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Symbolic Regression of Generalized Parton Distributions using PySR*

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AI/ML informed Symbolic Regression is the next stage of scientific modeling. We utilize a highly customizable symbolic regression package “PySR” to model the x and t dependence of the flavor isovector combination $H^{u-d}(x, t, Q^2)$ at $\zeta=0$ and $Q^2 = 4 \text{ GeV}^2$. These PySR models were trained on GPD pseudodata provided by both Lattice QCD and phenomenological sources GGL, GK, and VGG. Symbolic convergence and consistency of the Lattice-Trained PySR models is demonstrated through the convergence of their Taylor expansion coefficients and their first moment in the forward limit, $A_{10}(t=0)$. In addition to PySR penalizing models with higher complexity and mean-squared error, we implement schemes that provide Force-Factorized and Semi-Reggeized PySR GPDs. We show that PySR disfavors a Force-Factorized model for non-factorizing GGL and GK sources, and that PySR Best Fit and Force-Factorized GPDs perform comparably well for the approximately factorizing VGG source.

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Authors: KHAWAJA, Adil Khawaja (University of Virginia); DOTSON, Andrew (New Mexico State University); SINGIREDDY, Anusha (Old Dominion University); ADAMS, Douglas (University of Virginia); ORTIZ-PACHECO, Emmanuel (Michigan State University); CHERN, Gia-wei (University of Virginia); LIN, Huey-Wen; BAUTISTA, Joseph (University of Virginia); ČUIĆ, Marija (University of Virginia); SIEVERT, Matthew; LITUI, Simonetta (University of Virginia); LI, Yaohang (Old Dominion University); PANJSHEERI, Zaki

Presenters: DOTSON, Andrew (New Mexico State University); SINGIREDDY, Anusha (Old Dominion University)

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