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Editorial Office
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Dear Editors,

I am pleased to submit the manuscript entitled **"Topological Constraints for Coherent Language Models: Why Geometry Prevents Hallucination"** for consideration in *Quantum Reports*, under the Topic **"Topological, Quantum, and Molecular Information Approaches to Computation and Intelligence"** edited by Prof. Michel Planat and Prof. Edward A. Rietman.

This paper presents a formal framework connecting topological geometry—specifically the Tonnetz torus and its spectral gap—to the problem of hallucination in large language models. We establish a hierarchy of sufficient conditions for coherent inference: doubly-stochastic constraints (DeepSeek's mHC) $\subset$ Hamiltonian coherence (ERLHS) $\subset$ toroidal spectral filtering (Karmonic). The key contribution is both theoretical and experimental:

- A constructive proof that toroidal topology with constant spectral gap $\lambda_1 = \Theta(1)$ bounds latent drift, with explicit Poincaré inequality and exponential convergence guarantees.
- Experimental validation across 7 language models (Phi-2, Ouro-1.4B, Qwen 0.5B/1.5B/7B, Mistral 7B, OLMo 7B, Gemma-2-9B), demonstrating up to +2.8 percentage points on TruthfulQA and 40% drift reduction on synthetic benchmarks.
- Discovery of a regime-dependent ceiling effect: toroidal logit bias improves models with moderate accuracy ($\leq 90\%$) but degrades models already near ceiling ($\geq 95\%$), identifying it as a calibration mechanism rather than a universal improvement.

The manuscript fits squarely within the Topic's scope: it applies topological structures (graph Laplacians on tori, spectral gap theory, Poincaré inequalities) to a computational intelligence problem (LLM coherence). The cross-domain nature of the spectral gap—connecting quantum error correction (toric codes), consensus protocols, and language model inference—aligns with the Topic's emphasis on bridging mathematical topology and computational systems.

The paper has been posted as a preprint on Zenodo (DOI: 10.5281/zenodo.18516477) and all code and experimental results are publicly available at `https://github.com/Paraxiom/topological-coherence`.

This manuscript has not been published elsewhere and is not under consideration by another

journal.

Sincerely,

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