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Machine learning aided study of a three-dimensional gas of SU(N) fermions[1] ENTONG ZHAO, JEONGWON LEE, CHENGDONG HE, ELNUR HAJIYEV, ZEJIAN REN, TOBY T.H. MAK, GYU-BOONG JO, Department of Physics, The Hong Kong University of Science and Technology — Machine Learning (ML) techniques have introduced a new scientific approach in quantum matter research. Recently, various quantum systems have been efficiently investigated based on ML-enabled analysis with synthetic data sets created from underlying theories, however, the direct application of ML-enabled analysis to the experimental data of quantum matter has remained elusive without fully utilizing useful attributes processed by the ML. In this talk, we report the ML-aided detection of SU(N) fermions in which we apply ML techniques to classify nearly identical density profiles of ultracold Fermi gases based on their nuclear spin configurations. This ML-aided detection allows us to measure the spin multiplicity unattainable by any other method in a single shot. By testing and re-training of the neural networks (NN) with properly manipulated experimental images, we analyze how specific attributes of the density profile affect the classification accuracies of the NN. Our work demonstrates a new approach to machine learning aided classification problems in quantum physics, creating a potential to reveal and identify hidden features in highly complex quantum matter images.

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