

The Origin of the Energy

DPG Spring Conference

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Introduction: Basic Concept

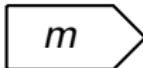
- ▶ energy is a **basic concept**, providing ...
 - ▶ ... structure
 - ▶ ... law of energy conservation, LEC
 - ▶ ... strategies for problem solving
- ▶ **new**
 - ▶ LEC in general relativity and cosmology
 - ▶ time evolution of energy from Big Bang until today
 - ▶ many exact analytic tools appropriate for pupils
 - ▶ ab initio calculations without fit parameters
 - ▶ precise accordance with observations
 - ▶ well documented (Carmesin (2019b), Carmesin (2020b), Carmesin (2021))
 - ▶ in PhyDidB: (Carmesin (2018), Carmesin (2019a), Carmesin (2020a))
- ▶ **experience with pupils** ...
 - ▶ ... since 2000
 - ▶ ... established parts: physics, mathematics, Seminarfach, astronomy club
 - ▶ ... innovative parts: research club → many awards

Introduction

Development of the Concept of Energy

Gravity: Newton (1686): ... $E_{gr} = \frac{-G \cdot M \cdot m}{r}$

Leibniz (1686): $E_{kin} = \frac{m \cdot v^2}{2}$



Mayer (1842): $\Delta \Sigma_j^{forms} E_j = 0$

Relativity: Einstein (1905): $E_{kin} = m_0 c^2 (\gamma - 1)$

with $1/\gamma = \sqrt{1 - v^2/c^2}$



Einstein (1915): EEP, SSM with $R_S = \frac{2GM}{c^2}$

Carmesin (2016): EEP $\rightarrow E = m_0 c^2 \gamma \epsilon$; $\epsilon = \sqrt{1 - \frac{R_S}{r}}$ $\hat{=} SSM$

Quanta: Planck (1900): $E = \frac{h \cdot c}{\lambda}$

Planck (1911): $E_{min} = ZPE = Zero - Point Energy > 0$

Tryon (1973): 'ZPE hypothesis': $E_{universe} = ZPE?$

Quantum Gravity

Planck scale

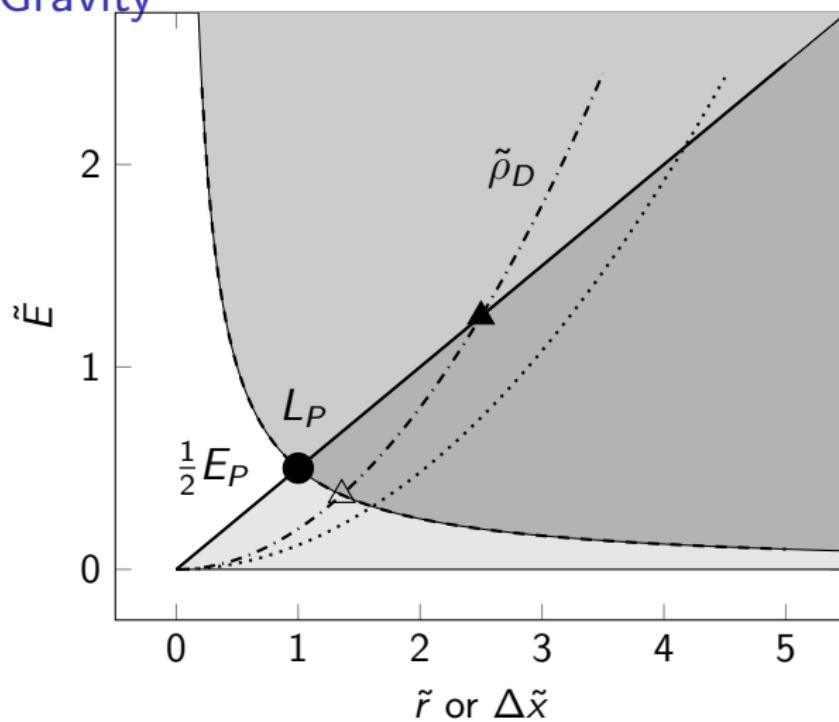
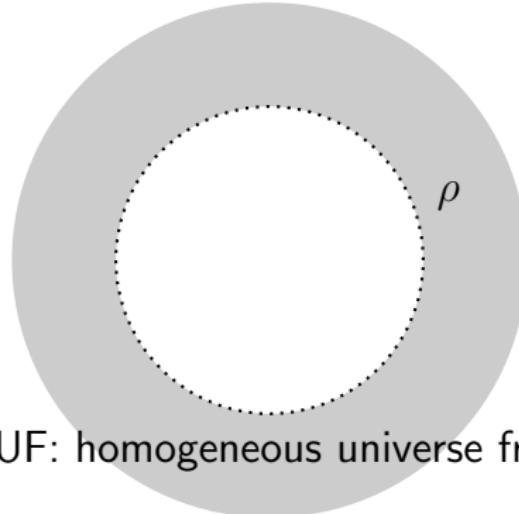
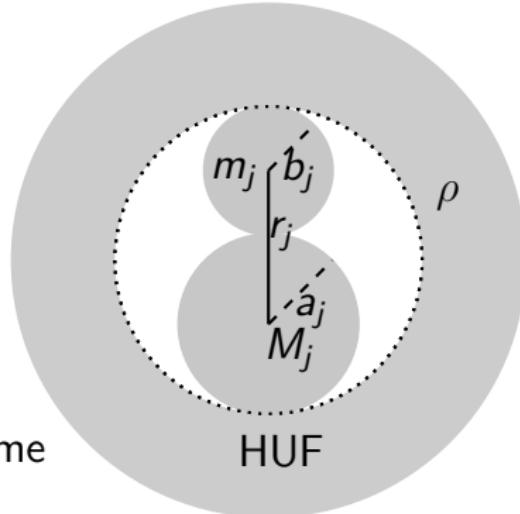


Figure: Limits of observation (Carmesin (2017)): the standard deviation $\Delta \tilde{x}$ and the Schwarzschild radius \tilde{r} limit the **range of observation**.

Law of energy conservation, LEC



HUF: homogeneous universe frame

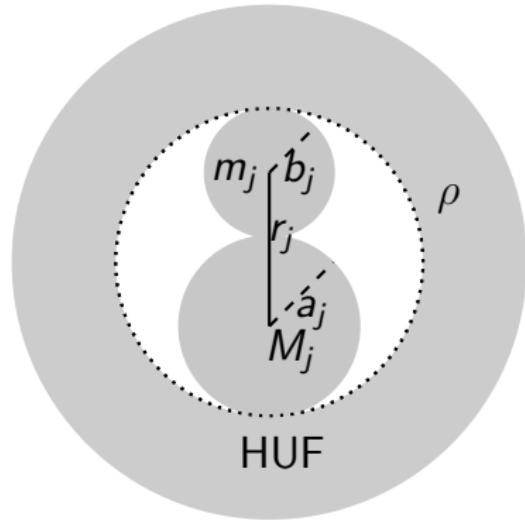


HUF

- ▶ **No field** \vec{G}^* in a HUF (Newton (1686), Birkhoff (1921), Carmesin (2021), Carmesin (2020c))
- ▶ $\rightarrow E(r, v) = m_{j,0} c^2 \gamma(v) \epsilon(r)$
 - ▶ $\epsilon(r) = \sqrt{1 - \frac{R_s}{r}}$
 - ▶ $1/\gamma(v) = \sqrt{1 - v^2/c^2}$
 - ▶ $\gamma(v) \cdot \epsilon(r) = 1$ (Carmesin (2016)) \rightarrow **LEC**

LEC

Photon $m_{j,dyn}$



- ▶ **No field** \vec{G}^* in a HUF (Carmesin (2021), Carmesin (2020c))
- ▶ $E(r, T) = \frac{h}{T_\infty} \cdot \gamma(T) \epsilon(r)$
 - ▶ $\gamma(T) \cdot \epsilon(r) = 1 \leftrightarrow \text{LEC}$
 - ▶ $E_{obs}(r, T) = \frac{h}{T(r)} = E_{kin}(r, T) = \frac{h}{T_\infty} \cdot \gamma(T)$
 - ▶ we insert $\rightarrow T(r) = T_\infty \cdot \epsilon(r)$

LEC in the expanding universe



- ▶ Excess energy $\bar{E} = \frac{E^2(r,v) - m_0^2 c^4}{2\gamma^2 m_0 c^2}$
 - ▶ $\bar{E} = \frac{m_0 c^2}{2} \left(\epsilon^2 - \frac{1}{\gamma^2} \right)$ (Carmesin (2021), Carmesin (2020c))
 - ▶ we insert $\bar{E} = \frac{m_0 c^2}{2} \left(\frac{v^2}{c^2} - \frac{R_S}{r} \right)$
 - ▶ we insert $\bar{E} = \frac{m_0 v^2}{2} - \frac{GMm_0}{r}$ **combined appr. is exact!**
- ▶ we average **pairs** $[v_j] = \dot{R}; [\frac{1}{r_j}] = \frac{1}{R} \approx [\frac{1}{r_j^2}]^{\frac{1}{2}}; k_j = \frac{-2\bar{E}_j}{m_{j,0} c^2} \frac{c^2}{r_j^2}$
 - ▶ $[k_j] = \frac{-2\bar{E}}{m_0 c^2} \frac{c^2}{R^2} = \frac{\dot{R}}{R^2} - \frac{8\pi G \cdot \rho}{3}$ **expansion DEQ: FLE**
 - ▶ LEC $\rightarrow \bar{E} = 0 \rightarrow [k_j] = 0$ **flatness problem solved**
- ▶ **included cases**
 - ▶ photon $m_{j,dyn}$ is included via $[v_j] = \dot{R}$
 - ▶ photon $M_{j,dyn} = M_P \frac{L_P}{r}$ is included via $\Phi_j = -\frac{GM_P L_P}{r^2}$ is a potential \rightarrow **LEC**
 - ▶ photon that was emitted after the Big Bang

Dark energy, DE

- ▶ symmetry analysis yields waves with vanishing classical energy (Carmesin (2021))
- ▶ quantization yields the following energy (Carmesin (2021))
- ▶ quanta have

$$\blacktriangleright E_{DE} = \frac{h \cdot c}{\lambda_{DE}} = \hbar \omega \cdot \left(\frac{1}{2} + n \right)$$

Energy conservation

- ▶ for all constituents ρ_{matter} , ρ_{photon} and ρ_{DE} :
 - ▶ LEC holds
 - ▶ description with dynamical mass m_j is possible → FLE
 - ▶ objects start at L_P
 - ▶ $\rightarrow v = v_{escape}$
 - ▶ $\bar{E} = E_{kin} + E_{gr} = 0$
 - ▶ observers measure in their frame:
 - ▶ mass: $v_{peculiar} \approx 0 \rightarrow E = m_{j,0}c^2$
 - ▶ wave: $E = \frac{h \cdot c}{\lambda}$
 - ▶ name $E = E_{obs}$ or $E = E_{own}$
 - ▶ E_{own} can be traced back from today back to the Big Bang

Measured energy traced back

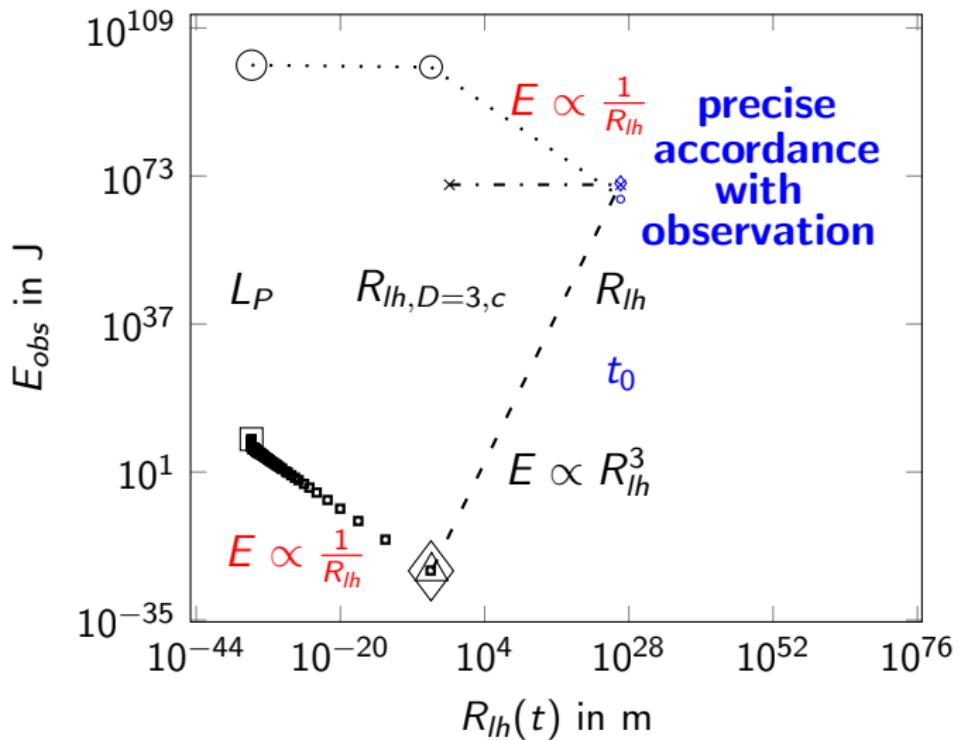


Figure: **Time evolution of E :** DE (squares, \diamond , dashed).
Photons (\circ , dotted). Dark matter (\times , dashdotted).

Discussion

- ▶ pupils discover: energy is a superb concept, also in cosmology
- ▶ pupils can apply the basic concept energy more clearly:
 - ▶ LEC holds for a **closed system only**
 - ▶ LEC is now **globally understood** → orientation
 - ▶ constituents of E are globally understood
 - ▶ time evolution of E is globally understood
 - ▶ **many new tools**
 - ▶ appropriate for pupils ϵ , γ , $[k_j]$, ...
 - ▶ can be applied in most curricula of physics
 - ▶ and exact and in precise accordance with observation
 - ▶ appropriate for quantum gravity
 - ▶ ab initio → orientation
 - ▶ pupils become competent for research projects
 - ▶ many innovative and interesting results have been derived
- ▶ Homepage: hans-otto.carmesin.org → Gravitation
- ▶ E-Mail: hans-otto.carmesin@t-online.de

Thank you

for your attention ;-)

Appendix

Calculations 1

► Own energy at t_0

- ▶ $u_v(t_0) = \rho_{cr,t_0} \cdot \Omega_\Lambda \cdot c^2$
- ▶ $u_v(t_0) = 8.66 \cdot 10^{-27} \frac{\text{kg}}{\text{m}^3} \cdot 0.6847 \cdot c^2 = 5.329 \cdot 10^{-10} \frac{\text{J}}{\text{m}^3}$
- ▶ $V_{lh}(t_0) = \frac{4\pi}{3} R_{lh}^3(t_0)$
- ▶ $R_{lh} = 4.142 \cdot 10^{26} \text{m}$ So we get $V_{lh}(t_0) = 2.977 \cdot 10^{80} \text{m}^3$
- ▶ $E_v(t_0) = u_v(t_0) \cdot V_{lh}(t_0) = 1.586 \cdot 10^{71} \text{J}$

► Own energy during expansion: $E_v(R_{lh}) = E_v(t_0) \cdot \frac{R_{lh}^3}{R_{lh}^3(t_0)}$

► Own energy at $\tilde{\rho}_{D=3,c}$

- ▶ $k_{\rho_{D=3,c} \rightarrow t_0} = \left(\frac{\rho_{D=3,c}}{\rho_r(t_0)} \right)^{1/4}$
- ▶ $k_{\rho_{D=3,c} \rightarrow t_0} = \left(\frac{5.353 \cdot 10^{95}}{8.335 \cdot 10^{-31}} \right)^{1/4} = 2.831 \cdot 10^{31}$
- ▶ $R_{lh,D=3,c} = \frac{R_{lh}(t_0)}{k_{\rho_{D=3,c} \rightarrow t_0}} = 1.463 \cdot 10^{-5} \text{m}$
- ▶ $E_v(R_{lh,D=3,c}, \text{backward}) = E_v(t_0) \cdot \frac{R_{lh,D=3,c}^3}{R_{lh}^3(t_0)} = 6.992 \cdot 10^{-24} \text{J}$

Appendix

Calculations 2

- ▶ Own energy at the Planck scale

- ▶ $\tilde{E}_{v, D_{horizon}} = \frac{1}{2}$
- ▶ $E_{v, D_{horizon}} = 9.781 \cdot 10^8 \text{ J}$

- ▶ Own energy during dimensional unfolding

- ▶ $E_{\text{own, vac, } D} = \frac{E_{\text{own, vac, } D_{horizon}}}{(D_{horizon}-D)/2 \cdot Z_{D_{horizon}} \rightarrow D}$

- ▶ $Z_{D_{horizon} \rightarrow D} = 2^{\frac{D_{horizon}-D}{D}}$

- ▶ For instance we get: $q_{D_{horizon} \rightarrow t_0} = \frac{R_{lh}}{L_P} = 2.563 \cdot 10^{61}$

- ▶ $k_{L_P \rightarrow t_0} = \left(\frac{\bar{\rho}_P}{\rho_r(t_0)} \right)^{1/4} = 3.486 \cdot 10^{31}$

- ▶ $Z_{D_{horizon} \rightarrow 3} = \frac{q_{D_{horizon} \rightarrow t_0}}{k_{L_P \rightarrow t_0}} = 7.352 \cdot 10^{29}$

- ▶ $D_{horizon} = 3 + 3 \cdot \frac{\ln(Z_{D_{horizon} \rightarrow 3})}{\ln(2)} = 300.64$

- ▶ $E_{\text{own, vac, } D=3, \text{ cr., forward}} = \frac{E_{\text{own, vac, } D_h}}{\frac{D_h-3}{2} \cdot Z_{D_h \rightarrow D=3}} = 8.869 \cdot 10^{-24} \text{ J}$

- ▶ $E_v(R_{lh, D=3, c}, \text{backward}) = 6.992 \cdot 10^{-24} \text{ J} \rightarrow \Delta E = 21.2 \%$

- ▶ **all quanta $E_v(t_0)$ within $R_{lh}(t_0)$ are traced back to one quantum E_v at the Planck scale**

Appendix

Calculations 3

- ▶ Own energy $E_{\text{own, rad, } D_{\text{horizon}}}$: $2^{D_{\text{horizon}}}$ quanta of radiation
 - ▶ $\rightarrow E_{\text{own, rad, } D_{\text{horizon}}} = 3.985 \cdot 10^{99} \text{ J}$
- ▶ Own energy during dimensional unfolding
 - ▶ $k_{D_{\text{horizon}} \rightarrow \tilde{\rho}_{D=3,c}} = \left(\frac{\tilde{\rho}_P}{\tilde{\rho}_{D=3,c}} \right)^{1/4} = 1.231$
 - ▶ $E_{\text{own, rad, } \tilde{\rho}_{D=3,c}, \text{ forward}} = \frac{E_{\text{own, rad, } D_{\text{horizon}}}}{k_{D_{\text{horizon}} \rightarrow \tilde{\rho}_{D=3,c}}} = 2.525 \cdot 10^{99} \text{ J}$
 - ▶ Transformation of arrangement: cube \rightarrow ball
 - ▶ radiation enters central ball from corners of cube
 - ▶ inwards $\propto \pi R^2$, outwards $\propto 4\pi R^2 \rightarrow \frac{E}{4}$ inside ball:
 - ▶ $E_{\text{own, rad, } \tilde{\rho}_{D=3,c}, \text{ forward, ball}} = \frac{E_{\text{own, rad, } \tilde{\rho}_{D=3,c}, \text{ forward}}}{4} = 0.63126 \cdot 10^{99} \text{ J}$

Appendix

Calculations 4

- ▶ Own energy at $t = 0$

- ▶ we divide the energy $E_{\text{own, rad, } \tilde{\rho}_{D=3,c}, \text{ forward, ball}}$ by the redshift:

$$\rightarrow k_{\tilde{\rho}_{D=3,c} \rightarrow t_0} = \left(\frac{\tilde{\rho}_{D=3,c}}{\tilde{\rho}_{t_0}} \right)^{1/4} = 2.8309 \cdot 10^{31}$$

$$\rightarrow E_r(t_0) = \frac{E_{\text{own, rad, } \tilde{\rho}_{D=3,c}, \text{ forward, ball}}}{k_{\tilde{\rho}_{D=3,c} \rightarrow t_0}} = \frac{0.63126 \cdot 10^{99} \text{ J}}{2.8309 \cdot 10^{31}} = 2.2299 \cdot 10^{67} \text{ J}$$

- ▶ test:

- ▶ direct calculation: $u_r(t_0) = \rho_{cr,t_0} \cdot \Omega_r \cdot c^2$

$$\rightarrow u_r(t_0) = 8.66 \cdot 10^{-27} \frac{\text{kg}}{\text{m}^3} \cdot 9.265 \cdot 10^{-5} \cdot c^2 = 7.491 \cdot 10^{-14} \frac{\text{J}}{\text{m}^3}$$

$$\rightarrow E_r(t_0) = u_r(t_0) \cdot V_{lh}(t_0) = 2.2299 \cdot 10^{67} \text{ J}$$

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Documentation

Modern physics is based on two great concepts: general relativity theory, GRT and quantum theory, QT. However, effects faster than light are called nonlocal, and they seem to be impossible in nature and in GRT, while they occur in QT, this contrast is called EPR paradox.

We solve it as follows: The curved spacetime in GRT corresponds to additionally forming vacuum. We calculate its volume, and we discover: It explains curvature of space as well as the expansion since the Big Bang. One half of that volume forms in a nonlocal manner: Thus nature and GRT are nonlocal and so no paradox remains.

The formation of spacetime, however, is local. With it we combine GRT and QT: We derive the field theory, the quadrupole or spin 2 symmetry, the waves and the quanta of spacetime. These provide precise accordance to observation without any fit parameter, of course.

The quanta of spacetime include the propagation and formation of vacuum. So they explain the dark energy and the time evolution of dark energy and structure, which in turn explains the discrepancy inherent to observed values of the Hubble constant H_0 and of matter fluctuations $\delta\theta$.

The quanta of spacetime include the quanta of gravitational interaction. So they explain the graviton by its symmetry, propagation, quantization and mechanism of interaction: Quanta of spacetime form, the resulting heterogeneity generates curvature, and this causes gravitational force. So the graviton is now understood in exceptionally deep detail!

The quanta of spacetime in the visible universe are traced back to one single quantum at the Big Bang. At its space, there immediately formed many quanta of zero-point energies of radiation. Altogether the complete energy and mass of the visible universe is traced back to the Big Bang.

The quanta of spacetime are invariant at Lorentz transformations and at all other linear transformations. These quanta solve many fundamental problems and explain various interesting systems, including black holes.

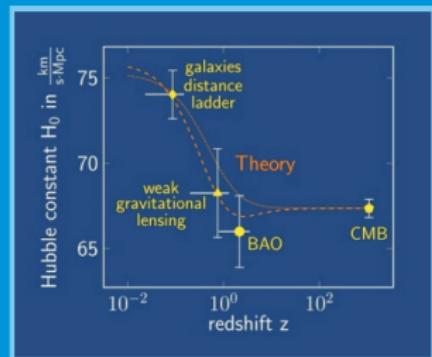
We derive all results with a smooth progression, and we summarize our findings in 15 propositions and 34 theorems.

ISBN 978 - 3 - 96831 - 008 - 4

4

Quanta of Spacetime Explain Observations, Dark Energy, Graviton and Nonlocality

Hans-Otto Carmesin



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Series
Universe: Unified from
Microcosm to Macrocosm

Documentation

We see stars at the sky, embedded in unlimited space.

In our universe, we discover, photograph and explain a lot by ourselves. With a telescope of length 1 m we take photos of objects near the end of the visible universe. So we observe satellites, comets, protuberances, the formation or explosion of stars, galaxies, curvature of spacetime and signs of the Big Bang. How can we understand all that?

Using basic experiments, we obtain the fundamental laws of nature including their universal constants:

the universal law of gravitation with the gravitational constant G,
thermodynamics with the Boltzmann constant k_B ,
the theory of relativity with the velocity of light c and
quantum physics with the Planck constant h.

With it we explain the history of the universe. Moreover, we resolve the following mysteries:

The cover shows the expansion of the space. We derive that macroscopic dynamics from the microscopic dynamics, and with it we show that the space is flat globally. The cover indicates a very rapid enlargement in the early universe, we explain it by a cosmic unfolding of space.

The masses in our daily world originate from the energy of electromagnetic waves, as illustrated at the cover. What is the source of that energy of radiation? For an analysis, we calculate the time evolution of the actual light horizon backwards in time, until we arrive at the smallest possible length, the Planck length. At that length, the omnipresent quantum fluctuations exhibit a huge zero-point energy, ZPE, in their local frame. This ZPE transforms to the available energy of radiation in the process of cosmic unfolding, as can be seen at the cover. In this manner we derive the origin of all mass and energy in the universe, and we achieve precise accordance with observation. On that basis, we can resolve even more mysteries...

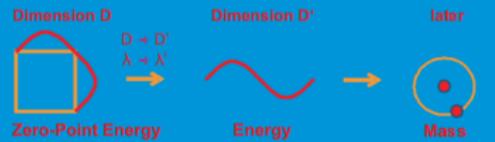
We are classes from grade 10 or higher, courses, enthusiasts, friends of experiments, natural scientists ...

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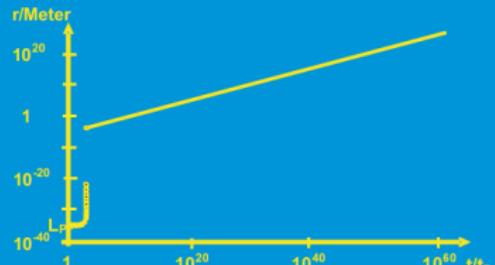
3

The Universe Developing from Zero-Point Energy Discovered by Making Photos, Experiments and Calculations

Hans-Otto Carmesin



H.-O. Carmesin Universe Developing Discovered by Making Photos, Experiments and Calculations



Reihe
Universe: Unified from
Microcosm to Macrocosm

Documentation

Als Folge der Quantengravitation gibt es kleinste beobachtbare Regionen, die gravitativ interagieren, dabei harmonische Oszillationen ausführen und so die lokale Raumstruktur darstellen. Langwellige Grundschwingungen werden frühzeitig wirksam und bilden die globale Raumstruktur.

As a consequence of quantum gravity, there are smallest observable regions that interact by gravity, perform harmonic oscillations thereby and form the local structure of space. Long-wave fundamental oscillations become effective in the early universe and form the global structure of space.

ISBN 978 - 3 - 89574 - 961 - 2

1

Die Grundschwingungen des Universums

The Cosmic Unification

Hans-Otto Carmesin



H.-O. Carmesin Die Grundschwingungen des Universums



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