# A View on Inflation through Kinematics and Holography

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## Abstract

A simple kinematic functional for metric evolution is proposed, allowing us to identify the functional relationship between the natural number e and π with a relative accuracy of 0–0.15%. It is shown that exponential growth (inflationary regime) may be a necessary condition for the formation of the Metagalaxy's Euclidean metric.

A hypothesis is put forward regarding the existence of a phase quantum—an elementary angle that determines the minimum step of spatial evolution. Based on this hypothesis, an analytical relationship is derived between the parameters of the microcosm: the fine-structure constant α, the Planck length lp, and the cosmological scale of the Metagalaxy—its radius Rm:

$$R_m - \left(\frac{e^{1/\alpha}}{\alpha}\right) l_p = 0$$

It is assumed that the true radius of the Metagalaxy is approximately 1.64 times larger than the observed one, which may indicate either an as-yet-unobserved boundary of the Metagalaxy or the existence of a limiting expansion scale.

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In [4], a cosmological model is discussed that postulates the emission of a metric with instantaneous initial rotation, which immediately evolves into local metrics.

Consider the following functional:

$$\mathrm{K}(\theta) = \ln(\theta) - \lambda\theta + (N+1) \qquad (1)$$

θ - is the number of accessible microstates.

Ln(θ) = -Ln(1/θ) is the logarithmic probability of a microstate, or the entropy of the system.

λ(θ,N) is a coefficient characterizing the degree of evolution of the system.

N is the number of cycles; For one cycle, N = 1.

We require maintaining balance to prevent system collapse, so from (1) for the first cycle:

$$\lambda = \frac{\ln\theta + 2}{\theta} \qquad (2)$$

To find the roots of functional (1) to a first approximation, assume $\lambda = 1$, N = 1:

$$\mathrm{K}(\theta) = \ln(\theta) - \theta + 2 = 0 \qquad (3)$$

Using the Lambert function,

$$\theta = -W(\frac{-1}{e^2})$$

The WolframAlpha mathematical resource found two real roots:

The first root is $\theta_1$ = 0.158594 ≈ 1/2π, the second root is $\theta_2$ = 3.146193 ≈ π (Figure 1), with the maximum value occurring $K(\theta) = 1$ at θ = 1.

As we can see, the first root is close to 1/2π (0.35% error), and the second root is close to π (0.15% error). Since the real roots of the functional K(θ) coincide with high accuracy with the angles in radians, it can be stated that the microstates of the system θ are phases.

Let's check:

In the first approximation, after substituting the first root:

$$\mathrm{K}(1/(2\ \pi)) = \ln(\tfrac{1}{2\pi}) - \tfrac{1}{2\pi} + 2 = 0.00296799 \qquad (4)$$

Knowing the first root, we can determine the coefficient λ from equation (2). After substituting into (3) $\theta_1 = \dfrac{1}{2\pi}$ we obtain λ = 1.01865, therefore, in the second approximation:

$$\mathrm{K}(1/(2\ \pi)) = \ln(\tfrac{1}{2\pi}) - 1.01865(\tfrac{1}{2\pi}) + 2 = -0.00001 \approx 0$$

After substituting the second root in the first approximation:

$$\mathrm{K}(\ \pi) = \ln(\pi) - \pi + 2 = 0.0031372323 \qquad (5)$$

Substituting into formula (3) $\theta_2 = \pi$, we obtain λ = 1.001, therefore, in the second approximation:

$$\mathrm{K}(\pi) = \ln(\pi) - 1.001\pi + 2 = -0.0000044 \approx 0$$

**Consider a multi-cycle process with an unlimited number of phases:**

$$\mathrm{K}(\mathrm{N}\theta) = \ln(N\theta) - \lambda(N\theta) + (N+1) \qquad (6)$$

As before, we require equilibrium $\mathrm{K}(\mathrm{N}\theta) = 0$, then

$$\lambda = \frac{\ln(N\theta) + N + 1}{N\theta} \qquad (7)$$

We find the limit:

$$\lim_{\mathbf{N}\to\infty} \lambda(\mathbf{N}) = \lim_{\mathbf{N}\to\infty} \left(\frac{\ln(\mathbf{N}\theta)}{\mathbf{N}\theta} + \frac{\mathbf{N+1}}{\mathbf{N}\theta}\right) = \frac{1}{\theta} \qquad (8)$$

Therefore, with an unlimited number of phases:

$$\lambda \to \frac{1}{\theta_1} = 2\pi \qquad (9)$$

extremum condition $\lambda'(\theta) = 0$ from (7) is satisfied at:

$$\theta^*(N) = \frac{e^{-N}}{N} \tag{10}$$

Substituting (10) into (7) yields the maximum value of the coefficient:

$$\lambda(\theta^*) = e^N \tag{11}$$

As follows from (10) and (11), $\lambda(\theta^*)$ increases in the region (0, θ*) and decreases in the region (θ*, ∞).
Moreover, as N increases, the region (0, θ*) decreases, and the coefficient λ at the extremum point grows exponentially, indicating inflation.

The maximum value occurs in the first cycle (N = 1), $\theta^*_{N=1} = e^{-1}$ = 0.1171π. At the extremum point of the first cycle, λ = e (Figures 2 and 3).

## Discussion of Results

### 1. Relationship between e and π

Classical Euler formula:

$$e^{i\pi} + 1 = 0$$

Deviation 0.

Ramanujan's first approximation:

$$\mathrm{e}^{\pi} - \pi \approx 20$$

Deviation 9 × 10⁻ 4, 0.45%

Ramanujan's second approximation

$$e^{\pi\sqrt{163}} = 262537412640768744$$

Deviation 7.499 × 10⁻ 3

Error 2.86 × 10⁻ 28%

Clearly, the proposed functional (3), even in its unrefined simple form (4.5), achieves a deviation three orders of magnitude smaller than Ramanujan's first approximation. Ramanujan's second approximation, which is highly accurate, is derived from number theory. Other approximations based on real numbers yield deviations exceeding 1 percent.

This coincidence for the functional K(θ) is apparently not accidental and is related to its dynamical structure. Another important point is that the functional K(θ) is not an algebraic relation between e and π, but exhibits a functional dependence.

**2. Holography and Information**

The functional K(θ) provides global information about the entire cycle through three points: the first, second, and final. The result resembles typical holography:

*the initial phase of the system knows everything about the system,* $\theta_1 = 1/(2\pi)$

*the second phase contains a phase inversion,* $\theta_2 = \pi$ (Fig. 1).

*Finally, the third point: the completion of cycles* $(\mathrm{N} \to \infty)$ *(7, 8, 9) is predetermined by the initial phase* $(\theta_1)$*:*

$$\lambda \to \frac{1}{\theta_1} = 2\pi$$

As is well known, the curvature of space is measured by comparing the radius of the circle circumscribed around any point with its length, that is, by determining the number π. As shown above, under the "holographic" balance condition K(θ) = 0, the functional behaves like a function of the relationship between information and geometry, "indicating" that in the limit, space is Euclidean, without curvature—the constant π does not change.

## 3. Inflation and Euclidean Space

As can be seen from (11),$(\mathrm{N} \to \infty)$ inflation is observed with increasing phase counts. The balance of the kinematic functional leads to the emergence of local Euclidean spaces as a result of inflation. Inflation smooths out the curvature [1]. Rapid stretching of the metric flattens space at all scales, which is consistent with real cosmological data.

## 4. The Phase Quantum Hypothesis

We assume that the cyclicity of N is bounded by a minimum phase, the phase quantum, below which the phase cannot be. From (10), we find:

$$\mathbf{N_{max} e^{N_{max}} = \frac{1}{\theta_{min}}} \qquad (12)$$

The phase quantum must be measured in radians and depend on boundary conditions within which the known laws of physics are observed. The lower limit is the Planck length $l_p$, and the upper limit is the radius of the Universe (metagalaxy) $R_u$ :

$$\theta_{min} = l_p / R_U \qquad (13)$$

Then:

$$\mathrm{N_{max}} e^{N_{\max}} = R_U / l_P \qquad (14)$$

Commonly accepted initial constants and parameters:

$$\mathbf{l_P = \sqrt{\frac{\hbar G}{c^3}} \approx 1.616 \times 10^{-35}} \ m$$

$R_U = R_m$ $=4.4 \times 10^{26} m$ (observable Universe)

Inverse fine structure constant $(\alpha^{-1})$:

$$\alpha^{\mathbf{-1}} \approx \mathbf{137.035999}$$

Therefore,

$$\theta_{min} = l_p/R_m = 3.67310 \times 10^{-62}$$

After substituting into (14), WolframAlpha returned the calculated value:

Nmax = 136.543 ≈ 137

It's worth noting that this value is approximately equal to the fine structure constant. This may be a coincidence, but we can assume otherwise and take advantage of the dimensionlessness of the parameters. Let's make the following transformations in (14):

$$\mathbf{R_m \approx \ N_{max} e^{N}_{max} l_P}$$

Since:

$$\alpha^{-\mathbf{1}} = \mathbf{N}_{\max}$$

$$R_m \approx \left(\frac{e^{1/\alpha}}{\alpha}\right) l_p \qquad (15)$$

Let's check by substituting the generally accepted data:

Rm = (137.036 * 2.718282 ^ 137.036) * 1.616 * 10 ^ (-35) = 7.232 * 10 ^ 26 m

So, if the Universe (for clarity, let's call it the Metagalaxy) is only 1.64 times larger than the visible one, then formula (13) relates the Planck length, the fine structure constant, and the radius of the Metagalaxy with absolute precision.The question arises: what happens if condition (16) is not satisfied?

$$R_m - \left(\frac{e^{1/\alpha}}{\alpha}\right) l_p = 0 \qquad (16)$$

Two answers are possible: either we have not yet observed the boundary of the Metagalaxy, or the limit of its expansion has not been reached. It is possible that both answers are true simultaneously: we do not see the boundary, and the limit has not been reached.

## Conclusion

A simple kinematic functional is proposed that establishes a functional relationship between universal mathematical constants. Based on this functional, an elegant equation is derived that unifies the microscopic and macroscopic parameters of the Universe (Metagalaxy). Despite numerical agreement with theoretical and some observational data, the results of this study require experimental verification.

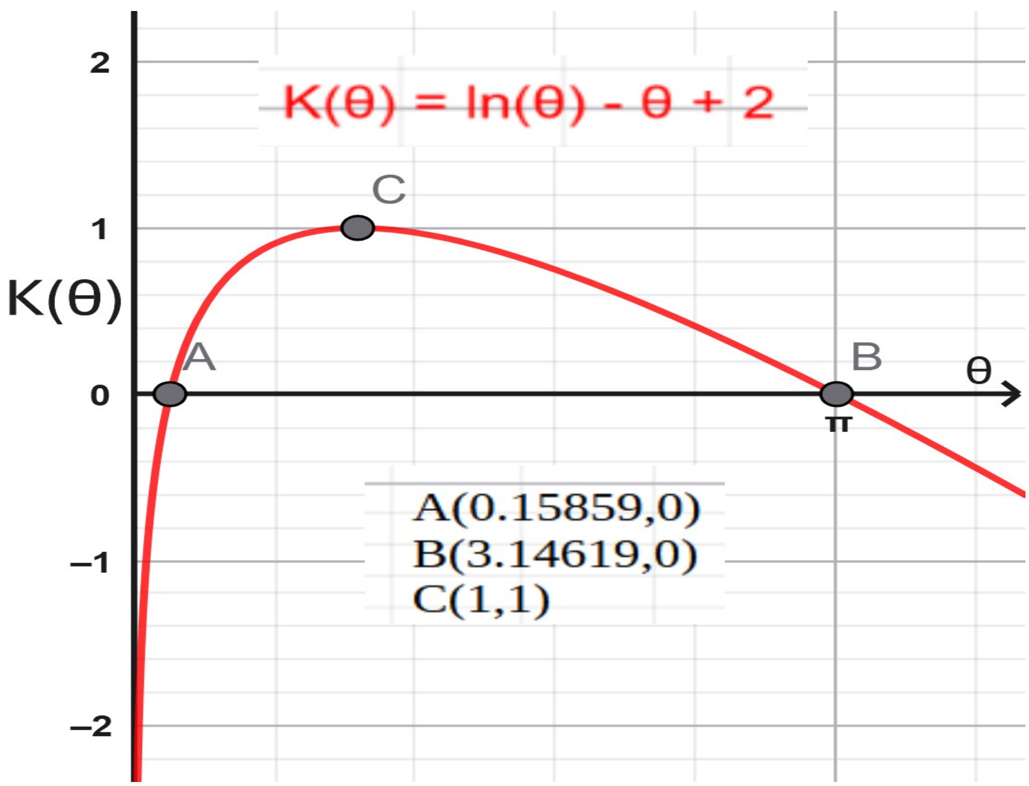
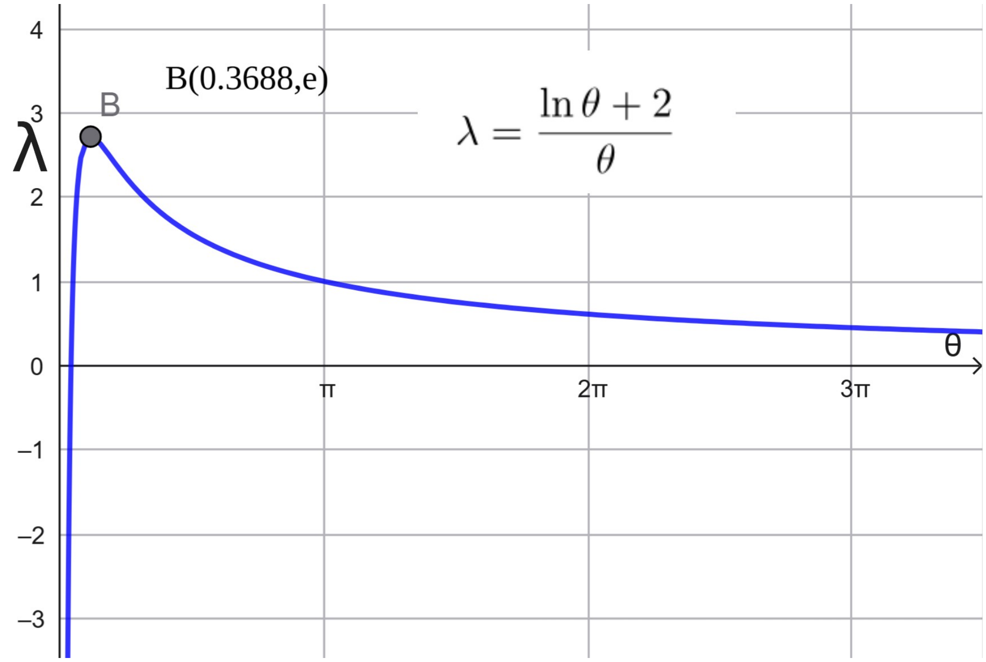
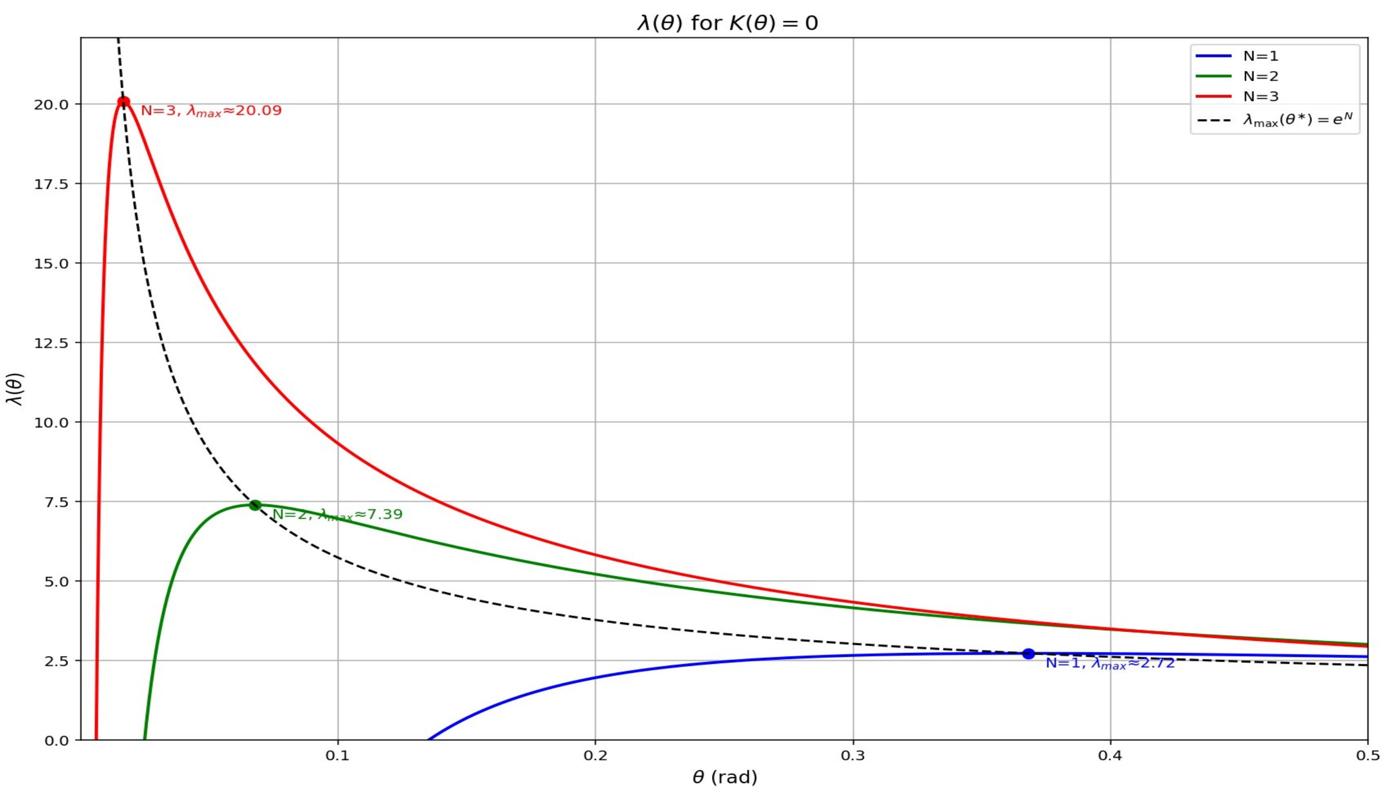



Fig.1



B(0.3688,e)
B
λ
$\lambda = \frac{\ln\theta + 2}{\theta}$
θ
4
3
2
1
0
–1
–2
–3
π
2π
3π


Fig.2



$\lambda(\theta)$ for $K(\theta) = 0$
N=1
N=2
N=3
$\lambda_{\max}(\theta^*) = e^N$
N=3, $\lambda_{max}$≈20.09
N=2, $\lambda_{max}$≈7.39
N=1, $\lambda_{max}$≈2.72
$\lambda(\theta)$
$\theta$ (rad)
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
0.1
0.2
0.3
0.4
0.5


Fig.3

This work was conducted independently and did not receive any external commission or financial support. Source code search, editing, and translation were performed using open-source AI models. Complex mathematical calculations were performed using WolframAlpha's Mathematica system and the GeoGebra calculator.

## Literature

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