

Berkeley 4-year overview

Barbara Jacak
UC Berkeley and LBNL

January 10, 2025

Group(s) members: current and past

UCB Graduate students

current: Tucker Hwang, Beatrice Liang-Gilman, Anjali Nambrath, Kirill Naumov, Emma Yeats

previous (& current location): Fernando Torales Acosta (LBNL), Dhruv Dixit (MIT Lincoln Lab), Alwina Liu (Hughes Research Lab), Ezra Lesser (CERN Fellow)

UCB Postdocs

current: Preeti Dhankher, Minjung Kim

previous (& current location): Wenqing Fan (U. of Houston), Rey Cruz Torres (startup), Kyle Lee (MIT postdoc)

* Worked on ALICE, not EIC

Group(s) members: current and past

Undergrads

current: Mito Funatsu, Skye Heiles

previous (& current location): Kyle Devereaux (MIT G.S.), Malika Gulshan, Richard Lew, Andy Park, Remi Seddigh, Ben Sterwerf (Johns Hopkins G.S.), Oscar Tapia Gallegos

LBNL postdocs

current: Raymond Ehlers, Yu Hu, Florian Jonas, Greg Ottino, Ashish Pandav, Rita Sadek

previous: Tyler Hague, , Yuanjing Ji, Peng Miao, James Mulligan

Group(s) members: current and past

LBNL Staff

current: Ernst Sichtermann*, Nikki Apadula, John Arrington, Irakli Chakaberia, Xin Dong, Barbara Jacak (50%), Spencer Klein, Shujie Li, Austin Raymer, Zhengwei Xue, Zhenyu Ye

former: Yue Shi Lai (LBNL Applied Nuclear Physics group), Yuan Mei (U.T. Arlington)

* SVT DSC leader

Main accomplishments in past 4 years

- Design of EIC Silicon Vertex Tracker using MAPS sensors
- Track reconstruction software development
- Tracking performance studies: resolutions, efficiency, purity, background and noise effects
- Heavy flavor reconstruction in SVT
- SVT mechanical and cooling design, disk prototypes
- Sensor prototype characterization (bench and beam)
- Physics studies: photoproduction, backward vector meson production, EECs, heavy flavor

Detector construction plans at campus/lab

- Leadership of SVT detector in ePIC
- Plan to construct SVT endcap(s) in Berkeley
- Contribution to ancillary ASIC design
- Lead construction of flexible printed circuits

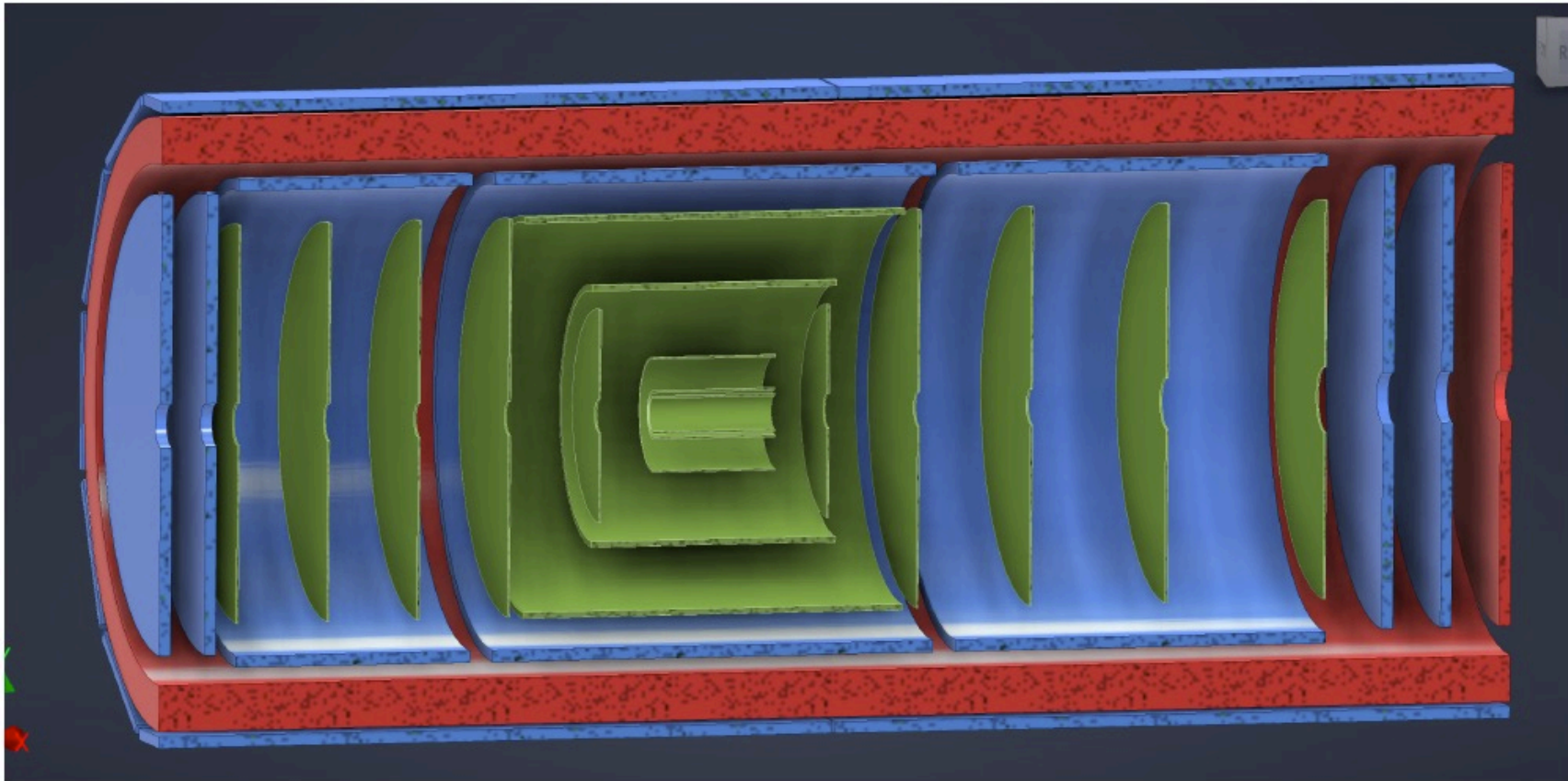
Key roles in ePIC

- SVT Detector System chair: Ernst Sichtermann
- SVT work package conveners: Nikki Apadula, Zhenyu Ye
- Reconstruction WG co-convenor: Shujie Li
- Tracking WG co-convenor: Ernst Sichtermann
- Collab. Council chair 2023-24: Ernst Sichtermann
- Nominating Committee chair 2023-24: John Arrington
- Executive Board: Barbara Jacak
- Conference, Charter, Result Release committees: Barbara Jacak
- Vertexing leader: Xin Dong

Key UCB non-EIC accomplishments

- EECs in pp, pPb and Pb+Pb collisions at ALICE
- Developed additional EEC observables
- EEC & jet axis differences in D^0 tagged jets in pp
- Jet axis differences in pp and Pb+Pb at ALICE
- Jet angularities in pp, Pb+Pb and D^0 tagged jets
- Direct γ production in pp and p+Au in ALICE
- Gamma-jet correlations in Pb+Pb in ALICE

SVT design



SVT

MPGDs

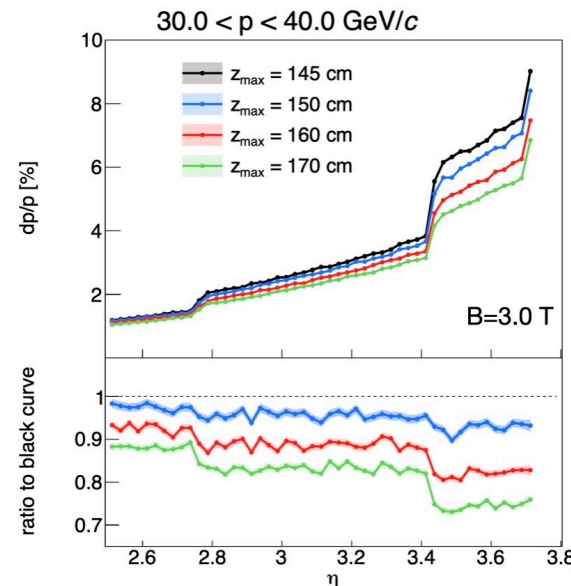
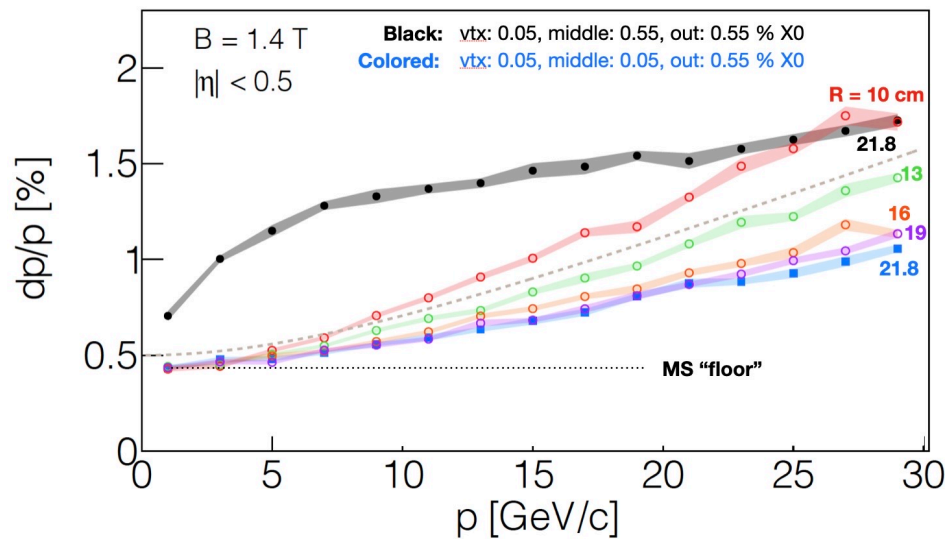
ToF (fiducial volume)

6

Implemented into ePIC simulation geometry by Shujie Li

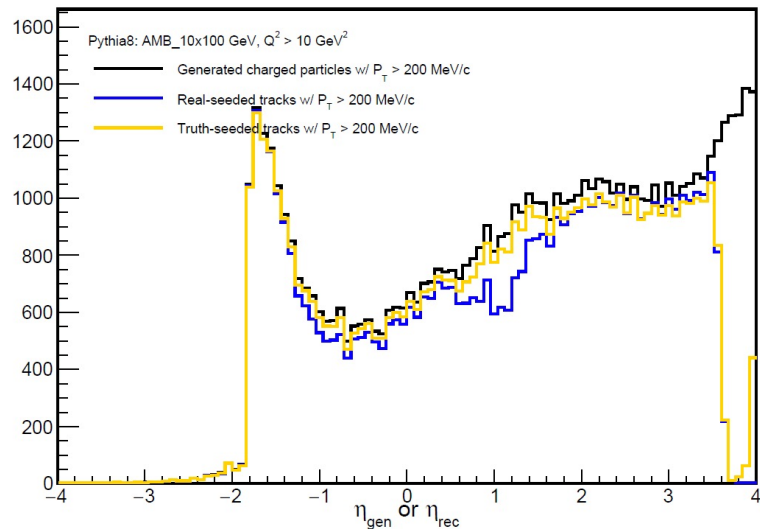
ePIC tracking performance studies

- Many fast MC studies by Ernst Sichterman to fix layout and specify design parameters
- Full MC studies of resolutions, informing design

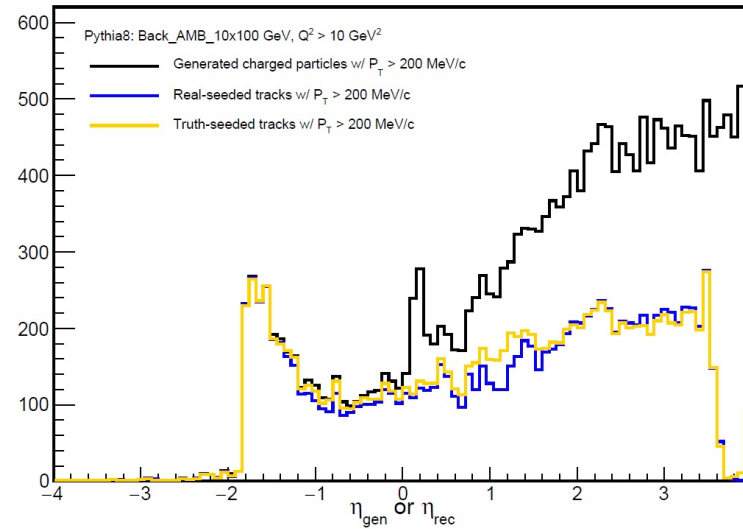


- Optimize ACTS parameters for track reconstruction

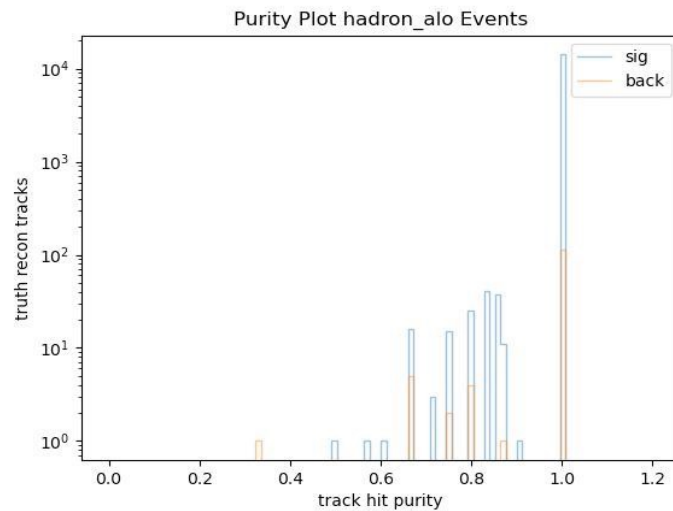
Tracking works in presence of background



10000 events signal only



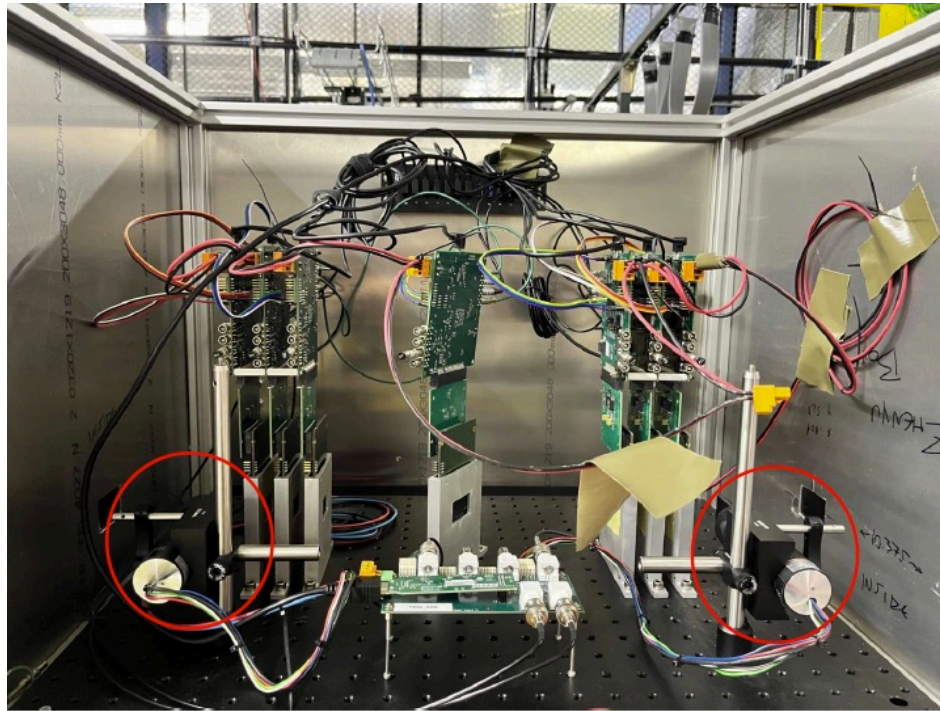
2000 events signal with p beam-gas bckgd



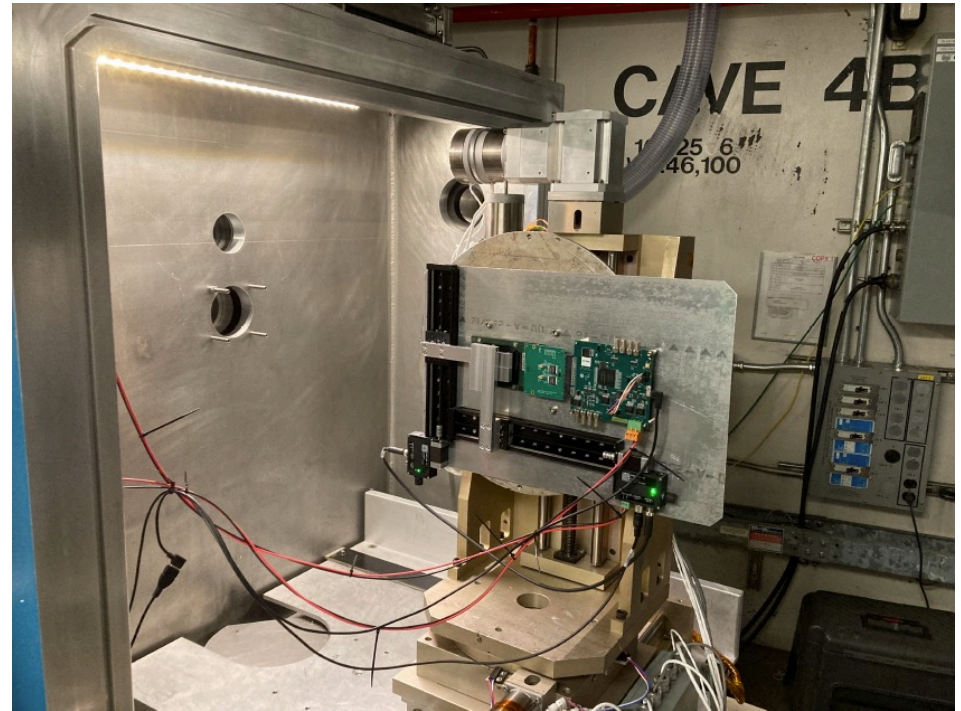
Admixed Hadron Beam Gas (ALO)
 Contaminated Signal Tracks: 1.1%
 Contaminated Back Tracks: 10.2%

Ben Sterwerf

Characterize sensor at FNAL & 88-inch cyclotron

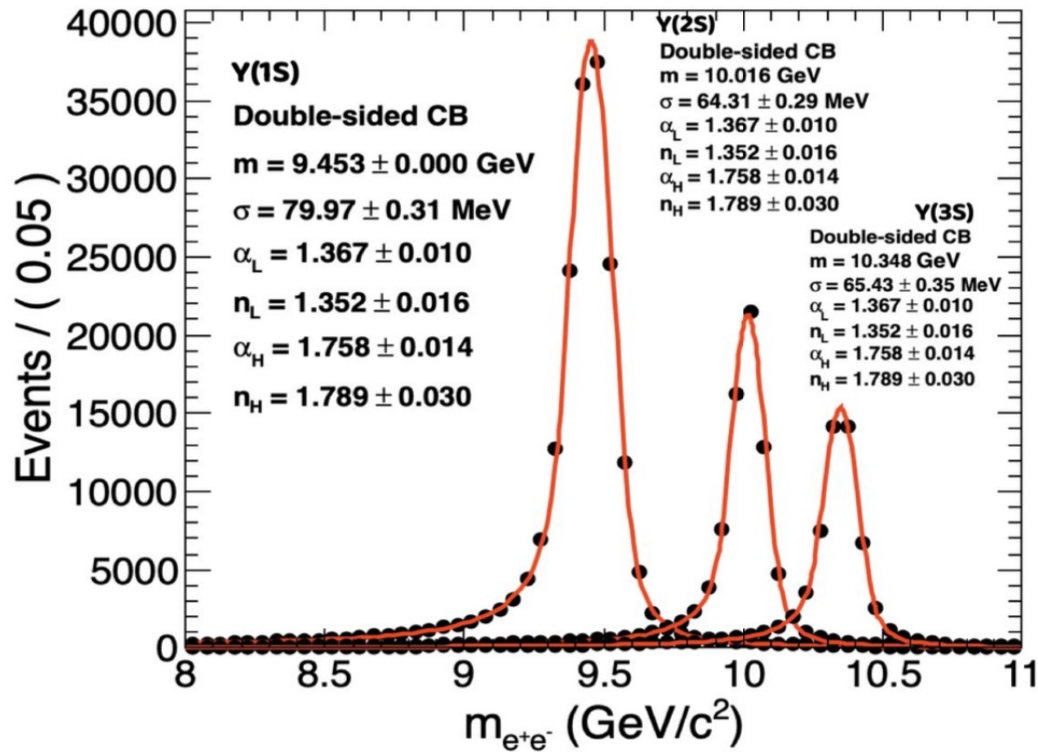


120 GeV protons at FNAL
Study different angles of incidence
Reconstruct tracks in telescope



10 MeV/A heavy ion cocktail at the LBNL
88" cyclotron
Look at single event upsets & latchups

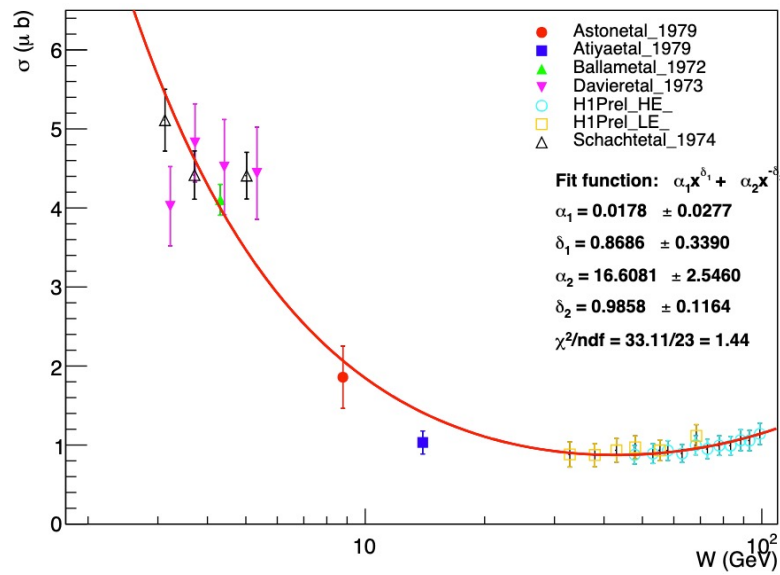
Photoproduction & vector meson studies



Many studies by LBNL and UCB together with UCD!
Study of upsilon state separation by Minjung Kim and Saeahram Yoo
[Full ePIC performance simulation](#)

ρ' \rightarrow 4 π photoproduction

- One or more (likely two) excited ρ states, decaying to 4 π
 - Data fit by single state with $M=1570$ MeV/ c^2 and $\Gamma=570$ MeV/ c^2
 - Good mass for saturation studies
 - Heavier than the $\rho \rightarrow$ pQCD is more applicable
 - The $\phi(1020)$ is hard to detect at small Q^2
 - Lighter than the J/ψ , so saturation is significant
- There is new HERA data on $\rho' \rightarrow 4 \pi$; together with STAR and recent ALICE results, so can model the production & decay

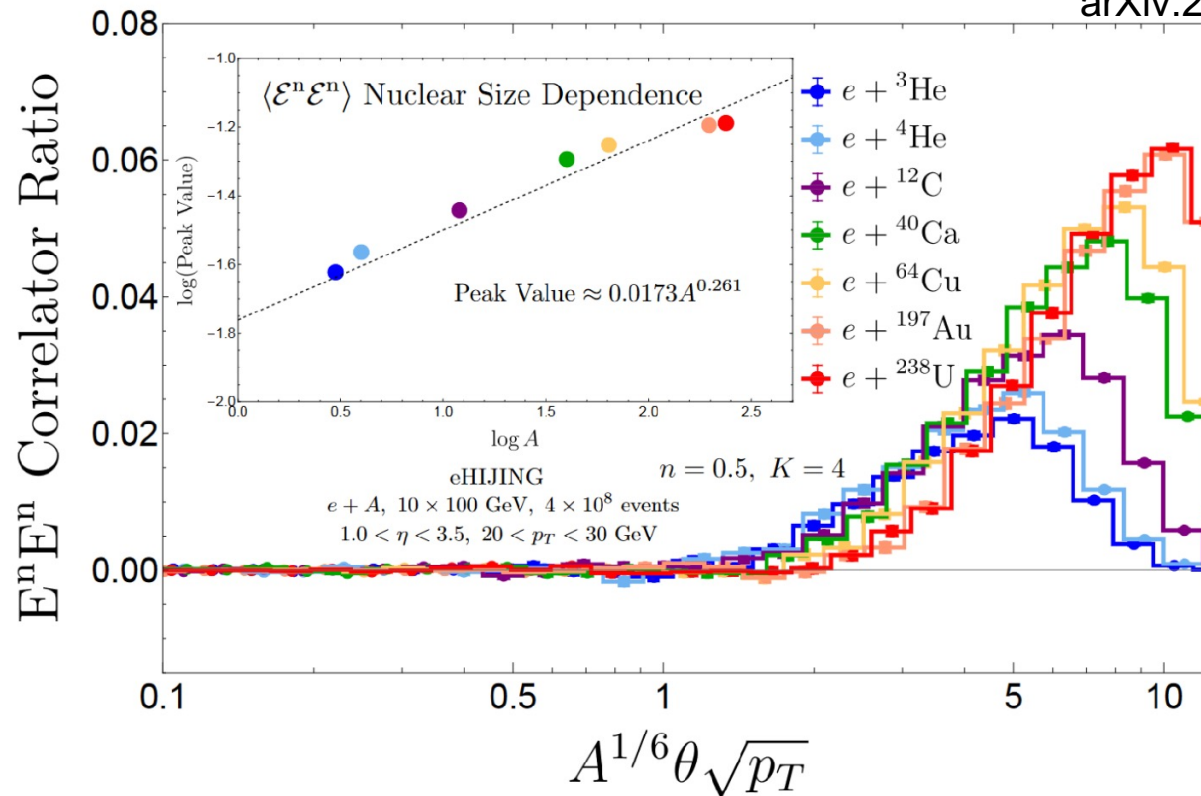


Fit to the H1 + fixed target data

Minjung Kim, Spencer Klein,
work in progress

EECs at the EIC

arXiv:2303.08143



A dependence of jet energy-energy correlators in e+A collisions
 Uses gluon PDF's parameterized by a saturation-inspired formula
 Illustrates effect of nuclear size on soft partonic splittings

Leveraged funding (grants due to MRPI project)

- Multiple EIC detector R&D awards for SVT to LBNL
- Jacak SC Distinguished Scientists Fellow Award

Future plans in the EIC program

- Complete design of SVT, particularly disks
- Lead SVT & tracking simulation efforts
- Construct SVT endcap disks, with LANL, Purdue, and other collaborators
- Contribute to SVT mechanical design & construction
- Flesh out physics programs at ePIC
 - Jet substructure
 - Heavy flavor jets
 - Photoproduction of vector mesons

Backup