FRB 150418 Confirms Predictions Made By New Tired Light

Lyndon Ashmore

Independent Researcher
Email: Lyndonashmore@outlook.com

Abstract

For the first time, in April 2015, both the Dispersion Measure (DM) of a fast radio burst, FRB 150418, and the redshift of the host galaxy were measured. This gave the opportunity to test the New Tired Light Theory and its predictions. DM in mainstream physics is found from the time delay between the arrival of different frequencies from a short, sharp cosmological source (FRB or pulsar). DM is related to the mean free electron density along the path, n, and the distance from source to observer, d, by the formula $DM = nd$.

New Tired Light (NTL) is an alternative cosmological theory to the Big Bang. In NTL the universe is static and redshifts are caused by photons of light interacting with the electrons in the plasma of the intergalactic medium (IGM). Energy is transferred from the photon to the recoiling electron on absorption and re-emission resulting in a reduction in frequency of the photon and an increase in the wavelength. The redshift distance relation is $z = exp(Hd/c) - 1$ where c is the speed of light and H the Hubble constant. In NTL the Hubble constant is derived in terms of, n, the plank constant, h, and m and r, the rest mass and classical radius of the electron giving $H = 2nhr/m$.

Making, d, the subject of both equations from DM and NTL gives us the SI equation $DM = (mc/2hr)LN(1 + z)$. Substituting the measured redshift, z, and values for m, c, h and r as well as converting from SI units to those used in radio astronomy $(pc\ cm^{-3})$ gives a predicted DM of $DM = 949\ pc\ cm^{-3}$. This compares well with the observed DM of FRB 150418 of $776.2\ pc\ cm^{-3}$ – a difference of just 22%.

It is noted that a DM is produced for all electron number densities whilst in NTL redshifts only occur in the sparsely populated plasma of the IGM since in dense plasma, strong electromagnetic forces reduce or even prevent the electrons from recoiling. Consequently it is possible to have a DM but no redshift if the plasma density is too high. It is possible that denser plasma along the path may have resulted in the predicted DM being a little higher than the measured one - though the agreement is close and gives strong support to NTL.

Keywords.

Redshift, Tired Light, Hubble Constant, expanding universe, Dispersion Measure, DM, FRB 150418

1. Introduction.

In April of 2015, for the first time the Dispersion Measure (DM) of a Fast Radio Burst (FRB) and redshift of its host galaxy were measured [1]. Prior to this we had DM's of FRB's but we did not know how far away they were. Having both the redshift and Dispersion Measure enables us to test predictions made by New Tired Light (NTL).

Just as in light, dispersion is the splitting up of white light into its component colours due to different frequencies traveling at different speeds in the medium it is travelling through, dispersion in radio is the splitting up of a 'white' radio pulse into its various frequencies. As radio signals travel through the plasma of the Intergalactic Medium (IGM) they interact with the electrons in that medium and suffer delays which slow them down. Importantly, different frequencies travel at different speeds through the IGM and thus have differing arrival times at Earth. In general, the velocity of electromagnetic radiation is proportional to the square of the frequency divided by the electron density.

New Tired Light (NTL) is an alternative theory to the '*Big Bang'* theory [2,3,4]. In NTL the Universe is static and redshift, z, (a measure of the increase in wavelength of characteristic lines in the spectra of distant galaxies compared to those measured in the laboratory) is caused by photons of light being absorbed and re-emitted by the electrons in the plasma of the IGM. The electrons recoil both on absorption and re-emission and thus some of the energy of the photon has been transferred to the recoiling electron. Since the energy of the photon is less, the frequency has been reduced and its wavelength increased. It has been redshifted.

Since Dispersion Measure in mainstream physics is related to the mean free electron number density, n, along the line of sight whilst in New Tired Light, the redshift is also caused by the very same electrons then we would expect there to be a relationship between the two.

In this paper, we will derive this relationship from first principles and then use the observed redshift and DM of FRB 150418 to check this relationship. Taking the measured redshift of the host galaxy we will predict the DM of FRB 150418 and compare it to the measured DM of this FRB. We will see that the predicted value and observed value are in very good agreement thus giving strong support for the New Tired Light theory.

2. Dispersion Measure.

An FRB is a short, sharp burst of radio energy and thus all frequencies are emitted at the same instant. Radio telescopes detect the arrival of these signals in a range of frequency bands and what is seen is the arrival of the signals in procession with each frequency arriving one after another. The lower the frequency, the slower the signal travels through the IGM and the later that frequency arrives at Earth. The time delay measured in milliseconds is given by:

$$delay = 4.15x10^6\left(f_{low}^{-2} - f_{high}^{-2}\right)DM \qquad 1$$

Where f_{low} and f_{high} are the lower and higher frequencies respectively measured in Mhz, DM is the Dispersion Measure measured in units of parsec per cubic centimetre ($pc\ cm^{-3}$).

By measuring the time delay between the arrival of the pulses of different frequencies from a source a distance, d, away we can determine a quantity known as the Dispersion Measure (DM) and standard Physics tells us the relationship between DM and the mean free electron number density (n) along the path followed by the signal. Technically the DM is the "*integrated column density of free electrons between an observer and a source.*" DM, n and the distance, d, are related by the formula:

$$DM = nd \qquad 2$$

Where DM is measured in $pc\ cm^{-3}$, n is measured in cm^{-3} and distance, d, is measured in pc.

3. New Tired Light.

In the plasma of the IGM the electrons interact by means of long range electromagnetic forces. Overall the plasma is neutral and so if an electron moves forwards the space in front of it has now '*gained*' an electron and is now overall negative whilst the space behind has '*lost*' an electron and so now has an overall positive charge. Restoring forces act on the electron to return it to its original position. The electron performs SHM and any electron that can perform SHM can absorb and emit photons of electromagnetic radiation.

A photon of light interacting with an electron in the IGM is absorbed, its energy transferred to the oscillating electron and after a short delay a '*new*' photon is emitted in the forwards direction. Since there is a delay, the electron recoils both on absorption and re-emission and some of the initial energy of the photon is *'lost'* to the recoiling electron. The energy of the photon has reduced, its frequency reduced and so its wavelength has increased. The photon has been redshifted. The Hubble law becomes, 'photons of light from a galaxy twice as far away, travel twice as far through the plasma of intergalactic space, interact with twice as many electrons, '*lose*' twice as much energy, have their frequency reduced by twice as much and thus experience twice the increase in wavelength.'

Note that since the recoil of the electron takes place along the line of sight there will be no change in direction of the photon and hence no '*blurring*' of the image as happens in the Compton effect. Note also that the electron can only recoil in the sparsely populated region of the IGM, as in dense plasma the electromagnetic forces between the ions in the plasma become so large so as to prevent recoiling.

The relationship between the redshift ,z, and the distance, d, between the source and observer was first published in 2006 [2,3,4] and is given by:

$$z = \exp(Hd/c) - 1 \qquad 3$$

Where c is the speed of light in a vacuum and H is the Hubble constant. In NTL, we already have ta relationship for the Hubble constant:

$$H = 2nhr/m \quad (4)$$

Where h is the plank constant, r, the classical electron radius and m the electron rest mass.

We now need to combine these two areas of astrophysics.

4. A Relationship Between DM and z.

Making ,d, the subject in equation 3 gives:

$$d = (c/H)\, LN(1+z) \quad (5)$$

Equation 4 gives H in terms of the electron parameters and the mean free electron density, n. Substituting in equation 5 gives:

$$d = (m\,c/2nhr)\, LN(1+z) \quad (6)$$

Equating 2 and 6 for d gives.

$$DM/n = (m\,c/2nhr)\, LN(1+z) \quad (7)$$

Notice, n, the mean free electron number density cancels and so for sparsely populated plasma the relation is independent of n. The reason being that the more electrons there are per cubic metre of IGM, the greater the delay to the signal and hence the greater the DM. Additionally, the more photon electron recoil interactions will take place and hence the greater the redshift – again provided the electrons are able to recoil.

Simplifying:

$$DM = (m\,c/2hr)\, LN(1+z) \quad (7)$$

We are now in a position to test NTL by using this relationship on FRB 150418.

5. Predicting the DM of FRB 150418 From the Redshift.

The host galaxy of FRB 150418 has a redshift of z = 0.492 ± 0.008 [2]. Substituting this along with values for $m, 9.1x10^{-31}kg$, $c, 3x10^{8}ms^{-1}$, $h, 6.6x10^{-34}\,Js$ and $r, 2.82x10^{-15}\,m$ gives:

$$DM = 2.93x10^{25}\,m^{-2} \quad (8)$$

This predicted value is in SI units and so, in order to compare, we need to change it to those used in radio astronomy ie $pc\ cm^{-3}$.

To do this we need a conversion factor: =

$$1\,pc\ cm^{-3} = 3.09x10^{16}m\ cm^{-3}$$
$$1\,pc\ cm^{-3} = 3.086x10^{22}\,m^{-2} \quad (9)$$

Consequently;

$$DM = 2.93x10^{25}\,m^{-2}$$

Gives: $$DM = 949\,pc\ cm^{-3} \quad (10)$$

The observed DM of FRB 150418 is $776.2\,pc\ cm^{-3}$ a difference of just 22%.

6. Conclusion and Discussion.

Dispersion Measure and its dependence upon the free electron number density of the IGM is mainstream physics and accepted as correct. The New Tired Light Theory is an alternative to the '*Big Bang Theory'* and thus is often considered as '*crank science.*' Yet here we have combined the two areas of DM and NTL and used it to predict the DM of FRB 150418 from the observed redshift of its host galaxy. The combination of DM and NTL gives a DM of $949\,pc\ cm^{-3}$ compared to the measured DM of $776.2\,pc\ cm^{-3}$. This represents a difference of only 22% and clearly gives great support for the NTL Theory. The NTL theory was first published in 2006, long before FRB 150418 was recorded and so the observed redshift, z, and DM form a true test of the theory. This is real science for once in cosmology ie use a theory to make a prediction then test it against observation.

The predicted relationship is derived from first principles and uses no observed data whatsoever to determine it. The relationship consists of DM, z, and a number of parameters which are universal constants and yet it leads to a predicted value for the DM of FRB 150418 that agrees to within 22% of the measured value.

In the *Big Bang Theory*, there should be no direct quantitative relationship between DM and z since in the *BB* redshift is due to the stretching of space and has nothing to do with the mean electron number density. True, one would expect a qualitative relationship such '*as z increases DM increases*,' but here we have a direct proportionality between the two with the constant of proportionality equal to $(m\,c/2hr)$. In the *BB*, to have any such a simple proportionality would have to be pure coincidence and yet the constant of proportionality is a combination of the speed of light, the plank constant and the mass and classical radius of the electron. Is this too much of a coincidence to believe? I for one believe so.

We said earlier that there was a proviso in all this in that NTL and its recoil redshift only applies if the plasma is sparsely populated. In dense plasma, the electrostatic forces are so strong that it greatly reduces any recoil to such an extent to make it negligible. Yet dispersion can still take place since it is only dependent upon the delay between absorption and re-emission of the photons by the electrons. To put it simply, in dense plasma there will be a DM but no redshift. This could be a reason why the predicted value of DM is a little higher than the observed one.

New Tired Light is a powerful cosmological theory that already predicts numerical values for the Hubble constant and the CMB and get them correct [2,3,4]. Now we see that we can apply NTL to a completely different area of cosmology, one where there should be no direct relation and yet NTL not only predicts the relationship but correctly predicts the DM given *z* for FRB 150418 – the first time we have both the DM and the redshift of a fast radio burst. As more data becomes available on FRB we should be able to improve the predictions.

References

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