Contribution ID: **3** Type: **not specified**

Detecting composite orders in layered models via machine learning

Tuesday 28 May 2024 11:30 (45 minutes)

Studying systems with tunable couplings between subsystems poses challenges in determining their phase diagrams and uncovering potential emergent phases. Using machine learning and a quasidistance metric, we investigate layered spin models where coupling between spin layers induces composite order parameters. Focusing on Ising and Ashkin–Teller models, we employ a machine learning algorithm on Monte Carlo data to accurately characterize all phases, including those with hidden order parameters. Our method, based on convolutional neural networks, requires no preprocessing of spatially structured data and can be applied without prior knowledge of the sought phases. Results are discussed alongside analytical data, demonstrating broad applicability to various models and structures.

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Session Classification: Talks