

# URF-LOVE-COHERENCE- COSMOGENESIS-01

From Collapse to Cosmos:  
Love–Coherence Coupling as a Reaction–Diffusion Model for  
Negative-Pressure Fields

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October 19, 2025

## Abstract

We introduce a coupled reaction–diffusion system describing the interplay between local coherence density,  $\rho_{\text{coh}}$ , and restorative field intensity,  $\rho_{\text{love}}$ . This framework models coherence loss and recovery in complex lattices and predicts a self-sustaining negative-pressure term analogous to dark-energy behavior in cosmology. The resulting equations unify microscopic healing dynamics and macroscopic cosmological expansion within a single order-parameter formalism.

## 1 Introduction

Order parameters that couple dissipative loss to restorative drive produce emergent negative-pressure effects. We interpret  $\rho_{\text{coh}}$  as a measure of local alignment and  $\rho_{\text{love}}$  as a restorative potential sustaining that alignment. Their interaction yields threshold phenomena and traveling healing fronts similar to reaction–diffusion waves in excitable media.

## 2 Mathematical Formulation

### 2.1 Dimensional System

$$\frac{\partial \rho_{\text{coh}}}{\partial t} = D_c \nabla^2 \rho_{\text{coh}} - \Gamma \rho_{\text{coh}} + \alpha \rho_{\text{love}} \left( 1 - \frac{\rho_{\text{coh}}}{\rho^*} \right), \quad (1)$$

$$\frac{\partial \rho_{\text{love}}}{\partial t} = D_l \nabla^2 \rho_{\text{love}} - \mu \rho_{\text{love}} + S(x, t) + \beta H(\rho_{\text{coh}} - \theta). \quad (2)$$

## 2.2 Dimensionless Reduction

Using characteristic scales  $\tau_c = 1/\Gamma$  and  $L_c = \sqrt{D_c/\Gamma}$ , and defining  $c = \rho_{\text{coh}}/\rho^*$ ,  $l = \rho_{\text{love}}/(\Gamma/\alpha)$ , the system becomes

$$\dot{c} = \nabla^2 c - c + l(1 - c), \quad (3)$$

$$\dot{l} = \delta \nabla^2 l - \kappa l + \sigma + \epsilon H(c - \theta), \quad (4)$$

with control parameters  $\delta = D_l/D_c$ ,  $\kappa = \mu/\Gamma$ ,  $\sigma = S/(\Gamma\rho_{\text{love}}^0)$ , and  $\epsilon = \beta/(\Gamma\rho_{\text{love}}^0)$ .

## 3 Analysis and Results

### 3.1 Steady States

Mean-field equilibria satisfy  $c = l/(1 + l)$  and  $l = (\sigma + \epsilon H(c - \theta))/\kappa$ . Critical transition occurs at  $l_{\text{crit}} = \theta/(1 - \theta)$ , giving  $\sigma_{\text{crit}} = \kappa \theta/(1 - \theta) - \epsilon$ .

### 3.2 Linear Stability

[Placeholder for Jacobian analysis, eigenvalue spectrum, and oscillatory regime conditions.]

### 3.3 Reaction–Diffusion Fronts

Propagation speed of the coherence-recovery front:

$$v_{\text{heal}} \approx 2\sqrt{D_c \alpha \rho_{\text{love,front}}}.$$

### 3.4 Effective Negative Pressure

Define an effective potential  $U(c, l) = \frac{1}{2}c^2 - \ln(1 + l)$ , yielding pressure term  $p_{\text{eff}} = -\partial U/\partial V \propto -l(1 - c)$ , interpreted as a dark-energy-like restorative pressure.

## 4 Discussion

The model reproduces threshold-driven expansion in coherence volume. When mapped onto cosmological scales, the mean  $\langle l(1 - c) \rangle$  term behaves as a slowly varying cosmological constant. Interpretation of  $l$  as a restorative field provides a field-theoretic analogue of vacuum energy with built-in self-regulation.

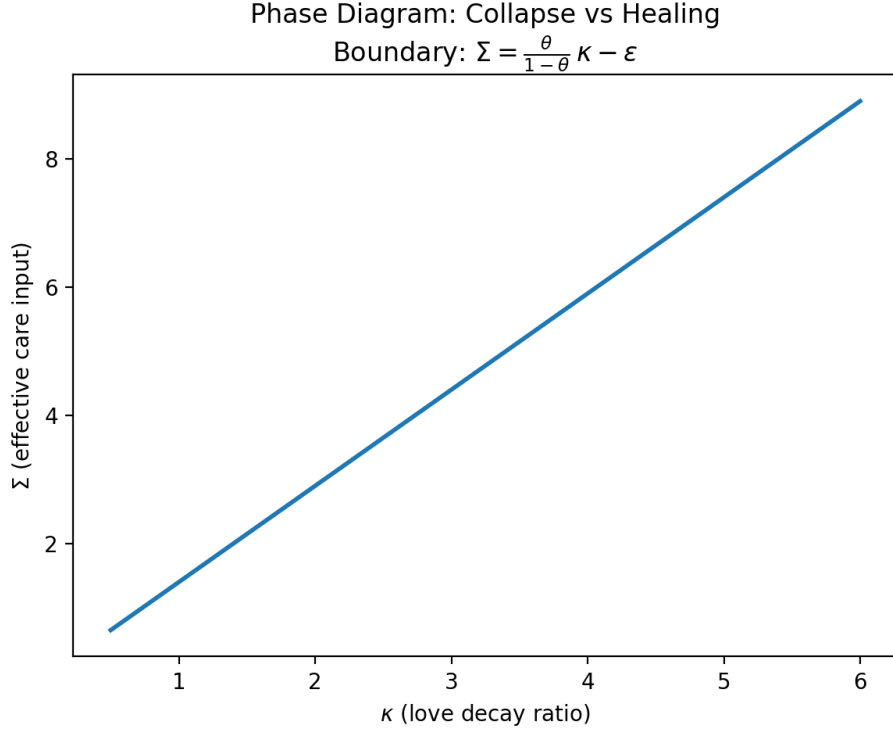


Figure 1: Phase diagram for the dimensionless system. The boundary  $\Sigma = \frac{\theta}{1-\theta} \kappa - \epsilon$  separates collapse (below) from healing (above). The shaded region above the line corresponds to sustained coherence recovery.

## 5 Conclusion

Coupled order-parameter dynamics of  $\rho_{\text{coh}}$  and  $\rho_{\text{love}}$  produce self-healing fronts and an emergent negative pressure. This mechanism offers a unifying mathematical description of local restoration and global expansion, laying groundwork for the cosmogenic interpretation developed in URF-COSMOGENESIS-REIGNITION-01.

## References

- [1] Fisher, R. A. (1937). *The Wave of Advance of Advantageous Genes*. *Annals of Eugenics*, 7, 355–369.
- [2] Murray, J. D. (2003). *Mathematical Biology II: Spatial Models and Biomedical Applications*. Springer, Berlin.
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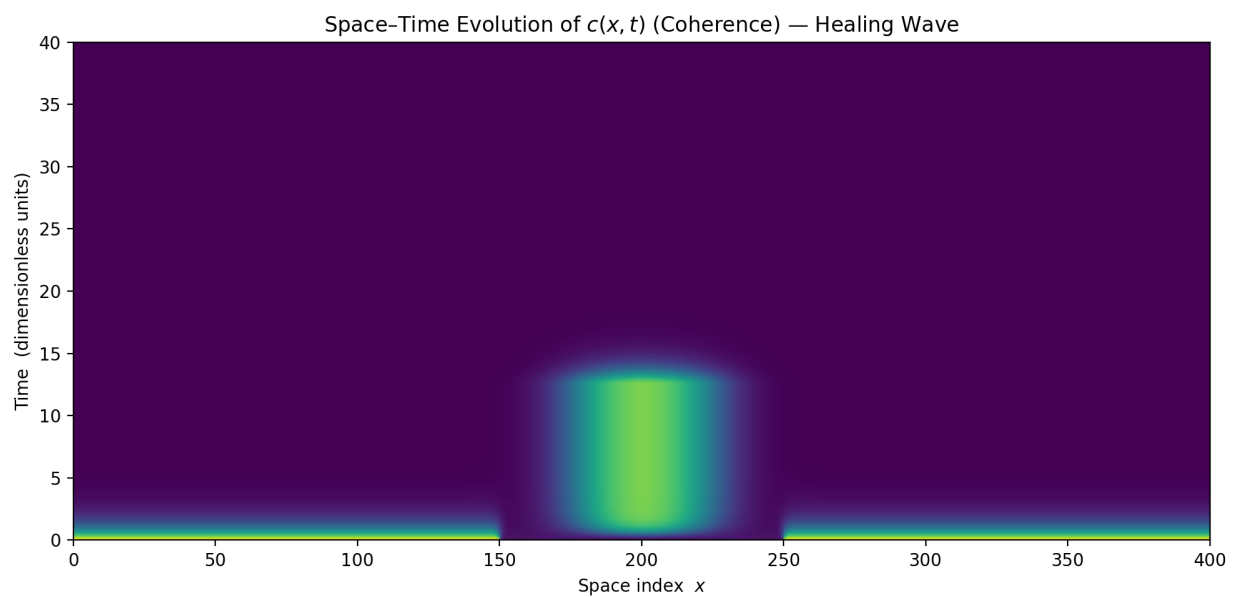


Figure 2: Space-time map of coherence  $c(x, t)$  for a localized restorative pulse. The bright region corresponds to recovered coherence spreading outward as a traveling front.