A Black Hole emerged Universe

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Abstract
A simple model of a Universe is presented composed of black holes and black branes. It uses the most simplest approximations and models of General Relativity and Quantum Dynamics to offer an idea of an unification and gives a possible answer to the quantization and entropy of Black Holes. It proposes a mass spectra for elementary particles and gives a vivid interpretation of the particle-wave-dualism.

1 Introduction
A simple model for the construction of fermionic matter by so-called black-holes will be suggested. This paper gives a short overview on cosmology in its first part. In its second part it proposes a possibly closed model for fermionic matter from neutrinos to the Universe itself, based on the concept of black-holes/black-branes.

1.1 The 'embedding' problem
The recent discussion on the origin and destiny of the Universe raises the question where the Universe comes from. The main explanation is that time and space were created with the big-bang and therefore the question, where the Universe is embedded in or what happened before the creation, is not permissive[1]. This implies the assumption that there was no reason for the creation and that the Universe was created from 'nothing' by a kind of quantum fluctuation and should have a zero overall-energy. Although this explanation sounds well, it doesn’t solve the problem really: If the Universe was created from 'nothing', why shouldn’t be there uncountable more Universes; and what relationship could there be between them? Numerous scientists tried to give an explanation to this question (e.g. A. Linde[2]). Whatever the correct answer to this question is, the explanation must be a kind of an infinite regress as otherwise the embedding problem would recur.

1.2 The 'matter-grain' problem
A still unsatisfactory answered question is, what matter, like elementary particles, really is. To answer this question, one tries to find the most elementary particles by experiment and theory. All matter should be composed of this smallest 'grains' of matter. But this explanation always raises the question that these 'grains' could be composed of something, that can be described by a more elementary description. Here comes in the so-called string-theory, which gives a topologic explanation, the strings, as the origin of matter. But what are these strings composed of? They should be pure topology, like space-time curvatures are[3,1].

1.3 The mass of the known Universe
The mass[3] of the bright matter lying in the reach of modern observation techniques may be derived for example from the outcome of the Hubble deep field: On this image made by the Hubble space telescope,
which contains galaxies down to about 29 th. magnitude, one can calculate about 1 Million Galaxies on an area of 1 square degree. With usual masses for galaxies this means that the mass of the bright matter reaches an amount of approximately some 10^{51} \text{ kg (Sexl)} \text{.} The critical mass density of the Universe is the amount of mass which is needed to bring the universal expansion to a halt in the future and to a collapse in a final big crunch. This mass is, depending on the world model, about 10^{55} \text{ kg.} This means that the visible mass of the Universe is sufficient for only about some percent of the critical mass density.

On the other hand the mass density of the baryons derived from the theory of nucleosynthesis and the measured photon density should be 10 to 12 percent of the critical mass density \text{.} Therefore the so-called dark matter should be about 10 times greater than the visible bright mass. This matter shows itself in the extinction of light on its way through the Universe as well as by its gravitational force on galaxies and galaxy clusters \text{.}

Nevertheless the mass density of baryonic matter is with that only about a tenth of the mass density needed to close the Universe. Besides of the classical baryonic matter therefore also exotic matter gets into considerations on the overall mass of the Universe. These are, for example, a not vanishing rest mass of the neutrino, super-symetric elementary particles as e.g. gravitinos, extremely weak interfering particles (WIMPS), and black holes of various sizes. So there exist a lot of estimations of the Universe mass density up to several times the critical mass density as is \( \rho_\text{U} \cong 0.01 - 2.0 \cdot \rho_{\text{critical}} \) in Coughlan \text{,} or \( \rho_\text{U} \cong 0.01 - 10.0 \cdot \rho_{\text{critical}} \) in Kaku \text{.}

### 1.4 The Schwarzschild-metric and the primordial expansion of the Universe

The Schwarzschild solution \( R_{\text{ss}} = \frac{2GM}{c^2} \) for the Schwarzschild-radius of a given mass \( M \) is derived from the Einstein field equations considering a point-like mass. The Schwarzschild solution is a static, homogenous and isotropic solution for the region outside the Schwarzschild radius (‘A black hole has no hairs’). The inside solution may have other solutions, the most interesting is the solution of Oppenheimer and Snyder \text{,} which shows the astonishing result, that the inside solution must be a Friedmann-Universe. This results from the fitting of the outside to the inside solution of a collapsing star: After the burning out of a star every pressure vanishes when the star shrinks to 9/8-th of its Schwarzschild-radius. When the collapsing star reaches the event-horizon one has to set \( p = 0 \) and one gets a Friedmann-Universe at its maximum expansion. So the Oppenheimer/Snyder-solution maybe taken for a speculation of a Friedmann-Universe inside a black hole, shrinking down to a singularity and from there expanding back to its maximum expansion again.

If one don’t like such an interpretation, there is the problem to explain how the expanding Universe let behind its own event-horizon. As the Universe expands starting at vanishing dimensions, this leads to the a paradox looking context: Either the Schwarzschild-radius is greater-equal to the world radius\text{,} of the Universe, as large estimations of the Universe mass assume, then the Universe may be called a black hole or white hole, because of the time-reversal of the dynamics. Or, as small estimates of the mass of the Universe assume, the Schwarzschild-radius is about 10 percent of the today world radius of the Universe. Now then the Universe should have expanded beyond\text{,} its Schwarzschild-radius in former times after the big bang when it crossed a radius of about 1.5 billion light-years which is an event that is supposed to be not in harmony with general relativity.

By this one could guess that our Universe should be indeed a black hole\text{.} The theory of inflation \text{,} although the dimension of the world radius and the Schwarzschild-radius may be equal, there is a considerable difference: The world radius is the ‘visible’ dimension which is defined by an infinite red shift. On the other hand, the Schwarzschild-radius can never be seen even by an observer placed close to this border as seen from ‘outside’. In this case the line of sight would be curved when seen from outside but an inside observer would observe it as free of any forces and straight. By this any number of world radius’ can be placed into the area of the Schwarzschild-radius even if both have the same dimension.

A ‘pushing in front’ of the event-horizon is easily possible due to the increasing scale-factor \( R(t) \) of the Universe. A black hole, if watched from inside, may be called a white hole because it is guessed that from its inside singularity everything can come into existence. A black hole actually needs an outer space which it is defined on, but the existence or not of an outer space is first of all a question of belief.
tries to avoid such a paradox by a kind of extremely fast inflationary expansion. But the inflation phase ends when the Universe is some cm in size, much smaller than its least possible event-radius. And last the inflationary model also demands a critical mass density for the Universe.

But even if one believes in a Universe which is not of critical mass density in its visible worldradius and which should expand over this range up to infinity, there will always be a radius where the mass density of the inner region gets critical; as vacuum is never empty of energy and as the Schwarzschild radius grows linearly with the mass, while the mass of a volume grows with the 3rd power of the radius:

$$\rho_c = \frac{3c^2}{8\pi G R^2} \Rightarrow R_c = \sqrt{\frac{3c^2}{8\pi G \rho}}$$

This gives a critical value for the mass density of the Universe of some $10^{-30}$ g cm$^{-3}$ if one considers the area of the visible worldradius which is $R_e = \frac{c}{H_0}$ in the socalled EdS-model. So if the mass density would be greater-equal to this value, our Universe may be explained as a black hole; if the value is less, one could avoid such an explanation if one claims that the regions outside the related event-horizon are gravitational incoherent. But the high uniformity of the 3K-background radiation and also the theory of inflation indicate that they are indeed coherent.

A lot of numerical simulations of Universes with different parameters were done (1, 2) (and will go on). A lot of models prefer cosmologies with $\Lambda \neq 0$ and small densities, which are also in agreement with the interpretation of the luminosities of far away Type-Ia-Supernovae, which seem to be about 0.3m darker than expected. But the recent work of Gawiser and Silk (3), which numerically calculates the 10 most discussed cosmological models and relates them to the variation of the observed cosmic microwave background (CMB), shows the astonishing result, that the critical standard model fits the observation of the CMB by far best.

In this sense a black-hole-Universe is defined through a Universe of critical mass density. The possibility of a black-hole-Universe was already taken into consideration e.g. in J-P.Luminets (13) book ‘Black Holes’ or in a controversial darwinistic view in the recent work of Smolin (22).

## 2 Simple solutions for a black-hole-Universe

### 2.1 The Einstein-deSitter model

The Einstein-deSitter model (EdS model) follows from the Friedmann-model simplified with $\kappa = 0$ and $\Lambda = 0$ which means an euclidic, isotropic and homogenous world model. Then the scale-factor $R(t)$ is a solution of $\dot{R}R^2 = \text{Const.}$ which gives

$$R(t) = R_0 \cdot \left(\frac{t_e}{t_0}\right)^{2/3}$$

in which $t_e$ is the time of emission of a signal ($t_e = 0$ is the time of the big bang) and $t_0$ the time today. The relationship for the age of the world follows from the Hubble equation

$$\frac{dR}{dt} = H(t)R(t)$$

which gives $t_0 = \frac{2}{3H_0}$

The actual distance $r$ between two points with distance $\rho$ is derived from the equation:

$$r(t) = R(t) \cdot \rho$$

The standardization is given referring to the present time by $R(t_0) = R_0 =: 1$.

General Relativity demands a maximal velocity $c$ only for the peculiar movement. The variation of the scale-factor

$$\frac{dR}{dt} = \frac{2R_0}{3t_0^{2/3}t_e^{1/3}}$$

runs to infinity for small times of emission. Therefore the overall-velocity of the Expansion

$$\frac{dr}{dt} = \frac{dR}{dt} \cdot \rho + R \cdot \frac{d\rho}{dt}$$

(2)

can be much greater than the speed of light. Considering events for which the speed of light is a given limit one has to look upon variations of $\rho$.

The red shift $z$ is interpreted as the scale variation of the wavelength of a photon:

$$\frac{\lambda_0}{\lambda_e} = \frac{R_0}{R_e} =: 1 + z$$

(3)

The fact that the EdS-model is simplified with a curvature parameter $\kappa = 0$ seemes to point out
as the Compton wavelength
from the theory of photon scattering on electrons
length of a resting particle
mass charged particle one gets the de-Broglie wave-
Einstein energy
If one equates the Planck energy
calculated partly numerically.
\[ \rho = \frac{3ct_0}{R_0} \left[ 1 - \left( \frac{t_s}{t_0} \right)^{1/3} \right] \] (5)
This distance should be equal at maximum to any
given Schwarzschild-radius \( \rho_{SS} = 2GM/c^2 \) which results in:
\[ M(t_e) = \frac{c^3}{H_0G} \left[ 1 - \left( \frac{3H_0t_e}{2} \right)^{\frac{1}{2}} \right] \] (6)
This time-dependent mass is the mass to be at least
included by a gravitational spherewave starting at
time \( t_e \) and running with velocity \( c \). Otherwise
the wave would have to go beyond its own event-
horizon. Inserting \( t_e = 0 \) for the origin of the Universe
one gets:
\[ M_{U \text{min}} \geq M(0) = \frac{c^3}{H_0G} \] (7)
This is the mass which makes an EdS Universe critical. The value of \( H_0 \) is still controversial and differs
depending on the source between approximately 50
and 100 km/secMpc. So the mass of the Universe should
be in the range of \( M_U \in [1.248, 2.497] \cdot 10^{53} \text{kg} \).
Since the geometry of space-time in our Universe
yet depends only on the mass included in
the Schwarzschild-radius, the equality sign in (7)
should be right: The mass of the Universe gets
herewith the rank of a constant of nature as it is
expected for a black hole. In this case one may formulate:
\[ c = \sqrt[3]{M_UH_0G} = \alpha \sqrt[3]{M_U} \] (8)
which means that a black-hole-Universe would relate
the speed of light to the mass and expansion rate of the Universe. One may define a topologic
constant \( \tau \) for the EdS model as
\[ \tau := M_UH_0 = \frac{c^3}{G} = 4.038 \cdot 10^{35} \text{kg/sec} \] (9)
which is the product of the Universe expansion rate
and mass and relates \( c \) and \( G \) as \( c = \sqrt[3]{\tau \cdot G} \).
2.4 The resulting force on elementary level

One may generalize the mass formula (9) to local gravitational waves running in a local flat spacetime. For that purpose the mass formula is expanded to a Taylor series at the time \( t_0 \) transforming the time coordinate to \( t = t_0 - t \). By this one gets the mass formula for small masses implicing small times \( t \ll t_0 \):

\[
m(t) = \frac{1}{2} \tau t + \frac{t}{6} t_0 \cdot t + \frac{5}{54} \left( \frac{t}{t_0} \right)^2 t + R(O^4)
\]

\[
= \frac{1}{2} \tau t + \frac{1}{4} \tau H_0 \cdot t^2 + \frac{5}{24} \tau H_0^2 \cdot t^3 + R(O^4)
\]

As the factor \( \left( \frac{t}{t_0} \right)^n \) rapidly drops to zero for small times one can calculate further on with only the first part of the sum:

\[
m(t) = \frac{1}{2} \tau t = \frac{1}{2} \frac{c^3}{G} \cdot t
\]

Equivalent to the derivation of (10) one gets for the peculiar distance of events travelling with the speed of light considering small times:

\[
\rho(t) = ct + \frac{cH_0}{2} t^2 + \frac{5}{12} cH_0^2 t^3 + R(O^4)
\]

From there the apparent force acting on a gravitational event running with \( c \) is:

\[
| \vec{F}_e | = \frac{d}{dt} (mv) = \frac{c^4}{2G} (1 + 3H_0 t + R(O^2)) \approx \frac{c^4}{2G}
\]

This practical constant force acts on the event over the area of the Schwarzschild-radius:

\[
E \approx F_e \cdot \rho_{ss} = \frac{c^4}{2G} c^2 = \frac{c^4}{2G}
\]

As it seems a gravitational wave may run unhindered just if the mass included in its sphere is zero or infinite. Every distortion of space-time causing a mass creates an event-horizon proportional to this

\[
F_e \cdot \rho_{ss} = \frac{c^4}{2G} c^2 = \frac{c^4}{2G}
\]

3 An approximate stationary solution for black hole particles

Because the elementary force \( F_e \) always obstructs the movement of the gravitational wave the integral of energy on a closed loop is not zero. The constant force \( \vec{F}_e = -\frac{c^4}{2G} \cdot \dot{e} \) has just a pseudo-potential

\[
V(r) = \frac{c^4}{2G} \cdot r
\]

As a simple approximation one can consider the effect of a wave in a rectangular potential well. The gravitational wave runs unhindered in a small area

\[
\frac{c^4}{2G} \cdot r
\]
until it is stopped, as mentioned from outside, by its selfmade event-horizon which exerts a nearly infinite apparent force of $F_e$ hindering the wave\textsuperscript{11} in going on:

$$V = 0 \quad \text{for} \quad r \in [0, \rho_{SS}]$$
$$V = \infty \quad \text{for} \quad r > \rho_{SS}$$  \hspace{1cm} (18)

The common known solution of the time-independent Schrödinger equation for a particle in such a rectangular potential well delivers the energy eigenvalues

$$E_n = \frac{n^2 \pi^2 \hbar^2}{2ma^2}$$  \hspace{1cm} (19)

with $n = 1, 2, 3 \ldots$ and $a$ the diameter of the well. With the substitution of $a = 2 \rho_{SS} = \frac{4Gm}{c^2}$ and $m = \frac{E}{c^2}$ one gets the energy eigenvalues as the real roots of $E_n = \frac{n^2 \pi^2 \hbar^2 c^9}{32G^2}$:

$$E_n = \pm \sqrt{\frac{\pi}{2^7 4}} \sqrt{n} \hbar c$$  \hspace{1cm} (20)

The factor $\frac{\sqrt{\pi}}{2^7 4} = 1.054$ origins from the simplification of the potential \textsuperscript{12} and is set equal to 1. Then the masses of the virtual Schwarzschild areas have the eigenvalues \textsuperscript{13}

$$m_n^\pm = \pm \sqrt{n} \cdot m_{pl}$$  \hspace{1cm} (21)

The difference of neighbouring positive eigenvalues is with this

$$\Delta m_n = m_{n+1} - m_n = (\sqrt{n + 1} - \sqrt{n})m_{pl}$$  \hspace{1cm} (22)

which can be written for large $n \to \infty$:

$$\Delta m_n = \frac{1}{2\sqrt{n}} \cdot m_{pl}$$  \hspace{1cm} (23)

From (21) and (23) follows

$$\Delta m_n = \frac{1}{2} \cdot \frac{m_{pl}^2}{m_n} \quad \text{with} \quad n = 1 \cdot \frac{m_{pl}^2}{\Delta m_n^2}$$  \hspace{1cm} (24)

and the relation between stimulated mass $\Delta m_n$ and positive virtual mass $m_n$ is:

$$\frac{\Delta m_n}{m_n} = \frac{1}{2n}$$  \hspace{1cm} (25)

The radius of an elementary particle in this model is the event-radius of the virtual mass

$$\rho_n := \rho_{SS}(m_n) = \frac{2Gm_n}{c^2}$$  \hspace{1cm} (26)

The formula (24) therefore serves the equation

$$\lambda_C = \frac{\hbar}{m_0 c} \quad \Leftrightarrow \quad m_0 \cdot \lambda_C = \frac{\hbar}{c}$$

for the Compton wavelength of an elementary particle:

$$\Delta m_n \cdot 2 \rho_n = \frac{m_{pl}^2}{2m_n} \cdot \frac{4Gm_n}{c^2} = \frac{\hbar}{c}$$  \hspace{1cm} (27)

with the substitutions $m_0 = \Delta m_n$ and $\lambda_C = 2 \rho_n$.

During the creation of the virtual black hole Heisenberg’s uncertainty relation is fulfilled for the stimulated mass:

$$\Delta E \Delta t = \Delta E_n \cdot \frac{\Delta \varphi}{c} = \Delta m_n c^2 \cdot \frac{4Gm_n}{c^2} \cdot c = \frac{Gm_{pl}^2}{c} = \frac{\hbar}{2}$$  \hspace{1cm} (28)

The angular momentum $\vec{L} = m\vec{v} \times \vec{r}$ of a wave having mass $\Delta m_n$ circulating on the horizon of a black hole with mass $m_n$ at the speed of light $c$ is:

$$|\vec{L}| = \Delta m_n c \cdot \rho_n = \frac{m_{pl}^2}{2\sqrt{n}} \cdot \frac{2G}{c^2} \sqrt{n} m_{pl} = \frac{G}{c} \cdot \frac{\hbar}{2G} = \frac{\hbar}{2}$$

$$\Rightarrow s_x = \pm \frac{\hbar}{2}$$  \hspace{1cm} (29)

The spin of a stimulated black hole particle is by this of half Planck’s quantum which corresponds to a fermion\textsuperscript{14}. Particles relating to the energy of stimulation of a virtual-miniature-black-hole \textsuperscript{23} will be herein referred to as SBH-particles.

4 Discussion

4.1 SBH-Particles

Table (1) shows the values of some selected masses referring to the formulas of chapter \textsuperscript{3} and gives an idea of an Universe which is build by a fractal manner of black-hole-topologies. All masses

\textsuperscript{14}However the value of the spin $|\vec{L}| = \frac{\hbar}{2} m_{pl}^2$ relates to the definition of the Planck mass: If one attaches instead of one two Compton wavelengths to one Schwarzschild-radius one gets $\sqrt{\frac{\pi}{2}}$ for the Planckmass and a Spin of $\hbar$, which corresponds to a boson.
are initiated by stimulated curvatures of space-time where every black hole has its typical quantum. For macroscopic black holes these quantum have energies much smaller than the electron rest mass in the area of (practical) massless particles like neutrinos or photons: a macroscopic black hole seems to radiate thermal like a black body. But for virtual-minature-black holes the stimulated energies are in the typical range of the well known elementary particle restmasses matching their typical properties as rest energy, Compton wavelength and spin.

The Hawking\textsuperscript{15} times $t_V$ are a rough hint for the lifetimes of SBH-particles which show meaningful values for stable particles in the range of typical masses for elementary particles. But effects of quantum gravitation should generate very different values for this lifetimes, namely those experimental seen values which can be much less for instable and much more for stable particles.

The product of virtual mass and stimulated mass

\begin{equation}
C_{m_n}^\pm := \Delta m_n \cdot m_n^\pm = \pm \frac{1}{2} m_{\text{pl}}^2 = \pm \frac{\hbar}{4G} = \pm 1.185 \cdot 10^{-16} \text{kg} \cdot \text{eV}^2
\end{equation}

is always a constant for every SBH-particle:

So large black holes have small stimulated masses and small black holes have large stimulated masses. The basic eigenvalue $n = 1$ of self-curvature is given by the Planck mass which has a stimulated mass of approximately the same quantity. The sizes of the self-curvatures of space-time increase with $n$ and reach their maximum at $\sqrt{n} = 9.3 \cdot 10^{50}$ with the Universe as the largest Schwarzschild area. An extrapolation of the $\Delta m_n/m_n$ dependence for an elementary SBH-particle to the (not allowed) eigenvalue $n = 0$ gives cause to a speculation of a nearly massless particle of which the stimulated mass is an Universe with an incredible small lifetime that satisfies the uncertainty relation.

Through the extrapolation of this supposition the stimulated mass of an SBH-Universe is a massless particle (like neutrino or photon) with a rather infinite lifetime, and the stimulated mass of a massless particle is an Universe with a rather incredible short lifetime. As follows from chapter \textsuperscript{16} these quantums may be fermions. The most light-weight is a neutrino and the most heaviest a Planck quantum. The speculative extrapolation to the (not allowed) eigenvalue $n = 0$ gives as the heaviest

\begin{table}
\centering
\begin{tabular}{|c|c|c|c|c|c|c|}
\hline
Eigenvalue $n$ & virtual mass $m_n$ & stim. mass $\Delta m_n$ & $\Delta E_n$ & SS-diam. $2\rho_n = \lambda_C$ & Hawk. time $t_V$ & Name of stim. mass $m_0 = \Delta m_n$ \\
|---|---|---|---|---|---|---|
|\(\approx 0\) & \(\pm 8.3 \cdot 10^{-70}\) & \(1.4 \cdot 10^{33}\) & \(7.8 \cdot 10^{88}\) & \(2.5 \cdot 10^{-96}\) & \(\approx 0\) & SBH-Universe \\
|1 & \(\pm 1.5 \cdot 10^{-8}\) & \(7.7 \cdot 10^{-9}\) & \(0.4 \cdot 10^{28}\) & \(4.6 \cdot 10^{-35}\) & \(\approx 10^{-43}\) & Planck quant \\
|2.1 $\cdot 10^{37}$ & \(\pm 7.1 \cdot 10^{10}\) & \(1.7 \cdot 10^{-27}\) & \(938 \text{[MeV]}\) & \(2.1 \cdot 10^{-16}\) & \(\approx 10^{12}\) & SBH-proton \\
|1.9 $\cdot 10^{41}$ & \(\pm 6.6 \cdot 10^{12}\) & \(1.8 \cdot 10^{-29}\) & \(10 \text{[MeV]}\) & \(2.0 \cdot 10^{-14}\) & \(\approx 10^{18}\) & SBH-quark \\
|7.2 $\cdot 10^{43}$ & \(\pm 1.3 \cdot 10^{14}\) & \(9.1 \cdot 10^{-31}\) & \(0.51 \text{[MeV]}\) & \(3.9 \cdot 10^{-13}\) & \(\approx 10^{22}\) & SBH-elektron \\
|8.7 $\cdot 10^{121}$ & \(\pm 1.4 \cdot 10^{53}\) & \(8.3 \cdot 10^{-70}\) & \(0.46 \cdot 10^{-33}\) & \(4.3 \cdot 10^{26}\) & \(\approx 10^{139}\) & SBH-massless \\
\hline
\end{tabular}
\caption{Chart of SBH-particles: The entries in italics for the 'SBH-Massless' ($n \to \infty$) and the 'SBH-Universe' ($n \to 0$) are values introduced by an extrapolation of the formulas of chapter \textsuperscript{3} to their limits. The value for the SBH-massless arises if one gives the mass of the Universe from (7) for the virtual mass $m_n$, and the value of the mass of the SBH-Universe arises if one gives the mass of the Universe for the stimulated mass $\Delta m_n$. The mass of a quark is herein estimated as $\approx 10 \text{[MeV]}$.

\textsuperscript{15}Also in classical quantum dynamics a massless particle may have at least a very small rest mass $\approx 0$ according to the uncertainty relation $\Delta E \Delta t = \Delta E \cdot t_0 \geq \hbar / 2 \implies \Delta E \geq \hbar / (2t_0) = \frac{\hbar}{2} h_0 \approx 10^{-34} \text{eV}$ if one considers a particle blurred over the whole Universe.

\textsuperscript{16}S. Hawking proposed 'orderly' primordial black holes in the mass-range in question of $10^{15}$ to $10^{15}$ kg, which should explode as an effect of the Hawking-radiation just nowadays, but couldn’t be observed yet.}
\end{table}
fermion an Universe. Here one may imagine a possible fractal construction of the world build up by black-areas of different sizes. The observation problem of the Kopenhagen interpretation of quantum dynamics \[ 9 \], which means 'who watches the Universe', could be brought closer to an explanation through the assumption that the Universe watches itself or the Universes watches themselves: 'The snake is eating its own tail' (S.Glashow in Luminet \[ 13 \]).

### 4.2 The entropy of black holes

A fundamental question in gravity physics is to explain the high entropy of black holes. The Bekenstein-Hawking-entropy \[ 10 \] is \( S_{BH} = \frac{A}{4\pi r_s^2} \). From the above follows by setting in the surface area of the black hole \( A = 4\pi r^2 \):

\[
S_{BH} = \frac{2\pi}{c^3} \cdot n \quad (31)
\]

which relates the black hole entropy directly to its excitation level \( n \). The herein proposed black area for elementary particles should therefore be a black membrane as proposed by string theory \[ 10 \]. Its size should be of the dimension like it is related to elementary particles from the energy of gravitational waves. As a source for this gravitational energy one can take the energy to create elementary particles from the energy of gravitational waves. This means that the gravitational power of a black-hole-Universe this time is about \( t_0 \).

The rest energy of the Universe at all is \( E_U = M_Uc^2 \) which is converted in the time \( t_0 \) since the big bang. The average power over all is with \( \langle P \rangle \):

\[
\langle P \rangle \approx \frac{E_U}{t_U} = \frac{M_Uc^2}{t_0} = \frac{c^3}{H_0Gc^2} \cdot \frac{3H_0}{2} = \frac{3c^5}{2G} > \frac{c^5}{G} \quad (34)
\]

This shows that the gravitational power of a black-hole-Universe at all should be large enough to create all the mass it contains.

The energy density of the \( \Delta m_n \) and \( m_n \) related to the Schwarzschild volume of the related virtual mass \( m_n \) is:

\[
\varepsilon_\Delta = \frac{\Delta E_n}{\text{Vol.}} = \frac{\Delta m_n c^2}{\frac{4}{3}\pi r_n^3} = \frac{3c^7}{32\pi G^2\hbar} \cdot \frac{1}{n^2}
\]

\[
\varepsilon_n = \frac{E_n}{\text{Vol.}} = \frac{m_n c^2}{\frac{4}{3}\pi r_0^3} = \frac{3c^7}{16\pi G^2\hbar} \cdot \frac{1}{n} \quad (35)
\]

The gravitational power \( P \) falls off with the fifth power of the dimension \( r \) of the object as \( (33) \) and close to the singularity \( P(t) \) diverges. So the following integration is made for a black-hole-Universe starting at the Planck dimension with \( t_p = \frac{\hbar}{m_p c^3} = 0.76 \cdot 10^{-43} \) sec. The time-dependent evolution of the gravitational power can be approached with this as follows:

\[
\int_0^\infty P(t) dt \approx \int_{t_p}^{t_0} \frac{\alpha}{c^3} \frac{c^5}{G} dt = M_Uc^2 \quad (36)
\]

Inserting for \( r(t) \) the expansion of the EdS model as referred in \( \langle P \rangle \) the constant \( \alpha \) can be determined and one gets after some elementary calculations:

\[
P(t) = \left( \frac{2}{3} \right) \left( \frac{G\hbar^7}{H_0^6c^5} \right)^{1/6} \frac{1}{t^{1/3}} \quad (37)
\]

From this the time \( t_B \) of baryogenesis through gravitational waves can be calculated. This is the time...
in which the energy density of $\varepsilon_n$ \[3\] for a virtual Schwarzschild area was available.

$$\varepsilon_n = \frac{E_n}{\text{Vol.}} \approx \frac{P(t_B) \cdot t_n}{\frac{1}{3} \pi \rho_n^3} = \frac{P(t_B) \cdot 3c^2}{8\pi nG \hbar}$$ \[38\]

in which $t_n$ is the time for traversing $\rho_{SS}(m_n)$. Inserting \[37\] and solving for $t_B$ gives:

$$t_B = \left( \frac{28 \cdot 2^{1/3}}{3} \right)^{3/10} \left( \frac{G \hbar}{c^3} \right)^7 \cdot \frac{1}{H_0^3} \cdot \varepsilon_n$$

$$= 1.643 \cdot \frac{t_{pl}^0}{H_0^{0.3}} \approx 2 \cdot 10^{-25} \text{ sec}$$ \[39\]

The time $t_B$ is independent on the eigenvalue $n$ and only has a small dependence on the value of the hubble constant because the $-3/10$-power of $H_0$ doesn’t matter so much as the $7/10$-power of $t_{pl}$. Great standardization theories \[3\] (GUT) predict the baryogenesis for the time between $10^{-35}$ sec and $10^{-10}$ sec after the big bang. The time value for a baryogenesis through primordial gravitational waves \[33\] is compatible with this prediction.

### 4.4 The mass of the proton

As \[33\] points out the gravitational power of the evolving Universe is greater than the power needed to create virtual black holes for the first primordial $t_B \approx 2 \cdot 10^{-25} \text{ sec}$. This time may be interpreted as a kind of phase change as the Universe stops boiling. On the other hand the uncertainty equation for the Universe at this time gives a mass-equivalent of $m_t = \frac{\varepsilon_n}{\varepsilon_n}$. Inserting \[33\] gives:

$$m_t = 0.239 \cdot \left( \frac{h^{13} H_0^6}{c^5 G^n} \right)^{1/3} \approx 1.8 \cdot m_p$$ \[40\]

for a $H_0 = 87 \frac{\text{km}}{\text{Mpc} \cdot \text{sec}}$, which relates close to the proton mass as a limiting upper value for SBH-masses.

### 4.5 The mass of the neutrino

In this model, the neutrino is the less weighted fermion, resulting from the fermionic excitation of the Universe as the underlying virtual-mass-particle. The mass relation \[24\] $\Delta m_n = \frac{1}{2} \cdot \frac{m_n}{m_p}$ gives a minimum mass for the lightest neutrino of $m_{\nu} \geq \frac{h}{m_p} = 0.46 \cdot 10^{-33} \text{ eV}$, which can also be interpreted as the minimum mass for a particle, blurred over the whole Universe, like shown by Heisenbergs uncertainty relation. The relation \[24\] shows resemblance to the Dirac-mass- term \[20\], which follows from the so-called see-saw-mechanism in GUT-theory:

$$m_{\nu} \cong \frac{m_d^2}{M_R}$$ \[41\]

In this case, the Dirac-mass $M_D$ could be identified with the Planckmass $m_{pl}$ and the mass of the right-handed neutrino $M_R$ with the mass of the Universe.

### 4.6 The photon and the mass of the Universe

From the theory of nucleosynthesis, which uses the relation of the occurrence of $^2\text{D}, ^3\text{He}, ^4\text{He}, ^7\text{Li}$, a fraction of photons to baryons was derived \[3\]:

$$\eta = \frac{n_B}{n_{\gamma}} = (4 \pm 1) \cdot 10^{-10}$$ \[42\]

From the measured photon-density, which is about $n_{\gamma} = 400 \text{ cm}^{-3}$, the mass density of the Universe, mainly protons, should be about 10 to 12 percent of the critical mass density \[3\] $0.1 \cdot \rho_c \leq \rho_B \leq 0.12 \cdot \rho_c$.

As most of these photons are cold ones, having the temperature of the cosmic-background-radiation $2.7 \text{ K}$, photons give not a worth mentioning amount of energy to the mass density of the Universe. But these photons are 'late' photons, which means that these photons origin somewhere else in the Universe and are much red-shifted due to the expansion. In the SBH-model, the photon can be identified with a bosonic excitation of the Universe (i.e. space-time). As the Universe is isotropic and homogenous at every point, one has to estimate the energy of the photon as a typical photon like it is emitted by the photospheres of stars in our neighbourhood, which have much higher temperatures or typical wavelengths around 500 nm. With this one gets a fraction of $E_{\gamma} = h c/\lambda$ as

$$\frac{E_{\gamma}/\eta}{m_p c^2} = \frac{h}{c \lambda \eta m_p} = 6.607$$ \[43\]

which is more than 6 times the energy-density of the baryonic mass density. For this example, with a baryonic mass density of $\rho_B = 0.131 \rho_c$ and a average photon wavelength of $\lambda_\gamma = 500 \text{ nm}$ at its origin, the photon would bring up the missing 86.9
percent of the critical Universe-mass-density\(^{17}\). In this interpretation, the photon energy could give a considerable contribution to the mass density of the Universe: the average-photon-energy and also a not vanishing mass of the neutrino could close the Universe without the need of exotic particles.

### 4.7 The electromagnetic force

Moreover a black hole has not to gravitate because as an effect of its event-horizon no gravitational waves or gravitons may leave it. An ordinary black hole gravitates because it leaves behind the gravitational field of a collapsing object. If e.g. a Daemon would cut out a stellar black hole exactly at the Schwarzchild-border and place it somewhere else in the Universe, such a black hole would not gravitate except by the small mass equivalent of its Hawking radiation. This mechanism defines elementary particles as the Hawking radiation of virtual-miniature-black-holes.

The main difference to classical quantumdynamics is the assumption that the Compton-wavelength of a particle is associated with a virtual black hole or a black brane, maybe a D-brane like suggested in string-theory, which means a quantum spacetime curvature of this diameter. Such a virtual-miniature-black-hole is charged with the constant of the Schwarzschild-border and place it somewhere else in the Universe, such a black hole would not gravitate except by the small mass equivalent of its Hawking radiation. This mechanism defines elementary particles as the Hawking radiation of virtual-miniature-black-holes.

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The classical ratio between the gravitational force \(F_G = G\frac{m_1 \cdot m_2}{r^2}\) and the electromagnetic force \(F_Q = \frac{e^2}{4\pi\varepsilon_0 \cdot r^2}\) for an electron in any given distance \(r\) is:

\[
\frac{F_Q}{F_G} = \frac{e^2}{4\pi\varepsilon_0 Gm_e^2} = 4.167 \cdot 10^{42} \quad (44)
\]

This ratio lies just between the eigenvalues for SBH-quarks and SBH-electrons. If the virtual mass of a SBH-particle would be present as a higher order effect in any unknown way, the gravitational force between a SBH-particle and the virtual-SBH-mass of its vis-a-vis would be:

\[
F_{G\text{-virtual}} = G\frac{\Delta m_n \cdot m_n}{r^2} = \frac{c\hbar}{4r^2} \quad (45)
\]

As this force is independent on \(n\) and therefore independent on the mass of the particle one may relate it to an electromagnetic charge:

\[
F_Q = \frac{1}{4\pi\varepsilon_0} \cdot Q_n^2 = F_{G\text{-virtual}} = \frac{c\hbar}{4r^2} \quad (46)
\]

which gives

\[
Q = \pm \sqrt{\pi\varepsilon_0 c\hbar} = \pm 5.853 \cdot c \quad (47)
\]

and is about 6 times the elementary charge. As this assumption is just a plain one (as it must be an effect of higher order), this charge is not so far away from unity as it seems at first sight. Maxwells equations of electrodynamics should be an outcome of a theory of quantum gravitation and for this reason should give some hints to the formulation of quantum gravity.

### 4.8 Interactions of SBH-particles

A crucial requirement for SBH-particles is that this particles should behave like known particles. So what happens if two SBH-particles collide? In this plain model, SBH-particles have at least two quantum-numbers: The spin \(s_z = \pm h/2\) and a virtual-mass-charge \(C_{mn} = \pm c\hbar/4G\), which corresponds to the electrical charge \(\pm e\) and a virtual-mass of \(\pm m_n\).

A SBH-positron has the opposite values of this quantum-numbers, so SBH-electron and SBH-positron annihilate to a radiation of 2-times the energy of the stimulated mass \(\Delta m_n\), just like electron and positron do. When two SBH-electrons meet, they will not merge to a double-massive SBH-electron, as the two \(h/2\)-spins would add to \(h\) or 0, but the double-massive SBH-electron would have a \(\pm h/2\)-spin.

Recent experiments\(^{18}\) in a quantum-Hall environment show the possibility of the creation of fractional charged pseudo-electrons. This splitted electrons, with e.g. \(e/3\) or \(e/5\) charges, are created.
between groups of close circulating Hall-electrons. They seem to behave like one would assume for SBH-electrons: in their close vicinity space-time can be bent enough to form a virtual fractional-electron.

In the SBH-picture, the photon is the most elementary particle: Massive elementary particles are photons ‘captured’ by virtual-black-holes. And indeed, every elementary particle can be transformed to photons by annihilation.\(^\text{18}\)

4.9 Resume

A simple model of the Universe and its elementary parts was derived by assuming that a gravitational wave should not overrun its own event-horizon. From this assumption follows the relation between masses, Compton-size, and spins of fermions and a vivid interpretation of the particle/wave-dualism is given. The origin of electromagnetic charge as an effect of the virtual mass of a particle was proposed. Also follows the quantization of black holes, as was also shown e.g. by Khriplovich\(^\text{13}\) by dimensional arguments.

All matter should be build up by the event-horizons of gravitational waves. Every natural wave, like waves running with the speed of light or sound, are kinds of black-branes: No information will leave the wavefront to the outer regions. As gravitation gravitates, these waves build up closed and stable regions, defining fermionic elementary particles and even the Universe itself. The Hawking-radiation of the black-branes of the derived particles resemble the masses of the known fermions.

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\(^{18}\)Another process to do this, is the capture of a particle by an ordinary black hole. The captured particle adds its mass to the black hole and after a while it is radiated away by Hawking-radiation and the black hole restores its mass as it was before the capture. By this mechanism, also known as the information-paradoxon, the particle is transformed to a photon loosing its quantum numbers.
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