New Tired Light Correctly Predicts the Redshift of the CorBor Galaxy Cluster.

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The New Tired Light Theory (NTL) is tested by using known data of the distance to the Corona Borealis galaxy cluster (A2065 in particular) and from this predicting the redshift of the galaxy. The predicted value is then compared to the measured value. In NTL, photons of light are continually absorbed and re-emitted by the electrons in the plasma of intergalactic space which recoil both on absorption and re-emission. Energy is transferred from the photon to the recoiling electron and thus the photon energy is reduced, the frequency is reduced and the wavelength is increased. It is redshifted. Using the wavelength of the 'K line' of ionised calcium, $\left(\lambda = 3.934 \times 10^{-7} m\right)$, standard physics and published collision cross-sections, the predicted redshift by NTL is found to be $z = 0.067$. This compares favourably with the measured redshift value of $z = 0.0714$ - they agree to within 6%. In NTL the energy transferred to the recoiling electron is emitted as secondary photons. The predicted wavelength of these secondary photons is calculated and is shown to be in the microwave region of the electro-magnetic spectrum. This again is consistent with the NTL prediction that these secondary photons form the CMB.

1. Introduction

The purpose of this paper is to take the New Tired Light Theory (NTL) and use it to make actual quantitative predictions on a galaxy with known and separately measured data of both its distance and redshift. Using only the distance measurement, standard physics, published data and cross-sections, the redshift of the galaxy will be predicted and compared to the measured value. We will see that they agree with remarkable accuracy.

In the transmission of light through glass, Photons are continually absorbed by the electrons in the atoms of glass which oscillate and, after a slight delay; a new photon is emitted [1]. Since the electrons are 'held' in the atoms and unable to recoil, no energy is lost and the new photon emitted has the same frequency and wavelength as the one absorbed. There is no redshift. The electrons in plasma can also oscillate and perform SHM [2] and so they too can absorb and then emit a new photon of light. Thus, the plasma in the intergalactic space transmits light in the same way as a transparent medium such as glass. However, there is one difference. Since the plasma is sparsely populated the electrons are not tightly bound and so recoil both on absorption and re-emission.

In NTL, on absorption and re-emission, energy is transferred from the photon to the recoiling electron and thus the photon energy is reduced, the frequency is reduced and the wavelength increased. It is redshifted.

The Hubble law becomes: Photons of light from a galaxy twice as far away, travel twice as far through the intergalactic medium, encounter twice as many interactions with the electrons in the plasma and lose twice as much energy in total. This results in twice the reduction in frequency and twice the increase in wavelength. There is now no need for expansion as redshifts are no longer attributed to '*velocities*.'

A full analytical and algebraic form of the NTL Theory has been published elsewhere [3] .However, in this paper we are going to use a simple approach and look at a single feature of a particular galaxy's spectrum and use this to determine the predicted redshift.

2. Predicting the redshift of CorBor.

Consider the 'K line' of ionised calcium $\lambda = 3.934 \times 10^{-7} m$ [4] in the spectra of the Corona Borealis (CorBor) galaxy cluster. A2065 is the most famous galaxy in this cluster and it has a redshift of z = 0.0714 and is at a distance of 960x10^{6}ly [5].

The photon-electron collision cross-section is known from the atomic photo absorption cross-section and low energy, X ray photons interacting with matter.

The Collision cross-section is given by, $\sigma = 2f'r_e\lambda$ [6] where r_e is the classical electron radius (2.818x10^{-15} m) and λ is the wavelength of the photon, 3.934x10^{-7} m. The value of the constant f' depends on the frequency of the incoming photon compared to the resonance frequency of the atom and determines the probability of the photon, having already been absorbed, being re-emitted or retained. For the single electron in Hydrogen f' has a range of values between zero and one. Since the resonance frequency of the plasma in intergalactic plasma is far away from the frequency of the incoming photons [7] the photons will always be re-emitted. Thus the collision cross-section for NTL is $\sigma = 2r_e\lambda$

This gives the collision cross-section for these photons:

$$\sigma = 2.22 \times 10^{-21} m^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

The mean free path l of a photon (or any particle for that matter) is given by:

$$l = \left(n_e\sigma\right)^{-1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

were n_e is the average electron density of intergalactic space. Published values of n_e lie between 0.1 and 1 electron per cubic metre.

For instance ref [8] gives $n_e = 1\,m^{-3}$ whilst ref [9] gives $n_e = 0.22\,m^{-3}$ electrons per cubic metre.

So for an order of magnitude calculation, let's take $n_e = 0.5$ electrons per cubic metre. Our mean free path now becomes, $l = 9\times10^{20}\,m$ or $l = 95.2\,ly$. That is, our photon travels, on average, just under $10^{21}\,m$, or $95.2\,ly$, between interactions with an electron on its way from CorBor to Earth.

Since CorBor is $960\,Mly$ away [5] our photons will make, on average, 10,081 interactions with electrons in Intergalactic space (IG) during their travel.

In NTL, the photons lose energy to the recoiling electron as they are absorbed and re-emitted. To calculate the energy loss we need to look firstly at conservation of momentum to find the velocity of the recoiling electron. From this we determine the Kinetic energy of the recoiling electron – as this is the loss in energy to the photon

Momentum, p, of incoming photon is given by, $p = h/\lambda$ and this is transferred to the electron.

$$\frac{h}{\lambda} = m_e v \text{ ....(3)}$$

Were m_e is the rest mass of the electron and v its recoil velocity.

For our photon in the 'K line', the recoil velocity of the absorbing electron will be 1,850 ms^{-1}.

The Kinetic Energy gained by our recoiling electron and lost to the photon on absorption is:

$$E = \frac{m_e v^2}{2} = 1.56\times10^{-24}\,J \text{ ....(4)}$$

This energy is lost both on absorption and re-emission since the electron recoils both times and so we must double this value.

Energy lost to the electron on each interaction = $3.12\text{x}10^{-24}$ J.

As we saw before, our photon makes 10,081 interactions on its journey to Earth, and so the total energy lost = $3.14\text{x}10^{-20}$ J.

The initial K Line photon, $\lambda = 3.934\times10^{-7}\,m$, has frequency $7.63\text{x}10^{14}$ Hz and energy $5.05\text{x}10^{-19}$ J $(E = hf)$.

The energy of the photons on arrival at Earth is their initial energy($5.05\text{x}10^{-19}$ J) less the energy lost ($3.14\text{x}10^{-20}$ J) giving the photon an energy on arrival of $4.736\text{x}10^{-19}$ J.

This corresponds to a wavelength of $4.197\text{x}10^{-7}$ m i.e. the photons have a longer wavelength on arrival than when they set off.

The shift in wavelength $\Delta\lambda$ = ($4.197\text{x}10^{-7}$ m) – ($3.934\text{x}10^{-7}$ m) = 0.263 $\text{x}10^{-7}$ m.

Redshift, $z = \Delta\lambda/\lambda$ and thus the predicted redshift by NTL is, z = 0.067.

This compares well with the observed value of the redshift for Corona Borealis, z = 0.0714. The predicted value, using New Tired Light from first principles, is within 6% of the observed value.

3. Predicting the CMB.

But what of the energy transferred to the recoiling electron in the plasma of IG space? In NTL this energy is re-radiated as secondary photons and forms the CMB. There are two secondary photons emitted at each interaction. One on absorption and another on re-emission. The wavelength of these secondary photons can be calculated.

Equation (4) gives the energy transferred to the recoiling electron.

Energy = $1.56\text{x}10^{-24}$ J

When this is emitted as a secondary photon the frequency is $4.71\text{x}10^{9}$ Hz. This corresponds to a wavelength of 0.032 m i.e. they are in the microwave region. The CMB is also in the microwave [11] and peaks at approx 0.21 cm. In NTL, the CMB photons at the peak in the CMB curve would be produced by photons in the UV from the CorBor spectrum $\left(\lambda = 5\times10^{-8}\,m\right)$. It is known that plasma clouds emit black body radiation [11].

4. Discussion.

Here we have only looked at one wavelength whilst it must be remembered that the redshift z is a constant for all wavelengths. That is,

$$z = \Delta\lambda/\lambda$$

In NTL this comes about because of the collision cross-section. A photon with twice the wavelength has twice the collision cross-section and thus makes twice as many interactions in travelling the same distance. These photons lose twice as much energy, undergo twice the reduction in frequency and thus twice the increase in wavelength. Thus the ratio $z = \Delta\lambda/\lambda$ is the same for all wavelengths.

Whilst we have only looked at one feature of the galaxy's spectrum here, a full analysis [3] gives the Hubble constant, H as:

$$H = \frac{2 n_e h r_e}{m_e} \text{ ....(5)}$$

Using the value of electron density $n_e = 0.5\,m^{-3}$ gives the predicted value of the Hubble constant as:

$$H = 2.1\times10^{-18}\,s^{-1} \text{ ....(6)}$$

Or, in more usual cosmological units:

$$H = 64\,km/s\ per\ Mpc \text{ ....(7)}$$

Which is in excellent agreement with accepted values.

5. Conclusion.

The Galaxy A2065 in the Corona Borealis (CorBor) is a distance of $960\text{x}10^{6}$ ly from Earth. Taking the 'K line' of ionised calcium $\lambda = 3.934\times10^{-7}\,m$ in the spectra of this galaxy the New Tired Light Theory was used to predict firstly the loss in energy of these photons on their journey to Earth and secondly, the shift in wavelength leading to the redshift of this line. Only published values for collision cross-sections and electron densities are used. The redshift was predicted to be by NTL as z = 0.067. This compares well with the measured value of z = 0.0714. The NTL predicted value and the observed value agree to within 6% of each other. The energy lost by the photons at each interaction is reradiated as two secondary photons and the predicted wavelength of these photons was determined by the NTL theory and found to be in the microwave region. This is consistent with the idea in NTL that these photons form the CMB.

References

[1] Feynman, R. Q.E.D. – the strange story of light and matter, p/76.Penguin. London 1990.

[2] Cairns, R.A. et al. Physica Scripta. Vol T7599-103, 1998

[3] Ashmore, L.E. http://www.worldsci.org/pdf/abstracts/abstracts_5340.pdf

[4] http://en.wikipedia.org/wiki/Calcium

[5] http://www.atlasoftheuniverse.com/superc/cbo.html

[6] http://www.scribd.com/doc/16180647/XRay-Data-Booklet-From-LBL#outer_page_75 eqn 3.

[7] http://ads.harvard.edu/cgi-bin/bbrowse?book=hsaa&page=286

[8]http://www.americanscientist.org/issues/id.922,y.0,no.,content.true,page.6,css.print/issue.aspx

[9] http://www.aanda.org/index.php?option=com_article&access=standard&Itemid=129&url=/articles/aa/full/2003/34/aah4525/aah4525.html

[10] http://en.wikipedia.org/wiki/File:Cmbr.svg

[11] Longair, M.S. "High Energy Astrophysics. Vol 1. Cambridge University press. Cambridge. Second ed. 1992. p79