A 160 MEV BARYONIC BOUNCE MODEL
OF THE BIG BANG

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The big bang required a core energy $\approx 160$ MeV to propel the farthest galaxies at $0.5c$. Its baryon/photon ratio becomes $\eta = 87.6\Omega_B h^2$, comparable to a supernova. Enough baryons can be produced by nucleosynthesis to close the universe. Accretion photons emitted during the prior contraction supplied the CMBR planck spectrum at $2.73^oK$. The expanding nonisotropic big bang did not change this smooth planck spectrum, which contains evidence of prior emission. The finding of primordial deuterium levels varying by a factor of 10 is evidence of large scale structure during nucleosynthesis. Rotating black holes from the exploding shell of matter were the density perturbations for galaxy formation. Sufficient baryonic matter was recaptured during the expansion, increasing the universe scale factor and allowing distant type Ia supernovas to occur in a closed universe. Collapse to infinite density states must be prevented by energy losses at supranuclear densities. A low energy bounce model with zeroing of the stress-energy tensor can solve

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the hot big bang problems.
I. INTRODUCTION: Limits on general relativity

General relativity was discovered early this century and twenty four years after its introduction, it was found to predict black holes [20]. Relativity has been extrapolated to where stars, galaxies and the whole universe could be compressed into a space smaller than an atom. There is not one shred of evidence that the universe started at Planck densities $\rho = 10^{93}g/cm^3$ and temperatures $T = 10^{31}\text{oK}$. No high energy phenomena have been found from the first instant of creation. The nucleosynthesis of light atomic nuclei $^4\text{He}$, $^2\text{H}$, and $^7\text{Li}$ took place around densities of $10^5g/cm^3$ and temperatures of $\sim 10^{10}K$, according to accepted models [23,31]. These conditions are the most extreme that has been confirmed in the big bang. Thus general relativity, as applied to the universe [27], has been extrapolated eighty orders of magnitude in density from points at which it has been validated. The Einstein field equation is

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} \equiv G_{\mu\nu} = 8\pi G T_{\mu\nu} + \Lambda g_{\mu\nu}$$ (1.1)

$G_{\mu\nu}$ is the Einstein tensor, $T_{\mu\nu}$ is the stress-energy tensor for all the matter and energy fields. $\Lambda$ is a cosmological constant. Only for a homogeneous, isotropic universe, the field equation has been simplified to the Friedmann equation

$$H^2 + \left(\frac{K}{a^2}\right) = \left(\frac{\dot{a}}{a}\right)^2 + \left(\frac{K}{a^2}\right) = \left(\frac{8\pi \rho G}{3}\right),$$ (1.2)

where $H \equiv \frac{\dot{a}}{a}$ is the Hubble constant, which is time dependent. $G$ is the gravitational constant, $\rho$ is the mass-energy density, $p$ is the pressure and $a(t)$ is the scale factor of the universe, $\sim 10^{28}cm$, presently. The perfect fluid in the stress-energy tensor

$$T_{\alpha\beta} = \rho \delta_{\alpha\beta} + p(g_{\alpha\beta} + \delta_{\alpha\beta}),$$ (1.3)
ignores viscosity, shearing forces and subatomic effects including differences between individual baryons and bulk baryons, \( n_B \gg 10^3 \). Since it has been validated up to nuclear densities in pulsars, changes in the stress-energy tensor \( T_{\alpha\beta} \) at higher densities will be investigated.

II. Theoretical changes necessary

The Oppenheimer and Volkoff equations of state \[21\] are used for neutron density matter and neutron stars up to \( 3 \times 10^{14} \text{gm/cm}^3 \),

\[
\frac{dm}{dr} = 4\pi r^2 \rho
\]

\[
\frac{dp}{dr} = -(\rho + p)(m + (4\pi r^3 \rho))/r(r - m), \tag{2.1}
\]

where \( m \) is the mass within a given radius \( r \). Since these equations result from the field equation, information about the density change with pressure is also necessary. Neutron stars theoretically have masses up to \( 5M_\odot \). Single neutrons have a compression energy about 300 MeV to smash them into quarks \[10\]. Colliders start producing quark-gluon plasma at energies over \( 2 \times 10^{12} K \approx 184 MeV \). If matter in this temperature range has an abrupt (first order) transition, superheating can trigger explosions \[33\]. After all the space in the neutron is eliminated \( \rho > 10^{17} \text{gm/cm}^3 \) with particle overlapping, the net quantum effect of further collapse must be repulsion, neutron deformation and a reversible energy sink. A reduction in kinetic energies including rotational and vibrational should result in a corresponding increase in potential energy. Since nuclear pressures can’t halt a gravitational collapse, sufficient energy loss at supranuclear densities must result in a stable configuration prior to
quark formation. An inhomogeneous collapse must stop when the compression energy losses of core neutrons at peak $\rho \sim 10^{18} - 10^{19} g/cm^3$ exactly match the gravitational energy, as shown in figure 1.

III. Resulting changes in our understanding

Prior to the big bang, core densities increased and the energy sink losses rapidly overtook the collapse energy by an overall mass-density $\rho \sim 10^{16} gm/cm^3$. If all the matter in the universe was in a spherical mass to start, its radius was $\sim 10^{13} cm$. As the density rose in the core, the field disappeared and the pressure $p = \rho/3 \rightarrow 0$ in the stress-energy tensor as well. By including this energy loss, energy-momentum is conserved. With $T_{\mu\nu} = 0$, the curvature tensor $R_{\mu\nu} = 0$ and the vacuum energy $\lambda = 0$, an open universe existed during $t \leq 0$. No singularities ever existed since there were no infinities in energy, density or time. Accretion and other photons from previous universes were very red shifted by release into volumes much greater than today, so that they played no role during the open universe period. Neutron compression energy supplied $\approx 160 MeV \approx 1.85 \times 10^{12} oK$ which propelled the farthest galaxies $\sim 0.5c$. After the bounce, the metric changed to flat. There was no difference whether the early universe was closed or open [18]. The extrinsic curvature $(6a^2)/a^2$ was much more important than the intrinsic curvature $±6/a^2$ within any hyperspace of homogeneity, since $\dot{a}^2$ was very large initially. The zones of influence were too small to respond differently to negative or positive spacetime curvatures.

The standard hot universe problems [17], can be summarized and solved with the above correction. The singularity problem follows from the scale factor of
the universe $a(t)$ vanishes as $t \to 0$ and the energy density becomes infinitely large. The inhomogeneity of matter with the energy sink and red shifting of radiation prior to the big bang caused the total energy-density $\to 0$.

The flatness problem can be stated in several ways. The ratio of the universe’s mean mass density to the cold Einstein-de Sitter universe

$$\frac{\rho}{\rho_c} = \frac{3H^2}{8\pi G}.$$  \hfill (3.1)

The Friedmann-Robertson-Walker (FRW) equation implies that this ratio, which was proportional to curvature, was $1 \pm 10^{-60}$ at the Planck era. The kinetic energy $(\dot{a}/a)^2$ was equal to the gravitational mass-energy $8\pi G/3$, so that $k \approx 0$ in equation (1.2). Only a bounce mechanism by which the gravitational mass-energy was converted into kinetic energy could allow the universe to be so flat without evidence of high energies such as monopoles or a sea of neutrinos. $\sim 160$ MeV was sufficient to break the shell into billions of cold baryonic masses $\leq 10^{16} M_\odot$. For mass $M$ the gravitational radius is $R_g = GM/c^2$. Then

$$\rho = c^6/G^3 M^2,$$  \hfill (3.2)

at black hole formation. Thus primordial holes could only be formed from the expanding shell neutrons in masses $\geq 7 M_\odot$ if $\rho_{\text{max}} \approx 10^{16} g/cm^3$. If this density can not be exceeded, then smaller black holes $< 1 M_\odot$ could not be formed, which would explain the missing Hawking radiation \[13\]. It would also explain the finding of six black holes all $\approx 7 M_\odot$, none smaller $4$.

The horizon problem has to do with areas in the initial instant of creation that are too far from each other to have been influenced by initial disturbances. A light pulse beginning at $t=0$ will have traveled by time $t$, a physical distance

$$l(t) = a(t) \int_0^t dt' a^{-1}(t') = 2t,$$  \hfill (3.3)
and this gives the physical horizon distance or Hubble radius $dH$. In a matter dominated universe without vacuum energy $\lambda = 0$, 

$$dH \approx 2H_0^{-1}\Omega_0^{-1/2}(1 + z)^{-3/2}, \quad (3.4)$$

where $\Omega_0 = \rho/\rho_c$ in the present universe. This distance is compared with the radius $L(t)$ of the region at time $t$ which evolves into our currently observed area of the universe $\approx 10^{10}$ years. Using any model near Planck conditions, this ratio $l^3/L^3$ is going to be very small, about $10^{-83}$. Since the average baryonic density initially is $\sim 10^{16} g/cm^3$ rather than Planck densities of $10^{93} g/cm^3$, the horizon problem is diminished by a factor of $\sim 10^{77}$. Either the continuing loss of shell mass during a Milne universe $R_{\mu\nu} = 0$ or a major disturbance near the end of the collapse phase, will allow a nearly simultaneous release of the stored neutron compression energy. Since state data on bulk nucleons at supranuclear densities is lacking, a reduction equation for a static system is extrapolated for compression losses of $E_{\text{sink}} = \exp(\rho/2 \times 10^{14})$ in the energy term $T_{\hat{\rho}0}$.

The homogeneity and isotropy problems arise due to the postulated start of the universe in such a state. The distribution of galaxies and clusters are not quite random on large scales. A compilation of 869 clusters has shown a quasi-regular pattern with high density regions separated by voids at intervals $\approx 120 Mpc$. The CMBR has dipole anisotropy not due to our Local Group motion. The universe is not quite isotropic on its largest scales. It has long been assumed that galaxy formation, which started after the decoupling of matter and energy, grew by gravitational amplification of small density fluctuations. With the Hubble space telescope, there is evidence that galaxies were assembled $z > 4$. Primordial galaxies, composed of hot $^1H - ^4He$ clouds orbiting the black hole remnants of the cold shell, were present prior to decoupling of matter.
and energy $z \approx 1100$. Evidence for this is found in the variation of primordial deuterium by a factor of 10. Large masses slow down the local expansion rate, allowing more time for deuterium to be converted to helium and correspond to a Jeans mass of $\sim 10^6 M_\odot$. As the universe expanded and these shell remnants separated, hydrogen was efficiently removed from intergalactic space down to the Gunn-Peterson $^1H$ limit, and attenuated the CMBR temperature gradients as follows. Hot electrons upscattered the redshifted photons emitted by orbiting hydrogen deeper in the protogalactic wells. With decoupling, there are three types of scattering which accomplished this. Thompson scattering by itself can not help thermalization because there is no energy exchange between the photons and electrons. If

$$\sigma_T = \frac{8\pi}{3(e^2/m)^2},$$

(3.5)

is the Thompson scattering cross section, then the mean-free-path for a photon between collisions is

$$\lambda_\gamma = (\sigma_T n_e)^{-1},$$

(3.6)

where $n_e$ is the number density of electrons. While traveling a distance $l$, the photon will perform a random walk and undergo $N$ collisions where $N^{1/2} \lambda_\gamma = l$. Since Compton scattering will not change the number of photons, it will not create a Planck spectrum. Free-free absorption at a frequency $\omega$, is given by

$$t_{ff} \cong 3(6\pi mT)^{1/2}m\omega^3/(32e^6n_e^2\pi^3)/(1 - e^{-\omega/T}).$$

(3.7)

For photons with a frequency $\omega \approx T$ in electron volts,

$$t_{ff} = 2 \times 10^{14}sec(\Omega_B h^2 x_e)^{-2}T^{-5/2}.$$
For ionization fraction \( x_e \approx 1 \),

\[
t_{ff}/H^{-1} \approx (T/1.9 \times 10^4 \text{eV})^{-1/2}(\Omega_B h^2)^{-2}.
\] (3.9)

Thompson scattering increases the effective path length for photon absorption of free-free scattering

\[
\bar{t} = 1.1 \times 10^{11} \text{ sec.} T^{-11/4}(\Omega_B h^2 X_e)^{-3/2}.
\] (3.10)

With primordial galaxies, free-free can dominate over Compton scattering between 90eV-1eV, lead to true thermalization and diminish temperature gradients in the CMBR. Figure 2 diagrams the universe starting with the big bang expanding in FRW geometry from an initial mass of radius \( a(t) \sim 10^{13} \text{cm} \). Radiation energy \( \rho_R \propto a^{-4} \) and \( T \propto a^{-1} \). An increase in \( a(t) \) from \( 10^{13} \text{cm} \) to \( 10^{28} \text{cm} \) today caused the corresponding temperature of big bang photons to drop from \( 1.85 \times 10^{12} \text{eV} \) to \( 0.00185 \text{eV} \). Big bang photons are thus the small tail of the thermal spectrum near absolute zero. See for example [34] which diagrams and discusses reasons for this tail. After the scale factor began to decrease from the maximum, galaxies began to merge \( a(t) \sim 10^{25} \text{cm} \). The smooth Planck spectrum at \( 2.73 \text{K} \) was released by accretion at \( T \approx 2.73 \times 10^6 \pm 16 \text{K} \) when \( a(t) \sim 10^{22} \text{cm} \), as their nuclei merged. After the massive black hole lost energy by core compression, open spacetime \( T_{\mu\nu} = 0 \) propagated outward. Figure 2 actually diagrams the thickness of \( R_g \) as outside the radius remained constant. The initiation of the big bang occurred prior to the end of the collapse phase. Reasons for this are discussed in the supernova Ia problem below. Due to the potential barrier, the universe will remain closed even if \( \Omega_o < 1 \). Evidence for the existence of this barrier comes from the highest energy cosmic rays. Particles coming into the expanding universe by crossing this great potential could easily be given > \( 10^{20} \text{eV} \) energies without the energy cutoff at \( 5 \times 10^{19} \text{eV} \) due
COBE satellite data showed a $\Delta T \approx 45$ microkelvins at CMBR photon separations greater than $40^\circ$ and diminishing toward zero for lesser separations. These are plotted as $\Delta T^2$ versus angle of separation in figure 3, adopted from Guth [11]. The horizon distance at decoupling in degrees is

$$\theta(dH) = 0.87^o \Omega_0^{1/2}(z_{dec}/1100)^{-1/2}$$

(3.11)

which is $\approx 0.8^\circ$ in the CMBR today. This temperature attenuation, which stretches over $40^\circ$ in the CMBR, required extensive time for coupling of baryons and photons. It began after accretion released the photons in the collapse phase, as shown in figure 2. It lasted until the zero curvature propagated far enough to sufficiently decouple the photons $a(t) \approx 10^{25} cm$. These accretion photons avoided the last scattering surface of the big bang which started $a(t) \approx 10^{13} cm$. They remained outside the universe until recaptured by the big bang expansion.

The mechanism of coupling was mediated by hot electrons, as described above, in the photon dense CMBR. The photon number density $cm^{-3}$

$$n_\gamma = 2.038 \times 10^{28} T_9^3,$$

(3.12)

where $T_9$ is the temperature in units of $10^9 K$. For the CMBR in total there are $422 cm^{-3}$. For $T = 0.00185^\circ$ remnant of the big bang, $n_\gamma = 1.29 \times 10^{-7} cm^{-3}$.

This changes its baryon/photon ratio to

$$\eta = 87.6 \Omega_B h^2,$$

(3.13)

where $h$ is the Hubble constant in units of $100 km.sec^{-1} Mpc^{-1}$. The explosion mechanism and $\eta$ are similar to that of a supernova. The hot baryon to photon ratio must be multiplied by the cold baryon factor CBF plus one to obtain the
total baryon/photon ratio

\[ \eta_{\text{total}} = \eta_{\text{hot}} (C B F + 1) . \]  

(3.14)

An \( \eta_{\text{total}} \approx 36 \) will produce a flat universe if \( h = 0.66 \). Greater values will close the universe with baryons. The nucleosynthesis program NUC123 of Larry Kawano was modified as follows. Cold baryons were calculated by multiplying the hot baryon density thm(9) in subroutine therm by the cold baryon factor. This was added to the total energy density thm(10) and thus to the Hubble constant. The program was compiled using the fortran77 compiler of the Absoft Corporation with the Vax compatibility option. A double precision option for all floating point variables and disabling of overflow checking allowed calculations with hot \( \eta > 1 \). Using cold baryons, neutrino degeneration and \( \eta \) as variables, it was found that \( \eta = 10^{-7} \), a cold baryon multiplier 10\(^9\) and an electron neutrino chemical potential \( \xi_{\nu_e} = 1.865 \) gave a D or \( ^2H/H = 1.06 \times 10^{-4} \) and a \( ^4He/H = .2326 \). The deuterium fraction increased with increasing cold baryons. The \( ^4He \) yields decreased with increasing electron neutrino chemical potential by reducing the neutron to proton ratio at freeze out, as first noted \[31\]. Doubling the cold baryons gave a \( ^2H/H = 2.07 \times 10^{-4} \) without much change to other yields. The other yields were

\[
\begin{align*}
^3H &= 5.11 \times 10^{-7} & ^3He &= 1.38 \times 10^{-5} & ^7Li &= 1.38 \times 10^{-10} \\
N &= 6.14 \times 10^{-8} & ^6Li &= 3.83 \times 10^{-14} & ^7Be &= 4.24 \times 10^{-11} \\
^8Li + up &= 1.48 \times 10^{-15},
\end{align*}
\]

(3.15)

These are all close to standard primordial nucleosynthesis yields except the nitrogen fraction which has \( N = 5.6 \times 10^{-16} \). By making the best match of primordial elements, \( \eta \) closes the universe by a factor of \( \approx 2 \). This supplies sufficient brown dwarfs for microlensing and other dark baryonic matter.
Galaxy formation problems [24] are greatly simplified. An explosive universe with galaxy formation will fit the large scale galactic pattern [32]. Although the Jeans mass is thought to be the point at which gravity overcomes pressure to form galaxies, massive rotating primordial black holes are necessary for galactic structure. In the Tully-Fisher relation

\[ V_c = 220 \left( \frac{L}{L_*} \right)^{22}, \]  

(3.16)

and Faber-Jackson

\[ V_c = 220 \left( \frac{L}{L_*} \right)^{25}, \]  

(3.17)

where \( V_c \) is the circular velocity \( km/sec \) and \( L_* \) is the characteristic galaxy luminosity. The former relation is for velocities in the dark halo of spiral galaxies and the latter for star velocity dispersion in central parts of elliptical galaxies [25]. Rotational energy \( E_{rot} \) is a function of \( MV_c^2 \). Galactic brightness results from \(^1H\) mass, \( M_{\text{galaxy}} \). The black hole capturing cross section

\[ \sigma_{\text{capt.}} = 16\pi M^2 / \beta^2, \]  

(3.18)

where \( \beta \) is the particle velocity relative to light [18]. Because of the \(^1H\) capture by primordial black holes, the brightness is proportional to the central nuclear mass \( M_{\text{nucleus}}^2 \). With \( M_{\text{nucleus}}^2 V_c^4 = \text{constant} \), its square root is a constant related to the rotational energy imparted prior to the big bang. Thus the stellar galactic mass and luminosity can be related to the depth of the dark matter potential well and asymptotic circular speed. Due to the capture mechanism of \(^1H\), the black hole nuclear mass \( M_{\text{nucleus}} \propto M_{\text{galaxy}} \). Galaxy formation never involved collapse dynamics with its different post collapse densities, circular speeds and disk asymmetries.

The quantization of galactic redshifts found in even multiples of 37\( \text{km}./\text{sec.} \) by W.G. Tifft [28, 29, 30] and other workers [3, 1, 14] and also [6, 12] is persuasive.
evidence that the cold baryonic shell, which formed galactic nuclei and quasars, was present already at the big bang. Its different layers received different energies from the hot expanding core, even producing supermassive black holes. Near Abell 3627 there is a mass $5 \times 10^{16} M_\odot$, the Great Attractor [13], which must result from a large initial homogeneity. It may be near the original site of the big bang.

The baryon asymmetry problem has been stated as to why there are many more baryons than antibaryons. Baryon-antibaryon pairs are only created from a vacuum at energies $> 10^{13} K$, which is higher than the $160 MeV \approx 1.85 \times 10^{12} K$ core temperature. Extreme energy phenomena such as domain walls, monopoles, gravitinos and symmetry breaking were not reached in the big bang.

The supernova Ia problem has been investigated by two groups [9], [26]. Using type Ia supernovas as standard candles, the Hubble plot of distance

$$d_L = r_1 R^2(t_0)/R(t_1)$$

against velocity $z = R(t_0)/R(t_1) - 1$ was extended to almost $z = 1$. By standard convention, the source coordinates $(t_1, r_1)$ are related to the reception coordinates $(t_0, 0)$ by

$$\int_{t_1}^{t_0} dt R(t)^{-1} = \int_0^{r_1} dr (1 - kr^2)^{-1/2}$$

The magnitude of received photon measurement $m$ is related to the magnitude of a standard supernova at ten parsecs $M$. The distances as measured by $m - M$, are $10 - 15\%$ greater than that for a low density universe. The basic problem with the calculated distance $d_L$ is that it requires the use of the current scale factor $R(t_0)$ or $a_0$, from the Friedmann equation. Since the matter density is not constant, the recapture of cold baryonic matter during the expansion phase caused $R(t_0)$ to be increased. Although the timing of matter recapture will affect the current scale factor, neither radiation nor initial size will significantly do so.
Evidence for this recapture comes from the heavy metals found evenly dispersed in the intergalactic medium (IGM) at high red shift \( z \approx 13 - 14 \). It is unnecessary to postulate isolated supernovas at \( z \approx 13 - 14 \), prior to galaxy formation \( z \approx 5 \) and well prior to star formation \( z \approx 3 \). Rather recapture of cold dark matter from a previous bounce significantly increased the universe scale factor. A sample of this effect is shown for a large fraction of baryon recapture in figure 4. The more distant supernovas of the two groups are shown.

IV. A cyclical universe

Although equation 1 is cyclical, it is valid only for a universe that is isotropic and homogeneous i.e. a perfect fluid. In figure 2, the maximum scale factor \( a_{\text{max}} \) of the universe is equal to the gravitational radius

\[
R_g = \frac{GM}{c^2} \sim 10^{29} \text{ cm.}
\]

(4.1)

where \( 10^{29} \text{ cm.} \) is for a universe about twice critical density. After \( a_{\text{max}} \) was reached, the galaxies were blue shifted as they reconverged. When \( a(t) \) was \( 10^6 \) smaller than today, the proportionately higher CMBR tore neutrons and protons from nuclei. In the center was a growing black hole resulting from merging galactic nuclei. Stars and galaxies were accreted onto this supermassive black hole in a massive thick disk. Once the mass of this black hole exceeded the size of an average galactic nucleus \( \sim 10^8 M_\odot \), tidal forces were no longer capable of tearing a star apart before it entered \( R_g \) with relatively little radiative losses. The collapsing scale factor \( a(t) \) forced matter and released energy inside the growing \( R_g \) in a Schwarzschild geometry. The spacetime propagation of the zero curvature slowly over cons reduced the potential barrier of the supermassive
black hole from the inside.

V. DISCUSSION

Although classical general relativity has been confirmed to one part in $10^{12}$, it must break down prior to the infinite densities of singularities. There is no reason why a small mass $> 7M_\odot$ can contract to a singularity while the mass of universe explodes into the big bang. If a star surface lies entirely inside the $R_g$, classical relativity concludes from Kruskal-Szekeres diagrams that it must collapse to a singularity or faster than the speed of light. Here coordinate reversal occurs, $\partial/\partial r$ is timelike ($g_{rr} < 0$) and proper time at the surface

$$\tau = - \int^{r_e} [g_{rr}]^{1/2} dr + \text{constant}.$$  

(5.1)

In order to allow a big bang, a reduction in the stress-energy tensor must occur before enormous densities and energies are reached inside $R_g$. As $T_{\mu\nu} \rightarrow 0$ quickly, the impetus for further collapse stops with eventual elimination of the event horizon. After the limiting density is reached, there is re-reversal of the time coordinate and no further reduction in size. The quantum requirement that $T_{\mu\nu} > 0$, will not be violated as it will approach zero on the positive side.

A solution to the covariant perturbation problem for quantum gravity would be as follows. The spacetime metric $g_{ab}$ is divided into a flat Minkowski component $\beta_{ab}$ and its deviation $\gamma_{ab}$, where $(M, {}^*g_{ab})$ is a solution to the field equation. The field equation can be seen as an equation for a self interacting spin-2 field $\gamma_{ab}$ in Minkowski spacetime. In the first order $\gamma_{ab}$ is a free spin-2 equation with much gauge arbitrariness which can be expanded into a perturbation series for non-abelian gauge fields. Although this part is non-renormalizable, the energy
sink correction eliminates this term at high energies leaving the background
metric $\beta_{ab}$ which satisfies causality conditions. The quantum mechanism by
which the energy sink suppresses vibratory and other modes remains to be
elucidated. The problem of evaporation for black holes under a solar mass due
to quantum particle creation with violation of lepton and baryon conservation is
avoided. Naked and all other singularities are mathematically eliminated. Black
holes can eventually influence their surroundings to achieve thermal equilibrium.
Thus there is no loss of quantum coherence as the final black hole state will be
a pure one and the scattering matrix $S$ deterministic. Supernovas $< 7M_\odot$,
when collapsing to the same limiting density, will bounce without black hole
formation. A supranuclear equation of state based on actual data (which does
not yet exist) and better nucleosynthesis modelling, taking into consideration
a gradient of temperature and all neutrino effects, will better determine $\eta$, hot
and cold baryons and the bounce temperature.

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[1] Arp, H. Ast. Astrophys. 229, 93-98 (1990)
[2] Bailyn, C.D., Jain, R.K. and Orosz, J.A. preprint astro-ph/9708031
[3] Broadhurst, T.J., Ellis, R.S., Koo, D.C.and Szalay, A.S. Nature 343, 726-
728 (1990)

[4] Copi, C.J., Olive, K.A. and Schramm, D.N. preprint astro-ph/9606156

[5] Cowie, L.L. and Songalia, A. Nature 394, 44-46 (1998)

[6] Depaquit, S., Pecker, J.C. and Vigier, J.P. Astr. Nachr. 306, 7 (1985)

[7] Einasto, J. et al. Nature 385, 139-141 (1997)

[8] Frank, J., King, A. and Raine, D. Accretion Power in Astrophysics (Cambridge University Press, Cambridge England, 1992) 171-265

[9] Garnavich, P.M. et al. Astrophys. J. Letts. 493, L53 (1998)

[10] Glendenning, N.K. Phys. Rev. C 37, 2733-2742 (1988)

[11] Guth, A.H. The Inflationary Universe (Addison- Wesley Publishing Co., Reading Massachusetts, 1997) 239-243

[12] Guthrie, B.N.G. and Napier, W.M. Mon. Not. R. Astr. Soc. 253, 533-544 (1991)

[13] Halzen, F., Mac Gibbon J.H. and Weeks, T.C. Nature 353, 807-814 (1991)

[14] Karlsson, K.G. Ast. Astrophys. 13, 333-335 (1971)

[15] Kraan-Korteweg, R.C. et al. Nature 379, 519-521 (1996)

[16] Lauer, T.R. and Postman, M. Astrophys. J. 425, 418-438 (1994)

[17] Linde, A.D. Rep. Prog. Phys. 47, 925-986 (1984)

[18] Misner, C.W., Thorne, K.S. and Wheeler, J.A. Gravitation (W.H. Freeman and Co., New York, 1973) 655-679, 703-816, 872-915

[19] Mo, H.J., Fukugita, M. preprint astro-ph/9604034
[20] Oppenheimer, J.R. and Snyder, H. Phys. Rev. 56, 455-459 (1939)

[21] Oppenheimer, J.R. and Volkoff, G.M. Phys. Rev. 55, 374-381 (1939)

[22] Padmanabhan, P. Structure Formation In The Universe (Cambridge University Press, Cambridge, England, 1993) 70-73, 108-112, 217-247, 325-352

[23] Peebles, P.J.E. Astrophys. J. 146, 542-552 (1966)

[24] Peebles, P.J.E. and Silk, J. Nature 346, 233-239 (1990)

[25] Peebles, P.J.E. Principles of Physical Cosmology (Princeton University Press, Princeton, N.J., 1993) 45-54, 527-564

[26] Perlmutter, S. et al. Nature 391, 51 (1998)

[27] Robertson, H.P. Astrophys. J. 83, 187-201, 257-271 (1936)

[28] Tifft, W.G. The Formation and Dynamics of Galaxies, IAU Symp. No. 58, ed. Shakeshaft, J.R. (Reidel, Dordrecht, 1974) 243

[29] Tifft, W.G. Astrophys. J. 206, 38-56 (1976)

[30] Tifft, W.G. and Cocke, W.J. Astrophys. J. 287, 492-502 (1984)

[31] Wagoner, R.V., Fowler, W.A. and Hoyle, F. Astrophys. J. 148, 3-49 (1967)

[32] Weinberg, D.H., Ostriker, J.P. and Dekel, A. Astrophys. J. 336, 9-45 (1989)

[33] Wilczek, F. Nature 391, 330-331 (1998)

[34] Zel'dovich, Y.A. and Novikov, I.D. The Structure and Evolution of The Universe (University of Chicago Press, Chicago, Ill., 1983) 209-233
FIG. 1 Inhomogeneous explosion mechanism at t=0, dictated by matching of kinetic energy with gravitational energy, i.e. the flatness problem. The shell became galactic nuclei, dark matter and quasars. The hot core became the initial $^1$H-$^4$He.
**Figure 2. Cyclical Universe**

FIG. 2 The cycle: When the core density exceeds $10^{17}$ gm/cm$^3$, the mass looses energy. While this occurs rapidly, the spacetime propagation through the potential barrier requires $> 10^{12}$ years. As the gravitational field diminishes, the shell begins to fall apart or receives a perturbation and the big bang occurs. When the scale factor finally decreases, the galactic nuclei merge. A supermassive black hole is formed containing all the matter in the universe. This and all black holes must loose energy by core nuclear compression, which very slowly propagates to surrounding spacetime.
Figure 3. CMBR average $\Delta T^2$ versus angle of separation. These are the COBE satellite results taken from Guth. The horizon distance from the time of decoupling is only about $0.8^\circ$ of the CMBR today. Note the attenuation of $\Delta T$ for angles less than $40^\circ$. This could have occurred only during matter and energy coupling and is evidence of release during the accretion phase prior to the time of the big bang.
Figure 4. Hubble diagram for Supernova Ia. MCLS distance modulus are plotted versus redshift $z$. The plot assumes that $>50\%$ of the matter was recaptured after the bounce of the big bang. This increased the current scale factor of the universe $a_0$ by $>25\%$, causing a high density universe $\Omega_m>1$ to appear low in density.