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BIG BOUNCE COSMOLOGY

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Two Groups of Oppositely Charged Particles as Building Blocks for the Start of the Universe

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ABSTRACT

A cold start of the universe is proposed where two spherical agglomerates collide. Each agglomerate contains the same amount of densely-packed, basic particles of Planck dimensions. One agglomerate contains "*neg*" particles with a charge of one-third of the charge of an electron, and the other "*pos*" particles with a charge of one-third of the charge of a positron. The first particles formed upon collision are very high-energy, static photons consisting of a *neg* and a *pos*. By colliding a small part of the photons with 1-3 *neg*'sor 1-3 *pos*'s, proto quarks and leptons are formed resulting in the formation of equal amounts of neutral matter and antimatter. The symmetry of proto quark combinations proves a good indicator for the stability of hadrons. In the model photons are dumbbell shaped spinning particles that are essential for the formation of fields. The vector sum of the rotational and the translational velocities of a photon is almost equal to the velocity of light in vacuum. Even the highest energy photons in cosmic gamma rays have a translational velocity very close to this velocity. Both mass and energy are manifestations of the polarisation of photons around bodies which explains their relation.

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INTRODUCTION

The fact that we have Planck dimensions makes *a priori* plausible that the universe started with particles having such dimensions. A cold start of the universe is proposed where two spherical agglomerates collide. Each agglomerate contains the same amount of densely-packed, basic particles of Planck dimensions. For two charged elementary particles having Planck masses of 5.5×10^{-8} kg, the product of the gravitational constant and the square of the Planck mass is two to three orders of magnitude larger than the product of their charges (taken as one third to two times the charge of an electron) divided by $4\pi\varepsilon_0$ (ε_0 is the permittivity of the vacuum). Assuming a negative gravitational mass for antimatter results in the symmetrical presence of matter and antimatter in the universe because at the very small scale of primordial particles, the gravitational repulsion between matter and antimatter avoided most annihilation. During the development of the universe, gravitational forces became more and more important resulting in larger and larger accretions of electrically neutral matter and antimatter, culminating in clusters of galaxies. This model explains the energy required for the expansion of the universe, the formation of quarks and leptons, and very high-energy photons, and the formation of equal quantities of matter and antimatter at the start of the universe.

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The very beginning of the universe does not require high temperatures which is consistent with low entropy.

THE MODEL

Two main assumptions are made as a start

- In nature, there are two spherical, atomic elementary particles called *basics*. A negative *basic* (*neg*) with a charge of one-third of the charge of an electron *e,* and a positive *basic* (*pos*) with a charge of one-third of the charge of a positron.
- Oppositely charged *basic*s "react" with each other and stick together when they collide.

If the universe is constructed of the two building blocks, *neg* and *pos,* for reasons of symmetry it seems logical that it started with two equally sized agglomerates, one of each kind. Upon bringing these two agglomerates together, immediately the three natural constants, the velocity of light in vacuum *c*, the gravitationalconstant *G* and the unit of spin $h/2\pi$ must have been established where *h* is the Planck constant. The two equally sized agglomerates are spherical, one containing *neg*'s and the other *pos*'s, both in a dense arrangement (Fig. 1). These starting conditions are only possible when there is no repulsive force between the *basics* in the agglomerates. The repulsive force requires a field to make itself manifest.

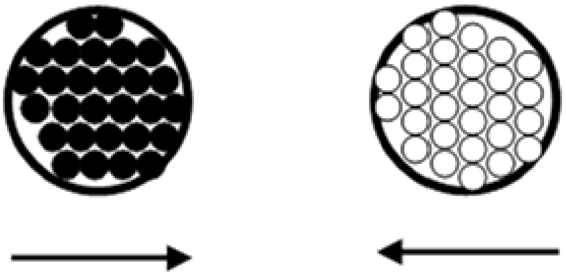

Fig. 1. Approach of agglomerates of *pos*● and *neg*○ particles at the start of the universe

As shown below, a field requires photons, which only become available after the collision of the agglomerates. The potential energy between basics in the agglomerates can only be unlocked when a field has been established after oppositely charged basics have come into contact with each other. This starting point where oppositely charged basics are separated complies with the lowest entropy and the highest energy density. Upon bringing the agglomerates together, three sources of energy can be identified. These are:

- The total potential energy of each of the charged *basics* in each agglomerate.
- The potential energy between the two oppositely charged agglomerates.
- The kinetic energy with which theybounce together

Because nothing is known about the size of the agglomerates or the translational and rotational velocity at which they are brought together (*2c relative to each other?*), it is impossible to calculate these energies. Upon colliding the two agglomerates, as depicted in Fig. 1, first of all *neg*'s and *pos*'s will join together to form dumbbell shaped photons having a spin of *h/2π* and a rotational velocity of *c*. These high energy photons contain, at least, all of the potential energy from the two constituent *basics* in the agglomerates and have initially no translational velocity. There can be little doubt that the collision will result in extremely high "Big Bang" temperatures. In the absence of knowledge of how the agglomerates are brought together, the initial distance between the agglomerates and the number of *basics* in an agglomerate, one must look elsewhere for information. Therefore, it seems logical to use the Planck data, which can be calculated by dimensional analysis of the constants *c, G* and *h,* as a source for the energy E_{pair} of the high energy photons (Table I).

Table 1. Planck Data, Values and Dimensions

Planck data	Symbol	Magnitude	Units
Planck constant	h	$6.62*10^{-34}$	$kg.m^2.s^{-1}$
Velocity of light	c	$3.00*10^{8}$	$m.s^{-1}$
Gravitational constant	G	$6.67*10^{-11}$	$m^3.kg^{-1}.s^{-2}$
Planck length	P_l	$1.62*10^{-35}$	m
Planck mass	P_M	2.1810^{-8}	kg
Planck time	P_t	$5.39*10^{-44}$	s
Planck frequency	P_f	$2.97*10^{42}$	s^{-1}
Planck energy	$P_E=P_M.c^2$	$1.96*10^{9}$	J
Planck force	P_K	$1.21*10^{44}$	N

Although Planck values for length, mass and time are low, the Planck energy is high. Assuming the Planck energy is the energy of the initial photon:

$$E_{pair} = P_E = h\nu$$

the frequency *ν* of these photons with low translational velocity can be calculated as$P_E\ /h$ = $7.4*10^{42}$ s^{-1} which is at least 10 orders of magnitude higher than that of the highest energy cosmic gamma rays that are currently known (Melandri, 2013).

Formation of proto particles

The first composite particles formed when the two agglomerates move into each other were therefore high energy photons. Some of the photons will then be hit by *pos*'s at the side of the universe of the *pos* agglomerate and others by *neg*'sat the side of the universe of the *neg* agglomerate (Fig. 2).

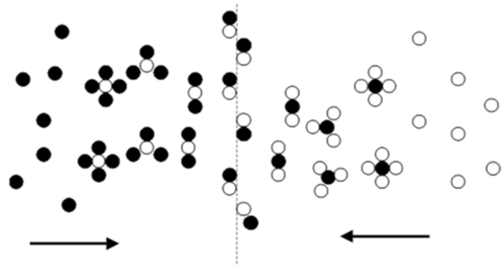

Fig. 2. Initial formation of photons, proto-quarks and proto-charged leptons from *pos*● and *neg*○ particles

During these collisions where a *pos* in a photon is hit by a single *neg* the spin is halved and a proto-quark is formed with a charge of one-third of an electron (*e)* and a spin of *h/4π* (Fig.3). Subsequently proto-quarks with charges of two-third *e* are formed when the central *pos* in a proto-quark with a charge of one-third *e* is hit by an additional n*eg*. Such an encounter where the central *pos* is hit does not alter the spin of the particle, which remains at *h/4π*. Finally a proto-lepton with a charge of *e* will form when the central *pos* in a proto-quark with a charge of two-third *e* is hit by yet another *neg*. Also during this collision the spin remains at *h/4π* (Fig. 3).

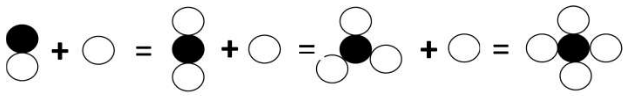

Fig. 3.Formation of protoquarks and leptons by collision of a photonwith one, two and three *neg* particles consecutively

The central *pos* in a lepton cannot accommodate more than 4 *neg*'s. Similarly, by reversing the roles of *pos* and *neg* particles, proto-quarks and charged leptons with positive charges will form. After all *basic*s have been consumed, the predominant particle will be the photon; quarks and leptons will be formed in much smaller quantities. The lower the charge of the proto-particle, the higher its prevalence. *Photons are present everywhere in the universe*; notably existing where there is a near perfect vacuum. In the absence of bodies they will have a random polarisation of their spin. However, with bodies present, these will polarise the photonsin their environment and give them overall a certain degree of polarisation. Photons are essential for the formation of fields. It is only with the formation of quarks and leptons that one can start to discriminate between matter and antimatter. Probably the first hadrons that were formed consisted of either only positive or only negative quarks at each side of the dividing plain as indicated in Fig. 2. However, very soon all the particles were mixed thoroughly, and other combinations of quarks became possible.

The quarks in hadrons are linked by additional *pos* and *neg* particles and are held together by the strong (colour) force. When the blending between the two sides of the dividing line in Fig. 2 began, at first hadrons and charged leptons were formed with the highest mass. These proto-particles will have had masses that are much higher than the present protons, neutrons and electrons as well as much smaller dimensions. Substitution of *up* and *down* quarks by *top* and *bottom* quarks and of electrons by tao-leptons will already result in particles that have a 10^4-10^5 higher mass. If more flavours than the three that are presently known are found, these values will become much larger. *This is a critical point; otherwise the gravitational force would not have been stronger than the Coulomb force at the start of the universe, which is a prerequisite for the agglomeration of separate bodies of neutral matter and antimatter without the danger of total annihilation.*

Symmetry and stability

As described above, there are reasons to describe the charged proto-lepton as a *pos* surrounded by four *neg*'s or vice versa for the anti-particle. Assuming the *pos* to beat the centre of a tetrahedron with the four *neg*'s located at the vertices, the simplest particle with a symmetrical spatial charge distribution is obtained. *Such a symmetrical distribution of charge in three dimensions is apparently a requirement to ensure stability and is the reason why all charged leptons and hadrons have an integer charge of zero, one or two.*

The electron, muon, tau-lepton and their anti-particles consist of the proto-lepton that is surrounded by an equal number of *pos* and *neg* particles. The resulting lepton, that is assumed to be roughly spherical, will hence have a net charge that is spread out over a much larger area, away from the centre of the particle. For quarks having a fractional charge, a symmetrical spatial distribution of charge is not possible. The only way to form a more stable particle is to team up with one or two quarks in such a way that the charge becomes either zero, or one or two times that of the electron or positron. For mesons that consist of two quarks, this always results in a particle that lacks symmetry in the charge distribution along the axis connecting the two quarks, which may well be the reason mesons are short lived. *An interesting aspect of mesons consisting of a quark and its anti-quark is that such mesons can neither be considered matter nor antimatter.* The same problem holds for positronium.

With *baryons* consisting of three quarks, more symmetrical configurations are possible. This is particularly pronounced for the proton where the central *basics* of the constituent quarks are all surrounded by four *basics* of opposite charge. Fig. 4 shows a simplified structure for the *u* and *d* quarks in the proton where the quarks are held together by the colour force. An isolated neutron is less symmetric than the proton and this may explain the fact that it is less stable. For simplicity, the quarks in the baryons are given in two dimensions without the additional *pos and neg* particles.

The heaviest proto-quarks and proto-leptons are the smallest particles where a central *basic* is surrounded by two, three or four *basics* of opposite charge. Given the discrepancy between the Planck length and the classical radii of the currently known leptons, the existence of more flavours becomes likely. For quarks and leptons, the highest speed (*c*) will be found at their equator.

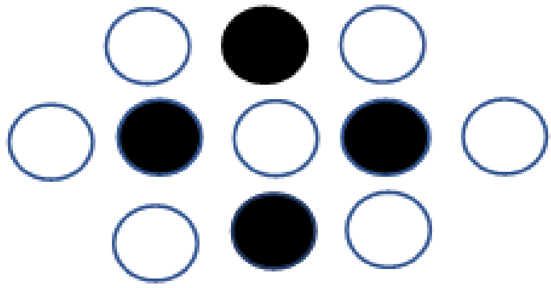

Fig. 4. Arrangement of *pos*● and *neg*○ particles in a proton

For hadrons, the situation is more complex because the quarks also rotate around each other. In all cases, no part of a particle may exceed the velocity *c*.

Photons

The rule that nowhere the velocity of *c* can be exceeded also must apply to photons. The question that immediately arises is why the visible light and gamma ray photons we are familiar with move with a translation velocity *c*. The explanation is that these photons have a relatively low energy compared with a "Planck" photon with a frequency of $2.97*10^{42}$ s^{-1}. Taking the radius of a photon to be the Planck length of $1.62*10^{-35}$ m results in a rotational velocity of *c*. Because the vector sum of the translational and the rotational velocity of a photon cannot be higher than *c*, this implies that such a photon has no translational velocity. Photons in the visible light region have a frequency of about 10^{15} s^{-1} have a rotational velocity of about 10^{-18} ms^{-1}. Therefore their translational velocity is to a very high approximation equal to *c*. This even holds for the highest energy cosmic rays with an energy of about 16 J and a frequency of $2.4*10^{34}$ s^{-1} having a rotational velocity of about 2 $m.s^{-1}$.

Mass and energy

In the absence of other bodies, photons have a random polarisation. The presence of bodies will polarise photons around them that will diminish as the distance from the body increases. For a body at rest the amount of polarization is measure for its mass. For bodies moving with a constant translational and/or rotational velocity, an equilibrium situation for the polarisation of the surrounding photons will be established. Acceleration will upset this equilibrium temporarily until the velocities again become constant. The energy required for the acceleration results in an increase to the polarisation of the surrounding photons. *What is called a field is in fact a polarisation of photons. The amount of polarisation of the photons surrounding a particle is a measure of both its mass and its energy and hence for their relation.*The polarisation can be considered as information embedded in the randomness (Verlinde, 2010). Polarisation is caused by the presence of bodies. The fact that matter and antimatter repulse each other is not only the cause for the expansion of the universe, but also that it prevents total annihilation between matter and antimatter. This in turn prevents that the universe will obtain its maximum theoretical entropy where in would contain only random orientated photons and no bodies. Neutrinos, which may be considered as a lepton stripped of its charge, still polarize their environment. The reason for this is the orientation of the *pos* and *neg* particles in the neutrinos. Therefore they can slightly polarise their environment and have a very small mass.

Summary and Conclusion

A model is proposed in which the universe started with two spherical agglomerates. Both spheres contain particles of Planck dimensions; one sphere of particles each with a charge of one-third of the charge of an electron and the other of particles each with a charge of one-third of the charge of a positron. On collision of the two spheres, first high energy photons are formed, followed by the formation of proto-quarks and proto-leptons. Because the gravitational force is much stronger than the Coulomb force for charged particles having Planck dimensions, and matter and antimatter are formed in equal quantities, relatively little annihilation occurred. Surrounding themselves with equal amounts of positive and negatively charged particles, protons, neutrons and electrons are formed. It is shown that symmetry is essential for the stability of elementary particles. The dumbbell shaped, high energy photons are responsible for the formation of fields. The polarisation of fields is caused by the prevailing charged bodies. The degree of polarisation is a measure of the strength of the field and therefore its energy. Mass also makes itself manifest by the polarisation of the surrounding photons. This proves the relation between energy and mass. The vector sum of the rotational and the translational velocities of a photon is almost equal to the velocity of light in vacuum. Even the highest energy photons in cosmic gamma rays have a translational velocity very close to this velocity.

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