INSTITUTE OF NUCLEAR & PARTICLE PHYSICS

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Extending the Range of Nuclear Many-Body Calculations with Bayesian Machine Learning

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Infinite nuclear matter can provide valuable insights into the behavior of nuclear systems, help us understand the fundamental properties of atomic nuclei, further our understanding of nuclear forces, and aid us in determining the equation of state for nuclear matter. Ab initio many-body methods, such as many-body perturbation theory and coupled cluster theory, can provide accurate calculations for infinite nuclear matter by considering the system from its individual particles and the forces at play between them. However, these calculations can suffer from very long run times and thus prevent large-scale studies. This work presents a set of algorithms based on Bayesian machine learning, which can drastically reduce the run times needed for ab initio calculations of infinite nuclear matter systems by predicting the values of the calculations from smaller, faster-running calculations. This work focuses on removing the basis truncation error from coupled cluster calculations by predicting the converged energies from calculations at smaller basis sizes and predicting the energy from a many-body perturbation calculation to the fourth order, using results from lower-order calculations. Both accuracy and time savings will be considered motivations for these Bayesian machine learning methods.

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4:00 pm

Lindley Hall room 321