

Topology Change and Wormhole Nucleation via Topological Surgery in Lorentzian Geometry

Saturday 1 November 2025 11:45 (15 minutes)

Classical singularity theorems and topological-censorship arguments seem to forbid the formation of a wormhole in 4-dimensional general relativity, even at the kinematical level, through the emergence of naked singularities. I will present a concrete example, developed in [1], in which the would-be singular set is excised and replaced by a controlled 0-surgery on a compact spacetime neighborhood. Taking the connected sum with the complex projective plane yields a smooth Lorentzian cobordism that interpolates between two spacelike hypersurfaces of different topology. The singularity is traded for a finite “chronology-violating bubble” containing closed timelike curves. The spacetime violates the standard energy conditions yet is entirely regular. After a concise review of Morse theory and the topological-surgery toolkit, the talk will present the explicit metric construction and analyze its causal structure, energy-condition violations, and consistency with topological obstructions. I will close with open questions and future directions, including possible extensions to more general Dehn surgeries.

[1] A. Pisana, B. Shoshany, S. Antoniou, L. H. Kauffman, S. Lambropoulou, “Wormhole Nucleation via Topological Surgery in Lorentzian Geometry,” arXiv:2505.02210.”

Author: PISANA, Alessandro (Brock University)

Co-author: Prof. SHOSHANY, Barak (Brock University)

Presenter: PISANA, Alessandro (Brock University)

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