EUROPEAN AI FOR FUNDAMENTAL PHYSICS CONFERENCE
EuCAIFCon 2025

Contribution ID: **153**

Type: **Parallel talk**

Physics-informed generative models for scattering amplitude reconstruction

While cross sections are the fundamental experimental observables in scattering processes, the full quantum dynamics of the interactions are encoded in the complex-valued scattering amplitude. Since cross sections depend only on the squared modulus of the amplitude, reconstructing the complete information from nuclear and particle physics experiments becomes a challenging inverse problem. In this talk, I present a physics-informed Generative Adversarial Network (GAN) approach to reconstruct the amplitude in $2 \longrightarrow 2$ elastic pion-pion scattering, focusing on spin-0 particles to avoid the complexities from the spin of external particles or coupled channels. To address the loss of phase information, I introduce constraints from fundamental properties of scattering amplitudes in the generator's loss function: one enforcing unitarity for probability conservation and another ensuring causality through conditions on the scattering phase shifts. I will show how these constraints enable accurate amplitude reconstruction within uncertainties. I will also outline steps toward extending generative models for amplitude-level unfolding in more complex hadronic reactions.

AI keywords

Physics-informed generative models; Generative Adversarial Networks; Amplitude-level unfolding; AI/ML for inverse problems

Primary author: MONTANA, Gloria (Jefferson Lab)

Presenter: MONTANA, Gloria (Jefferson Lab)

Track Classification: Explainability & Theory