What is physical reality?
I spy with my little eye – and what I see is different.
Trapped surfaces of local multiversal overlapping quantum states in Bohms many-world theory

Abstract:
If a form of interaction like a crossing over of events is defined between two different universal worldlines in two near neighbour universes after Bohms theory of many worlds in quantum physics, then local observers in the same universe can measure different values of a physical size, when one of them is trapped in a local closed surface of the crossing over zone and the other one isn't in this state but in the state of the "normal" universe. In this case, physical measurements are no longer clearly defined.

Key-words: multiverse; many-world-theory; trapped surface; coupled pilot-waves; deterministic overlapping; cross-over zone; Linzeteum-term; inconclusive measurements; equal, same different events; coupled probabilities.

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1. Introduction:

The inifinitive of "go" [1.] : A mathematical frame model can be constructed as a multispectral Bohm-Everett-system with backcoupling of a crossing over between two near neighbour universes with similiar probability. In this overlapping structures two local observers can observe/measure different events, although they are global in the same quantum- phase universe-space. Local there exists a trapped area, in which the different observing is possible. That means, that there could be *really* two states of Schrödingers cat can be measured: living *and* dead, not only one of them and not only an uncertain state of limbo, when the wavefunction not has collapsed yet. The overlapping coupling of two collapsing wavefunction states could be measured simultaneously.

2. Methods/Calculation:

2a. Basic structure of many worlds with partial coupling:

In Everett formalism there is the whole wavefunction Ψ of the universe in a very highdimensional configuration space H.

Normally there is:

$$i\hbar\frac{\partial\Psi}{\partial t}=\widehat{H}\Psi \tag{1.}$$

and decoherence is the reason, that Ψ mostly divides in two orthogonal branches Ψ_i.

$$\Psi=\sum_i c_i\Psi_i;\langle\Psi_i|\Psi_j\rangle\approx 0\, for\, i\neq j. \tag{2.}$$

Now let   the Schroedinger-equation be modified:

$$i\hbar\frac{\partial}{\partial t}\begin{pmatrix}\Psi_A\\ \Psi_B\end{pmatrix}=\begin{pmatrix}\widehat{H}_A & \widehat{K}_{AB}\\ \widehat{K}_{BA} & \widehat{H}_B\end{pmatrix}\begin{pmatrix}\Psi_A\\ \Psi_B\end{pmatrix} \tag{3.}$$

Thereby is:

$\widehat{H}_{AB}$--- the respective Hamilton-dynamics of the two different universe branches,

$\widehat{K}_{AB}$--- a cross-over coupling operator, which generates the recoherence between the branches of the two closed neighbor universe states.

A possible ansatz for this coupling term is (inspirated by quantum field theory-couplings and analogous to crossing over in genetics of chromosomes):

$$\widehat{K}_{AB}=\lambda e^{\frac{-\Delta s}{\sigma}}\cdot\widehat{M} \tag{4.}$$

with following terms:

λ--- strength of coupling,
ΔS--- entropical distance between the states of both universes,e.g. macroscopical differences,
σ--- scaling parameter like length of decoherence or temperature
$\widehat{M}$--- A changing or swap operator, which recombines local state-segments.

There follows:

---for very similiar universes with $\Delta S\approx 0$ there is a strong coupling,
---for strong different universes there is an exponential opression.

2b. Generation of the trapped surfaces:

Let‘s lokk to a local area $\Omega\subset\mathbb{R}^3$ of the configuration, where is a very strong coupling, there   a partial hybridization occurs:

$$\Psi_{Hyb}(r,t)=\alpha(r,t)\Psi_A+\beta(r,t)\Psi_B \tag{5a.}$$

with normation factors of:

$$|\alpha^2|+|\beta^2|=1 \tag{5b.}$$

This area is the trapped surface. WithinΩ is the state an overlay --- the crossing-over area. Out of this area the both universes are different and divided again. This would correspond in formalism of Bohm to a dual-valued pilot wave that steers particles differently dependent from local quantum potential $Q(r,t)$.

2c. Differences of measurement or perception:

For conscious observers O_i in both branches A, B there is:

$$P_i\langle O|A\rangle \propto \left|\langle O|\Psi_A\rangle\right|^2 ; P_i\langle O|B\rangle \propto \left|\langle O|\Psi_B\rangle\right|^2 \quad , \tag{6.}$$

If observers now are involved through their perception or measurement in the local phase space Ω, their perceptive state O can itself become part of the overlapping of two possibilities and so of the hybridisation:

$$\langle 0|O\rangle = \langle \alpha|O_A\rangle + \langle \beta|O_B\rangle \tag{7.}$$

This results in an interindividual dissonance/difference or variance in measurement/perception. Some observers see state A, others state B, although they nominally share the same global universe.

2d. Dynamic feedback:

To ensure the system remains stable, a feedback condition could be introduced:

$$\frac{d}{dt}\Delta S = -\gamma \cdot |\hat{K}_{AB}|^2 \tag{8.}$$

In interpretation this process means: the stronger the cross-over coupling, the closer the branches get, the more they approach each other due to a decrease in entropy distance.
This process generates a sort of resonance-synchronization between the two universes.

2e. Interpretation:

Mathematically a nonlinear coupled Schrödiner-system with local limited overlapping. Physically a sort of quantum-membran between two Everett-branchees. From a perceptual theory perspective, this leads to local, selective deviations from reality and thus to two different measurement results.

2f. A mathematical and conceptual simulation of a cross-over zone between two universes:

Let's begin with a 1D-model, where two universes A and B meet together and are overlapping in one spacelike dimension. Described is, how a trapped surface, which means a local hybrid-area, can be generated in a stable way.

There are two coupled Schrödinger-equations:

$$i\hbar \frac{\partial \Psi_A}{\partial t} = \left[\frac{-\hbar^2}{2m}\nabla^2 + V_A(x)\right]\Psi_A + K(x)\Psi_B \tag{9a.}$$

$$i\hbar \frac{\partial \Psi_B}{\partial t} = [\frac{-\hbar^2}{2m} \nabla^2 + V_B(x)] \Psi_B + K(x) \Psi_A \quad (9b.)$$

where:

$K(x)$ --- local coupling function representing the crossover-zone,

$V_A(x), V_B(x)$ --- slightly different potentials of the two universes,

Ψ_A, Ψ_B --- wave-functions of the two universe-realities.

2g. Coupling-function in the cross-over region:

Defined is:

$$K(x) = \lambda e^{\frac{-(x-x_0)^2}{2\sigma^2}} \quad (10.)$$

The meaning of this equation is:
The coupling only exists near x_0 with width of σ . There exists the trapped area.
Description of simulation:
If that is simulated in *Python* or *Julia*, the process would look like this:
1. Initial-state of two slightly offset wave packets, e.g. Gaussian packets with slightly different dynamics.
2. Separate development outside the coupling region. Within: energy exchange and recombination via interference patterns.
3. In the meantime, a stationary hybrid state forms in the middle:

$$\Psi_{hyb}(x) \approx \alpha(x) \Psi_A(x) + \beta(x) \Psi_B(X) \quad (11.)$$

with $|\alpha|^2, |\beta|^2$ --- location dependent. This is the trapped area. May be, this area can be described mathematically by a Lambert-function.

2h. Physical interpretation:

In $x < x_0 - \sigma$ --- domination of reality A ,

in $x > x_0 + \sigma$ --- domination of reality B -
In the middle: stable mixing with possible different measuring state.
The zone acts like a local recoherence-bubble in the multiverse.

2h. Bohm-trajectories in the cross-over field:
The describing of the system now is transformed in Bohm-formalism. For every particle or field-point there is:

$$\frac{dx}{dt} = \frac{\hbar}{m} \Im(\frac{\nabla \Psi}{\Psi}) \quad (12a.)$$

with: $\Psi = \Psi_{hyb}(x,t)$ (12b.)

The needed quantum-potential is:

$$Q(xmt) = \frac{-\hbar^2}{2m} \frac{\nabla^2 R(x,t)}{R(x,t)}; R = |\Psi_{hyb}| \quad (12c.)$$

This quantum potential acts in addition to the classical potential V .

Therefore in the model there is :

$$V_{eff}(x) = \alpha^2 V_A(x) + \beta^2 V_B(x) + Q(x) \quad (13.)$$

The structure of trajectories is numerical and qualitative: Outside from the cross-over zone: classical smooth trajectories, inside the zone: knots of interfernce, where $R(x,t)$ has minima where a strong quantum potential exists with chaotic, spiral shaped or multilayered trajectories. This means, that particles flicker back and forth between the two branches of reality. A dynamic description of a trapped surface. In perspective of the pilot-wave this description looks like a sort of quantum vortex between the stable universe states. An area where particle trajectories overlap and cannot be clearly assigned to one area of a special branch.

2i. Implication of measurement:

It could be said that states of consciousness in Bohm's formalism as well as all macroscopic states are guided by quantum potentials. In regions with a cross-over tendency, shared leadership potentials arises; this means that observers who are there can end up in slightly different macroscopic path branches. This means, their measurements or perceptions can differ.

Partial summary of universe overlap in Table 1:

Level	Description	Physical modelling
Schrödinger	Two coupled universes A, B with coupling term of $K(x)$	Cross-over-zone, area of hybridization
Bohm	Pilotwaves lead particles through a combined quantum potential $Q(x,t)$	Trapped surface, interference controlled zone
Measurement	Paths of observers differ through local hybridization	Different measurement of the same object or different perceptions

Table1: In the model now appear two universes A and B, whose wave functions are slightly different. Between them there is a local coupling that acts like an energetic bridge term.

Analyzed is now, under what conditions does this bridge form or even remain stable.

3. Effective energy of the coupled system:

The whole energy of the system can be described by the term:

$$E_{eff} = E_A + E_B + E_{inter} \quad (14a.)$$

with:

$$E_A = \int \hat{\Psi}_A H_A \Psi_A dx ; E_B = \int \hat{\Psi}_B H_B \Psi_B dx ; E_{inter} = \int K(x) \Re[\hat{\Psi}_A \Psi_B] dx \quad (14b.)$$

Interpretation:
If $E_{inter} < 0$ --- the cpouüling is energeticallyfavorable, the cross-over zone is stable,
if $E_{inter} > 0$ --- the universes repel each other, no recoherence exists.
Therefore E_{inter} is the decisive parameter for description of a system of coupled quantum states of two universes in a trapped surface with probability overlapping.

3a. Conditions of stability:

These stability conditions can be formulated similar to a minimum in a potential landscape area.

$$\frac{\partial E_{eff}}{\partial \lambda} = \frac{\partial^2 E_{eff}}{\partial \lambda^2} > 0 \quad (15a.)$$

This provides a critical coupling strength λ_{crit} ,from which the cross-over zone persists on its own. An approximation as an example: if $K(x)$ is supposed as a Gauss-coupling and Ψ_A, Ψ_B are approximated as Gauss-packets, then there is after integration:

$$E_{inter} \approx e^{\frac{-\Delta x^2}{4\sigma^2}} \cos(\Delta \phi) \quad (15b.)$$

with:
Δx --- distance of centers of both universes in configuration space,
$\Delta \phi$ --- relative phase,
σ --- width of coupling.
This fact shows immediately, that the probability for the crossing-over is the greatest, iff

$$\Delta x --- klein ; \Delta \phi \approx 0 \quad ,$$

which means, that similar universes with a coherent phase are overlapping more easily.
Note: the critical coupling strength is called from now on "Linzeteum-strength" – after the novel of Haiblum [2.].

3b. The effective probability-landscape:
The probability for a spontan generation of a crossing-over zone can be described qualitatively as:

$$P_{cross} \propto e^{\frac{-E_{barrier}}{kT_{eff}}} ; E_{barrier} \approx |E_{inter}| \quad (16.)$$

and T_{eff} is a measure of the thermic or quantumdynamic fluctuation like quantum noise or cosmic background fluctuations. From this comes the probabilty for generation of a crossing-over zone:

$$P_{cross} = \exp\left[\frac{\lambda^{-1} \cdot e^{\frac{\Delta x^2}{4\sigma^2}}}{kT_{eff}}\right] \tag{17.}$$

This means, the probability increases exponential, if the universes are very similar and the coupling λ is strong.

3c. Symbolic visualizing picture:

If P_{cross} would be drawed in a diagram, e.g. as a function of Δx or λ, then the following terms are connected as Table 2:

λ --- strength of coupling	Δx --- distance	Result
small	big	No coupling, divided universes
big	big	weak interference, unstable
big	small	Trapped surface, stable, cross-over zone

Table 2: A kind of valley is formed in the probability landscape, in which the cross-over is favored. See Appendix B.

3d. Elaborated perspective, Stability of entropy- condition of an entropic part:
It is possible to add an entropic part.

$$E'_{eff} = E_{eff} - T_{eff} S_{mix} \tag{18.}$$

with S_{mix} as a mixing entropy-term and state:

$$S_{mix} = -k_B \int [|\Psi_A|^2 \cdot \ln|\Psi_A|^2 + |\Psi_B|^2 \cdot \ln|\Psi_B|^2] dx \tag{19.}$$

This situation leads to a point of selforganisation, where energy- and entropy-burst are in an equilibrium. There generates a cross-over zone itself out in a spontan way, similar to a dissipative muster like a whirl or a standing wave.

A summary of all existence-conditions is concentrated in Table 3:

Concept	Formula/Condition	Meaning
energy-criterion	$E_{inter} < 0$	Cross-over zone energetically stabile
coherence-condition	$\Delta \approx 0; \phi \approx 0$	Similiar universes are coupling easier
Linzeteum-coupling/critical coupling	$\lambda > \lambda_{crit} = \lambda_{Linz}$	Minimal strength for recohernce
Entropic balance	$\frac{\partial E'}{\partial t} = 0$	Self-stabilization of the zone

Probability	$P_{cross} \propto e^{\frac{-E_{barrier}}{kT_{eff}}}$	E_{inter}

Table 3: energy-and entropy conditions for the existence of a cross-over zone between two neighbour-universes .

3e. The valley of stability from energetic perspectives:

In the coupling between two universes $A \wedge B$ can be assumed, that their possible difference-space with its variables like distance Δx , difference of phase $\Delta \phi$ or strength of coupling λ can be seen as an existing surface of an energy landscape-process.

$$E_{eff}(\Delta x, \Delta \phi, \lambda) = E_0 + e^{\frac{-\Delta x^2}{4\sigma^2}} \cdot \cos(\Delta \phi) \qquad (20.)$$

If this area is seen from above, it lokks like a lamdscape from valleys and hills. For small distances Δx and phase-equality $\Delta \phi \approx 0$ there is a deep energy funnel. There E_{eff} is minimal and this is a stable cross-over zone. For great distances Δx or $\Delta \phi \approx \pi$, there are hills – no quantum-coupling of universes is possible. This states can be imagined as follows: The system moves into the valley on its own when parameters get close to it. Then there is generated a spontaneous coupling of the two universes.

3f. Landscape of probability in statistical view:

The probability $P_{cross} \propto e^{\frac{-E_{barrier}}{k \cdot T_{eff}}}$ is like a relief, where the deepest valleys are the most probable settled.
Hillarea: the universes are very different, overlapping sparsly and rarely.
Valleyground: universes mostly identically, stable cross-over zone. The width of the valley depends on the length of decoherence σ :

σ small: valley deep and narrow, very specific conditions necessary,
σ big: flat, wide valley, where the cross-over is easier to build.

3g: dynamical picture: quantum flux through the valley:

This picture can be imagined like a fluid in the mountains:
The whole wavefunction $\Psi = \Psi_A + \Psi_B$ fluids through this landscape and in the valleys there collects the quantum probability fluid generating a coherent mixture. At the hilltops fluids it divided- this leads to divided universes. This streaming in the sense of Bohm is like the pilotwave-trajectories. A particle near the bottom of the valley will be lead by both pilotwaves at the same time, this is the trapped surface.

3h. Symbolic time-evolution:

On the time-axis there would:

1. In the beginning two divided valleys A and B without any connection,
2. Nearing: fluctuations bring A and B nearer together, the valleys get contact,
3. Bridge: a small pass generates - the cross-over area,
4. Stabilization: energy- and entropyfluxes balance out – this leads to a stable zone,
5. Optional: Retreat - because when decoherence arieses, the bridge rupts off again.

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From the topological side this model looks like two drops on an area or surface, which touch shortly at one point and build there a thin canal of fluid which couples the two quantum probability- drops.

3i. Experimental and philosophical note in the sense of consciousness:

If two paths of observers overlap in this valley of virtual possibilities, they have the same information-base for a short time. Outside the valley the two path diverge again. This is an elegant but rather pure theoretical assumption, why two local selective differences in the measuring or consciousness were possible thinkable, without injuring a global reality.

4. Definition of an effective potential:

The earlier described valley can be written as an effective potential.

$$V_{eff}(x,\lambda)=E_0-\lambda\cdot e\frac{-x^2}{4\sigma^2} \qquad (21.)$$

x – distance between to realities, which means in general distance in state of phasespace,
λ --- strength of coupling between the realities,
σ --- width of the coupling zone.
This potential has a minimum at $x=0$ which will become deeper with increasing λ .

4.1 Equation of motion in the potential:

Analog to classical mechanic there is for a particle of mass m :

$$\frac{m\cdot d^2 x}{dt^2}=\frac{-\partial V_{eff}}{\partial x} \qquad (22.)$$

his equation is a description, how a testing system moves along the distance x , pushed by the potential. The gradient is:

$$\frac{\partial V_{eff}}{\partial x}=\frac{\lambda x}{2\sigma^2}\frac{e^{-x^2}}{4\sigma^2} \qquad (22.)$$

This means:

if $x>0$, the force strikes back in direction of $X=0$,
if $x<0$, also back to direction of $x=0$.

The center of $x=0$ ergo is a stable equlibrium point – the heart of the cross-over zone.

4.2. Small oscillations – quantum resonance:

Near the minimum of $x \approx 0$ the potential can be developed in a quadratic form:

$$V_{eff}(x) \approx V_{min} + \frac{1}{2} k \cdot x^2 \;\; ; \;\; k = \frac{\lambda}{2\sigma^2}$$

(23a.)

Then the quantum probability system of the zone behaves like a harmonic oscillator:

$$m \frac{d^{2x}}{dt^2} + k \cdot x = 0 \qquad (23.b)$$

Small deviations lead to oscillations around the center of the cross-over zone with the frequency of:

$$\omega = \sqrt{\frac{k}{m}} = \sqrt{\frac{\lambda}{2 m \sigma^2}} \qquad (23.c)$$

These oscillations are the resonance movements between the both universes – a physical analogy to the recoherence fluctuations in the cross-over area.

4.3. Energy -interpretation:

The whole energy can be formulated (in a classical way):

$$E_{tot} = \frac{1}{2} \cdot m \left(\frac{dx}{dt} \right)^2 + V_{eff}(x) \qquad (24.)$$

With this equation a dynamical description can be formulated in Table 4:

State	Description	Model-meaning
$E_{tot} < 0$	system stays at minimum	coupling stable, trapped surface
$E_{tot} = 0$	hard at the edge	shorttimed recoherence
$E_{tot} > 0$	rolling out of the valley	Decoherence, dividing of realities

Table 3: The system behaviour in dependence from the total energy.

4.4. The path of an observer:

An observerpath can be interpreted as movement of a particle on the plane. If the measurement is taken near $x = 0$, the observer will measure both realities at the same time in a state of hybridisation. In this case as an example: Schrödingers cat is seen living ***and*** dead - *there are two observed cases of the state.* *I*f the observer oscillates away from the equilibrium state, there are musters of interference measured or transfer states. If he rolls out of the valley, he is without doubt only in one branch $A \vee B$. The velocity of the transfer depends from the beginning energy and from the controlling term λ, which controlls the depth of the valley.

4.5. Entropical damping:

To describe the stability more realistic, a dampingforce resp. frictionforce can be announced.

$$m\frac{d^2x}{dt^2}+\gamma\frac{dx}{dt}+kx=0 \quad (25.)$$

in analogy to the system of a damped oscillator. The system relaxed after disturbations back to the center of the dale. In the quantum interpretation this means a loss of coherence to the surrounding space, which local will be compensated by backcoupling.

4.6. Visual model:

A sphere rolls in a smooth valley, which depth depends on term λ. Small bumps causes resonance of the sphere. Stronger bumps can lead it over the edge of the valley, which means decoherence. Changing of energy with the surrounding or damping brings it back again. This causes the situation of a stabile but dynamical equlibrium between two branches of reality.

The whole situation in a summary shows Table 5:

Value	Formula	Meaning
potential	$V_{eff}=E_0-\lambda e^{\frac{-x^2}{4\sigma^2}}$	form of the cross-over valley
force	$F=\frac{-\partial V}{\partial x}=\frac{-\lambda x}{2\sigma^2}e^{-\frac{x^2}{4\sigma^2}}$	pulls the system to the center
resonance-frequency	$\omega=\sqrt{\frac{\lambda}{2m\sigma^2}}$	oscillation around the center
damping	λ	loss or backleading of coherence
equilibrium point	$x=0$	stabile hybridization

Table 5: the overlapping conditions of the stabile equilibrium of two quantum states of two universes.

5.Sumary. Potential model of two coupling quantum universes:

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Between two quantum branches of reality in Bohms many-world-theory there can exist a cross-over zone, where two realities are overlapping in their quantum states. This system can be described over a classical potential system.

5.1 Effective potential:

$$V_{eff}(x,\lambda,\phi)=E_0-\lambda e^{\frac{-x^2}{4\sigma^2}}\cdot\cos(\phi) \quad (26.)$$

1. x --- distance of universes in configuration space,
2. λ --- strength of coupling,
3. σ --- width of coupling zone,
4. ϕ --- relative phase, muster of interference,
5. E_0 --- energy of reference.

Interpretation: valley in the center at $x=0$, depth modulated by λ , muster of waves through $\cos(\phi)$.

5.2. Force on an observer/testing system:

$$F(x,\lambda,\phi)=\frac{-\partial V_{eff}}{\partial x}=\frac{-\lambda x}{2\sigma^2}e^{-\frac{x^2}{4\sigma^2}}\cdot\cos(\phi) \quad (27.)$$

direction: back to the valley --- stable equlibrium point,
strength: maximal at small x , decreases for great x in an exponential way.

5.3. Dynamic of the testing system:

$$m\frac{d^{2x}}{dt^2}+\gamma\frac{dx}{dt}+\frac{\partial V_{eff}}{\partial x}=0 \quad (28.)$$

m --- effective mass of observer/system,
γ --- damping/ influence of surrounding,
description: damped oscillator-movement around $x=0$.

Small oscillations as an approximation of harmonization.

For $x\ll\sigma$ there is:

$$V_{eff}\approx V_{min}+\frac{1}{2}kx^2;k=\frac{\lambda}{2\sigma^2}\cos(\phi) \quad (29.)$$

$$\omega=\sqrt{\frac{k}{m}}=\sqrt{\frac{\lambda\cos(\phi)}{2\sigma^2}} \quad (30.)$$

w --- frequency of the resonnce-oscillation around the cross-over zone,
stability --- $\cos(\phi)>0$.
Probability for cross-over:

$$P_{cross}(x,\lambda;\phi)\propto\exp\left[\frac{\lambda e^{\frac{-x^2}{4\sigma^2}}\cdot\cos(\phi)}{k_B T_{eff}}\right] \quad (31.)$$

Density of probability fog-band above the landscape. a maximum in stable valleys, a minimum at hills with decoherence-zones.

5.4 The whole model:

1. Valley at x=0, stable coupling between branches of reality,
2. Spheres as examples for testing systems move like particles in a potential,
3. Phases of interference ϕ modulate the stability and generates musters of waves,
4. Damping as a cause for backfall of little outrunners into the valley.

This system of equations couples:
1. Geometry of cross-over zone (V_{eff}) ,
2. Mechanical dynamics $\left(m\frac{d^{2x}}{dt^2}+\gamma\frac{dx}{dt}\right)$.
3. Statistic probability (P_{cross}) ,
4. Quantum interference $(\cos(\phi))$.

6. Interaction of multiple zones and elaboration of the dynamics:

Basic idea of multiple cross-over zones: there are several valleyzones in the phase of statespace $x_1, x_2, \ldots, x_n$, not only one at $x=0$. Every zone corresponds to a stable coupling between two branchrs of reality. If these zones come near together, they can influence the other zone.
This leads to an overlapping of the potentials and the whole potential is the sum of the individual potentials as parts:

$$V_{tot}(x)=\sum_{i=1}^{n} V_{eff}^{(i)}((x-x_i);\lambda_i;\phi_i) \qquad (32.)$$

This phenomenon then leads to an overlapping of coherence: if two valleys are near enough to each other, then their oscillations of resonance can couple and there would be an exchanging of energy between the two zones (possible is a sort of "tunneleffect", either). Two nearby valleys act like coupled oscillating circles. Collective oscillations are generated. Two valleys with a greater distance act practically independent, merely without any influence to one another.

6.1. Dynamic of multiple zones:

For the testing system, on which several cross-over zones act, there is a developed equation of motion:

$$m\frac{d^2x}{dt^2}+\gamma\frac{dx}{dt}+\sum_{i=1}^{n}\frac{\partial V_{eff}^{(i)}}{\partial x}=0 \qquad (33.)$$

The whole force in the system now is the sum of all parts. The system can oscillate between different valleys, dependent of initial energy and damping. This also leads to resonance and coupling between the zones. If two zones are coupled with $(x_i/n/x_j);i\neq j$ (where n means "near"), collective modi of resonance are generated. A symmetrical mode can created: the measurement or the observer moves evenly between the two quantum probability states, which means, that:

Both quantum probability ***states of the two reality branches are synchronously measured and are experienced synchronously.***

In the asynchronous mode, there is an antisymmetric state and the two systems oscillate in opposite directions towards the observer. Changing of measurement between the branches, a sort of "flickering" of the two realities. The frequencies of the coupled zones can be approximated over a matrix:

$$K_{i,j}=\begin{Bmatrix} k_i; & for \quad i=j \\ k_{i,j}; & for \quad k\neq j \end{Bmatrix} \tag{34.}$$

The eigenvalues of K then gives the collective frequencies of resonance.

6.2 Probability in coupled zones:

The probability for an cross-over encounter develops to multiple zones:

$$P_{cross}(x)\propto \exp\left[\frac{\sum_{i=1}^{n}\lambda_i\cdot e^{\frac{-(x-x_i)^2}{4\sigma_i^2}}\cdot\cos(\phi_i)}{k_B T_{eff}}\right] \tag{35.}$$

Valleys, which lay near to one another, strengthen the probability in the overlapping zone, valleys with geat distance proceed independent.

6.3. Summary of the multizone-model:

1. The whole potential is the sum of all several, single potentials,
2. Dynamics: equation of motion with summing force,
3. Resonance: coupled oscillations lead to collective existence modes,
4. Probability: overlapping of the different, several " foglike orbital states",
5. Model: a mountain, connected via bridges or sinks with several valleys. A testing system can oscillate between two valleys, from the one to the other and back or forth. Or it can stay in an overlapping state, where it experienced both realities at the same time.

Table 6 shows as example the parameters of a tri-zone model:

Zone	Position x_i	Coupling λ_i	Width σ_i	Phase ϕ_i
1	0.0	1.0	0.5	0
2	1.0	0.8	0.4	$\frac{\pi}{4}$
3	2.0	0.6	0.3	$\frac{\pi}{2}$

Table 6: Parameter selection of an overlapping of a tri-zone of probability valleys in Bohms many-world-theory

- Thereby are Length measurements in units of state space,
- λ_i in any energy unit,
- phases $\phi{:}i$ modulate the interference.

6.4. the whole potential:

$$V_{tot}(x)=\sum_1^3 V_{eff}^{(i)}(x)=\sum_1^{3-\lambda_i} e^{\frac{-(x-x_i)^2}{4\sigma_i^2}}\cdot\cos(\phi_i) \qquad (36.)$$

If the values from Table 6 are used, the result is:

$$V_{tot}(x)=-1.0\, e^{\frac{-x^2}{4*0.5^2}}\cdot\cos(0)-0.8\, e^{\frac{-(x^{-1})^2}{4*0.4^2}}\cdot\cos\left(\frac{\pi}{4}\right)-0.6\, e^{\frac{(x-2)^2}{0.3^2}}\cdot\cos\left(\frac{\pi}{2}\right) \qquad (37.)$$

Note: zone 3 is currently inactive and contributes no potential to the total potential.
Valley 1: deep and width, strong stable,
valley 2:medium-low, slightly pushed, weaker
Valley 3: Currently neutral, only dynamic effect occurs during movement due to phase change.

The equations of dynamics:

Foe a testing system of mass $m=1$ and $\gamma=0.1$ there is:

$$\frac{d^2x}{dt^2}+0.1\frac{dx}{dt}+\sum_{i=1}^{3}\frac{\partial V_{eff}^{(i)}}{\partial x}=0 \qquad (38.)$$

with the gradient of every zone:

$$\frac{\partial V_{eff}^{(i)}}{\partial x}=\frac{\lambda_i(x-x_i)}{\sigma_i^2} e^{\frac{-(x-x_i)^2}{4\sigma_i^2}}\cdot\cos(\phi_i) \qquad (39.)$$

Summing over all three zones leads to the resulting force.

The approximation of resonance-frequencies is near $x\approx x_i$

$$k_i=\frac{\lambda_i}{2\sigma_i^2}\cos(\phi_i)$$

This can be seen in Table 7:

Zone	k_i	$\omega_i = \sqrt{\frac{k_i}{m}}$
1	$\frac{1}{2 \cdot 0.25} \cdot 1 = 2$	$\sqrt{2} \approx 1.414$
2	$\frac{0.8}{2 \cdot 0.16} \cdot \cos\left(\frac{\pi}{4}\right) = 2.5 \cdot \frac{1}{\sqrt{2}} \approx 1.77$	1.33
3	$\frac{0.6}{2 \cdot 0.09} \cdot 0 = 0$	0

Table 7: The oscillation-values of the corresponding probability zones in multiphase model (three universes/possibilities).

Interpretation: zone 1 and zone 2 oscillate nearly synchronous because of similar frequencies. Zone 3 is momentary inactive.

6.5 The probabilities:

There is:

$$P_{cross}(x) \propto \exp^{\frac{V_{tot}(x)}{k_b T_{eff}}} \qquad (40.)$$

Example given with values of:

$k_B T_{eff} = 0.1$. The greatest probability in valley one, then valley two, in valley three minimal. Illustrative behavior:

A testing system starts at $x = 0.5$; it maintains both zones one and zone two, is oscillating between them, with damping it tends slowly to the most stable state:valley one. Changing of phase $\phi_3(t)$ cam activate zone three. The whole testing system can change to valley three.
Note: if the zones have a nonlinear selfcoupling like solitons, they reject any influence after the overlapping. If the selfcoupling is only linear, the superposition of two probability states can change the local system (valley-state) even after the overlap is over.

7. Model summary:

1. Parameters of cross-over zones are formulated,
2. The whole potential is the sum over all zones,
4. The dynamics of an testing system including damping is given,
5. The probability distribution is given,
6. An illustrative example for understanding the zone coupling is demonstrated.

With these seizes the behaviour of a multispectral probability zone overlapping in multiverse quantum universe can be described and explained. Now there is a possible mathematical frame model for a multispectral Bohm-Everett-system with backcoupled cross-over.

8. Measurement, perception and consciousness:

Most people's measurement or perception compared to that of everyone but not of all:

1. Every cross-over zone influences the potential measuring/perception of an object or state,
2. The strength of the coupling λ_i and the stability of the valley determine, how easily a system can languish there,
3. Damping simulates individual differences: some people stay in stable valleys longer (stable monoverse measurement), others fluctuate more (different measurement states).

Probability of measurement/perception:

A weighted probability for measurement can be defined:

$$P_{true}(x)=\frac{1}{N}\sum_{j=1}^{N}\chi_j(x) \qquad (41a.)$$

where:
N --- number of observers,
$\chi_j(x)=1$ --- if the observer j measures the valley-values at x ,
$\chi_j(x)=0$ --- if not.

Or in a continous manner:

$$P_{true}(x)\propto P_{cross}(x)\cdot f_{meas}(x) \quad , \qquad (41b.)$$

where f_{meas} --- different measurement - or perception – sensitivities.

Selective measurements:
deep and width valleys generate strong coupling and small phase fluctuations--- mostly measured,
flat or weak interferring valleys --- can only measured by some instruments or only perceived by some observers,
through existence of phases of interference ϕ_i a valley can be temporally weakened or strengthened. Measurement is a dynamic process.

Interpretation from example:
Zone one --- valley at x=0 stable. This means: objects or states can be measured by mostly all observers perceived by almost everyone.
Zone two --- weaker, near zone one: measured/perceived by most but not all observers (and their machines),
Zone three --- flat. Only by special observers measurable, else invisible, undetectable (!).
This explains how a state or object can be perceived or measured differently by the majority of observers, without these measurements being clearly perceived by everyone as a conclusion:

9. Conclusion:

Coupling and depth of potential determines the stability of measuring-state i-like n a Bohm-Everett multiverse system with cross-over. Interference of phases modulates temporarily the possibility or potentail of measurement of individual observers. Individual damping or sensitivity means, that only some people can escape from a valley and there is a difference in measuring processes between a majority and a minority.

10. Compact, comprimated mathematical and ontological summary of the model:

Deep valleys, --- majority of measurements/observers,
weak valleys, --- minority of observers/measurements,
phase-changing --- temporal visibility/invisibility,
Combining several zones leads to complex patterns of several perceptions. It is as if the multiverse were filtering which states are observable for the most observers while other conditions remain almost but not entirely invisible and are only perceptible to a few observers.

Matrhematical basic groundmodel of multiple cross-over zones:

1. Every zone i is defined by the description variables of:

x_i --- position; λ_i --- coupling; σ_i ---width; ϕ_i --- phase.

2. Every zone generates a local potential:

$$V_{eff}^{(i)}(x)=-\lambda_{(i)}e^{\frac{-(x-x_{(i)})^2}{4\sigma^2}}\cdot\cos(\phi_{(i)})$$

3. The whole potential is the summing over all zones:

$$V_{tot}(x)=\sum_i V_{eff}^{(i)}(x)$$

4. The dynamics of the testing system with:

4.1 Equation of motion:

$$m\frac{d^2x}{dt^2}+\gamma\frac{dx}{dt}+\sum_i\frac{\partial V_{eff}^{(i)}}{\partial x}=0$$

4.2. Gradient of every zone:

$$\frac{\partial V_{eff}^{(i)}(x)}{\partial x}=\lambda_{(i)}\frac{(x-x_{(i)})}{2\sigma_i^2}e^{\frac{-(x-x_{(i)})^2}{4\sigma^2}}\cdot\cos(\phi_{(i)})$$

4.3 Description near the valleys: harmonic approximation with resonance frequencies:

$$\omega_i=\sqrt{\frac{k_{(i)}}{m}};k_{(i)}=\frac{\lambda_{(i)}}{2\sigma_{(i)}^2}\cdot\cos(\phi_i)$$

5. Probabilities for cross-over, probability, that the testing system visits a valley:

$$P_{cross}(x)\propto\exp^{\left[\frac{V_{tot}(x)}{k_B T_{eff}}\right]} ,$$

where deep and width valleys mean a high probability and flat or interfering valleys mean less probability.

6. Multizone-interaction:

6.1.Neighbored valleys ➔ coupled oscillations ➔ collective modi (and perhaps nodi),
6.2. Valleys far away from each other --- almost independent,
6.3. Dynamic oscillates between valleys, “hybrid” measuring/perception.

7. Selective measurements or perceptions:
7.1 Stability of the valley determines, how many observers the measuring can perceive,
7.2. If there are deep and width valleys - the majority of observers measure the state,
7.3. Flat or interfering valleys - only a few observers from all can check the state (result of measurement),
7.4. Changing of phases ϕ_i - temporally visibility/invisibility of physical system, flickering measurement,
7.5. Individual damping – difference between single operators of measurement.

8.Interpretation:
The multiverse is like a mountain with includes several valleys. An object or state occurs in one of these valleys. The majority of observers of measuring systems reads stable, deep valleys. Some observers escape flat or phasemodulated valleys – they have a selective measurement probability (perception).This results in a complete, consistent overview from physical modeling to the explanation of how measurement-technically different results can arise in an overlapping multiverse state. This is the situation, how the zone-model generates the possible selective different measurement states.

Appendix A: scheme of symbolic simulation, the cross-over between two universes:

1. Definition of parameters:

text
hbar = $\hbar$ --- # Planckconstant,
$m=1.0$ --- # effective mass of system,
λ = strength of coupling --- # intensity of interaction,
σ = width of cross-over zone --- # size of the trapped surface
x_0 = center of coupling --- # place of zone,
dx, dt --- spacelike and timelike Auflösung.

2. Potentials and initial states
text

potentials of both universes

$V_A(x)=0.5\cdot(x+\Delta x)^2$
$V_B(x)=0.5\cdot(x-\Delta x)^2$
--- a little shifted harmonic potential.

Initial wavepackets, two small shifted Gauss-packets.

$$V_A(x,0)=e^{-\left[\frac{(x-x_0)^2}{2\sigma^2}\right]}\cdot e^{ik_1 x}$$

$$V_B(x,0)=e^{-\left[\frac{(x-x_0)^2}{2\sigma^2}\right]}\cdot e^{ik_2 x}$$

This situation simulates two universes with only little differences.
3. Coupling-function of cross-over zone:

$$K(x)=\lambda e^{\left[\frac{-(x-x_0)^2}{(2\sigma^2)}\right]}$$

Only in a small area around x_0 the two universes have some interaction.

4. Coupled Schrödinger-equations:
text

timestep for Ψ_A and Ψ_B according to Schrödimnger:

$$\frac{d\Psi_A}{dt}=\left(\frac{i}{\hbar}\cdot\left[\frac{\hbar^2}{2m}\right)\nabla^2\Psi_A-V_A(x)\Psi_A-K(X)\Psi_B\right]$$

$$\frac{d\Psi_B}{dt}=\left(\frac{i}{\hbar}\cdot\left[\frac{\hbar^2}{2m}\right)\nabla^2\Psi_B-V_B(x)\Psi_B-K(X)\Psi_A\right]$$

These are two coupled differential equations. in a real simulation, the Crank-Nicolson method would be used or the system would be integrated by a split-step-Fourier-method.

5. Normalizing and stability:
After every timestep there is:

text

Normalize Ψ_A ,
Normalize Ψ_B ,
this condition conserves the normalizing of the probability of the coupled system:

$$|\Psi_A|^2+|\Psi_B|^2=1$$

6. Validation of hybridization:

After some time there is:

text

$$\Psi_{hyb}(x,t)=\alpha(x,t)\cdot\Psi_A(x,t)+\beta(x,t)\cdot\Psi_B(x,t)$$

with:

$$\alpha(x,t):=\frac{\Psi_A}{\sqrt{|\Psi_A|^2+|\Psi_B|^2}}$$

$$\beta(x,t):=\frac{\Psi_B}{\sqrt{|\Psi_A|^2+|\Psi_B|^2}}$$

Then the analyzing can begin:
where $|\Psi_A|^2\approx|\Psi_B|^2$, there are the cross-over areas, where one of them domonates, there are different, divided areas.

7. Conceptual Visualization:

Three curves could be plotted:
$|\Psi_A|^2$ # --- density in universe A

$|\Psi_B|^2$ # ---- density im universe B

$|\Psi_{hybrid}|^2$ # --- common density of cross-over ➔ in the center there generates a zone, where both are overlapped - the trapped surface.

8. Bohmlike trajectories in qualitative form:
For every particle there is:

text

$$V(x,t)=\left(\frac{\hbar}{m}\right)\cdot\Im\left[\frac{\partial x\,\Psi_{hyb}}{\Psi_{hyb}}\right]$$
$$x(t+dt)=x(t)+V(x,t)\cdot dt$$

drawing of these trajectories would lead to:

out of the zone --- smooth lines,
in the zone --- woven lines, which changes between both states.

9. The interpretation is shown by Table A:

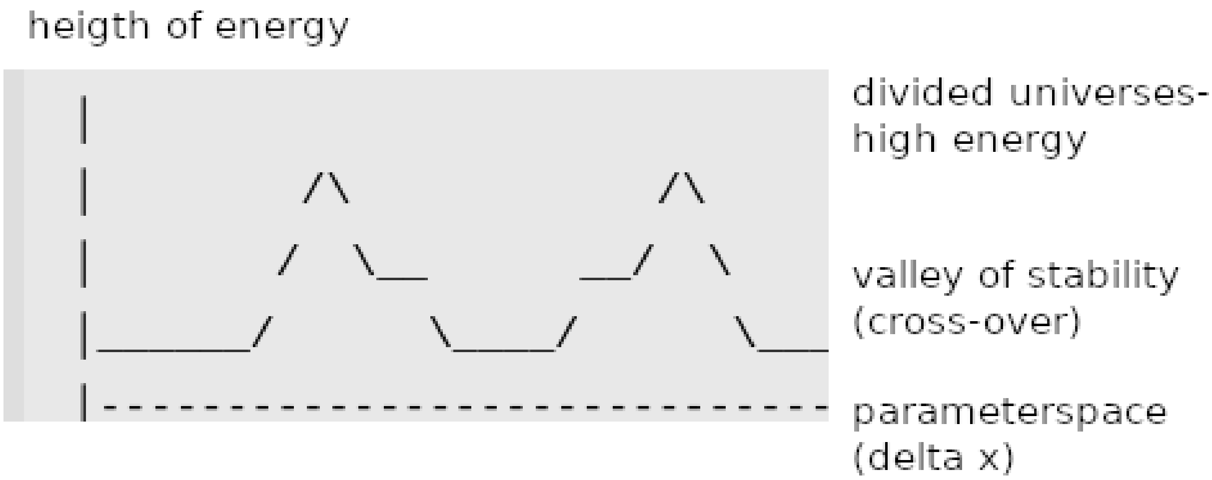
Area	Dynamics	Interpretation
$x\ll x_0-\sigma$	Ψ_A - dominating	universe A
$x\gg x_0+\sigma$	Ψ_B - dominating	universe B
$x\approx x_0\pm\sigma$	Ψ_A couples Ψ_B	Trapped surface – local cross - over

Table A: areas of coupling and the trapped surface of overlapping incidences.

10. Conclusion:

This simplified symbolic model shows:
1. how two near neighbored realities can be coupled locally,
2. how in the middle of the center a stable hybrid state is generated,
3. how this hybrid-state manifests itself in the Bohmian view as a pilotwave-whirl.

Appendix B: graph of Energy over parameterspace:



Picture 1: Parameterspace and axes: take the choice for independent variable $x=\Delta x$. This is the distance of the two universes in configuration space. Strength of coupling: $y=\lambda$ The middle valley marks the region, where a trapped surface can be generated spontaneous and can stay stable.

1. A pure theoretical but elegant explanation, why local, selective differences can occur in measurements, without injuring the global reality. As relief there can be seen $E_{eff}(x,y)$ or $P_{cross}(x,y)$.

A basic form, derived from the nearing:

$$E_{eff}(x.y)=E_0-y e^{\frac{-x^2}{(4\sigma^2)}}\cdot\cos(\Delta\phi)$$

2. For the visualization there can be set: $\Delta\phi=0$ what means maximal coherence.. Then remains:

$$E_{eff}(x.y)=E_0-y e^{\frac{-x^2}{(4\sigma^2)}}$$

Then there is at $x=0$ a deep minimum with $E_{eff}=E_0-y$. At large distances x energy comes near to E_0 --- there is no coupling.

Appendix C. Stabilization zone of the multiverse:

1. Symbolic plot rule of the landscape of the multiverse:

text
area of parameters:

$x\in[-5\sigma;5\sigma]$,
$y\in[0:y_{max}]$,

area of energy:

$$E_{eff}(x,y)=E_0-y\cdot e^{\frac{-x^2}{(4\sigma^2)}}$$

or area of probability:

$$P_{cross}(x,y;)=\exp\left[\frac{y e^{\frac{-x^2}{4\sigma^2}}}{k_B T_{eff}}\right]$$

presentation ideas:

contour plot of $E_{eff}(x,y)$,
coloured map of $P_{cross}(x,y)$,
3D-surface with z-axis as $E_{eff}\vee P_{cross}$ -

Interpretation of coordinate-axes:

x-axis--- Gauss profile for overlapping of universes,
y-axis --- linear depression: stronger coupling means deeper valley.

Extended version with phase dependency:

$$E_{eff}(x,y,\phi)=E_0-y\cdot e^{\frac{-x^2}{(4\sigma^2)}}\cdot\cos(\phi)$$

At $\phi=0$ there is constructive interference with/in a valley,
at $\phi=\pi$ there is destructive interference on a hill.

From this description there can be constructed in three dimensions $(x;\phi;E_{eff})$ a picture of alternating mountains and valleys, similar to musters of standing waves.

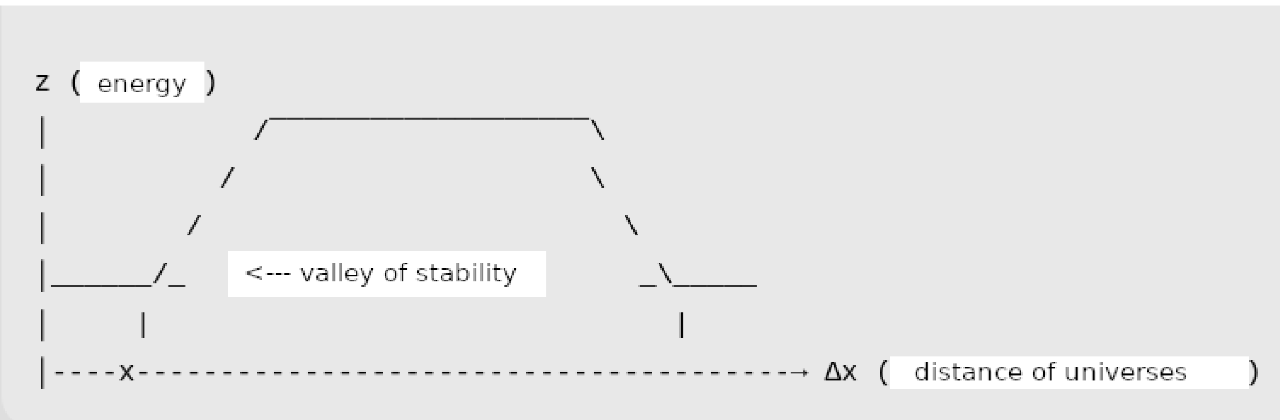
A conclusion can be seen in Table C:

Size	Formula	Form of area	Meaning
Energy	$E_{eff} = E_0 - \lambda e^{\frac{-x^2}{(4\sigma^2)}}$	Valley with Gauss-profile	Area of energetic stability
Probability	$P_{cross}(x) \propto \exp\left[\frac{\sum_{i=1}^{n} \lambda_i \cdot e}{}\right.$	Mirrored image, maximal depth in the valley	Probability of occurence
With phase	$E_{eff} \propto -\lambda e^{\frac{-x^2}{(4\sigma^2)}} \cdot \cos(\phi)$	Hills and valleys in wave-form	constructive/destructive coupling

Table C: The summary of the conditions for a visual plot of states.

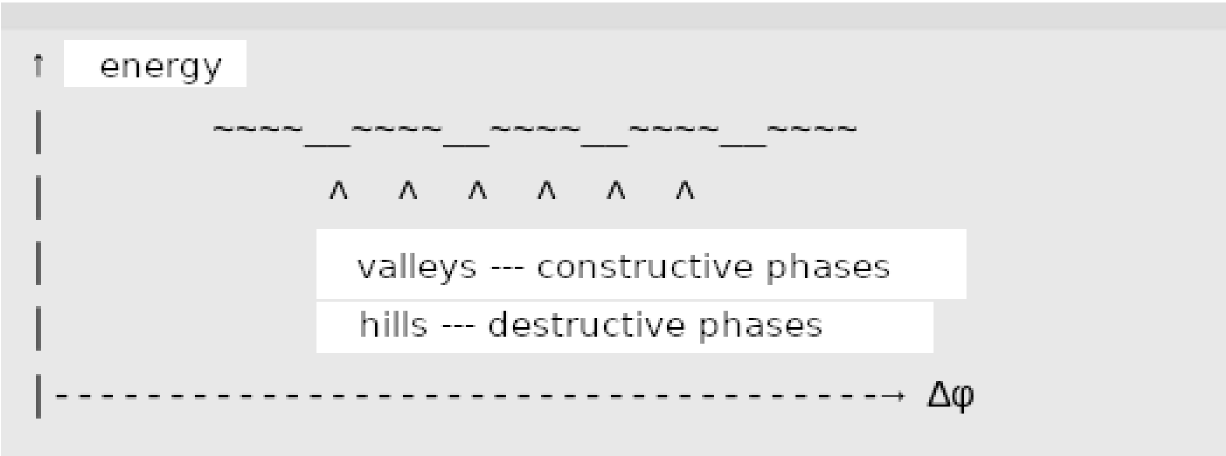
The shape of the multiverse:
On a threedimensional landscape, the x-axis stands for the distance between to universes. The more one moves to the left or the right, the difference increases in other measuring results or other quantum configurations. The y-axis stand for the strength of the coupling term (Linzeteum-term) λ. The more the moving is to the front, the stronger the coupling of both universe states is and the stronger the interaction between both. The z-axis represents the effective energy $E_{eff}(x,\lambda)$. The deeper, the cross-over zone is more stable.

The form of the area can be seen in picture 2:



Picture 2: Shown is the valley of stable universe overlapping of the cross-over zone in the center of the coordinate-system. The hill at the right is the area of decoupling with more probability for divided, different universal quantum-states. When this area is viewed from the side, it can be seen that it has a long, shallow depression in the middle and rises towards the outside. Mathematically speaking, this is a Gaussian trough that becomes deeper with increasing coupling of λ, the Linzeteum-term. Looking into the deep, along the term λ shows, that the valley at ascending coupling will really tear open, gets wider and deeper. The intermitting

The alternating appearance of valleys and hills is shown in picture 3:



Picture 3: The alternating occurrence of valleys with an overlapping of cross-over coupling of measurable quantum states of two Bohmian universes and the hills of stable measurements with mono-deterministic observer-states for different, separated, divided universes.
This process can be imagined like standing waves in a water basin: the valleys are the places, where the both universes oscillate in a syncronized form, coherent --- and the hills are the places of decoherence, where the universes oscillate against each other, a desynchronized form.

Dynamical movement on the surface:
Let the measuring testing system now be like a sphere on the landscape .It rolls spontaneous to the places, where energy is the lowest, into the valleys. If the system is in the center of the valley, there are stable coupled zones with a cross-over measuring effect in a trapped zone-area. If it rolls a little away from the stable equilibrium point, the connection breaks down and the universes separate from each other. In reality this process is a dynamic equilibrium-state. Energy supply, like quantum fluctuations, can briefly lift the ball out of the valley but mostly it falls.

Entropical elaboration with fog over the landscape:

Including this description of entropic stabilization, there can be inatalles a form og probability-fog above the landscape like in molecular orbital-model of Schrödinger-equation. The deeper the valley, the denser the fog. That's where the system is most likely to accumulate. This fog stands for the probability P_{cross}, that a zone is being generated right there.

1.densest fog --- highest probability P_{cross} --- stable connection between two measuring zones.
2. Fog thin --- probability of coupling small.

Overview: overall geometric picture:
In form of a 3D-relief:

1. Along x-axis: difference of realities, separation of measurable states,
2. Along y-axis: Strength of coupling, probable-stability, bridging-force, *Linzeteum-term.*
3. Along the z-axis: Heigth of energy, physical stability of the zone,
4. Above: semitransparent probability-cloud, entropy-effect.

This is a sort of topographic map of the multiuniversal states with valleys as a stable hybrid zones of deterministic cross-over, with passes, where recoherences happens at short time-intervalls and hills or mountains with complete divided, separated states. Only there classical (quantum)-measurements are possible.

Main result:
The cross-over valley is like a groove of resonance in the quantum landscape of multiverse – there, where two nearly equal or most similar universes and their measuring states occur and meet --- oscillating in coherent harmony--- for a moment an intervall of two divided sections of reality occurs.

Appendix D: On classical and multiple reality from an ontological point of view:

Humans perceive their environment, attribute certain properties to things, and verify these assumptions through measurements. These processes—observation, movement, thought, and action based on rational, cognitive processes—form the basis of sensory perception, which is the very prerequisite for the perception of measurement processes. The individual's experiential world changes in its fundamental definition as soon as several people become part of this experiential world. Through living together with others, one's own reality is defined, shaped, and solidified. Communication, or linguistic understanding, plays an important role in this. Experiences are stabilized when they are confirmed by others. In this process, cognitive structures such as concepts, relationships, and rules are developed intersocially through intellect and reason. Concepts are the names of objects, their common designations. Relationships are their interactions, how they act with one another. Rules are the laws according to which they interact.

The actions and communications of other people influence our thought structures, acting as a filter. What is true is accepted, what is false is rejected—this has been the scientific way of thinking since the Renaissance and Galileo (though fundamentally Socratic). Nevertheless, other people are not initially objective entities, but rather part of our subjective world of experience. Their confirmation does not grant experiences an independent existence. Instead, it demonstrates that certain concepts and ways of thinking, the prevailing paradigms, are important for understanding reality. These concepts can be divided into two areas:

1. Ordering one's own experiences through perceptions and measurement processes,

2. Ordering through the presentation of models that one learns from others and forms a judgment upon, ranking them according to their usefulness in understanding reality and accepting or rejecting them.

These models emerge and are accepted by attributing similar cognitive abilities to others as one possesses oneself. If concepts function in both domains, they can be accepted as universally valid and form an accepted consensus model as a representation of reality. This universal validity is called objectivity. It is defined as the smallest sum of shared experiences that are repeatable in measurements and lead to jointly accepted laws, such as those described by mathematical formulas. A classical measurement process, as well as a quantum mechanical one, is such a case. It is assumed that the mapping of reality occurs unambiguously in this way. In a classically conceived monoverse, this would indeed be the case. However, in the multiverse of the Everett-Bohm many-worlds interpretation, such a classical, monomaniacal, hermetic model of measurement and perception can no longer be valid or accepted. Rather, different realities must be examined for their possible superposition and mutual influence; at least within the quantum mechanical measurement domain. Whether meso- or macro-couplings might also exist must be verified through experiments. If not, the Copenhagen interpretation applies. Otherwise, the possibility of superposition of realities must be studied.

Appendix E: Outlook

I. The two-drop flux-model of two intercoupling universal states in its context between quantum description and Thoms catastrophic theory of abrupt changing of behaviour (abrupt phase-changing between to states, mathematically mapped from one Riemann-surface to another).

If it is assumed that the drops represent two different quantum states in two Bohmian universes and consider the "confluence of universal probabilities" in the context of Thom's catastrophe theory, there can be entered a field that combines quantum mechanics with concepts from nonlinear dynamics and catastrophe theory.

1. Bohmian Universes and Quantum Probability probabilities arise from the complex interaction between the particles and a "pilot wave" that controls the particles' motion [3.],[4.]. In a Bohmian universe, two distinct quantum states would exist as different "wave packets," each representing a different form of probability and evolution [5.],[6.].

If now there is spoken of a confluence of "universal probabilities," this could be understand as the convergence of two different quantum mechanical developments or "wave functions." At a certain point, a transition between two such probability distributions could occur, which could potentially be understood as a kind of quantum catastrophe.

2. Catastrophe Theory and Quantum Mechanics

In Thom's catastrophe theory, there are different types of transitions: unfoldings and catastrophes, which, even with small changes in a system's parameters, lead to abrupt changes in the system's behavior. Here, you could view the transition of the two "drops" as such an unfolding process, where the two quantum states (represented by the drops) collide in a critical way, resulting in a new, unified state.

Imagine that the universes are separated by different probability distributions of the wave functions. Now, when a critical point is reached (e.g., due to a sudden change in the parameters of the probability distributions or an interaction between the universes), a catastrophic merger occurs, in which the two wave functions "flow together." This could lead to a sudden, discontinuous change in the quantum mechanical state — a kind of quantum catastrophe.

3. Formulation of the Idea

In a Bohmian universe, where two distinct quantum states exist through different probability distributions, the merging of these states could be described as an example of a cataclysmic transition. Here, the states correspond to drops whose merging is triggered by the critical point of a nonlinear process. In accordance with Thom's cataclysmic theory, a small change in the parameters of the wave functions, such as the phase shift or the superposition of the probability distributions, could lead to an abrupt merging.

This represents a transition from two separate universes to a unified state, where the wave functions merge into a new, shared state that cannot be described by the sum of its individual states but assumes a completely new structure.

4. Interpretation as a Quantum Catastrophe

In this scenario, you could use the term "quantum catastrophe" to describe the transition in which the probabilities and their associated states change abruptly. Such transitions, in which quantum state spaces merge nonlinearly, would be analogous to the catastrophic transitions described by Thom in his theory. Here, the dynamics of the merging of probabilities could be understood as a form of "critical point" analysis, leading to an abrupt change in the system in a deterministic Bohmian universe.

5. Summary

In this formulation, there could be considered the "confluence of drops" as the moment of catastrophe in which two Bohmian universes, separated by different quantum states (represented by drops), merge into a new, unified state. This transition could be a nonlinear, abrupt process compatible with Thom's catastrophe theory. Small changes in the probabilities or parameters of the quantum wave functions could cause the two universes to "merge," resulting in a new, continuous wave function.

The question of the joint wave function after the confluence of the two Bohmian universes is truly fascinating, and there are some interesting perspectives that could be developed from quantum mechanics and Thom's catastrophe theory. To understand what such a "joint wave function" might look like, there is a need to consider both the mathematical structure of the wave function and the physical significance of this confluence.

II. Wave Functions in Bohmian Mechanics

In Bohmian quantum mechanics, there is no classical wave function directly linked to the "probability" of a particle, as in the traditional Copenhagen interpretation. Instead, there is a pilot wave that determines the trajectory of particles. This wave has the same mathematical form as the wave function in the Schrödinger equation, but its interpretation and role in the system are different: it determines the trajectories of the particles, not their probabilities. In a Bohmian universe, there are different wave functions that describe different states. When we speak of a confluence of universes, this means that two different probability waves (each describing different universes or states) combine to form a new, common wave function.

1. Mathematical Structure of the Merging

If there is considered the wave functions as superpositions of states, the "merging" of the two wave functions could be mathematically formulated as a superposition of the two original wave functions. In quantum mechanics, a superposition of wave functions is a linear combination of the individual wave functions [7.]. If (ε_1) and (ε_2) are the two original wave functions of the two universes, the joint wave function after the merging could be described as a kind of linear superposition (in a simplified case):

$$\Psi_{whole} = \alpha \cdot \Psi_1 + \beta \cdot \Psi_2$$

Here, (α) and (β) are complex coefficients that determine the weighting of the two wave functions and reflect the amplitudes of their respective probabilities. The exact form of the joint wave function depends on the specific physical parameters that influence the merging of the two universes and their states.

2. Nonlinear Interactions and Catastrophes

In Thom's catastrophe theory [8.],[9.], there are certain transition points at which a system undergoes a discontinuous change. With regard to the wavefunction, this could mean that the transition from two separate wavefunctions to a common wavefunction is nonlinear. Instead, the interaction between the two wavefunctions could give rise to nonlinear dynamics leading to an abrupt, "catastrophic" transition.

Such a transition could be characterized, for example, by the emergence of a singular point in the wavefunction, where the amplitudes of the two original wavefunctions are not simply added, but superimpose in a more complex way, resulting in a new, nontrivial waveform. One way to formulate this mathematically would be to use nonlinear wavefunctions or soliton-like solutions, which can occur in quantum mechanics, to represent the abrupt, nonlinear transitions.

3. Example of a Possible Wave Function After the Catastrophe

Imagine that the confluence of the wave functions of two universes constitutes a kind of "catastrophe" in which the two wave functions merge in a way that is distinctly different from a simple superposition. An example of a possible wave function could therefore be a singular wave function that reflects an abrupt change in the structure of the original wave functions:

4. Physical Significance of the Merger

The physical significance of the shared wavefunction is that it now describes a new universe or a new state in which the properties of the two original universes are combined in a new, coherent way. The merger could, for example, lead to a change in the physical laws or dynamical properties that were previously different in the two universes.

I*n Bohm's interpretation, the transition from two universes to a shared universe would be determined by the motion of the particles and the change in the guiding waves. The new state would be determined by a shared guiding wave that takes into account both the previous states and the transition phases.*

5. Wave Function Collapse and Catastrophes

Considering the collapse of the wave function, the confluence of the wave functions could also be interpreted as a form of "collapse," where the probability spaces of the two universes merge into one. This could represent a kind of quantum catastrophe, where the transition between the universes is not smooth but sudden and discontinuous.

6. Conclusion

The combined wavefunction after the confluence of the two Bohmian universes would likely be a linear combination of the two original wavefunctions (if the transition is linear), but it could also exhibit nonlinear features if the transition involves a catastrophic, abrupt change. It would have a new, complex structure that reflects the properties of both original universes, but in a new form that might not be fully described by simply adding the individual states. The result could be a "singular" wavefunction, indicating a discontinuous change in the system's dynamics.

It is entirely conceivable that local overlaps of the wave functions arising from the merging of the two Bohmian universes could have meso- or macroscopic effects. These overlaps could manifest themselves in various ways, both in experimental observations and in the theoretical description of the system. Let's explore this idea further:

III. . Local Overlaps of Wave Functions:
In quantum mechanics, there is the concept of wave function superposition, where wave functions overlap and thus influence the probability of a state in a given region. If two Bohmian universes merge and their wave functions overlap, this could lead to interfering waves, similar to classical quantum interference.

1. Quantum interference and macroscopic systems:

Interference patterns: If the two wave functions superimpose, they could produce interference patterns that would be measurable not only theoretically but also experimentally for macroscopic systems. This could manifest, for example, as quantum mechanical interference or even quantum coherence if the overlap extends over a large area.

2. Local changes in probability density:

An overlap of the wave functions could cause the probability density to change in certain regions. In a classical experiment, this could lead to deviations, such as in the distribution of particles or measured values in a quantum system.

3. Macroscopic Measurability:

The question of whether these overlaps would be mesoscopically or macroscopically measurable depends strongly on the strength of the superpositions and how far they extend in spacetime. In macroscopic systems (i.e., systems with many particles or larger volumes), quantum phenomena are usually considered "average" — meaning that the effects are not as strong due to decoherence or wave function collapse [10.],[11.]. Nevertheless, there are some interesting points where these quantum phenomena could manifest:

Quantum interference is often associated with microscopic systems such as electrons or photons [12.],[13], but there is a growing body of research showing that quantum interference can also occur on mesoscopic or macroscopic scales, particularly in systems such as quantum dot arrays, superconducting qubits, or nanostructures. An example could be the double-slit experiment, which has been performed for macro objects under extremely controlled conditions, as in quantum optics. If the wave functions of two Bohmian universes overlap in a mesoscopic system such as a superconducting wire or a nanotube, measurable interference patterns could emerge. Even though decoherence often occurs in such systems, it is possible that certain quantum mechanical superpositions between universes could influence these systems and lead to measurable effects.

4. Non-classical states and macroscopic effects:

In a scenario where two universes overlap their wave functions, a non-classical state measurable by macroscopic instruments could arise. Such a state might be a superposition, where the two universes exist in a "floating" state, which would appear as a fluctuating but coherent signal in classical instruments.

An experiment might show that measuring a particular system simultaneously detects different states with varying probabilities, representing a kind of "quantum mechanical mixing" of the two universes. Macroscopic superpositions of states or particles could be measurable in specific experimental settings, such as quantum optics or quantum information theory.

5. Decoherence and its effects:

Decoherence is the process by which a quantum system transitions from a coherent state to a classical state [14.]. In macroscopic systems, decoherence is often a strong phenomenon that very quickly destroys the superposition of states. However, there are certain circumstances under which even macroscopic systems do not become completely decoherent:

In superfluid systems or under superconductivity, such overlaps might not yet become decoherent, so their quantum interference remains visible. Research is also underway in quantum computing on technologies that allow the use of nonclassical states on larger scales. Such technologies could be relevant for experimental measurements.
Mesoscopic systems: In mesoscopic systems (e.g., systems comprising several dozen to one hundred particles), effects of quantum interference and superposition could still manifest before decoherence sets in. Here, overlaps and interferences could leave measurable signatures that could be experimentally detected.

6. Possible Experimental Approaches:

There are several experimental approaches that could be used to search for locally measurable overlaps:

1. Interference Experiments: An experiment could be set up to measure interference effects between different states. This could be done, for example, in quantum optics experiments (such as interferometers) or in measurements of quantum coherence.

2. Quantum Coherence Measurements: If the overlap of wave functions between universes affects the coherence of a system, this could be detected through quantum interference or coherence length measurements. Coherence is frequently used in quantum computers and communication systems, and these measurements are already part of the standard methods for validating quantum operations.

3. Superconducting Circuits: In superconducting circuits or quantum dot arrays, local quantum overlaps could manifest as sudden changes in the measured current or voltage values. These systems could provide a practical testing environment to observe such effects.

Conclusion:
Yes, it is quite possible that local overlaps of the wave functions arising from the confluence of Bohmian universes could have mesoscopic or macroscopic effects. These effects could manifest as interference patterns, non-classical states, or quantum mechanical coherence. In certain experimental setups, particularly in mesoscopic systems or in quantum information theory, these effects could be detected before decoherence fully sets in. Crucially, this depends on the strength and extent of the overlaps and the practical techniques available for measuring these phenomena.

There are certainly many theoretical and experimental challenges to overcome, but the possibility of measuring such effects would be a fascinating area for future research!

To design experiments that demonstrate that local overlaps of the wavefunctions of Bohmian universes could have meso- or macroscopic effects, there must first be established some theoretical assumptions and experimental principles that enable the interplay of quantum mechanics and classical systems in a practical setup. We can draw upon modern quantum optics, superconducting quantum bits (qubits), quantum interference, and decoherence phenomena.

6. Theoretical Foundations for Wavefunction Overlap:

The fundamental idea behind the overlap of two Bohmian universes is that two different wavefunctions (describing different quantum worlds) interfere or merge in some way, resulting in a new, "shared" wavefunction. Quantum mechanics offers several principles that we can utilize:

Superposition: In quantum mechanics, the superposition of states is a fundamental aspect. We assume that the two universes exist in a form of superposition, such that their wave functions overlap in some way.

Interference: This superposition could lead to measurable interference patterns. Interference occurs when two wave functions interact, and the wave amplitudes either reinforce or cancel each other out.

Decoherence: However, in real-world experiments, quantum superpositions quickly become decoherent when they interact with the environment[15.],[16.] . Therefore, we need to find a suitable mechanism to measure these overlaps before decoherence sets in.

2. Experimental Approaches

Several experimental approaches could be used to investigate the effects of quantum overlap at the mesoscopic or macroscopic level.

a) Interferometric Measurements (Double-Slit Experiment and Extended Versions)
An extended double-slit experiment could be one way to observe interference patterns resulting from the superposition of wave functions from two Bohmian universes. In classical double-slit experiments (with electrons, photons, or other quantum objects), interference patterns can be visualized that demonstrate the wave nature of particles.

Scaling up the system: To reach meso- or macroscopic scales, one could apply a double-slit experiment to larger objects, such as nanoparticles or quantum dot arrays. These systems consist of many particles that behave as quantum objects and could exhibit interference patterns resulting from the superposition of wave functions from different universes.

Multiple universes: One could also increase the number of overlapping wave functions (by superimposing more than two "universes" with their wave functions) to observe whether the superposition causes a systematic distortion of the interference patterns on a macroscopic scale.

The experiment would potentially include the following:

Production of quantum dots or nanoparticles described by the wave functions in a quantum mechanical state.

Measurement of quantum interference over extended periods or in a low-decoherence environment to test whether the superposition of wave functions from different universes produces measurable interference patterns.

Quantum Coherence and Quantum Measurements in Superconductors (Qubits and Quantum Computers)

A second possibility would be the use of superconducting circuits or quantum computer-based systems (such as qubits), which are particularly stable and exhibit long coherence times. In these systems, quantum coherence between different states is used to perform quantum operations. Such systems could lead to experiments that measure the effects of wave function overlaps at the macroscopic level. Superconducting qubits: These are sensitive to quantum coherence and could be used in experiments to measure the superposition of wave functions. If two wave functions (representing different universes) are coupled via a superconducting circuit, interference or a change in the quantum state could lead to a measurable change in quantum operations.

Quantum error correction: Modern quantum computers employ error correction to maintain coherence. This error correction could be used in experiments to investigate the stability of wave function superposition and determine whether systematic changes occur when two wave functions from different universes interfere.

Measuring coherence times: One way to measure the effects of wave function overlap would be to examine the coherence time of a qubit. A change in coherence time could indicate that the wave functions of the universes "mix" in some way, thus affecting coherence.

Quantum Optics and Quantum Interferometry

Another experiment could rely on quantum optics, using photons to measure the effects of wavefunction superposition. Quantum interferometers, such as Mach-Zehnder interferometers, are already capable of measuring extremely small differences in the phases of wavefunctions.

Photon superposition: If it is considered the wave functions from the two universes as superimposed states of photons, there could be observe how the interference patterns change as the overlap increases. Measurements of the photon intensity on different detectors could reveal differences caused by the superposition of two Bohmian universes.

Quantum optical measurement: By using single-photon sources and tracking the coherence of photons over large distances, it could be detected whether there are collapses or shifts in the measured phases caused by the confluence of wave functions from different universes.

Superfluids and Bose-Einstein Condensates (BECs)In superfluid systems or Bose-Einstein condensates (BECs), quantum phenomena are particularly pronounced and can often be observed at the macroscopic level, since many atoms are in a coherent state and act as individual quantum objects. Quantum superpositions in BECs: A Bose-Einstein condensate could be considered a macroscopic superposition of quantum states, in which the overlap of the wave functions of the universes could lead to measurable phenomena, such as interference between different quantum fields or changes in the condensate state.Experimental measurement: Here, one could look for changes in the behavior of the condensate, such as plasma-like phase transitions, wave collapse, or density fluctuations caused by the overlap of the wave functions.

The experimental data resulting from these measurements could be interpreted in several ways:
Coherence disturbance: A measurable change in the coherence time of qubits or the phase shift in quantum interferometers could indicate that a superposition of wavefunctions has occurred between the Bohmian universes.
Change in interference patterns: Any distortion of the interference patterns in a double-slit experiment or with nanoparticles could point to the interaction and superposition of the wavefunctions.Changed macroscopic states: In systems such as BECs or superconductors, a sudden change in the system's behavior could indicate the interaction between the universes and their wavefunctions.

Conclusion
Experiments to measure local overlaps of wave functions from different Bohmian universes could be carried out at various levels, from interference measurements in quantum optics and double-slit experiments to complex quantum computers and superconducting circuits. The challenge would be to isolate and measure these
extremely small and often subtle effects in such a way that the interaction of the universes and its effects on macroscopic systems become visible.

In contrast to the usual interpretation, this alternative interpretation permits us to conceive of each individual system as being in a precisely definable state, whose changes with time are determined by definite laws, analogous to (but not identical with) the classical equations of motion. Quantum-mechanical probabilities are regarded (like their counterparts in classical statistical mechanics) as only a practical necessity and not as an inherent lack of complete determination in the properties of matter at the quantum level. This statement also is true for overlapping quantum states of two universes.

Appendix F:

1. I met a man upon a stair,
and then I saw - he wasn't there.
He wasn't there again today,
oh, how I wish he'd go away.

2. This house is new --- oh no, it's always been there. Your memory isn't very well.
The big window was upstairs yesterday, but now it's downstairs? --- Nonsense, it's always been like this. Your memory is bad.

3. Valley so deep and mountain so high --- Genesis

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12. 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.

13. Warning: This article may disappear in your perception tomorrow if you stumble in a trapped surface of quantum overlapping! A template disappeared from the computer while typing.

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