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Topological Data Analysis of Monopole Currents in $U(1)$ Lattice Gauge Theory

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Compact $U(1)$ Lattice Gauge Theory is known to have a confinement phase that can be explained in terms of condensation of magnetic monopoles. In this talk, we shall explain how Topological Data Analysis (TDA) may be used to quantitatively analyse monopoles across the deconfinement phase transition of the model. We construct a cubical complex from monopole current networks and show that homological invariants associated to current networks allow for a precise estimation of the critical inverse coupling. Further, by designing a suitable filtration, we show that persistent homology may be used to quantitatively characterise the nature of current networks in the deconfined phase.

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