Big Bang Cosmology Meets an Astronomical Death

By Paul Marmet (1932-2005)

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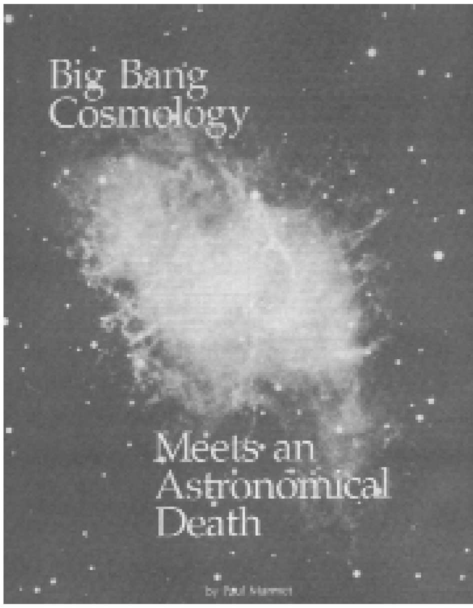

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More and more astronomical evidence shows the weaknesses of the theory stating that the universe started with a Big Bang. A Canadian Astrophysicist presents this evidence and explains how the cosmic redshift is caused by gaseous matter in space.

Caption for Crab Nebula.
Interstellar matter, seen here in the Crab Nebula in Taurus, has its counterpart on a larger scale in the rarefied intergalactic medium. The intergalactic medium was first shown to exist in the 1970s. It is impossible, the author says, for the light we see from distant galaxies not to interact with this medium as it passes through it.

1 --- Introduction.

We are all so accustomed to reading that the universe "began" once a time with the Big Bang that most people no longer think it necessary to question or scrutinize it. A detailed analysis of the Big Bang theory, however, leads to consequences and implications that are inconsistent, or are contradicted by astrophysical observations, including important ones.

At the same time, one of the pillars of the model, the all important cosmic redshift- the shifting of spectral lines toward the red end of the spectrum, in proportion to the distance of the source from us- can be explained without invoking the Doppler velocity interpretation[(1)] so dear to Big Bang theorists. The redshift is explained instead by taking the intergalactic medium into account, and correcting our understanding of how light interacts with such a medium on its way to the observer. Two different theoretical approaches, semi classical electrodynamics and quantum electrodynamics, have shown that *all* interactions or collisions of electrodynamics waves (photons) with atoms are inelastic; that is, the photons lose a very small part of their energy as a result of the interaction. Hence, the greater the depth of the intergalactic medium through which a galaxy's light must pass, the more toward the low-energy end of the spectrum - that is, toward the red - is the light frequency shifted.

These considerations eliminate the limit on the size of the universe imposed by the Big Bang theory. Indeed one can say that the universe far greater than imagined.

2 --- The Big Bang Universe.

It is widely believed among scientists that the universe originated from an extremely dense concentration of material. The original expansion of this material is described as the Big Bang. Although the primeval soup is thought to have originated at zero volume, quantum physics considerations require that it could not be described before its diameter in centimeter reached about 10^{-33} (that is, 1-billion-trillion-trillionth cm). This means that the universe, then expanding at near the speed of light, was about 10^{-43} second old.

After that instant, according to the Big Bang theory, the universe kept expanding and became many billions of billions of times (on the order of 10^{20} times) larger and older, until it reached the size of an electron that has a radius of approximately 10^{-13} cm, when the universe was 10^{-23} second old. During the following 15 billion years, according to the theory, the universe expanded to a radius of 15 billion light-years to the size it is claimed today. (A light-year, the distance traversed by light in a vacuum in one year, is 9.5×10^{12} kilometers.)

The author (center) with the organizers of the Feb. 1989 Plasma Universe conference in La Jolla, Calif., Nobel laureate Hannes Alfvén (right) and Anthony Peratt of Los Alamos National Laboratory (left).

These are the dimensions and time scale required by the Big bang model, a model that has certainly not been accepted by all scientists because it leads to insurmountable difficulties. Prominent scientists like R. L. Millikan and Edwin Hubble thought that the Big Bang model created more problems for cosmology than it solved, and that photon energy loss was a simpler and "less irrational" explanation of the redshift than its interpretation as a Doppler effect caused by recessional velocity, in keeping with the Big Bang (Reber 1989; Hubble 1937).

In more recent years, Nobel Laureate Hannes Alfvén, and other students of astrophysical plasma have challenged the Big Bang with an alternative conception called Plasma Universe. In this cosmology, the universe has always existed and has never been concentrated in a point; galaxies and clusters of galaxies are shaped not only by gravity, but by electrical and magnetic fields over longer times that available in the Big Bang model (Peratt 1988, 1989; Bostick 1989).

From its birth in the 1930s, the Big Bang theory has been a subject of Controversy (Reber 1989, Cherry 1989). Indeed, our view of the universe must always be open to consideration and reconsideration.

This article will demonstrate that the big bang model is physically unacceptable because it is incompatible with important observations. Severe philosophical problems with the Big Bang are also brought up (see Maddox 1989). Science, however, is dedicated to the discovery of the causes of observed phenomena; the Big Bang model thus leads to the rejection of the principle of causality that is fundamental in philosophy as well as in physics. It is actually a creationist theory that differs from other creationisms (for example, one that claims creation took place about 4000 B.C.) only in the number of years since creation. According to the Big Bang model, creation occurred between 10 and 20 billion years ago.

3 --- Defective Evidence.

Support for the Big Bang theory has been built upon three main kinds of evidence:

First, the Big Bang assumes that the observable universe is expanding. Support for this is offered by interpreting the redshifts of remote galaxies and many other systems as Doppler shifts. Hence these redshifts would show that these systems are all flying away from each other.

Second, the Big bang theory predicts the cosmic abundance of some light elements like helium-4, deuterium, and lithium-7. The available evidence of cosmic abundances is said to confirm the predictions.

Third, Alpher, Bethe, and Gamow in 1948 used the Big bang theory to predict the existence of a low temperature background radiation throughout the universe at 25K as a relic of the initial Big Bang explosion. A background radiation at a temperature of about 3K (emitting radiation 5000 times less intense, see Planck's law) has indeed been discovered[(2)], and is being interpreted as the predicted relic.

The support afforded by the Big bang model by these three arguments is, however, only apparent and does not withstand a serious detailed analysis. In fact, the observational evidence from astrophysics is more in keeping with the model suggested by this author of a stable universe. Here, in brief, is the evidence from astrophysics:

The Redshift.

A large number of redshift observations cannot be explained by the

Doppler theory. Astronomer Halton Arp's 1987 book "Quasars, Redshifts and Controversies" provides an extensive review of them, as does a lengthy 1989 review article by the Indian astrophysicist J. V. Narlikar. A catalogue of 780 references to redshift observations inexplicable by the Doppler effect was published in 1981 by K. J. Reboul under the title, "Untrivial Redshifts: A Bibliographical Catalogue". Many other papers indicate that non-velocity produced redshifts have been observed.

A non-Doppler interpretation of the redshift actually leads to better agreement of theory with the actual observations, as shown below.

Light Element Production.

It is not necessary to invoke a Big Bang in order to explain the observed abundances of light elements. A plasma model of galaxy formation accomplishes the task very well (Rees 1978; Lerner 1989). The plasma model shows that the elements are produced during galaxy formation in their observed abundances by early massive and intermediate stars. The nuclear reactions and cosmic rays generated in and by these stars lead to production of the elements. As a recent reviewer of plasma theory wrote, the plasma model: "***accounts accurately for the observed overabundance of oxygen in the lowest metallicity stars, and deuterium, and does not over-produce the remaining rare light elements - lithium, beryllium, and boron***" (Lerner 1989).

Cosmic Background Radiation.

The existence of the 3 K microwave radiation is no longer valid evidence for the Big Bang. There is no need to assume, as Big Bang believers do, that this background radiation came from a highly Doppler-redshifted blackbody[(3)]at about 3,000. K - that is, from the exploding ball of matter - when its density became low enough for energy and matter to decouple. The background radiation is simply Planck's blackbody radiation emitted by our unlimited universe that is also at a temperature of about 3 K (Marmet 1988).

The inhomogeneity of matter in the universe today means that there should be some inhomogeneity in the cosmic background radiation if it originated in a Big Bang. But no fundamental inhomogeneity in the background has been clearly found, despite tests that are sensitive down to small scales. Matter is concentrated in galaxies, in clusters and super clusters of galaxies, and in what has been called the Great Attractor (a tentatively identified but huge concentration of mass centered 150 million light-years away). These important inhomogeneities in the composition of the universe as we see it today must have first appeared in the early universe (if it exists). In fact, a comparable inhomogeneity must have existed in the matter that emitted the 3 K radiation. That inhomogeneity must appear as a distortion in the Hubble flow[(4)] (Dressler

1989) and must lead to observable irregularities in the 3 K background. Inhomogeneities in the 3 K radiation have been looked for but nothing is compatible with the mass observed in the Great Attractor. A. E. Lange recently reported that there is no observable inhomogeneity even with a resolution of 10 seconds of arc and a sensitivity in temperature as high as $\Delta T = \pm\ 0.00001$ K (Lange 1989).

Nor can Einstein's general theory of relativity be applied in a consistent manner to the Big Bang model. According to the model, when the universe was the size of an electron and was 10^{-23} second old, it was clearly a black hole - a concentration of mass so great that its self-gravitation would prevent the escape of any mass or radiation. Consequently, according to Einsteinian relativity, it could not have expanded. Therefore, one would have to assume that gravity started to exist only gradually after the creation of the universe, but that amounts to changing the laws of physics arbitrarily to save the Big Bang model. In contrast, a stable universe as suggested here agrees with Einstein's relativity theory, taking into account the cosmological constant(5) he proposed in 1917.

Recent astronomical discoveries pose an additional and very serious problem for the Big Bang theory. Larger and larger structures are being found to exist at greater and greater redshifts, indicating their existence in the increasingly distant past. (Whether one assumes the Big Bang or the theory presented here, the redshift is normally an indicator of distances, and because it takes time for light to travel, the image of a highly redshifted object is seen on Earth today as it was when the light began to travel.)

In 1988, Simon Lilly of the university of Hawaii reported the discovery of a mature galaxy at the enormous redshift of 3.4; that is, the amount of the redshift for any spectral line from the galaxy is 340 per cent of the line's proper wavelength (Lilly 1988). This puts the galaxy so far in time that the Big Bang scheme does not allow sufficient time for its formation! In a news report on Lilly's work, Sky & Telescope reports: "***The appearance of a mature galaxy so soon after the Big Bang poses a serious threat . . .***" (Aug. 1988, p. 124).

In 1989 came the discovery of the "Great Wall" of galaxies, a sheet of Galaxies 500 million light-years long, 200 million light-years wide, and approximately 15 million light-years thick, with the dimensions of the structure being limited only by the scale of the survey (Geller and Huchra 1989). It is located between 200 and 300 million light-years from Earth. In an interview with the Boston Globe (Nov. 17 1989), Margaret Geller of the Harvard-Smithsonian Center for Astrophysics offered some frank comments on the implications of her discovery:

> ***The size of the structure indicates that in present theories of the formation of the universe "something is really wrong that makes a big difference,"***

Geller said in an interview:

No known force could produce a structure this big in the time since the universe was formed", She said.

4 --- The Redshift and the Intergalactic Medium.

All the observed phenomena cited above can be explained without recourse to the Big Bang theory. But what about the cosmic redshift, the central subject of this article? This author has explained the cosmic redshift by improving our understanding of the interaction of light with atoms and molecules. The observational fact upon which Big Bang advocates and opponents agree is that the redshift of galaxies generally increases with distance. This relationship would arise if the light we receive from galaxies loses some of its energy to the intergalactic medium through which it must pass. In that case, the greater the depth of the intergalactic medium between a galaxy and the observer, the more its light is shifted toward the low-energy (red) end of the spectrum.

A redshift from the interaction of photons with atoms in the galactic and intergalactic media was previously denied: Most scientists are accustomed to thinking that when photons interact with the medium through which they pass, losing some energy in the process, some significant angular dispersion of the photons must result. Most of the light from other galaxies, they say, cannot undergo any appreciable interaction with the intervening medium, because the resulting angular dispersion would cause their images to become blurred, and our images of other galaxies are, indeed, not blurred.

The usual explanation of how light travels through gases, however, is inconsistent and incomplete. Physicists understand that when a beam of light passes through the atmosphere, a fraction of the photons interacts with the medium and loses energy to it, undergoing angular dispersion. This is known as Rayleigh scattering after British physicist John Rayleigh. Most physicists assume that the rest of the light, which suffers no dispersion, passes through the medium without interaction. Given the density of the atoms and molecules of the atmosphere, however, this is clearly impossible.

A more sensible conclusion is that most interactions involve an atom or molecule absorbing a photon and reemitting it in the forward direction. We shall see that these interactions are inelastic; that is, the reemitted photons have lost some of the original energy to the atom or molecule, and hence their wavelengths are longer (redder) (Marmet 1988); (Marmet and Reber (1989). The familiar concept of the index of refraction exposes the problem to view.

The velocity of light (group velocity) is reduced in gases, relative to its velocity in a vacuum, as expressed by the index of refraction. The derivation of the index of refraction assumes that matter is homogenous and that one neglects the existence of individual atoms. The reduced velocity applies to all of the light. At atmospheric pressure, one does not easily notice this reduced speed of propagation in air, precisely because almost all photons are transmitted without angular dispersion (scattering).

At a distance of 100 meters, for example, it is everyday experience that light is transmitted through calm air without any noticeable angular dispersion and does not produce any visible fuzziness - even when images are observed through a telescope. The index of refraction of air (n=1.0003) shows that interactions or collisions of photons on air molecules are such that the photons are delayed by 3 centimeter in a trajectory of 100 meters, with respect to transmission in a vacuum (see Figure 1). Only that small delay of 3 cm can be explained by a large number of photon-molecule collisions.

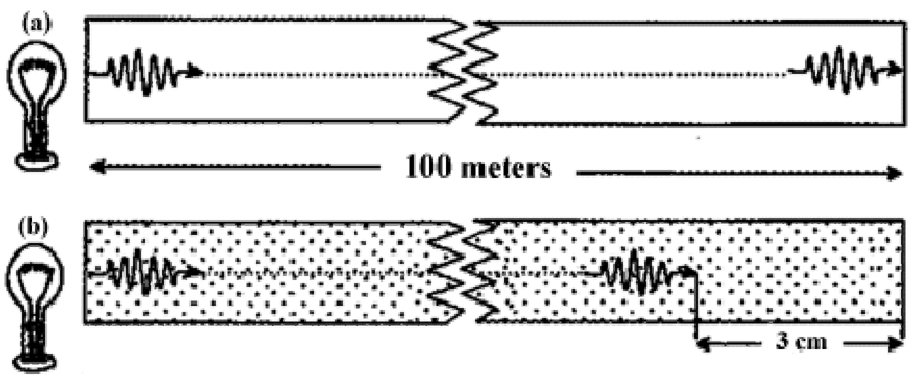


Figure 1

MOST PHOTONS DO NOT UNDERGO ANGULAR DISPERSION WHEN THEY INTERACT WITH MOLECULES.

Light transmitted through air is slowed by its interaction with air molecules. In the same time, that light traverses 100 meters in a vacuum (a), it traverses only 99.97 meters in air (b). This is expressed in the index of refraction for air, 1.0003. Many photon-molecule interactions are required to explain such a long delay. Since an object seen at 100 meters is not fuzzy, one must conclude that these photon-molecule interactions do not lead to angular dispersion of most of the light, although this is still the common assumption. In fact, the photons must be reemitted from such interactions in the forward direction.

A delay of 3 cm corresponds to about one billion the size of the atom. Therefore we can be sure that not only all photons had more than one interaction with air molecules, but that it must take on the order of one billion collisions to produce such a delay. The photons have undergone about one billion collisions with air molecules without any significant angular dispersion, because the image is not fuzzy. Photon-molecule collision without angular dispersion is an everyday experience that has been completely overlooked.

In space, where the gas density is lower by more than 20 orders of magnitude, the same phenomenon takes place. A photon undergoes about one interaction (due to the index of refraction, with no angular dispersion) per week.; Rayleigh scattering producing diffusion in all directions, is enormously less frequent just as in the atmosphere. Hence, almost all interactions of photons with gas molecules take place without any measurable angular dispersion.

5 --- The Consequences of these Interactions.

What then are the consequences of these interactions? It is necessary to examine the character of photon collisions with individual atoms. We have just seen above that the collisions produce a delay in the transmission of light; Therefore, there is a finite interval of time during which the photons is absorbed before being reemitted.

An atom is polarized, in a transverse direction, by the passage of electromagnetic waves (photons) moving across it. The positively charged nucleus is attracted on one direction while the negatively charge surrounding electrons cloud is attracted in the other. In this field, at least a part of the energy of the electromagnetic wave is transmitted, in the axial direction, to the electron of the atom. This is called a polarized atom (with an energy of polarization). The momentum[6] of this transferred energy necessarily gives an acceleration to the electron, causing a secondary photon to be emitted, a phenomenon known as *bremsstrahlung* (braking radiation) (see Figure 2).

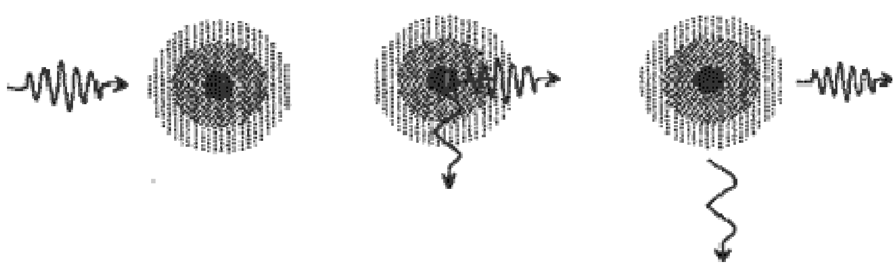
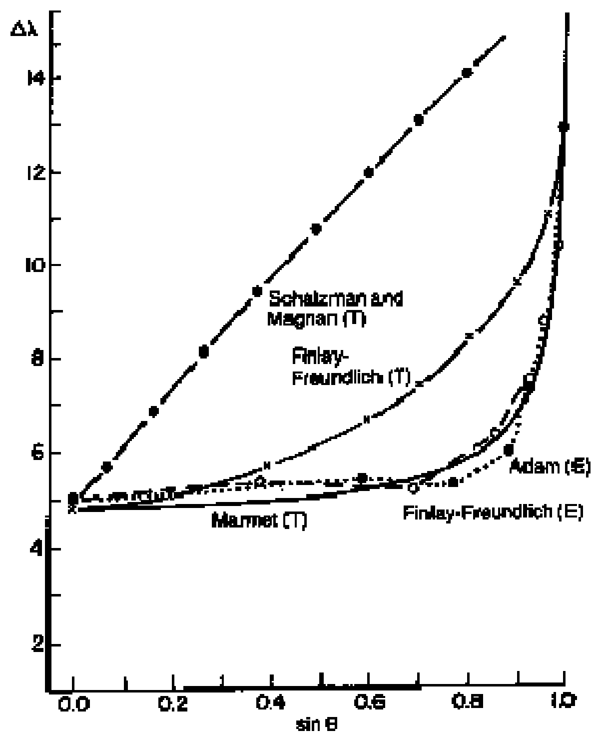


Figure 2
PHOTONS ALWAYS LOSE ENERGY INTERACTING WITH ATOMS.

It is a very rare physicist who recognizes that photons must always lose energy in interacting with atoms and molecules. The author demonstrates the truth of this assertion however in 1980, using semi classical electrodynamics to explain and calculate the energy loss. In the diagram, a photon is being absorbed and reemitted in the forward direction by an atom, which emits at least one very soft (long-wavelength) secondary photon in the process.

It has been calculated that under ordinary conditions, the energy loss per collision is about 10^{-13} of the energy of the incoming photon (Marmet 1988). Hence the phenomenon produces a redshift that follows the same rule as the Doppler effect: Whatever the wavelength emitted by the source, the relative change of wavelength is constant ($\Delta\lambda/\lambda$ =constant). The secondary photon (*bremsstrahlung photon*), which carries away the lost energy, has a wavelength several thousand kilometers long. Because the longest wavelength observed so far in radio astronomy is 144 meters (Reber 1968, 1977), these secondary photons of very long wavelength cannot yet be detected. They are, however, predicted by electrodynamics theory.



CAPTION OF FIGURE 3

Marmet's photon-atom interaction theory mentioned above is the only "non ad-hoc" explanation predicting the amount and the rate of change of the solar redshift (solid line labeled Marmet). The experimentally determined redshift on the solar disk, moving from the disk's center (Sin θ =0) to its limb (Sin θ =1.0), is shown in the dotted and dashed curves. Observational values of Adam (1948) and Finlay-Freundlich (1954). The redshift is given in wavelength units of 10^{-13} meters on the y-axis. Other theories that attempt to explain this redshift as a Doppler effect produces the two upper curves: Schatzman and Magnan (1975), motion of gas in the solar granules) and Finlay-Freundlich (1954), motion in the photosphere and chromosphere). Allowances has been made for the differential Doppler shift arising from the Sun's rotation.

The conclusion that interactions of photons with atoms must *always* result in the production of secondary photons has been derived from quantum electrodynamics (Jauch and Rohlich 1980); Bethe and Salpeter (1957), and was independently derived by this author from classical electrodynamics (Marmet 1988). However, only the last-mentioned study was able to predict the amount of energy lost in the process.

6 --- Experimental Confirmation.

Experimental confirmation of the theory of the redshift developed here has been achieved in several instances, with observations of the Sun (Marmet 1989), binary stars, and other cases (Marmet 1988a; Marmet and Reber 1989). Perhaps the most dramatic of these confirmations is in the case of the Sun, where the theory has been applied to the redshift anomaly associated with the solar chromosphere. When spectroscopic measurements are made of light from the center of the Sun's disk and compared with those from the limb (edge of the disk), the latter are found to be redshifted with respect to the former - Above and beyond the Doppler shift that arise from the Sun's rotation. This anomaly was first reported in 1907, and has been confirmed by all experts in the field.

Attempts have been made to explain this redshift as a Doppler effect on the basis of the motion of masses of gas in the photosphere and chromosphere, or such motions in the solar granules (convection cells). The inadequate predictive power of these hypotheses can be seen in Figure 3. The figure shows the observed amount of the redshift as a function of the position between the center of the redshift as a function of position between the center of the Sun's disk and the limb, and compares this observed curve to the curves required by two of these theories.

If, however, the redshift arises from the increasing number of photon-atom interactions between source and observer as the spectroscope sample positions nearer the limb (Figure 4), the theory developed here applies, and provides an accurate prediction of the observed curve) Figure 3). The theory is also successful in explaining the absence of redshifting for several spectral lines in terms of their known origin in very high layers of the Sun, and in explaining a stronger redshift for the iron line at 5,250 angstroms in terms of its known origin in a deeper layer.

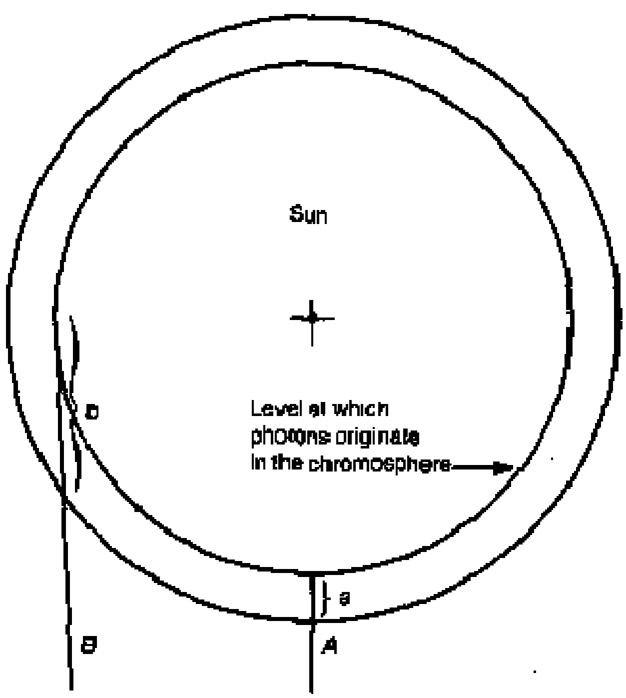
7 --- Is there Enough Matter in Space?

Is there enough matter in space to account for the observed redshift in terms of the theory offered here? An average concentration of about 0.01 atom/cm^3 is required to produce the observed redshift, as given by the Hubble constant (Marmet 1988b). This required density of matter in space is larger than what has been measured experimentally until presently, but our ability to detect such matter is still very imperfect. Almost all of our methods of detection are selective and can detect only one kind of matter. Most methods use spectroscopy to detect radiation emitted or absorbed by the matter. There are strong reasons for thinking that there is much more matter in space than has been observed.

Although atomic hydrogen is found extensively in space and can be detected by the emission and absorption of its characteristic radiowaves of 12-

cm wavelength, it is likely that cold atomic hydrogen condenses to the molecular form (H_2), which must be also present extensively in space. Cold molecular hydrogen and helium, however, are undetectable at visible or radio wavelengths. Since molecular hydrogen (H_2) has no permanent electric dipole(7), it does not easily emit or absorb radiation. Most excited molecules emit photons in about 10^{-8} second. However, the spontaneous emission of the first rotational state of molecular hydrogen is practically nonexistent (rotational states are different molecular energy levels) even after many thousands of years. A transition (by spontaneous emission) from the second rotational state of molecular hydrogen is relatively much more probable but would require about 30 billion seconds (about 1,000 years). That is about 18 orders of magnitude less probable than an ordinary dipole transition. At the sixth rotational state the quantum transition still takes as much as one year.

The extreme rarity of these "forbidden" transitions means that one cannot hope to detect molecular hydrogen spectroscopically. Only in the far ultraviolet portion of the spectrum can some molecular hydrogen be detected in the neighborhood of ultraviolet-emitting stars. Because of its nature, molecular hydrogen is very likely extremely abundant in space - but not detectable with methods now available.



Caption of Figure 4
Application of the Photon-Atom Interaction Theory to the Solar Redshift.
Light observed at the center of the solar disk along line of sight A, passes through an amount of solar atmosphere represented by "a". Light observed at the solar limb along line of sight B passes through a much larger amount of solar atmosphere represented by "b". (A and B converge at the observer). Hence the photon-atom interaction theory predicts an increasing redshift toward the limb.

There are other indications of large amounts of invisible matter in the universe. For example, it has been unexpectedly discovered that the matter in galaxies may extend to as much as 10 times the radius of its visible component. This possibility arises from the study of differential rotational velocity of the matter in galaxies. From the laws of orbital motion, we expect the orbital velocity of matter (in kilometers per second, for example) to fall off as the square of the total mass enclosed within the orbit. In other words, in moving from a galaxy's nucleus to its periphery, we expect to encounter ever lower velocities, just as in the solar system the outer planets move more slowly. Instead, it has been found that the velocity remains roughly constant. The conclusion drawn from this apparent deviation from the laws of motion is that there must be an important amount of invisible matter in galaxies, comprising as much as 90 to 99 percent of the whole (Rubin 1983, 1988). It is reasonable to expect that a still much larger amount of invisible matter lies farther out, *around* galaxies.

The Big Bang model suffers from crucial failures that are becoming increasingly serious with continuing progress in astronomical observations. These observations, however, are consistent with a universe that is *unlimited in time and space*. The density of matter that may exist in intergalactic space - allowing for molecular hydrogen - is compatible with the density (about 0.01 atom/cm^3) required in the author's cosmological model. At the same time, the background radiation predicted in an unlimited universe is compatible with the high homogeneity of the observed 3 K background (Marmet 1988).It is clear that God did not limit Himself to a finite universe at one time and place, but made the universe in His own image, infinite in space and time.

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About the Author.

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9 --- Notes:

(1)---
The wavelength of radiation observed is longer (redshifted) than the wavelength emitted when it comes from a source that is moving away from the observer, a discovery made by J. C. Doppler in 1842. Likewise, the wavelength observed becomes shorter (blueshifted) when the object is approaching the observer. The redshift of light from remote galaxies is usually interpreted as being caused by the relative motion of these galaxies away from

our own, in an expanding universe.
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(2) ---
"3 K" means a temperature of 3 degrees on the absolute scale (Kelvin), 3 K is equal to -270 degrees Celsius. All bodies emit electromagnetic radiation in accord with their temperature. For example, a hot filament emits visible light. At 3 K, the electromagnetic radiation emitted is in the microwave range with a wavelength of about 1 mm. The "3 K background radiation" is the radiation observed from all directions in the universe that has the same wavelength distribution as that emitted by a blackbody at a temperature of 3 K.
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(3) ---
When a hot blackbody emits electromagnetic radiation, it emits the range of frequencies at varying rates described by a curve known as the Planck function. Using this function, one can predict the distribution of wavelengths and rates emitted by any blackbody if one knows its temperature. If the surface is not black (such as gray, semitransparent or a mirror) the rates emitted are different.
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(4) ---
In the Big Bang theory, matter flows away from the observer at a velocity that depends on its distance from him. Since the rate of change of his assumed velocity was originally determined from Hubble's observations, the supposed recessional flow of matter in the Universe has been called the Hubble flow.
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(5) ---
Cosmological constant is a force term introduced by Einstein into his field equations to permit static, homogenous, isotropic model of the universe.
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(6) ---
The momentum of a particle is the product of its mass and its velocity. During the interaction (collision) of two particles, total momentum is conserved.
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(7)---
Some molecules, like the water molecule H_2O, have naturally distorted electron shells. They are naturally polarized without the presence of an external electric field, and are said to have permanent dipole.
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