# Verrell's Law — Everettian QM Bias Extension

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Abstract
This note frames a minimal-axiom extension to Everettian (Many-Worlds) Quantum Mechanics (MWI) called Verrell's Law (VL). VL preserves unitary quantum evolution while introducing a physically grounded electromagnetic (EM) memory functional that biases branch weights after decoherence. The result: MWI's mathematical simplicity is retained, while providing a testable mechanism for why certain decohered branches dominate observed experience (history-dependent bias).

## 1. Interpretation framing: Copenhagen vs MWI vs Verrell's Law (VL)

Standard (Copenhagen) QM is usually presented with two core axioms: Unitary evolution by Schrödinger equation / QFT. Non-unitary probabilistic collapse upon measurement (Born rule applied at collapse). The collapse postulate (2) is not defined as a precise dynamical law (when/where/how a measurement occurs), leaving an interpretational gap. Everettian QM (MWI) keeps only axiom (1) — unitary evolution — and explains apparent collapse as an emergent phenomenon due to decoherence: the global wavefunction branches into effectively independent decohered sectors. No additional collapse axiom is introduced. Verrell's Law (VL) keeps unitary evolution (as MWI) and adds a single, physically motivated channel: an EM memory functional that records outcome imprints in the observer–apparatus–environment field and biases branch measures accordingly. Importantly, this is not an ad-hoc collapse; it is a physically instantiated weight adjustment that remains compatible with unitary dynamics and decoherence.

## 2. Minimum Math Scaffold (core equations)

Below is a minimal mathematical scaffolding that implements the VL idea. All dynamics remain fundamentally unitary on the full Hilbert space; the memory bias enters as a history-dependent multiplicative factor on decohered branch weights (a physically sourced re-weighting of Born measures).

2.1 Unitary evolution (density operator):

$$\frac{d}{dt}\rho(t) = -\frac{i}{\hbar}[H,\rho(t)]$$

with the Hilbert space decomposition $\mathcal{H} = \mathcal{H}_S \otimes \mathcal{H}_A \otimes \mathcal{H}_E$ (system, apparatus, environment). 2.2 Memory functional (EM imprint):
Define an electromagnetic memory functional $\mathcal{M}(t)$ that accumulates causal imprints:

$$\mathcal{M}(t) = \int_{-\infty}^{t} K(t-\tau)\, \Phi[E(\cdot,\tau)]\, d\tau,$$

where $E(x,\tau)$ denotes the relevant coarse-grained EM degrees of freedom, $\Phi$ maps field configurations to a scalar imprint intensity, and $K$ is a causal kernel (decay or oscillatory). 2.3 Biased Born weights within decohered pointer basis:
Given a set of decoherence-selected pointer projectors $\{\Pi_i\}$, define VL-adjusted outcome probabilities:

$$p_i^{(\mathrm{VL})}(t) = \frac{b_i(t)\,\mathrm{Tr}[\Pi_i\,\rho(t)]}{\sum_j b_j(t)\,\mathrm{Tr}[\Pi_j\,\rho(t)]},$$

with

$$b_i(t) = \exp\Big(\beta \int_{-\infty}^{t} K(t-\tau)\, I_i(\tau)\, d\tau\Big).$$

Here $I_i(\tau)$ is the imprint intensity associated with outcome-class $i$, and $\beta$ parameterizes memory coupling strength. For $\beta=0$ we recover the ordinary Born measures.

## 3. Toy discrete model (2-outcome update)

A discrete-time toy model captures the essential feedback loop. Let $q_i^{(n)}$ be the Born (unitary+decoherence) weights at trial $n$, and let $m_i^{(n)}$ be scalar memory states per outcome-class. Then:

$$p_i^{(n)} = \frac{e^{\beta m_i^{(n)}} q_i^{(n)}}{\sum_j e^{\beta m_j^{(n)}} q_j^{(n)}},$$

$$m_i^{(n+1)} = \lambda m_i^{(n)} + \alpha\,\mathbf{1}\{\text{outcome }i\}, \quad 0\le\lambda<1,\; \alpha>0.$$

This discrete model gives run-length amplification when $\beta>0$: outcomes that have occurred more often in the recent past inherit larger $m_i$, increasing their future selection probability beyond IID Born expectations.

## 4. Dynamical back-reaction (sketch)

The memory field can feed back weakly into the dynamics through effective interaction terms. For example, an effective coupling term could be written as:

$$H_{\text{int}} = -\int J(x,t) \cdot A_{\text{mem}}(x,t)\, dx, \quad A_{\text{mem}}(x,t) = \int_{-\infty}^{t} K(t-\tau)\,\mathcal{G}(x;\tau)\, d\tau,$$

where $J$ are local currents (apparatus/neural), and $\mathcal{G}$ encodes how recorded outcomes source EM structure. This provides a physically plausible channel for how stored records slightly perturb future coupling strengths (a weak feedback loop consistent with unitary evolution on the full system).

## 5. CPT-symmetric cosmology (note)

To align with CPT-symmetric cosmology, choose a time-symmetric kernel:

$$K(\Delta t) = \tfrac{1}{2}(K_+(\Delta t) + K_+(-\Delta t)).$$

Macroscopic arrow arises from boundary conditions (record-rich future/past asymmetry), while the microscopic kernel respects CPT. Practically, causal past-imprints dominate accessible records, preserving observed causality while allowing CPT-compatible advanced/retarded balance at the micro level.

## 6. Testable predictions & falsification

– Persistence / run-lengths: repeated-measure sequences will show statistical run-lengths exceeding IID Born predictions when $\beta>0$.
– Context lock-in: local lab context and recording chain cause drift toward previously instantiated outcomes.
– Ablation: scrambling or erasing recorded imprints (reducing $I_i$) should collapse $b_i \to 1$ and return statistics to Born predictions.
– Freeze test: preventing new writes halts further bias evolution (plateau in $m_i$).
– Parameter sweeps: varying $\beta, \lambda, \alpha$ in controlled setups allows quantitative model fits and falsification.

## 7. Practical notes (implementation & simulation)

– Use coarse-grained EM observables (e.g., integrated device currents, persistent magnetization, logging timestamps) to model $\Phi$ and $I_i$.
– Run randomized control ablations where recorded traces are physically and irreversibly scrambled between trials.
– Simulate the discrete toy model to estimate expected effect sizes for given $\beta, \alpha, \lambda$ parameter regimes before attempting physical experiments.
– Keep all core quantum dynamics unitary; implement memory bias as a classical-like readout channel applied to decohered pointer subspaces (no extra non-unitary collapse operator is added).

## 8. Summary

Verrell ’ s Law preserves the mathematical economy of Everettian QM by keeping unitary evolution as the only quantum axiom while adding a single, physically motivated EM memory bias mechanism. This mechanism supplies an empirically testable account for branch dominance in lived experience without invoking ad-hoc non-unitary collapse. The framework yields clear experimental protocols (ablation, freeze, parameter sweeps) and a path for simulation and lab-scale falsification.

Filename: verrells_law_MWI_bias_extension_v1_VMR-Core_watermarked.pdf

Brief description: Full technical note describing Verrell's Law as a minimal-axiom extension to Everettian QM. Includes interpretational framing (Copenhagen vs MWI vs VL), a Minimum Math Scaffold (unitary evolution, memory functional, biased Born weights), a discrete toy model, CPT-symmetric kernel notes, testable predictions, and practical implementation suggestions. Watermarked for authorship protection under VMR-Core.