

The Exclusion Interaction in Relativity of Matter

Constitutive Saturation and a First-Passage Theorem

Pierre Benaros

Independent Researcher, Cannes, France

ORCID: 0009-0000-0427-0217

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Abstract

The Relativity of Matter (RM) programme uses the name **Exclusion Interaction** for a constitutive principle: as a physical channel approaches its finite admissible capacity, continuation through that same channel becomes progressively harder and is excluded at the capacity boundary. The principle is intentionally more general than any particular constitutive function. A current geometric realization may be written with a dimensionless load $X_{\mathcal{R}} < 1$ and a stiff response whose derivative diverges as $X_{\mathcal{R}} \rightarrow 1^-$, but that realization is not identified with the fundamental law itself.

This note separates the law from one dependent operational consequence. Consider a fixed stochastic transport process with local generator $\mathcal{L}_{\text{loc}}$ and a positive cadence field $N(x)$ satisfying $d\tau_{\text{cad}} = N dT$. If the material and spatial process is held fixed and only its cadence is changed, the mean first-passage time measured on the universal parameter T satisfies

$$\mathcal{L}_{\text{loc}}\Theta = -\frac{1}{N}, \quad \Theta|_{\partial\Omega} = 0.$$

Equivalently, the time-changed generator is $\mathcal{L}_T = N\mathcal{L}_{\text{loc}}$. On a frozen spherical background this yields an exact positive weighted-average theorem for the first-passage correction. The result does not calibrate a star, replace standard radiative diffusion, establish a Black Core, or derive nuclear fusion. Its purpose is narrower: to give the Exclusion Interaction a clean canonical statement and to exhibit one falsifiable mathematical consequence of the RM cadence map without adding a fitted coefficient.

Epistemic map. This note deliberately distinguishes four levels.

1. **Canonical principle:** the Exclusion Interaction – finite constitutive capacity progressively excludes further evolution through the same channel.
2. **Candidate realization:** a stiff constitutive function, for example one with $F'(X_{\mathcal{R}}) \rightarrow \infty$ as $X_{\mathcal{R}} \rightarrow 1^-$. No unique function is declared by the principle alone.
3. **Derived consequence under explicit premises:** the first-passage equation $\mathcal{L}_{\text{loc}}\Theta = -1/N$ when the only added operation is the positive cadence map $d\tau_{\text{cad}} = N dT$.
4. **Open physics:** microscopic plasma derivation, strong-field stellar closure, nuclear applications, collapse endpoints and observational discriminants.

1. Why isolate the Exclusion Interaction?

In the RM corpus the Exclusion Interaction appears in several contexts: strong constitutive response, stellar compactness, saturation candidates and the discipline that no physical channel may be extended indefinitely merely because an equation remains algebraically writable. The common idea is not a specific equation of state and not a new adjustable coefficient. It is a structural restriction on admissible continuation.

A useful independent note must therefore avoid two opposite errors. The first is to make the principle so broad that it becomes a slogan. The second is to identify it prematurely with one preferred constitutive function and thereby make the function look fundamental. The present note adopts a minimal formulation and then attaches one calculation that can fail.

Definition EI-1 – minimal constitutive statement

Let X denote a dimensionless constitutive load for a specified physical channel, with an admissible branch $X < X_{\text{cap}}$. The **Exclusion Interaction** is the RM postulate that the incremental cost of further evolution through that same channel increases as X approaches X_{cap} , and that continuation through the channel is excluded at the capacity boundary. The principle fixes neither a universal analytic form nor a new fitted coefficient.

For convenience one may rescale the load so that $X_{\text{cap}} = 1$. A frequently used RM realization is then a monotone response $F(X)$ with an increasingly stiff derivative and, in the limiting model,

$$X < 1, \quad F'(X) > 0, \quad \lim_{X \rightarrow 1^-} F'(X) = +\infty. \quad (1)$$

Equation (1) is a *candidate realization class*. It is not the definition of EI-1.

2. What the principle does not establish

Constitutive exclusion is not, by itself, a completed theory of any of the systems in which RM uses it. In particular it does not by itself determine a stellar profile, a collapse radius, a nuclear reaction rate, a cosmological boundary law or a microscopic opacity. Each application requires its own variables, constraints and matching conditions.

Non-claims of this note

The following statements are explicitly **not** derived here:

- that standard stellar radiative diffusion is an illusion or should be replaced;
- that a stellar plasma possesses a new “relational viscosity”;
- that nuclear fusion is caused by a transition $\mathcal{A} \rightarrow E$;
- that the mass defect Δmc^2 is a latent heat of the continuum;
- that a Black Core is dynamically stable or observationally established;
- that a specific function $F(X)$ is uniquely selected by EI-1.

Those are separate hypotheses or programmes and cannot be imported into the theorem below.

3. A dependent operational question: cadence without new transport physics

The cleanest place to test the separation is a first-passage problem. Consider an optically thick medium in which the material microphysics fixes a local stochastic transport process. We do *not* modify that process. We ask only what happens to the accumulated duration if RM’s cadence map is applied.

Let X_τ be a diffusion process parameterised by a local process parameter τ_{cad} . Its generator is

$$\mathcal{L}_{\text{loc}} f \equiv \nabla_i (D_{\text{loc}} \nabla^i f), \quad D_{\text{loc}}(x) > 0, \quad (2)$$

where the covariant derivative is associated with a positive spatial metric g_{ij} . All ordinary material transport physics is placed in D_{loc} and g_{ij} .

The RM cadence map is postulated as

$$d\tau_{\text{cad}} = N(x) dT, \quad N(x) > 0. \quad (3)$$

Here T is the universal ordering parameter used by RM; τ_{cad} is a parameter of the local process, not a second physical time coordinate.

3.1. Assumptions of the theorem

The first-passage result uses only the following premises:

1. the absorbing spatial domain Ω is fixed;
2. g_{ij} and D_{loc} are fixed during the comparison;

3. the local stochastic process is generated by $\mathcal{L}_{\text{loc}}$;
4. $N(x)$ is positive and acts only through Eq. (3);
5. no additional force, drift, opacity correction or interaction is introduced.

4. Dynkin placement of the cadence field

Let τ_{exit} be the first exit time of the local process from Ω . Since $dT = d\tau_{\text{cad}}/N$, the mean exit time measured in T is the additive functional

$$\Theta(x) = \mathbb{E}_x \left[\int_0^{\tau_{\text{exit}}} \frac{d\tau_{\text{cad}}}{N(X_\tau)} \right]. \quad (4)$$

The standard Dynkin/Feynman–Kac first-passage relation for this additive cost gives

$$\boxed{\mathcal{L}_{\text{loc}}\Theta = -\frac{1}{N}, \quad \Theta|_{\partial\Omega} = 0.} \quad (5)$$

Equivalently, when the same process is referred to T , the time-changed generator is

$$\boxed{\mathcal{L}_T = N\mathcal{L}_{\text{loc}},} \quad (6)$$

so that $\mathcal{L}_T\Theta = -1$ reproduces Eq. (5).

Theorem EI-D1 – pure-cadence first-passage theorem

Under the assumptions above, the cadence field enters the mean first-passage problem as the positive cost $1/N$ in Eq. (5). Matter microphysics remains in D_{loc} , spatial structure remains in g_{ij} , and no new numerical coefficient is introduced.

4.1. Why putting N inside the divergence is a different theory

A superficially similar equation,

$$\nabla_i (ND_{\text{loc}}\nabla^i\Theta) = -1, \quad (7)$$

expands to

$$N\nabla_i (D_{\text{loc}}\nabla^i\Theta) + D_{\text{loc}}\nabla_i N \nabla^i\Theta = -1. \quad (8)$$

The second term is an effective spatial drift induced by $\nabla_i N$. Such a drift may be physical in another model, but it is *not* generated by a pure local change of cadence. It would need an independent microscopic or dynamical derivation.

5. Exact spherical theorem on a frozen background

Take an isotropic spatial representative

$$g_{ij} = A(r)\delta_{ij}, \quad A(r) > 0, \quad (9)$$

with radial $D_{\text{loc}}(r) > 0$ and $N(r) > 0$. Equation (5) becomes

$$\frac{1}{A^{3/2}r^2} \frac{d}{dr} \left[r^2 A^{1/2} D_{\text{loc}} \frac{d\Theta}{dr} \right] = -\frac{1}{N}. \quad (10)$$

Impose regularity $\Theta'(0) = 0$ and absorption $\Theta(R) = 0$. Direct integration gives

$$\Theta(0) = \int_{B(R)} \frac{1}{N(x)} K(x) dV_{\text{prop}}, \quad (11)$$

where

$$K(r) = \int_r^R \frac{dr'}{4\pi r'^2 A(r')^{1/2} D_{\text{loc}}(r')} > 0, \quad dV_{\text{prop}} = 4\pi r^2 A(r)^{3/2} dr. \quad (12)$$

Let Θ_N be the solution for a given $N(r)$ and Θ_1 the solution on the same frozen background with $N = 1$. Then

$$\boxed{\frac{\Theta_N(0)}{\Theta_1(0)} = \frac{\int_{B(R)} \frac{1}{N} K dV_{\text{prop}}}{\int_{B(R)} K dV_{\text{prop}}} \equiv \left\langle \frac{1}{N} \right\rangle_{K dV_{\text{prop}}}.} \quad (13)$$

By positivity of the weight,

$$\min_{B(R)} \frac{1}{N} \leq \frac{\Theta_N(0)}{\Theta_1(0)} \leq \max_{B(R)} \frac{1}{N}. \quad (14)$$

Corollary EI-D2 – sign and bounds

If $0 < N \leq 1$ on the frozen domain, a pure cadence change can only increase the mean first-passage time. The magnitude is not a free parameter: it is the positive weighted average in Eq. (13).

6. Toy counter-audit: two placements, two answers

The purpose of the following calculation is not stellar calibration. It checks whether two seemingly similar placements of N are mathematically equivalent. Set $R = 1$, flat space, $D_{\text{loc}} = 1$, and

$$C(r) = C_c(1 - r^2), \quad N(r) = \sqrt{1 - C(r)}. \quad (15)$$

We compare:

1. the pure-cadence Dynkin equation $\Delta\Theta = -1/N$;
2. the alternative divergence equation $\nabla \cdot (N\nabla\Theta) = -1$.

The ratios of the central first-passage time to the $N = 1$ reference are

C_c	N inside divergence	Dynkin $1/N$ source
0.10	1.0263	1.0372
0.50	1.1716	1.2541
0.90	1.5195	1.8641

The difference grows with the strength of the cadence gradient. This is exactly what Eq. (8) predicts: the two placements are not alternative notations for the same process.

7. Scale check: why this is not a manufactured solar anomaly

A weak solar benchmark used in the RM audit gives a central cadence deviation of order

$$\frac{1}{N} - 1 \simeq 9.05 \times 10^{-6}. \quad (16)$$

At that scale the pure-cadence contribution is far too small to make ordinary stellar radiative transport cadence-dominated. That negative result is useful: the theorem does not create a large effect merely because the framework introduces a new field.

The result should therefore be read as a **placement theorem**, not as a claimed solar observation. A full physical prediction would need $N(r)$, $g_{ij}(r)$ and $D_{\text{loc}}(r)$ from one self-consistent stellar model together with the appropriate microscopic opacity and plasma physics.

8. Relation to the broader RM programme

The Exclusion Interaction is used elsewhere in RM as a common constitutive idea, but the logical arrows must remain one-way:

$$\boxed{\text{EI-1 principle} \not\Rightarrow \text{a unique } F(X) \not\Rightarrow \text{a unique stellar or nuclear model.}} \quad (17)$$

Conversely, a successful application can support a particular realization without turning that realization into the principle itself.

The current RM architecture uses this separation for three reasons. First, it prevents an attractive strong-field function from being promoted by analogy into unrelated sectors. Second, it allows a dependent theorem such as EI-D1 to be tested independently. Third, it makes failure informative: the first-passage theorem can fail while the constitutive principle survives, or a constitutive realization can fail while the cadence theorem remains mathematically correct under its own premises.

9. Failure conditions

What would force revision or withdrawal?

The operational branch in this note must be revised or withdrawn if any of the following occurs:

1. an explicit microscopic derivation of the intended transport process yields a generator different from $\mathcal{L}_T = N\mathcal{L}_{\text{loc}}$ while preserving the same declared physical meaning;
2. an additional drift or force is unavoidable, showing that the “pure cadence only” premise is incomplete;
3. the cadence map $d\tau_{\text{cad}} = N dT$ is replaced or falsified in the relevant RM sector;
4. N fails to remain positive on the domain where the first-passage problem is posed;
5. the claimed frozen-background comparison is used outside its domain, for example while g_{ij} or D_{loc} changes between the two branches;
6. EI-1 is shown to require a different constitutive notion of capacity than the one used by the active RM realization.

No fitted correction is to be added merely to preserve Eq. (5).

10. The useful question left open

Discriminating question

Assume that the spatial stochastic process is fixed by $\mathcal{L}_{\text{loc}}$ and that the only new operation is the positive local cadence map $d\tau_{\text{cad}} = N dT$. Is the Dynkin placement

$$\mathcal{L}_{\text{loc}}\Theta = -\frac{1}{N}$$

the unique admissible first-passage formulation under those premises, or can another generator preserve the same material/spatial process without introducing an effective drift, force, opacity change or additional interaction?

A negative answer is valuable. If another admissible generator exists, the RM cadence formulation must be sharpened. If microscopic physics selects another generator, EI-D1 is modified or withdrawn rather than rescued by a free coefficient.

11. Conclusion

The Exclusion Interaction is most useful when stated less ambitiously and tested more aggressively. Its canonical content is a finite-capacity constitutive restriction: continued evolution through the same physical channel becomes progressively more costly and is excluded at the capacity boundary. That statement does not select one function and does not complete any stellar, nuclear, strong-field or cosmological model.

The first-passage calculation supplies a dependent mathematical consequence with a different status. If local transport is held fixed and only the RM cadence map is applied, the universal-time mean first-passage problem obeys $\mathcal{L}_{\text{loc}}\Theta = -1/N$. On a frozen spherical background the correction is exactly a positive weighted average of $1/N$. This is small in a weak solar benchmark, which is consistent with the deliberately narrow claim.

The value of the note is therefore not that it announces another completed sector of RM. It creates a stable citation point for the Exclusion Interaction and attaches to it one transparent theorem, one counter-audit and explicit conditions under which the operational branch must fail.

Source trail and references

This note is distilled from RM working calculations on stellar cadence and the current constitutional definition of the Exclusion Interaction. The broader RM documents are cited for architecture and status only; none is required to verify the first-passage derivation above.

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