Chapter

Model of an Evolving and Dynamic Universe: Creation without a Big Bang

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Abstract

This chapter describes a non-relativistic, dynamic universe that *evolves* through continuous transformations of energy forms in contradistinction to a *devolving* Big Bang model. The new cosmology is accurately consistent with Hubble's galactic redshifts, interpreted as simple Doppler shifts of fleeing galaxies, and as viewed from any arbitrary observer in the universe. It postulates the existence of repulsive electromagnetic (EM) force fields between galaxies, while maintaining the purely gravitational dynamics within each galaxy. Observed cosmic redshifts of galaxies and their apparent velocities and accelerations are matched, if galactic cores are assumed to have an unbalanced electric charge of 3×10^{32} C for an average galaxy with a mass of 4×10^{41} kg. Valid arguments are presented for the probable existence of intergalactic EM fields emanating from Supermassive Black Holes (SMBHs) in galactic cores. Special sections in this chapter are devoted: (a) to suggest plausible sources of new matter creation, (b) to discuss how Quasi-stellar Objects (QSOs or Quasars) can fit into this cosmological model, and (c) to counter critiques of the model.

Keywords: cosmology, expanding universe, gravitational fields, intergalactic EM fields, supermassive black holes, galactic redshift, continuous cosmic renewal, age of universe, Hubble's Law, quasars, QSOs, galactic dynamics, cosmic dynamics, globular clusters, baby galaxies, active galactic nuclei, AGN, Kerr-Newman black holes

1. Introduction

Making use of the high resolving power of the 100-inch telescope at the Mt. Wilson Observatory, Edwin Hubble discovered in 1929 that many so-called nebulae were not relatively close accumulations of gas and dust, but were in fact huge systems of billions[1] of stars located at distances far outside of our own Milky Way star system. He also found that light from these *Galaxies* was redshifted in a linear relationship with their distance. This led to two distinct cosmological theories describing an expanding universe populated by billions of galaxies: First, a *Big Bang* model as proposed by Georges Lemaître and Willem de Sitter in 1930/1931, a universe that explosively expanded from a *singularity* of infinitely high energy

[1]Throughout this text, the word *billion* is considered to be equal to 10^9.

density, and which continues to unfurl on its own without further energy input; Second, a *Quasi-Steady State* theory that relies on new hydrogen being continuously created in intergalactic space, as proposed in 1948 by Fred Hoyle, a universe that could have existed forever. The two theories were accepted as being plausible alternative cosmologies for over three decades. In 1964, radio astronomers Arno Penzias and Robert Woodrow Wilson succeeded in measuring an isotropic microwave background temperature of intergalactic space as being 3.5 K [1]. The new measurements were interpreted as evidence for the afterglow of a hot early universe, in support of the Big Bang theory and as evidence against any rival steady-state theory. Yet, other explanations for the presence of this cosmic microwave background do exist, as discussed in Section 9. Since the late 1960s, the Big Bang theory has been considered the only viable cosmology. In more recent times, however, more deficiencies in the Big Bang scenario have come to light, and it seems prudent to reconsider alternative models of the universe. The author strongly believes that Quasi-Steady models were dismissed in error and need to be revisited.

The present model describes a dynamic, evolutional universe, in which matter is continually created and dissolved back into non-material energy forms in an ongoing cyclic process. It may have existed forever, or it could have evolved in a gradual process over eons of time. Hubble's [2] galactic redshift is interpreted as a recession of galaxies, propelled by an EM force field acting between galaxies. Stars within galaxies are not affected. In this model, new matter is continuously created in intergalactic space and/or is recycled from matter previously swallowed up by SMBHs, so as to keep the population density of galaxies approximately constant as the universe ages [3].[2] Unlike the process proposed by Hoyle [4], it does not depend on intergalactic gas pressure to drive galaxies apart. The present model may be considered analogous to a Friedmann [5], de Sitter [6] universe with a non-zero cosmological constant Λ. Here we interpret the observed galactic redshifts as simple Doppler shifts, and Hubble's constant is taken as H = 74 km/s per megaparsec.

Stellar evolution within galaxies is quite well understood. Stars continually condense from gases and dust, known to be present in the galactic disc. This matter consists of primordial hydrogen, existing since the genesis of a galaxy, and also of matter more recently ejected cataclysmically from nova and supernova explosions. Life cycles of most stars last from 1 to 20 billion years until their nuclear fuel is exhausted. During their relatively short life spans they slowly spiral toward the galactic center, where they are absorbed into a monster SMBH. It is projected here that star systems evolve into brilliant galaxies, containing typically 10^{11} stars, and then slowly blink out after devolving into burned out cinders that may be referred to as naked SMBHs. The process of accumulating all or most of the galactic mass into a central SMBH may take as much as 100 billion years, or longer.

QSOs may be nascent new baby galaxies forming around *condensed* black-hole matter ejected from SMBHs when these become unstable.[3] They may also be burned-out cinders of extinct galaxies. We thus expect to find quasars at all distances in the cosmos, not just at *cosmological* distances. Note that spectral emission lines from most quasars clearly show evidence of C, O, N, S, Al, Si, and Fe. These should not have been present during initial periods in a Big Bang scenario. Many QSOs appear to be clearly associated with mature galaxies that are less than a billion light years away. Halton Arp [7] has made a lifelong study of QSOs, and he ascribes their large spectral redshift to an *intrinsic redshift* in addition to their Doppler shift.

[2]Core elements of this model have previously been derived and presented in Ref. 3. The present version contains additional arguments and evidence in favor of the theory.

[3]See discussion in Section 11.

Here we postulate that SMBHs at galactic centers display a diminutive electric charge, accounting for intergalactic EM fields that drive galaxies apart. Because stars within galaxies are electrically neutral, they remain gravitationally bound within their galaxy in the traditional manner. The present theory is offered with similar sentiments as those expressed by plasma physicist Hannes Alfvén: [8] "*Instead of searching for new laws of physics, we should be trying to find out how to use the ones we already know*."

2. Cosmic dynamics

In the following analysis, we will avoid relativistic formulae, so as to circumvent unnecessary complexity. The author believes that a valid description of the cosmos requires an *absolute* point of view, not one that is limited by the speed of light *c* for transmission of information.[4] Consider a universe containing a uniform, quasi-steady population of *n* galaxies per unit volume. As the space between fleeing galaxies increases, new galaxies form to maintain a comparable galactic number density n. We select an arbitrary center *C* to serve as reference point. Consider now a typical galaxy of mass *M* and core charge *q*, lying on the surface of an arbitrary spherical boundary at a distance *r* from center *C* (**Figure 1**).

For analyzing the motion of this galaxy, we label the volume enclosed by the spherical boundary as Region I, everything outside as Region II. Because of symmetry and because gravitational and electric forces fall off inversely with the square of distance, the cumulative electrical repulsive force F_E on the sample galaxy from all galaxies in Region I and the gravitational attraction force F_G to all galaxies in Region I are the same as if all those galaxies were concentrated at center C. Cumulative gravitational and electric forces on the sample galaxy from Region II outside of the reference sphere cancel out to zero because of symmetry. The electric and gravitational forces are then given by:

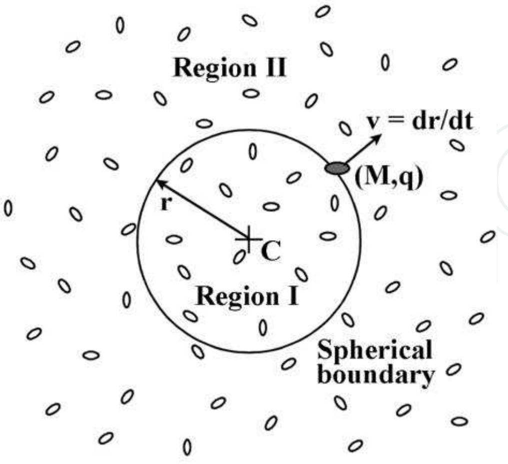

Figure 1.
Division of universe into Region I and Region II to facilitate analysis. This figure has been previously published in: Ref. [3] (http://www.physicsessays.org/browse-journal-2/product/1532-26-dietmar-e-rothe-the-case-for-a-gentler-bang-a-cosmology-of-gradual-creation.html). It is reprinted with permission of Physics Essays Publication.

[4]For spiritually inclined readers, *God* is omnipresent in all that exists. Hence the entire universe remains in his/her/its consciousness at every moment.

$$F_E = \frac{q}{4\pi\varepsilon_0 r^2}\left(\frac{4}{3}\pi r^3 nq\right) = \frac{nq^2 r}{3\varepsilon_0}, \tag{1}$$

and

$$F_G = -\frac{GM}{r^2}\left(\frac{4}{3}\pi r^3 nM\right) = -\frac{4\pi nGM^2 r}{3}, \tag{2}$$

where ε_0 is the electric permittivity of space and G is the universal gravitational constant. Assuming the electric repulsion dominates over the gravitational attraction, the sample galaxy is subjected to a net force F and acceleration directed away from the reference center.

The net force per unit mass on the sample galaxy is then

$$\frac{F}{M} = \frac{n}{3}\left(\frac{q^2}{\varepsilon_0 M} - 4\pi GM\right)r. \tag{3}$$

At time t, the net repulsive force is assumed to have imparted a velocity v = dr/dt to the sample galaxy. From Newton's second law of motion and Eq. (3), we write

$$\frac{F}{M} = \frac{dv}{dt} = v\frac{dv}{dr} = H^2 r, \tag{4}$$

where

$$H = \sqrt{\frac{n}{3}\left(\frac{q^2}{\varepsilon_0 M} - 4\pi GM\right)}. \tag{5}$$

Solving differential Eq. (4) and applying the boundary condition that v = 0 when we shrink the arbitrary reference sphere to zero, we find

$$v = Hr. \tag{6}$$

This is Hubble's Law, consistent with observation. The parameters contributing to Hubble's constant are given by Eq. (5). Solving this equation for the galactic charge required to account for the observed cosmic expansion, we find

$$q = \pm\sqrt{M\varepsilon_0\left(\frac{3H^2}{n} + 4\pi GM\right)}. \tag{7}$$

Note that both, velocity and acceleration of galaxies are proportional to r. This naturally indicates that the flight of galaxies has always been accelerating. Evidence to that effect was first reported in 1998 by Schwarzschild [9], giving rise to the need for *dark energy* in the Big Bang model.

Assuming 2.4×10^{11} galaxies exist within a radius of 14.25 Gpc, we derive an average galactic number density of n = 6.7×10^{-70} galaxies per m^3. Taking the average mass of a galaxy as M = 4×10^{41} kg and Hubble's constant as H = 2.4×10^{-18} s^{-1}, we obtain $q = \pm 3 \times 10^{32}$ coulombs per galaxy, which works out to one elementary charge, i.e. one extra proton or electron for every 1.3×10^{17} atomic mass units (nucleons) in the galaxy. We only need such a slight deviation from neutrality because electric repulsion between protons is over 10^{36} times stronger than gravitational attraction between nucleons. The minimum electric charge necessary to balance gravitation is approximately one elementary charge for every 10^{18} nucleons.

It is generally taken for granted that the number of positively charged subatomic particles in the universe is exactly balanced by an equal number of negatively charged particles, although this assumption may be challenged. So, we need to explain how SMBHs can become electrically charged. First, it is possible that charge may not be conserved in the extremely compressed state of matter inside a black hole. Second, charges may become irretrievably separated during the accretion process onto a rapidly spinning SMBH in the presence of strong magnetic fields. We only need a minute imbalance in charge, and hence only a minute preference for particles of different charge and mass to be captured. If it is slightly more probable for protons to enter the SMBH horizon than for electrons, then a net positive charge would accumulate inside the event horizon and a net negative charge outside.

In a paper by Price and Thorne [10], they verified analytically that a black hole's event horizon can be considered an electrically conducting membrane with a resistivity of 377 ohm, the dynamic impedance of space, $Z_0 = \sqrt{\mu_0/\varepsilon_0}$, where μ_0 is the magnetic permeability of *empty* space. Such a conductive event horizon can easily shield the internal charge from outside view by induced electric currents in the conducting event horizon, so that externally the SMBH appears to be negatively charged.

3. Continuous renewal process

In the above derivations the number density n of galaxies in space has been assumed to be independent of time. In an *expanding* universe, this condition requires new matter to enter physical space between galaxies on a continuing basis. Note that the present model does not require space itself to expand, even though that idea, if true, could easily be incorporated into the model. New matter then condenses into new galaxies. In our model, we can estimate what the influx of new, or recycled, matter energy per unit volume of space would need to be. Consider Region I in **Figure 1** to contain N galaxies within the spherical volume V. The rate of expansion of this hypothetical spherical volume is then given by

$$\frac{dV}{dt} = 4\pi r^2 \frac{dr}{dt} = 4\pi H r^3. \tag{8}$$

The number of new galaxies needed per unit volume per unit time is:

$$\left(\frac{1}{V}\right)\frac{dN}{dt} = \left(\frac{n}{V}\right)\frac{dV}{dt} = 3nH = 4.82 \times 10^{-87} \text{ galaxies m}^{-3}\text{s}^{-1}. \tag{9}$$

This corresponds to only one new proton per cubic meter every 30 billion years, or one solar-mass star per mega-parsec cubed every year. Continuous creation of new matter takes place most slowly. Similarly, the rate of acceleration in the cosmic expansion, driven by new matter energy, is only $H^2 r$ as given by Eq. (4), where $H^2 = 1.77 \times 10^{-16}$ km/s^2 per mega-parsec.

Formation of new matter may occur in different ways:

1. Subatomic particles may arise out of the stressed quantum vacuum field. Protons uniting with electrons form hydrogen atoms, the basic stuff in the cosmos.

2. New matter energy bleeding into this universe from *parallel universes* has also been seriously considered by cosmologists. But that speculation is not needed for the model discussed here.

3. Alternatively, matter could be recycled by aging SMBHs, known to exist in the cores of mature galaxies. Based on observational evidence, this appears to be the most probable source.

High-velocity jets of particles, and apparently also of QSOs, shooting out of magnetic poles of active galactic nuclei (AGN) are common in the universe. These phenomena strongly imply the presence of electromagnetic fields emanating from galactic cores. When spinning SMBHs are assumed to inhabit galactic centers, most astronomers would consider that they play a central role in the evolution of QSOs, of AGNs, and of galaxies. Certain globular star clusters also seem to be possible steppingstones in the formation of *Baby Galaxies*. Entire globular star clusters, ejected at high speed from active galactic nuclei, have recently been observed. Black holes have been found in many global star clusters, and stars seem to be orbiting in an organized way around the center of star clusters. More details of these new observations are reviewed in following Sections 4 and 5.

4. QSOs, globular clusters, and baby galaxies

Relatively recent press releases by NASA/JPL-Caltech reported new observations obtained via the *Galaxy Evolution Explorer* (GALEX) satellite. The new findings took astrophysicists and cosmologists by surprise [11]. Equipped with highly sensitive UV detectors, the GALEX spacecraft was launched in 2003 to scan the heavens in search of young galaxies in their formation stage at the edge of the observable universe, more than 10 billion light years (ly) from us. Newly forming, young galaxies are about ten times brighter at ultraviolet wavelengths than mature galaxies. The unexpected discovery was that such baby galaxies have not only existed around 10 billion years ago, as per accepted cosmology, but dozens of them were found to exist relatively close to us at inferred distances ranging from 2 to 4 billion ly away, with some possibly being as young as 100 million years. The impact of this discovery to cosmologists should be huge. They may need to rethink their cosmological perspectives. As nature is able to renew itself indefinitely, the universe may also be evolving by renewing itself in an ongoing process, instead of devolving toward an ultimate entropy death.

Other new observations imply that globular star clusters and dwarf spheroidal galaxies are in an evolutionary sense related to galaxies. They may well be precursory star formations that gradually grow into those newly discovered baby galaxies mentioned above. Globular star clusters and dwarf galaxies may be found around most mature galaxies, including our Milky-Way galaxy. Spheroidal galaxies also appear to contain great amounts of dark matter, an indication of the presence of massive black holes there [12].

A similar discovery, which may revolutionize our understanding of the nature and origin of globular star clusters, shocked astrophysicists in 2014, *upsetting 40 years of theory* about these spherical star formations [13]. A team led by Prof. Tom Maccarone of Texas Tech University in collaboration with Maximilian Fabricius at the Max Planck Institute for Extraterrestrial Physics in Garching, Germany, *recently found a surprise* when new observations ascertained that stars at centers of older star clusters *rotated around a common axis instead in random orbits, as once thought*. They also found that many stars in these clusters consisted of relatively young stars, and not just of old stars as previously perceived. The Texas Tech team had been investigating globular star clusters for many years in search of intermediate size black holes. In 2007, they made the first discovery of a stellar mass black hole in a star cluster near a neighboring galaxy NGC4472. In 2012 astronomers from several universities, using the *Very Large Radio Telescope Array* found a binary black hole in the core of the M62 star cluster [14]. Since then many more black holes, containing many solar masses, have been detected in numerous extragalactic globular clusters. We may conclude that certain globular clusters can evolve into baby galaxies. We should also note that in 2014 astronomers discovered a globular star cluster of thousands of stars, near the supergiant elliptical galaxy M87 in the Virgo Cluster. This globular star cluster appears to have been ejected in its entirety from the supermassive core of M87 at a velocity of over 2000 km/s. [15] Even though M87 weighs as much as 6 trillion (10^{12}) Suns, the globular star cluster will escape the gravitational pull of its source galaxy. However, there may be another more direct alternative source for baby galaxies and QSOs, as described below.

5. QSOs born out of mature galactic cores

The first bright quasi-stellar objects were observed and recorded around 1960. All of them emit strong EM radiation from radio waves to X-rays and Gamma rays [16, 17], and all of them exhibit a high redshift in their emission spectra. If interpreted as Doppler shifts or as cosmological expansion redshifts, they appear to be receding from us at extreme speeds. As per contemporary models of the universe, this would put them far out into the cosmos, where cosmologists believe to see them as early precursors in the evolution of the first galaxies some 10 billion years ago. Cosmologists did not expect to find any QSOs nearby.

Present understanding is that QSOs are powered by SMBHs. But not until the Hubble telescope in the 1980s could detect faint traces of matter around QSOs extending approximately 10 ly out from the bright quasi-stellar objects, suggestive of galactic spiral arms, were QSOs considered *Active Galactic Nuclei* (AGNs) in young galaxies in formation.

In general,[5] AGNs are considered to consist of SMBHs containing more than a billion solar masses, surrounded by active accretion discs, where matter spirals into the black hole at relativistic speeds. It should be noted here that gravitational force gradients at the *Event Horizon* of black holes get weaker the more massive and large the SMBH is. When a black-hole mass exceeds about 200 million solar masses, stars sucked into the hole no longer get torn apart near the event horizon. They get swallowed whole. Thus, it is not clear how the accretion discs of AGNs can produce strong X-ray radiation.

Average sizes of active regions of QSOs that are brilliantly bright may typically have estimated radii of half a light year. The Schwarzschild radius ($r_S = 2GM/c^2$) of a SMBH's *event horizon*, containing 10^9 solar masses is only $r_S = 3.12 \times 10^{-4}$ light years. Hence, the visible radiation emitted from the accretion disc appears to extend to at least a thousand r_S, or to 0.31 ly from the center. Applying Newtonian/Keplerian mechanics, we find that matter orbiting an SMBH at that distance and emitting EM radiation (at $r_E = 10^3\ r_S$) has an orbital speed of $v = (GM/r_E)^{1/2} = 6710$ km/s. However, the radial velocity gradient there is only $dv/dr = 5.7 \times 10^{-13}$ km/s per meter, far too small for any thermal radiation in the visible or X-ray spectrum to be

[5]AGNs were originally believed to exist only in large mature galaxies.

produced. If there were any light emitted from the accretion disc at $r_E/r_S = 10^3$, any gravitational redshift[6] would only be $z_G = 5 \times 10^{-4}$, and it would not significantly contribute to the observed redshifts of QSOs. For gravitational redshifts to play a significant role, the radiation must then come from locations r_E closer to the event horizon than $r_E = 10r_S$ where z_G is greater than 0.054. The source for the brilliance of QSOs, which is assumed to be greater than the combined radiation from 10^{14} stars, remains an unanswered enigma, if QSOs are at cosmological distances of 4 to 10 billion light years from us.

Astrophysicists are generally at a loss to explain what the power source is that drives the immense radiative power output from a quasar. It would have to be much more efficient in converting matter energy and kinetic energy to radiation energy than nuclear fusion. One concept discussed by astrophysicists consists of a complete conversion of gravitational potential energy of matter to radiation at the edge of the SMBH. Yes, gravitational potential energy of matter falling toward a black hole is converted to kinetic energy, while also gaining relativistic mass. But what are the conditions and processes necessary to convert this energy into electromagnetic radiation? Any required non-thermal condition is not likely to be met outside of the event horizon of a SMBH. The needed compression of in-falling matter would only occur well within the black hole event horizon, wherefrom radiation cannot escape, unless perhaps the SMBH is a fast spinning, electrically charged *Kerr-Newman* black hole [18]. The enigma can however be significantly alleviated, when we consider QSOs to be much closer to home; i.e. if at least the very bright ones are a 100 times closer. If they were 100 million ly away, instead of 10 billion ly, the apparent visible area of their active nuclei would be 10,000 times smaller, and their much smaller radiative power output more explicable with conventional physics. The radius of the active region, instead of being half a light year, would be 5×10^{-3} ly and would only be approximately 10 times larger than the event horizon of the central SMBH. In that case, a matching accretion disc, mostly spinning at hyper-velocities, can easily supply the lesser radiative power output, if QSOs are much closer than previously believed. Making that assumption would vindicate astronomer Arp's hypothetical claims based on decades of meticulous and accurate observations and data. His deductions [19] include:

1. High redshift QSOs are often closely associated with lower redshift mature galaxies with active nuclei and are, therefore, at similar distances.[7]

2. QSOs are ejected at hyper-velocities from AGNs of mature galaxies.

3. High redshifts of QSOs have two component parts: the major part is based on an *Intrinsic Redshift*, in combination with a lesser Doppler shift.

4. QSOs ejected from a parent galaxy are lined up with their intrinsic redshifts decreasing with distance from their source galaxy.

5. QSOs evolve into normal galaxies over eons of time.

[6]See Eq. (14) below.

[7]For example, a high-redshift quasar is clearly in front of the low-redshift galaxy NGC 7319. Many others are connected by luminous bridges to a parent galaxy.

6. Alignment and motion of QSOs

In 1969, Morley Bell of NRC, Canada published a statistical analysis [20] of 150 QSO redshifts, which suggests that *there are groupings of QSOs extending over large areas of sky*, with the inference that *QSOs are not at cosmological distances.* This paper is significant, because it was written 21 years before the *Hubble Telescope* was launched into orbit and before newly discovered quasars were relegated to the far corners of the universe. Hence, the 150 QSOs listed at that time by Burbidge and Burbidge [21] were a select group of quasars with high apparent brightness and relatively low redshifts, indicative of their non-cosmological distances, before skies became cluttered with thousands of more recently discovered QSOs that may truly be located much farther away. Bell presented in his paper statistically significant evidence that these QSOs can be grouped according to their redshift; the groupings being evident from redshift histograms, which indicate population peaks at regular redshift intervals of 0.172 or multiples thereof. He thus sorted the redshifts into twelve groups and found within each group a linear relationship between the redshifts and their angular distance from a somewhat arbitrary group center in the sky. His most far-reaching observation, however, has been the connecting of QSOs into orderly spiral patterns, covering large areas of the sky and having redshifts either increasing or decreasing monotonically along the spirals.[8]

Bell identified each spiral group by two numbers; the first being the number of the peak in his redshift histogram, the second specifying whether the group is in the Northern Hemisphere (near 12 h right ascension) or in the Southern sky (near 0 h right ascension). The same numbering is retained here to afford easy reference to Bell's paper. From the twelve spiral groups identified by Bell, the present author has selected two such spirals, N = (2, 12 h) and N = (1a, 0 h). When considered as 3D helices instead of 2D spirals, these two are the only pair that can reasonably be connected across the galactic equator gap, where any intergalactic QSOs are obscured by the *Milky Way* galactic disc. **Figure 2** shows a plot of these two QSO spirals in a sky chart using Earth equatorial coordinates. It is essentially a copy of Bell's sky chart [Ref. [20], Fig. 9], with spiral groups other than N = (2, 12 h) omitted and with group N = (1a, 0 h) added in the Southern sky.

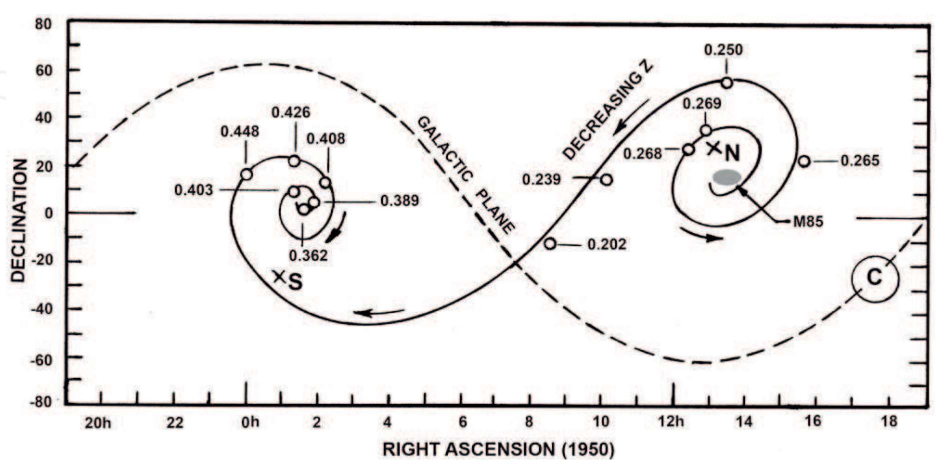

Figure 2.
QSO Spirals N = (2, 12 h) in Northern sky and N = (1a, 0 h) in Southern sky. N = Galactic North, S = Galactic South, C = Galactic Center.

[8]In the present paper the spiral groups are interpreted as 3-dimensional helices, and an intergalactic magnetic field is postulated.

In the diagram, individual QSOs are represented by small circles together with their redshifts. Note how the redshifts decrease in a counter-clockwise direction going outward from the center of the spiral in the Northern sky and then decrease in a clockwise direction toward the center of the Southern spiral. When viewed as a 3D helix, the combinations of the two spirals represent a continuous helical path spiraling in the same direction from north to south. The spiral centers are considered vanishing points as seen from an observer on Earth. The redshifts decrease in the same direction from north to south in both hemispheres. The Northern vanishing point lies in the direction of the Virgo cluster of galaxies, and is very close to the giant elliptical galaxy M85, which is known to have an active nucleus. Thus, the diagram would be consistent with the proposition that the QSOs traveling along their helical path are ejected from an AGN source, as portrayed in **Figure 3**.

The relatively large number of QSOs in the Northern sky spiral belong to a well-defined redshift group, and that spiral curve is unambiguous. Thus, there is a reasonable statistical support in favor of a causal connection between these QSOs. From **Figure 2** it is clear that the QSOs could not have been ejected from the center of our local Milky Way Galaxy. Assuming that the helical path conjecture is correct, this helical path must have intergalactic dimensions, as shown in **Figure 3**. Our entire Milky Way galaxy then lies within the helix, though not on its central axis.

Gravitational and other central fields cannot put moving objects on a helical trajectory. Alternatively, helical trajectories are a common occurrence in magneto-plasma physics, where ions and electrons are found to spiral around magnetic field lines along helical paths. We know that strong magnetic fields are created by AGNs that enable and guide material to be ejected as hyper-velocity jets from their magnetic poles. Sources of these intergalactic magnetic fields can easily be identified and understood, if rapidly rotating SMBHs are present in galactic cores and QSOs, and if their *event horizons* display an electric charge.[9] Thus, electrically charged QSOs fit well into the author's theory presented here. To complete the picture shown in **Figure 3**, the QSOs shown have probably been ejected from a source galaxy (AGN) that is also the source of the magnetic field; i.e. the major velocity vector of the QSOs must be aligned with the magnetic field lines, with a minor transverse velocity component to produce the helical trajectory.

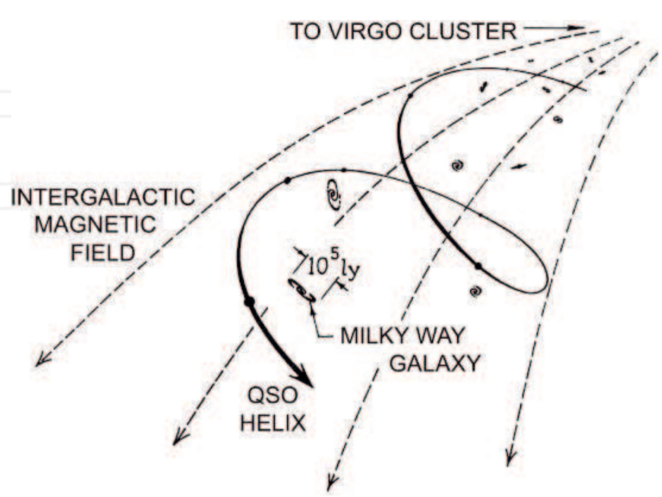

Figure 3.
Helix of electrically charged QSOs within an intergalactic magnetic field originating in the Virgo Cluster of galaxies.

[9]See Section 2: *Cosmic Dynamics*.

According to Hubble's Law, distances of QSOs in the Northern sky in **Figure 2**, as derived from their redshifts, are approximately 3 billion ly from us, whereas in the Southern sky QSOs would be twice as far. Thus, the two groups of quasars could not possibly be connected in any way by their Doppler shifts alone. However, if we accept Arp's suggestion that redshifts of quasars are partly intrinsic and partly Doppler shifts, we can make a case for the two QSO groups being indeed related. From Earth's viewpoint the northern QSOs are approaching us and the ones in the Southern Hemisphere are receding from us. Let the redshift of the approaching ones be z_A and that of the receding ones be z_R. Then we can write the following relations:

$$z_A = z_I - z_V \simeq 0.24 \tag{10}$$

and

$$z_R = z_I + z_V \simeq 0.46, \tag{11}$$

where z_I is the intrinsic redshift and z_V is the redshift due to velocity. By adding and subtracting Eqs. 10 and 11 we get:

$$z_I = \frac{z_R + z_A}{2} \simeq 0.35 \tag{12}$$

and

$$z_V = \frac{z_R - z_A}{2} \simeq 0.12. \tag{13}$$

To an approximate degree this would mean that the speed v of the QSOs along their helical trajectory is around 36,000 km/s, and that 74% of the observed redshift is due to an intrinsic redshift at their closest approach to our galaxy. These numbers are quite consistent with claims made in the author's theory and also with Arp's conjectures. The intrinsic redshifts are consistent with gravitational redshifts for radiation coming from areas close to SMBHs. A back-of-the-envelope analysis to this is given hereunder:

What are typical distances of the QSOs studied?

If the source of QSOs is the AGN galaxy M85, their distances must be less than 60 million ly, the distance to M85. The large geometrical patterns in the sky by the helical trajectory suggest that at closest approach to our galaxy the radius of the helix may be of the order of a million ly. An average geometric mean of the QSO distances may be 8 million ly. By comparison with the generally accepted distance of 3 billion ly, based on a redshift of 0.24, these QSOs may on the average be 400 times closer.

What is the actual size of the active region?

Statistical size estimates of active nuclei in quasars, when at cosmological distances, seem to be at approximately 1 ly in diameter. The corresponding radius of the active region at the closer distance would be 1.2×10^{-3} ly.

What is the expected intrinsic gravitational redshift?

The redshift of light escaping from close to the event horizon of a Schwarzschild black hole is,

$$z_G = \frac{1}{\sqrt{1 - r_S/r_E}} - 1, \tag{14}$$

where r_S is the radius of the black hole and r_E is the radius of the source of the escaping radiation. To explain a gravitational redshift of $z_G = z_I = 0.35$ as calculated in Eq. 12 for a typical QSO, we need r_S/r_E to be 0.45, or $r_E/r_S = 2.22$. The Schwarzschild radius of a 1 billion solar mass black hole is 3.1×10^{-4} ly. A fast spinning, charged Kerr-Newman hole of that mass may have an equatorial radius of $r_S = 6 \times 10^{-4}$ ly. Observed radius of the active region of typical QSO at the closer distance is $r_E = 12 \times 10^{-4}$ (see above). We then have $r_E/r_S = 2.0$ as required to show that the intrinsic redshift of 0.35 can easily be explained as a gravitational redshift.

7. Minimum age of the universe

The theory discussed here does not explain how the present structure of the universe came into being. It may have been in existence forever, or it started from a small mini-universe some 200 billion years ago. Arguments that have been presented here essentially describe a dynamic universe that has perhaps existed for an unimaginably longer time than the estimated age of the Big Bang universe. If the universe evolved from a simple beginning, we first need to define how large an initial volume was needed to define a process of expansion that could keep evolving in a systematic manner as described in Section 2. Similarly, we would need to know how large the universe really is now. Defining the radius R_O of the *Observable Universe* by the edge at which the fleeing galaxies reach the speed of light, the extent of this universe, as we observe it, is given by $R_O = c/H = 13.2 \times 10^9$ ly. But we see these farthest observable galaxies where they were 13.2 billion years ago. By the time light from galaxies at the observable edge of the cosmos reaches us, they are now approximately $R_K = 40 \times 10^9$ ly from us. Let R_K be the radius of the *Known Universe*. For obtaining a minimum age of the universe, according to the present theory, a certain minimum original size is needed for Eqs. 4 and 6 to be meaningful, and for H to be approximately constant at its present value.

In Ref. [3] the author has made an analysis for estimating a time period needed for an initial *mini-universe* to evolve into the present state of our universe. He assumed an initial mini-universe consisting of a spherical volume of 1.7×10^{13} ly^3, having radius $r_I = 13{,}000$ ly at time t_I, and containing 20 globular star clusters with electrically charged central black holes.[10] Such a mini-universe may already be quite old, given the time needed for stars to form and to collapse into black holes. Using formulas from Section 2, it can be shown that

$$t_U - t_I = \frac{1}{H}\ln\left(R_K/r_I\right) = 200 \times 10^9 years, \tag{15}$$

where t_U is the present time.

The age of the universe is thus more than 2×10^{11} years. If the *Actual Universe* extends beyond the *Known Universe*, then it would be much older.

8. Expanding space or fleeing galaxies?

The author's mathematics have assumed that n and H are not functions of time. They implicitly assumed that galaxies move through an existing stationary space (Situation A). If the cosmic expansion is one of space itself that carries galaxies with

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[10]Evidence of black holes in globular star clusters has been accumulating since 2007 (see Section 4). Additional evidence shows that certain star clusters can evolve into galaxies.

it (Situation B), most of the above arguments would still stand. But what we mean by the *Observable Universe* and the *Knowable Universe* would be different. In an Einsteinian situation B universe, in which the speed of light is an absolute limit,[11] galaxies nevertheless moving away faster than c, could not be observed, because EM signals could never reach us. Even if they could, their redshifted photons would have lost all their energy, dissipating themselves. In a *Maxwellian* situation B universe, EM waves from faster-than-light moving galaxies would also never reach us. In a *Maxwellian* situation A universe, however, EM waves from faster-than-light galaxies moving through a stationary space would eventually reach us, and their Doppler frequencies would appear to be less than half their emitted frequencies (more than twice their normal wavelengths).

As of this date the farthest galaxy detected has a redshift of z = 11. In a linear system obeying Hubble's Law (v_{GAL} = Hr = zc), this galaxy is receding from us at a speed of 11 times the speed of light. It was at a distance r_0 of 1.45×10^{11} ly from us when at time t_0 it emitted the light we are receiving now. This light took 145 billion years to get to us $(\Delta t = t_{NOW} - t_0)$. According to Eq. (15),

$$R_{NOW} = r_0 e^{H\Delta t}. \tag{16}$$

This places the galaxy at $R_{NOW} = 8.6 \times 10^{15}$ ly away from us. In a non-relativistic cosmos, the present theory predicts a much older and larger universe than the Big Bang Theory.

The current version of the Big Bang Theory (BBT), augmented with Einstein's General Relativity Theory, attributes the cosmological redshift to the expansion of space itself, which stretches EM waves passing through it. In this theory, the speed of light is never exceeded by the receding galaxies, even as their redshift z goes to infinity. Hence, according to the BBT, the Observable Universe is limited in size to a radius of R_{OBS} = 13.8 Gly, and the *knowable* edge of the universe is limited to R_K = 46 Gly. We note that a space that warps and stretches cannot be a total void, in contradistinction to basic assumptions made in the Special Theory of Relativity. A vacuum space that can warp is equivalent to the contentious and disparaged *luminiferous aether*, assumed to be necessary by Maxwell for propagation of EM waves. Post-modern Quantum Physics recognizes vacuum space as a zero-point, high-energy field and not as a total void. The last word regarding the validity of any cosmological model has to await future discoveries in our understanding of basic reality; discoveries about the nature of space, time, mass, and electric charge.

9. Answers to critiques of the cosmology presented

Critique 1: Steady State universe models have been proven wrong.

Answer: Firstly, the cosmology presented here is anything but static. The universe is shown to be highly dynamic and evolving. Secondly, it cannot be considered wrong just because it is incompatible with the BBT. It should be noted that *quasi-steady state theories* rest on fewer *a priori* assumptions than the BBT. Moreover, they can match most observations with few, if any, adjustable parameters, whereas the BBT critically relies on a growing number of them. Astrophysicist and cosmologist Tom van Flandern [22] has made a list of *The Top 30 Problems with the Big Bang*, a theory which needs introduction of new concepts and new adjustable parameters to make it more compatible with any new observations. Quasi-steady

[11] By definition a contradiction in *relativistic* theories.

state universe models have been mistakenly abandoned on observational data that can be interpreted in alternative ways. See further discussion below.

Critique 2: The theory cannot explain the cosmic microwave background radiation (CMB).

Answer: The CMB discovered in 1964 corresponds to a uniform isotropic background temperature of space of 2.7 K. It was heralded as clear proof that the BBT is the most realistic cosmology. But as Van Flandern states, *the CMB makes more sense as the limiting temperature of space heated by starlight than as the remnant of a fireball* [22]. Astrophysicist Arthur Eddington [23] had already determined in 1926 that interstellar space would have a limiting temperature of 3.2 K. In 1933, Ernst Regener [24] predicted that intergalactic space has a temperature of 2.8 K. These predictions were made for steady-state models, well in advance of the BBT. Yet they accurately predicted what is observed now as the CMB. Conversely, early pioneers and proponents of the BBT failed to predict the measured CMB temperature correctly. George Gamow predicted a CMB temperature, as the afterglow of the Big Bang plasma, of 7 K in 1955, then updated it to 50 K in 1961. The discrepancy is highly significant, because energy radiated from a *black body* per unit surface area per second is 118,000 times higher at 50 K than it is at 2.7 K. The BBT failed to explain the temperature of the CMB. It also fails to explain other aspects of the observable universe. For example, it cannot explain why space does not seem to expand within galaxies and within galaxy clusters.

COBE satellite data of the CMB also conflicts with BBT expectations in two ways. Firstly, the microwave background varies only by less than one part in a hundred thousand and cannot explain how super-clusters, sheets, walls, and filaments separated by immense voids in the large-scale distribution of galaxies could have formed in less than 100 billion years [25]. Secondly, the COBE temperature data displays unequivocal dipole anisotropy [26], believed to be due to the Earth's motion relative to a *co-moving* reference space that follows the general expansion of the universe. This nonconforming motion of the Earth amounts to 370 km/s. Measurement of the motion of Earth relative to a cosmic background in effect defines a preferred reference frame, the existence of which was prohibited by Einstein.

Critique 3: The theory confuses cosmological redshifts with Doppler shifts.

Answer: The present theory treats observed redshifts as Doppler shifts and as intrinsic redshifts, such as gravitational redshifts (specifically as applied to quasars) [7]. See 3rd and 4th paragraphs in the Introduction. A separate *cosmological redshift* caused by expanding space is not needed.

Critique 4: The mechanism of creation of new matter is not clear.

Answer: True, we do not understand the exact mechanisms by which energy takes on material form.[12] Matter is itself an energy form, and space itself contains enormous amounts of energy. Even the BBT, based on expanding and distortable space, cannot explain how new energy is produced for the creation of new space, as the universe expands. This is a paradox that seems to violate energy conservation laws.

The main text of the present theory hints at different possible *mechanisms of creation of new matter* (see Sections 3 to 7).

Critique 5: Since galaxies have different mass, they would have different electric charges and the universe should be very inhomogeneous.

Answer: The universe is indeed very inhomogeneous at all levels, an observational fact that the BBT cannot explain, but which is easily explained by the present theory.

[12]We know it happens, as demonstrated by electron-positron pair production from gamma rays.

Critique 6: In an accelerating universe the number density of galaxies must vary with time.

Answer: In the BBT, the number density of galaxies varies with time, with or without acceleration, except when measured against an expanding *co-moving reference frame*, which does not fit the scientific definition of a reference frame. Within precepts of the present theory, acceleration of galaxies is a natural consequence of electric fields. Continuous new creation of matter is only needed to keep the number density of galaxies approximately constant. The theory is amendable, should new observations prove that H or n change with time. Note also that in the present model the velocity differential between galaxies one million parsecs apart increases by only 6 km/s in a billion years.

Critique 7: The theory does not resolve the *dark energy* problem.

Answer: The theory has no need for the presence of *dark energy*, other than the energy contained in electric fields and in the underlying zero-point quantum vacuum field.

10. Author's suggestions

As this composition exemplifies, detailed knowledge about the inner workings and relationships of SMBHs and quasars is a cosmological key to understanding the universe we live in. We must be free and able to contemplate and pursue fresh ideas and to let go of unworkable old traditional concepts. For example, we will not solve the mysteries of AGNs until we really understand what happens inside the *event horizon* of SMBHs. For making progress along these lines, I offer a few suggestions:

1. Recognize that in the balance of nature, there can be no physical *Singularities* or *Infinities*. The mere concepts are inherently contradictory within themselves and cannot exist in a tangible reality.

2. Give electromagnetic forces and effects proper importance in any meaningful cosmology. Most powerful electromagnetic forces in addition to relatively weak gravitational forces need to be acknowledged.

3. Encourage and engage the brightest plasma physicists to become *Plasma-Cosmologists*.

11. Passing thoughts

There appears to be sufficient evidence to believe that AGNs in massive, mature galaxies are driven by events occurring in central SMBHs; that these black holes have gravitationally accrued matter, primarily in the form of hydrogen atoms, hydrogen ions (protons), and electrons over eons of time; that this matter entered the event horizon via a rapidly spinning (near the speed of light) equatorial accretion disc; that this spinning galactic nucleus causes a strong inter-galactic magnetic field; that this active nucleus periodically ejects material jets from its magnetic poles at relativistic velocities.

We can perhaps get a better picture of structures and processes associated with AGNs by comparison with other similar processes at smaller scales more familiar to us. An axiom of the so-called *Perennial Philosophy* proclaims: *As above,* *so below*. This is generally understood to mean: *Structures and processes in the Macrocosm simulate those present in the Microcosm*. Certainly, the same basic laws of physics are valid in both domains.

Compare the strong magnetic field effects of an active galactic nucleus (AGN) with the weak magnetic field of planet Earth. Earth's solenoidal magnetic field catches and entraps high-energy ionic particles from the *Solar Wind* to form the *Van Allen Belts*, two somewhat distorted toroidal belts surrounding the globe. The inner belt consists primarily of high-energy protons. The much larger outer belt holds mostly high-energy electrons. These particles are forced into helical pathways encircling magnetic field lines. Electrons and protons coming from the sun or from the Van Allen belts can enter the Earth's ionosphere at the magnetic poles, causing aurora displays. Trapped ions in each belt reach the outer layers of the atmosphere at the poles, because there the guiding magnetic field lines curve inwards to the planet's surface.

We should expect similar processes to occur in the ultra-strong magnetic field produced by an AGN, only immensely more intense. As generally believed, an AGN should have a central SMBH that accumulates matter via an accretion disc, where strong gravitational forces impel entire stars, dust, and other non-ionized matter[13] to swirl into the black hole. Because most galactic matter had been orbiting around the galactic core in one direction already, conservation of angular momentum will speed this matter up to relativistic velocities. For this reason, all SMBHs must be rapidly spinning oblate Kerr-type holes.

Observational evidence seems to indicate that AGNs and QSOs are enveloped in strong magnetic fields, with the magnetic poles acting as gates that enable matter to be ejected as material jets at relativistic speeds. In addition to neutral accretion discs, AGNs should also be surrounded by electron belts and by positive heavy-ion belts closer to the event horizon. If, as suggested in Section 2, protons and alpha particles find their way through the event horizon more easily than electrons, then the AGNs would present a surplus negative charge to the outside world. Electric and magnetic fields from the corresponding surplus positive charge within the SMBH are neutralized by electric currents in the event horizon and cannot go beyond it [10]. Hence, a spinning AGN or QSO will appear to be electrically charged and will be the source of its own EM fields.

To explain how jets of matter and QSOs can be ejected out of AGNs, consider galaxies as the *atoms of the cosmos*. In analogy, charged atomic nuclei have a mass limit beyond which they become unstable and undergo radioactive decay, emitting protons, alpha particles, or ejecting whole portions of nuclear material, as in nuclear fission processes. Similarly, spinning and electrically charged black holes may also have an upper mass limit. They may not be able to compress matter much beyond neutron-star density before they become unstable. Remember that electrical repulsion between protons is 10^{36} times stronger than their gravitational attraction. Whenever, during the mass accumulation process, AGNs reach the point of inner instability they will eject nuclear material and/or burp out QSOs. The periodicity of such events may be responsible for the apparent redshift *quantization* observed with quasars. QSOs appear to be *born* with their own relatively small but charged SMBHs. As these SMBHs become more massive and larger with time, as they travel along their trajectories, the gravitational field gradients at their event horizons become smaller, accounting for their decreasing gravitational redshifts, the farther they travel from their mother AGN.

[13]Like hydrogen atoms and molecules, whose emission lines show up in QSO spectra.

12. Summary

This study describes an expanding cosmos that maintains an approximately uniform concentration of galaxies. It explains many observed mysteries, and it addresses inconsistencies in other theories. Galactic velocities and accelerations increase linearly with distance from any observer. Such a universe is shown to be older than 200 Giga-years. The theory has no need to search for large amounts of *dark matter* to make the universe *flat*, as there is no overriding requirement for it to be so. We do not have to invent unproven conditions and mechanisms, such as near-infinite energy densities and near-infinite accelerations (as in inflationary periods), to explain the initial phases of creation, and we have no irreconcilable conflicts with observational evidence. The above analysis of the proposed theory shows that the evolution of QSOs may be the most probable creation process needed to keep the number density of galaxies in the cosmos approximately constant in time in an *expanding* cosmos.

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