Exploration

Cryogenic Origin & Nature of the Cosmos

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Abstract

This paper reviews evidence from which it may be inferred that the Cosmos emerged cryogenically from a universal void and that a hot big-bang was not needed for nucleosynthesis of hydrogen and more massive elements and their isotopes. This is based on an inventory of the material content of the Cosmos in terms of particulate mass flow. The Cosmos can be partitioned into hierarchical domains of *particles* ranging from neutrinos to galaxies. This leads to the estimation of a mass flux associated with each domain. At each level of the hierarchy, mass flux is found to be associated with a particular constant. Cosmic mass flux is given by the relation A = Fm, where m is mass of representative objects. F is the cumulative flux of objects with masses equal to or greater than m. The constant A is mass flow per unit area per unit time. The A = Fm relation indicates that neutrinos, electrons, protons, together with nonluminous condensed baryonic matter, constitute up to 85 percent of the gravitational content of the Cosmos. Analysis of the relation suggests that nonluminous condensed matter is but an extraordinary cryogenic phase of ordinary baryonic matter which formed and agglomerated during the nascency and evolution of the Cosmos. Cosmic microwave background blackbody radiation temperature of ~3 degrees Kelvin appears to be a relic indicator that the Cosmos began as a vast Bose-Einstein condensate which fractionated, expanded, and agglomerated hierarchically; ultimately forming cryogenic dark matter galaxies which subsequently spawned the stars that illuminate them. It is conjectured that the nucleating cores of galaxies are black holes at near zero degrees Kelvin.

Keywords: Cosmic hierarchy, cosmic mass flux, dark matter, cryogenic nucleosynthesis.

Introduction

This paper is based on the virtually unassailable argument that the Cosmos is but an observable, measurable, material subset of the Universe which is an unbounded continuum beyond description or definition. There may be an infinitude of space-time-bounded cosmoses beyond the range of terrestrial observation. The Universe has no history while the Cosmos, a massive discontinuum filled with particles in motion, has a history. A history of the Cosmos is given by the hot big bang theory and chronology which posit its origin and rapid expansion from a point singularity. We propose an alternate chronology which assumes that the Cosmos emerged from a vast Bose-Einstein condensate, fractured, expanded, agglomerated hierarchically, ultimately forming cryogenic dark matter galaxies which spawned the stars that illuminate them.

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Energetic Substratum

Current estimates of the spatial density of matter in the Cosmos range from approximately $0.2{\cdot}10^{-28}$ to $1{\cdot}10^{-28}$ g/cm^3. Attempts to measure the actual mass density of the Cosmos have followed one of two methods: the accounting approach and the geometrical approach. Both methods return values for the mass density and which are consistent with the critical density, $\rho_o \approx 10^{-28}$ g/cm^3, suggesting that the Cosmos is flat, balanced and stable. Flat geometry implies that parallel light rays remain parallel and that density is the critical density. Under critical density, infinite big bang expansion is halted after a finite time. The critical mass density also results directly from evaluating Cosmic mass flux as given by the A = Fm relation. This leads to the question of why three approaches converge to the same cosmic mass density - or about 10 proton masses per cubic meter - which is needed to keep the Cosmos balanced on a 'knife edge' between high and low densities.

We assume that the material content of the Cosmos sprang from the zero-point field - an energetic substratum of the Universe which pre-exists the Cosmos and any companion cosmoses. The energy density of the ZPF substratum is putatively available for generating massive particles such as protons. The ZPF energy density is taken as $\varepsilon = \rho_o c^2 \approx 9{\cdot}10^{-8}$ g/cm s^2 $\approx 9{\cdot}10^{-8}$ erg/cm^3, where c is light velocity = $2.998{\cdot}10^{10}$ cm/s. Proton mass equals 938.27231 MeV or 0.001503 erg. Accordingly, the ZPF can either support ~60 protons per cubic meter or provide for the kinetic energy for the flux F = A/m of protons and other particles that pervade cosmic space.

Computation of the Mass Flux Relation

Figure 1 shows a plot of computed flux for cosmic objects within the mass range from m = 10^{-30} g to m = 10^{50} g, corresponding to hierarchy levels N = -5 through N = 8. Particulate fluxes for, electrons and protons in interstellar space can be found in readily available sources. Particulate fluxes can be easily determined for more massive chunks of solar space matter - such as comets and asteroids - and compared with fluxes of the lesser particles such as meteors or meteoroids. Particulate flux data can also be computed for interstellar and cosmic space. Using catalogued data on their masses and velocities and calculating fluxes based on the volumes of the domains of cosmic space they occupy, one may calculate fluxes of planets, stars, galaxies, galactic clusters, and galactic superclusters [1].

Treating galaxies and galactic superclusters - like micrometeoric dust - as merely different types of particles allows accounting for their flux, whether measured in number-per-square-light-year-per-century or number-per-square-centimeter-per-second. Because of the immense range of particulate flux and mass involved, it is necessary to plot the data on a logarithmic (log-log) plot so that the data are on a line. The resultant data are shown as particulate flux versus mass in Figure 1. Despite possible deviations by a factor of $\pm 10^3$, the remarkable alignment of the data over a 10^{80} range is profound and provocative.

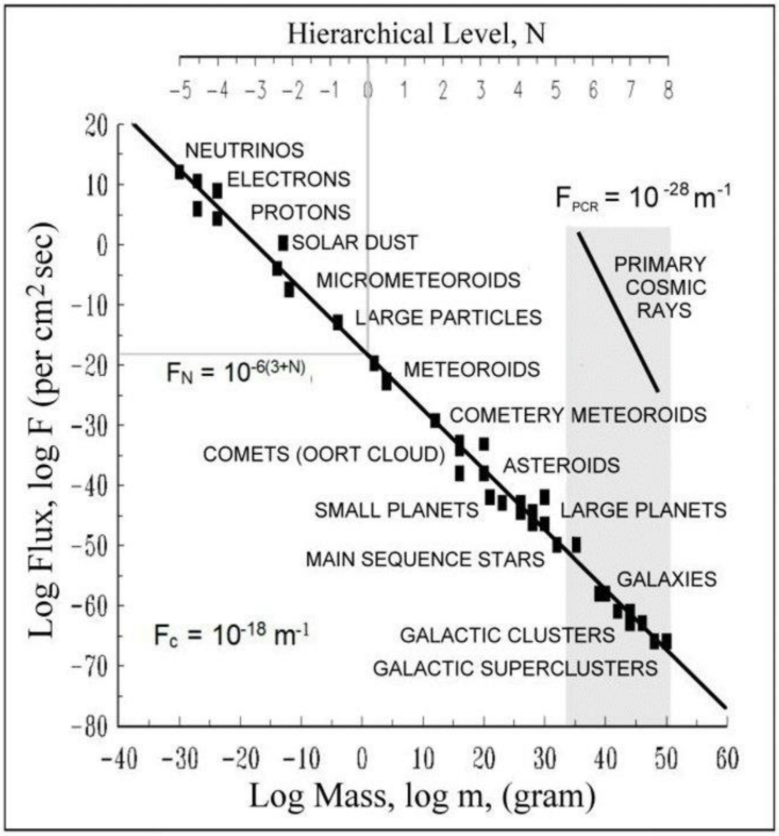

Figure 1 - Cosmic Particulate Flux versus Mass

The graph would be incomplete unless a datum for neutrino flux is added - based on estimates of a cosmic flux of ~10^{12} hits per square centimeter per second. The most abundant type of neutrino, the electron neutrino, has a mass of approximately 10^{-30} gram, based on the Standard Model of particle physics. The neutrino datum fits the overall cosmic flux plot, as indicated in Figure 1. It is not surprising that cosmic neutrino flux is greater than expected solar neutrino flux of $6 \cdot 10^{10}/cm^2s$ and, indeed, measured lower solar neutrino flux. If neutrino mass is much less than 10^{-30}g, then cosmic neutrino flux may be even greater than $10^{12}/cm^2s$, due to the presumed higher velocity of less massive neutrinos.

In the vicinity of the earth the cumulative micrometeoroid and meteoroid flux may be represented by a general relation of the form, $F = Am^B$, where F is cumulative particulate flux of meteoroids, solar and interplanetary dust, etc. The relation also applies to particulate fluxes associated with other portions of solar space. Classes of particles in solar space for which the $F = Am^B$ relation holds range from zodiacal dust to asteroids, for masses from 10^{-12} to 10^{25} g, where the exponent B ranges from -0.7 to -1.3 and A ranges from $\approx 10^{-15}$ to $\approx 10^{-20}$ g/cm^{2}s. These variations of A and B are likely because of peculiarities of local spaces.

The data suggest that particulate cosmic flux in solar space may be represented by, $F = Am^B = 10^{-18}m^{-1}$ or

$$Fm = A = 10^{-18} \text{ g/cm}^2\text{s} \tag{1}$$

As indicated in Figure 1, Equation 1 is taken to characterize not only mass flux in solar space but interstellar, intergalactic, and intragalactic space, indeed the entire Cosmos.

Hierarchal Fractal Flux Relation

It is interesting to consider the hierarchical and fractal nature of the Cosmos and how it leads to an heuristic calculation of particulate flux, F_N. An equation for computing cosmic flux on for any hierarchy level, N, from electrons and protons to galaxies, galactic clusters, and superclusters, is

$$F_N = 10^{-6(3+N)} \tag{2}$$

where N assumes integral vales, i.e., ... -2, -1, 0, 1, 2 ... etc. The thirteen hierarchical levels N, shown at the top of the Figure 1 are based on a systematic partitioning scheme [1]. Equation 2 gives the same value of flux, F_N, for integral values of N as Equation 1 does for F. For example, when N = 0, Equations 2 and 1 each give the same numerical value: $F_N = F = 10^{-18}$ (as indicated in Figure 1).

It is apparent from Equation 2 that successive values of N correspond to huge decrements in flux and the fractal nature of cosmic matter. The spatial density of objects in any given level of the cosmic hierarchy is so much greater than in the next higher level that objects in the lower levels may be treated as if they existed in empty space. When calculating cumulative flux, contributions of higher levels of hierarchy may be ignored. It is possible to calculate a particulate flux and add this to cumulate flux F due to a higher hierarchical level.

Discussion & Interpretation

Mass Flux Parameter A: While it may vary locally, overall the quantity A in Equation 1 is apparently a cosmic constant with a value between $10^{-18.6}$ and $10^{-17.7}$ or an approximate mean value of $\approx 10^{-18}$ g/cm^{2}s over the entire mass range between 10^{-30} to 10^{50} g. Evaluation of the F = A/m plot reveals a close relation with the critical mass density ρ_o, discussed next. Equations 1 and 2 appear to be strange attractor relations from which cosmic mass flux of discrete particles from electrons to galaxies may not deviate appreciably in order to maintain the critical mass density.

Critcal Mass Density: The constant A is apparently quantifies the momentum and energy density of all discrete objects in the Cosmos. A = mF is dimensionally equivalent to momentum density, thus

$$A = mF = \rho_o c = 10^{-18} \text{ g/cm}^2\text{s} = 10^{-18} \text{ g}\cdot\text{cm/cm}^3\text{s} \tag{3}$$

were ρ_o the ‘critical’ density of cosmic matter and c is the velocity of light. We need not assume a value for ρ_o, but solving Equation 3 for ρ_o, using 3×10^{10} cm/s for c and 10^{-18} g·cm/cm^{3}s for A, gives $\sim0.3\times10^{-28}$ g/cm^3 agreeing with current range estimates of the cosmic spatial density of matter: $0.2\cdot10^{-28}$ to $1\cdot10^{-28}$ g/cm^3.

Neutrino Mass Flux: Because mass flux A = mF apparently has the same value at each level of the cosmic hierarchy, Equation 1 indicates that cosmic neutrino mass flux is equivalent to the mass flux of stars and galaxies and galactic clusters at higher levels of the hierarchy. This remarkable finding suggests that the flux of neutrinos may have had a major gravitational role in the evolution of the Cosmos and formation of galaxies. Neutrinos are the extreme case. Because the constant A applies to each level of the hierarchy, cosmic electron and proton mass fluxes also equal the cosmic mass flux of galaxies at the higher hierarchic level.

Cosmic Ray Flux: A separate curve $F_{PCR} = 10^{-28}m^{-1}$ characterize primary cosmic ray flux in Figure 1. Cosmic rays are very high energy particles that constitute a species different from the particulate cosmic flux represented by $F = 10^{-18}m^{-1}$. Primary cosmic rays are mostly protons and ≈10% of the primaries are helium nuclei (alpha particles) and ≈1% are heavier nuclei of the elements such as carbon, iron, and lead [2, 3].

The curve for primary cosmic ray data is placed in the shaded rectangular area in Figure 1. The equation $F_{PCR} = 10^{-28}\ m^{-1}$ is based on masses of the assumed cosmic ray generators (stars, galaxies, clusters) of the different energy levels of primary cosmic ray fluxes. The highest flux datum corresponds to low energy flux from the sun or main sequence stars. Lower flux levels correspond to higher intermediate energies associated with intra-galactic cosmic rays. The lower fluxes correspond to much higher energies associated with the arrival of extra-galactic cosmic rays presumed to have been generated by active galaxies exerting a magnetic field strong enough to accelerate a bare proton to energies of 10^{20} eV and higher. It appears that the spatial density of cosmic ray particles is less by a factor of 10^{10} when compared with particles represented by Equation 1.

Cold Dark Matter: The presence of cold dark matter in the Cosmos is inferred from gravitational lensing of background objects by galaxies. The first robust indications of the presence of dark matter came from measurements of galaxy rotation curves [4, 5]. It was inferred that most galaxies were dominated by some form of exotic cold dark matter when their stars were observed to revolve around the centers of galaxies at increasing speeds or the same speed over a large range of distances from the center of the galaxy. Were cold dark matter absent, orbital speed should decline exponentially at greater distances from galaxy centers.

The presence and energetic influence of baryonic cold dark matter becomes evident upon taking the definite integral of Equation 1 based on upper and lower mass limits taken from Figure 1

$$\mathbf{F}\mathrm{m} = \mathrm{A} \int_{m1}^{m2} (1/m)dm$$

We calculate the momentum density **F**m of all matter in the Cosmos by setting $m_1 = 10^{-30}$ gram and $m_2 = 10^{50}$ gram. This includes the entire cosmic mass range depicted in Figure 1. We calculate the momentum density due only to galaxies and superclusters by setting $m_1 = 10^{38}$ gram and $m_2 = 10^{50}$ gram. This narrower mass range encompasses only diffuse objects (galaxies) and excludes their discrete components (stars). The quantity **F**m for the entire range of cosmic matter is 184.2A, and for galaxies through superclusters it is 27.6A. Evidently, cryogenic dark baryonic matter contributes

~84.7 percent of the cosmic momentum density. This compares with the ~84.5% currently attributed to exotic forms of cold dark matter.

Although stars are included with non-luminous dark matter, they comprise only 3 to 4 percent of the cosmic momentum density. It is not unreasonable to assume that galaxies are filled with cold dark stellar mass objects which may comprise the dark lanes in galaxies, conventionally attributed only to dust. Apparently, cold dark matter, in the form of ordinary matter, is diffusely distributed through spiral and perhaps other types of galaxies and galactic clusters - and probably throughout cosmic space - and can easily account for galaxy rotation curves, gravitational lensing, and anisotropies in the cosmic microwave background.

This finding is relevant, especially in the current endeavor to identify the nature of the cold dark matter which pervades cosmic space, produces gravitation lensing, and affects the rotation velocity of galaxies. Moreover, it appears that neutrinos along with electrons and protons which also pervade the Cosmos exert a pronounced gravitational effect, indeed, greater than that of all directly-observable luminous matter in the Cosmos, as represented by galaxies, galactic clusters and superclusters.

Kinetic Energy Density: A kinetic energy density ε for each level of the cosmic hierarchy can be obtained from A by applying Equation 3

$$\varepsilon = Av = \rho_o cv \tag{4}$$

where, v is the mean velocity for a particular class of objects in the cosmic hierarchy. For interstellar protons v equals approximately 10^6 cm/s [1]. Based on mF = 10^{-18}, $\varepsilon = 10^{-12}$ erg/cm^3 for protons. This kinetic energy density is comparable to the peak microwave background which equals roughly $6\cdot10^{-13}$ erg/cm^3. The mean random velocity of galaxies is 10^7 cm/s and this gives $\varepsilon = 10^{-11}$ erg/cm^3. This is comparable to the cosmic background radiation density when integrated over all wavelengths is $\leq 2\cdot10^{-11}$ erg/cm^3. This corresponds to the CMB radiation or the cryogenic Cosmos with a kinetic temperature of ~3^o Kelvin. Since these energy densities are kinetic and not due to luminosity, they apparently manifest a dark energy ZPF substratum.

Conclusion

This study produced an informative inventory of the material content of the Cosmos in terms of particulate mass flow. The A = Fm relation reveals that neutrinos, electrons, protons, together with nonluminous condensed matter, constitute up to 84.7% of the gravitational content of the Cosmos. It has long been assumed, but is now evident, that neutrinos which pervade the Cosmos exert a large gravitational effect throughout galactic and intergalactic space. Accordingly, neutrinos correspond to weakly interacting massive particles, WIMPs, hypothesized as leading candidates for dark matter. This leads to the possibility of galaxysized neutrino density waves ripple throughout the Cosmos and help generate the observed galactic spiral arms and other galactic patterns.

Analysis of the strange attractor relation A = Fm suggests that nonluminous condensed matter is an extraordinary cryogenic phase of ordinary baryonic matter which formed and agglomerated during the nascency and evolution of the Cosmos. The cosmic mass flux parameter, A, identifies and explains the abundance and nature of the cold dark matter which probably existed since the initial stage of big bang expansion, the nascency of the Cosmos. During nascency of the Cosmos, the original baryonic cold dark matter (atomic and molecular hydrogen and helium and their isotopes) may have consisted of an extraordinary cryogenic phase which has persisted to the current cosmic epoch. Cosmic microwave background blackbody radiation temperature of ~3 degrees Kelvin may be a relic indicator that the initial and persistent cryogenic phase of baryonic matter - a Bose-Einstein condensate - fractionated, expanded, and agglomerated hierarchically; ultimately forming galaxies which subsequently spawned the stars that illuminate them [6].

The data seem to support the conjecture that hierarchical dispersions of clumps of cryogenic baryonic matter preceded galaxy and star formation and continue to dominate intra and intergalactic space. Frigid solar system asteroids, comets, Jupiter, Saturn, Uranus, Neptune, and their satellites are obvious relics of the primordial cold dark matter. Black holes at galaxy centers may just be forms of supermassive cold dark matter which, despite Hawking radiation, exhibit virtually zero degrees Kelvin temperatures [7, 8]. Hoag's Object and AM 0644-741are ring galaxies that await formation explanations, but which may revolve around vast amounts of nonluminous matter and ostensibly yet-to-be detected supermassive black holes.

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