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Chiral anomaly in effective open quantum systems

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The chiral anomaly underlies various phenomena, including dissipationless transport currents in topological systems. While many investigations have explored the chiral anomaly in various closed topological systems, much less attention has been given to exploring this anomaly in open quantum systems. By employing the non-Hermitian description of open quantum systems in this talk, I will address whether there are anomalous conservation laws that remain unaccounted for. For this purpose, I will present a unified formulation to calculate anomalous responses in Hermitianized, anti-Hermitianized, and non-Hermitian systems of massless electrons with complex Fermi velocities coupled to non-Hermitian gauge fields. Using this formulation, I will show that the quantum conservation laws of chiral currents of non-Hermitian systems are not related to those in Hermitianized and anti-Hermitianized systems, as would be expected classically, due to novel anomalous terms that we derive. I will further present some physical consequences of our non-Hermitian anomaly that may have implications for a broad class of emerging experimental systems described by non-Hermitian Hamiltonians.

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