielding a revised understanding of the Higgs mechanism and a prediction that the Higgs boson mass should be $m_W + (m_Z/2)$ = 125.979±0.024 GeV/c² [5], compare with the measured 125.09±0.24 GeV/c² [6].

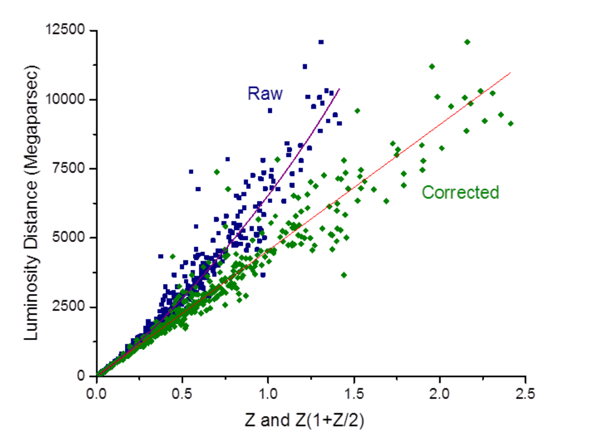


**Figure 1: Type 1a supernovae data [5] for luminosity distance versus raw (Z) and corrected distance (Z(1+Z/2)).**

## References

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