



# UC Davis Overview

*Daniel Cebra*  
*UC Davis*





# People

## The UC Davis team for EIC:

- Daniel Cebra
- Manuel Calderon
- Ramona Vogt (also LLNL)
- Zach Sweger (GS 5<sup>th</sup>)
- Saeahram Yoo (GS 5<sup>th</sup>)
- Mathias Labonte (GS 2<sup>nd</sup>)
- Ziyuan Zeng (GS 1<sup>st</sup>)

## Soon to be joining:

- Andrew Liggett (GS 2<sup>nd</sup>)
- Arnav Batra (Undgr)
- Peyton Hilford (Undgr)

Daniel



Zach



Mathias



Manuel



Saeahram



Ziyuan



## Other Senior Students

- Ota Kukral (CMS)
- Graham Waegel (CMS)
- Matt Harasty (STAR)
- Frank Gonzalez (CMS)

Group Policy is that all new people joining the group will share time between EIC and other UCD efforts.



# Prospects for more People

## Prospects for a new faculty member:

- UCD Physics is in the process of writing a new five-year hiring plan.
- Current thoughts for five-year hiring goals and priorities:

Area	CME	CMT	HEE/PEX	HET	FSG	AST obs	AST T	Complexity	Nuclear	New initiatives
Average number Scaled to 20 FTE	3	2.5	2	1.5	0.5	2.5	1.5	2.5	1	2.5

### Ranked by number of votes (tiebreaker = average priority)

- Complexity (6 votes, with 5 as first priority; included by N-1 voters)
- CME (6 votes)
- AOC (5 votes; 4 voters)
- CMT (4 votes)
- New initiative (4 votes; 3 voters)
- Nuclear (3 votes)
- HEE/PEX (3 votes)
- HET (2)
- FSG (1)
- COS-T (1)

- 20 Hires in five years would be growth of about ten (to total faculty of size of 50).
- Dean will likely not grant more than two per year.
- At two per year, Nuclear would come up in 2026.
- We have been arguing for a joint hire will LBNL, which could move the search up to 2025.  
→ Search in Winter to start July 1<sup>st</sup> 2025

→ Faculty positions at UCD will be very hard to get



# Prospects for more People

## Prospects for a Postdoctoral Scholar:

- We had been holding back trying to fill this spot in hopes that we could get a new faculty member sooner, and we would then involve that new faculty member.
- This had proven to be not practical.
- Decided to convert the PD funding into more partial funding for GS (now funding two students to be resident at LBNL and split time between STAR and EIC, also funding for a third student in the summer).

## New graduate students:

- Although 2023 was a challenging year for graduate admissions, we will targeted enrolling one new graduate student in Nuclear Physics → Ziyuan Zeng
- All new students joining the group will split time between EIC and another UCD effort.



# Physics Interests

How do our current interests mesh with the EIC?

Daniel



Manuel



- Phase Diagram on QCD Matter
- → Working with Spencer Klein on Backward Vector Meson Production, and now DVCS. (Sam Heppelmann, Zach Sweger, Ziyuan Zeng)
- Nuclear Data for Space Radiation Protection
- Astatine-211 production and applications
- Detector development
- → Efforts to assist Nikki Apadula's work (Mathias Labonte, Saeahram Yoo, and Ziyuan Zeng)
- Heavy Flavor (Upsilon) Production
- → Saeahram Yoo has made progress. Working with LBNL group (Minjung, Yuanjing, Xin, and Spencer)
- Outreach (IMAX Movie)





# Progress

## MRPI Goals:

*Encourage collaboration between personnel from campuses and labs to develop EIC detector proposals.*

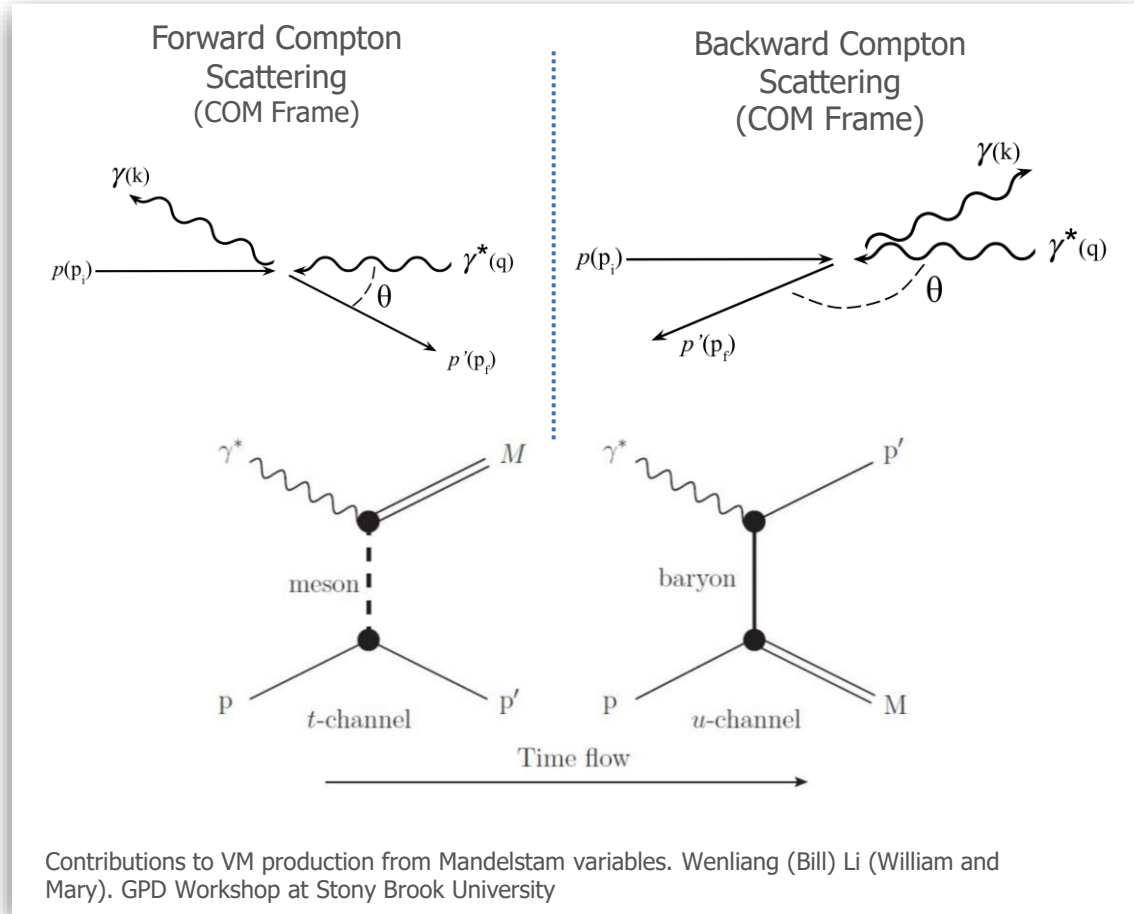
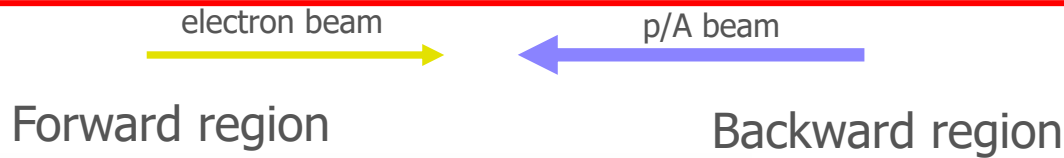
## Brief timeline:

- Sam Heppelmann (UCD GS) moved to LBNL to work with Spencer on Vector Meson Production (2019-2021)
- Zach Sweger (UCD GS) completed the Backward Vector Meson Production project. Paper published in 2022 (Phys.Rev.C 106 (2022) 1, 015204). (**LDRD 2021**)
- Zach moved to LBNL in summer 2022.
- Zach starts DVCS project with Spencer in summer 2022. Paper now ready to submit.
- UCD hosts EIC Consortium meeting July 2022.
- Mathias Labonte, Saeahram Yoo, and Ziyuan Zeng commit to going to LBNL to work with Nikki on thermal measurements of carbon fiber structures in Fall 2022.
- Mathias moved to Berkeley in summer of 2023

***One of our goals has been to have a UCD grad student resident at LBNL (now two):  
→ Sam Heppelmann (2020-2021), Zach Sweger (2022-2025), Mathias Labonte (2023-)***



# Backwards ( $u$ -channel) Compton Scattering



## Forward vs Backward Scattering

- Forward Production
  - $t$ -channel: low Mandelstam  $t$ , high  $u$
  - Momentum transfer to target is small
  - $\gamma$  is produced in backwards ( $e^-$ -going) direction
  - Proton continues in forward direction
- Backwards Production
  - $u$ -channel: low Mandelstam  $u$ , high  $t$
  - Momentum transfer to target is large
  - $\gamma$  produced in forwards ( $p$ -going) direction
  - **Proton shifted many units in rapidity**

**Backward scattering results in a large rapidity shift of the incident proton and probes the question of whether the baryon number is carried by the valence quarks or by the gluon junction.**



# Plans

## Physics Goals: Heavy quarkonia production in DIS and in photon-nucleus collisions

Building on the expertise of Calderon, who has studied upilon production at RHIC and at the LHC in  $p+p$ ,  $p+A$ , and  $A+A$  collisions, and the theoretical work of our colleague, Ramona Vogt, we would like to continue this research into the EIC era.

Photonuclear collisions involving the exclusive production of light vector mesons ( $\rho$ ,  $\omega$ ,  $\Phi$ ) and of heavy quarkonia ( $J/\psi$  and  $Y$  particles) provide an excellent tool to probe gluon distributions at low  $x$ . Tagging the outgoing electron and is necessary to fully constrain the kinematics. Tracking is essential for the measurement of the leptons from the decays of the vector mesons and heavy quarkonia – this stimulates our interest in tracking simulations and performance.





# Summary and Outlook

## Summary:

- UCD has had a GS resident at LBNL (SH → ZS → ML → ...). Now two students.
- Zach completed and published work started by SH and supervised by SK.
- Zach has completed the DVCS project, paper to be submitted (supervised by SK).
- Mathias, Saeahram, and Ziyuan has joined the hardware effort at LBNL (led by NA).

## Outlook:

- Faculty hire likely in the 2025-2026 timeframe.
- Converted Postdoctoral scholar position to more GSR funding.
- Started UCD efforts in heavy flavor production.