February 18, 2026

Editorial Office
Physical Review A
American Physical Society

Dear Editors,

I am submitting the manuscript "Observer Quality as a Resource Variable in Quantum Darwinism: Optimal Decoding, ε-Approximate Spectrum Broadcast Structure, and a Central-Spin Worked Example" for consideration as a Regular Article in Physical Review A.

This paper addresses a gap in the quantum Darwinism (QD) and spectrum broadcast structure (SBS) literature: existing analyses typically treat observers as ideal, with perfect access, noiseless readout, and unlimited temporal horizons. We introduce an explicit observer-quality triple (R_O, Λ_O, τ_O) encoding access fraction, calibration noise, and temporal horizon, and propagate these constraints through sample-complexity bounds for pointer-value inference. The main technical results are Chernoff-type decoding bounds under calibration, a data-processing theorem showing calibration cannot increase the quantum Chernoff exponent, and ε-robust upgrades from ideal to approximate SBS with explicit additive error control. A central-spin pure-dephasing example demonstrates the framework with quantities computed from Hamiltonian couplings and depolarizing readout noise, including robustness checks against coupling heterogeneity and access assumptions.

Two aspects of this work may be of particular interest to PRA readers. First, the inverted sophistication result (Section VI E) shows that an unmonitored collective decoder can be strictly outperformed by product decoding when coherence reliability falls below a critical threshold, with the inversion requiring observer-side rather than system-side decoherence. This is a counterintuitive consequence of the factor-of-two exponent gap between collective and product measurements for pure-state binary hypotheses. Second, the paper introduces a decoder-stage classification $(q_D/q_L/q_N)$ that connects observer measurement constraints to the Dot/Linear/Network (DLN) framework developed in a companion preprint; the PRA paper is self-contained and does not require familiarity with DLN.

The scope is deliberately restricted to binary pointer alphabets and pure-state fragment records. Mixed-state extensions and multi-hypothesis generalizations are noted in the text but deferred to future work.

All numerical code and figure-generation scripts are publicly available at `https://github.com/aliawu08/dln-observer-quality-quantum-darwinism` and archived at Zenodo (DOI: 10.5281/zenodo.18610548). This paper has not been submitted elsewhere.

Suggested referees. Given the paper's intersection of quantum Darwinism, spectrum broadcast structure, and quantum hypothesis testing, the following colleagues are well placed to evaluate it:

1. **Jarosław K. Korbicz** (University of Gdańsk) — leading contributor to SBS theory and author of a recent comprehensive review of quantum Darwinism and SBS.
2. **Kamil Roszak** (Wrocław University of Science and Technology) — expert on entanglement and objectivity in pure-dephasing spin models, closely related to our central-spin worked

example.

3. **Akram Touil** (University of Maryland / Los Alamos National Laboratory) — recent work on operational approaches to quantum Darwinism emphasizing accessible information.
4. **Thao P. Le** (University of Melbourne) — contributor to the formal equivalence between strong quantum Darwinism and SBS.

Sincerely,

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