Maldwyn Centre for Theoretical Physics

Update September 2019

Photon Red Shift Energy Loss

One of the pillars of the pre-fermion TOE is that all motion, other than within tunnels between entangled particles where the background is excluded which is the QM environment, happens within the background of ZMBHs which act as a type of viscosity. So all motion by particles which is not in a QM environment loses energy. This means that no motion can be reversed without further losses, so there is an arrow of time that is not reversible.

The question is how much energy is lost in motion against the background as a photon moves. Since there are six meons in a loop, and six in an anti-loop, forming the six rotating ZMBHs that comprise the photon, each meon travels in a spiral. There are actually three positive meons and three negative meons in each loop, but unless needed for clarity they will simply be called meons in the following description. It is the length of the spiral that defines how much viscosity is encountered in motion against the background, not the overall path length of the photon.

Each time a meon rotates once it loses an amount of energy related to its path at that rotational photon frequency w_i, or its current radius r_i. As energy is lost, the rotational frequency reduces and the radius of rotation increases.

Although the amount of viscosity present within a volume depends on the local conditions, being greater nearer larger masses, it is the average effect on a photon over long distances that is of interest here.

At all times the internal chasing between meon and anti-meon in each ZMBH drives the photon to move at maximum force against the background. The result is a maximum speed for the photon, which we call light speed *c*. However, in terms of metres per second, the actual value of that speed will be determined by the amount of viscosity within which the photon is moving. If the gravity field is very large, the speed of the photon could be zero, but this would still be the local *c*.

That photons travel at a terminal velocity defined as the local speed of light shows that there is internal chasing between meon and anti-meon from loop to loop. This can only be explained if there are negative and positive fundamental masses which chase, which are the fundamental mass properties of the positive and negative meons.

The energy used in matching the background viscosity in order to travel at *c* reduces the rotation rate of the meons in the two loops that comprise the photon. This is tired light and, apart from at very high rotational frequencies, is proportional directly to the distance travelled by the meons, and thus by the photon, almost regardless of photon frequency.

In the calculation of the different distances, there is no differential effect due to relativity because that is an effect at composite loop level where relative loop rotational rates are observed. A meon in a photon loop travels helically at *c*, the rotation of the meons at the loop velocity v_i and the effective external velocity of the photon is v_{ext}.

Using the unwrapping into a triangle of a helix on a cylinder gives the equation for the relative speeds as

$$c^2 = v_i^2 + v_{ext}^2$$

which is another way of saying that

$$v_{ext}/c = \sqrt{1 - v_i^2/c^2}$$

This may look like the usual relativistic formula, but it is not subject to any relativistic time dilation since each of the three paths, the rotation, meon and photon paths, happens in the same time – otherwise there would be no helix to unwind into a right angled triangle.

So the spiral distance D_m travelled over time t_i by each meon in a photon loop completing one rotation with frequency w_i if it always travels at *c* is given by

$$D_m = ct_i = 2\pi c/w_i$$

where w_T would be the DAPU Planck frequency.

Where $w_i \ll w_T$ then the meons in different energy photons will each have experienced virtually the same viscosity red shift. The path difference travelled by each meon, comparing a gamma ray at around 10^{24} Hz and visible light around 10^{14} Hz, is the difference between $\sqrt{1+10^{-18}}\,ct$ and $\sqrt{1+10^{-28}}\,ct$ respectively – not significant given the uncertainty in the emission point of each.

So the redshift observed in any photon has to take account of this extra viscosity redshift factor. This implies that the size of dark energy may need to be radically reassessed, to the extent that possibly the rate of expansion of the universe is not accelerating at all, if all the excess redshift were due to tired light. Alternatively, the universe, or our successful big bang event, may actually be failing and we are contracting - if the viscosity red shift is larger than the contraction blue shift, or the expansion could be zero and the main red shift is caused by tired light. Overall, it is likely that the observed redshift is a mix of factors including the tired light effect, but here only viscosity is considered as producing the red shift.

Although *c* has been defined classically as the speed of the photon at all times, it is more correct to use the external velocity v_{ext} of the photon. At very high frequencies the spiral path of the meons is the constraining factor in that it is they themselves that cannot travel above *c*.

When the photon has a very high frequency, its external speed is less than *c*. As the frequency reduces, the external speed approaches *c*. The total velocity v_G (all v are really v/c) of the meons around the loops and externally is given by

$$v_G(n) = \frac{\{\prod(1+v_a) - \prod(1-v_a)\}}{\{\prod(1+v_a) + \prod(1-v_a)\}}$$

where the products are from velocities v_a to v_n. Where there are only two velocities this reduces to

$$v_G(2) = \frac{\{\prod(1+v_a)(1+v_a) - \prod(1-v_a)\}}{\{\prod(1+v_a)(1+v_a) + \prod(1-v_a)\}} = \frac{(1+v_a)(1+v_b) - (1-v_a)(1-v_b)}{(1+v_a)(1+v_b) + (1-v_a)(1-v_b)} = \frac{v_a + v_b}{(1+v_a v_b)}$$

which is the usual relativistic addition formula. Here $v_a = v_{ext}$ and $v_b = v_i$. However, the meon always has a total velocity of *c*, provided at least one of the velocities is *c*, so $v_G = c$ mathematically.

As the viscosity reduces the energy of the meons, the internal velocity around the loop reduces by a fraction and the external velocity increases closer to *c*. Over time, as the radius r_i increases and the frequency w_i decreases, v_{ext} approaches *c*.

Consider a meon in a photon loop rotating at r_i where the meon travels spirally at *c*. The relationship between the photon path D_γ , the meon path D_m and the loop radius r_i is derived from the velocity triangle as

$$v_{ext}t_i = \sqrt{c^2t_i^2 - v_i^2t_i^2}$$

$$D_\gamma = \sqrt{4\pi^2r_i^2(c^2/v_i^2) - 4\pi^2r_i^2} = 2\pi r_i\sqrt{(c^2/v_i^2) - 1} = 2\pi r_i(c/v_i)\sqrt{1 - v_i^2/c^2}$$

$$= 2\pi(c/w_i)\sqrt{1 - v_i^2/c^2}$$

with $w_i = 2\pi/t_i$. The meon travels at *c* along its spiral path for time t_i which represents one rotation of the loop at frequency w_i.

The helical path is

$$D_m = 2\pi c/w_i$$

When the photon frequency is highest, $v_i = c$ and $r_i = r_T$ so that $D_m \to 0$. When the photon frequency is low, with $v_i \to 0$ and $r_i \to \infty$ then $D_m \to \infty$. It should be remembered that the path is the sum of each circumferential revolution in turn, rotated slightly less than a full revolution when viscosity is taken into account. It is also the case that the photon frequency can never be w_T , the DAPU Planck frequency because the physical size of three r_T radius same-type meons at the centre of a loop form an equilateral triangle of side $2r_T$, meaning that the smallest possible radius of rotation is $r_T\ /cos30$ or $1.1547r_T$, which is slightly larger than at w_i.

The distance travelled D_γ by the photon during each rotation at radius r_i confirms that as the loop increases in size and the rotational velocity decreases, the meon spiral path unravels towards a straight line. When $r_i = r_T$, so that $v_i = c$, then the photon has a path length of $D_\gamma = 0$. When the photon frequency is low, with $v_i \to 0$ and $r_i \to \infty$ then $D_\gamma \to \infty$ as the meon path does.

The relationship between the meon path and the photon path is

$$D_\gamma/D_m = \sqrt{1 - v_i^2/c^2}$$

When $r_i = r_T$, so that $v_i = c$, then the photon path length is zero. When the photon frequency is low, with $v_i \to 0$ and $r_i \to \infty$ then $D_\gamma/D_m \to 1$.

However, the effect of viscosity needs to be included. The assumption is that there is a loss of energy proportional to the path that the meon travels, which is directly related to the loss of frequency of the photon. The energy loss E_i over each rotation at frequency w_i is defined as

$$E_i = k2\pi c/w_i$$

where *k* is a force due to viscosity acting to oppose the internal chasing force between positive and negative meons within the six ZMBHs comprising the photon. It is proportional only to the meon distance travelled assuming that the background is the same on average everywhere.

The energy loss over two adjacent rotations will be

$$E_i + E_j = k2\pi c/w_i \quad + k2\pi c/w_j$$

$$= k2\pi c(1/w_i + 1/w_j)$$

This means that the fraction *k* of energy lost over the meon path is simply the sum over the meon path from one rotation to another rotation, or more generally between any initial loop radius r_i frequency w_i and final radius r_n frequency w_n

$$\sum_i^n E_i = k2\pi \sum_i^n c/w_i$$

Assuming that the initial loop radius is the Planck radius, the loop effectively being formed at Planck energy and the final loop corresponding approximately to the cosmic microwave background (CMB) of 2.725 K which peaks at the microwave range frequency of 160.2 GHz, corresponding to a 1.873 mm wavelength gives the initial and final loop sizes. Unfortunately the summation is too difficult to manage over such an extreme number of variables. If it were possible, it would provide an estimate for the value of *k*.

During the loss of energy of the meon path, the photon travels

$$D_{\gamma i \to n} = \sum_i^n 2\pi(c/w_i)\sqrt{1 - v_i^2/c^2}$$

And the relative length of the photon path to the meon path overall is given by

$$\sum_i^n D_\gamma/D_m = \sum_i^n \sqrt{1 - v_i^2/c^2}$$

which tends at each rotation towards 1 as loop frequency and meon rotational velocities decrease.

Looking at the energy side directly, the energy$\varepsilon_i$of the loop at v_i will be

$$\varepsilon_i = \frac{1}{2} M_T v_i^2$$

Where M_T is the meon mass (not adjusted for twist, to keep the explanation simple).

The energy of the following loop at v_j will be

$$\varepsilon_j = \frac{1}{2} M_T v_j^2 = (1 - K)\varepsilon_i = (1 - K)\frac{1}{2} M_T v_i^2$$

Since the loop energy has been reduced by the fractional value of the viscosity factor *K*, being how much each loop energy is reduced by in each rotation. This is equivalent to *k*, although related to the energy of the loop rather than the distance travelled during each rotation. This can be generalised for *n* rotations to the energy at that rotation of

$$\varepsilon_n = (1-K)^{n-1}\frac{1}{2}M_T v_i^2 = (1-K)^{n-1}\frac{1}{2}hw_i$$

So that the viscosity energy loss from emission to observation will be

$$E_n = [(1-K)^{n-1} - 1]\frac{1}{2}hw_i$$

Another way of describing this energy reduction is

$$\varepsilon_n = \frac{1}{2}h(w_n - w_i)$$

So that

$$\varepsilon_n = \frac{1}{2}hw_n = \frac{1}{2}hw_i(1-K)^{n-1}$$

Knowing the energy loss from emission to observation and the number of rotations allows the calculation of the value of *K*. Unfortunately it is not possible to observe the number of rotations and the value D_m is not directly comparable when estimating the value of *n*.

However, using the summation of time spent travelling along the meon path may provide an estimate of *n*, if that time is considered approximately correct. The value of *K* may then be used as a maximum estimate of the proportion of viscosity versus motional red shift.

The total energy loss from before is

$$\sum_i^n E_i = k2\pi \sum_i^n c/w_i = k\sum_i^n ct_i = kcT = \varepsilon_n - \varepsilon_i$$

So that

$$kcT = -[(1-K)^{n-1} - 1]\frac{1}{2}hw_i$$

The relationship between *K* (a dimensionless fraction) and *k* (a viscosity or force in opposition to motion) is that

$k2\pi r_i = K\frac{1}{2}hw_i$ so that

$$k/K = \frac{1}{2}hw_i\,/2\pi r_i$$

which is the loop energy per loop circumference. As the loop energy reduces, the circumference increases and $k/K \to 0$.

Now the relationship between total path time T and loop properties will be

$$cTK\frac{1}{2}hw_i\,/2\pi r_i = -[(1-K)^{n-1} - 1]\frac{1}{2}hw_i$$

or

$$T = [1-(1-K)^{n-1}]2\pi r_i\,/\mathrm{cK}$$

The issue is still not knowing what the value of *n* is for the path time, but this equation relates the fractional energy loss factor K, the initial emission loop size and the number of rotations n during the total path time T. If $K = 1$, the whole energy would be taken from the loop and the path time would be zero. If $K = 0$, the path time would be infinite, with no energy loss at all. Between these two extremes lies the actual value of K, although what is observed to be the actual energy loss will include gravitational and motional energy factors as well as the viscosity effect. Where K is shown to be very small, then T will be very large.

If the initial energy is the Planck energy at the Planck distancer_T , then the total time T can be related directly to the Planck time t_T , n and K as

$$T = [1-(1-K)^{n-1}]2\pi r_T\ /\mathrm{cK} = [1-(1-K)^{n-1}]2\pi t_T\ /\mathrm{K}$$

M Lawrence
Maldwyn Centre for Theoretical Physics
21 August 2019