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Hyperbolic quantum information and matter

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Quantum information processing, at its very core, is effected through unitary transformations applied to states on the Bloch sphere, the standard geometric realization of a two-level, single-qubit system. That said, to a geometer, it may be natural to replace the original Hilbert space of the problem, which is a finite-dimensional vector space, with a finite-rank Hermitian vector bundle, through which unitary transformations are replaced very naturally with parallel transport along a connection. This imparts new degrees of freedom into the generation of quantum gates. A new approach to quantum matter —relying upon exotic hyperbolic geometries —that has emerged in my work over the past half decade with mathematicians, theoretical physicists, and experimentalists suggests that this setup may be achievable as an actual computing platform. I'll describe these developments, and there will be lots of pictures.

Keyword-1

quantum information

Keyword-2

quantum matter

Keyword-3

mathematical physics

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