Hydrogen Cloud Separation as Direct Evidence of the Dynamics of the Universe.

Lyndon Ashmore.

Abstract.

Despite the idea of an expanding universe having been around for nearly one hundred years there is still no conclusive, direct evidence for expansion. This paper examines the Lyman Alpha forest in order to determine the average temperature and the average separation of Hydrogen clouds over the aging of the universe. A review of the literature shows that the clouds did once become further and further apart (showing expansion?) but are now evenly spaced (an indication of a static universe?). Doppler parameters give an indication of the temperature and/or the degree of disturbance of the clouds and the evidence is that the temperature or degree of disturbance is increasing rather than decreasing as required by an expanding universe. Whilst these results do not support any cosmology individually, they do support one where the universe expanded in the past but that expansion has now been arrested and the universe is now static. A separate mechanism for redshift would be required to explain why, in this scenario, the Hydrogen Clouds are evenly spaced in the local universe - but have differing redshifts. High z hydrogen cloud separation can be used to give an independent estimate on the lower limit of the age of the universe in an expanding model and it is found that the age must be far greater than the presently accepted value of 13.8 billion years - if the H1 clouds are to achieve their present separations without some mechanism other than inflation being involved.

Key words: Early Universe, Distance Scale, Miscellaneous.

1. Introduction.

Every pocket of gas along the line of sight of distant quasars will absorb certain wavelengths of light characteristic to the atoms within that gas. After absorption the spectrum is redshifted - only for other photons having been ‘stretched’ to these same wavelengths to be absorbed by the next pocket of gas. In this way a whole series of absorption lines is built up. The absorption spectrum of quasars has been studied in detail [1,2,3,4] and, with the introduction of UV detectors in space, these are now known for redshifts from 0 to 5. There are four main types of absorbing systems (Lyman-alpha forest, Lyman limit systems, and metal-line and damped Lyman-alpha absorbers) but the one that is of interest to us here is the Lyman-alpha forest as these absorption lines are the ones representing the number of clouds of Hydrogen gas (or at least regions of higher Hydrogen density) in intergalactic space. The cosmological principle tells us that on the large scale, the universe is homogeneous and isotropic and thus, at any epoch in time the clouds of Hydrogen should, on average, be evenly spaced. Redshift not only represents distance but also represents time. The larger the redshift of an ‘event’ then the earlier in the life of the universe that ‘event’ took place. Light from a distant quasar was emitted when the universe was young and so this light has been travelling for most of the life of the Universe and written on it, like the black dots on a high school Physics ticker timer tape, will be these absorption lines - giving a record of the history of the motion of the universe. Thus the dynamics of the universe can be examined over its lifetime.

2. Line Counting and Average Cloud Separation.

As a measure of the spacing of the Lyman Alpha lines the line density (dN/dz) is often quoted. This is the number of lines (N) per unit redshift (z).

In a static, non expanding, universe the gas clouds, on average, have a constant distance between them and so the absorption lines will be equally spaced with redshift and hence time. Here the line density will be the same for all redshifts.

In a universe which is contracting, the gas clouds and hence the lines will become closer and closer together with time and thus the line density will decrease as the redshift increases.

In a universe that is expanding, the gas clouds and hence the absorption lines will become further and further apart with time and thus the line density will increase as the redshift increases.

The line density is usually expressed as:

$$dN/dz = (dN/dz)_0 (1+z)^{\gamma} \qquad \text{……………Equation 2}$$

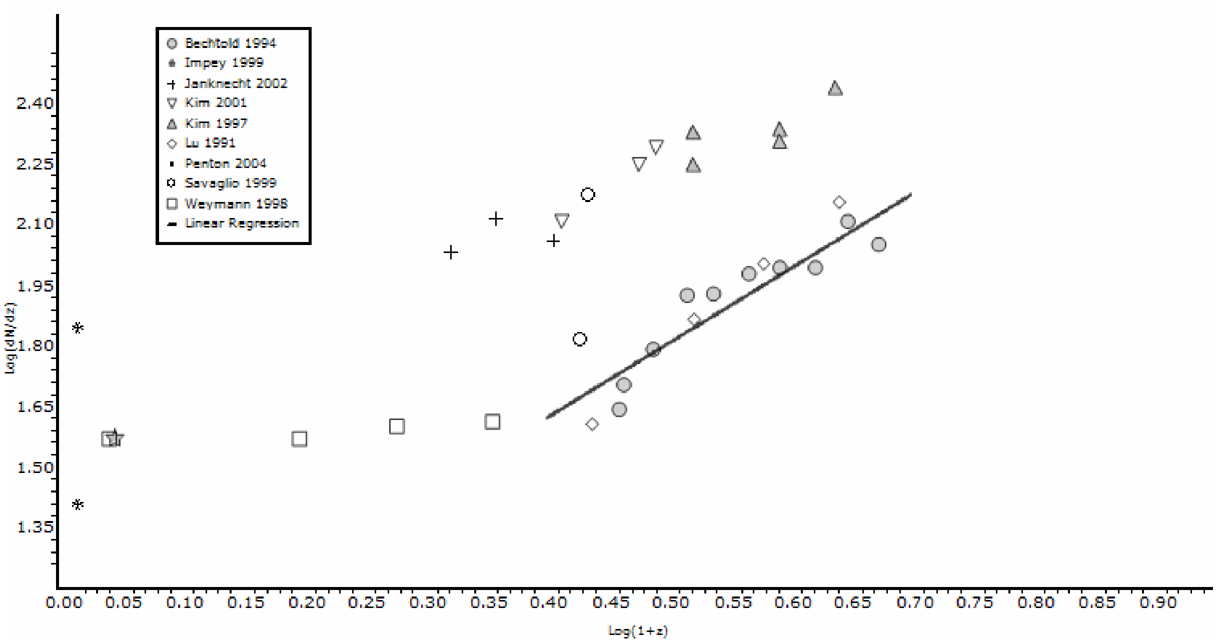
Or just

$$dN/dz \propto (1+z)^{\gamma} \qquad \text{……………Equation 1}$$

Where γ is a constant [5] and $(dN/dz)_0$ is the line density at zero redshift. Bechtold states that for $0 \le q_0 \le 0.5$, if γ>1 then there is intrinsic evolution in the observed number density of absorbers. From a study of 34 high redshift QSO’s with z >2.6, it was found that γ =

1.89±0.28 and concluded that there must be intrinsic evolution [6]. Similar values for γ were reported by other workers [7,8,9,10,11,12]. Since the Hydrogen clouds appeared to be disappearing at a greater rate than was expected from expansion alone, other, additional, mechanisms put forward were both the thinning out of the clouds due to galaxy formation and the effect of UV radiation from Quasars ionizing the Hydrogen atoms within the clouds. The combined result of these effects would be a reduction in the number density of the clouds and/or a reduction in their collision cross-section and thus a reduction in (dN/dz). For observations in the low redshift region one had to wait until the Faint Object Spectrograph (FOS) on the Hubble Space Telescope came into operation as Lyman – alpha lines in this region are still in the UV and had not been redshifted enough to move into the visible region and be observable by ground based instruments. Weymann et al studied 63 QSO's and 987 Lyman Alpha lines in the range 0.0 to 1.5 and when these were analysed it came a quite a surprise that there were many more lines per unit redshift than expected from merely extrapolating the line from high redshift [12]. They found the evolution almost flat giving the value of γ = 0.1-0.3 in this region. These results have been supported by other workers [13,14]. Hydrodynamic simulations designed to explain this phenomenon included the assumption that the UV background declines at low redshift in concert with "the declining population of quasar sources" [15].

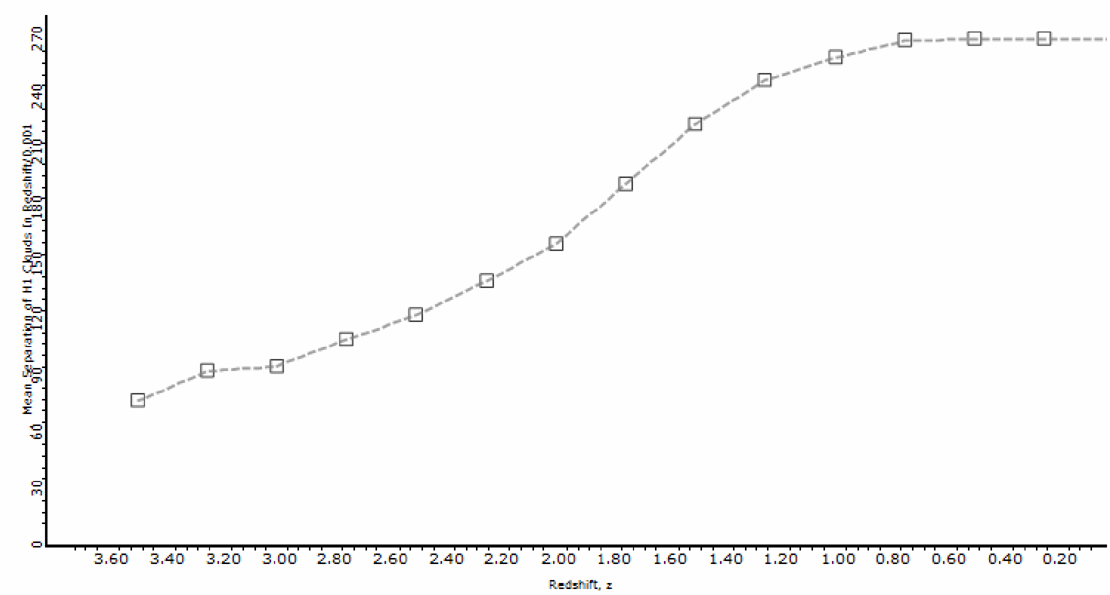
Fig 1. Graph of log(dN/dz) versus log(1+z)



More recently, further studies give more startling conclusions. Janknecht,E et al. [16] looked at the range 0.5< z ≤1.9 and stated, quote, "A comparison with results at higher redshifts shows that it (dN/dz) is decelerated in the explored redshift range and turns into a flat evolution for z → 0." Lehner et al [17] looked at results for the range z > 0 and z ≤ 0.4 and stated, quote: "dN/dz is very similar for either column density range implying no redshift evolution of dN/dz between z > 0 and z ≤ 0.4." Kirkman et al. [18]. looked at 74 QSO's in the range 0< z ≤1.6 using the HST FOS but instead of 'line counting' chose to use measurements of the flux decrement (DA) in the Lyman alpha region of the spectra as a function of redshift. They concluded that if the absorption came from lines with fixed rest equivalent widths then there was, quote: "no change in the number of lines per unit redshift. "

Since (dN/dz) is the number of lines per unit redshift then the reciprocal of this quantity (dz/dN) is the average spacing between Hydrogen clouds in redshift space and hence distance (certainly in the local region). Consequently, what these results are saying is that even though these clouds have differing redshifts 'showing expansion effects', they still manage to be, on average, evenly spaced. Taking the Kirkman result by itself shows that the clouds are evenly spaced over a redshift range from 0.0 to 1.6 – a region that includes most of the supernovae used to show time dilation and hence expansion [19]. Taking all the results together along with the later results we can smooth the data by eye and find the reciprocal to show how the average separation of the Hydrogen clouds has changed over time.

Fig 2. Mean Separation of H1 Clouds Versus Redshift

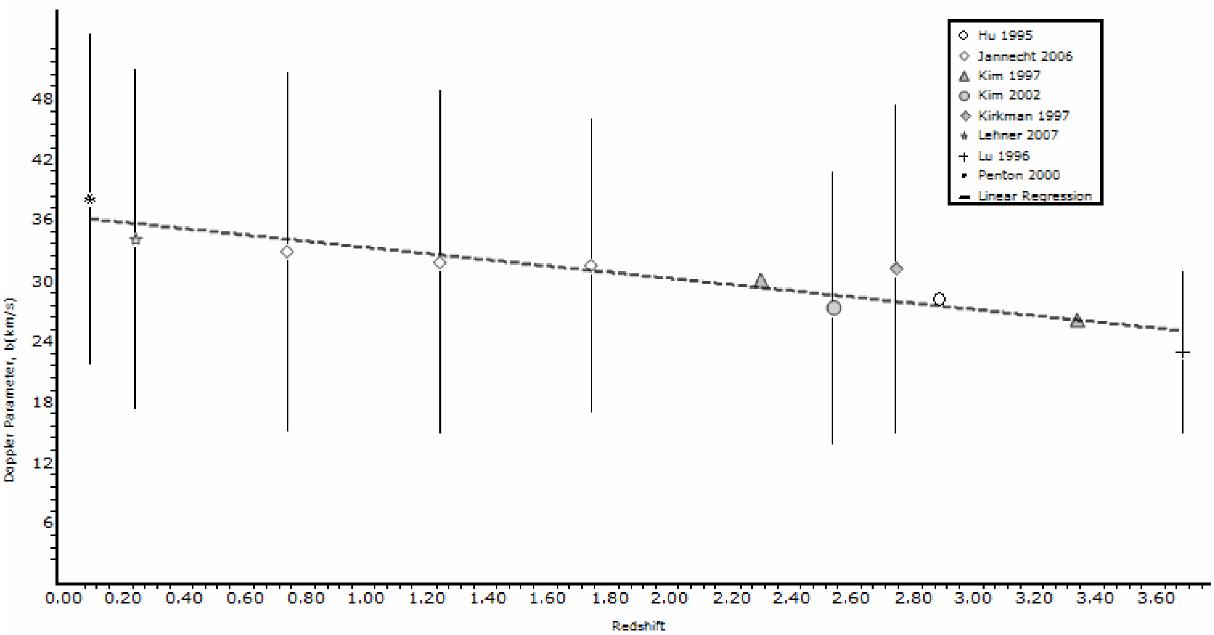


3. Temperature.

The Doppler parameter, b, gives an indication of the temperature of the Hydrogen cloud and is found from the width of the Lyman-alpha lines. The Doppler Parameter (b) is related to the temperature of the gas by: $b^2 = b_{th}^2 + b_{nt}^2$ were b_{th} and b_{nt} are the thermal and non thermal broadening of the line and so b gives an upper limit to the cloud temperature. From a search of the literature [8,16,17,20,21,22,23,24] we can determine how 'b' and hence the upper limit of cloud temperature has changed over redshift and hence time (uncertainties shown where available).

It can be seen that the Doppler parameter, on average, is less at lower redshifts than it is at higher redshifts (though some put it as being constant) implying that the universe is either becoming hotter or more disturbed as time goes on. This goes against the predictions of the expanding universe.

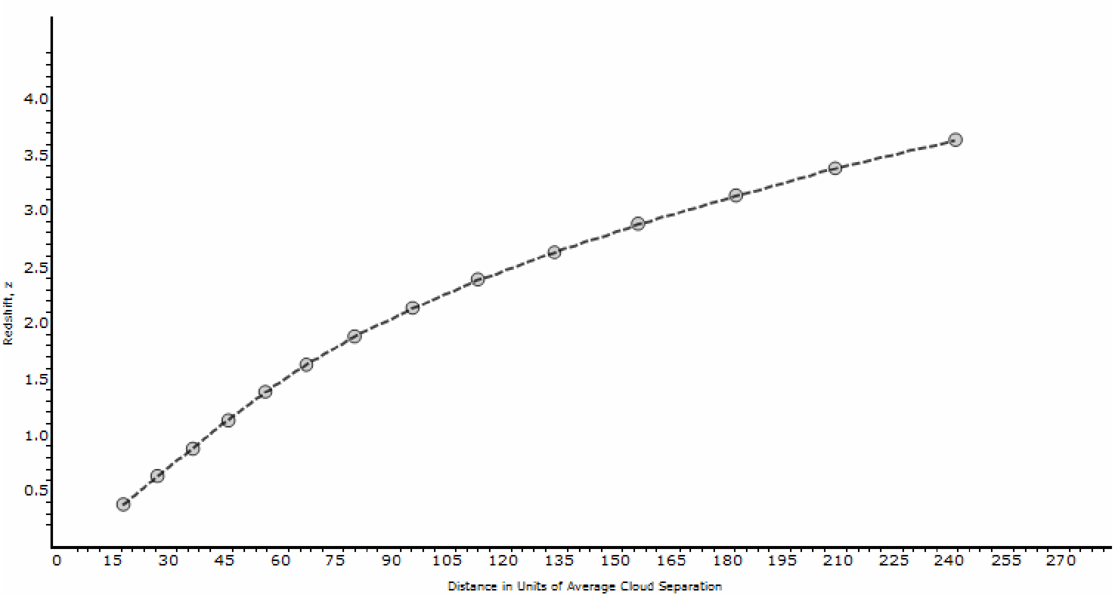
Fig. 3. Mean Doppler Parameter Versus Redshift



Furthermore, a temperature that does not rise uniformly with redshift causes problems for the blackbody curve of the CMB. Since this curve is 'perfect' and yet comprises of radiation arriving from various epochs superimposed here at Earth, then the earlier in time this radiation set off, the hotter that region should have been. Thus the wavelengths would have been originally shorter and, when redshifted, correspond to local values on arrival here. To have a perfect blackbody spectrum with a universal temperature that is constant or rising would, imply that the CMB must be local.

Let us now examine if these results support a solely static universe. Here, one would expect the Hydrogen clouds to be evenly spaced and so we could use average cloud separation as a unit of distance. In this scenario, the Hubble diagram would be as shown in fig 4.

Fig 4. Hubble Diagram for a Steady State Universe



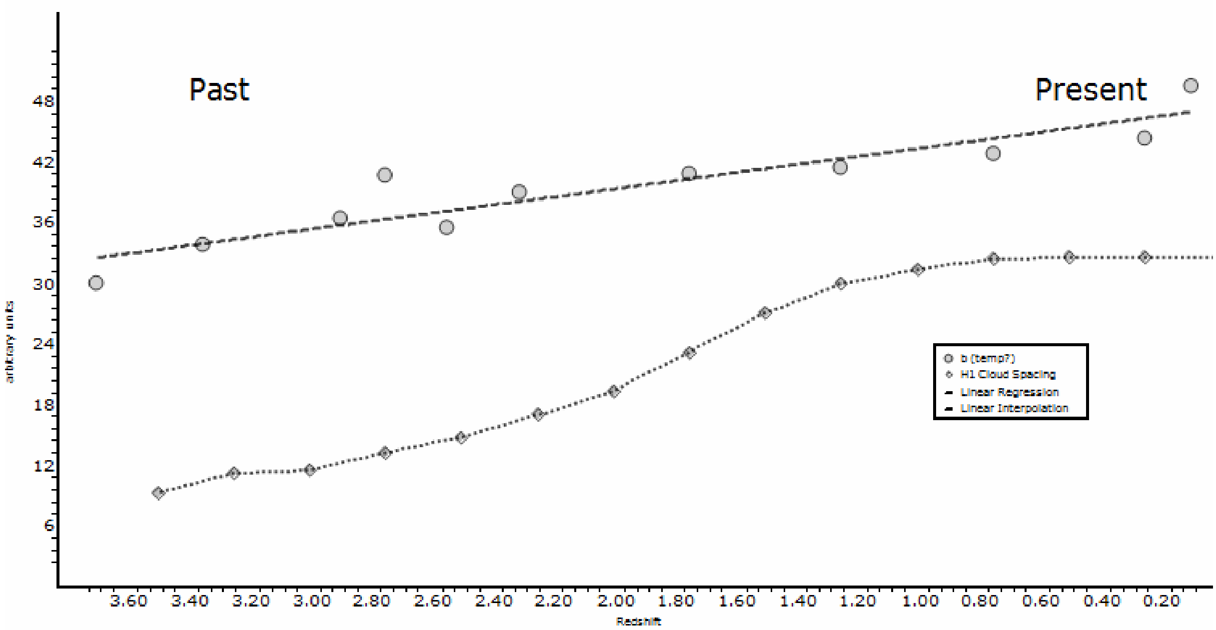
On first sight, this diagram does not support purely stationary universes (linear graph), expanding universes (linear or one curving upwards with acceleration) or purely tired light (exponential curving upwards). If anything, it must be said that on inspection the curve appears to be exponential tending to a limiting value

Plotting all data (temperature and mean cloud separation) on the same axes gives fig 5. This is consistent with a universe that once expanded but has now stopped. Is it possible that

- The Big Bang Happened?
- The elements formed as per mainstream?
- The Universe expanded?
- Einstein’s equations hold?
- But – The density of the Universe is exactly equal to the critical density.
- So the universe stopped expanding?
- There is no need for inflation.

- And, since the Universe did expand, high z supernovae will still exhibit time dilation as the universe was expanding at the time this light was emitted.

Fig. 5 All Data Versus Age of Universe



However, in that case we would need an alternative mechanism for redshift that does not rely on expansion as the clouds in the linear, local, region have differing redshifts that increase with redshift. This could be Tired Light [25] or other mechanisms. Note that these mechanisms are often discounted on the basis that the universe would 'heat up' – but we see that the Doppler parameter curve is implying just that.

4. Age of the Universe.

The high redshift data gives an independent test of the age of the universe in an expanding model. Fig 6. Shows the graph with the Bechtold [6] data extrapolated to determine $(dN/dz)_0$.

We have:

$$dN/dz = (dN/dz)_0 (1+z)^{\gamma} \quad \ldots\ldots\ldots\ldots\ldots\text{Equation 1}$$

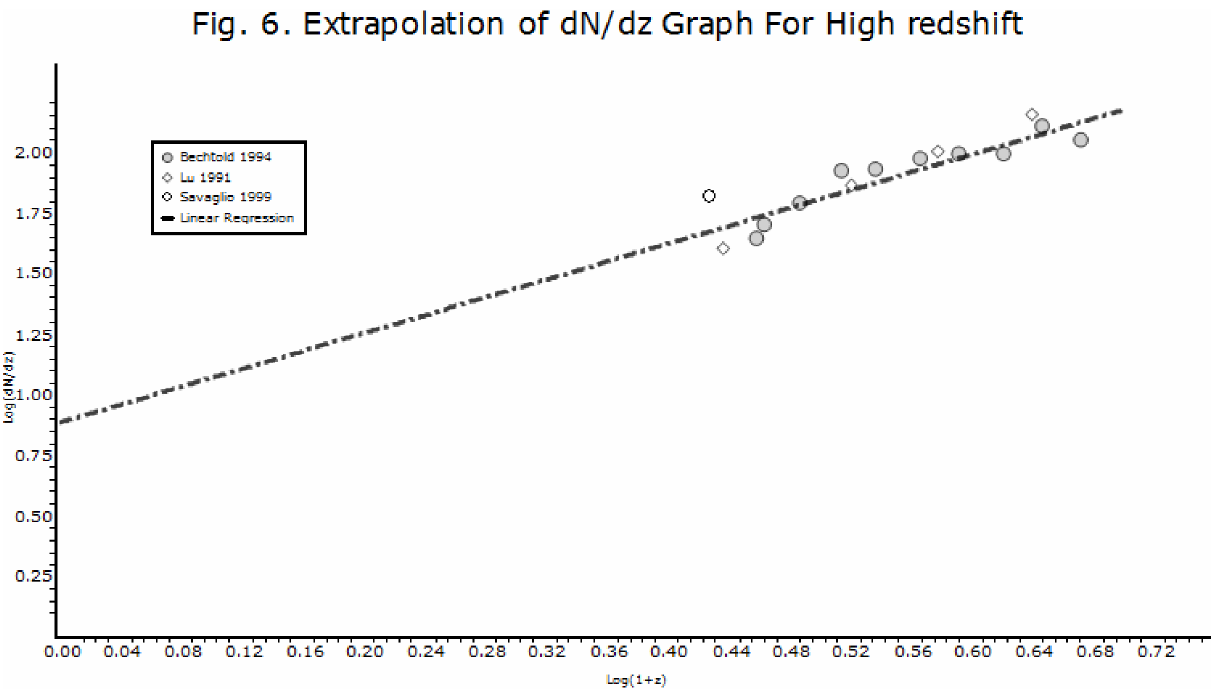
$$\textit{with } \gamma = 1.89 \pm 0.28 \textit{ giving } (dN/dz) \approx 9$$

We are now in a position to extrapolate back in time and estimate at what redshift the clouds were 'touching.' i.e. H1 clouds are ≈ 70kpc in size, so there would be 6600 per unit redshift at the time that these clouds were 'touching'..

So, at what redshift were they 'touching' - assuming expansion?

$$dN/dz = 6600 \quad \textit{gives}: \; z = 31.8^{-11.8}_{+27.2}$$

We could also ask the question, “at what redshift did the clouds have an ‘atomic separation’ of 10^{-10} m?” Here there would be 1.5×10^{36} H1 clouds per unit redshift.



$$dN/dz = 1.5x10^{36} \qquad gives: \; z = 4.32x10^{18}$$
$$with \; a \; range \; of \; 1.67x10^{16} \;\; to \; 7.3x10^{21}$$

Clearly, in an expanding universe cosmology, either the universe is very much older than the presently estimated age of 13.8 billion years or some mechanism other than inflation must have happened in order for the clouds to have spread so far apart in the time available with the Big Bang theory.

5. Conclusions and Discussion.

This paper has taken the main stream ideas of [1)] Quasars being at the origins of the universe and of [2)] Hydrogen cloud formations being responsible for the Lyman Alpha lines in the Quasar spectra - and taken these ideas through to their natural conclusions. Whilst the Hydrogen cloud separation results do not agree with any presently known cosmology, static or expanding, they do agree with a view that in the local universe, the universe is static. Whilst workers in this field agree that in our locality, the average line separation (dN/dz) is constant and hence the clouds equally spaced on average, as to what is ‘local’ differs from author to author and the region where the H1 clouds are, on average, evenly spaced, could extend up to a redshift of 1.7. This range includes most of the supernovae used to show time dilation and hence expansion. How is it that that these Hydrogen clouds can have differing redshifts (‘showing expansion’) whilst at the same time, having a constant average separation over both distance and time (showing a static universe)? Mainstream cosmology explains it as a coincidence and puts it down to a precarious balance between expansion and galaxy formation on the one hand and rate of ionization on the other. As z reduces, expansion and galaxy formation have the effect of diluting the density of H1 clouds but the “scarcity of local quasars” and thus the reduction in the local background UV have the effect of reducing the rate at which the clouds disappear by ionization under the set column density. The net result being that the number of clouds per unit redshift remarkably remains constant. However, recent results [26] show that there are far more quasars locally than previously thought and so this must cast doubt on this explanation.

Accepting that the line density results at higher redshifts are due to expansion alone and extrapolating these results back in time to gain an estimate of the age of the universe (or at least place some lower limit on it) presents problems for the currently accepted age of 13.8 billion years. There would not appear to be enough time for these Hydrogen clouds to have achieved their present separations in the time available and indicate that in an expanding universe cosmology the universe must be very much older than that predicted by the Hubble constant.

The Doppler parameter gives an indication of the upper limit of the temperature of the Hydrogen clouds and there is no indication of the universe cooling down as required by an adiabatically expanding universe. If anything the local universe is either hotter or at least more disturbed than the earlier universe was. This not only causes problems for the Big bang Theory, but also for the Cosmic Microwave Background (CMB) as, in order to provide a ‘perfect black body spectrum’ here on Earth, that arriving from more distant regions should have been emitted from a hotter region with shorter wavelengths so that as it arrives locally, it will have been redshifted enough to exactly superpose on the local CMB. Since there is no indication of an adiabatic expansion, to achieve a perfect black body radiation then this implies that the CMB must be local in origin.

A cosmology that does agree with these results is a compromise solution where the universe did expand, but the density was equal to the critical density and thus stopped expanding some time ago. In the local universe, redshift would be solely caused by another mechanism and would, in the distant past, receive a contribution from expansion. Since we would then not be restricted by the value of the Hubble constant in determining the age of the universe the predicted time taken for the Hydrogen clouds to achieve their present separation would no longer be a problem as the universe could be very much older than presently believed. Supernovae time dilation would be explained since, in this scenario, the universe was expanding at the time the light from these supernovae was emitted.

Whilst these results may seem difficult to comprehend, they are based on main stream cosmology interpretations and direct physical evidence. No doubt the problems will be sorted out, one way or the other, as more and more quasars are found and investigated.

References.

1. Murdoch, H.S. et al , ApJ 309:19-32 1986 October
2. Lu, L. et al ApJ, 367:19-36 1991 January;
3. Bahcall, J.N. et al ApJ Supplement Series 87:1-43, 1993 July;
4. Hu et al. Astron.J 110 (4) October 1995
5. Murdoch et al , APJ 309:19-32 1986 October
6. Bechtold,J. 1994. ApJS, 91,1.]
7. Janknecht, E. et al. A&A,391, L11. 2002
8. Kim, T-S. et al. AJ. 114,1. 1997
9. Lu, L. et al. ApJ,367,L19. 1991
10. Savaglio, S. et al. ApJ, 515, L5. 1999
11. Kim, T-S. et al. A&A,373, 757. 2001
12. Weymann, R.J. et al ApJ, 506:1-18,1998

13a Impey, C.D. et al. ApJ, 524 1999

14aPenton, S.V et al. ApJ (Supp) 152:29-62 2004.

15. Dave, R. et al ApJ 511: 521-545, 1999
16. Janknecht, E. et al. [14]A & A458, 427-439. 2006
17. Lehner, N. et al. ApJ658:680-709. 2007
18. Kirkman, D. et al. MNRAS 376, 1227-1237, 2007
19. Blondin,S, et al. 2008ApJ...682..724B.
20. Hu,
21. Penton, S.V. et al. ApJ. 544, 150. 2000.

22. Lu, L. et al. ApJ.472, 509. 1996.

23. Kim T-S. et al. MNRAS, 335, 555. 2002.
24. Kirkman, D. et al. ApJ 484, 672. 1997.
25. Ashmore, L.E. Galilean Electrodynamics. Vol 17, Special Issue. 3.
26. Hartnett J.G. arxiv.org/pdf/0712.3833v2. 2008.