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A multimodal probe for general holographic coherence of quantum space-time states on causal horizons

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Gravitational-wave observatories such as LIGO and Virgo have enabled a new era in multimessenger astronomy. In recent years, predictions of quantum gravity signatures in interferometers by Craig Hogan, Tom Banks, Eric Verlinde, Frank Wilczek, and Kathryn Zurek have inspired multiple new experiments deploying precision laser interferometry at smaller scales to probe such phenomena, such as the Holometer at Fermilab, QUEST at Cardiff, GQuEST at Caltech, and a prototype interferometer at INRiM. Many such models of holographic quantum space-time phenomena are inspired by ‘t Hooft’s algebra of black hole information, which shows large-scale spacelike coherence on causal horizons. This talk will report on efforts to generalize such holographic coherence to the inflationary horizon and causal diamonds in flat space-time (conformal Killing horizons), enabling a multimodal probe connecting primordial signatures in the Cosmic Microwave Background to concordant spectra predicted for tabletop interferometric searches in laboratory space-times. Future expansions of this multimodal research program are explored, with 3D correlations of galaxy distributions in large-scale structure surveys that show intriguing parity violations, and with future experiments in gravitationally mediated entanglement that can shed light on the excited states of quantum gravity if the current experiments detect signatures for the ground state of gravitational entanglement.

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