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Compton Form Factor Extraction using Quantum Deep Neural Networks

We present a comparative study of Compton Form Factor (CFF) extraction using pseudodata derived from Deeply Virtual Compton Scattering (DVCS) experiments at Jefferson Lab. The analysis is based on the twist-two formalism of Belitsky, Kirchner, and Müller, incorporating a minimally biased fitting strategy inspired by local fits to reduce model dependence. Two machine learning approaches are explored: Classical Deep Neural Networks (CDNNs) and Quantum Deep Neural Networks (QDNNs). Our results show that QDNNs generally outperform their classical counterparts in both accuracy and precision, particularly in scenarios constrained by limited model complexity with large experimental errors and data sparsity. These findings highlight the promising role of quantum-enhanced learning techniques in the extraction of hadronic structure observables and suggest a viable path forward for future quantum-optimized analyses in spin-dependent exclusive processes.

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