

# Constitutive Exclusion and the Conicus3D Forward Operator in RM

From zero-mode closure to the cosmological projection problem

RM – Conicus3D Technical Note – Version 6

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**Abstract.** Conicus3D separates a learned three-dimensional matter prior from a differentiable weak-lensing forward model. Earlier RM notes used that separation as an external consistency test and exposed a missing homogeneous cosmological closure. Version 5 then closed the reduced homogeneous bulk through the surviving scalar constraints GHC–1 and GEC–1 and their preservation law HBR–1, while explicitly leaving boundary production and the observational cosmological lift open. Version 6 does not alter that frozen Version-5 theorem. It asks the next narrower question: *given the present RM bulk closure, which pieces of the Conicus3D forward chain are already compatible with RM, which require an RM replacement, and which remain underived?*

The answer is a layered one. The local weak-lensing response and the angular shear operator remain compatibility sectors on the selected scalar optical branch. The reduced homogeneous interior rate is now supplied internally by HBR–1 rather than imported from a Friedmann equation. However, the complete manifested-volume rate still contains the independent boundary term  $g\partial$ ; the distance–redshift map, cosmological perturbation equations, growth operator and an RM-specific simulation prior are therefore not yet derived. The active stellar interpretation is also updated: thermal-radiative loading is primary, while redshift remains a propagation observable and only a possible secondary energetic contribution. The historical  $P_z/W_z$  ledger is not used as the active stellar source law.

Version 6 therefore advances the Conicus3D programme from “derive the missing homogeneous bulk law” to a precise forward-operator replacement map. Conicus3D remains an external benchmark and future discriminator; no observational validation of RM is claimed.

**Version-6 claim.** The Version-5 zero-mode theorem survives unchanged in its declared reduced domain. The new result is a *concordance map*: local optics and the angular operator can remain as compatibility layers, the reduced homogeneous rate is internally supplied, while boundary production, distance–redshift propagation, perturbative growth and the simulation prior remain separate derivation or reconstruction problems.

**Frozen-target rule.** Version 6 does not retroactively modify the Version-5 PDF frozen by the public falsification protocol. Any challenge to Version 5 continues to address that exact eight-page artefact and its seven frozen propositions. Version 6 is a later scientific branch.

## Why Version 6 exists

The Conicus3D exercise originally exposed a structural problem internal to RM. Its forward model may be written schematically as

$$e_{\text{obs}} = \mathbf{P} \mathbf{Q} \delta + \varepsilon, \quad (1)$$

where  $\mathbf{P}$  denotes the angular weak-lensing map and  $\mathbf{Q}$  contains the cosmological line-of-sight projection. The learned prior for the three-dimensional density field is trained on simulated cosmic light cones and therefore carries a specific structure-formation history [1].

Versions 1–4 progressively isolated the question of whether RM could legitimately supply the background dynamics entering such a projection without importing them from standard cosmology.

Version 5 answered the reduced zero-mode part: HCR–1 was rejected rather than repaired, while GHC–1, GEC–1 and HBR–1 survived from the declared homogeneous action and ledger.

The scientific situation changed again after Version 5. Three later concordance results matter here:

1. the active stellar energetic interpretation is thermal-radiative rather than redshift-dominant;
2. the curvature constitutive energy  $U(X)$  produces a conditional extension of the homogeneous constraint system and of HBR–1;
3. boundary formation is now explicitly separated into reference matching, deposited newborn state, formation cost, layer storage, outgoing products and exchanged work.

These changes do not invalidate the reduced Version-5 theorem. They narrow its domain and clarify the route from the theorem to an observational forward operator.

### The frozen Version-5 core is retained

For the reduced  $U = 0$  homogeneous branch, the surviving constraints are

$$\boxed{P^{(3)}R = \rho_m + u_\gamma + \varepsilon_z(e) + u_0} \quad (\text{GHC-1}), \quad (2)$$

$$\boxed{\rho_m + 2u_\gamma - 2u_0 = 2\varepsilon_z(e) + 3\varepsilon'_z(e)} \quad (\text{GEC-1}). \quad (3)$$

With

$$B(e) = 2\varepsilon_z(e) + 3\varepsilon'_z(e), \quad (4)$$

and the declared bulk balances

$$\dot{\rho}_m = -3H\rho_m - s, \quad \dot{u}_\gamma = -4Hu_\gamma + s, \quad \dot{u}_0 = 0, \quad \dot{e} = 3H, \quad (5)$$

preservation of GEC–1 gives

$$\boxed{H[3B'(e) + 3\rho_m + 8u_\gamma] = s} \quad (\text{HBR-1}). \quad (6)$$

For the rational constitutive reservoir used in the frozen branch,  $B'(e) > 0$  on the regular sub-capacity domain, so the denominator is positive and the rate is fixed without introducing a Friedmann equation,  $H_0$ ,  $\Omega_m$  or a fitted response coefficient.

**Non-repair statement.** HCR–1 remains historical. Version 6 does not restore it, recalibrate it or reinterpret HBR–1 as a disguised relaxation law.

The scope is equally important. Equations (2)–(6) govern the already manifested reduced homogeneous bulk. They do not determine the complete manifested-volume history because

$$H_{\text{AE}} = H + g_\partial, \quad g_\partial = \frac{\Gamma_\partial}{3V_{\text{AE}}}, \quad (7)$$

and  $g_\partial$  belongs to the inhomogeneous boundary-production problem.

### Thermal concordance: what changed after Version 5

Version 5 retained a historical propagation-energy reading in which the redshift ledger was discussed through  $P_z$  and  $W_z$ . That bookkeeping is no longer the active primary energetic interpretation for stellar loading.

The current RM stellar notation uses a distinct thermal stock  $\varepsilon_{\text{AE}}^{\text{th}}$ . Radiation in local thermal equilibrium carries

$$u_\gamma = a_R \Theta^4, \quad p_\gamma = \frac{1}{3} a_R \Theta^4, \quad a_R = \frac{\pi^2 k_B^4}{15 \hbar^3 c_{\text{AE}}^3}. \quad (8)$$

The active hierarchy is therefore:

**thermal-radiative loading: primary in the stellar application      redshift: propagation observable, possible secondary energetic channel.**

No numerical thermal/redshift partition is imposed.

The distinction matters for Conicus3D because redshift continues to enter the observational map as a propagation/distance variable; it is not promoted into the microscopic source that closes the stellar or cosmological energy ledger. A measured redshift may therefore remain part of the observable forward chain even when the internal RM energy interpretation changes.

### Conditional curvature extension of the bulk rate

When the homogeneous reduction also contains the constitutive curvature density

$$U(X) = u_\star F(X), \quad F(X) = 1 - \sqrt{1 - X} - \frac{X}{2}, \quad 0 \leq X < 1, \quad (9)$$

with  $X \propto a^{-4}$  on the isotropic branch, the scalar constraints acquire the corresponding  $U$  and  $U'$  terms. Under the same declared matter-to-radiation balances, their preservation yields the conditional extension

$$H [3B'(e) + 8XU'(X) + 16X^2U''(X) + 3\rho_m + 8u_\gamma] = s. \quad (10)$$

Equation (10) reduces exactly to HBR–1 for  $U = 0$ . It is not a new microscopic conversion law. If an additional transfer into  $\varepsilon_{\text{AE}}^{\text{th}}$  is introduced, opposite ledger terms must be written and the rate equation must be rederived.

**Status.** HBR–1 is the formal reduced  $U = 0$  result. Equation (10) is a conditional thermal/curvature extension under the written balances. Neither equation by itself supplies the boundary term  $g_\partial$  or the perturbation/growth sector.

### Boundary mechanics is no longer one unnamed debt

Version 5 correctly separated boundary production from the homogeneous zero mode, but its boundary programme was still compressed into a small number of symbols. The later mechanical audit makes the separation sharper.

In the reduced  $U = 0$  branch, simultaneous preservation of the homogeneous constraints during a uniform advancing front, with no remodelling of the old reference, selects a matched birth state under the declared balances. This is a compatibility condition, not a universal birth theorem.

The formation-energy balance must also distinguish at least:

$$\boxed{\text{deposited newborn state} \neq \text{complete formation cost}} \quad (11)$$

in general. The complete formation cost may include layer storage, outgoing products and exchanged work. Consequently the conditional unit branch

$$\mathcal{U}_\partial = \frac{P}{\ell_\star^2}, \quad \Gamma_\partial = \frac{\ell_\star^2}{P} \mathcal{P}_{\gamma,\partial}, \quad (12)$$

remains a constitutive boundary branch, not a theorem identifying  $\mathcal{U}_\partial$  with the residual energy density of newly manifested volume.

This is progress for the Conicus3D problem because it removes an ambiguity: the missing observational background is not represented by a single hidden “boundary coefficient”. It is a coupled production-and-matching problem with separately named physical entries.

## The Conicus3D forward chain, layer by layer

The useful question is no longer whether RM “uses” or “does not use” the Conicus3D operator. The operator must be decomposed into physical layers.

| Layer                         | Role in Conicus3D                                                   | Current RM status                                                                                             | Version-6 verdict                                   |
|-------------------------------|---------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|
| Local light propagation       | Deflection/shear response along the line of sight                   | Selected scalar optical branch reproduces the ordinary weak-field response conditionally                      | <b>Retained compatibility layer</b>                 |
| Angular operator $\mathbf{P}$ | Converts convergence to the angular shear field                     | Kinematic scalar weak-lensing convolution survives on the selected branch                                     | <b>Retained compatibility layer</b>                 |
| Matter–potential relation     | Maps matter inhomogeneity into local gravitational response         | CLG–1 supplies the local Newtonian matching in its domain                                                     | <b>RM local replacement available conditionally</b> |
| Homogeneous background rate   | Supplies the background evolution entering the line-of-sight kernel | Reduced old-bulk rate $H$ is fixed by HBR–1; total $H_{\text{AE}}$ still also requires $g_\partial$           | <b>Partially closed</b>                             |
| Distance–redshift map         | Converts observation into radial/cosmic history                     | No complete RM $w(z)$ or distance–redshift operator has yet been derived                                      | <b>Open</b>                                         |
| Perturbation/growth operator  | Evolves $\delta$ and the cosmic web                                 | Full cosmological perturbation system and growth law remain open                                              | <b>Open</b>                                         |
| Learned prior $p(\delta)$     | Encodes the statistics of simulated 3D matter light cones           | Existing prior is trained on a definite simulation history; RM-specific portability has not been demonstrated | <b>Must be tested or reconstructed</b>              |

This table is the central Version-6 result. It prevents two opposite mistakes. RM must not import the complete Conicus3D cosmological history as if it were its own dynamics. But it also need not discard the parts of the forward architecture that depend only on the local weak-lensing map and angular reconstruction once those parts have passed their own compatibility tests.

## What an RM cosmological projection would require

Write schematically

$$\mathbf{Q}_{\text{std}} = \mathbf{Q}[H_{\text{std}}, w_{\text{std}}(z), D_{\text{std}}(z), \mathcal{G}_{\text{std}}], \quad (13)$$

where the notation only records that the standard projection depends on a background distance history, a growth history and a matter-to-potential relation. Version 6 does *not* assert an explicit RM operator  $\mathbf{Q}_{\text{RM}}$  because the required ingredients are not all derived.

The RM construction must instead proceed in the order

bulk constraints and HBR–1  
 → boundary production  $g_\partial$   
 →  $H_{\text{AE}}(T)$   
 → distance/redshift law  
 → perturbation and growth equations  
 →  $\mathbf{Q}_{\text{RM}}$   
 → Conicus3D-style reconstruction test.

(14)

The order is part of the falsifiability discipline. A standard  $w(z)$ , growth factor or distance law may

be recovered later, but it may not be inserted upstream merely to make the RM curve agree with a chosen benchmark.

### The learned prior is a separate scientific question

Conicus3D uses high-resolution cosmological simulations to learn a diffusion prior for the three-dimensional matter field. That is one of its strengths: the prior captures non-Gaussian filamentary structure that simple analytic regularisers miss [1]. It also means that the prior is not logically identical to the measurement operator.

For an alternative dynamical framework, the correct question is therefore not “can the Conicus3D prior be reused unchanged?” but

*Which statistical features learned from the simulation ensemble are robust to a change in cosmological dynamics, and which must be retrained or reweighted once the light-cone growth history changes?*

Version 6 does not answer that machine-learning question. It isolates it as an external interface problem rather than silently treating the learned prior as a cosmology-independent object.

Two concrete questions follow for a future Conicus3D/RM comparison:

1. Can the implementation expose  $\mathbf{P}$ , the geometric/photometric part of  $\mathbf{Q}$ , and the simulation-dependent growth/background ingredients as separately replaceable modules?
2. If an alternative set of self-consistent light cones is supplied, can the score prior be retrained or importance-adjusted without changing the observational likelihood model?

These are methodological questions about portability of the reconstruction architecture; they do not require the Conicus3D authors to adopt RM ontology.

### What Version 6 closes and what it leaves open

**Retained formal result.** The reduced Version-5 zero-mode closure  $\text{GHC-1}/\text{GEC-1}/\text{HBR-1}$  remains unchanged under its stated  $U = 0$  ledger.

**Conditional closure.** The curvature/thermal extension, Eq. (10), survives only under the explicitly written homogeneous balances. Any new transfer channel requires rederivation.

**Corrected interpretation.** Thermal-radiative loading is primary in the active stellar application. Redshift remains a physical propagation observable and may enter a secondary energetic ledger only when such a channel is independently derived. The historical  $P_z/W_z$  picture is not the active primary stellar source law.

**Boundary progress.** Matched birth is restricted to its reduced  $U = 0$  assumptions, and formation cost is separated from deposited newborn density. The conditional scale  $P/\ell_\star^2$  does not by itself solve the complete boundary dynamics.

**Open programme.** The following remain necessary before Conicus3D can become a quantitative RM discriminator:

1. derive the physical boundary conversion law and  $g_\partial$ ;
2. derive the complete  $H_{\text{AE}}(T)$  background;
3. derive the RM distance–redshift relation;
4. derive cosmological perturbations and structure growth;
5. determine whether an existing Conicus3D prior is portable or must be regenerated on RM-consistent simulations;

6. compare the resulting forward predictions with data without refitting the theory to the target catalogue.

### Falsification conditions after Version 6

Version 6 is falsified, replaced or narrowed if any of the following occurs:

1. a valid refutation of a frozen Version-5 proposition destroys the inherited zero-mode core;
2. the thermal/curvature extension fails constraint preservation under its declared ledger;
3. every admissible boundary completion necessarily inserts an additional homogeneous term that invalidates the bulk/boundary separation;
4. the local optical branch fails the weak-lensing compatibility conditions on the domain in which Version 6 retains it;
5. construction of  $\mathbf{Q}_{\text{RM}}$  requires an adjustable background or growth function chosen only to reproduce the external Conicus3D result;
6. the claimed modular separation of the benchmark is shown to be mathematically or computationally inapplicable to the intended comparison.

A disagreement with RM ontology, by itself, is not a falsification of these technical statements. Conversely, agreement of a future reconstructed map with a particular catalogue would not by itself validate State  $\mathcal{A}$ .

### Conclusion

Conicus3D has played a productive role in RM precisely because it did not supply an answer that RM was entitled to import. It exposed where the local theory ended and the cosmological problem began. Version 5 closed one part of that problem: the reduced homogeneous bulk can obtain its own constraint-preserving rate through HBR-1. Version 6 keeps that theorem frozen and moves to the next layer. The forward problem is now decomposed into local optical response, angular reconstruction, matter-potential matching, homogeneous background, boundary production, distance/redshift propagation, perturbative growth and a learned simulation prior.

The resulting status is neither “Conicus3D already tests RM” nor “Conicus3D is unusable for RM”. It is sharper:

#### Version-6 route.

local lensing compatibility survives  $\longrightarrow$  bulk background partially closes  
 $\longrightarrow$  boundary + growth + distance remain to derive  
 $\longrightarrow$  Conicus3D becomes a discriminator.

The next decisive object is therefore not another fitted cosmological curve. It is the internally derived RM projection operator  $\mathbf{Q}_{\text{RM}}$ .

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**Authorship and computational assistance.** Pierre Benaros is the sole author and assumes full responsibility for all assumptions, calculations, interpretations and claims. Symbolic computation tools and AI assistants were utilized strictly to verify mathematical identities and for language.

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