Appendix A — Glossary and fundamental notations

Name	Symbol	Description
Relational coexistence	Ω_{ij}	Coexistence function between original entities e'_i and e'_j in R', with $0 \leq \Omega_{ij} \leq 1$. In R it manifests as a degree of observable correlation.
Relational entropy	S_{rel}	Defined as $S_{\mathrm{rel}} \propto -\sum_{i<j} \Delta\Omega_{ij}$. Increases when coexistences lose specificity; it is the cause of the original symmetry breaking, cosmic expansion, the arrow of time, and decoherence.
Relational temperature	T_{rel}	Proportional to the sum of oscillations (in frequency and amplitude) of the coexistences Ω_{ij}. At $T_{\mathrm{rel}} = 0$ absolute entanglement is achieved.
Total relational coherence	$C_{\mathrm{rel}}^{(e)}$	Sum of the coexistences $\Omega_{e'i}(\tau)$ between the actualized entity e and all the other entities connected to it in R'. Measures the degree of relational integration of e.
Relational reduction factor (lapse)	$\gamma_{\mathrm{rel}}(z)$	Parametrizes in R the combined reduction due to entropic variation and the lower creation of relational time; typically $\gamma_{\mathrm{rel}}(z) < 1$. Drives the observed expansion rate.
Arrow of time	—	Emergent direction defined by the growth of S_{rel}. Under perfect coherence ($\Omega_{ij} \to 1$) the arrow halts.
Quantum decoherence	—	Loss of relational specificity ($\Delta\Omega_{ij} < 0$) and thus increase of S_{rel}; beyond a critical coherence threshold $C_{\mathrm{rel}}^{(e)}$, the system cannot maintain superpositions and actualizes an outcome through Π.
Cosmic expansion	—	Manifestation in R of the progressive relational degradation in R'. A structural and irreversible phenomenon in TCR dynamics.
Gravity	—	Emergent effect of gradients in Ω_{ij}; in TCR it acts as an anti-entropic force that can locally restore maximum coexistence (e.g. in black holes).
Principle of Relational Indifferentiation	—	Postulate according to which, on average, coexistences in R' tend to lose specificity ($d\Omega_{ij}/d\tau < 0$), causing the increase of S_{rel}.
Entanglement	—	Limiting case of perfect coexistence ($\Omega_{ij} = 1$): in R it manifests as ideal quantum correlation, independent of distance.
Black holes	—	Systems in which gravity locally overcomes entropy, restoring relational coherence: initially the creation of new space-time units halts; in the limit $\Omega \to 1$ time comes to a stop.
Spatiotemporal distance	d_R	Distance between two actualized entities in R, measured according to the spatiotemporal metrics of the actualized reality.
Observed expansion rate	$H_{\mathrm{obs}}(z)$	Effective rate in R resulting from the action of the relational lapse $\gamma_{\mathrm{rel}}(z)$ on the "bare" dynamics; it is the quantity compared with CC/BAO/SN.
Voids (bimodal)	—	Two phenomenological families of voids ("deep"/"shallow") that determine the effective volumetric fraction and contribute to the shape of $\gamma_{\mathrm{rel}}(z)$ in the low-redshift regime.
Dynamic mix of voids	—	Combination (possibly sigmoidal in z) of the two void families that controls the transition and the evolution of $\gamma_{\mathrm{rel}}(z)$ and the effective curvature.
"Bare" vs observed	—	Distinction between average (bare) geometric quantities and measured (observed) quantities after the relational lapse; crucial to interpret apparent acceleration without dark components.
Model "normalization"	—	Implementation constraint that ensures consistency between r_s computed at early-time, comoving distances, and compressed BAO vectors without free rescaling factors.
"Effective curvature"	—	Average curvature induced by the void/wall mix that acts phenomenologically together with $\gamma_{\mathrm{rel}}(z)$ in determining observable distances.

Name	Symbol	Description
"Mass transfer" in walls	—	Migration of matter from void regions to walls that modulates the average geometry over time and therefore the shape of $\gamma_{\rm rel}(z)$.
"Derivative of the lapse"	$\gamma'(z)$	Numerical derivative (centered differences) used in stability evaluations and in model transitions; relevant for constructing $H_{\rm obs}(z)$.
"TCR set" of parameters	—	Collection of phenomenological parameters (e.g. $A, p, z_t^{\rm mix}, \beta_{\rm mix}, H_0, \Omega_m$) specifying the shape of $\gamma_{\rm rel}(z)$ and the associated observables.
"Observational pipeline"	—	Operational sequence: computation of r_s and θ_* (if used), definition of the TCR set, construction of $\gamma(z)$, evaluation of $H_{\rm obs}(z)$, distances and BAO vectors, then total χ^2 with SN/CC/BAO.
"CMB prior on θ_*"	$100\,\theta_*$	Optional constraint on the characteristic CMB angle (if enabled), computed with the early-time branch consistent with the model; not used in the main runs of the *Results* section.
"Sound horizon"	r_s	Primordial acoustic scale computed by integrating c_s/H in the selected early-time regime (without free rescalings); sets the normalization of compressed BAO.
"Early reference"	$r_s^{\rm ref}$	Reference value of r_s for the internal comparison between TCR and ΛCDM (same pipeline, common normalization rules).

Table 1: Glossary of fundamental TCR terms.