Universidade do Minho

1st Crisis in Cosmology Conference, CCC–I
Program

Monção, Portugal

23 to 25 June 2005

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- José B. Almeida
- Yurij Baryshev
- Michael Ibison
- Eugene Savov
- Riccardo Scarpa

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Welcome

Accepting the invitation to host this conference was both a challenge and a pleasure. It all started in the discussion group initiated by Eric Lerner as a follow up of the open letter published by New Scientist; I offered the North of Portugal as a possible venue, not expecting that this would eventually become the elected choice. I am glad it was. Working over the internet with my colleagues from the Organizing Committee was a very enriching experience and I am sure we established long lasting bonds that will continue to be productive as years pass.

At startup I intended to host the conference in the campus of Universidade do Minho (UM), my university, but suddenly I could not resist bringing everybody to Monção, to the Museum House, still on UM's grounds. The target number of participants indicated that a large room was not needed and a rural location would favour interaction and group discussions. Besides, Monção is a lovely village, which made me confident that people would enjoy the stay; only time will tell if this was a wise decision.

As we get ready to receive participants, authors or just attendants, I wish to express to everyone, in the name of the Organizing Committee, a warm welcome and a sincere desire that they will find their stay in Monção a profitable one. That will be the best incentive for the organizers of next year's CCC-II.

Braga, May 6, 2005,
José B. Almeida

(3-4) **Mass boom versus big bang: an alternative model**

A. Alfonso-Faus

In an effort to advance a first step in the long journey to harmonize Einstein's General Relativity and Quantum Mechanics, we interpret the gravitational field as a sea of gravity quanta. We calculate the value of the mass of these quanta by imposing the condition that they must be unlocalizable in the Universe. Also they have negative energy that is emitted, in each quantum one by one, from every fundamental particle with gravitational properties. From here one gets a picture for the emitting positive masses that imply that their masses increase linearly with the cosmological time. In particular, the mass of the Universe M is equivalent to its age t, and to its gravitational entropy S, (i.e. $M = t = S$), in a certain system of units that convert many fundamental laws to very simple relations. This is the Mass Boom model, which we have published elsewhere under various points of view. The resultant cosmological model is identical to the one that Einstein initially proposed: a static, finite, curved and unlimited model.

The Hubble interpretation of the red shift as indication of an expanding Universe is here seen in a different way: we consider our LAB systems not to be absolute ones. If the Universe is static, as Einstein first saw, then the Hubble observations must be interpreted as a proof of the local shrinkage of the quantum world, instead of an expanding Universe. This new view is very well justified because it explains many of the problems that have plagued the standard model (the big bang). It also eliminates the need for additions/corrections to the standard model like the addition of ”inflation”. We can enumerate the following 7 typical cases:

1) The age of the Universe problem.

2) The horizon problem.

3) The flatness problem.

4) The entropy problem.

5) The monopole problem.

6) The fine tuning problem.

7) The dynamo paradox between galaxies.

And our model presents the following definite predictions:

a) The Universe must have a decreasing speed of light, as $c = 1/t$, (time being also quantized, with the first instant of time being $t = 1$). There is experimental evidence (from Australian astronomers) that this law is in fact observed.

b) We get definite values for the pressure of quanta with $w = 1$ ($p = w \times \text{energy density}$), and for the deceleration parameter $q = -0.5$.

(3-18) **Some theoretical and experimental facts which require going ”beyond Einstein” with the replacement of general relativity by the Yilmaz curved spacetime gauge field theory of relativistic gravity**

C. Alley

There are many paths to the establishment of the Yilmaz theory of relativistic gravity as must be true for any correct theory. This talk will be a sequel to the talk by Huseyin Yilmaz at this conference and will complement that talk by including paths not covered by him for lack of time and by emphasizing important points from different perspectives.

The difference between the Yilmaz theory and general relativity is in the treatment of the gravitational field stress energy. Each treats relativistic gravity as curved spacetime but the field equations for the metric coefficients are different.

Yilmaz Theory: Gravitational stress-energy is **included** as a source of curvature

General Relativity: Gravitational stress-energy is **excluded** as a source of curvature

As a result of this exclusion from the field equations, gravitational field stress-energy is a coordinate artifact in general relativity whereas in the Yilmaz theory it is a true tensor. Since interactions are carried by the field stress energy there are no interactive N-body solutions to the field equations of general relativity. This means that the Newtonian correspondence, with the all-important equality of action and reaction, is missing in general relativity, even in weak gravitational fields. This is a disastrous consequence for a theory purporting to describe gravity. This strong conclusion has been verified by numerous symbolic computer calculations, including the repetition of many lengthy calculations originally done by hand by Huseyin Yilmaz.

In addition to the failure or general relativity to describe correctly the observed advance of the perihelion of Mercury, as emphasized by Huseyin Yilmaz in his talk, there are other more recent experiments which require interactive N-body solutions for their correct descriptions. These include several in which the present author has been actively involved: the lunar laser ranging measurements, the flying of atomic clocks in aircraft and the observed relativistic behaior of clocks in the global positioning system.

(3-11) **Geometric drive of the Universe's expansion**

J. B. Almeida

The validity of any theory and its usefulness stem from the correctness of the predictions it allows; this is an unquestionable truth for all physicists and for the public in general. The elegance of a theory, however, is usually associated to a small number of principles or postulates and to a small set of mathematical equations, even if these turn out mathematically intricate and difficult to solve. This has been the case with General Relativity (GR) for many years, a theory which many physicists see as the paradigm of elegance. In spite of the unescapable validity of GR in celestial mechanics and laboratory experiments the situation is not as clear in cosmology. The frustration of all known attempts to unify GR with Quantum Mechanics and the Standard Model of particle physics is another motivation for many serious people to burn their eyelashes in the search of some alternative way of formulating a new all encompassing theory.

In this work I will discuss geometry under the assumption that a well chosen geometry will allow, one day, the derivation of all the equations of physics from purely geometrical relations. This is, to a great extent, a question of personal faith without too much evidence to support it at the present time, but enough to motivate my continued search. If my assumption that physics is born out of geometry is true, then what we have to do is start off with the appropriate space, make the correct assignments between coordinates and physical entities and formulate the equations resulting from space symmetries and other space properties; these equations shall be the same as we encounter in physics. In previous work [1] it was shown that hyperbolic 5-dimensional space, also known as 5-dimensional space-time, can generate 4-dimensional space without a metric by the condition of null displacement. This 4D space acquires a metric by promoting one of the coordinates to interval; depending on the choice of coordinate one can obtain either the usual GR space or an Euclidean 4D space designated as 4-Dimensional Optics (4DO). Mapping of geodesics between the two spaces can be done for all static metrics, as was shown in the cited work; it is not clear at present if the same operation is possible in some cases for non-static metrics, although it seems very likely that it is not. However, many interesting cases in GR are governed by a static metric and we can easily analyse these in 4DO to gain a different perspective. Einstein's equations cannot be applied in 4DO and a suitable replacement was proposed in the cited paper, which leads to similar results in many cases but not in extreme ones.

The purpose of this presentation is to show how 4DO can be used to explain a flat rate expansion of the Universe under zero mass density. When one of the coordinates of 4DO is associated with the radius of an hypersphere this coordinate takes the physical meaning of proper time and flat rate expansion becomes a direct consequence of geometry. The basic principles involved have been explained in another paper [2] but the formulation is now cleaner than the original one. The usual 3 spatial coordinates are then associated with arc lengths on the hypersphere surface. The metric of Euclidean 4-space in hyperspherical coordinates is dependent on the hypersphere radius (proper time) which precludes its direct mapping into a GR metric; mapping would be possible by resorting to Cartesian coordinates at the expense of a simple interpretation of their significance. I will also discuss the influence of non-zero mass density to show that an accelerated expansion is to be expected. This conclusion can be reached independently of the set of equations used to find the metric of space with uniform mass density. Schwarzschild's metric is PPN equivalent to the exponential metric proposed in both cited papers and consequently it is irrelevant which one is chosen if only first order approximation is envisaged.

Dark matter has been postulated not only to explain the rate of expansion in the Universe but also to account for the incredible orbital velocities found in spiral galaxies. This is a subject which cannot be properly addressed in this short presentation. Galaxy dynamics is a difficult subject which I have not investigated properly but, also in this case, the postulate of 4DO in connection with an hyperspherical Universe seem to provide a qualitative explanation for the observations. I will give a brief indication of what may become an interesting subject for further work.

References

[1] J. B. Almeida, *The null subspace of G(4,1) as source of the main physical theories*, in *Physical Interpretations of Relativity Theory – IX* (London, 2004), physics/0410035.

[2] J. B. Almeida, *An hypersphere model of the Universe – The dismissal of dark matter*, 2004, physics/0402075.

(1-5) **Falsification of the expanding Universe model**

T. Andrews

This talk presents observations and logical arguments leading to a falsification of the expanding universe model.

It is well known that type Ia supernovae show a significant anomalous dimming relative to a flat expanding universe model. It was expected then that the brightest cluster galaxies (each defined as the brightest galaxy in a cluster) should also show anomalous dimming. However, from observations of two independent sets of brightest cluster galaxies, it is quite clear that neither set of brightest cluster galaxies shows any anomalous dimming. The lack of anomalous dimming might be expected to be due to luminosity evolution but this explanation is ruled out by a logical argument.

Furthermore, because the light from the supernovae and the galaxies traverses the same space, the anomalous dimming must be specific to supernovae. In particular, the current explanation of the anomalous dimming - an acceleration in the expansion of space - can not be responsible for the anomalous dimming. With these arguments as a clue, the cause of the anomalous dimming of supernovae was traced to the relatively short duration of the supernovae light curves.

Based on a Fourier analysis of the light curve at a supernova, the Hubble redshift of the Fourier harmonic frequencies is shown to broaden the light curve at the observer by a factor of $(1+z)$. Since this broadening spreads the total luminosity over a longer time period, the apparent luminosity at the observer is decreased by the same factor. This effect accounts quantitatively for the anomalous dimming of supernovae. On the other hand, no anomalous dimming occurs for galaxies since the luminosity of galaxies remain nearly constant over time periods much longer than the light travel time from the galaxies.

Since the expanding universe model currently predicts an independent light broadening effect due to time-dilation, two light curve broadening effects are predicted for supernovae (and one for galaxies). However, Goldhaber (preprint astro-ph/0104382) observed only one light curve broadening effect for supernovae. Because Goldhaber's result directly contradicts the prediction of two light curve broadening effects, the expanding universe model is logically falsified. Then, following the scientific method, the expanding universe model must be rejected.

However, the existence of a new broadening effect for supernovae and the corresponding absence of a broadening effect for galaxies is consistent with the static universe model. Consequently, a static universe is hypothesized. Because this hypothesis is confirmed observationally by surface brightness tests of each set of brightest cluster galaxies, it is quite certain that the universe is static rather than expanding.

(2-1) **Conceptual problems of the standard cosmological model**

Y. Baryshev

Davis & Lineweaver (2003, astro-ph/0310808) recently revived an old discussion on the nature of cosmological redshift in the Big Bang model, because in many papers it was misinterpreted as the Doppler effect. Actually this misinterpretation has its roots in poorly defined physics of expansion of space, which is not experimentally tested yet. There are several especially spectacular puzzles of the standard cosmological model (SCM) related to the expanding space: 1) recession velocities of galaxies can be much more than velocity of light; 2) cosmological redshift is not due to the Doppler effect; 3) global gravitational redshift exists in homogeneous matter distribution; 4) Friedmann equation in isotropic universe defines global Friedmann force which exactly equals to Newtonian force; 5) energy content of any comoving ball of matter (with nonzero pressure) is continuously changing during expansion of space. A review of conceptual problems of the SCM was done by Baryshev, Sylos Labini, Montuori, Pietronero (1994, Vistas in Astronomy, v.34, pp.419- 500, astro-ph/9503074) and Baryshev (2000, Astron. Astrophys. Transaction, v.19, pp.417-435, astro-ph/9912074)

It is emphasized that such surprising features of SCM as galaxies flying away with $v > c$ and continuous disappearance of the energy of hot gas and radiation from the Universe to nowhere, are direct consequences of applying the geometric gravity theory (general relativity) to cosmological scales. These paradoxes arise from the long standing energy problem of general relativity (GR): it is well known (see e.g. Landau & Lifshitz: The classical theory of fields, 1971, p.304) that in GR there is no satisfactory concept of energy-momentum tensor of the gravity field. It also relates to the fact that GR is not a quantum theory, while all other theories of physical interactions are quantum ones.

This is why it is important in cosmology to consider alternative gravity theories which are free from such surprises and consistent with other physical interactions. A good candidate for such alternative gravity theory is Feynman's quantum field approach to gravitational interaction which describes gravity as usual material tensor field in Minkowski space (Baryshev 1999, gr-qc/9912003).

(3-16) **Physics of gravitational interaction: geometry of space or quantum field in space?**

Y. Baryshev

Modern cosmological models are based on particular solutions of gravitational field equations, e.g. Friedmann model is a solution of Einstein equations for homogeneously distributed matter. This is why the gravity physics should be in focus of cosmological reseach.

The main problem of the physics of the gravitational interaction is to understand nature of gravity. Starting from the beginning of 20th century two opposite views on the nature of gravity were proposed by Poincare and Einstein. The first one is a presentation of gravity field as a relativistic quantum field in Minkowski space with gravitons as mediators of the gravitational interaction, and now it is called Thirring–Feynman field approach to gravitation (Thirring W., 1961, Ann. Phys.,v.16, p.96; Feynman et al. "Feynman Lectures on Gravitation", Perseus Books, 1995). The second one is the description of gravity as a geometrical property of curved space-time itself, and it is widely known as general relativity (Einstein 1915; Landau & Lifshitz 1971).

Inspite of desire of many physicists to reduce the field approach to the geometrical one it was shown by Baryshev (1999, gr-qc/9912003) and Straumann (2000, astro-ph/0006423) that these theories are principally different though up to now all really tested relativistic gravity effects can not distinguish between them. Main conceptual difference between these approaches is that in the field gravity theory there is well-defined energy-momentum tensor of the gravity field, while in general relativity there is no tensor characteristics of the energy of gravity. Also GR is not a quantum theory but field approach is based on quantum principles.

Feynman's quantum field approach to gravitation opens new understanding on the physics of gravitational interaction and stimulates novel experiments on the nature of gravity. Laboratory and astrophysical experiments which may test the predictions of the field approach, will be performed in near future. In particular, studies of motion of binary pulsars may test the equivalence principle for rotating bodies and observations at modern gravitational observatories will check the predicted scalar gravitational waves from supernova explosions.

(3-1) **The big bang picture: a wonderful success of modern science**

A. Blanchard

During the XXth century a scientific picture of the universe and its history has emerged on the basis of the ”Primeval Atom”, the original proposition of Georges Lemâitre. Indeed, I will show during this review that modern cosmology is a scientific theory, and as such does not pretend to provide the ”Truth”, but a framework in which predictions are possible and can be confronted to observations for possible falsification in Poper sense. The last forty years have offered a remarkable list of observational verifications of the predictions of the standard picture, on the basis of well established physics. During the last twenty five years a more revolutionizing picture has emerged: essential pieces of information for fundamental physics are obtainable from cosmology. Although definitive conclusions are obviously more uncertain, this approach is still a fully scientific path which past successes have been remarkable and allow to consider cosmology as a new and rich branch of modern physics.

(2-4) **The Dyer-Roeder relation in a universe with particle production**

M. de Campos

Cosmology has been, for a long time, a fertile ground for speculation. The choice between competing theories was very difficult due to the small amount of reliable experimental data.

Things have changed, however, in the last decades. The quantity of experimental results relating to the age of universe, its expansion and its matter distribution, as well as gravitational lens occurrence statistics and related subjects, has grown to such a extent that the room left today for speculative reasoning in Cosmology has been considerable reduced.

Among the most interesting recent results, are the supernova IA type data, obtained at the end of the 1990s, which gave support to the hypothesis that our universe has an accelerated expansion.

These observations lead to a revival of the cosmological constant, as well as to new proposals for candidates able to generate a negative pressure, for example, quintessence.

According to some of these hypothesis, the universe would have, beyond its usual baryonic matter content and dark matter, also a negative pressure-generating content, a kind of dark energy that represents the vacuum contribution.

One of the attractive features of the hypothesis of particle production is that it therefore relates the large-scale properties of the universe to atomic phenomena. On the other hand, the introduction of this new component for the cosmological fluid gives not only an explanation for the cosmological acceleration, but also eliminates the age problem of the universe, which in the standard model is smaller than the one obtained for the age of the globular clusters. The estimate for the age of the universe depend upon the value of the Hubble constant. If the value of H_0 is near the upper limit obtained by Freedmann et al. ($H_0 = 80\,\mathrm{km/s/Mpc}$) and considering the usual standard model ($H = \frac{2}{3t}$), we get some "relief" for the age problem, although not a definitive solution.

The model with particle production (OSC) provides also a reasonable fit with respect to kinetic tests, like luminosity distance, angular diameter and the number counts of galaxies versus redshift relation and in the radiation-dominated era (photon creation) the model can be compatible with present day isotropy and the spectral distribution of Cosmic Microwave Background Radiation.

The inclusion of Λ solves the age of the universe puzzle, but at the expense of creating a new one, the so-called cosmological constant problem. The conciliation between a very large value for this constant, predicted by quantum field theory, and a small one or zero, can be obtained if we consider the cosmological term time-dependent or quintessence models. In spite of, these models cannot explain why the dark energy density is comparable with the matter one.

As an alternative model for the universe, we can introduce a cosmological particle production term, resulting in a scenario that can mimic the effects generated by the inclusion of Λ. The physics involved is, nevertheless, quite different.

In this work we are going to study the exact solutions of the Dyer-Roeder equation, considering a homogeneous and isotropic universe where particle production occurs at the expense of gravitational field energy. We discuss the influences of inhomogeneities in the path of a light beam on the apparent diameter of astrophysical objects and consider both redshift independent and redshift dependent distributions of the inhomogeneities.

(3-15) **Tommy Gold revisited**

G. Chapline

Understanding gravitational collapse requires understanding how 10^{58} baryons can be destroyed in 10^{-5} seconds. The recent proposal of Bob Laughlin and the speaker that the endpoint of gravitational collapse is a ”dark energy star” entails supposing that baryons are converted to vacuum energy when one gets near to conditions where classical general relativity predicts that a trapped surface would form. The negative pressure associated with a large vacuum energy prevents a trapped surface from forming, and resolves the long-standing puzzle as to why gravitational collapse leads to an explosion. An indirect consequence is that the reverse process - creation of matter from vacuum energy - should also be possible. Indeed this process may be responsible for both the ”big bang” and the formation of cosmic voids. In this new picture of cosmology the observable universe began as a fluctuation in an otherwise steady state universe. The fluctuations in the CMB are not the result of inflation but quantum turbulence. This has the advantage that there is a natural explanation for both the level of CMB fluctuations and the deviation from a scale invariant spectrum at large scales.

(2-2) **The insignificance of current cosmology**

M. Disney

I compare the number of truly independent measurements that have been made, and which are relevant to current cosmology, with the number of free parameters available to the theory. The difference between these numbers is controversial, but is certainly less than 5, and may be as low as 1. In either case it can be argued that there is little statistical significance attached to the good fits which impress conventional cosmologists. I go on to show that this same worrying situation has existed throughout the modern era of cosmology, as the number of free parameters has expanded to accommodate the new data. This expands and updates my " The Case against cosmology"[General Relativity and Gravitation, 32, 1125, 2000. astro-ph 009020]

(P-3) **Implications of thermodynamics on cosmologic models**

A. M. Hofmeister and R. E. Criss

The Universe is an isolated system with constant mass-energy. The second law requires that its entropy must increase over time, i.e., the Universe is irreversible, yet standard cosmological models presume isentropy. Entropy production due to expansion of the Universe is calculable and negligible, but enormous entropy is created in as matter is converted to energy and irreversibly transferred from hot stellar interiors to cold dark matter. Previous omission of entropy production from the cosmological equations is the source of reversible-time and has led to the misconceptions that the Universe is expanding and that a big bang is necessary. Instead, the evolution of the Universe is guided by irreversible mass loss through stellar burning. Specifically, the mass of the Universe (M) is contained within an event horizon. For a hypothetical test particle of rest mass m to escape the mass horizon, its kinetic energy must equal its gravitational binding energy, and the escape velocity is c. Accounting for relativistic effects yields $mc^2 = GMm/r$, as is also required by conservation of energy. Using radius $r = c/H$, where H is Hubble's constant provides $M = 2 \times 10^{53}$ kg in agreement with extrapolating density. From this equation, stellar burning requires contraction, as is observed among our local group of galaxies, or that c, H, or G vary with time.

Cosmic microwave background radiation (CMBR) does not require a big bang, but instead is the white cavity radiation of the dusty Universe. CMBR is blackbody emissions from dark matter that is warmed to 2.7 K by radiative transfer from the stars; this balance of flux is required by the zeroth law of thermodynamics. The luminosity L of the Universe, which equals $-c^2 dM/dt$, is equated to the energy radiated by the dark matter at 2.7 K: $L = 4\pi r^2 sT^4$, where s is the Stefan-Boltzmann constant. The entropy change in an isolated system is related to the uncompensated heat: $dS = dQ/T$. These equations and the fact that heat is produced by stellar burning lead to the important relationship: $dS/dt = L/T$. At the present time the entropy of the Universe is therefore increasing at a rate close to 7×10^{47} Joules/(sec $\times$ deg). One means of visualizing this increase is the conversion of ordered matter to high frequency luminous energy, emanating in a radial fashion from the stars, to the totally disordered, low frequency, 2.7 K cavity radiation (Criss and Hofmeister, 2001, Geochim Cosmochim Acta. 65, p. 4077).

Entropy production is therefore closely linked with time. In that sense, omitting the uncompensated heat in the standard cosmological models is tantamount to divorcing time from evolution. It should come as no surprise that strange phenomena, such as the big bang where density is infinite at creation, is predicted by equations that not only improperly account for time, but further require reversibility.

(3-3) **The Yilmaz cosmology**

M. Ibison

A central claim of the Yilmaz theory is that there exists a proper, localizable stress-energy tensor for the gravitational field, and which acts as a source in the Einstein equation. The theory has been characterized in the literature by its prediction of an 'exponential metric' (in isotropic coordinates) for a singular mass point. This metric agrees with the GR Schwarzschild metric only up to second order in $1/r$, though this is enough to guarantee agreement with GR up to the current observational precision. More generally, the Yilmaz theory has not, allegedly, been refuted by observation. That said, the theory has not been applied to situations in which GR predicts frame dragging, nor has it been applied to Cosmology.

Here we consider the latter case, assuming a priori the usual FLRW metric with zero spatial curvature to generate the two Friedmann equations for the theory. We discover the Yilmaz theory is consistent with this metric only in a universe where the total energy density and pressure are zero, and, in particular, the total mass energy density is zero. We also consider the predictions of the theory in the case of a steady state universe, i.e. wherein matter and radiation are assumed generated at a rate sufficient to maintain a constant density. Here we discover the Yilmaz theory is consistent only with a universe in which there is a constant negative total pressure, but once again the total energy density and pressure must be zero, and, in particular, the total mass energy density must be zero. Since these outcomes are obviously at variance with observation, it is concluded that the theory as presented by its author is flawed.

We offer some reasons to suggest that a variant of the theory, wherein the (alleged) gravitational stress-energy tensor appears with a different weight relative to the (traditional) matter-energy tensor, may be more successful.

(3-13) **Electromagnetic self-consistency, the zero-point field, and the cosmic microwave background in the steady-state cosmology**

M. Ibison

In the Friedmann Cosmologies we point out that the ZPF is the unique EM field whose energy spectrum is independent of cosmological time. We investigate the novel interpretation that this field is the result of electromagnetic self-consistency between charges moving on the geodesics in conformity with the cosmological expansion. Several interesting implications follow: Consistency between the fields and matter gives rise to an eigenvalue problem wherein the eigenvalues are the masses of the charges. For a uniform distribution of matter the calculation derives the Dirac Large Number relation between the electron mass and the Hubble radius. Further, deviations from uniformity affect the mass in such a way as to generate gravitational attraction, at least (for the present state of development of the theory) in accord with the Newtonian theory. We find that this picture however, is consistent only with the direct-action implementation of EM. It leads us to reconsider the absorber hypothesis of Wheeler and Feynman - which explains the emergence of retarded radiation in the direct-action theory as the result of absorbers on the future, but not the past, light cone. In particular we suggest that the zero Kelvin state may be associated with acceleration of charges producing equal amounts of advanced and retarded 'radiation fields' associated with the absence of absorption on both the past and future light cones. Further, we observe that the Wheeler-Feynman mechanism may also fail for a limited spectral range, this time due to the presence of full absorption on both the past and future light cones. We discuss the possibility that the Cosmic Microwave Background is this minimal self-consistent field. That is, we consider the possibility that the CMB comprises both advanced and retarded fields, and that its spectral signature is not the result thermalization in the usual sense, but, in the context of the steady-state theory, is a requirement for self-consistency imposed by the time-symmetry of past and future absorbers.

(3-12) **Low-energy quantum gravity leads to another picture of the Universe**

M. A. Ivanov

If gravitons are super-strong interacting particles and the low-temperature graviton background exists, the basic cosmological conjecture about the Dopplerian nature of redshifts may be false: a full magnitude of cosmological redshift would be caused by interactions of photons with gravitons. Non-forehead collisions with gravitons will lead to a very specific additional relaxation of any photonic flux that gives a possibility of another interpretation of supernovae 1a data - without any kinematics. These facts may implicate a necessity to change the standard cosmological paradigm. Some features of a new paradigm are discussed. In a frame of this model, every observer has two different cosmological horizons. One of them is defined by maximum existing temperatures of remote sources - by big enough distances, all of them will be masked with the CMB radiation. Another, and much smaller, one depends on their maximum luminosity - the luminosity distance increases with a redshift much quickly than the geometrical one.

If the considered quantum mechanism of classical gravity is realized in the nature, than an existence of black holes contradicts to the equivalence principle. In this approach, the two fundamental constants - Hubble's and Newton's ones - should be connected between themselves. The theoretical value of the Hubble constant is computed. Also, every massive body would be decelerated due to collisions with gravitons that may be connected with the Pioneer 10 anomaly.

(1-3) **Was there a decelerating past for the Universe?**

M. V. John

The recent apparent magnitude-redshift data of Type Ia supernovae seem to bring in a paradigm shift in cosmology since these data indicate that the suspected dark energy in the universe can no longer be regarded as a cosmological constant of general relativistic origin or as the vacuum energy encountered in quantum field theories. Our knowledge of the physical world now remains deficient since no tested theory involves such a dark energy. Under this circumstance, an equation of state of the form $p = w\rho$ is not well motivated and one is unable to use the Einstein equation in this case as well. This major gap in our understanding of the density components in the universe and the equations of state obeyed by them leaves the solution of the Einstein equation speculatory to a great extent. The explanation of all other cosmological observations needs this solution, as it describes the expansion of the background spacetime. We argue that the reasonable remaining option is to make a model-independent analysis of SNe data, without reference to the energy densities. In this basically kinematic approach (John, M. V. 2004, ApJ, 614, 1), we limit ourselves to the observationally justifiable assumptions of homogeneity and isotropy, i.e., to the assumption that the universe has a RW metric. This cosmographic approach is historically the original one in cosmology. We perform the analysis by expanding the scale factor into a fifth-order polynomial, an assumption that can be further generalised to any order. The present expansion rates h, q_0, $r_?$ etc. are evaluated by computing the marginal likelihoods for these parameters. These values are relevant, since any cosmological solution would ultimately need to explain them.

Using this method, we also address an important question relevant to cosmology: Was there a decelerating past for the universe? To answer this, the Bayes's probability theory is employed, which is the most appropriate tool for quantifying our knowledge when it changes through the acquisition of new data. The cosmographic approach helps to sort out models which were always accelerating from those which decelerated for at least some time in the period of interest. Bayesian model comparison technique is used to discriminate these rival hypotheses with the aid of recent releases of supernova data. We also attempt to provide and improve another example of Bayesian model comparison, performed between some Friedman models, using the same data. It is argued that the lessons learnt using Bayesian theory are extremely valuable to avoid frequent U-turns in cosmology.

(3-10) **Quantum-redshift: explanation of the Hubble law by non-linear optics**

C. Jooss and J. Lutz

The hypothesis that the increase of the redshift of optical line spectra with the distance of the emitting source is due to the expansion of the universe, is one of the most important arguments of the big bang theory. However, E. Hubble did not support this opinion. An alternative explanation was given by F. Zwicky in 1929 with the tired light hypothesis. But Zwicky's theory was rejected with the argument, interaction with particles on the way of the light would lead to fuzzy pictures of distant objects, which is not the case.

In this paper we present a simple model for the energy loss of a photon during his travel which origins from non-linear optics. The model just assumes that the harmonic oscillator model of light has to be extended somewhat by an extremely small anharmonic contribution. This assumption seems to be very natural, since the model of a harmonic oscillator represents an idealization in the theory which is not perfectly realized in nature. An indirect proof of this model comes from standard laboratory experiments with non-linear optical media, where the anharmonicity is much stronger. There, the mechanism of parametric down conversion is applied to split a photon with Energy E into two or more fractions. In such quantum optical experiments also the interaction of photons with the zero-point radiation field is demonstrated via parametric amplification. The proof of the presence of the zero-point radiation field implies that the assumption of the travel of photons in an empty space is wrong.

Applying these well-established results of non-linear and quantum optics to the long distance travel of photons, the mechanism of parametric amplification represents a natural explanation of cosmological redshift. It results in a thermalization of photons and thus in the presence of a thermal radiation as it is observed with the microwave background radiation. Our model allows explaining further anomalies, such as the observed deviations from the linear Hubble law or the dependence of the redshift on the light intensity as observed by Finlay-Freundlich.

As a consequence of the explanation of the Hubble law by quantum optics, no expansion of space occurs and no big bang is necessary.

(P-1) **The evolution of the Universe in the light of modern microscopic and high-energy physics**

C. Jooss and J. Lutz

In the recent decades, experimental physics brought up the discovery of more and more structures of matter in the cosmos on increasingly larger but also on increasingly smaller length scales. Quantum-field- and high-energy-particle-physics both show that below the level of ”elementary particles”, a qualitatively new kind of continuous matter is present. The concept of a quantum aether was already introduced by Paul Dirac in the 1930ties. The huge progress of experimental investigation of quantum liquids in laboratories has brought up a new connection between condensed matter physics and high energy physics which shows that baryonic and leptonic particles are nothing as stable excitations of a new aether with properties similar to quantum liquids (Fig. 1). This insight has deep impact for the understanding of evolution processes of matter in the universe on macroscopic and microscopic scales which turn out to be strongly connected.

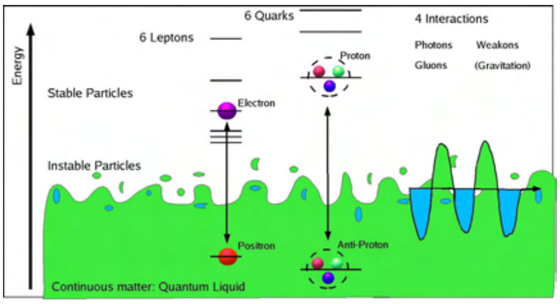

Figure 1: Continuous matter beyond the level of particles. According to quantum field theory all particles and interactions are instable and stable excitations similar to the excitations of a quantum liquid.

The evolution processes on the level of stars is already well known and their relation to the fusion of heavy elements and the evolution processes of atomic nuclei on the micro-scale are well established. But astronomy shows also an evolution process of galaxies (Fig. 2). This evolution process contradicts the big bang theory which postulates a creation of all galaxies at the same time.

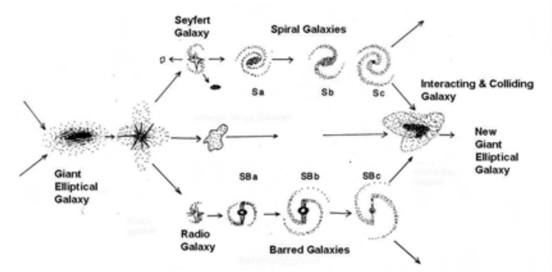

Figure 2: Evolution of Galaxies, based on assumptions of V. Ambarzumjan, extended with new facts from astronomic observations. Active states of giant Galaxies eject matter in continuous and in explosive form, new galaxies are formed, active in the first state (Seyfert state). Merge of galaxies form new giant Galaxies.

During their evolution, huge galaxies enter into a state with a highly active galaxy core. This state is related to the ejection of matter which in turn can form pre-states of new galaxies. The assumption of ”black hole like singularities” as driving force in active galaxies is much too primitive. Based on the concept of particles as topological defects in the aether quantum liquid, we suggest a model for the core of active galaxy nuclei: Similar to the compression of atoms to nuclear matter in a neutron star, a new extremely dense, high energy state of baryonic and leptonic particles develops in the core of galaxies. It is related to a local phase transition in the aether quantum liquid at the location of the galaxy core. After a certain critical mass (or energy) is exceeded, the particles lose their properties as massive and stable topological objects of the quantum liquid. They evaporate and the superdense core of the galaxy becomes instable towards the ejection low energy particles and hydrogen out of the dense region in jets.

Consequently, a connection between macroscopic and microscopic evolution processes of matter is also present on the level of galaxies.

The acceptance of an aether-like contiuum beyond the level of particles, introduced already by Paul Dirac, leads to an natural explanation of the redshift of distant galaxies as result of non-linear optics. No expansion of space an no big bang is necessary. The universe is infinite and a rich variety of evolutionary processes are present on all length scales of matter.

(1-4) **New analysis of observed high redshift Supernovae data show no time dilation when fitted to restframe templates where the restframe template timescale is not dilated**

S. P. Leaning

The SNe 1A data to date has been shown to compare favourably with a time dilation in line with those predicted by an expanding universe. However it is also true that these best fitting methods used to date, only test for dilation, and at no time test for results against a non dilated template. The incorrect conclusion from these papers is that a good fit to the data rules out any similar results possible for a non dilated fitting procedure. Whereas in fact the same high redshift data can be fitted to non dilated templates and give results that show no dilation of SN lightcurves is present and within the same error margins as those that are fitted to dilated templates.

In this paper the HST and groundbased data from 11 high redshift supernovae at $z = 0.36 – 0.86$ are fitted to undilated restframe composite lightcurves made from Supernova Cosmology project data.

The conclusion is that high redshift SNe 1A data can be shown to exhibit no time dilation within the same error margins as those of previous time dilated fittings and a non expanding universe can still be shown to be supported by this data.

(1-6) **Is the universe expanding? Tests of physical geometry**

E. J. Lerner

Recent galaxy data from Hubble UDF and HDF combined with comparison low and medium-z survey data make possible a definitive test between the Euclidean non-expanding and Friedman-Robertson-Walker FRW ($\Omega = 1$) Big Bang geometries as the appropriate physical geometry at cosmological scale. This is possible due to divergent predictions of surface brightness (SB) and the angular size of objects with increasing distance. FRW predicts that for a given absolute luminosity, SB scales as $(z+1)^{-3}$ when measured in photons/s, while the non-expanding model predicts a constant SB. As a corollary, predictions as to angular radius at a given luminosity are similarly divergent. We here compare the observed surface brightness and angular radius values for matched samples at redshifts up to 6 from the Goods and HUDF fields with the low redshift samples from GALEX. All samples are observed in the same at-galaxy wavelengths in the UV. The data allows us not only to distinguish between expanding and non-expanding models, but also to test various non-Big-Bang formulae for and explanations of the Hubble relationship.

The same data allows tests of the Big Bang hypothesis that the predicted surface brightness scaling does not hold because high-z galaxies are in actuality much smaller and have much higher intrinsic surface brightness than existing galaxies. We look at limits on UV surface brightness, UV extinction, ratios of stellar to gravitating mass, and L/M. These comparisons can rule out or confirm the evolutionary FRW explanation for the observations.

Finally we further test the non-expanding hypothesis against Type 1a supernovae data. Although this pure luminosity data does not well distinguish among various models, consistency with this data is necessary for a successful geometric model.

(3-2) **An overview of plasma cosmology**

E. J. Lerner

Plasma cosmology, which assumes no origin in time for the universe and no hot, ultradense phase of universal evolution, uses the known laws of electromagnetism and the phenomena of plasma behavior to explain the main features of the universe. Plasma cosmology is based on the following premises:

Since the universe is nearly all plasma, electromagnetic forces are comparable in importance with gravitation.

The same basic physical processes exist on earth as in the rest of the universe. The link between laboratory and cosmos exists for us as well as for Galileo.

Since we never see effect with cause, we have no reason to assume an origin in time for the universe, which is an effect with a cause.

Since we see evolution in every part of the universe, we can assume that the universe itself is evolving, but not necessarily at the pace assumed by the Big Bang

Finally, plasma cosmology takes the methodological stance that we should try to explain as mush of the universe as possible using known physics, before resorting to "new physics."

From these premises, plasma cosmology has been able to develop theories that can explain many of the observations that are challenging the Big Bang.

Observations of voids in the distribution of galaxies that are in excess of $100\ \mathrm{Mpc}$ in diameter, imply an age for these structures that is at least triple and more likely six times the hypothesized time since the Big Bang. The plasma cosmology approach can, however, easily accommodate large scale structures, and predicts a fractal distribution of matter with density being inversely proportional to the distance of separation of objects. This relation flows naturally from the necessity for collapsed objects to be collision, and from the scale invariance of the critical velocities of magnetic vortex filaments, which are crucial to gravitational collapse.

The predictions of the Big bang theory for the abundance of ^{4}He, ^{7}Li and D are more than 7σ from the data for any assumed density of baryons. In contrast, the predictions of the plasma alternative have held up remarkably well. Plasma filamentation theory allows the prediction of the mass of condensed objects formed as a function of density. This leads to predictions of the formation of large numbers of intermediate mass stars during the formations of galaxies. These stars produce and emit to the environment large amounts of ^{4}He, but very little C, N and O. In addition cosmic rays from these stars can produce by collisions with ambient H and him the observed amounts of D and ^{7}Li.

The observed preferred direction in the background anisotropy completely contradicts Big Bang assumptions. The plasma alternative views the energy for the CBR as provided by the radiation released by early generations of stars in the course of producing the observed ^{4}He. The energy is thermalized and isotropized by a thicket of dense, magnetically confined plasma filaments that pervade the intergalactic medium. The model can explain the observed anisotropies in the CBR and this alignment with the Local Supercluster.

(1-11) **Spectroscopic constraints on the cosmological variability of the fine-structure constant**

S. Levshakov

The dependence of fundamental physical constants on cosmic time is predicted by modern theories of fundamental interactions, such as super-string theories and cosmologies with compactified extra spatial dimensions. Changes in the sizes of the extra dimensions, R_{ex}, can be detected through variations of coupling strengths and masses in our low energy 4-D world. Spectral observations of distant quasars provide a framework for measuring time variations of the fine-structure constant, alpha. Predicted oscillations of alpha, if $(\mathrm{d}R_{ex}/\mathrm{d}t)$ is not equal zero, require accurate measurement of $(\mathrm{d}\alpha/\alpha)$ at each space-time coordinate. We have developed a method for probing such oscillations of alpha from pairs of FeII lines. The method provides an accuracy for a single absorber comparable to that of ensemble averages obtained in previous estimations from numerous absorbers distributed over a wide range of redshifts. Newest measurements of $(\mathrm{d}\alpha/\alpha)$ based on the VLT/UVES archive data will be presented.

(1-2) **Research on candidates to non-cosmological redshifts**

M. López-Corredoira

The paradox of apparent optical associations of galaxies with very different redshifts, the so-called anomalous redshift problem, is around 35 years old, but is still without a clear solution and is surprisingly ignored by most of the astronomical community. Statistical correlations among the positions of these galaxies have been pointed out by several authors, especially for QSOs with galaxies. Gravitational lensing by dark matter has been proposed as the cause of these correlations, although this seems to be insufficient to explain them, and it cannot work at all for the correlations with the brightest and nearest galaxies. Some of these cases may be just fortuitous associations in which background objects are close in the sky to a foreground galaxy, although the statistical mean correlations remain to be explained, and some lone objects have very small probabilities of being a projection of background objects.

The sample of discordant redshift associations given in Arp's atlas is indeed quite large, and most of the objects remain to be analyzed deeply. For about 5 years, we have been running a project to observe some of these cases in detail, and some new anomalies were added to those already known. For instance, in some exotic configurations like NGC 7603 or NEQ3, which can even show bridges connecting four object with very different redshifts. Not only QSOs but emission-line galaxies in general are found to take part in this kind of event.

(P-2) **Isotopes tell Sun's origin and operation**

O. K. Manuel

Measurements of isotope abundances and masses offer these conclusions on the Sun.

Abundances: The Sun and its planets formed out of highly radioactive, poorly mixed debris of a supernova that exploded $5\,\mathrm{Gy}$ ago. This conclusion is based on measurements of a) the decay products of actinide elements (^{235,238}U, ^{244}Pu) [1] and short-lived isotopes in meteorites and in the Earth [2,3], b) residual excesses in meteorites of stable isotopes made by the α-, r-, p- and s-processes of stellar nucleosynthesis [4], c) excess ^{16}O [5] and excess ^{136}Xe [6] in the Sun itself, and d) linked chemical and isotopic heterogeneities preserved in meteorites and planets [4]. Measurements on 22 atoms in the solar wind [7] and 72 s-products in the photosphere [8] show that the Sun acts as a huge plasma diffuser that selectively moves lightweight elements and isotopes of each element to its surface. Iron is the most abundant element in the Sun, in rocky planets and in ordinary meteorites.

Masses: Fusion cannot be the main source of luminosity in the Sun and Sun-like stars. The most abundant isotope of iron, ^{56}Fe, has tightly bound nucleons, and abundances of other elements in the Sun correlate with nuclear stability [9]. The discovery of rocky planets orbiting pulsar, PSR $1257+12$ [10], and systematic properties in the rest masses of the 2,850 known nuclides [11] suggest that neutron repulsion drives solar luminosity, solar mass separation, solar neutrinos, and the H-rich solar wind leaving the surface of an Fe-rich object that formed on the collapsed core of a supernova [12]:

- Neutron emission from the solar core: $<\mathrm{n}> \rightarrow \mathrm{n} + 10\text{-}22$ MeV
- Neutron decay: $\mathrm{n} \rightarrow \mathrm{H}^{+} + \mathrm{e}^{-} + \mathrm{anti}{-}\nu + 0.782$ MeV
- H^{+} upward migration and fusion: $4\,{}_1{}^1\mathrm{H}^{+} + 2\mathrm{e}^{-} \rightarrow {}_2{}^4\mathrm{He}^{++} + 2\nu + 27$ MeV
- H^{+} that reaches the surface: $2.7 \times 10^{43}\ \mathrm{H}^{+}/\mathrm{yr} \rightarrow$ Departs in the solar wind

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(3-9) **The parametric light-matter interactions in astrophysics.**

J. Moret-Bailly

The parametric (coherent) light-matter interactions (refraction, photon echoes, phase conjugation mirrors, photon splitting, ...) are strong effects which transfer energy and (or) momenta without quantification if the matter returns to its initial state. While these effects are commonly studied in the labs, they are ignored in astrophysics (except refraction) because they require uncommon conditions. However, atomic hydrogen in its states 2S or 3P (called H*) is able to "catalyse" transfers of energy from beams of ordinary light which have a high Planck's temperature (given by Planck's blackbody law) to colder beams, producing frequency shifts. Being coherent, the effect improperly called "Coherent Raman Effect on Incoherent Light" (CREIL), does not blur the images, and the relative frequency shifts are constant if the dispersions of the spectroscopic parameters are neglected. H* may be found if hydrogen is heated enough to become atomic ($T > 10000\,\mathrm{K}$), then excited either by a much higher temperature (100 000 K), provided that a sufficient density limits the ionisation, or by a Lyman alpha pumping. These conditions are fulfilled close to accreting neutron stars, leading to a very complicated spectrum which has exactly the characteristics of a quasar spectrum. The complexity of the spectrum is, in particular, a consequence of an instability due to the coupling of the Lyman alpha absorption with the frequency shift it provides through the CREIL in the produced H*. Thus, the periodicity of redshifts $z = 0.062$ observed by several authors results from the spectroscopy of hydrogen. The proximity of a hot source (quasar) produces H*, so that the objects close to a quasar appear anomalously redshifted. The transfers of energy to and inside the low frequencies produces a thermal, isotropic radiation whose temperature may reach several hundreds of kelvins close to bright, much redshifted objects. The CREIL in the photosphere of the Sun explains the fraction of the redshift proportional to the path of the light in this region. The Pioneer 10 and 11 probes have reached a region of the space where the protons and electrons of the solar wind are cold enough to combine, producing some H* which allows a transfer of energy from the solar light to the radiowaces which are blueshifted.

Using the CREIL, an elementary optical effect, explains a lot of observations, avoiding the introduction of strange theories and objects (dark matter, ...).

(3-8) **Large-scale gravitational quantization states in galaxies and the Universe**

F. Potter and H. G. Preston

Recent observations continue to challenge our understanding of the universe, with some results perhaps suggesting that there may be quantization behavior in its large-scale systems. We accept the challenge by discussing the key concepts and predictions of an alternative explanation, our proposed theory of large-scale gravitational quantization that predicts quantization states in solar systems, in galaxies, and in galaxy clusters, and describes some aspects of the present state of the accelerating universe. This theory is not the quantum gravity which would apply at the Planck scale, but instead a theory for quantization in large gravitationally-bound systems. Our only assumption is the simple replacement of Planck's constant $\hbar$ in a Schrödinger-like equation by the ratio $H = L/M$ of the total angular momentum to the total mass of the bound system, an equation which can be derived also from the general relativistic Hamilton-Jacobi equation and appropriate approximations. In the Schwarzschild metric the approximate solutions mimic hydrogen wave functions. Application to the Solar System reveals that the enormous angular momentum in the Oort Cloud determines the allowed equilibrium orbital spacings of the planets! At a larger scale, from galaxy quantization states calculated from the known baryonic matter, we derive (1) the galaxy disk rotation velocity $v = GM2/L$ without requiring dark matter, (2) the baryonic Tully-Fisher relation, (3) the MOND acceleration parameter, (4) the large angles for gravitational lensing results, etc. The theory predicted our Galaxy's halo stream of stars moving at one-half the disk velocity, halo stars that are in a different quantization state than the disk stars. Using the interior metric approximation, we derive a new Hubble relation that accounts for the acceleration of distant galaxies and allows us to achieve a reasonable estimate of the energy density of the vacuum with only a 5% matter density, suggesting that the total matter/energy density of the universe is at the critical density. A possible laboratory test might be the sensing of equilibrium distances for a torsion bar near a spinning mass or the drift of a satellite toward an equilibrium orbital radius. Many details are at gr-qc/0303112 and gr-qc/ 0405025.

(3-5) **Existing and unique firework universe and its 3D-spiral code**

E. Savov

The discovery of normal galaxies and heavy elements at the fringes of the observable universe is one of the sources of crisis in cosmology. The real universe unfolding is essential for progress in all scientific fields because the origin of chemical elements and space bodies creates the framework for understanding of everything. The big bang universe is believed to originate from a single point, called singularity. It is unknown why and how it remains finite. Singularity makes big bang picture incomplete because the laws of physics before big bang and universe evolution are uncertain. Once a fundamental flaw is allowed, i.e. universe born from an uncertain cause from something that can be infinite, then deep problems follow. For example, the origin of matter-antimatter asymmetry and density fluctuations accounting for structure buildup are poorly understood. The big bang is confused by found surprising similarity between near and most distant cosmos. In the big bang universe more than 90% of matter has unknown nature. Everything is interaction. Then the pattern of interaction explains everything. It creates what we see as matter, space and time. The pattern in which it remains always finite and generates the finite sources of reality accounts for many puzzling observations. This unifying 3D-spirally-faster-inward-oscillating pattern is discovered from spacecraft and ground observations of the solar wind-magnetosphere interaction [1, 2 and references therein]. It indicates hierarchical, fractal like, dynamic, 3D-spiral structure of existing and unique ”firework universe”, considered in theory of interaction [2 and references therein]. The ”firework universe” is singularity free, self-consistent and complete [2]. It shows that similar laws of physics describe self-similar 3D-spiral transforms of one all-building interaction that has 3D-spiral code [2]. The values of seen as fundamental physical constants originate in the process of observation, performed in the cyclic ”firework universe”, in which observer is born [2]. Dark matter, comic repulsion and the surprising similarity between the near and most distant universe are explained [2]. Observer in the ”firework universe” will measure constant speed of light, will obtain inverse square laws and principle of uncertainty [2]. One basic matter attracts itself by moving 3D-spirally faster inward. It over spins and bounces back, ejecting like fireworks similar finite sources of interaction that do the same [2]. Quantitative assessments made in theory of interaction terms: 1) indicate observation of constant speed of light; 2) confirm the ratio between masses of Sun and Earth and 3) are in agreement with the enigmatic sunward force that acts on Pioneer 10 and 11 spacecraft. Simply speaking, the discovered existing and unique ”firework universe” is made of multi-scale nuclei. The smaller nuclei are ejected from the insides of finite larger ones and move around them. Every body moves around its source, driven by its outer 3D-spirallyoscillating structure. Stars move around galactic nuclei. Atoms move around centers of stars and planets, accounting for the rotation of these space bodies.

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(1-1) **Modified Newtonian dynamics as an alternative to non-baryonic dark matter**

R. Scarpa

By the time, in 1937, the Swiss astronomer Zwicky measured the velocity dispersion of the Coma cluster of galaxies, astronomers got somehow use to the idea that the universe is filled by some sort of invisible matter. After almost a century of investigations, we have learned two things about this invisible matter, (i) it has to be non-baryonic, that is, it is made of something new that interact with normal matter only by gravitation and (ii) that mass discrepancies are observed in stellar systems when and only when the internal acceleration of gravity falls below a fixed value $a_0 = 1.2 \times 10^{-8}\,\mathrm{cm\,s^{-2}}$. From point (i) we get that dark and normal matter can mix in any ratio to form the objects we see in the universe, and indeed observations show that the relative content of dark matter varies dramatically from object to object. This is in open contrast with point (ii). Indeed, there is no reason why normal and dark matter should conspire to mix in just the right way for the mass discrepancy to appear always below a certain threshold. This systematic, more than anything else, tells us we might be facing a failure of the law of gravity in the weak field limit rather then the effects of dark matter. In an attempt to avoid the need for dark matter, of the many modification of the law of gravity, several of which have already been proved wrong, the most successful is the MOdified Newtonian Dynamics. MOND posits a breakdown of Newton's law of gravity (or inertia) below a_0, after which the dependence with distance became linear with an asymptotic value of the acceleration $a = \sqrt{a_0 g}$, where g is the Newtonian value. Despite many attempts, MOND resisted stubbornly to be falsified as an alternative to dark matter and succeeds in explaining the properties of an impressively large number of stellar systems without invoking the presence of non-baryonic dark matter. This suggests MOND is telling us something important about gravity in the weak field limit. In this talk, I will review the basics of MOND and its ability to explain observations without the need of dark matter.

(3-7) **Using globular clusters to test gravity in the weak acceleration regime**

R. Scarpa, G. Marconi, and R. Gilmozzi

Non-baryonic Dark Matter (DM) appears in galaxies and other stellar structures when and only when the acceleration of gravity, as computed considering all baryons, goes below a well defined value $a_0 = 1.2 \times 10^{-8}\,\mathrm{cm\,s^{-2}}$. This fact is extremely important and is also at the basis of the MOdified Newtonian Dynamics (MOND) that posits a breakdown of Newton's law of gravity (or inertia) below a_0. Observations do agree with MOND prediction in an impressive number of cases, suggesting MOND is telling us something important about gravity in the weak field limit.

Irrespectively of the validity of MOND, it is important to verify whether Newton's law of gravity holds below a_0. In order to do this, one has to study the dynamics of objects that does not contain significant amounts of DM. In this case, the dynamic should follow Newton's prediction for whatever small accelerations. Globular clusters are believed, even by strong supporters of DM, to be free from DM and therefore are ideal for testing Newton's law below a_0.

Here, we present the results of the study of three globular clusters. The novelty is that we were able to trace the velocity dispersion profile of these clusters far enough from the center to probe gravitational accelerations well below a_0. In all three clusters the velocity dispersion is found to remain constant at large radii rather than follow the Keplerian falloff. On average, the flattening occurs at the radius where the cluster internal acceleration of gravity is $1.78 \pm 0.4 \times 10^{-8}\,\mathrm{cm\,s^{-2}}$, fully consistent with MOND predictions.

Though it is still possible to find explanations of our observations within the boundaries of Newtonian dynamics (e.g., the constant velocity dispersion might be due to tidal heating), the conclusion of this work is that a striking similarity between the dynamical properties of elliptical galaxies, explained invoking DM, and globular cluster is emerging. More and more ¯ne tuning is necessary to account for all these ”coincidences”, making more naturale to think to a breakdown of Newton's law of gravity below a_0.

(1-9) **Real properties of magnetic fields and plasma in the cosmos**

D. E. Scott

Fundamental disagreements about the properties and behavior of magnetic fields exist between many modern astronomical hypotheses and the experimentally verified laws of electrical engineering and physics. Solar astronomers claim that magnetic fields begin on or beneath the Sun's surface and extend outward to infinity. Cosmologists have attempted to explain the twisting object observed at the center of the Milky Way called "The Snake" as having rigid magnetic connections to a (presumed) rotating molecular cloud at each end. Electrical engineers, most physicists, and historical investigators in electromagnetic theory disagree. Magnetic fields have no beginning or end - and field aligned (Birkeland) currents in arc mode plasma twist. There is basic disagreement about this basic physics.

Since these two viewpoints are mutually exclusive, both cannot be correct - one must be completely false. Any theories and/or proposed investigations based on demonstrably false physics are worthless. So this disagreement must be resolved. Many astrophysicists also claim that magnetic fields are "frozen into" electric plasma. We examine the basis for this claim. It has been shown to be incorrect in the laboratory. The oft-pronounced "magnetic reconnection" hypothesis of solar astronomers is reviewed in light of both theoretical and experimental investigations. The cause of filamentation in plasma is also simply explained.

Recently astrophysicists have been discovering (inventing) hypothetical entities and forces at an increasing rate. They have done so with impunity because these entities are not falsifiable - no in situ experiments are possible in remote space. But, when experimentally verified laws of electrical science that have been used successfully for decades are disregarded or misinterpreted, it is time to present a challenge - to initiate a dialog between the two camps that will resolve this contradiction.

(2-3) **Absolute simultaneity forbids the big bang**

F. Selleri

According to Reichenbach, Jammer and Mansouri-Sexl, the Lorentz transformations contain a purely conventional term, the coefficient of x in the transformation of time. Reconsidering the whole matter I reformulated the transformation of the space and time variables between inertial frames and obtained the ”equivalent transformations” containing an indeterminate term, e_1, the coefficient of x in the transformation of time (”synchronization parameter”). The Lorentz transformations are obtained for a particular $e_1 = 0$. No standard experiment on relativity depends on e_1, but if accelerations are considered the conceptual situation is modified to the point that absolute simultaneity ($e_1 = 0$) becomes necessary. We will recall four experiments (real or *gedanken*) whose explanation requires $e_1 = 0$. In all of them accelerations play a role, one way or another: the linear nonuniform motion of two spaceships, the propagation of light on rotating platforms, the aberration of starlight and the clock paradox.

An often used method for providing an intuitive understanding of the *big bang* is the analogy between the universe and the surface of an inflating rubber balloon covered with dots, with the proviso that the real world is, however, the three dimensional surface of a four dimensional sphere. The use of the four dimensions is essential. In fact, in ordinary three dimensional space the *big bang* would be a great explosion producing matter, throwing it in all directions and generating galaxies with different velocities. Seen globally the cosmos would be an irregular structure composed of an empty central region, the ”crater of the explosion”, an intermediate region containing the galaxies and an external part containing only radiation. Whatever our position might be in the intermediate region, we would see a vault of heaven very different from the basically isotropic one disclosed by the great telescopes. No structure in three dimensional space, born from an explosion occurred 10-20 billion years ago, could resemble the universe we observe.

As a result, all theoretical *big bang* models introduce a fourth dimension. We should then stress that from a conceptual point of view these models have a very unstable equilibrium, based as they are on the four dimensional space of general relativity, in turn derived from the Minkowski space of the TSR. Thus the *big bang* depends heavily on the mixing of space with time of the TSR. In other words, it is in great danger if one modifies the fourth Lorentz transformation. But this is exactly what we did by adopting the transformations with $e_1 = 0$ and giving up the Lorentz transformations! With $e_1 = 0$ time is independent of space and a conception of reality is introduced in which no room is left for a four dimensional space. Forced by the experimental evidence to reappropriate a space with three dimensions, we conclude that the *big bang* theory cannot be true. No structure of three dimensional space, originating from an explosion 10-20 billion years ago, could represent a universe similar to the one we observe. The *big bang* never happened!

(1-7) **Is the low-λ microwave background cosmic?**

G. D. Starkman

The Wilkinson Microwave Anisotropy Probe (WMAP) has measured the fluctuations in the microwave background radiation over the entire sky at impressive angular resolution and signal to noise. This allows us to investigate the properties of the universe on the largest scales – it's geometry, topology, thermal and expansion history. But the microwave background radiation on large angular scales seems to have some rather bizarre statistical properties. Not only is there a lack of "low-λ power", but the low-λ modes are aligned with each other and with the geometry of the solar system. This suggests that the reported microwave background fluctuations on large angular scales are not in fact cosmic, with important consequences.

(4-1) **Differentiating between modified gravity and dark energy**

G. D. Starkman

The nature of the fuel that drives today's cosmic acceleration is an open and tantalizing mystery. We entertain the suggestion that the acceleration is not the manifestation of yet another new ingredient in the cosmic gas tank, but rather a signal of our first real lack of understanding of gravitational physics. By requiring that the underlying gravity theory respects Birkhoff's law, we can derive the modified gravitational force-law necessary to generate any given cosmology, without reference to the fundamental theory, revealing modifications of gravity at scales typically much smaller than today's horizon. We discuss how through these modifications, the growth of density perturbations, the late-time integrated Sachs–Wolfe effect, and even solar-system measurements may be sensitive to whether today's cosmic acceleration is generated by dark energy or modified gravitational dynamics, and are subject to imminent observational discrimination. We argue that these conclusions are more generic, and probably not dependent on the validity of Birkhoff's law.

(3-6) **Back to the basics – observations support spherically closed dynamic space**

T. Suntola

The description of space as the surface of a 4-sphere expanding in a zero-energy balance between the energies of motion and gravitation allows the conversion of Einsteinian spacetime in varying time and distance coordinates to dynamic space in absolute coordinates [1-6]. In such an approach, space as the surface of a static 4-sphere proposed by Einstein in 1917 [7] is replaced by the surface of a dynamic 4-sphere, which is how the description of space and time most probably would have been formulated if Edwin Hubble's observations, or at least if atomic clocks and recent supernova observations, had been available in the early 1900's.

In dynamic space the rest energy of matter appears as the energy mass has due to the motion of space in the direction of the 4-radius of the structure and, as a consequence of the conservation of the zero energy balance, the velocity of light in space becomes fixed to the velocity of space in the fourth dimension. Motion *in* space becomes related to the motion *of* space, and the local reference at rest becomes related to the state of rest of the local energy system instead of the state of an inertial observer. The concept of proper time in relativity theory is replaced by a direct effect of motion and gravitation on the characteristic emission and absorption frequencies of atomic objects, thus creating a direct link to quantum mechanics.

Local space near mass centers is tilted due to the zero energy balance; the fourth dimension of true metric nature allows closed mathematical solutions of perihelion advance, the bending of light, and the Shapiro-delay. Further, it extends the validity of celestial mechanics to local singularities in space. In dynamic space a point source of electromagnetic emission can be studied as a dipole in the fourth dimension: By solving Maxwell's equations, the energy of a quantum can be identified as the energy of one cycle of radiation emitted by a single transition of a unit charge in a point source [6]. Electromagnetic resonators appear as closed energy systems - as a consequence, Michelson-Morley type experiments in moving frames show a zero result.

Instead of a sudden appearance in a big bang, the buildup and release of the rest energy of matter is described as a zero energy process of motion and gravitation of spherically closed space from infinity in the past through singularity to infinity in the future. The basic form of matter appears as formless dark matter. Conversion of formless matter to electromagnetic radiation, elementary particles and structured material can be understood as a secondary energy buildup process in local singularities in space.

As a consequence of the conservation of energy in interactions in space, the orbital radii of local gravitational systems expand in direct proportion to the expansion of the 4-radius of space resulting in, for example, the Euclidean appearance of galactic radii in distant space. As a consequence of the expansion in zero energy mode, the age estimates obtained by radioactive dating are reduced due to the higher decay rate in the young expanding universe (the decay rate is inversely proportional to $t^{1/3}$). The prediction derived for the magnitude versus redshift of a standard emission source gives a perfect fit to recent supernova observations without an assumption of dark energy [8].

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(1-8) **Non-linear structures in gravitation and cosmology**

F. Sylos Labini

I will first give a brief overview of the state of observations of large scale structure in the distribution of galaxies in the Universe, and also of the main theoretical instrument – gravitational N-body simulation – used to explain their origin in standard cosmological models. I will then discuss the principal properties of the ”non linear” structures encountered in both contexts, describing some of the basic statistical methods for their characterization. I explain that despite a similar power-law two-point correlation function characterising both cases, the fluctuations may in fact be qualitatively very different in nature, and I report observational evidence that this is indeed the case. Particularly I will comment about recent results on galaxy correlations obtained from the SDSS data. I conclude with a discussion of some of the open theoretical questions raised by these results.

(P-4) **Common absorption lines in two quasars**

Y. P. Varshni

We have found that in the absorption-line spectra of two quasars, 0237-233 and HE 1122-1648 there are a large number of common lines in the observed frame (earth frame). The number of common lines in the interval 3716-4116 AA is 64 while the expected number from the chance–coincidence theory is only 49.7 plus/minus 3.8.

The redshift hypothesis can not explain these coincidences. On the other hand, these coincidences can be readily understood on the basis of a theory of quasars proposed by us (1975, ApSS 37, L1; 1977, ApSS 46,443; 1979 Phys.Canada 35,11) according to which a quasar is a star in which the surface plasma is undergoing rapid radial expansion giving rise to population inversion and laser action in some of the atomic species.

The assumption of the ejection of matter from quasars at high speed is supported from the fact that the widths of emission spectral lines observed in quasars are typically of the order of 2000 - 4000 km/sec. The ejected matter can form a nebulosity around the quasar or dissipate into space. Laser action is enhanced if the hot plasma contacts this colder gas. No redshifts are needed. This model is called the plasma-laser star (PLAST) model. Most of the observational evidence on quasars either supports this theory or is consistent with it.

If we consider two stars which belong to the same spectral class or to very neighbouring spectral classes, for example two A2 type stars or one A2 type star and the other A3 type star, then they have very many common absorption lines. This arises because in the two cases the plasma where the absorption is occurring is very similar in the two cases. In our theory of quasars the absorption is occurring in the extended atmosphere of a star, much like a shell star. The coincidences between the wavelength of lines in 1122-1648 and 0237-233 is occurring because the shells of these two stars are quite similar.

(P-5) **Peaks in emission lines in the spectra of quasars**

Y. P. Varshni, J. Talbot and Z. Ma

We report on a rather remarkable and surprizing result in the distribution of emission lines (in the observed frame) in the spectra of quasars. We converted to observed frame 14277 rest frame emission lines listed in the Hewitt and Burbidge (1993) quasar catalog. When a histogram is plotted with frequency of an emission line against the wavelength, 37 very strong peaks are found. We were further surprised to find 27 of these 37 lines in the spectra of Wolf-Rayet stars. An additional 5 lines are seen in novae like stars. Further, one more line is possible in Wolf-Rayet stars. In the redshift hypothesis there is no reason why the emission lines in the observed frame should show these peaks. Thus the redshift hypothesis is unable to account for these peaks.

Theoretical and experimental investigations in physics in the 1960's and 1970's showed that when a high temperature plasma rapidly expands (for example, in vacuum) the resulting cooling leads to a population inversion in the lower levels of the atom, and this can lead to laser action.

This led Varshni (1975, ApSS 37, L1; 1977, ApSS 46,443; 1979 Phys.Canada 35,11) to propose that a quasar is a star in which the surface plasma is undergoing rapid radial expansion giving rise to population inversion and laser action in some of the atomic species. The assumption of the ejection of matter from quasars at high speed is supported from the fact that the widths of emission spectral lines observed in quasars are typically of the order of 2000 - 4000 km/sec. The ejected matter can form a nebulosity around the quasar or dissipate into space. Laser action is enhanced if the hot plasma contacts this colder gas.

No redshifts are needed. This model is called the plasma-laser star (PLAST) model. Most of the observational evidence on quasars either supports this theory or is consistent with it. The existence of the wavelength peaks can be readily understood on this theory. It is known that some atomic transitions are more susceptible to laser action than others. The peaks correspond to such transitions and such lines occur more often in quasar spectra.

(1-10) **The top problems with the big bang: the case of light elements**

T. van Flandern

The Big Bang theory has never achieved a true prediction success where the theory was placed at risk of falsification before the results were known. It is instead a series of accommodations of existing observations aided by a variety of ad hoc helper hypotheses, the best known of which are ”dark matter” and ”dark energy”. A decade ago, a list of the top 10 problems with the theory seemed to encapsulate the situation. That list of problems has since expanded twice, and now stands at 50. We will discuss the light element abundances problems in some detail, and mention a few of the more remarkable recent additions to the problems list.

Contradictions with light element predictions include:

1. Observed deuterium abundances are inconsistent with observed ^{4}He and ^{7}Li abundances. Attempts to explain this have fallen flat.

2. D/H near the Galactic center is 5 orders of magnitude higher than predicted. Either value measured for quasars produces problems.

3. Be and B are thought to be secondary elements from supernovae produced by spallation. However, the Be abundance in at least one metal poor star is greater than spallation allows.

Another outstanding problem is that there is too little time to form large scale structures, especially those existing at high redshift: The time required to form voids in the early universe was not available in BB models. A string of perhaps thousands of galaxies at 10.8 billion light years distance (in a 13.7 Gyr old universe) is too large to have formed that quickly in any existing models.

Nor is there evidence of the enormous evolution that should have occurred in a 14 Gy-old universe: Gamma ray bursts at high redshifts indicates that star formation rate remains constant even for $z > 10$. Supernovae during the last 11 Gyr seem to have had no significant effect on average metal abundances.

It should be evident to objective minds that nothing about the universe interpreted with the Big Bang theory is necessarily right, not even the most basic idea in it that the universe is expanding.

(3-14) **Kinematic cosmology**

M. Wegener

Kinematic Cosmology (KC) is a scientific program that derives from the British tradition in relativistic cosmology, represented by the names of E.A. Milne, A.G. Walker and G.J. Whitrow.

Milne developed his Kinematic Relativity (KR) in direct opposition to Einstein's theories, viz., that of Special Relativity (SR), and that of General Relativity (GR), Milne (1935) & (1948). By placing the Lorentz Transformations (LT) firmly in a cosmological context from the beginning he avoided the artificial distinction between a special theory without gravity and its generalisation. Milne's ingenious proposal was to view gravitation as a local consequence of universal expansion, instead of seeing it as a brake on that expansion; in this way he obviates the need for reviving . By this move relativistic kinematics is taken to be more basic than gravitational dynamics.

Walker soon generalized Milne's ideas in a series of papers: first by showing how Milne's world model of uniform expansion could be replaced by a general metric, the so-called Robertson-Walker Metric (RWM), which encompasses an infinity of world models subject to the principle of Cosmic Isotropy, often called the Cosmological Principle (CP) - and then by demonstrating how KR could be expanded into a complete relativistic dynamics for time & 3-space, thus avoiding the combrous 4-space geometries of Minkowski and Riemann characterising Einsteinian SR and GR. With RWM, the Newtonian idea of a Cosmic Time is in fact restored against the spirit of Einstein and in spite of his celebrated dissolution of classical time and absolute simultaneity.

Whitrow - famous for his monumental Natural Philosophy of Time, Whitrow (1967/1980), that furthered the founding of International Society for the Study of Time (ISST) - first served as Milne's assistant with important contributions to KR, but later deserted his master by surrendering to the prevailing paradigm of Einstein. However, by his acute analyses of the concepts of time in relativity theory and relativistic cosmology, by his thoughtful comparison of those concepts to the idea of a pre-established harmony as conceived by the great philosopher and mathematician G.W. Leibniz (1646-1716), and by his interesting derivation of RWM from the famous -factor of SR, he prepared the way for a coming renaissance of KR in a more general context as KC.

The present paper goes a further step towards developing a genuine KC by taking CP, and thereby the assumption of a Cosmic Time, as its point of departure. The Idea of a Cosmic Time which pervades the universe as a cosmic rhythm (Whitrow) is latent in the tacit assumption of GR that atoms of the same kind always oscillate with the same natural frequency in zero-field space. CP implies a distinction between a privileged equivalence class of fundamental particles (FP), called the substratum, which taken together define the general structure of the universe as one of perfect symmetry, and a class of non-equivalent accidental particles (AP), not belonging to the substratum and in various ways deviating from that symmetry. This deviation explains why the LT - which undoubtedly are valid for all FP, members of the substratum, but which for equivalent particles are easily transmuted into the classical Galileo Transformations (GT) - may be invalid for the transformation of coordinates between FP and AP, as well as for those between AP alone.

If the Relativity Principle (RP) of Poincaré and Einstein does not hold between AP, nor between AP and FP, but only between FP, the situation in cosmology is very similar to that envisaged by T.E. Phipps and F. Selleri, where not the entire SR, but only its -factor, is valid for the accelerated motion of test particles (AP). Identifying RP with CP, and exploiting the -factor in new ways, the paper concludes by suggesting Three World Models of Continued Creation: 1) a new Steady State model, avoiding the number count difficulty facing the old one, 2) a new model of a Heavy Blow, starting with a ”bang” and approximating a steady state, and 3) a new model of a Gentle Flow, starting with a ”whimper” and approximating the same state.

The difference between the old SS-model of Bondi & Gold and the one here presented is crucial since the new model implies a relativistic crowding effect which allows the new SS-model to simulate the increase of density with distance displayed by the (evolving) standard BB-model. In this model there is no horizon separating a finite visible universe from an infinite invisible one. By accepting a Cosmic Time as its very foundation, our new model naturally incorporates the classical idea of an absolute and universal simultaneity (referring to Newtonian coordinates) as well as the modern idea of the local relativity of simultaneity (relating to Einsteinian coordinates). So it easily accomodates all evidence counting in favour of an absolute simultaneity (aberration, Sagnac effect, GPS-signals) as argued by Phipps, Hatch, Selleri, and Guy.

(3-17) **The planetary perturbative part of the perihelium advance of the planet Mercury**

H. Yilmaz

As is well known, the planetary advance of Mercury has two parts: 1) The $523"$ per century planetary perturbative part, and 2) the $43"$ per century relativistic test-body part. Observation yields a single number $575"$ which is the sum of the two. It is found that the sum can be represented as

$$\dot{\tilde{\omega}} = 532"\lambda + 43" \text{ per century}$$

where λ is related to the field equations as

$$\frac{1}{2}G^{\nu}_{\mu} = \tau^{\nu}_{\mu} + \lambda t^{\nu}_{\mu}$$

Here t^{ν}_{μ} is the gravitational field stress-energy tensor.[1] Thus the observed result, $575"$ per century, implies that the field equations of general relativity be modified with value $\lambda = 1$. This remarkable conclusion is explained in detail.

[1]The expression of t^{ν}_{μ} is $t^{\nu}_{\mu} = -\partial_{\mu}\phi\partial^{\nu}\phi + \frac{1}{2}\delta^{\nu}_{\mu}\partial^{\alpha}\phi\partial_{\alpha}\phi$ where ϕ is an N-body potential $\phi_A = \sum_B m_B/|x_A - x_B| + C$.

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Map of Monção

Courtesy of Região de Turismo do Alto Minho