Big Bang as a skyrmionlike interaction of two topological defect- configurations in a nonlinear field without initial singularity – the yin-yang model

Abstract:

An interaction of two coupling fields of fourth order leads to a local energy overthrow, which can generate a form of Big Bang over a phase transition. The interaction of two topological, skyrmionlike objects can cause this sort of Big Bang in a form of Φ^4description. The assumption, that the first cause thereby is generated from a pointlike singularity is neglected through a substitute of a kink an its antikink of a skyrmionlike structure. The theory- description is a $(1+1)/(2+1)$ approximation of spacetime – for one/two spacelike dimensions and one timelike dimension. As well as the early but also later phases of the universe are similiar in description to classical theories in inflation and later phases for a universe caused by a single singularity.

Key-words:
skyrmion; kink and antikink; universe enfolding; collision; topological defects; spacetime; Big Bang; inflation phase; expansion; vacuum bubble.

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1. Introduction:

A description of spacetime generation form of a Big Bang can be given from a skymionlike- model without an initial singularity but over a kink and its antikink. This skyrmion can be coupled to gravity-equation and its description leads to the same model and observation behaviour of early and later universe as in a model with an assumed singulatity. The exponential expansion as well as the later phase with less dynamics of spacetime can be explained by this theory.

2.Methods/Calculation:

2.1 A classical starting point is the scalar-field $\phi(x,t)$ with the Lagrange-density of:

$$L(x,t)=\frac{1}{2}\partial_\mu\phi\,\partial^\mu\phi-V(\phi) \qquad (1a.)$$

with the potential of a double-valley:

$$V(\phi)=\frac{\lambda}{4}(\phi^2-\eta^2)^2 \qquad (1b.)$$

2.2. Topological solutions as kinks and anti-kinks:

This theory exists in two stable vacuum-states $\phi=\pm\eta$.
A solution, which interpolates between both states, is called a kink:

$$\phi_K(x)=\eta\cdot tanhyp\left[\frac{m}{\sqrt{2}}(x-.x_0)\right];m=\sqrt{2\lambda}\eta \qquad (2a.)$$

and then the corresponding antikink is:

$$\phi_{AK}(x)=-\eta\cdot tanhyp\left[\frac{m}{\sqrt{2}}(x-.x_0)\right];m=\sqrt{2\lambda}\eta \qquad (2b.)$$

Both terms carry a topological charge:

$$Q=\frac{1}{2\eta}[\phi(+\infty)-\phi(-\infty)];|Q_K|=+1,|Q_{AK}|=-1 \qquad (3.)$$

2.3. Collision of two topological defects:

Consider a description of following configuration:

$$\phi(x,t=0)=\phi_K(x+x_0)+\phi_{AK}(x-x_0)-\eta \qquad (4a.)$$

Both terms are moving in a collision form:

$$\phi(x,t)=\phi_K(x+x_0-vt)+\phi_{AK}(x-x_0+vt) \qquad (4b.)$$

If kink and antikink collide, then there emerges a strong energy-compression in the center and the dynamics is nonlinear and chaotic. At certain enrgies from the pushing shock impact-energy can generate a new special metastable field e.g. a local „heating“ or a bubble in the field. This bubble can in a $(3+1)-D$ generalization interpreted as a new gravity bubble of a vacuum – a new universe.

2.4. Extrapolation and elaboration: the skyrme-model in a $(3+1)-D$ version of topological solitons:

The skyrme-model describes a $SU(2)$quality field $U(x)$ of:

$$U(x)=\sigma(x)+i\cdot\vec{\pi}(x)\cdot\vec{r} \qquad (5a.)$$

with the additioning condition of:

$$\sigma^2+(\vec{\pi})^2=1 \qquad (5b.)$$

then the Lagrange-density is:

$$L=\frac{f_\Pi^2}{16}Tr\left(\partial_\mu U\,\partial^\mu U^\chi\right)+\frac{1}{32e^2}Tr\left(\left[U^\chi\partial_\mu U\,,U^\chi\partial_\nu U\right]^2\right) \qquad (6.)$$

The topological charge then is analogous to baryon- number:

$$B=\frac{1}{24\pi^2}\int d^3x\,\epsilon^{ijk}\,Tr\left[\left(U^\chi\partial_i U\right),\left(U^\chi\partial_j U\right),\left(U^\chi\partial_k U\right)\right] \qquad (7.)$$

Then the two skyrmions with $B_{1,2}=\pm 1$ can interact at this place. In high-energy limit of their collision the nonlinearities of the fieldequations can lead to a new topological phase, e.g. to a region with $B=0$ but extremely high local energy-density in analogy to a Big Bang.

2.5. Cosmological analogy:

The energy-density T_{00} of this collision can be included into the Einstein-equation via coupling into

$$G_{\mu\nu}=8\pi G\,T_{\mu\nu}[\phi] \qquad (8.)$$

Then there is examined, if the local genetated energy-density leads to a form of spacetime curvature [1.],[2.],[3.] , which is similiar to an expanding spacetime e,g. a FRW-metric inside the bubble[4.],[5.],[6.]. From this the Big Bang would not be a singularity but a dynamical field-configuration. Two topological charged configurations ϕ_1,ϕ_2 interact strongly nonlinear:

$$L=\frac{1}{2}\partial_\mu\phi_i\partial^\mu\phi_i-V(\phi_1,\phi_2) \qquad (9.)$$

Their collision generates an energy-density $\rho=T_{00}$, which initiates a local spacetime-expansion:

$$\dot{a}^2(t)\propto\rho_{eff}(\phi_1,\phi_2)\quad . \qquad (10.)$$

The result is a phase transition. similiar to a Big Bang. Therefore the nonlinear field-model of skyrme or Φ^4 now is coupled to gravity to analyze how the spacetime reacts to the field-collision.

2.6. Starting point is field and gravitation with the entire, total effect of action and units of $c_0=\hbar=1$:

$$S=\int d^4x\sqrt{-g}\left[\frac{1}{16\pi G}R+L_{field}(\phi\,g_{\mu\nu})\right] \qquad (11a.)$$

with

$$L_{field}=\frac{1}{2}g^{\mu\nu}\partial_\mu\phi\,\partial_\nu\phi-V(\phi)\quad . \qquad (11b.)$$

The first term is Einstein-Hilbert action [7.],[8.],[9.], the second term is the field. Variation according to $g_{\mu\nu}$ yields to Einstein-equation[10.],[11.],[12.] :

$$R_{\mu\nu}-\frac{1}{2}R\,g_{\mu\nu}=8\pi G\,T_{\mu\nu} \qquad (11c.)$$

and the energy-momentum-tensor:

$$T_{\mu\nu}=\partial_\mu\phi\,\partial_\nu\phi-g_{\mu\nu}\left(\frac{1}{2}g^{\alpha\beta}\partial_\alpha\phi\,\partial_\beta\phi-V(\phi)\right) \qquad (11d.)$$

<u>2.7. For analytic developement some symmetry announcements are supposed:</u>

1. The both topological defects of kink and antikink collide symmetric head to head,
2. The configuration is nearly of spherical symmetry in $3-D$ or in a $(1+1)-D$ analogy nearly plane-symmetric.
This conditions ergo lead to a spherical-symmetrical metric-ansatz:

$$ds^2=A^2(t,r)\,dt^2-B(t,r)\,dr^2-r^{2d}\,\Omega^2 \qquad (12.)$$

and variation according to ϕ leads to the field-equations in curved spacetime :in form of Klein-Gordon-equation:

$$\nabla_\mu\nabla^\mu\phi-\frac{dV}{d\phi}=0 \qquad (13.)$$

and for the metric-ansatz above (12.) to:

$$\frac{1}{ABr^2}\partial_t\left(\frac{Br^2}{A}\partial_t\phi\right)-\frac{1}{ABr^2}\partial_r\left(\frac{Ar^2}{B}\partial_r\phi\right)+\frac{dV}{d\phi}=0 \qquad (14.)$$

<u>2.8. Energy-density and spacetime-curvature:</u>

The local energy-density for the resting-system timecomponent is:

$$\rho(t,r)=T_{00}=\frac{1}{2A^2}(\partial_t\phi)^2+\frac{1}{2B^2}(\partial_r\phi)^2+V(\phi) \qquad (15a.)$$

This quantity directly enters into the Einstein-equation. For spheric-symmetric spacetime there is (eg. according to Misner-Sharp) [13.],[14.],[15.]:

$$\frac{\partial M(t,r)}{\partial r}=4\pi r^2\rho(t,r) \qquad (15b.)$$

where $M(t,r)$ the enclosed energy is (mass-function).

The needed gravitational potential is:

$$B^{-2}=1-\frac{2GM(t,r)}{r} \qquad (16.)$$

and the timelement A follows from the energyflux-equation.

<u>2.9. Behaviour near the collision point:</u>

The cosmic energy at the collision from two defects like kink and antikink is concentrated near the middle of the center

$$\rho(t,r=0)\approx\rho_{max}(t) \qquad (17.)$$

If this energy-density is big enough, two scenarios can occur:
1. Gravitational collapse, because if

$\frac{2GM(r)}{r}>1$, then there constructs itself a local apparent horizon, a micro black hole.

2. Expanding bubble similiar to a Big Bang:
If the field changes in a tip over after the collision to a new hollow of potential with conditions of:

$V(\phi_{new})<V(\phi_{old})$, then in the center a new vacuum is generated with a higher energy potential. There acts really an effective cosmological constant with the condition of:

$$\Lambda_{eff}=8\pi G V(\phi_{new}) \qquad (18.)$$

In the inner space therefore generates a de-Sitter-like spacetime metric of:

$$ds^2=dt^2-e^{2Ht}(dr^2+r^2 d\Omega^2) \qquad (19a.)$$

with the condition of:

$$H^2=\frac{8\pi G}{3}V(\phi_{new}) \qquad 19b.)$$

Formally this is the same description of early inflationary universe [16.],[17.],[18.].

<u>2.10. Summary: BB from defect collision:</u>

1. Beginning with two topological field configurations (ϕ_1,ϕ_2),
2. Their collision generates an energy density of $\rho(t,r)$,
3. The Einstein-equations $G_{\mu\nu}=8\pi G T_{\mu\nu}$ determine, if the just originated spacetime collapses or local expands: $\dot{a}>0$,
4. If the overflow of energy generates a new local minimum v_{new}, then the region expands in an exponential way :

$$a(t)\sim e^{Ht}, H^2=\frac{8\pi G}{3}V_{new} \quad , \qquad (20.)$$

a new Big Bang [19.],[20.].

2.11. Elaboration to skyrme-fields:

If, istead of Φ a $SU(2)$ -like potential of form $U(x)$is used, then the description of energy-momentum-tensor becomes a little more complicated but in principle the mechanism stays the same:

The topological energydensity $Tr\left([L_\mu, L_\nu]^2\right)$ can trigger locally a de-Sitter-like expansion. The system ergo can describe a topological induced Big Bang - mathematically a local transition:

$(U_1, U_2) \rightarrow U_{merged} \Rightarrow T_{00} \rightarrow V_{eff} \rightarrow \Lambda_{eff}$.

How do now the metric-functions $A(t,r); B(t,r)$ develop themselves in the middle of the colliding center?
Trying with a $(1+1)$ dimensonal Φ^4 dynamic with a gravitative backcoupling over a FRW- similiar metric. Consider the metric of a model of:

$$d\acute{s}^2 = dt^2 - a^2(t)dx^2 \qquad (21a.)$$

and the scalar-field of $\phi(x,t)$ with its potential of:

$$V(\phi) = \frac{\lambda}{4} \cdot (\phi^2 - \eta^2)^2 \qquad (21b.)$$

The needed equations then take the form of:

1. Field-equations: Klein-Gordon-equation of expanding spacetime:

$$\ddot{\phi} + \frac{\dot{a}}{a}\dot{\phi} - \frac{1}{a^2}\phi'' + \lambda\phi \cdot (\phi^2 - \eta^2)^2 = 0 \qquad (22a.)$$

2. Friedman-equation of gravitation:

$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\langle\rho\rangle, \qquad (22b.)$$

where:

$$\rho = \frac{1}{2}(\dot{\phi})^2 + \frac{1}{2a^2}(\phi')^2 + V(\phi) \qquad (22c.)$$

and $\langle\rho\rangle$is the spacelike average.

2.12. Listing and analysis of the coupled equations:

In following, the coupled fiel-equations for gravity backcoupling in a FRW-like spacetime metric and for the scalar-field Φ^4 are formulated. The aim is, to explain explicitely how the metric with its scalefactor $a(t)$ develops in terms of causing fieldenergy, ergo how the local BB generates, induced through the collision of the two defects.

Ansatz:

1. homogenious$(1+1)-D$ FRW-metric. There is:

$$ds^2 = dt^2 - a^2(t)\,dx^2 \tag{23.}$$

with a scalar field $\phi(x,t)$.
In the average over x homogenity is assumed, ergo
$\phi(t) := \langle\phi(x,t)\rangle$. This is justified , when the collision leaves an uniform energydensity approach.

2. Effective action and Lagrange-density:

The whole effect of action is:

$$S = \int dt\,dx\,a(t)\left[-\frac{1}{16\pi G}R + \frac{1}{2}\dot{\phi}^2 - \frac{1}{2a^2}(\phi')^2 - V(\phi)\right] \tag{24a.}$$

and for this $(1+1)$- metric there is:

$$R = -2\frac{\ddot{a}}{a}$$

Then after integration over x, the reduced action comes to:

$$S_{eff} = \int dt\,a(t)\left[-\frac{1}{8\pi G}\frac{\ddot{a}}{a} + \frac{1}{2}\dot{\phi}^2 - V(\phi)\right] \tag{24b.}$$

<u>2.13. Variation and equations of motion:</u>

1. Variation to ϕ:

$$\ddot{\phi} + \frac{\dot{a}}{a}\dot{\phi} + \frac{dV}{d\phi} = 0 \tag{24c.}$$

This is as a dynamic field-equation, the Klein-Godon equation with Hubble-damping.

2. Variation right to a. An equation similiar to Friedman. From the energy-momentum tensor there comes:

$$\rho = \frac{1}{2}\dot{\phi}^2 + V(\phi);\; p = \frac{1}{2}\dot{\phi}^2 - V(\phi) \tag{24d.}$$

3. The 00- component of Einstein-equation gives:

$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\rho \tag{24e.}$$

and the derivation after time – equation of acceleration – is:

$$\frac{\ddot{a}}{a}=-\frac{4\pi G}{3}(\rho+3p) \qquad (24f.)$$

2.14. Compounded system:

The coupled system of equations ergo is:

$$\left\{\ddot{\phi}+3H\dot{\phi}+V'(\phi)=0\,;H^2=\frac{8\pi G}{3}\left(\frac{1}{2}\dot{\phi}^2+V(\phi)\right)\right\} \qquad (25.)$$

with $:H=\frac{\dot{a}}{a}$.

(In $1-D$ the factor before H would not 3 but 1 --- but the fundamental structure is the same).

2.15. Example: Φ^4-potential system:

$$V(\phi)=\frac{\lambda}{4}\left(\phi^2-\eta^2\right)^2;V'(\phi)=\lambda\phi\left(\phi^2-\eta^2\right) \qquad (26.)$$

Input gives:

$$\ddot{\phi}+3H\dot{\phi}+\lambda\phi\left(\phi^2-\eta^2\right)=0 \qquad (27a.)$$

and

$$H^2=\frac{8\pi G}{3}\left[\frac{1}{2}\dot{\phi}^2+\frac{\lambda}{4}\left(\phi^2-\eta^2\right)^2\right] \qquad (27b.)$$

3. Analysis: behaviour after the collision:

3.1. Early behaviour:

Suppose, the collision of the two both defects sets the system away from its equlibrium.

$$\phi(t=0)\approx 0;\dot{\phi}(t=0)\neq 0. \qquad (28a.)$$

Then there is first of all:

$$V(0)=\frac{\lambda}{4}\eta^4. \qquad (28b.)$$

This is the term of maximal potential energy, corresponding to a local cosmological constant of :

$$\Lambda_{eff}=8\pi G\cdot V(0)=2\pi G\lambda\eta^4. \qquad (29a.)$$

Then there is in the beginning:

$$H^2=\frac{\Lambda_{eff}}{3}\Rightarrow a(t)=a_0 e^{Ht} \qquad (29b.)$$

This means an exponential spacetime expansion, an inflation. This beaviour exactly is the situation of a Big Bang in the inner region of the fieldcollision area.

<u>3.2. Later behaviour:</u>

While ϕ rolls in one of the minima $(\phi\rightarrow\pm\eta)$, $V(\phi)$ decreases and the expansion becomes slower. There follows:

$$H(t)\sim\sqrt{\frac{8\pi G}{3}\left[\frac{1}{2}\dot{\phi}^2+V(\phi)\right]}\downarrow. \qquad (30.)$$

At the end, when ϕ lies at the minimum $(V\rightarrow 0)$, the expansion expires and $a(t)$is nearing itself to a constant value. From the sight of the local bubble, the universe becomes "frozen".

<u>3.3. Physical interpretation:</u>

1. The collision of two topological defects locally carries the field over the potential wall,
2. Through this there generates itself a region with very high energy density,
3. This energy acts about T_{00} like a positive cosmological constant wich causes a spacetime expansion,
4. When the field is rolling in a stable vacuum, the energy dendsity decreases which leads to an end of the expansion.

Formally this situation is a form of a "false vacuum" bubble.

<u>3.4. Conclusion:</u>

The following coupled equation-system demonstrates, that every topological concentration of a collision of two kinks, if it is heavy enough, can generate a local de-sitter-phase with $a(t)\sim e^{Ht}$ and $H:=\frac{\dot{a}}{a}$ from :

$$\ddot{\phi}+3H\dot{\phi}+\lambda\phi\cdot(\phi^2-\eta^2)=0 \text{ and } H^2=\frac{8\pi G}{3}\cdot\left(\frac{1}{2}\dot{\phi}^2+\frac{\lambda}{4}(\phi^2-\eta^2)^2\right) \qquad (31./32.)$$

Ergo mathematically a Big Bang from field-interaction --- without a singularity.

4. Symbolic solution of the coupled equation-system with Φ^4 and gravitational backcoupling:

4.1. Given are equations (31./32.). Then there can made some simplified assumptions:

Suppose: $\eta=\lambda=1; \frac{8\pi G}{3}:=\kappa$. This leads to a shorter form of the needed equations of:

$$\ddot{\psi}+3H\dot{\psi}+\phi(\phi^2-1)=0 \tag{33a.}$$

and

$$H^2=\kappa\left(\frac{1}{2}\dot{\phi}^2+\frac{1}{4}(\phi^2-1)^2\right) \tag{33b.}$$

With
$H:=\frac{\dot{a}}{a}$ to put in to get a closed system of $a(t) \wedge \phi(t)$.

4.2. Symbolic and analytic structural solution of $\phi(t), a(t)$:

Since H only depends from ϕ and $\dot{\phi}$, equation (33a.) can be reduced to a single form of second order DE in $\phi(t)$:

The result in nearing, when ϕ is small and $V(\phi)$ constant, is:
1. early phase for $\Phi\approx 0$:

There is $V(\phi)\approx\frac{1}{4}$, nearly constant and therefore

$H\approx H_0=\sqrt{\frac{\kappa}{4}}$, from this then there follows:

$$\ddot{\phi}+3H_0\dot{\phi}-\phi=0 \tag{34.}$$

The solution of that linearized equation is:

$$\phi(t)=A e^{\alpha_{+0}\cdot t}+B e^{\alpha_{-0}\cdot t} \tag{35.}$$

with the condition of:

$$\alpha_{\pm 0}=\frac{-3H_0\pm\sqrt{9H_0^2+4}}{2} \tag{36.}$$

Since $H_0>0 \rightarrow \alpha_{+0}>0$,
the field grows out in exponential form from the instable point $\phi=0$.
In this time there is $H\approx const.$, therefore follows:

$$a(t)=a_0 e^{H_0 t}. \tag{37.}$$

This is the inflation phase of local Big Bang.

2. Late phase for $(\Phi \rightarrow \pm 1)$:

If the field falls into a minimum, there is:

$$V(\phi)\approx 0; H\rightarrow 0; \quad \ddot{\phi}+\phi(\phi^2-1)=0 \tag{38.}$$

This equation gives oscillations:

$$\phi(t)\approx \pm 1+\epsilon \cos(\sqrt{2}\,t). \tag{39.}$$

The inflationary expansion ends:

$a(t)\rightarrow const.$

Possibly this oscillation generates a pre-quark-system of matter from its vacuum-oscillations, which later lead to protons, neutrons and hydrogen/helium. The other two particle generations of standard model $U(1)\,x\,SU(2)\,x\,SU(3)$ can be generated over an energy cascade of this oscillation period and in this way create matter garbage.

4.3. Summary of symbolic solution:

$$\text{I}\,\phi(t)\approx A\,e^{\alpha_{+0}t}+B\,e^{\alpha_{-0}t};\ \text{II}\ \alpha_{\pm 0}=\frac{-3H_0\pm\sqrt{9H_0^2+4}}{2};\ \text{III}\ a(t)=a_0\,e^{H_0 t};$$
$$\text{IV}\ \ H_0=\sqrt{\frac{2\pi G\lambda\eta^4}{3}}. \tag{40.- 43.}$$

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1. Starting phase: exponential spacetime- expansion: Big Bang,
2. Endphase: damping and stabilization in the new vacuum.

4.4. Physical interpretation:

Aspects of the symbolic solutions are:

1. The collision of the kink and the antikink lifts ϕ to $\Phi=0$ and generates maximal potential energy which leads to exponential, inflationary expansion,
2. The field rolls down, transformation of energy from potential into kinetic, expansion slows down,
3. Afrer some time the field reaches the minimum of $V=0; H=0$, $\rightarrow$ stable universe.

4.5. Developement of $\phi(t)$ and $a(t)$:

Described is, what these two curves mean physically and how they describe the transition and connection of the topological collision between the two kinks and how there can be generated a Big-Bang like expansion-process.

1. The starting point is:

$\phi(0)=;\dot{\phi}=1\cdot 10^{-3}$.

The field is near the instable center of the Φ-potential

$$V(\phi)=\frac{1}{4}(\phi^2-1)^2. \qquad (44a.)$$

Then the field has in this position maximal potential energy of

$$V(0)=\frac{1}{4} \qquad (44b.)$$

This situation correspondens with a highly, quasi-constant state of energy. Physically a “false vacuum“ with an effective positive, cosmological constant.
This energy feeds the spacetime-expansion over Einstein-equation:

$$H^2=\frac{8\pi G}{3}\cdot\rho \qquad (45.)$$

The universe begins to expand in an exponential way.

2. Early phase – Big Bang-like expansion.

In the beginning there is:

$$\rho\approx V(0)=\frac{1}{4};H\approx H_0=\sqrt{\frac{8\pi G}{12}} \qquad (46.)$$

This situation leads to:

$$a(t)\approx a_0 e^{H_0 t}. \qquad (47.)$$

This is the Big Bang moment: the energy of the collision of two topological defects like kink and antikink generates a dense, hot region, where its energydensity is blowing up spacetime locally.

3. Middle phase: the field $\phi(t)$ rolls down the potential wall during the expansion phase .

$$\ddot{\phi}+3H\dot{\phi}+\phi(\phi^2-1)=0 \qquad (48.)$$

Explanation: the second term $3H\dot{\phi}$ is the Hubble-damping – the expansion acts like a friction; nevertheless ϕ is accelerated, as soon as it slips down from the peak. This is the reason, that $V(\phi)$ decreases and the potential energy changes to a kinetic one in the description system.

Result: $\phi(t)$ increases first of all slowly, then faster, crosses $\Phi\approx 1$, and then oscillates slightly around the minimum.

4. Late phase: stabilization in vacuum.

If $\phi \rightarrow \pm 1$, then $V(\phi) \rightarrow 0; H \rightarrow 0$. No source of energy anymore for expansion, the scalefactor $a(t)$ flats down . In a simulation would be:

1. $a(t)$ in the beginning increases in an exponential form,
2. Then the ascent slows down, until $a(t)$ is nearly constant.

This is the end of the inflation – and the beginning of a quite, more silent era, where the field is oscillating in its minimum, which has its analogy in the matter-dominated phase of real cosmos.

4.6. Interpretation of the process in Table 1:

Phase	Behaviour of $\phi(t)$	Behaviour of $a(t)$	Physical meaning
I. Unstable beginning	$\Phi \approx 0$, small disturbance	$a(t) \sim e^{H_0 t}$	Local energy density pushes Big Bang
II. Rolling phase	Φ accelerates, leaves 0	H slowly decreases	Field rolling, energy changing
III. Vacuumphase	$\Phi \rightarrow \pm 1$, oscillating	$a(t) \approx constant$	Universe is stabilizing

Table 1: How the collision of to kinks as topological disturbances create an universe without a singularity.

4.7. Analogy in cosmology:

This dynamic formally is identic to classical inflationary cosmology description
1. The scalar field $\phi \rightarrow$ the inflaton field,
2. The potential $V(\phi)$ drives the expansion,
3. The Hubble-damping finishes the inflation complete, when V is falling down.
Difference; in this model the trigger is not an only universal field but two topological defects in local prae-spacetime vacuum, which acts like a substitute for a classical singularity. This situation brings the field into an unstable, energy rich configuration. This configuration-state generates for a short time a de-Sitter-like inflation of spacetime. Afterwards the field stabilizes and at last the new universe freezes in another vacuum state.

4.8. Definition of an e-fold:

The number of the e-folds N measures, by which factor the scale factor $a(t)$ changes its size by increasing exponentially

$$N = \ln\left(\frac{a_{end}}{a_{start}}\right) \qquad (49.)$$

a_{start}--- scalefactor at the beginning of the inflation with $t=0$ or $t=t_{Planck}$
a_{end} --- scalefactor at the end of inflation, when ϕ reaches its minimum.

The inflation ends, when H is strongly decreasing; let‘s take for this the condition:

$$\epsilon_H = -\frac{\dot{H}}{H^2} \sim 1 \tag{50.}$$

In numerical simulation, there can be simply supposed:

$\phi(t_{end}) \approx 0.9 \sim \eta = 1$. Therefore $\phi(t)$ is near at its minimum , the Hubble-damping isn‘t of great size any longer and the expansion slows down.

4.9. Analytic approximation:

Look at the early phase: $\Phi \approx 0 ; H \approx H_0 \approx const. \rightarrow$ exponential expansion.

$$a(t) \approx a_0 e^{H_0 t};\ H_0 = \sqrt{\frac{8\pi G}{3} V(0)} = \sqrt{\frac{8\pi G}{a2}} \approx 0.513. \tag{51a./51b.}$$

Period until Φ reaches $\Phi \approx 0.9$:

$$\phi(t) \approx \phi_0 e^{a_{+0} \cdot t};\ a_{+0} = \frac{-3H_0 + \sqrt{9H_0^2 + 4}}{2} \approx 0.618 \tag{52a./52b.}$$

Set

$$\phi(t_{end}) = 0.9 ; \phi_0 = 1 \cdot 10^{-3} \Rightarrow t_{end} \approx 11.6 \tag{52c./52d.}$$

Then the e-folds:

$$N = H_0 \cdot t_{end} \approx 0.513 \cdot 11.6 \approx 5.95 \tag{53.}$$

1. This also leads to an approximation of $N \approx 6$ e-folds for a mini Big Bang-model with a short eponential expanding. For the real, visible universe there are approximately $50-60$e-folds necessary.
2. The expanse is strong enough to encouple the local bubble from the rest space, the remnant residual.
3. Then the field stabilizes in the minimum --- the generated universe exists isolated.

5. Summary:

1. Two topological defects collide, the field is lifted on an unstable point-state, this causes a short inflation.
2. The scalefactor arises with value of approx. 6e-folds. Then the field falls into the vacuum and generates a stabile universe.

3. With greater initial disturbances or stronger gravity effects more e-folds could be generated, which would lead to a greater expansion.

6 , Parametrical examination:

How the number N of e-folds dependends from eminent physical values like gravitational constant G, the initial steering ϕ_0, the starting energy $V(0)$ and the Hubble-parameter H_0.

Used is the linearized early phase:

$$\phi(t)\approx\phi_0 e^{\alpha_{+0}t};\ \alpha_{+0}=\frac{-3H_0+\sqrt{9H_0^2+4\lambda}}{2}\ ;\ H_0=\sqrt{\frac{8\pi G V(0)}{3}}$$ and the e-folds of:

$$N=H_0\cdot t_{end};\ t_{end}=\frac{\ln\left(\frac{\phi_{end}}{\phi_0}\right)}{\alpha_{+0}}\ ;\ \phi_{end}\approx\eta. \qquad (54.\text{-}59.)$$

Result of the numerical simulation:

1. Smaller $\phi_0\rightarrow$ more e-folds, because the field stays longer at the unstable plateau, before it rolls,
2. bigger $G\rightarrow$ bigger e-folds because if there is a stronger gravitation, there is a bigger H_0 and faster exponential expansion,
3. areas could be found easier, where ca. $50-60$e-folds exist, which leads to a more realistic simulation of the universe inflation.

7. Conditions for a greater universe and its encoupling from the topological underground:

The conditions ergo for enough inflation are: $N=H_0 t_{end}\geq 50$ and the equations of (54.-59.) with $\phi_{end}\approx\eta=1$.

Then there is:

$$N=H_0\frac{\ln\left(\frac{\eta}{\phi_0}\right)}{\alpha_{+0}}\geq 50\text{'} \qquad (60.)$$

this leads to:

$$\phi_0\leq\eta\cdot\exp^{\left(-50\frac{\alpha_{+0}}{H_0}\right)} \qquad (61.)$$

From this equation is seen: the smaller ϕ_0, the longer the field stays at the plateau and there are more e-folds generated.

Example of numbers, take following values:

$G=0.1;\lambda=1;V(0)=0.25;\rightarrow H_0\approx 0.513;\alpha_{+0}=0.618$ like above. Then there is numerically:

$\phi_0 \sim 1 \cdot 10^{-26}$.

Interpretation of the result:
1. To get 50 e-folds, the initial steering must be very small,
2. In realistic sceneries the gravity (G) could be greater or the potential be more flat to get less extreme ϕ_0 needed.
Conditions for the encoupling from the underground virtual topology- space.

A universe can encouple, when it builds up a local de-Sitter bubble,
1. Pressure and energy density inside the bubble cause a background-expansion, which is faster than the expansion of the surrounding.
2. Mathematically: the Hubble-radius of the bubble $R_H = \frac{1}{H_{bubb}}$ must be smaller than the typical length of the background surrounding. In this model:

$$R_H \sim \frac{1}{H_0} \approx \frac{1}{0.513} \sim 2 \qquad (62.)$$

If the bubble is initial smaller than Hubbleradius and expands fast, it divides quasi-cosmological from the topological basis background of spacetime.

Conclusion: the parameter-dependence of the generating process is summarized in in Table 2:

Parameter	Effect/Action
ϕ_0	The smaller, the longer inflation - more e-folds
G	The bigger, the bigger also $H_0 \rightarrow$ - faster exponential increasing - more e-folds
$\Phi < \lambda$; potential more flat than λ	α_{+0} - smaller $\rightarrow$ field rolling slower $\rightarrow$ longer inflation

Table2: Parameter-dependence of inflation-phase of universe-bubble. Key-idea is, that a great universe is being built from a very small local initial non-equlibrium ϕ_0 deviating from the whole global equlibrium-state on a flat potential and with a sufficient strong gravity. Then the field is rolling into its minimum, the expansion slows down and the new universe stays stable at an only isolated bubble.

8. Generation of a stable universe, in dependence of the three parameters $G ; \phi_0 ; V(0)$:

8.1. Key-idea: a new universe gegenrates from the collision of two topological defects, if:

1, The field ϕ stays for a short time on an unstable platform, near $\Phi \approx 0$, to have enough potential energy for an expansion,

2. The exponential expansion is big enough inside the bubble, to encouple it from the surrounding background,

3.At the end, the field stays in a stable minimum, the bubble stays isolated, the expansion slows down and fulfills a transition into the hot and later cold matter state.

8.2. Choice of the parameters:

1. Initial oustearing of ϕ_0 must be very small to generate enough e-folds, from a heatmap or a nearing comes:

$$\phi_0 \le \eta \cdot \exp^{\frac{-N_{target} \cdot \alpha_{+0}}{H_0}} \quad (63.)$$

Figures: Example for $N_{target}=50; G=0.1; \alpha+o\approx 0.618; H_0\approx 0.513; \phi_0 \sim 1\cdot 10^{-26}$.
In models with flatter potential $\lambda<1$ or greater gravity G there can exist a less extremely small value of ϕ_0.

2. Choice of gravity constant:
If G is chosen with a greater value, less extreme values of ϕ_0 can be chosen for the simulation.

3. Heigth of potential $V(0)$:
If $V(0)$ is higher, then more greater energies fore inflation are possible, which also leads to a greater value of H_0.
4. For a realistic bubble $V(0)$ mustn‘t be too small because in this case the expansion wouldn‘t be big enough to guarantee an encoupling.

8.3. conditions of encoupling:

That the bubble isolates itself from the rest of the praespace,

1. The Hubbleradius of the bubble must be smaller than the typical extension region of the surrounding with the condition of:

$$R_h \sim \frac{1}{H} < L_{surrounding} \quad (64.)$$

2. The period of the inflation must be long enough to blow up the bubble and divide it quasi-cosmological from the surrounding vacuum. For values of:
$H_0\approx 0.5; \phi_0\approx 1\cdot 10^{-26} \rightarrow N\sim 50$, which means, that the bubble increases its size in short time about a scale factor of e^{50}, in this case it becomes practically isolated from the surrounding vacuum space.

8.4. Conclusion of the simulation process in Table 3.

Items	Conditions
Define potential Φ	Φ^4 potential with $\lambda\le 1$ and $V(0)\sim 0.25$
Select initial elongation ϕ_0	Small enough for desired e-folds (read Heatmap)
Choose G	G increasing $\rightarrow$ less extreme ϕ_0 necessaŕy
Simulation of Friedman - and Φ^4-dynamics	Proof, if $N\ge 50$

Proof of endstate	Field lands in minimum, Hubble-parameter decreases $\rightarrow$ universe-bubble stable

Table 3: Simulation of conditions for e-folds in dependence of physical parameters to generate a realistic universe.

8.5. Result:

With the parameter-choice above there is a situation of a strong expanding, stable universe, the Big-Bang-like incident is the collision of the two topological defects of kink and antikink, which lifts the field high at the platform above the potential-wall. Then there follows: inflation $\rightarrow$ field-rolling $\rightarrow$ stabilizing of bubble $\rightarrow$ encoupling from surrounding background $\rightarrow$ stable new universe with oscillations [21.],[22.], prae-quark soup and beginning hot and cold matter-phase (garbage) of standard model $U(1)\,x\,SU(2)\,x\,SU(3)$.

8.6. summary:

1. Heatmap of the e-folds $N(G,\phi_0)$ shows, how strong the inflation turns out,
2. Contour of $N=50$ $\rightarrow$ limit for big universe,
3. Area of encoupling marked $\rightarrow$ all points with $H_0 \geq 0.5 \rightarrow$ universe bubble expands fast enough to be isolated from the surrounding subspace.
4. Key-effect of very small ϕ_0 means a longer inflatonary expansion. Greater gravity term G means that less fine tuning for ϕ_0 is necessary. Combination of both parameters leads to a stable encoupled bubble.

9. The course of fieldfactor $\phi(t)$ and scalefactor $a(t)$ proceed during the generation and expanse of the new universe by taking a Φ^4-potential coupled to the Friedman-equation.

9.1. Smallest homogenious supposing as a Superspace-approximation with well-known equations:

$$\ddot{\phi}+3H\dot{\phi}+\lambda(\phi^2-\eta^2)\phi=0 \quad H^2=\left(\frac{\dot{a}}{a}\right)^2=\frac{8\pi G}{3}\left[\frac{1}{2}\dot{\phi}^2+V(\phi)\right]$$

$$V(\phi)=\frac{\lambda}{4}(\phi^2-\eta^2)^2 \,. \qquad (65./66./67.)$$

9.2. Initial state-conditions in the beginning: $\phi(0)=\phi_0 \ll 1;\dot{\phi}(0)=0$, scalefactor $a(0)=1$ and interpretation of the following developement process:

1. Potential $\phi(t)$:

Starts extremely small on the platform with $\phi_0 \ll 1$. Rolls slowly in direction of minimum of $\phi\rightarrow\eta$ - slow slowroll.

2. Scale-factor $a(t)$:

Exponential expansion, while ϕon the platform $\rightarrow$ inflation. When ϕ arrives minimum, $\rightarrow H$ decreases, expansion gets slower.

3. Encoupling:

when $a(t)$ increases strongly during the inflation, the bubble gets quai-isolated from surrounding space. Typical factor of size is: e^{50}- like multiple extension $\rightarrow$ practically a seperate bubble.

9.3. Summary of universe generating process:

1. Field on unstable platform → some cosmic energy for inflation,
2. Exponential expansion of the scale-factor,
3. Rolling in in minimum, expansion slows down,
4. Bubble of universe stays stable and decoupled of the surrounding prespace.

9.4. The whole concept:

1.Skyrmion-collision: two topological defects get near to another and overlap each other,
2. Potential or field $\phi(t)$lands on the platfom →potential energy for inflation,
3. Exponential expansion: scale-factor $a(t)$ increases within the bubble,
4. Size of the bubble as function of potential-field $\phi(t)$ and scalefactor $a(t)$.

9.5. Calculation of scale-factor $a(t)$ from Friedman-equation and its coupling to $\phi(x,y,t)$ in a physical consistent description:

Homogenious 3D-field from $\phi(x,y,t)$, two skyrmions are closing one another, after the collision ϕ is lifted onto its platform and the potential energy $V(t)$ drives the inflation. The scalefactor $a(t)$ fulfills the Friedman-equation.

$$H^2=\left(\frac{\dot{a}}{a}\right)=\frac{8\pi G}{3}\left[\frac{1}{2}\dot{\phi}^2+V(\phi)\right] \qquad (68.)$$

The expansion acts back to the developement of the field:

$$\ddot{\phi}+3H\dot{\phi}+\frac{\delta V}{\delta\phi}=0 \qquad (69.)$$

wuth a simplified homogenus superspace-approximation of using only the average of the field-strength for the bubble by using $a(t)$.

Then ϕ_{avg}--- average of field -strength of the bubble,
$\phi_{field-visual}$--- the 3D-field will be scaled with $a(t)$, so that the bubble is optical blowed out,
$H \wedge \dot{\phi}$--- are actualized according to Friedman-equation and field-equation,
Result is after collsion a realistic, dynamic increasing exponential expanding bubble with physically consistent coupled inflation.

9.6. Physical interpretation:

1. Skyrmions as topological defects:
--- in many fieldtheories skyrmions are stable, topological configurations,
--- their collision can concentrate local energy in a platform/plateau of potential - suitable to start an inflation,
--- analogy to classical Big Bang: the collision generates a decoupled expanding bubble, a new universe,
2. The universe developing mechanism:

--- the bubble begins a on platform at the potential and energy drives exponential expansion of inflation,
--- through inflation as a cause the bubble will be decoupled to its global surrounding in practice, an own stable universe spacetime,

9.7. Possible conclusions and observations :

1. Cosmic relics and/or gravity waves:
Such a form of collision could create prae-inflationary gravity waves, which in principle could be detected. They were extremy weak but would be detected in future constructed detectors (like cosmic interferometers out of earth atmosphere or orbit, may be in a Lagrangr-point).

2, Topological signatures:

If one/some of the skyrmions (or not all) don't decouple complete, then small measurable topological defects could be stayed behind in the universe structure. Since the field Φ is a scalar-field-model like Higgs-field, may be this rest-ripples are a model of explanation for causing local inertia . Maybe they exist in an analogy to cosmic strings or monopole-like structures.

3. Inflation and fluctuation:

The initial fieldconfiguration of Φ determines the primordial fluctuation of density.
Different bubbles could have different physical constants resp. physical laws.

9.8. Theoretical consequences:

1. Non-singular Big Bang but „Yin-Yang"-model:
Instead of a classical monocausal singularity, the birth of universe can date from a topological collision.

2. The singularity is substituted by an topological energy distribution, an allocation.

3. Perspective of a possible multiverse:
Every collision causes an only own noncoupled universe-state. The local bubble then is only one of a possible lot, which develops independent. Statistical the lot of universes could be generated over different probabilities in an overlapping probability-function of praespace but this subtheme isnt' examined yet. May be, in a more philosophical way of ontology, our universe is the "best of all possible worlds" in interpretation of Leibnitz, which means, that it has maximal probability but it shall be warned about all those rather anthropological principles or more impossible announcements without a rational, mathematical or rather physical reason.

4. A link to quantum field theory:
collisions of skyrmions can be examined by looking into quantum field theory simulations. From this research there can be derived statistics about sizes and probabilities of other universes (universeeds). So this model here, connects toplogical defects, field-theory and cosmological expansion in an elegant way. It produces an alternative look at the Big-Bang-theory and a concrete, clearly basis for an inflation theory with possibly traces of measurable gravity waves or primordial topological relics.

10. Topological stability of the skyrmions:

10.1. Skyrmions as topological solitons:

Their stability follows from their nontrivial backcoupling-structure of space-field configurations. $\phi: S^3 \rightarrow S^3$ for 3D-case or $\phi: S^2 \rightarrow S^2$ in 2D-case. Every skyrmion-configuration has a winding-number or topological number:

$$B=\frac{1}{24\pi^2}\int d^3x\,\epsilon^{ijk}\,Tr\left[\left(U^{-1}\partial_i U\right)\left(U^{-1}\partial_j U\right)\left(U^{-1}\partial_k U\right)\right] \quad (70a.)$$

This number B is an integer, ergo it cannot changed in a continuous way, which causes a great stability against decay. For a collision between two skyrmions there are linear combining laws, as long as the topological structure is conserved:

$$B_{tot}=B_1+B_2 \quad (70b.)$$

10.2. Homogenious approximation and Friedman-coupling:

For the scalefactor-expansion the Friedman-equation is used [23.],[24.] with

$$H^2\equiv\left(\frac{\dot{a}}{a}\right)^2=\frac{8\pi G}{3}\rho \text{ and } \rho=\frac{1}{2}\dot{\phi}^2+V(\phi) \quad (71a./71b.)$$

and the fieldequation in expanding spacetime:

$$\ddot{\phi}+3H\dot{\phi}+\frac{\partial V}{\partial\phi}=0 \quad (71c.)$$

The coupling: $H=\sqrt{\frac{8\pi G}{3}\left(\frac{1}{2}\dot{\phi}^2+V(\phi)\right)}\rightarrow$, (71d.)

ϕ drives the expansion, the expansion slows

down the field through $3H\dot{\phi}$.

Superspace-approximation:
Taken is the spacelike averaged value of

$$\phi_{avg}(t)=\langle\phi(x,y,t)\rangle \quad , \quad (72.)$$

which is coupled to $a(t)$.Therefore the description becomes practical, wthout view of the fact that every spacelike gradient energy- field exists.

10.3. Scalefactor and field in a simulation of numerical steps (Euler-method):

$$\phi_{n+1}=\phi_n+\dot{\phi}\,\Delta t;\dot{\phi}_{n+1}=\dot{\phi}_n+\left[-3H_n\dot{\phi}_n-\frac{\partial V}{\partial\phi_n}\right]\Delta t;\; a_{n+1}=\exp^{H_n\Delta t} \quad (73a.-73c.)$$

Thereby is:

$$H_n = \sqrt{\frac{8\pi G}{3}\rho_n} \text{ with } \rho_n = \frac{1}{2}\dot{\phi}_n^2 + V(\phi_n) \quad (73d./73e.)$$

Through $a(t)$ the virtual bubble in the 3D-simulaton increases.

10.4. Summary of coupling-process:

1. Topology creates stability: skyrmions exist long enough, to generate collisions,
2. Collision → field lands on platform because of enough potential energy → driving inflation,
3. Friedman-coupling: $\phi_{avg}(t) \Leftrightarrow a(t) \rightarrow$ dynamical expansion of the universe- bubble,
4.Simulation: 3D- visualization and scaling of fieldvalue → realistic description of universe.

10.5. Influence of gradient-energy $(\nabla\phi)^2$ on expansion and its integration into the Friedman-equation:

Total energy including gradient-function. Until now, only the homogenious field-energy is used.

$$\rho_{hom} = \frac{1}{2}\dot{\phi}^2 + V(\phi) \quad (74a.)$$

For an inhomogenious field $\phi(x, y, t)$the gradient energy must be added.

$$\rho(x, y) = \frac{1}{2}\dot{\phi}^2 + V(\phi) + \frac{1}{2}(\nabla\phi)^2 \quad (74b.)$$

with

$$\frac{1}{2}(\nabla\phi)^2 = (\partial_x\phi)^2 + (\partial_y\phi)^2 \quad (74c.)$$

This energy als contributes to the local expansion force.

10.6 Average value of Friedman-coupling:

Since the Friedman-equation is intended for homogenious scalefactors, the spacelike average is used.

$$\bar{\rho}(t) = \frac{1}{A}\int dx\,dy\left[\frac{1}{2}\dot{\phi}^2 + \frac{1}{2}(\nabla\phi)^2 + V(\phi)\right] \quad (75a.)$$

A--- area of the 2D -spacelike grid-lattice,
$\bar{\rho}$ then substitutes ρ in the Friedman-equation.

$$H^2 \equiv \left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\bar{\rho}(t) \quad (75b.)$$

10.7. Numeric implementation:

Discrete calculation of gradients:

$$\partial_x \phi \approx \frac{\phi_{i+1,j} - \phi_{i-1,j}}{2\Delta x}; \Delta_y \phi \approx \frac{\phi_{i,j+1} - \phi_{i,j-1}}{2\Delta y} \quad (76.)$$

Building energy of gradients (e.g. in python), then formulation of the mean, then as before: ϕ actualizing via Euler-steps, building scalefactor $a \leftarrow a \cdot \exp^{(H\Delta t)}$.

11. Physical consequences:

1. Energy of gradients retards the inflation slightly, local peaks of energy could drive the inflation stronger, valleys of energy could do this weaker,
2. Form of the bubble stays stable: Skyrmion-topology protects from decay, even if effects of gradient are strong,
3. Realistic universe scenario: the bubble doesn‘t expand regularly total homogenious, small irregulations appear like is predicted in the theoretical concept,
4. Result: the inclusion of the gradient-function $(\nabla\phi)^2$ makes the process more consistent in a way of physical description. It demonstrates, that inhomogenious distributions of energy slightly modify the dynamics of inflation without destroying the topological stability.

12. Summary (general description):
Topological stability of skyrmions. Coupling of Friedman-equation with homogenious fieldvalues. Extrapolation to gradient-energy for description of a more realictic expansion.
With these explanations the mathematical and physical description of this article is rather complete.

12.1 Skyrmions as a topological base.
1. Skyrmions are stable topological field configurations,
2. Their winding number protects them of decay, even by collisions like the nonlinear overlapping superposition of solitons.
3. By the collision, there can be created some sort of cosmic energy, which can occupy a platform of the potential,inflation of local spacetime is possible,
4. The inflation process of the expanding spacetime decouples the local universe bubble from its surrounding prae-field and brings a new universe into being [25.].

12.2 Field and potential as driver of inflation:
1. The field $\phi(x,<,t)$ carries kinetical energy of $\frac{1}{2}\dot{\phi}^2$, contains a form of gradient-energy $(\nabla\phi)^2$ and possesses potential energy of $V(\phi)$,
2. After the collision ϕ increases to a platform-level of high potential energy wich drives the bubble expansion,
3. Friedman-coupling leads to a dynamical expansion, the scalefactor $a(t)$ fulfills the Friedman-equation:

$$H^2 = \left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\bar{\rho}(t); \bar{\rho} = \left\langle \frac{1}{2}\dot{\phi}^2 + \frac{1}{2}(\nabla\phi)^2 + V(\phi) \right\rangle ,$$

Field and expansion are backcoupled: $\phi_{avg}(t) \rightarrow a(t)$ drives expansion. Expansion has a causal acting effect on ϕ over $3H\dot{\phi}$.

4. Gradient energy leads to a realistic modulation:
Gradient energies take care of a stronger expansion of local peaks– valleys expand weaker, slower, slightly inhomogenious expansion. Bubbleform stays stable $\rightarrow$ topological stability protects the bubble,

5. Physical scenery:
Collision $\rightarrow$ bubble $\rightarrow$ inflation, $\rightarrow$ expansion is dynamic and realistic, determined throgh total energy of kinetic-, gradient- and potential energy. The model allows alternative Big Bang perspectives and might be it could be an ansatz for realistic multiverse sceneries. These descriptions generate a consistent, dynamic bubble of a new expanding universe.

12.3. Conclusion as a complete consistent picture:

Topological skyrmions act as a stable starting point of genesis. Collision generates inflation over local energy processes with platform-lifting. Inflational expansion couples to Friedman-equation $a(t)$ which drives the expanse. Small modulations of bubble-expansion by gradient energies. Decoupling from surrounding background. Physical interpretation as a new born independent universe.

13. Summary (of the used equations):

13.1. Field-equation of Skyrmion Φ^4- field and gravitation.

$$\ddot{\phi}+3H\dot{\phi}-\nabla^2\phi+\frac{dV}{d\phi}=0 \qquad (13.1.)$$

$\phi(x,y,t)$ --- scalarfield,
$\nabla^2\phi$--- Laplaceoperator, describes gradient-energy,
$V(\phi)$--- potential like Φ^4 or platform for inflation.

13.2. Some cosmic energy:

Local energy-density:

$$\rho(x,y,t)=\frac{1}{2}\dot{\phi}^2+\frac{1}{2}(\nabla\phi)^2+V(\phi) \qquad (13.2.)$$

Average of energy density for Friedman-equation:

$$\bar{\rho}(t)=\frac{1}{A}\int(dx\,dy\,\rho(x,y,t)) \qquad (13.3)$$

13.3. Friedman-equation for expansion with scalefactor $a(t)$:

$$H^2=\left(\frac{\dot{a}}{a}\right)^2=\frac{8\pi G}{3}\bar{\rho}(t) \qquad (13.4.)$$

$a(t)$--- scalefactor of the bubble,
$\bar{\rho}(t)$--- contains kinetics+ gradient+potential.

13.4. Gradient-description for a possibl discrete numerical simulation:

$$(\nabla\phi)^2 \approx \left(\frac{\phi_{i+1,j}-\phi_{i-1,j}}{2\Delta x}+\frac{\phi_{i,j+1}-\phi_{i,j-1}}{2\Delta y}\right)^2 \qquad (13.5.)$$

Discrete description for numerical modelling in a 2D - lattice-simulation.

13.5. Dynamical coupling of the system numerical Euler-steps:

Field-update; $\phi(t+\Delta t)=\phi(t)+\dot{\phi}(\Delta t)$, (13.6.)

scalefactor: $a(t+\Delta t)=a(t)\exp^{H\Delta t}$ (13.7.)

Key-idea:
This system of equations describes together a consistent model of skyrmion collision with local energies, field on potential-platform and expanding bubble-universe including inhomogenous effects through gradient energies.

14. Final summary:

1. Skyrmions as stable starting points,
2. Collision leads to local energy peaks, lifting field on an potential platform,
3. Energy of gradients causes small inhomogenities,
4. Coupling to Friedman-equation leads to dynamical expansion $a(t)$,
5. All elements of description constitute a consistent dynamic description of a new universe.

15. Conclusion:

A consequent and consistent description of the beginning of the universe over a Big Bang without a solely singularity but over two skyrmion kinks as a first cause is possible and its description is in a logical way without contradictions. These state of generating the universe not by one singularity but by two skyrmions of kink and antikink can be called a Yin-Yang-model of the universe.

1**6. Discussion:**

In principle this model leads as well as other models to an imagination of a possible polybubble multi-or metaverse. Since there is but no physical evidence in measurement for this conclusion today, the ideas for universe description shall be as near as possible to measurements and/or observations of the real universe and measurable statements. All other talking posh is waffle, prattle and blather today. May be, that in future times the methods of measuring in astrophysics and far primordial astronomy are developed fine enough to distinguish between the several model descriptions of genesis of the universe which exist today especially when the observations can be made from space, far away from Earth.+

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17. References:

[1.] --- Friedman,A., Über die Krümmung des Raumes, Z.f.Physik,10,**1922** ,
[2.] --- Friedman,A., Über die Möglichkeit einer Welt mit konstanter negativer Krümmung des Raumes, Z.f. Physik 21, **1924** ,
[3.] --- Sitter,W. De, Kosmos, Cambridge,Mass. **1932**
[4,] --- Robertson, H.P., On the Foundations of Relativistic Cosmology, In: Proceedings of the National Academy of Sciences of the United States of America, 15. **1929** ,
[5.] --- Farhi, E., Guth, A.H.,Guven,J. Is it possible to create a universe in the laboratory by quantum tunneling? Nuclear Physics B, 339,2, **1990** ,
[6.] --- Robertson, H.P., Relativistic Cosmology, In: Reviews of Modern Physics, 5, **1933** ,
[7.] --- Robertson, H.P., Kinematics and World-Structure I-III, In: Astrophysical Journal 82, **1935** ,
[8.] --- Robertson, H.P., On the Present State of Relativistic Cosmology, In: Proceedings of the American Philosophical Society 93,7, **1949** ,
[9.] --- Guth, A.H. Inflation Universes, a Possible Solution of the Horizon and Flatness Problem, Phys. Rev. (D),23,2 , **1981** ,
[10] --- Ellis, G.F.R. Is the Universe Expanding? General Relativity and Gravitation, 9,2, **1978** ,
[11.] --- Einstein, A. Zum kosmologischen Problem der Allgemeinen Relativitätstheorie, In: Sitzungsberichte der Königlich-Preussischen Akademie der Wissenschaften, Physikalisch-Mathematische Klasse,Berlin, **1931** ,
[12.]--- Rees,M.I., Our Universe And Others, In: Quarterly Journal of the Royal Astronomical Society, 22, **1981** ,
[13.] --- Pachner, J. An Oscillating Isotrop Universe without Singularity, In:Monthly Notices of the Royal astronomical Society 131, **1965** ,
[14.] --- Einstein, A., Kritisches zu einer von Herrn de Sitter gegebenen Lösung der Gravitationsgleichungen. In: Sitzungsberichte der Königlich-Preussischen Akademie der Wissenschaften, Physikalisch-Mathematische Klasse,Berlin **1918,**
[15.] --- Skyrme, T., A non linear theory of strong interactions. In: Proc.Roy.Soc. A 247, **1958**, , doi:10.1098/rspa.1958.0183.
[16.] --- Skyrme, T., A nonlinear field theory, Proc.Royal Society A 260, 1961,
[17.] --- Krauss, L.,: *A Universe from Nothing*, Free Press, Simon & Schuster Inc. **2012**, ISBN 978-1-4516-2445-8,
[18.] --- Kragh, H., Conceptions of cosmos – from myths to the accelerating universe – a history of cosmology. Oxford Univ. Press, Oxford 2007, ISBN 0-19-920916-2
[19.] --- Spergel, D., et.al., First-Year Wilkinson Microwave Anisotropy Probe (WMAP) Observations: Determination of Cosmological Parameters. In: ApJS. 148, **2003**,
[20.] --- Planck Collaboration: XVI. Cosmological parameters. In: Planck 2013 Results Papers. **2013**. According to data from the Planck space telescope ESA, **2013**, the values are slightly corrected compared to WMAP: Visible matter: 4.9%, Dark matter: 26.8%, Dark energy: 68.3%, Age of the universe: 13.82 billion years, Planck reveals an almost perfect Universe, accessed **2013 .**
[21.] --- Parker, B., R., The vindication of the big bang: breakthroughs and barriers. New York: Plenum Press. 1993 ISBN. OCLC 27069165.
[22.] --- Luminet,J.-P., The Rise of Big Bang Models, from Myth to Theory and Observations. Arxiv:0704.3579 ,**2007**,
[23.] --- Hubble, Edwin 1929. "A Relation Between Distance and Radial Velocity Among Extra-Galactic Nebulae". Proceedings of the National Academy of Sciences of the United States of America. **15** (3) **1929**, Bibcode:1929PNAS...15..168H. doi:10.1073/pnas.15.3.168. ISSN 0027-8424. PMC 522427. PMID 16577160.

[24.] --- Lyth, D., Introduction to Cosmology, arXiv:astro-ph/9312022. ICTP (Trieste) **1993**,
[25.] --- Ellis, G.F.R., King,A.R., Was the Big Bang a Whimper? In: Communications in Mathematical Physics, 38, **1974** ,
[26.] --- Popper, Sir K.R., Objective Knowledge, An Evolutionary Approach, Oxford, **1972.**

18. Appendix:

Non-scientific Comments:

Note one: *"Blowing bubbles in the air!" - Song by Clark-Sisters,*
Note two: *"But our knowledge is fragment and our predictions are fragment … we now look through a mirror in a dark word." - Paulus, 1st letter to the Korinther, bible, chapter 13, line 9/11,*
Note three: *"To build a universe, this practical task is only an engineers problem – no theology is needed." - by author,*
Note four: *Anecdote, concerning Sir Isaac Newton: Once he was asked, where god stays by all his explanations in Principia Mathematica and his other research. His answer was: "This hypothesis I don't need!"*
Note five: *Thomson, Charles: "Novus ordo saeclorum (in God we trust)", text on US-1$-note,*
Note six: *"Science is irritating forward! Truth always is searched - not found." - Sir Karl Popper [26.].*

19. Verification: This paper definitely is written without support from an AI, LLM or chatbot like Grok or Chat GPT 4 or other artificial tools. It is fully, purely human work in every universe.