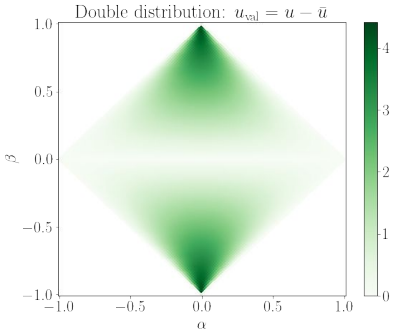
LD2406 Q2 - GPDs from polarization asymmetries with photoproduction in Hall D: highlights

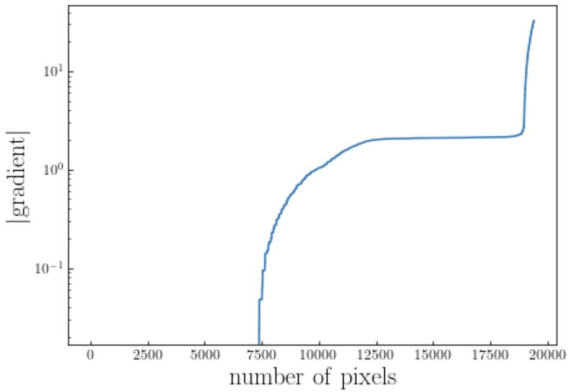
Objective Number	Milestone	FY23 Q1	FY23 Q2	FY23 Q3	FY23 Q4	FY24 Q1	FY24 Q2	FY24 Q3	FY24 Q4
1	Develop numerical codes for GPD evolution in Pytorch								
2	Calculate and implement LO hard cross sections in pQCD								
3	Simulate $\gamma N \rightarrow \pi \gamma N'$ observables at Hall D kinematics using existing GPD models								
4	Develop the GPD extraction toolkit for $\gamma N \rightarrow \pi \gamma N'$ observables using ML								
5	Calculation of NLO hard cross sections in pQCD								
6	Extend the framework to include pQCD NLO corrections								
7	Execute closure tests to validate the reconstruction of the x-dependence of GPDs								
8	Explore the sensitivity of extracting GPDs as a function of beam polarization and energy dependence at Hall D kinematics								

- **#1:** Matrix based evolution is still under development. Need to extend this to Q3/Q4
- **#4:** Issues with pixel optimization was found. Many pixels were not connected to the autograd (38% of vanishing gradients). Origin of the problem has been identified which required to revisit the dd modeling of GPDs. Solutions to this problem has been identified and is in development.
- **#5:** Calculation of the NLO short-distance matching coefficients is still in progress, needs to evaluate over 500 uncut loop diagrams, with some theoretical challenges that is currently being investigated.

Image of dd (pixels)

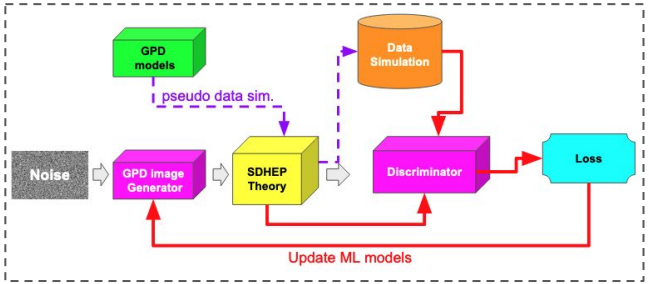


Gradient loss



~38% of vanishing gradients

Objective #: 4 ML extraction toolkit



LD2406 - GPDs from polarization asymmetries with photoproduction in Hall D: financial report

Objective Number	Milestone	FY23 Q1	FY23 Q2	FY23 Q3	FY23 Q4	FY24 Q1	FY24 Q2	FY24 Q3	FY24 Q4
1	Develop numerical codes for GPD evolution in Pytorch								
2	Calculate and implement LO hard cross sections in pQCD								
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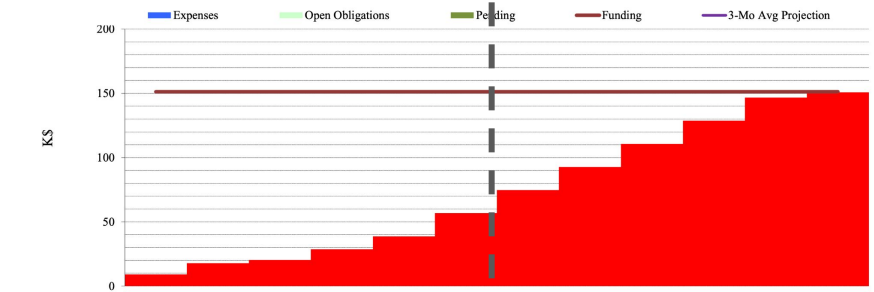
7	Execute closure tests to validate the reconstruction of the x-dependence of GPDs								
8	Explore the sensitivity of extracting GPDs as a function of beam polarization and energy dependence at Hall D kinematics								



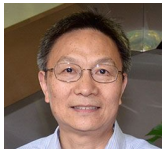
	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24	Apr-24	May-24	Jun-24	Jul-24	Aug-24	Sep-24
YTD Spending	9	18	20	29	39	57	75	93	111	129	147	151
Pending	0	0	0	0	0	0	0	0	0	0	0	0
Open Obligations	0	0	0	0	0	0	0	0	0	0	0	0
Expenses	0	0	0	0	0	0	0	0	0	0	0	0
Labor	9	18	20	29	39	57	75	93	111	129	147	151
Funding	151	151	151	151	151	151	151	151	151	151	151	151
3-Mo Avg Projection												

PI 5%

NS

Co-PI

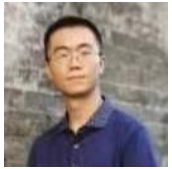
W. Melnichuk



J. W. Qiu

J.Stevens

theory



Z-Y. Li

scidac

A. Freeze

FY24 pdoc

100%

Z. Yu

FY24 grad

TBA

LD2406 - GPDs from polarization asymmetries with photoproduction in Hall D

Publications

Single Diffractive Hard Exclusive Processes for the Study of Generalized Parton Distributions
Phys. Rev. D 107 (2023)
Qiu, Yu

Extraction of the Parton Momentum-Fraction Dependence of Generalized Parton Distributions from Exclusive Photoproduction
Qiu, Yu,
Phys. Rev. Lett. 131 (2023)

Extracting Transition Generalized Parton Distributions From Hard Exclusive Pion-Nucleon Scattering
Qiu, Yu,
e-Print: 2401.13207 (2024) PRD in press

Conferences

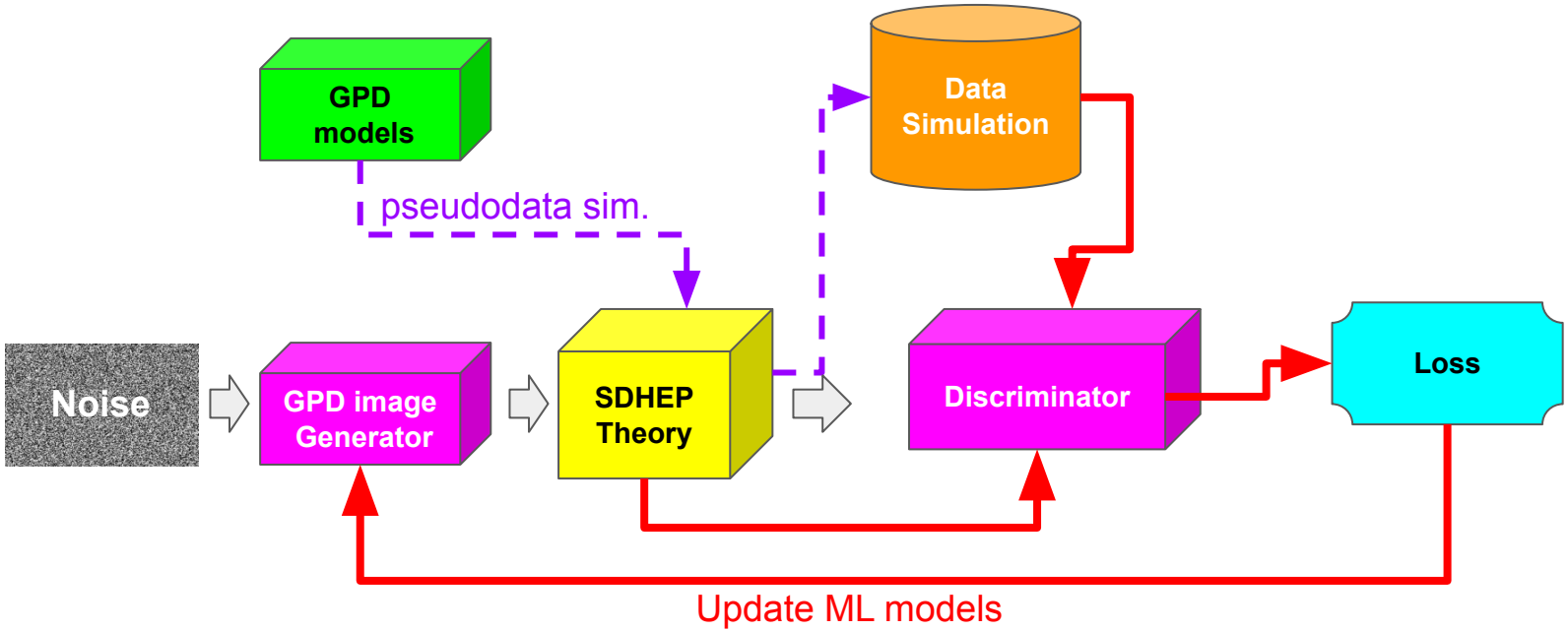
Exclusive Diphoton Mesoproduction at J-PARC for Probing QCD Tomography with Enhanced Sensitivity. "Fourth International Workshop on the Extension Project for the J-PARC Hadron Experimental Facility (HEF-ex 2024)"
Z. Yu

Exclusive Photoproduction Reactions for Nucleon Structure (GPDs). "Workshop on Polarized Target Studies with Real Photons in Hall D"
Z. Yu

Single Diffractive Hard Exclusive Processes for Studying Generalized Parton Distributions (GPDs). "Workshop on GPDs for Nucleon Tomography in the EIC Era"
Z. Yu

Single Diffractive Hard Exclusive Processes for Studying Generalized Parton Distributions (GPDs). "The 2023 Fall Meeting of APS DNP and JPS"
Z. Yu

Explore Nucleon's Quark/Gluon Structure without Breaking it.
Nuclear physics seminar, Physics Department, University of Illinois at Urbana-Champaign
J. Qiu


GPD models
Data Simulation
pseudodata sim.
Noise
GPD image Generator
SDHEP Theory
Discriminator
Loss
Update ML models