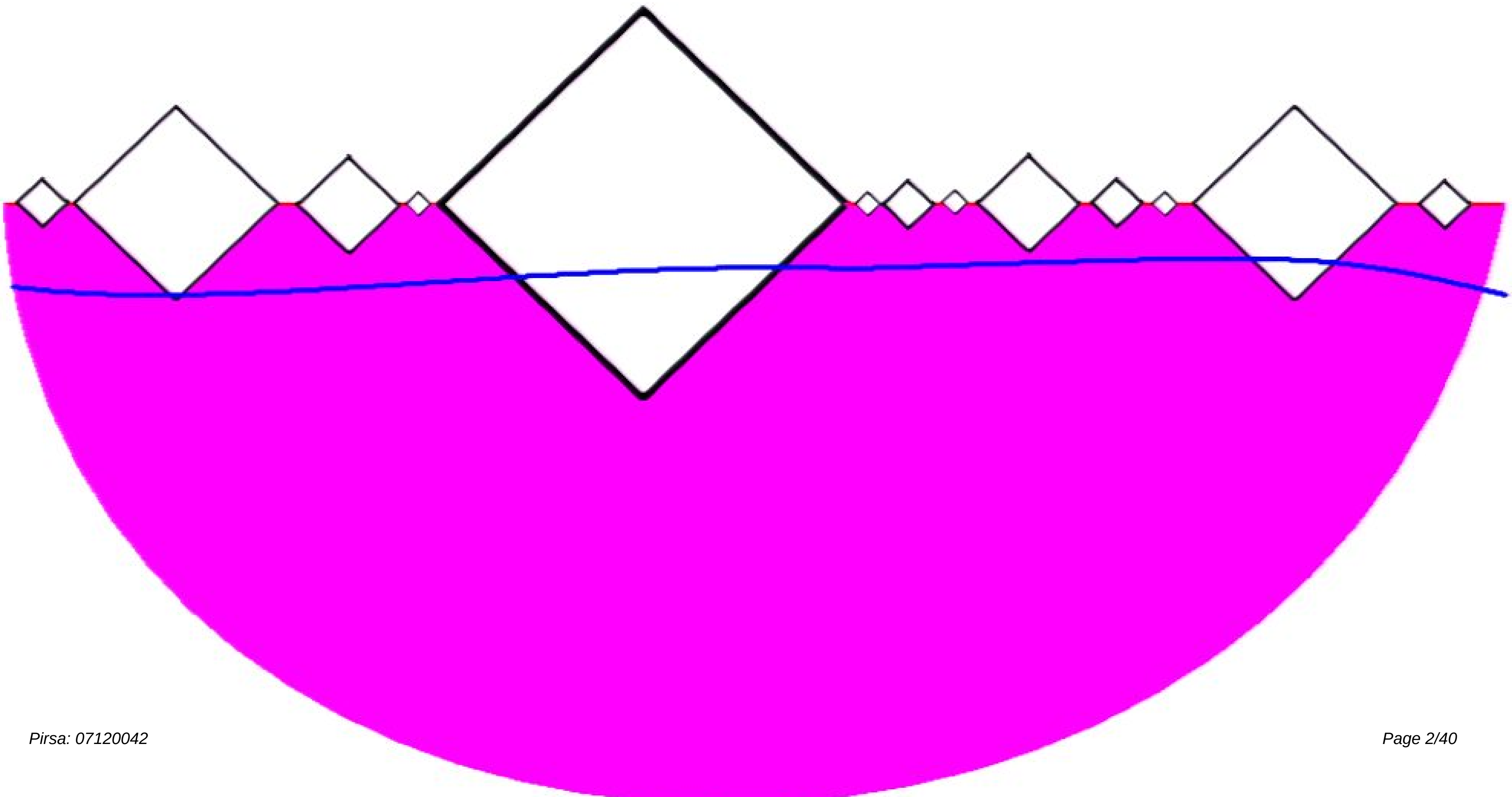
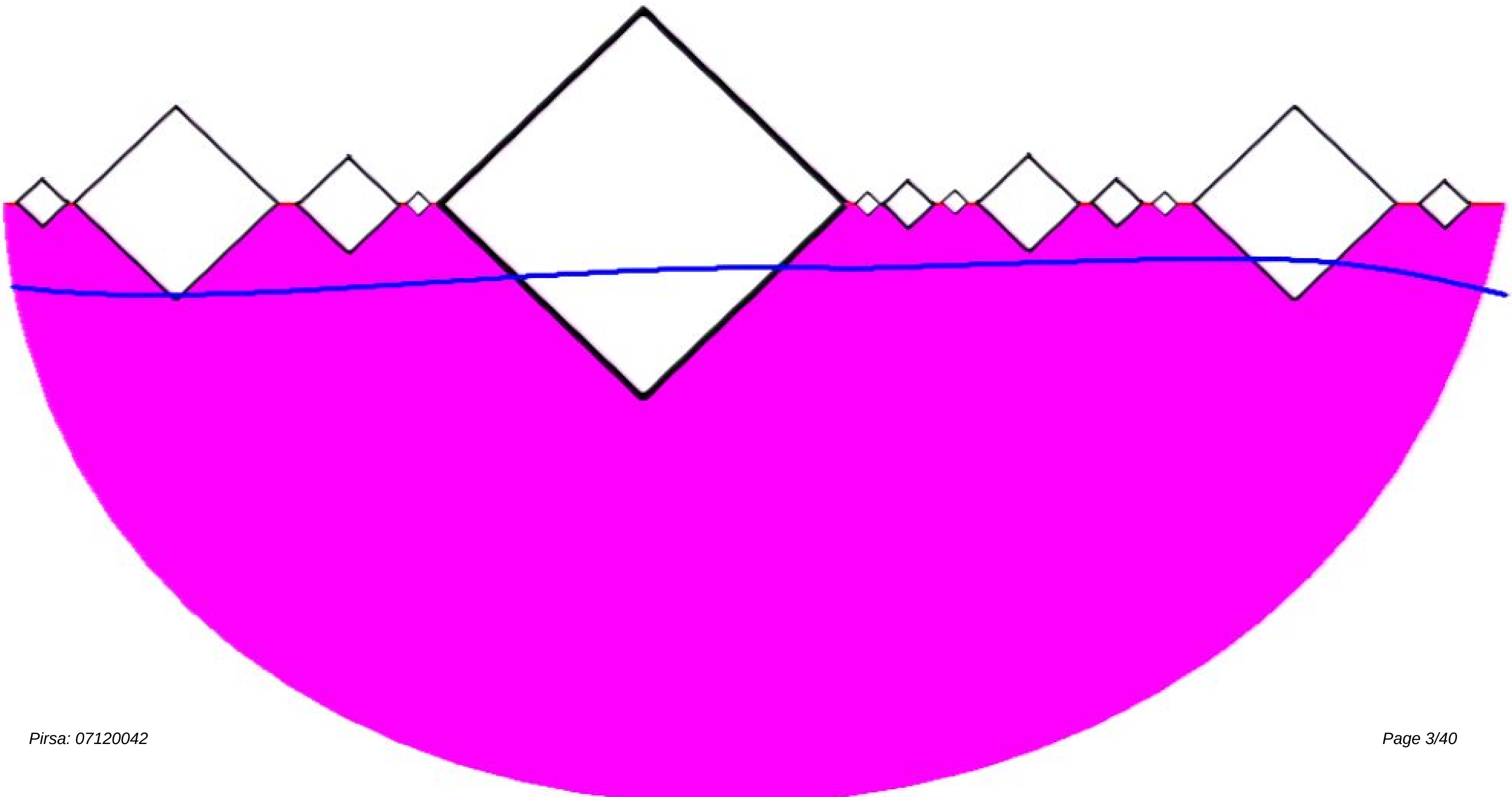
Title: TBA

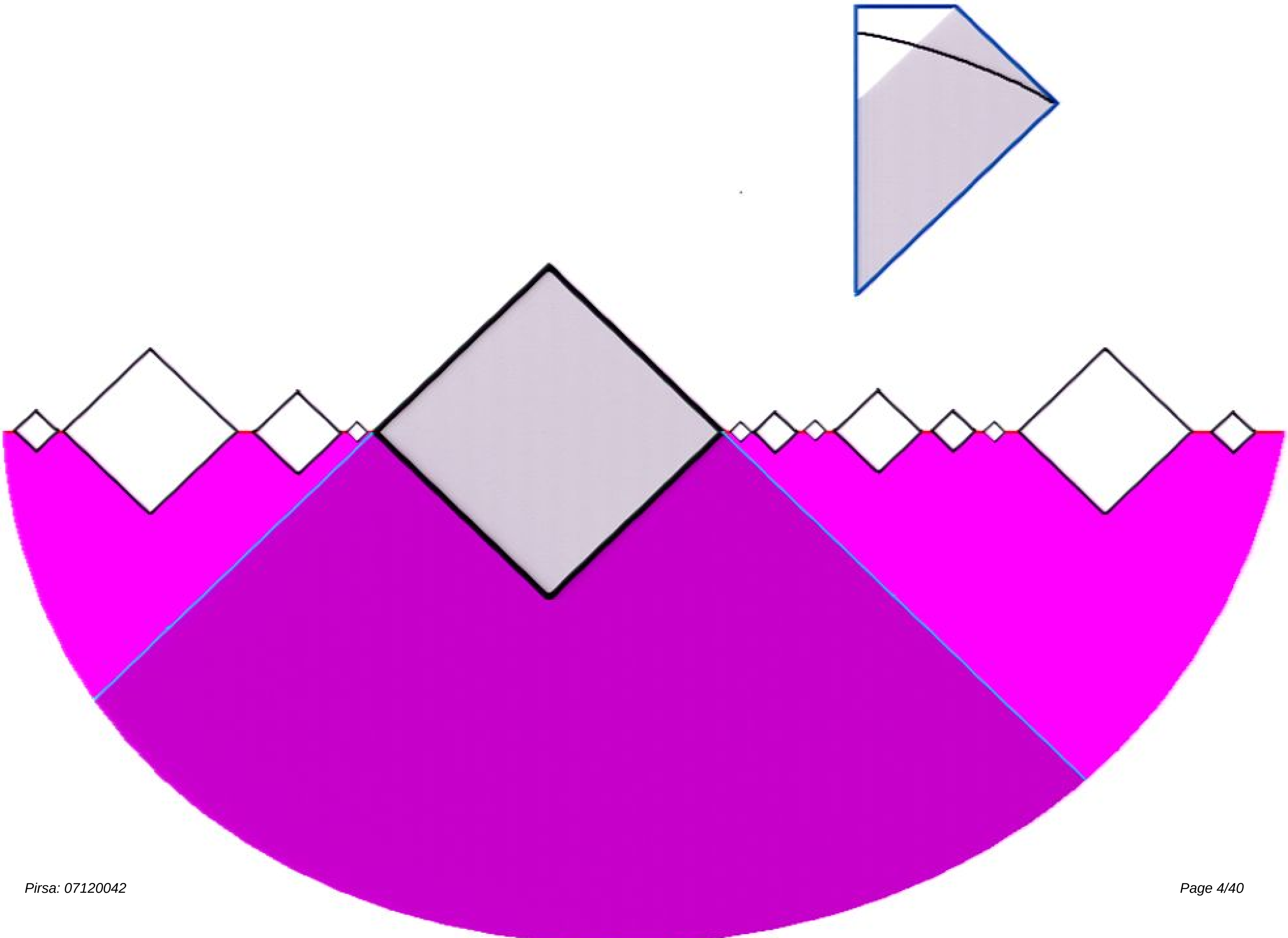
Date: Dec 07, 2007 02:45 PM

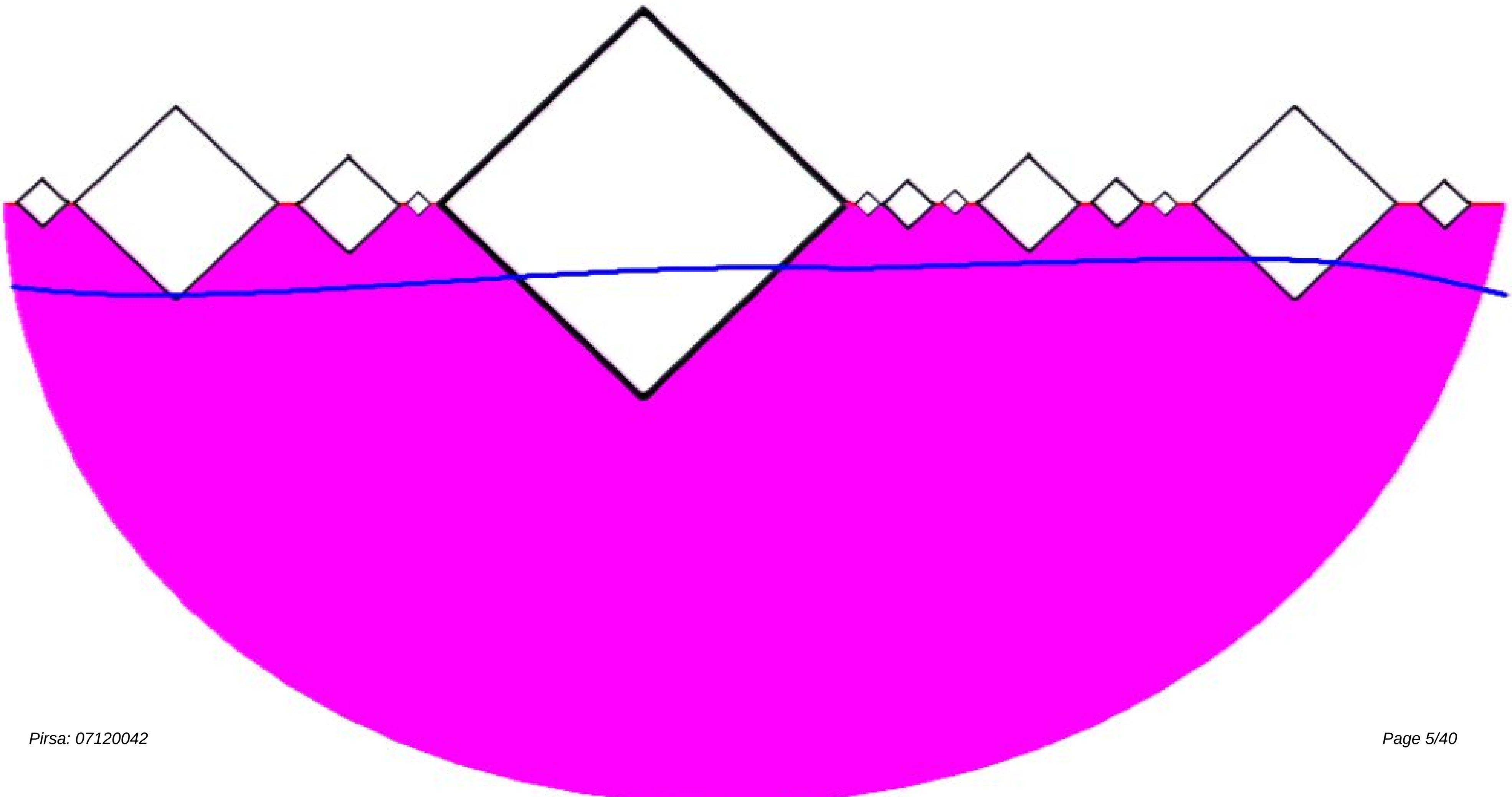
URL: http://pirsa.org/07120042

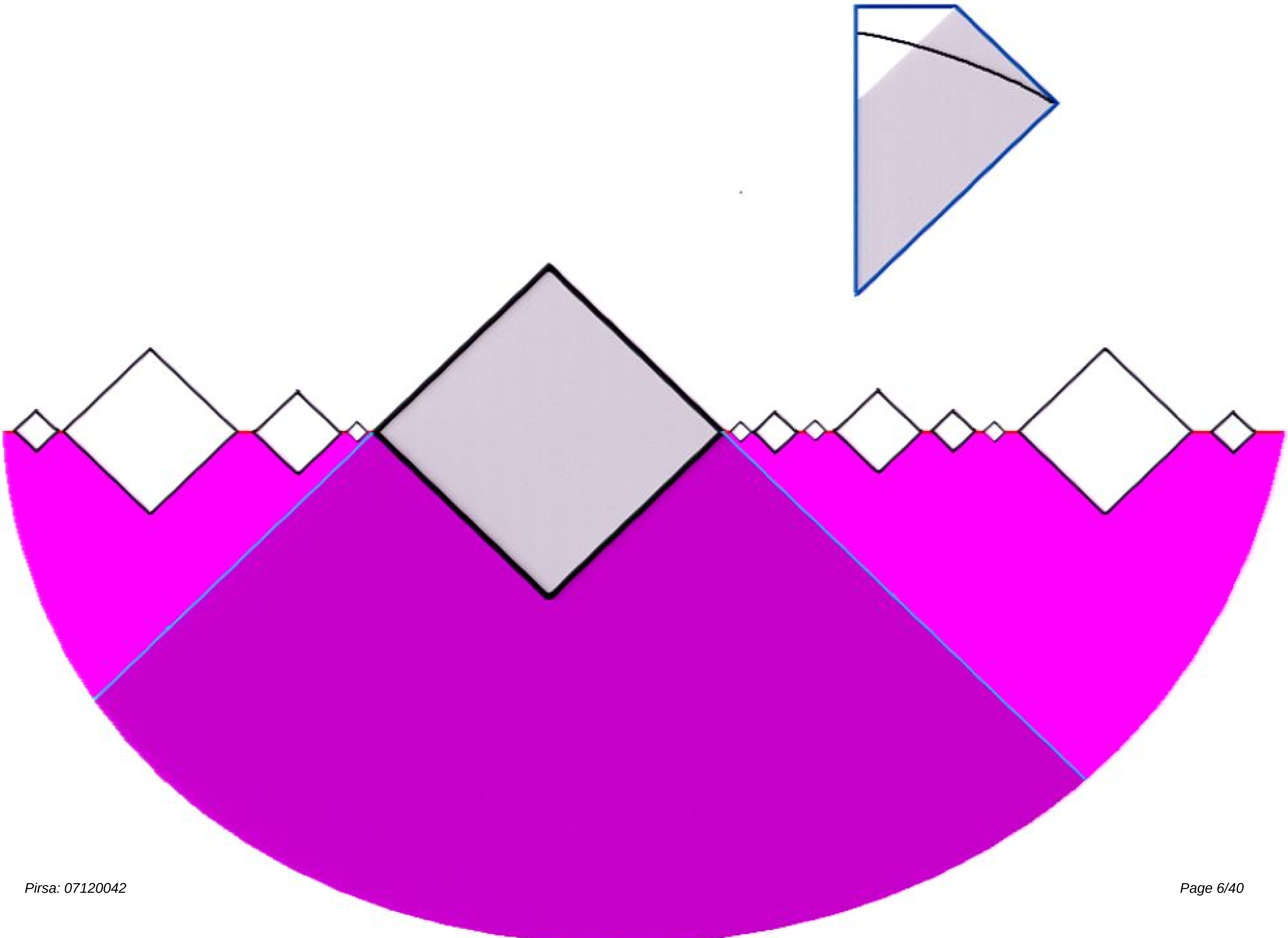
Abstract:



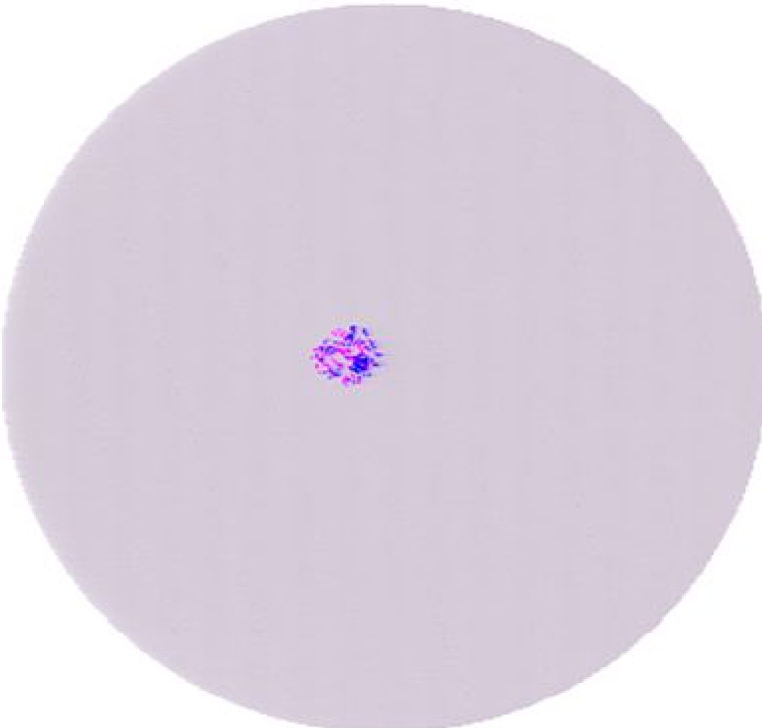




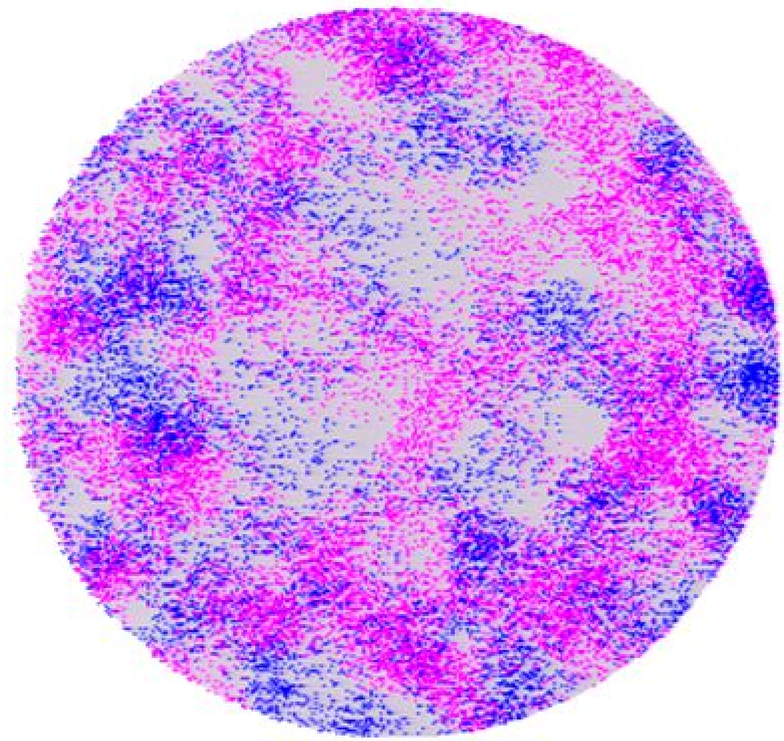





07120042

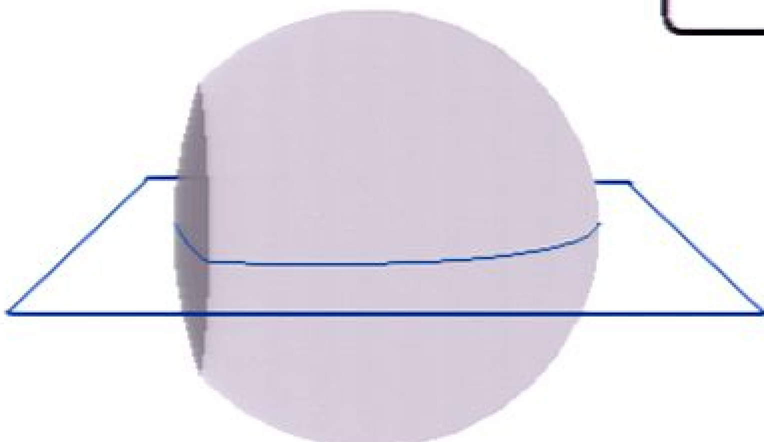


Asymptotically Cold
Flat, ADS

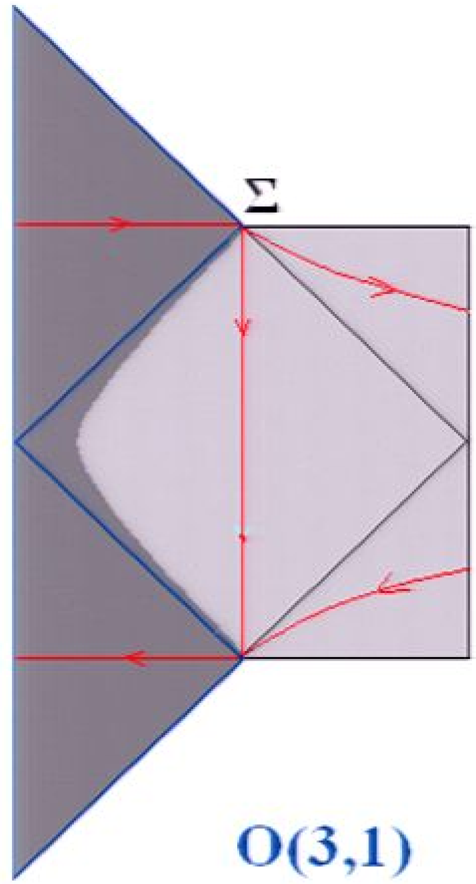


Asymptotically Warm
Open FRW

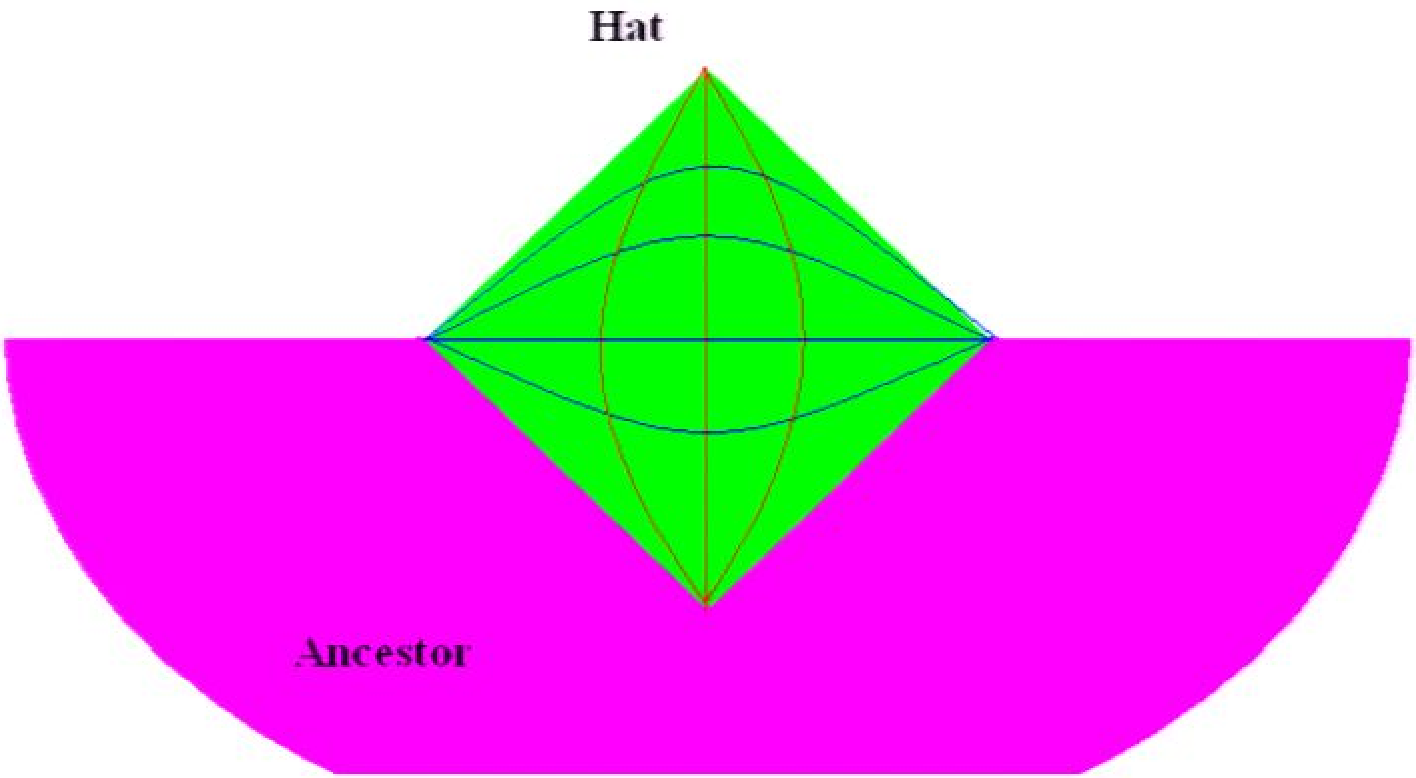
$$\Lambda_{\text{final}} = 0$$



O(4) symmetry



O(3,1)



$$ds^2 = -dt^2 + a(t)^2 \{dR^2 + \sinh^2 R \; d\Omega_2^2\}$$

$$= a(T)^2 \{-dT^2 + dR^2 + \sinh^2 R \; d\Omega_2^2\}$$

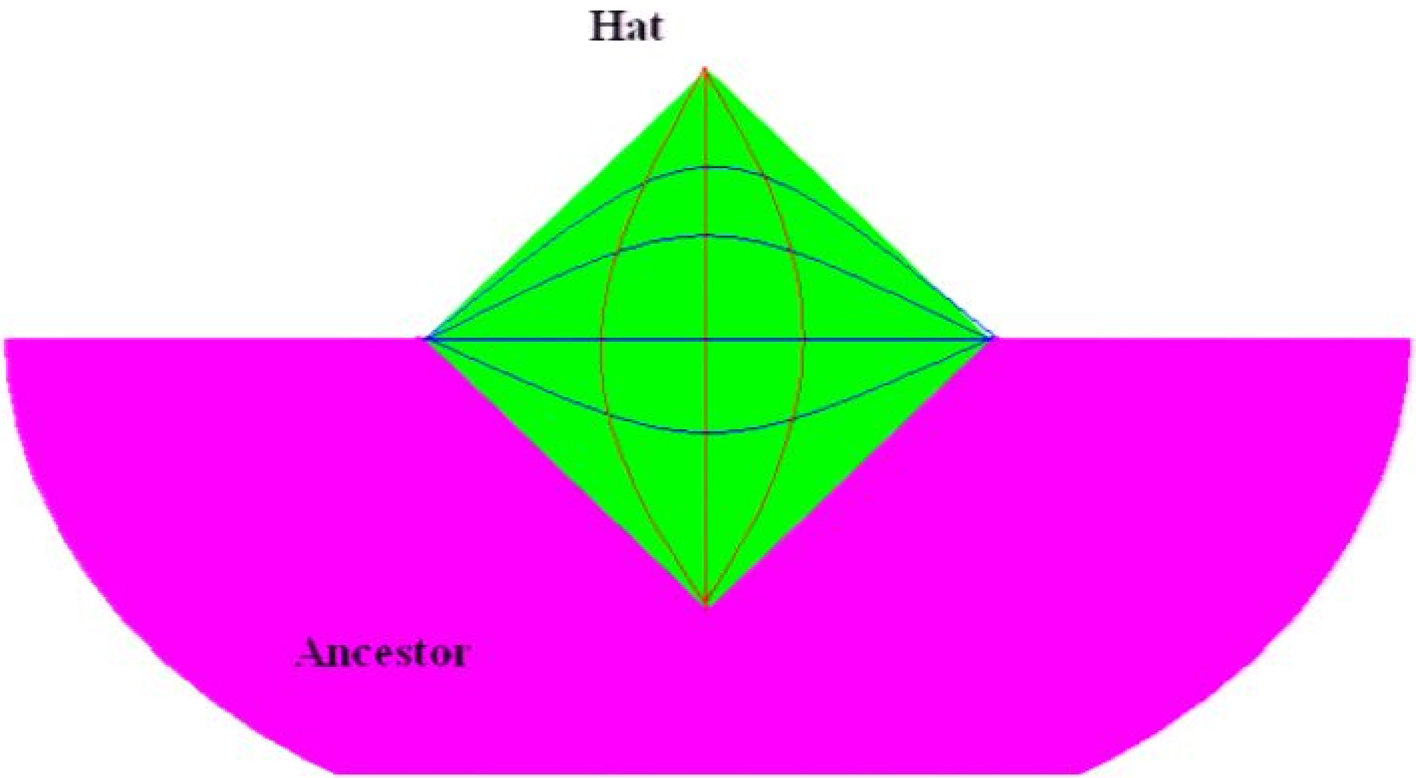
$$= a(T)^2 \{-dT^+ dT^- + \sinh^2 R \; d\Omega_2^2\}$$

At early and late times the universe is curvature dominated.

$$a(t) \sim t$$

$$a(T) \sim \exp(T)$$

$$ds^2 \to -e^{2T}\, dT^+\, dT^- + e^{2T^+} d\Omega_2^2$$



$$ds^2 = -dt^2 + a(t)^2 \{dR^2 + \sinh^2 R \; d\Omega_2^2\}$$

$$= a(T)^2 \{-dT^2 + dR^2 + \sinh^2 R \; d\Omega_2^2\}$$

$$= a(T)^2 \{-dT^+ dT^- + \sinh^2 R \; d\Omega_2^2\}$$

At early and late times the universe is curvature dominated.

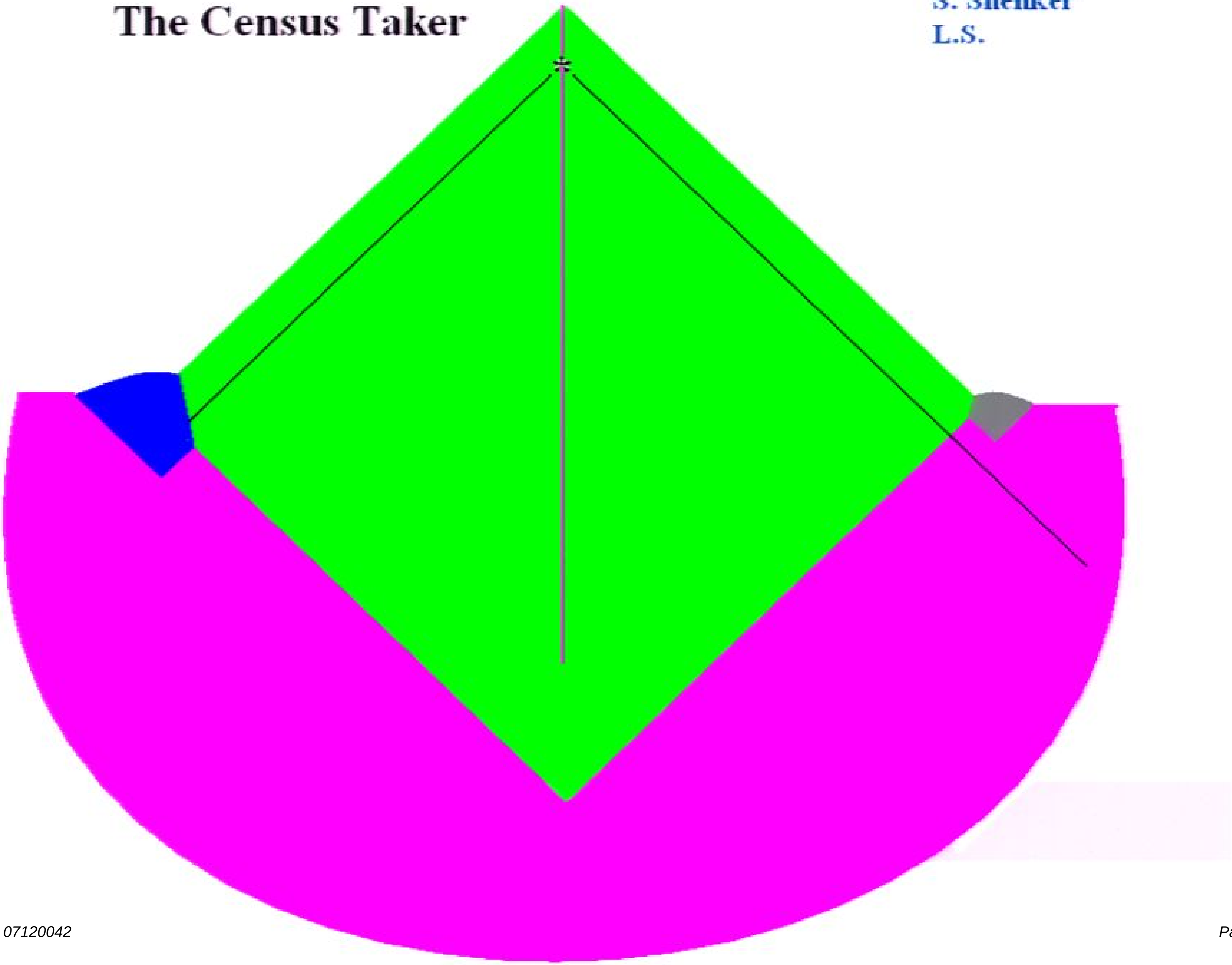
$$a(t) \sim t$$

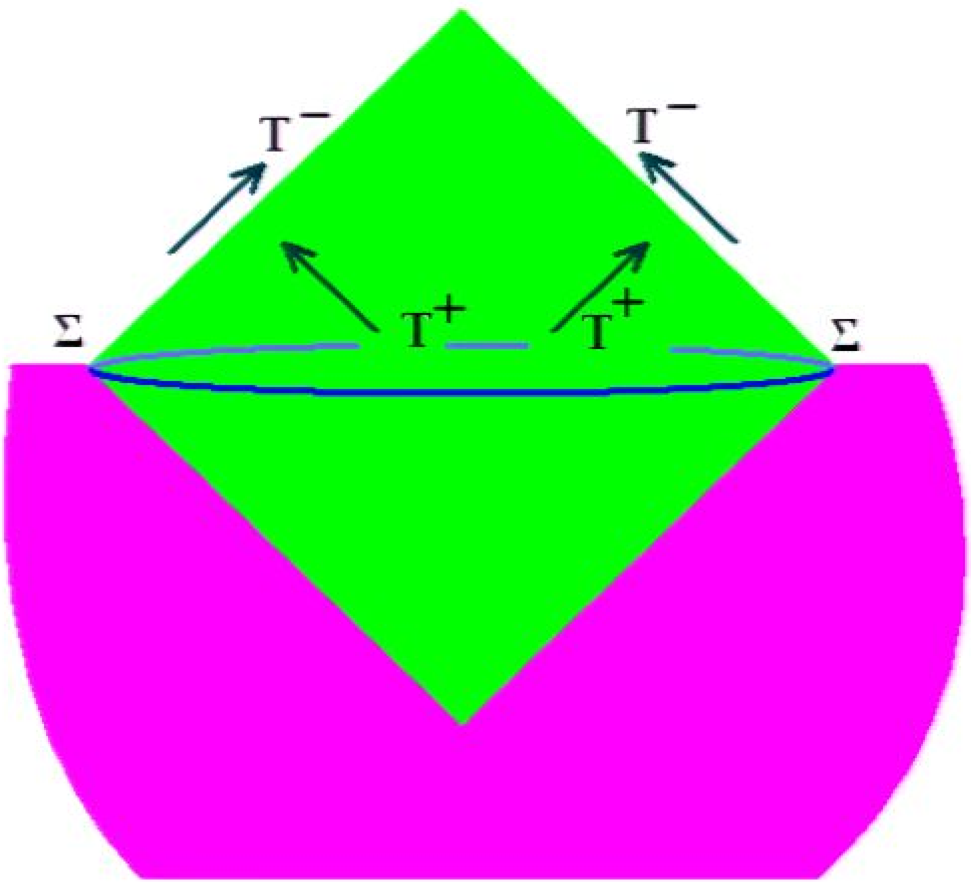
$$a(T) \sim \exp(T)$$

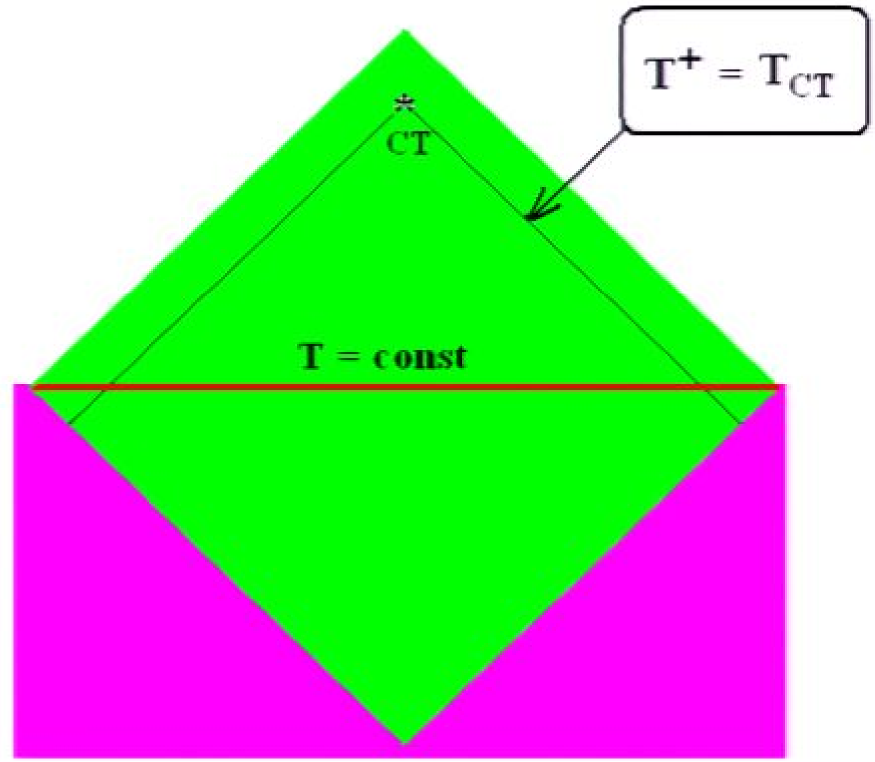
$$ds^2 \rightarrow -e^{2T}\, dT^+\, dT^- + e^{2T^+} d\Omega_2^2$$

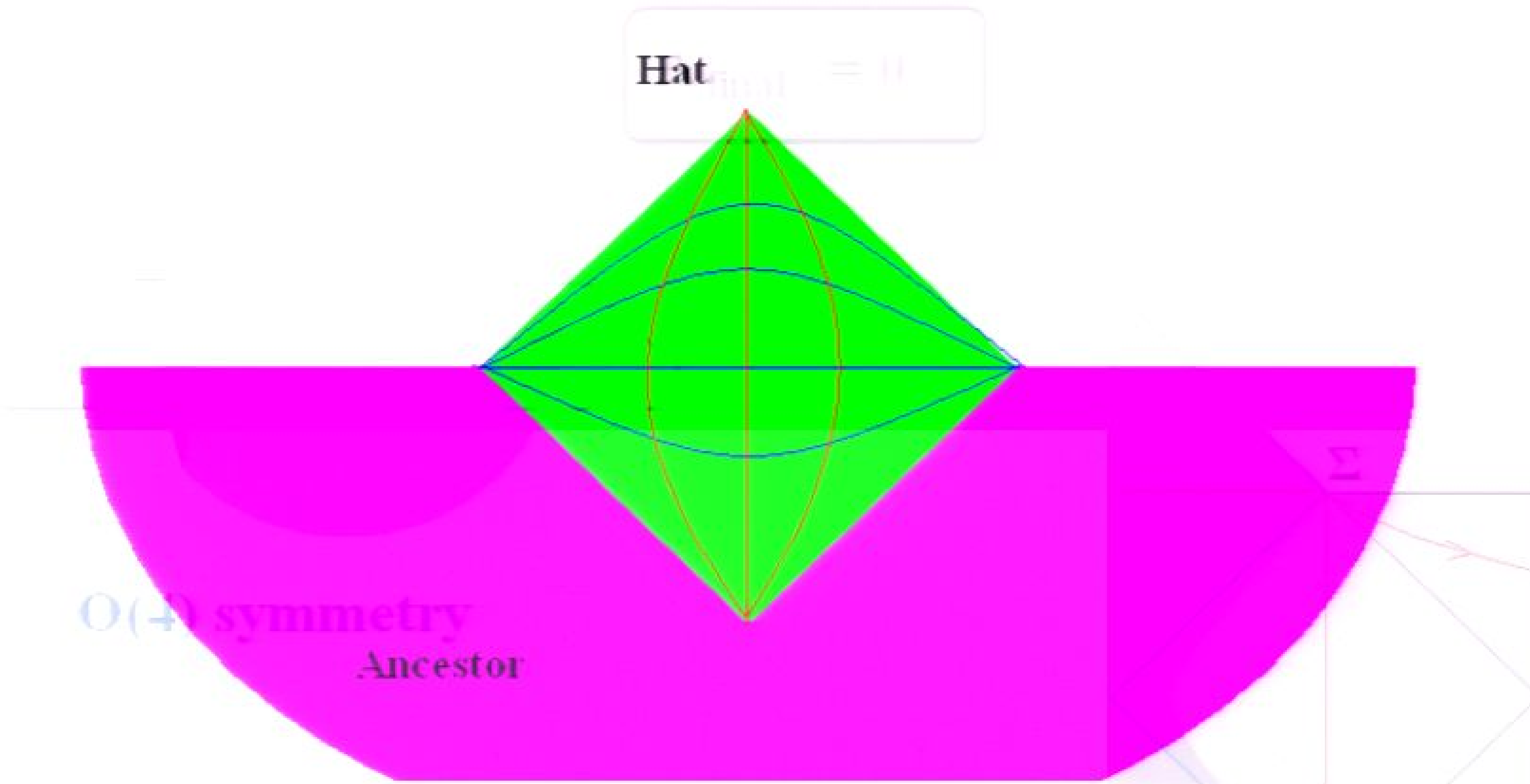
The Census Taker

A. Maloney
S. Shenker
L.S.




T⁻
T⁻
T⁺
T⁺
Σ
Σ


T⁺ = T_CT
CT
T = const



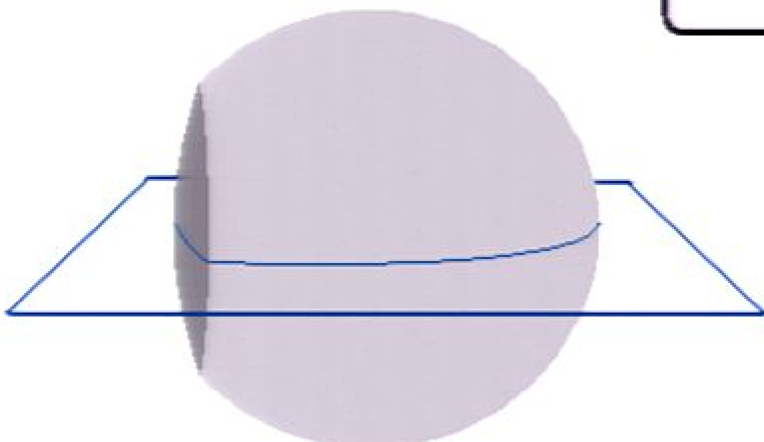
$$ds^2 = -dt^2 + a(t)^2\ \{dR^2 + \sinh^2 R\ \ d\Omega_2^2\}$$

$$= a(T)^2\ \{-dT^2 + dR^2 + \sinh^2 R\ \ d\Omega_2^2\}$$

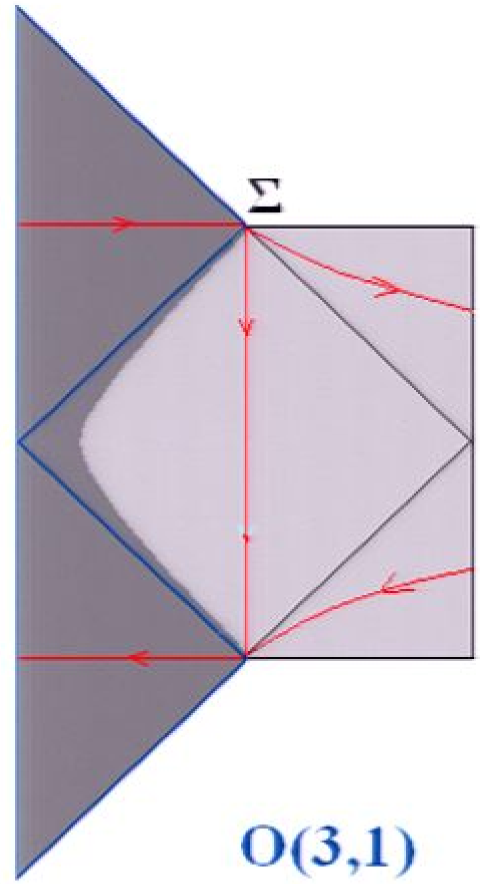
$$= a(T)^2\ \{-dT^+\, dT^- + \sinh^2 R\ \ d\Omega_2^2\}$$

O(3,1)

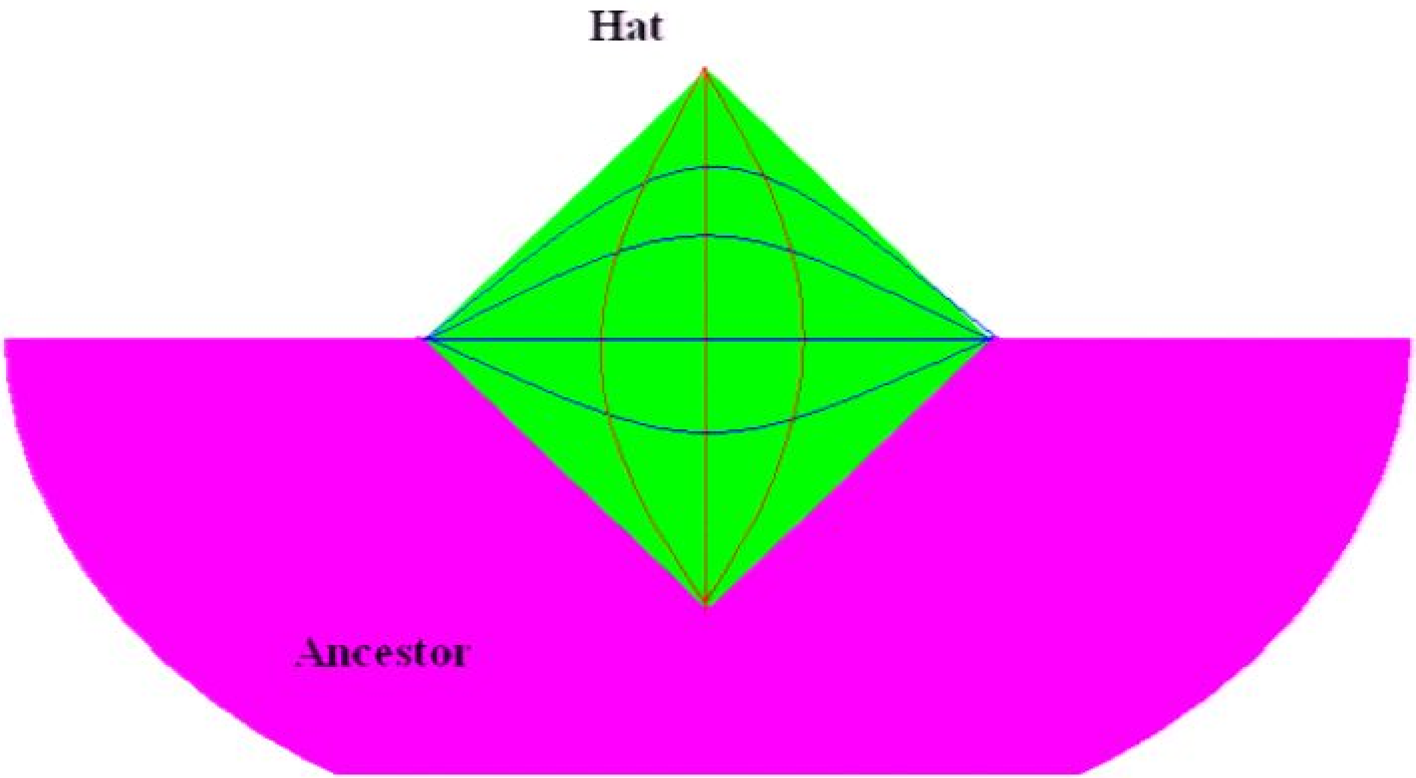
$$\Lambda_{\text{final}} = 0$$



O(4) symmetry



O(3,1)



$$ds^2 = -dt^2 + a(t)^2 \{dR^2 + \sinh^2 R \; d\Omega_2^2\}$$

$$= a(T)^2 \{-dT^2 + dR^2 + \sinh^2 R \; d\Omega_2^2\}$$

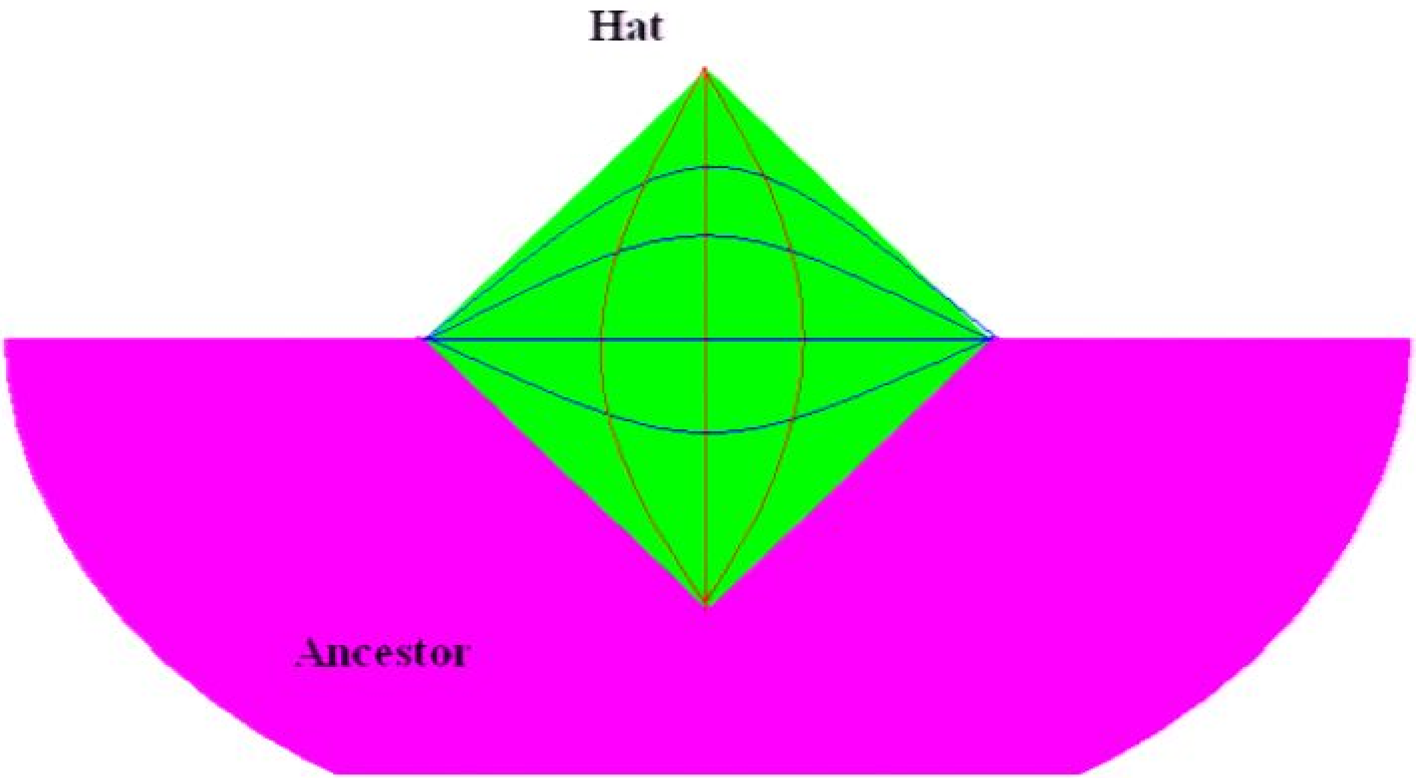
$$= a(T)^2 \{-dT^+ \, dT^- + \sinh^2 R \; d\Omega_2^2\}$$

At early and late times the universe is curvature dominated.

$$a(t) \sim t$$

$$a(T) \sim \exp(T)$$

$$ds^2 \to -e^{2T}\, dT^+\, dT^- + e^{2T^+} d\Omega_2^2$$



$$ds^2 = -dt^2 + a(t)^2 \{dR^2 + \sinh^2 R \; d\Omega_2^2\}$$

$$= a(T)^2 \{-dT^2 + dR^2 + \sinh^2 R \; d\Omega_2^2\}$$

$$= a(T)^2 \{-dT^+ \, dT^- + \sinh^2 R \; d\Omega_2^2\}$$

At early and late times the universe is curvature dominated.

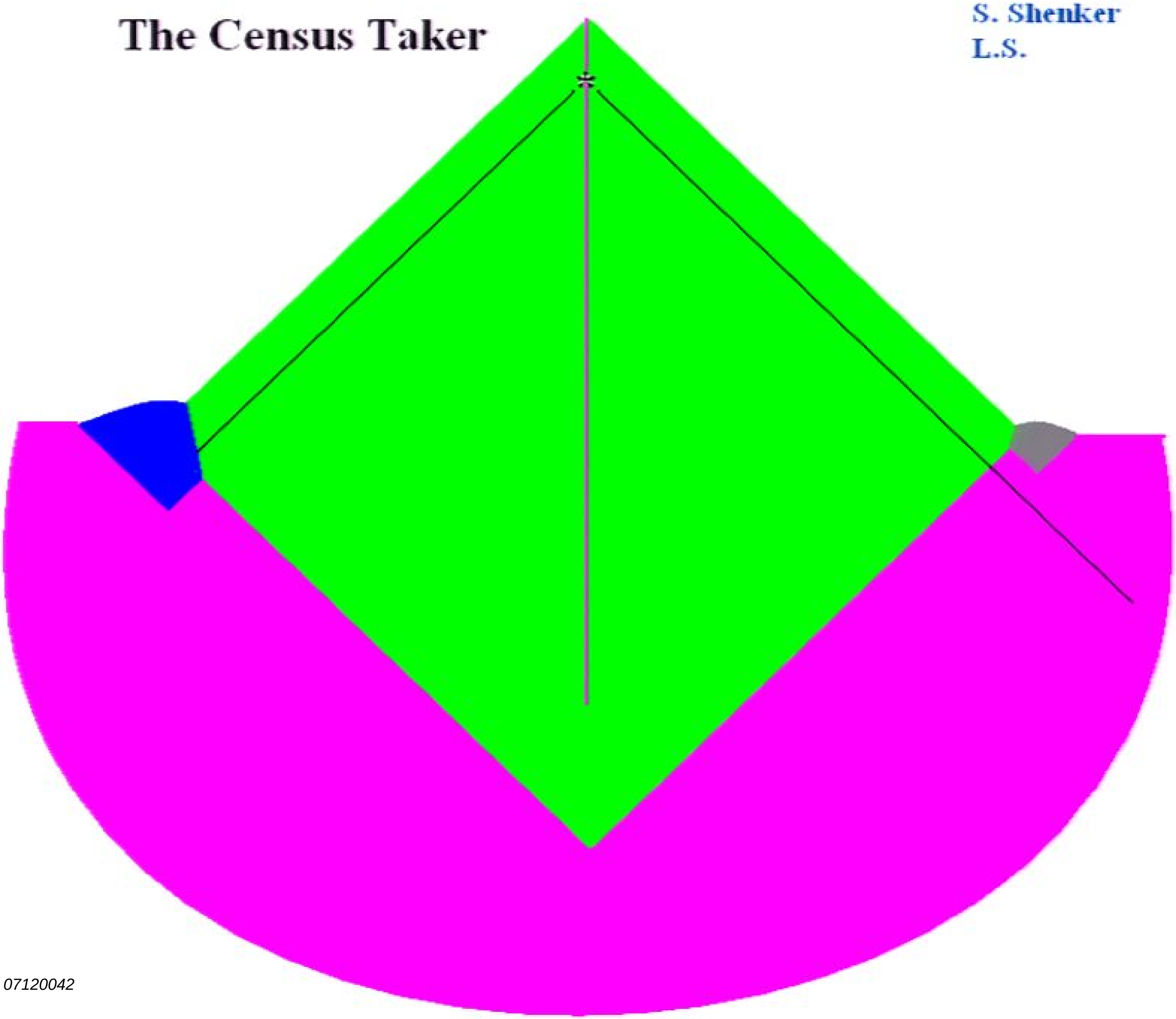
$$a(t) \sim t$$

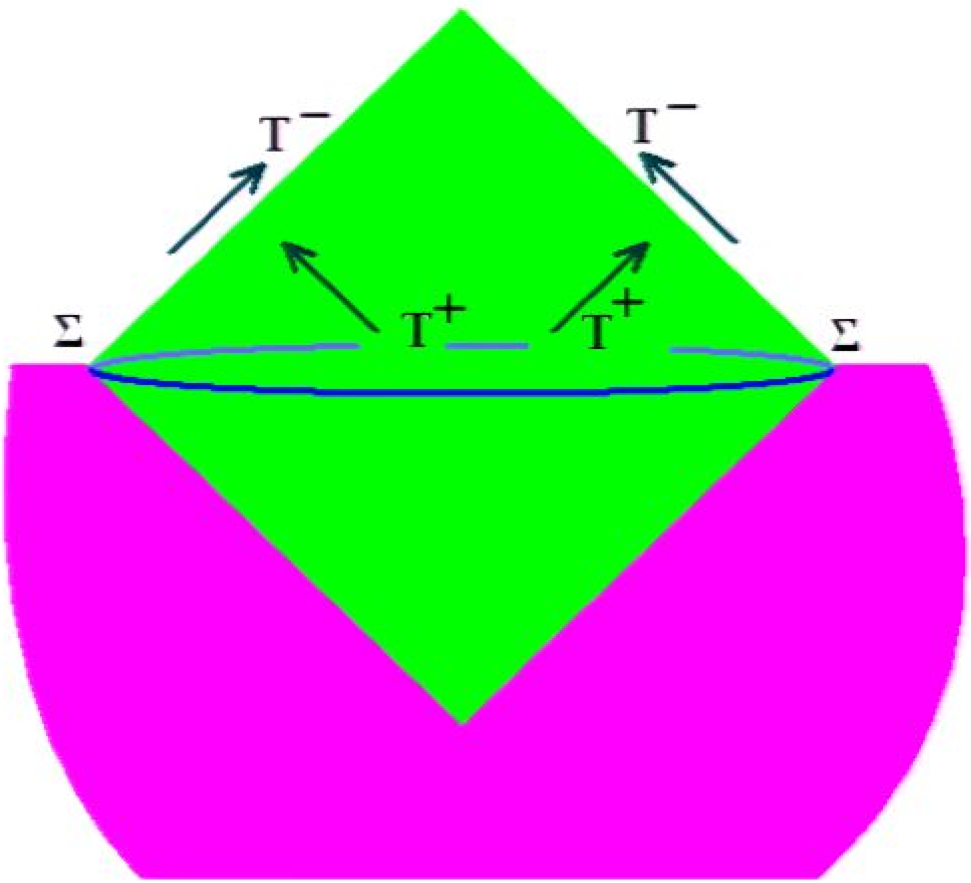
$$a(T) \sim \exp(T)$$

$$ds^2 \rightarrow -e^{2T}\, dT^+\, dT^- + e^{2T^+} d\Omega_2^2$$

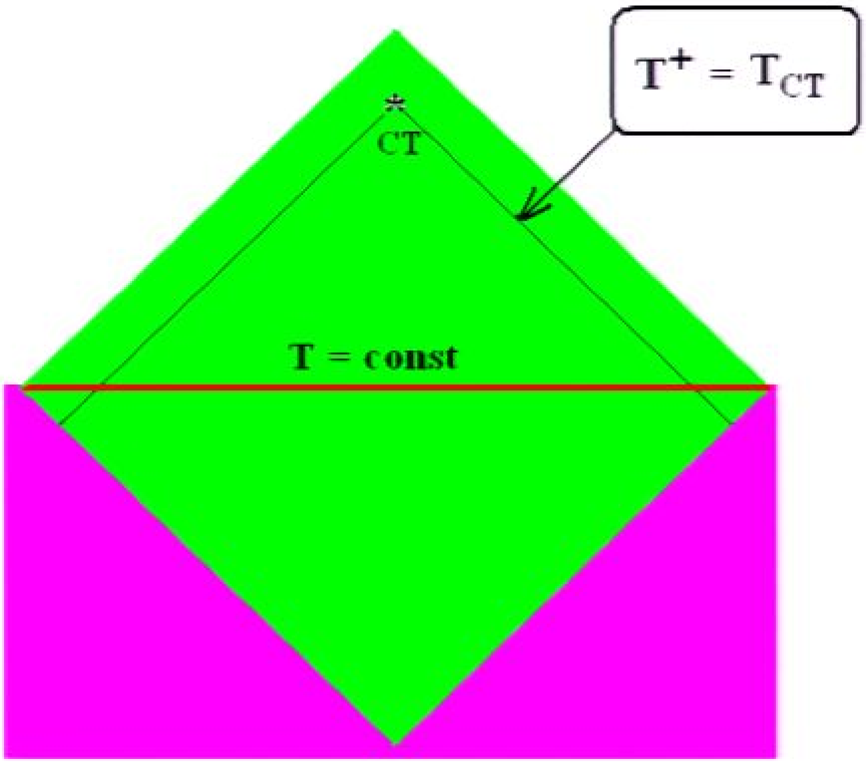
The Census Taker

A. Maloney
S. Shenker
L.S.



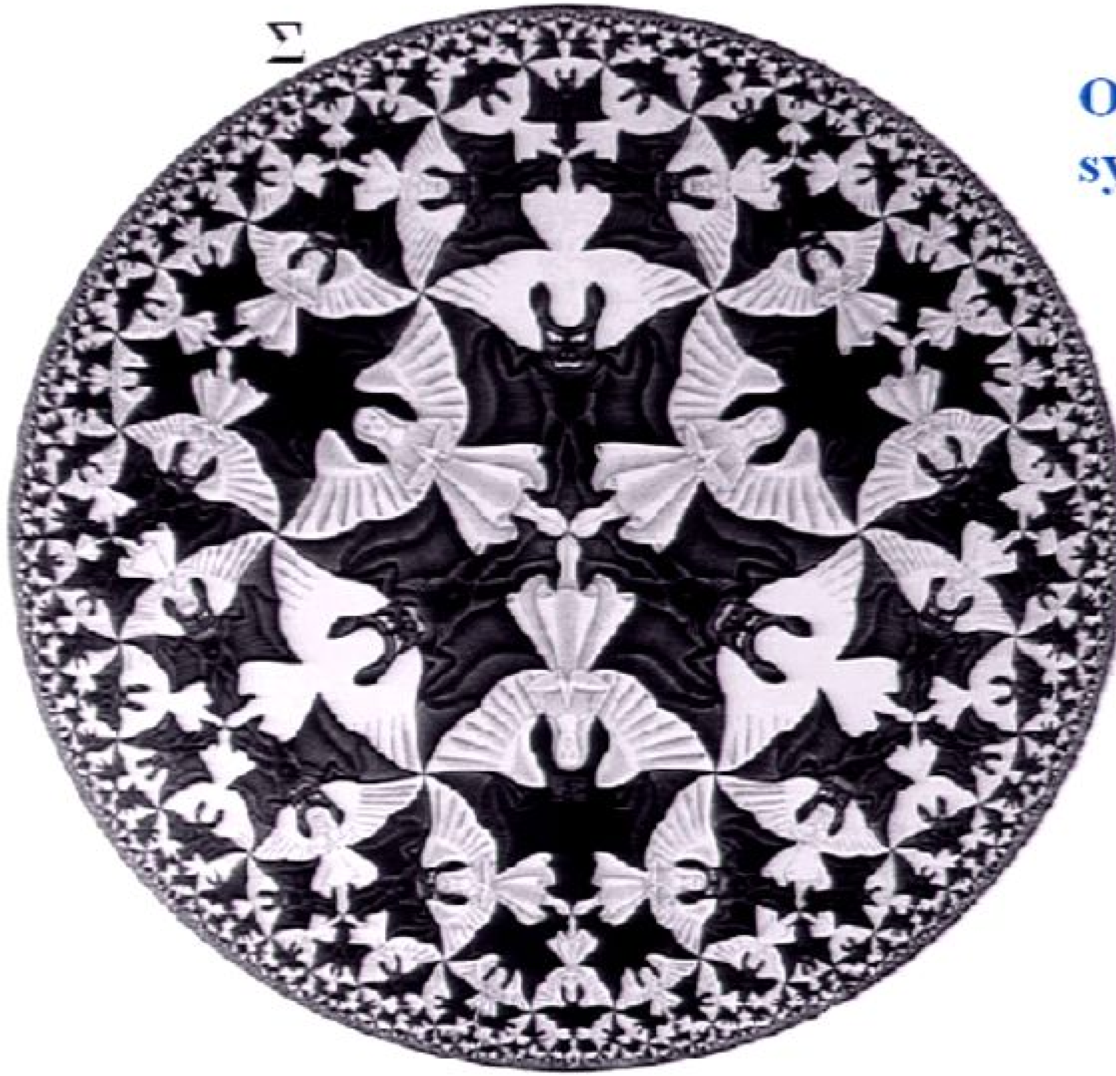


T⁻
T⁻
Σ
T⁺
T⁺
Σ



T⁺ = T_CT
*
CT
T = const

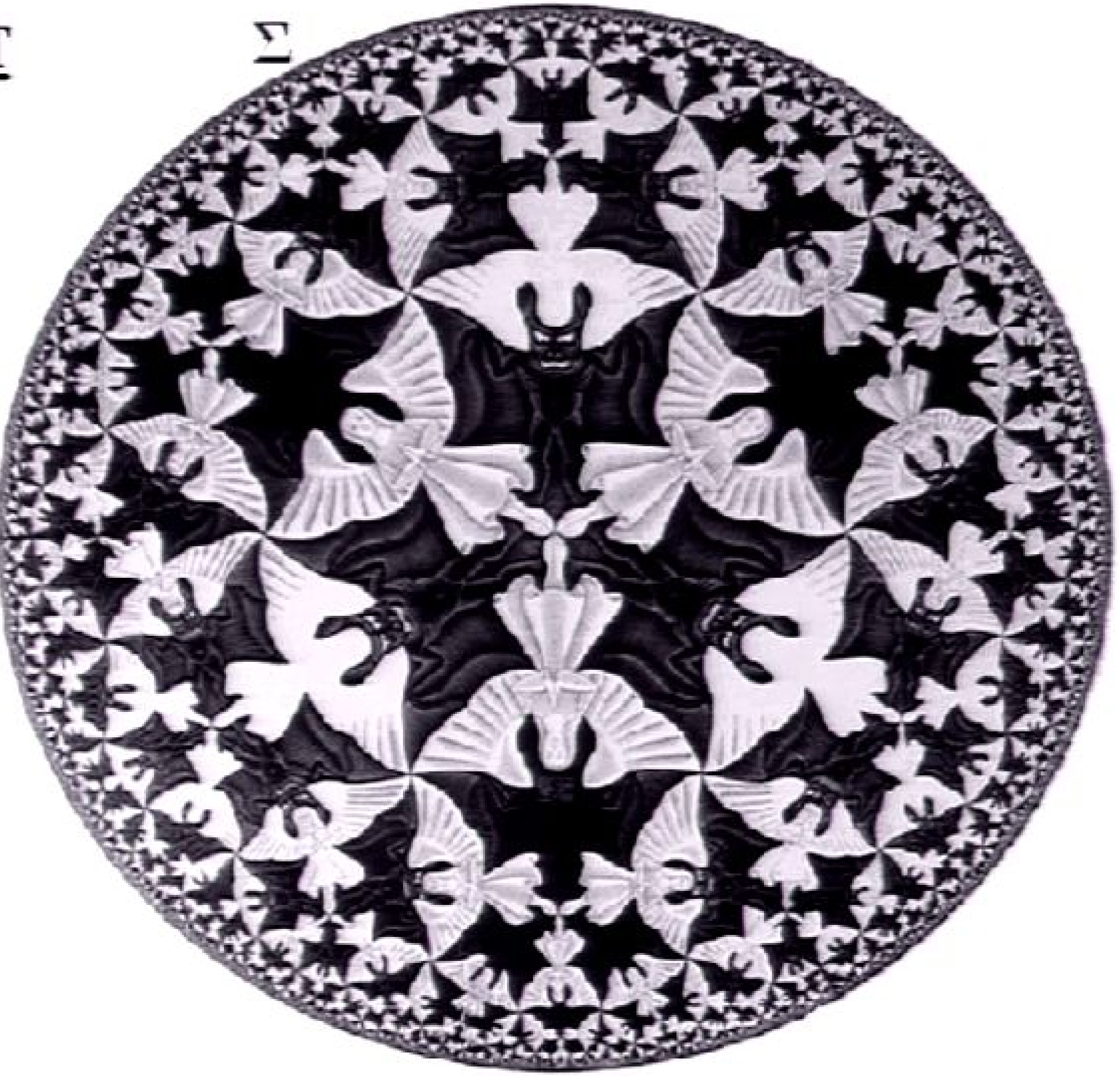
Σ



O(3,1)
symmetry

ADS/CFT

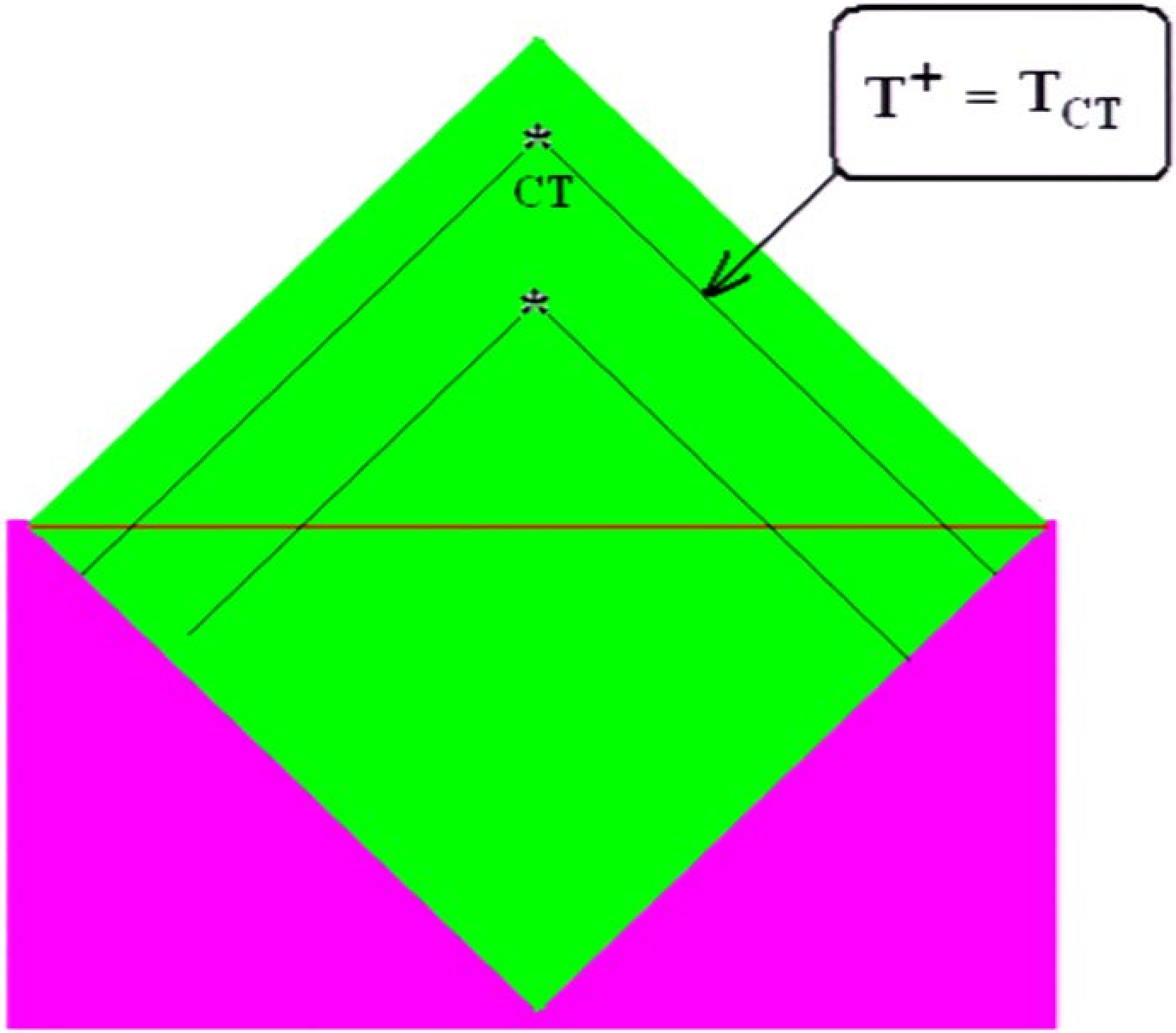
Σ

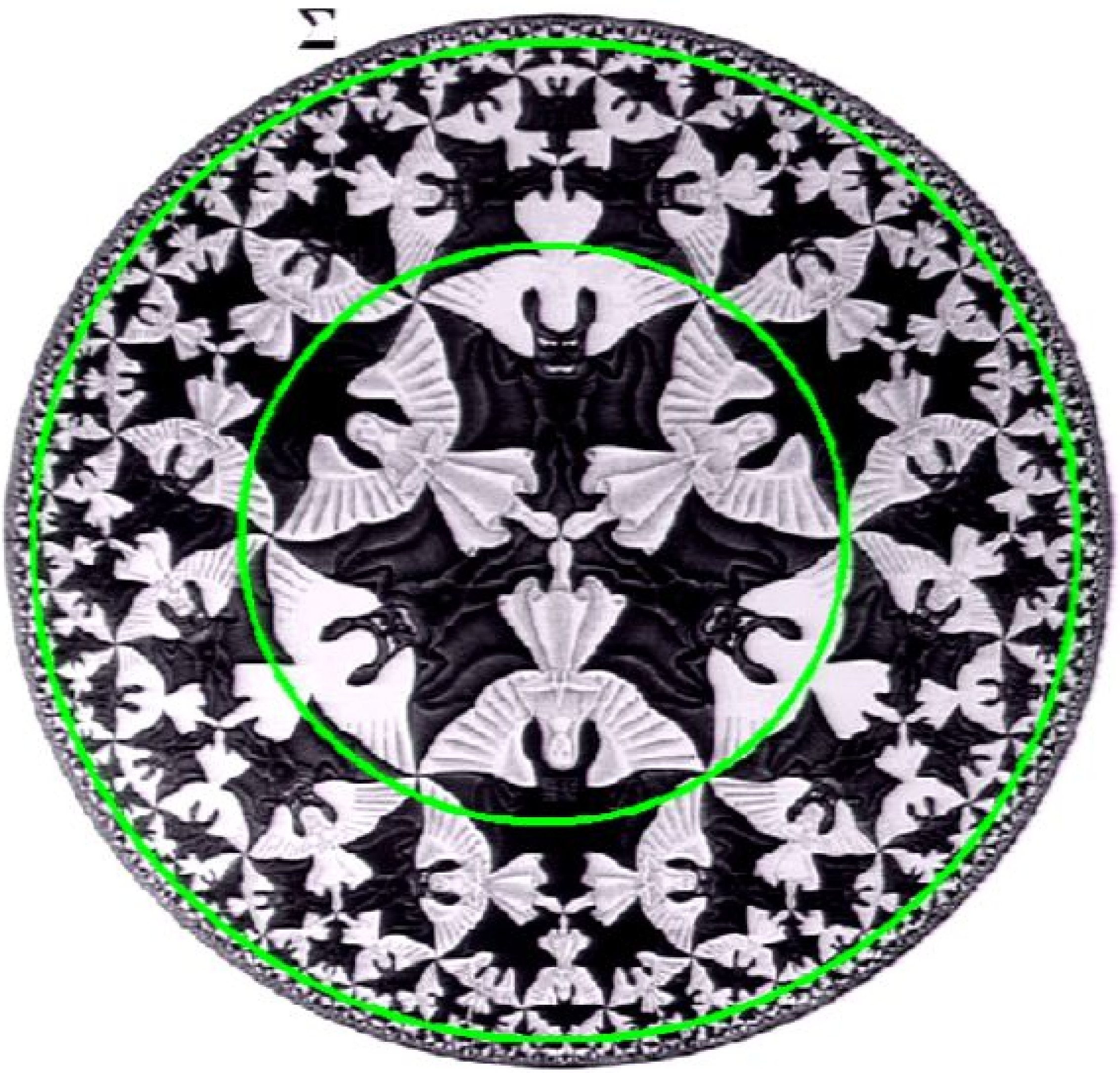


The radial direction = RG flow.

R = log κ

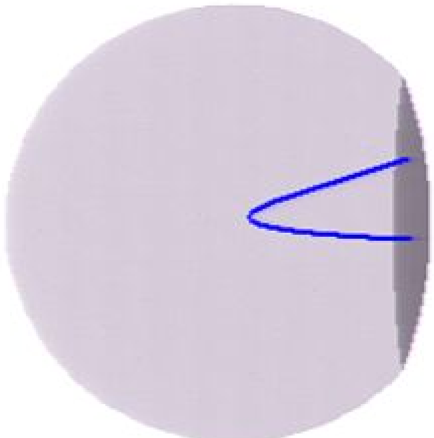
$$\langle \Phi_\Delta \, \Phi_\Delta \rangle = \kappa^{-\Delta} \, \kappa^{-\Delta} \quad (1\text{-}\cos\alpha)^{-\Delta}$$

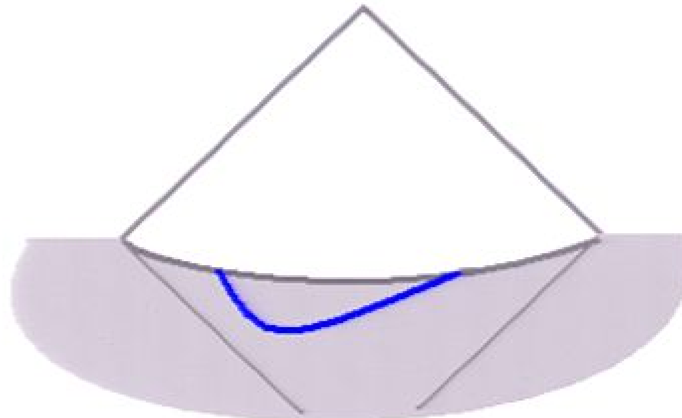

$T^+ = T_{CT}$
CT



Open FRW

Census taker time defines an RG flow.





Correlations on Σ are covariant under O(3,1).
This means CONFORMAL symmetry.

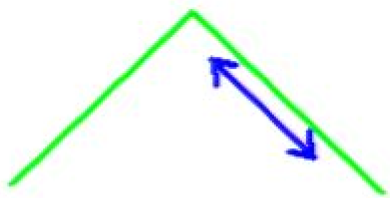
Is there a dual Euclidean 2D CFT on Σ?

Ben Freivogel
Yasuhiro Sekino
L.S
Chen Pin Yeh

FSSY : Tensor and scalar

RG covariant Proactive

$$G_1 = e^{-(T_1^+ + T_2^+)} \sum_{\Delta=2} G_\Delta \, e^{(\Delta-1)(T_1^- + T_2^-)} \, (1-\cos\alpha)^{-\Delta}$$



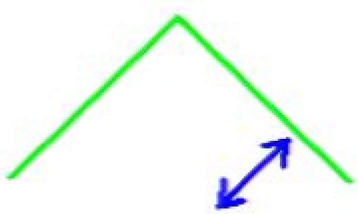
$\Delta = 2$ term is exactly T_{ij}

RG invariant Reactive

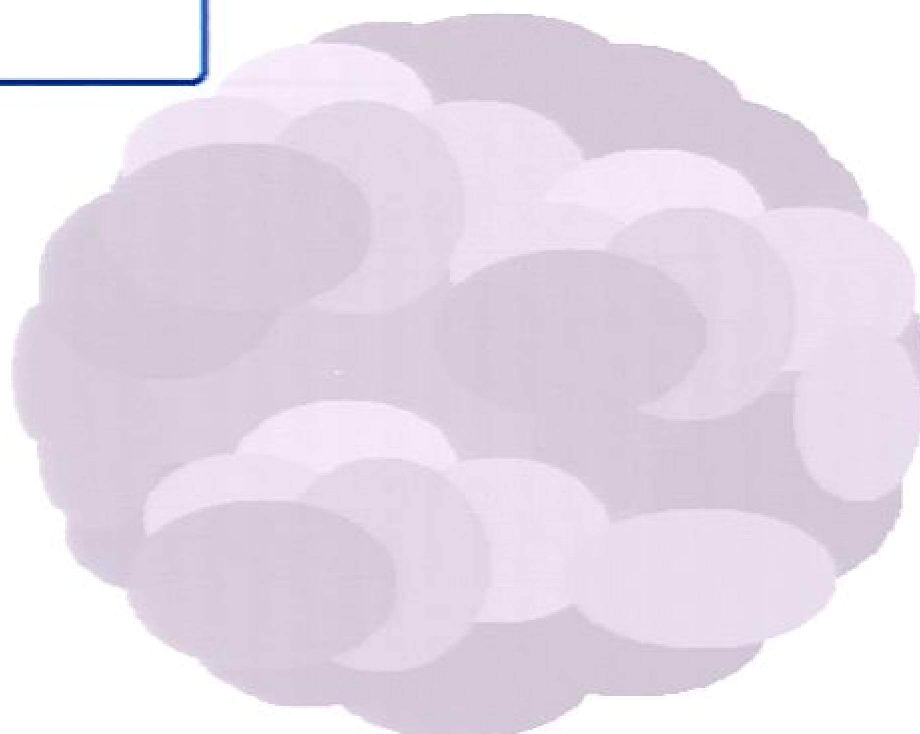
$$G_2 = T_1^+ + T_2^+ + \log(1-\cos\alpha)$$

Liouville

$$+ \sum_{\Delta} G_\Delta \, e^{-\Delta(T_1^+ + T_2^+)} \, (1-\cos\alpha)^{-\Delta}$$



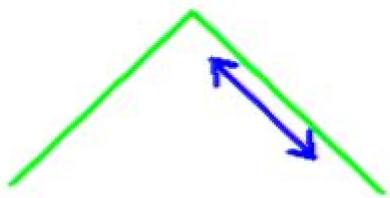
Gravitational fluctuations do not go to zero at space-like infinity.



FSSY : Tensor and scalar

RG covariant Proactive

$$G_1 = e^{-(T_1^+ + T_2^+)} \sum_{\Delta=2} G_\Delta \, e^{(\Delta - 1)(T_1^- + T_2^-)} \, (1-\cos\alpha)^{-\Delta}$$

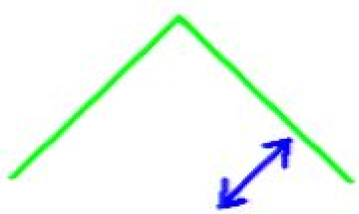


$\Delta = 2$ term is exactly T_{ij}

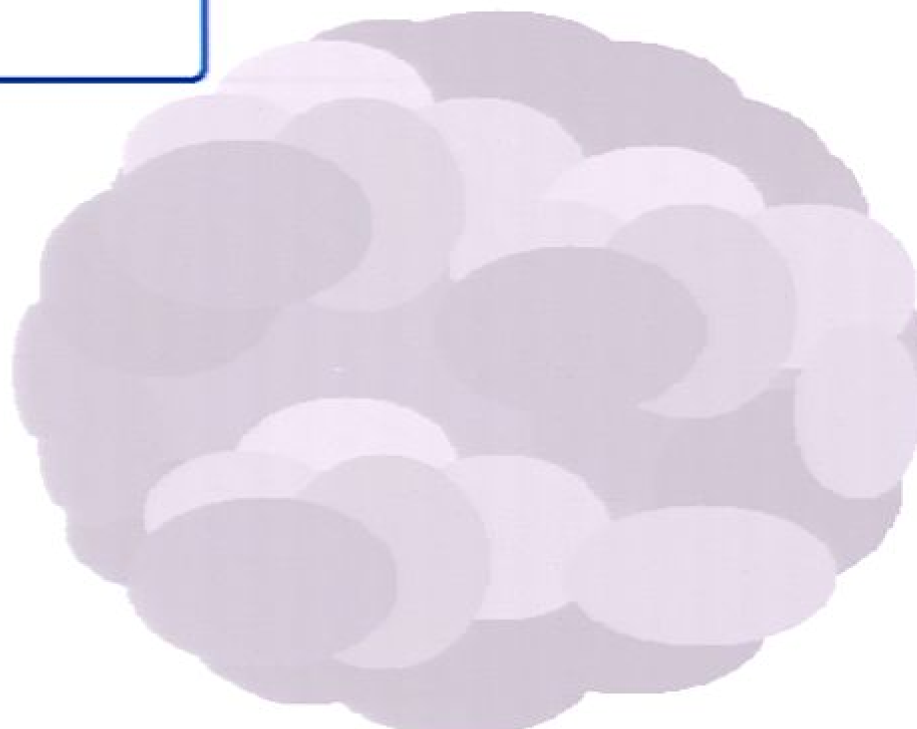
RG invariant Reactive

$$G_2 = T_1^+ + T_2^+ + \log(1-\cos\alpha)$$ **Liouville**

$$+ \sum_{\Delta} G_\Delta \, e^{-\Delta (T_1^+ + T_2^+)} \, (1-\cos\alpha)^{-\Delta}$$



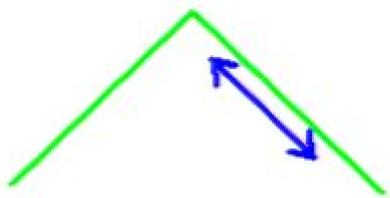
Gravitational fluctuations do not go to zero at space-like infinity.



FSSY : Tensor and scalar

RG covariant Proactive

$$G_1 = e^{-(T_1^+ + T_2^+)} \sum_{\Delta=2} G_\Delta \, e^{(\Delta - 1)(T_1^- + T_2^-)} \, (1-\cos\alpha)^{-\Delta}$$

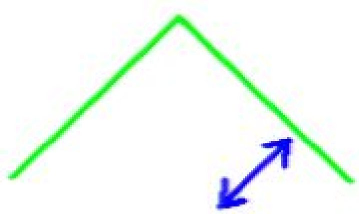


$\Delta = 2$ term is exactly T_{ij}

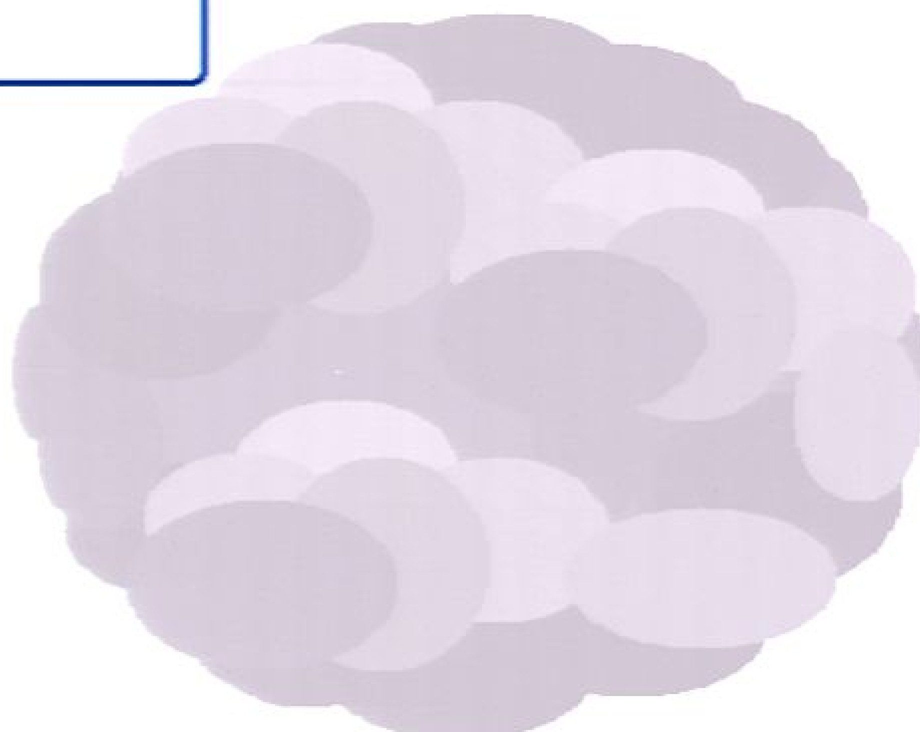
RG invariant Reactive

$$G_2 = T_1^+ + T_2^+ + \log(1-\cos\alpha)$$ Liouville

$$+ \sum_{\Delta} G_\Delta \, e^{-\Delta(T_1^+ + T_2^+)} \, (1-\cos\alpha)^{-\Delta}$$



Gravitational fluctuations do not go to zero at space-like infinity.



$$ds^2 = a(T)^2 \sinh^2 R \; d\Omega_2^2$$

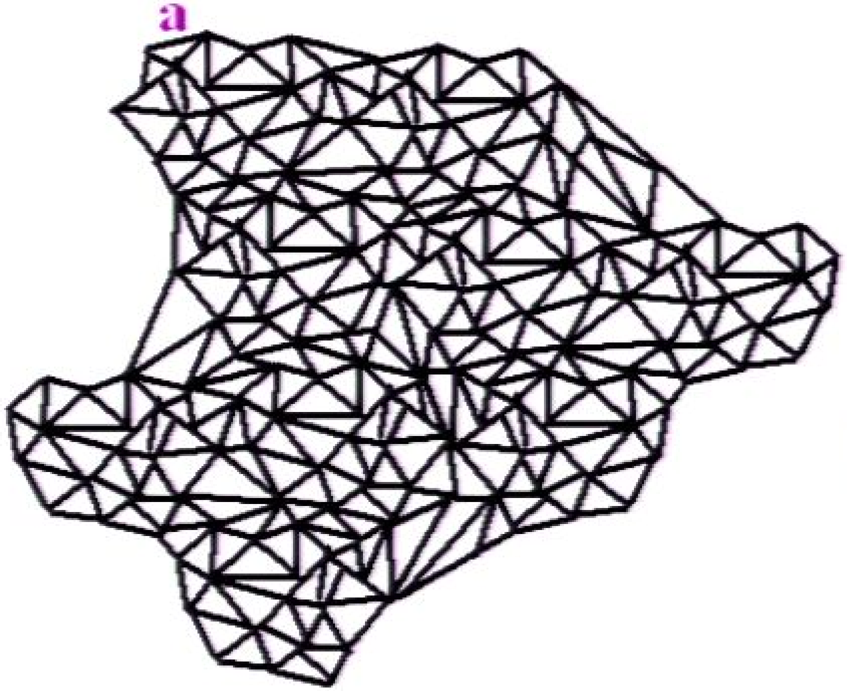
$$\approx \quad a(T)^2 \; \{e^{2R} d\Omega_2^2\} \longleftarrow \text{reference metric}$$

$$T \longrightarrow T + f(\Omega_2)$$

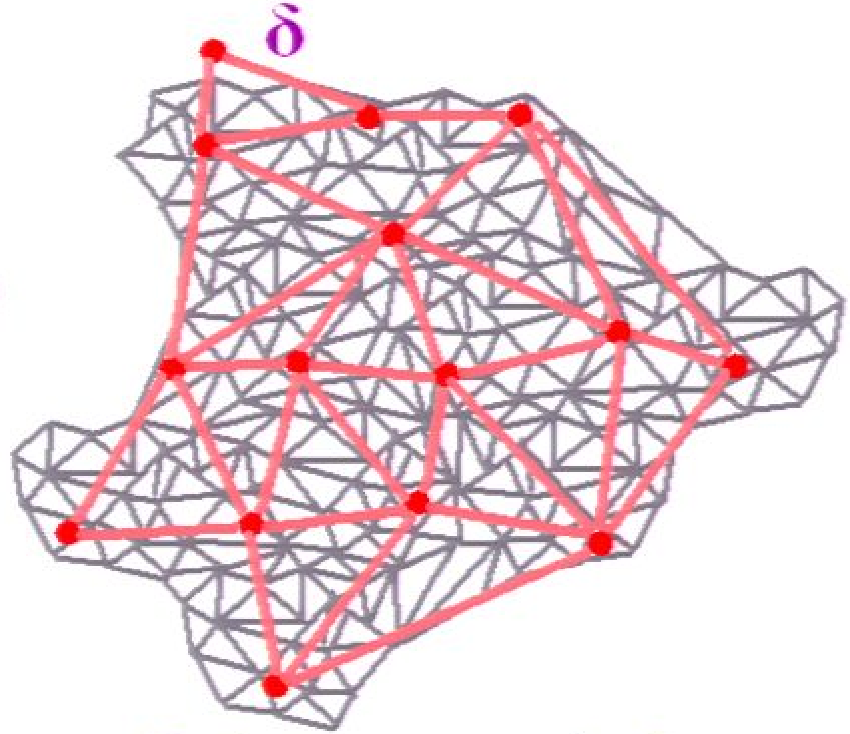
$$ds = e^{U(\Omega_2)} \; ds_R$$

U is a (time-like) Liouville field.

$$C_L = -C_M$$



True metric ds



Reference metric ds_R

$$ds = e^U ds_R$$

$$ds^2 = a(T)^2 \sinh^2 R \; d\Omega_2^2$$

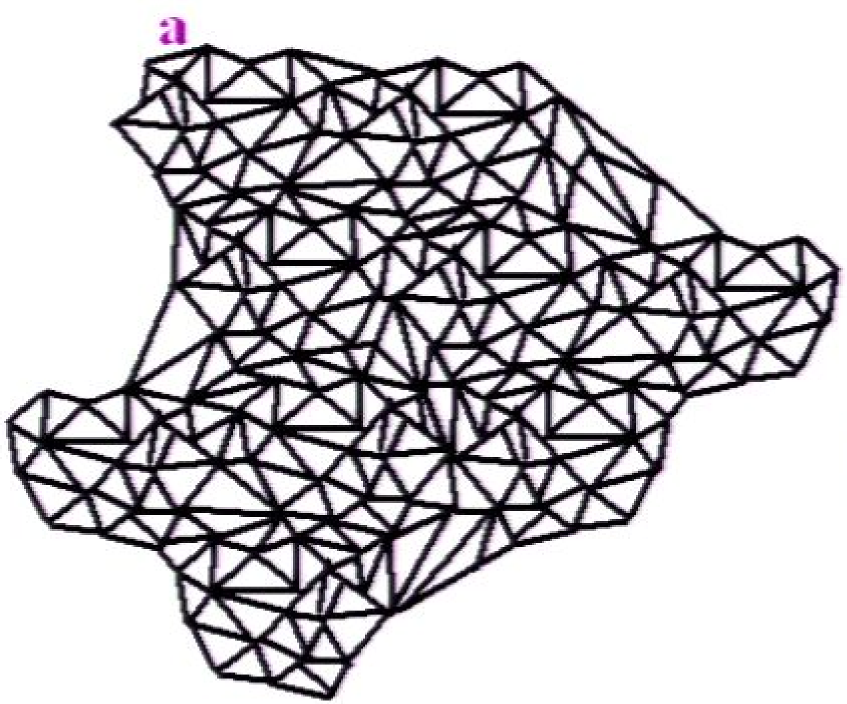
$$\approx \quad a(T)^2 \; \{e^{2R} d\Omega_2^2\} \longleftarrow \text{reference metric}$$

$$T \longrightarrow T + f(\Omega_2)$$

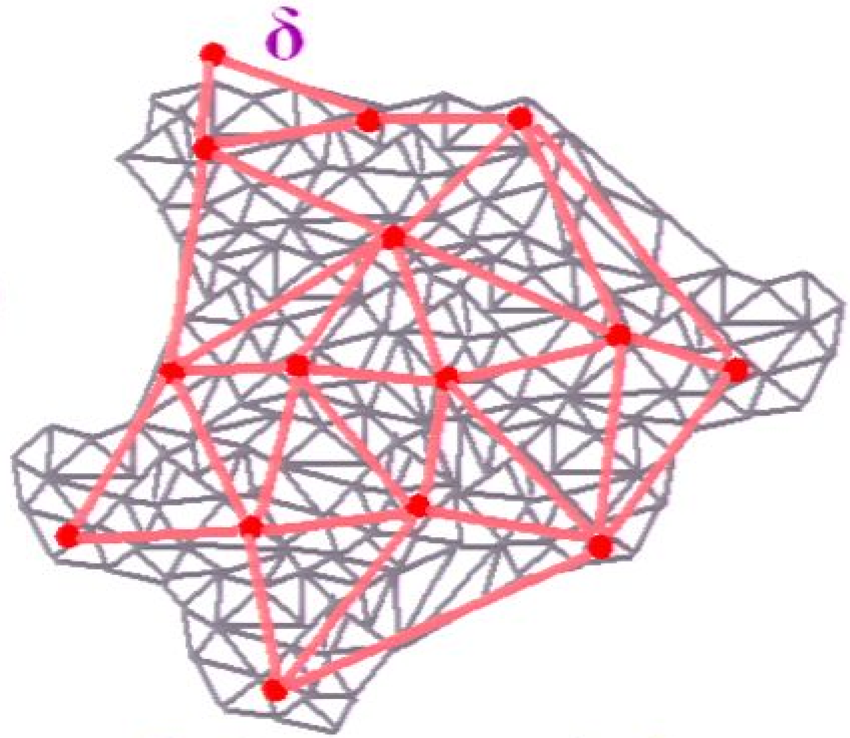
$$\boxed{ds = e^{U(\Omega_2)} \; ds_R}$$

U is a (time-like) Liouville field.

$$c_L = -c_M$$



True metric ds



Reference metric ds_R

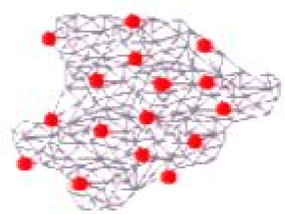
$$ds = e^{U} ds_R$$

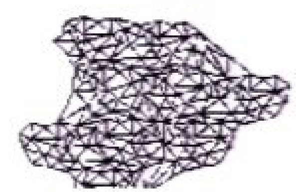
IR — R = | log δ | — integrate out → ∞

Wilson Line

L(R) = effective action

IR — R = | log δ | — T = log δ /a — fishnet scale





L(R, T) = effective action

Flow to a fixed pt as T → ∞

RG Flow:
RG covariant and RG invariant Quantities

covariant: effective action, energy momentum tensor

$$L = \sum_{\Delta} g_{\Delta} O_{\Delta}$$

$$\hat{g}_{\Delta} = g_{\Delta} \, \delta^{(2-\Delta)}$$

$$\frac{d\hat{g}_{\Delta}}{\log\delta} = \beta(\hat{g}) = 0 \qquad (\text{fixed pt})$$

$$g_{\Delta}(\delta) = g_{\Delta}(a) \left\{ \frac{\delta}{a} \right\}^{(\Delta-2)}$$

$$L(\delta) = \sum_{\Delta} O_{\Delta} \left\{ \frac{\delta}{a} \right\}^{(\Delta-2)}$$