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The Application of Deep Learning to Event-by-Event Simulations of Relativistic Hydrodynamics

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The state-of-the-art pattern recognition method in machine learning (deep convolution neural network) has been used to classify two different phase transitions between normal nuclear matter and hot-dense quark gluon plasma. Large amounts of training data have been prepared by simulating heavy ion collisions with event-by-event relativistic hydrodynamics. High level correlations of particle spectra in transverse momentum and azimuthal angle learned by the neural network are quite robust in deciphering the transition type in the quantum chromodynamics phase diagram. Through this study, we demonstrated that there is a traceable encoder of the phase structure that survives the dynamical evolution and exists in the final snapshot of heavy ion collisions and one can exclusively and effectively decode this information from the highly complex output using machine learning.

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