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Hybrid Regression and Explainable AI for Phase Transition Analysis of two flavour Quark Matter

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We investigate a hybrid approach of parametric and nonparametric regression techniques to analyse the phase boundary between the confined and deconfined phases of two-flavour quark matter. Data derived from the Nambu-Jona-Lasinio (NJL) and Polyakov-loop extended NJL (PNJL) models are trained and further used for the prediction of phase transition boundaries with enhanced accuracy. We also observe the classification of the order of phase transition and interpret the model's predictions with extreme gradient boosting and SHapley Additive exPlanations(SHAP) values. Our findings demonstrate that this learning method effectively captures the complex behaviour of quark matter transitions and is also useful to balance interpretability and flexibility.

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