A New Mechanism to Explain Observations Incompatible with the Big Bang

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The Big Bang model describing the origin of the Universe has been accepted mainly on account of the lack of alternatives to explain certain observations. This model, in which the redshift of remote galaxies is interpreted as a Doppler phenomenon, runs into impossible difficulties with the cosmological background at 3 K because this background is too homogeneous. Many observations, such as the redshift on the solar limb, the redshift of hot binary stars, the K-effect and a plethora of other observations, are not compatible with current theories. An alternate mechanism is described which yields a redshift without Doppler effect. This mechanism is already confirmed by several observations, and leads to an unlimited Universe model. Results are compared with proposals made by Halton Arp.

Introduction

We show here that too many observations are incompatible with the Big Bang model. Furthermore, many *ad hoc* hypotheses are needed in order to resolve the conflicts that emerge from the Big Bang hypothesis. Here we consider some vital observations which show that the Big Bang hypothesis is not acceptable. First, however, we wish to point out a fundamental confusion about the Big Bang Model, as exemplified by the book *Gravitation* by Misner *et al.* (1973, page 410), where we read that "*...Hubble discovered the expansion of the Universe*". Hubble's name is often used to support the Big Bang hypothesis. Yet Hubble's book (1937) and many articles by him show clearly that he spent most of his life trying to disprove the hypothesis that the cosmological redshift was due to the Doppler effect. Hubble neither discovered nor even believed in the expansion of the Universe: he discovered the cosmological redshift.

Another misleading statement is to be found in (Misner *et al.* 1973), in a chapter entitled: "Cosmologies that violate general relativity". This chapter seeks to justify the Big Bang model by disproving other cosmologies. However, the authors do not state that the Big Bang model violates Einstein's general relativity. In fact the Big Bang model leads to a primeval atom containing all the mass of the Universe concentrated in near zero volume. This primeval atom represents the most extreme example of a black hole that we can think of. Since it is known the nothing can be emitted from black holes, how can the primeval atom expand?

Big Bang supporters suggest a solution by adding an unrealistic *ad hoc* hypothesis. They assume that gravity did not exist at the beginning of the Universe. Gravity slowly appeared after creation, exactly at the moment when it was needed. A gradual increase of the Cavendish gravitational constant is supposed, for example by Misner *et al.* (1973) and Weinberg (Weinberg 1989). The artifice of slowly increasing the gravitational constant just when it is needed has nothing to do with Einstein's general relativity. In Einstein's theory, the massive primeval atom is simply a black hole and cannot expand.

It collapses. Will gravity also disappear at the end of the Universe when the Big Crunch occurs?

Other proofs of the inadequacy of the Doppler interpretation to explain the redshift in space are easily found. For example, in the case of quasars (Hewitt & Burbidge), one finds that, in general, they do not exhibit the same redshift in absorption and in emission. This cannot be explained by the Doppler interpretation. Even worse, in some papers more than one redshift is noted for the same QSO (Lynds *et al.* 1966, Varshni 1989). In other papers, several spectral lines remain unidentified. Finally, in many cases the claimed agreement between two wavelengths corresponding to a single redshift is not satisfactory. Even in case of the redshift of spectral lines in the Sun's chromosphere (Marmet 1989), many spectral lines can be seen with different redshifts even from one single location on the solar surface.

Another suspicious result is that all measurements are claimed to show that quasars all lie beyond a certain distance around us. This result, however, depends on how the redshift is interpreted. According to the Big Bang model, we must conclude that we are located right at the centre of the universe. This is the same belief people had in Galileo's time. A circle is a perfect figure, and the perfect location is its centre, where we are located in the Universe. This suspicious result has been studied in depth (Varshni 1976). Modern cosmology has even turned back to the anthropic principle that was so popular under different names millennia ago. But why should we be located at the centre of the Universe, and why should the Universe be created just for us on Earth?

It is also claimed that the 3 K radiation proves the Big Bang theory. The Big Bang theory, (in conjunction with relativity) is indeed compatible with a low temperature blackbody radiation. However, low temperature blackbody radiation in the Universe can easily be explained in other ways. For example, all interstellar and intergalactic matter in an endless Universe *must* emit Planck radiation, characteristic of its temperature (3 K).

In the case of the Big Bang theory, we expect that the blackbody radiation generated cannot be homogeneous since the visible matter that is coupled with it is extremely lumpy in the form of galaxies and clusters of galaxies. The most recent observations from the COBE (COsmic Background Explorer) satellite show that the blackbody spectrum is so highly homogeneous that it cannot be reconciled with the Big Bang model.

In the case of an endless Universe, interstellar matter (gaseous or dusty), far removed from stellar light, must be in equilibrium with the radiation in space. Therefore, the low temperature Planck spectrum it emits must be homogeneous, just as observed. Consequently, observations of the highly homogeneous 3 K radiation are not compatible with the Big Bang theory, but they are compatible with an endless Universe.

New Cosmology

In any text on cosmology, the question "What is the origin of the Universe?" always arises. Before deciding how the Universe might have originated, we must first consider whether the Universe had an origin, or if it is instead unlimited in size and in time.

Galaxies, we know, cannot have existed shortly after the Big Bang because they did not have enough time to form. However, "mature galaxies" have been seen with redshifts of $z = 3.4$ by Lilly (1989). He concludes: "*The appearance of a mature galaxy so soon after the Big Bang poses a serious threat* ...". Pictures of *mature galaxies* at the 27th magnitude have been taken by Waldrop (1986). Possible observations of redshift values between 6 and 10 are reported. In the Big Bang model, these observed *mature galaxies* had to be formed long before the time of the Big Bang. These galaxies are thus incompatible with the predictions of the Big Bang theory.

The Big Bang cosmology is incompatible with the recent discovery of the "Great Wall" and the "Great Attractor". It is impossible to conceive of an interaction between matter during a period long enough to produce such gigantic structures within the limited age of the Universe implied by the Big Bang.

The unlimited Universe proposed here is compatible with the Perfect Cosmological Principle, which states that the Universe looks the same wherever the observer is located in space or in time. Other experiments showing the inadequacy of the Big, Bang model are given in this article.

The Beginning of the Big Bang Expansion

The Big Bang model assumes that our Universe was created from an extremely high concentration of material. Although the primeval Universe is believed to have originated at zero volume, quantum physics considerations dictate that our Universe cannot be described before its diameter reached about 10^{-33} cm. This means that the Universe, then expanding at about the speed of light, was about 10^{-43} seconds old.

According to the Big Bang model, our Universe kept expanding and became many billion times (about 10^{20} times) larger and older, until it reached the size of an electron, with a radius of 10^{-13} cm, when the Universe was 10^{-23} seconds old. In the ensuing 15 billion years, the Universe supposedly expanded to a radius of 15 billion light-years.

In the early part of the century, many scientists rejected the Big Bang model because it leads to insurmountable difficulties. For example, prestigious scientists like R. L. Millikan and E. Hubble

(1937) pointed out that the tired Iight mechanism is simpler and less irrational than the velocity-Doppler interpretation. Even now, Nobel laureate Hannes Alfvén (1990) and many plasma physicists actively challenge the conventional view of the origin of the Universe with an alternative model called Plasma Cosmology. The Big Bang theory has always been surrounded with controversy (Reber 1989, Cherry 1989).

Rationality and Causality

The Big Bang model is not acceptable philosophically. For example, it implies that time began to exist at the instant of creation. Consequently, as noted by Maddox (1989), there is no way to find either the cause of the Big Bang or the cause of the sudden creation of time. The "cause" of the creation is very important to us because it deals with the origin of our Universe. Science, on the other hand, is dedicated to the discovery of the causes of observed phenomena.

In the case of the Big Bang theory, the cause of creation (which must obviously predate creation) cannot even be considered since the cause cannot have originated before time existed. Even quantum fluctuations could not produce the Universe since, at that instant, time did not exist. The Big Bang model leads to the rejection of the principles of causality and rationality, which are fundamental to philosophers as well as to many physicists. The Big Bang is a creationist theory and differs from other creationist models (for example, the one that claims that creation took place about 4000 years B.C.) only in the number of years since creation. In the Big Bang model, creation happened about 15 billion years ago.

Arguments in Favour of Big Bang Cosmology

The Big Bang hypothesis rests mainly on four arguments:

a) It implies that the redshift of remote galaxies and many other systems is due to recessing velocities (Doppler interpretation).
b) It predicts the cosmic abundance of some atoms, such as helium 4, deuterium and lithium 7.
c) It provides an interpretation for the 3° K radiation.
d) Finally, it is supposed to agree with the theory of relativity.

Although these results have been claimed to favour the Big Bang hypothesis, we will see that an unlimited Universe is much more compatible with existing observations. The apparent compatibility of the four arguments with the Big Bang model is largely superficial, and the agreement is not supported by serious analysis.

a) So many redshift observations cannot be explained by the Doppler theory that books (Arp 1987, Narlikar 1989) containing long lists of non-Doppler redshift observations have appeared. A catalogue listing 780 references (Reboul 1981) to redshift observations that cannot be explained by the Doppler effect has been published under the title *Untrivial redshifts: a Bibliographical Catalogue*.

Many more papers indicate that nonvelocity redshifts have been observed and reported. If a non-Doppler redshift mechanism cannot exist, all these papers, published by professional scientists on the subject, have to be erroneous! This is certainly suspicious. The systematic rejection of all of more 1000 papers related to nonvelocity redshift observations suggests that many scientists have become too comfortable with the old framework to allow it to be challenged. Yet a non-Doppler redshift interpretation actually provides a better agreement with observations.

b) The second argument, relating to the distribution of light isotopes in the Universe, has been rebutted by the plasma scientist Lerner (1989), who shows that Helium 4 and other isotopes (atoms) are formed in massive stars by nuclear reactions (and gamma rays), in agreement with observations. Lerner concludes: “*Thus either the* *blackbody spectrum or the light element predictions of the Big Bang is clearly wrong.*”

c) As stated above, the 3 K microwave background does not prove the Big Bang model. There is no need to assume that it comes from a Doppler redshifted blackbody at about 3000 K.

Contrary to observations, the Big Bang theory predicts that this radiation should not be homogeneous because radiation is expected to be coupled with matter. Recently, Lange (1989) reported that at a resolution of as little as 10 arcseconds, there is no observable inhomogeneity even with a sensitivity in temperature difference as high as $\Delta T = \pm 0.00001$ K. A report of the COBE satellite (Goddard News 1990) states: “*COBE's new results severely limit the magnitude and character of such a release (of energy)*.” Therefore this satellite has clearly shown the extreme homogeneity of the 3 K radiation, which implies that the Universe started out incredibly smooth and homogeneous as well. Now such an early homogeneous Universe could not lead to the inhomogeneity we observe at present in the form of galaxies and clusters of galaxies. The homogeneity is in disagreement with the Big Bang model but is in perfect agreement with the Planck radiation emitted by an unlimited Universe at 3 K.

d) Even Einstein's relativity, does not agree as such with the Big Bang model. In the example stated above, when the Universe was the size of an electron or smaller and was 10^{-23} seconds or less old, it was clearly a deep black hole, and consequently could not expand (according to Einstein's general relativity). The hypothesis of gravity appearing gradually, after the creation of the Universe, is too subjective to be acceptable.

New Redshift Mechanism

The observations of the cosmological redshift mentioned above can be explained without recourse to the Big Bang theory. There are several alternatives to the Doppler interpretation. For example, this author (Marmet 1988a) has shown that a redshift results from the inelastic collisions of photons with atoms and molecules. Many scientists reject this mechanism, because they are not aware that photon-molecule collisions are inelastic and can take place without any significant angular dispersion of photons in all directions. This has been described in detail (Marmet 1988a, Marmet & Reber 1989) and can be demonstrated by the following simple argument.

Physics teaches that the average velocity of transmission of energy (group velocity) of photons is reduced in gases, as calculated by the index of refraction. In calculations of the index of refraction, we usually assume, as an approximation, that matter is homogeneous, and we neglect individual atoms. If we are only interested in calculating the velocity of light in gases, we find the same result whether we use an average velocity (corresponding to a homogeneous medium) or we consider multiple delays from interactions of photons with individual atoms. At atmospheric pressure, the average reduced speed of propagation in air is not easily noticed, precisely because almost all photons are transmitted without angular dispersion (scattering). For example, at a distance of 100 meters, it is an everyday experience that light is transmitted through (calm) air without any noticeable angular dispersion and does not produce any visible fuzziness (even when observed with a telescope). From the index of refraction of air (n=1.0003), we know that photons colliding with air molecules are delayed by 3 cm over a path of 100 meters, compared to transmission in vacuum (see Figure 1).

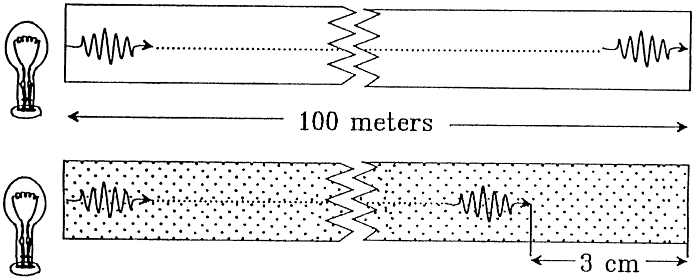

Figure 1 - Light transmitted through air is slowed down by interactions with molecules. Over a distance of 100 meters, photons are delayed by 3 centimeters, as calculated from the index of refraction (n = 1.0003). Many photon-molecule interactions are required to explain such a long delay. However, since the image of an object seen 100 meters away does not appear fuzzy, we must conclude that these photon-molecule interactions do not result in angular dispersion.

The 3 cm delay, which can only be caused by a large number of photon-molecule collisions, is about one billion times the size of the atom. We can therefore be sure that all the photons had more than one interaction with air molecules. In fact, something on the order of one billion collisions are required to produce such a delay in light transmission. Consequently, the 3 cm delay proves that the photons have made about one billion collisions with air molecules *without any* (observable) *angular dispersion* since the image observed through air is not fuzzy. Photon-molecule collisions without angular dispersion are an everyday experience that is completely ignored.

In extragalactic space, where the gas density is lower by more than 20 orders of magnitude there is, on the average, about one such interaction with an atom per week. Rayleigh scattering, meanwhile, which does produce diffusion in all directions, is considerably less frequent. Hence most interactions of photons with gas molecules take place without any measurable angular dispersion.

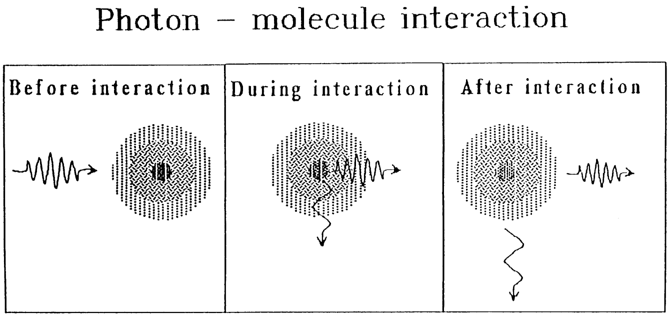

Figure 2 - During the passage of one photon through an interacting atom, at least one very soft secondary photon is generated by *Bremsstrahlung* and emitted. Consequently the photon reemitted in the forward direction has lost the energy given to the secondary photon.

The next step is to examine the properties of such photon-collisions on each individual atom. We have just seen above that each collision produces a delay in the transmission of light; thus there is a finite interval of time during which the photon is absorbed before being re-emitted.

We know that an atom is polarized by electromagnetic waves (photons) moving across it. The polarizing field moves the electron (of the atom) out of its normal quantum distribution around the atom. The polarized atom acquires at least a part of the energy of the electromagnetic wave traversing it. The energy extracted from the photon is transferred to the electron of the atom, producing a polarized atom with an energy of polarization. When the momentum of this transferred energy is imparted to an electron (of the atom), it necessarily accelerates the electron. Now Maxwell's equations show that electromagnetic radiation (*Bremsstrahlung*) is emitted (see illustration Figure 2) when an electron is accelerated. Consequently, a secondary photon is emitted due to the passage of the initial photon, and this is what makes photon-atom collisions inelastic.

The results of quantitative calculations of this slightly inelastic non-dispersive forward scattering have been published in more detail (Marmet 1988a). It is found that in ordinary conditions, the energy loss per collision is about 10^{-13} of the energy of the incoming photon. Therefore this phenomenon produces a redshift that is identical in character to the Doppler effect, *i.e.*, the relative change of wavelength is constant ($\Delta l/l =$ constant). Calculations show that the secondary photon emitted, which carries the extra energy, has a wavelength a few thousand kilometers long (about 10^{13} times longer). Since the longest wavelength observed in radio-astronomy is 144 meters (Reber [1968, 1977), observations cannot yet detect these secondary very long wavelength photons.

The fact that collisions of photons on atoms are *never* perfectly elastic has been known theoretically for many years from quantum electrodynamics (Jauch & Rohrlich 1980, Bethe & Salpeter 1957), so no new basic physics is required. It is also important to realize that this phenomenon produces a redshift similar to—in fact almost undistinguishable from—the Doppler redshift.

Experimental Confirmation

Experimental confirmation of this new theory of redshift has been achieved in several experiments with the Sun (Marmet [1988), in binary stars and other cases (Marmet 1988a, Marmet & Reber 1989).

One of the most dramatic of these confirmations is in the case of the Sun, where this theory has been applied to the redshift anomaly observed in the solar chromosphere. When spectroscopic measurements from the centre of the solar disk and the limb are compared, the latter are found to be redshifted with respect to the former above and beyond the Doppler shift that arises from the Sun's

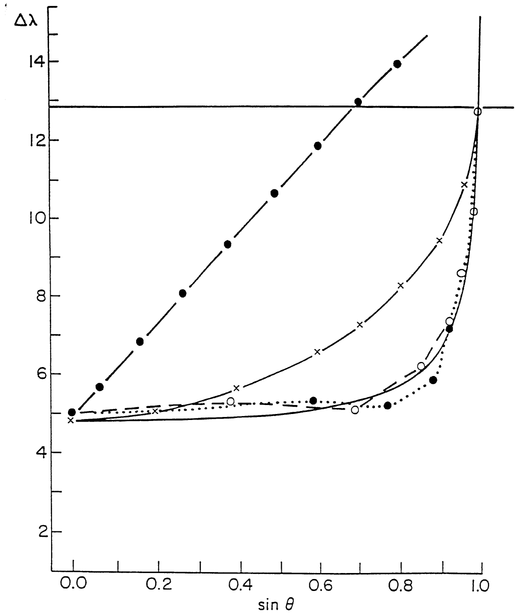

Figure 3 - Observed and predicted redshifts on the solar disk from the disk's centre (sin *q* = 0) to its limb (sin *q* = 1). The redshift is given in wavelength units of 10^{-13} meters on the Y axis. Some of the independently measured redshifts are shown in the dotted and dashed curves. The theory presented here is illustrated by the continuous curve. The Schatzman-Magnan (linear increase from centre due to motion of gas in solar granules) and Finlay-Freundlich (x) theories are also illustrated. Allowance has been made for the shift due to Sun's rotation.

rotation. This anomaly was first reported early in this century (Halm 1907), and has been confirmed by all experts in the field since.

Attempts have been made to explain this redshift as a Doppler effect due to the motion of masses of gas in the solar photosphere and chromosphere, or due to motion in the solar granules. The inadequate predictive power of these hypothesis is shown on Figure 3. The figure shows the observed amount of the redshift as a function of distance from the centre of the Sun's disk out to the limb. The observed curves are compared with the predictions of two other theories.

When the theory developed here is applied, assuming that the redshift arises from the increasing number of photon-atom interactions, we find an accurate agreement with the observed curves. This theory also successfully explains the absence of redshift for several spectral lines originating in very high layers of the solar chromosphere and accounts for a stronger redshift for the iron line at 5250 Å, since it originates at a deeper layer.

In the case of binary stars, where one component has a vastly different temperature from the other, our theory predicts that the redshift of the hotter star (in absorption) should be greater than the redshift of the cooler component. Amazingly, this is confirmed experimentally and has been reported for years. An example is given in Figure 4.

The larger redshift of the hotter component of the binary is predicted naturally from the shorter length of coherence of its radiation (Marmet 1988a). Physics shows that radiation carries information about the temperature of the blackbody emitter as the length of coherence of the radiation emitted. Hotter emitters (stars) emit radiation with a shorter length of coherence, as calculated by the Fourier transform. Consequently a larger redshift is observed in the hot component of a binary star.

Consequences of the New Model

Calculations (Marmet 1988a) have shown that an average concentration of about 0.01 atom/cm^3 in the Universe leads to the same cosmic redshift as the one given by the Hubble constant. Since this density is greater than what is usually reported, we must explain why so much matter remains invisible in space.

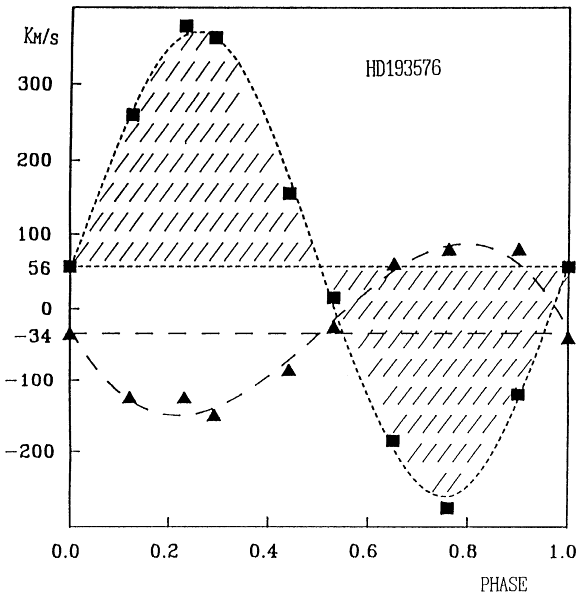

Figure 4 - Redshift in km/s of each component of the binary HD193576 versus the phase of rotation. The radial velocities of the centres of mass differ by 90 km/s.

There are several experimental techniques for detecting matter in space. Unfortunately, almost all those methods are selective and can only detect one kind of matter. Most of the detecting methods use spectroscopy to detect radiation emitted or absorbed by matter. Spectroscopy is an excellent way to identify atoms and molecules as long as spectral lines are emitted.

One type of matter, cold interstellar and intergalactic molecular hydrogen, cannot be detected by these methods. While atomic hydrogen is found extensively is space and can be detected in emission and in absorption at its characteristic radiowaves of 21 cm wavelength, cold atomic hydrogen is expected to condense and form molecular hydrogen. Cold molecular hydrogen (or helium), however, is not detectable at visible or radio wavelengths. Since molecular hydrogen (H_2) has no permanent electric dipole, it does not easily emit or absorb radiation. For example, it is known that normally excited molecules generally emit photons in about 10^{-8} second. However, spontaneous emission is practically nonexistent in the first rotational state of hydrogen. A transition from the second rotational state of H_2 is *relatively* much more probable, but would require about 30 billion seconds (one thousand years). This transition is about 18 orders of magnitude less probable than for an ordinary dipole transition. Not until the sixth state does the transition time drop to one year. There are so many highly forbidden transitions that we cannot hope to detect cold H_2 spectroscopically. Only some molecular hydrogen can be detected in the far ultraviolet spectrum in the neighborhood of UV stars. Owing to its nature, H_2 is very likely extremely abundant in space, although it generally cannot be detected.

When the first galaxies were discovered and studied many years ago, it was believed that stars and other matter rotated around the nucleus much like planets moving around the Sun, according to Kepler's law. This was so strongly believed that authors of several books claimed this was an observed fact. Unexpectedly, spectroscopic data have shown clearly that this is not so. Matter and stars moving around the nucleus of galaxies do not move according to Kepler's laws, but have a constant tangential velocity. This constant velocity is observed easily and appears very clearly on spectrograms of galaxies (Rubin 1983, 1988). To explain the velocity distribution of stars around the nucleus, it has been calculated (Rubin 1983, 1988) that there must be a large amount of invisible galactic matter in galaxies so that the gravitational force decreases linearly as the distance from the centre of the galaxy. This non-Keplerian motion proves clearly that there is considerable invisible matter in galaxies. Furthermore, this unexpected motion extends as far as we can observe from the nucleus of the galaxy, so the total amount of matter in galaxies must be very much greater than the visible component. The fraction of invisible matter is as much as 90% to 99% or more of the total mass. Possibly even more invisible matter fills the space around the observed galaxies. The observation of the rotation of galaxies proves that a gigantic amount of unseen gas and dust exists in the Universe.

Also, as reported by Burbidge (1990), almost all groups and clusters of galaxies appear to have far more kinetic energy than gravitational energy. This leads to the conclusion that a tremendous amount of invisible matter is present in clusters of galaxies. Molecular hydrogen is very likely the most significant component of this matter.

Other observations, such as tests based on the Faraday effect, have been used to determine the amount of "missing mass". More and more new cosmic matter has been discovered recently. The most recent example of mass anomalies is the massive, previously undetected object called "The Great Attractor" discovered by Rood (1988) and DressIer (1989) in studies of the distribution of galaxies in space. Rood states that in order to solve these anomalies one has to consider that: "Galaxies and systems of galaxies contain enough dark matter in one or more forms that have so far escaped detection to solve the mass anomaly". The "Great Attractor" is another example of a gigantic amount of newly discovered invisible matter, since it contains on the order of 10^{16} solar masses (probably in the gaseous phase). Clearly, most of the galactic and intergalactic gas responsible for the non-Doppler redshift is molecular hydrogen.

Another model has been suggested by Arp (1987) in order to explain the systematically higher redshifts in some astronomical objects. Arp uses the hypothesis that the observed redshift is a function of the epoch of creation of the matter rather that a Doppler effect. His model is compatible with the observation that some galaxies made of young matter exhibit larger redshifts. Yet it should be remembered that young stars in formative galaxies are also hotter. Consequently, as we have seen above, radiation coming from hotter stars is expected to possess a larger redshift due to photon-atom collisions. Based on this redshift data, both models (Arp's and mine) lead to a similar agreement with observations.

However, in at least one case there is a divergence: the redshift of the solar limb. It is highly unlikely that matter on the sun's limb (as seen from earth) is younger than matter everywhere else on the sun's surface, as one would deduce from Arp's theory. The extensively studied redshift on the sun's limb is therefore incompatible with Arp's theory.

If we calculate the average redshift across the entire solar disk due to inelastic collisions on atoms, as outlined above, we find that the result is much less than one kilometer per second. Even in much hotter stars, the predicted redshift would be of the order of one km/s, with an extreme value of ~ 5 km/s for the hottest O stars. Now, if we want to investigate a group of stars (and not to a single resolved object), we have to consider the average redshift of a statistically large number of stars in each spectral class. This is because there is a velocity distribution of stars in the Cloud. The existing data on the Magellanic Cloud would seem inadequate to determine the redshift of each spectral class of stars with the required accuracy (~ 1 km/s), especially when the error of the spectroscopic value must be added to the error due to the random velocity distribution of stars in the Magellanic Cloud. Consequently, in my view, the data from the Magellanic Cloud is insufficiently accurate at this time to confirm or invalidate the redshift mechanism presented in this paper.

Conclusion

The failure of observations supporting the Big Bang model can now be remedied by considering the tired light mechanism described in this paper. One of its consequences is that our Universe is unlimited. This is now becoming apparent in various ways (Phipps 1989). The title of a recent letter in the *New York Times* "The Unscientific Charm of the Big Bang" (Segal 1990), suggests that the Big Bang cosmological model has lost its credibility.

On the one hand, we find that the amount of matter in the Universe is apparently compatible with the amount (~ 0.01 at/cc) required to satisfy the cosmological model involving non-Doppler redshift (due to molecular hydrogen). Similarly, the unlimited Universe model leads to a prediction of background radiation quite in agreement with the highly homogeneous 3 K background (Marmet 1988b) observed from space.

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