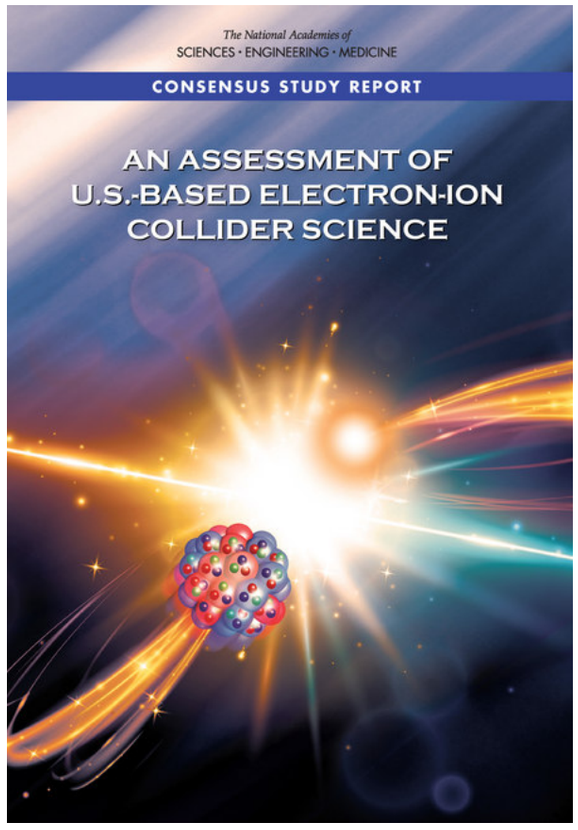
LBNL Progress & Plans

Ernst Sichtermann

University of California Consortium Meeting
LBNL - September 18, 2019

Context



Endorsed science case,

Four nuclear-physics themes:
- nucleon spin,
- imaging in nucleon and nuclei,
- gluon-dense matter / saturation,
- hadronization and fragmentation

Most/all measurements *require* large acceptance,

High resolution is a must in the solenoidal fields of current general purpose detector designs,

Traversed material will need to be kept in check, especially in the electron direction.

Current Status and Path forward of EIC

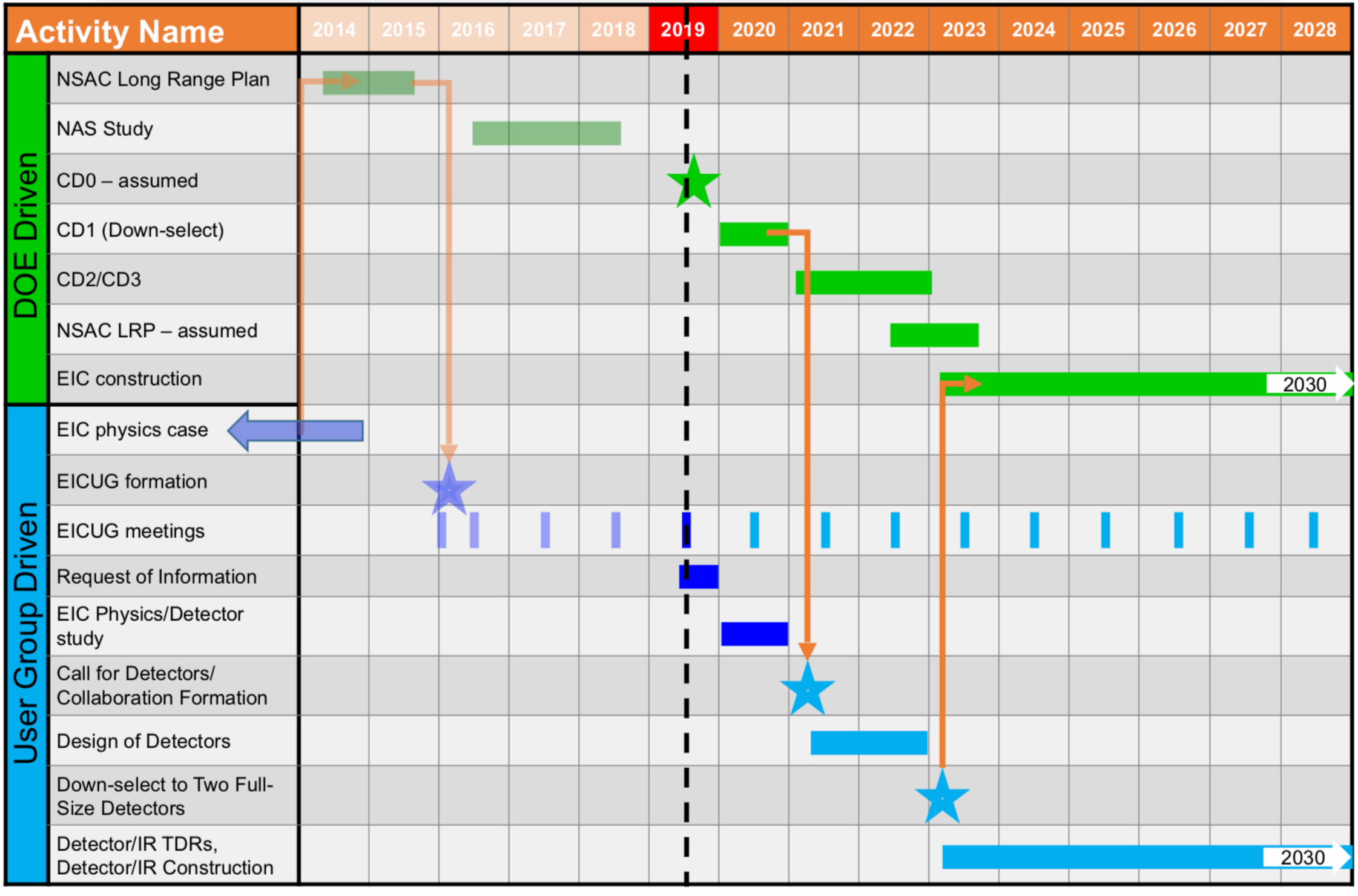
The “wickets” are substantially aligned for a major step forward on the EIC

- A Mission Need Statement for an EIC has been approved by DOE
- An Independent Cost Review (ICR) Exercise mandated by DOE rules for projects of the projected scope of the EIC is very far along
- DOE is moving forward with a request for CD-0 (approve Mission Need)
- DOE has organized a panel to assess options for siting and consideration of “best value” between the two proposed concepts
- The Deputy Secretary is the Acquisition Executive for this level of DOE Investment
- **The FY 2020 President’s Request includes $ 1.5 million OPC. The FY 2020 House Mark includes $ 10 million OPC and $ 1 million TEC.**

From Tim Hallman’s talk at the EICUG meeting in Paris this Summer.

My understanding: ICR complete, site-selection in progress,
Some timelines will be sooner than many have internalized.

EICUG Timeline

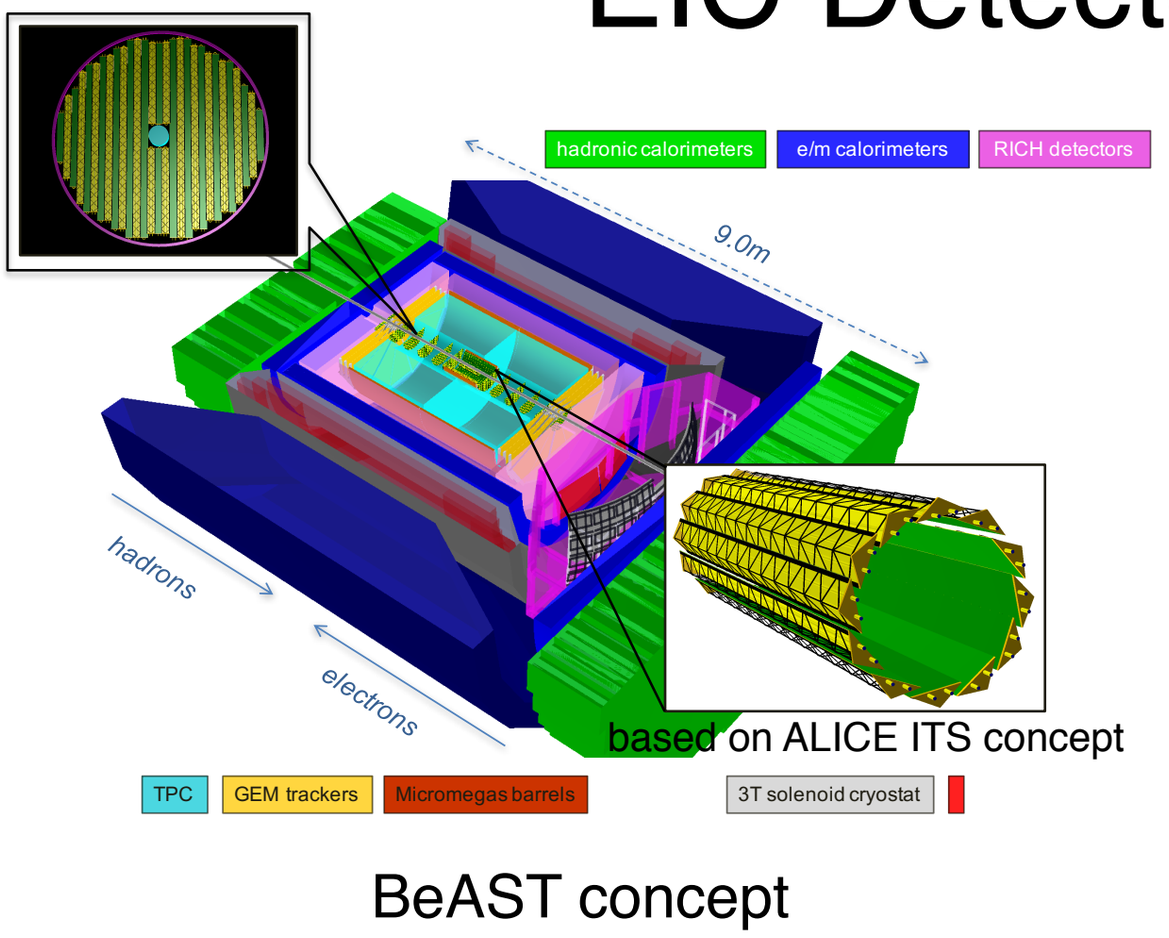


EICUG Detector Timeline Steps

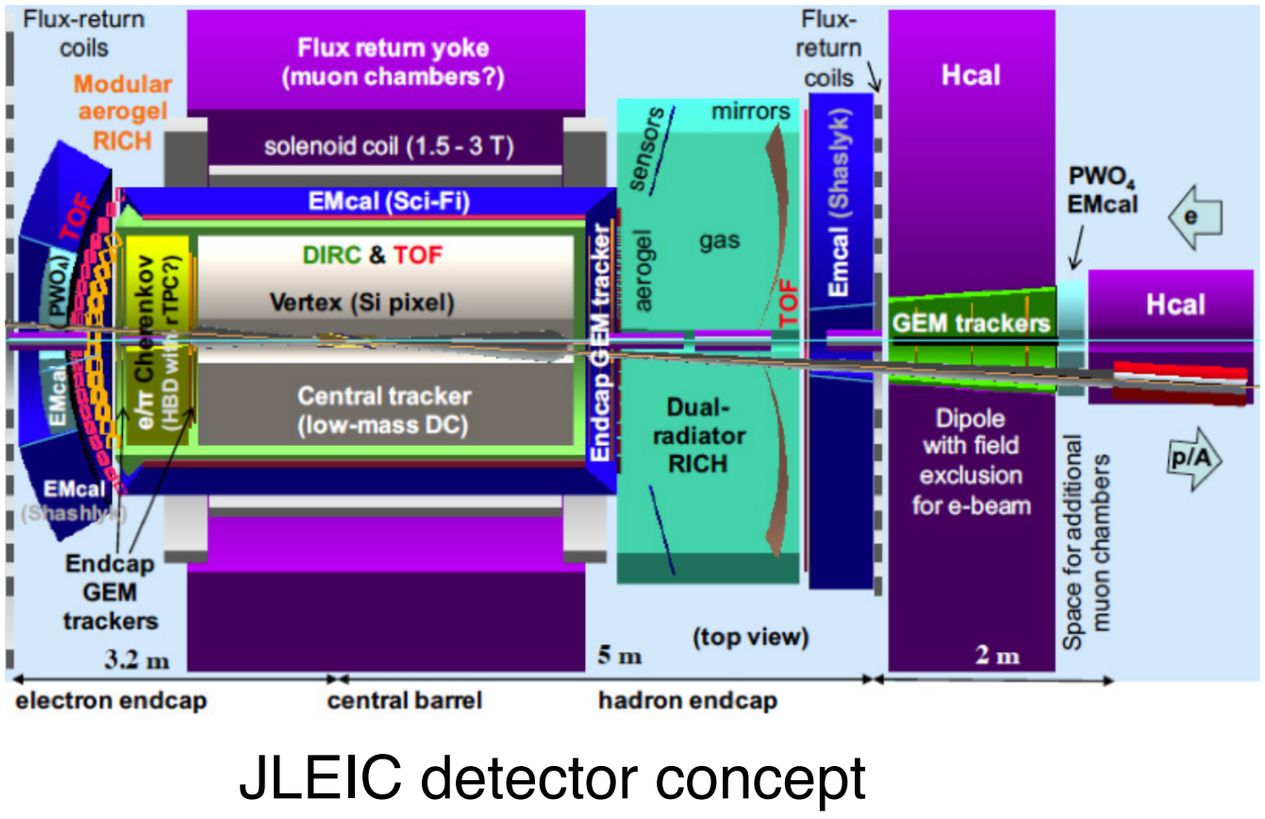
	Request of Information	EIC Physics / Detector Design Study	Collaboration Formation. Call for Detectors	Design of Detectors	Down Select to two full size detectors	Detector/IR TDR and Construction
2019	User Group Driven				Collaboration Driven	
2020						
2021						
2022						
2023						
2024						TO 2030

My understanding: some timelines will be much sooner than many have internalized.

EIC Detector Concepts*



BeAST concept



JLEIC detector concept

Si-based *inner* tracking and vertex detectors*, covering central and forward regions, for eRHIC as well as JLEIC detector concepts,

EIC needs: large acceptance, low mass, and high resolution.

All-Si detector concepts were until this cycle mostly outside the scope of our R&D; made a start following a committee suggestion.

*Other concepts exist; e.g. J. Repond et al. have put forward an all-Si tracker sPHENIX transition to a day-1 EIC detector.

EIC Physics and Detector Conceptual Development

As discussed at the annual meeting in Paris in July, we are in the process of organizing a 12-18 month intensive study of the EIC physics and detector concepts by the members of the EIC users group. This study seeks to build on the 2014 EIC White Paper and the 2018 NAS science assessment and will be complementary to the ongoing R&D at laboratories and universities worldwide. The study is open to all EICUG members and we would particularly encourage participation by colleagues from universities.

We are proposing that sub-groups of EICUG members would consider in detail specific experiments using realistic accelerator and detector concepts over about a year and write a summary of about 15 pages in length. These studies should use, in so far as possible, the current accelerator and detector concepts and simulations should be carried out using the EICUG developed software tools. The summaries would be edited and published in a volume, in the style of the CERN Yellow Reports.

We envision a 2-day kick-off meeting in fall 2019, regular workshops about every 4 months and a meeting in spring 2021 to finalize the reports. We are in the process of putting in place an organizational structure. Suggestions and advice are welcome.

The EICUG Steering Committee

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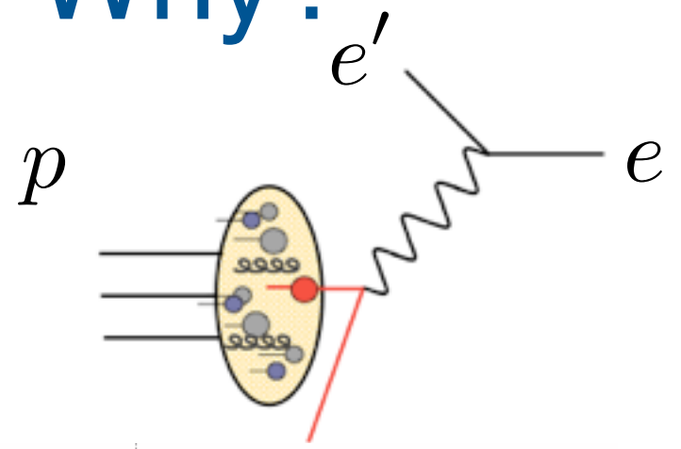
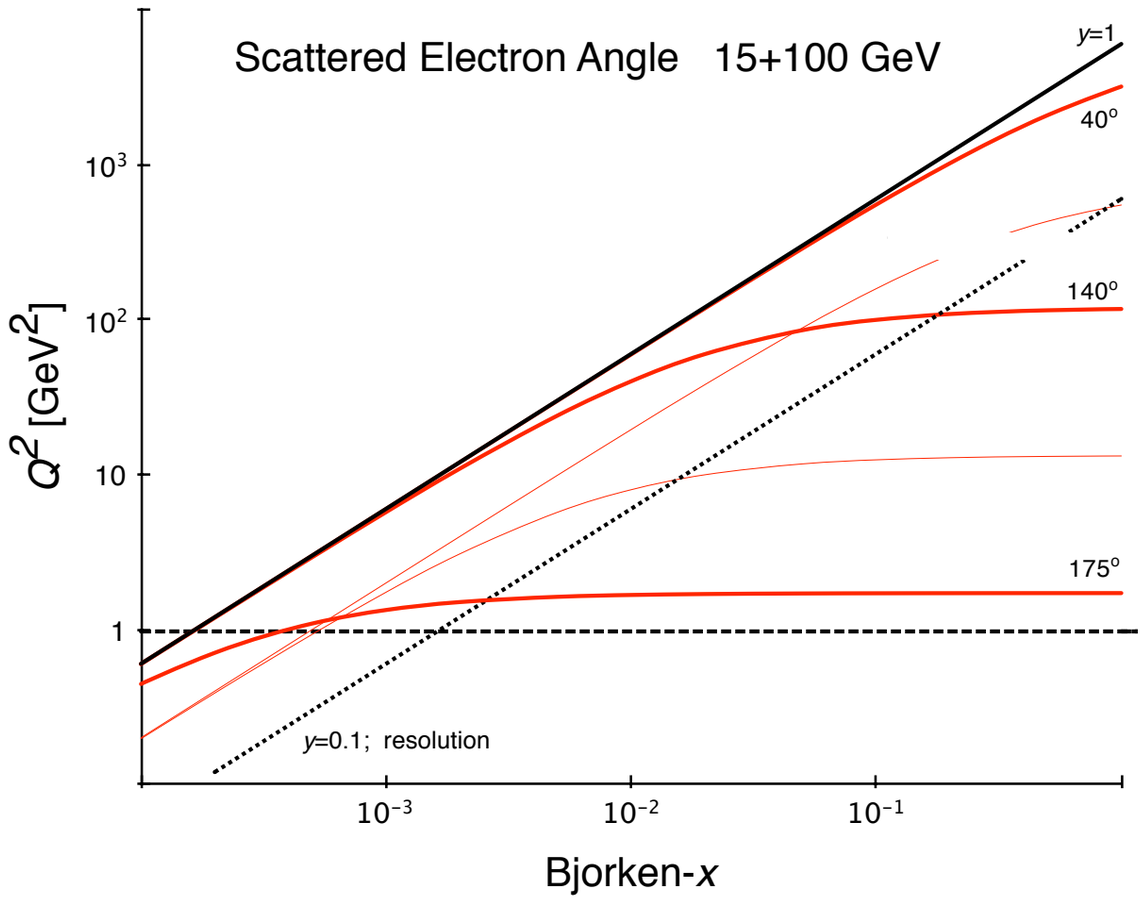
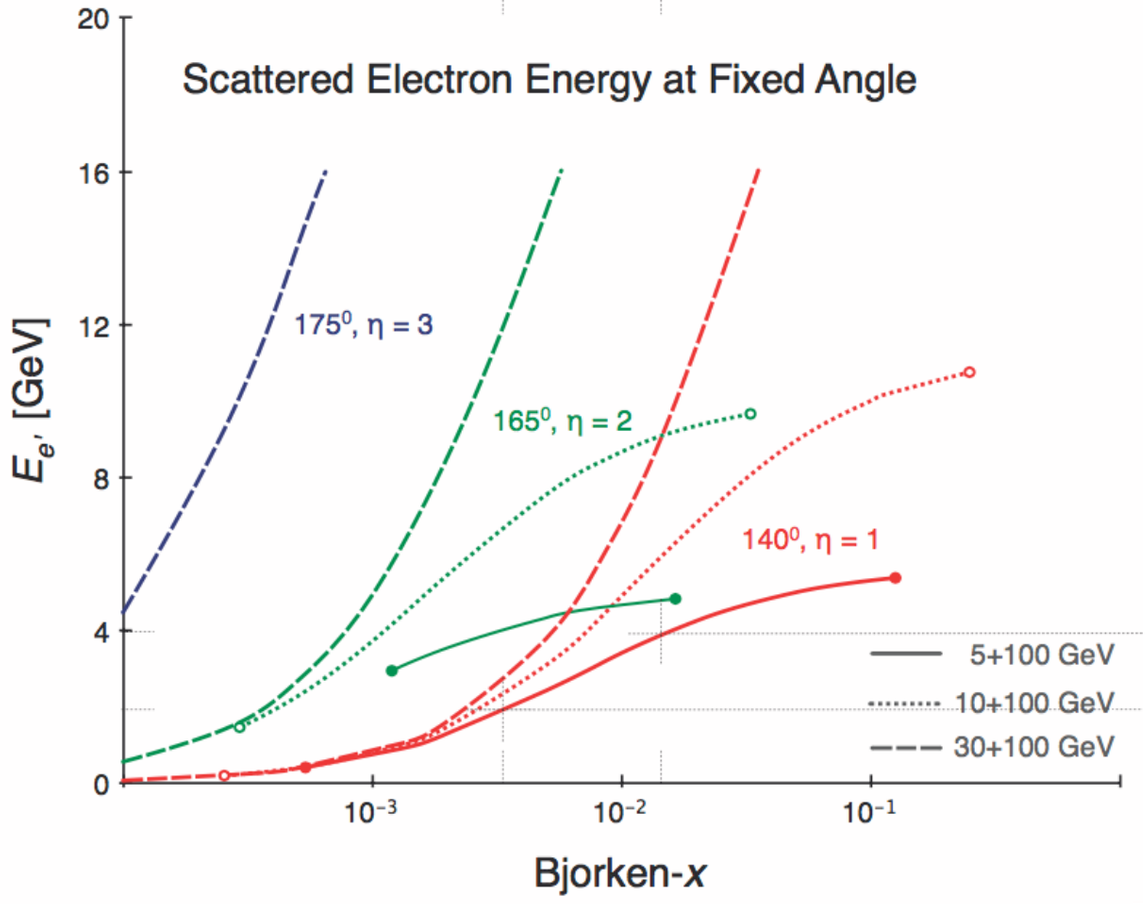
Forward/backward Tracking - Why?



The scattered electron, for example,

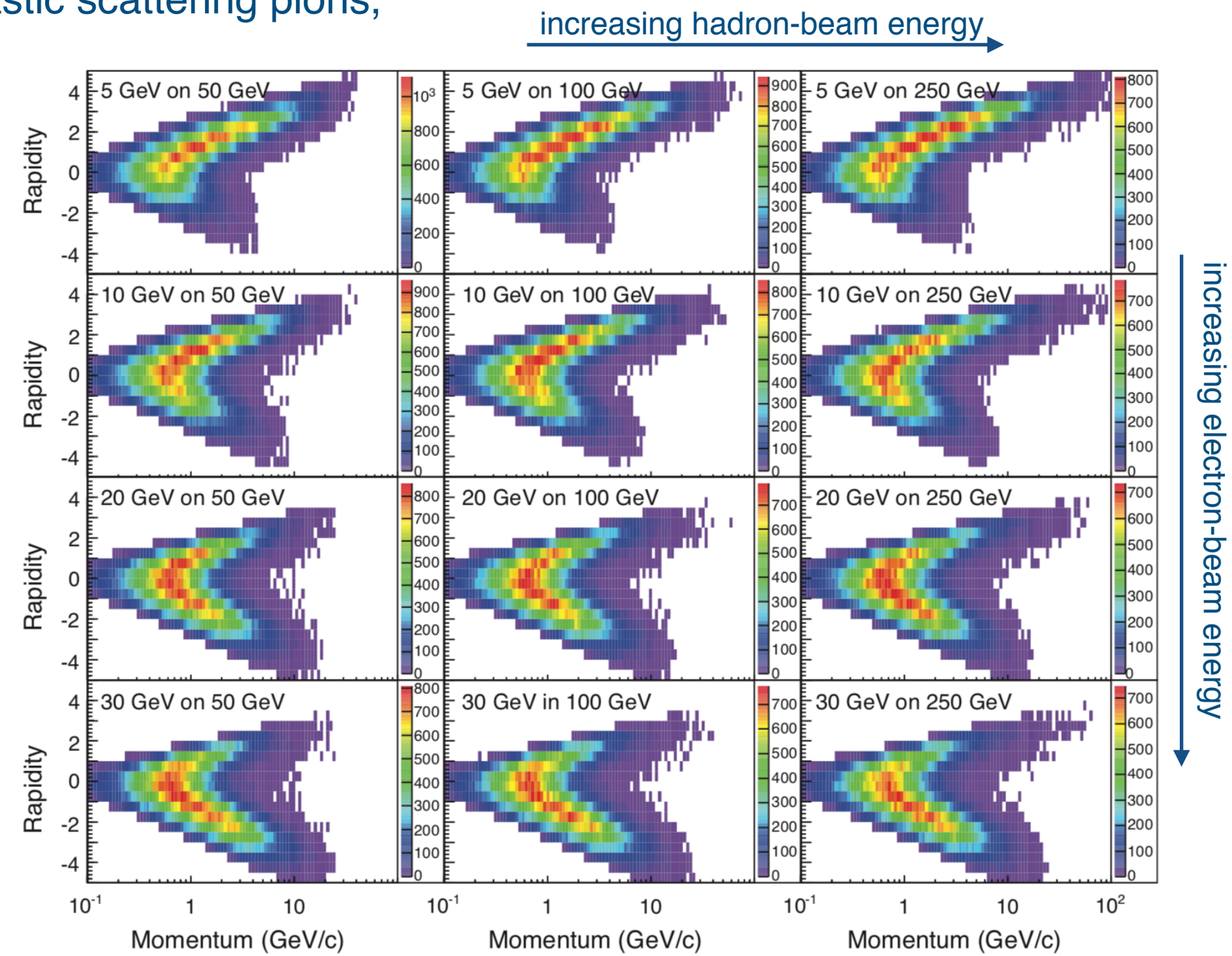




will in many cases need to be observed at large *backward* angles with respect to the hadron beam (HERA angle convention).

Forward/backward Tracking - Requirements

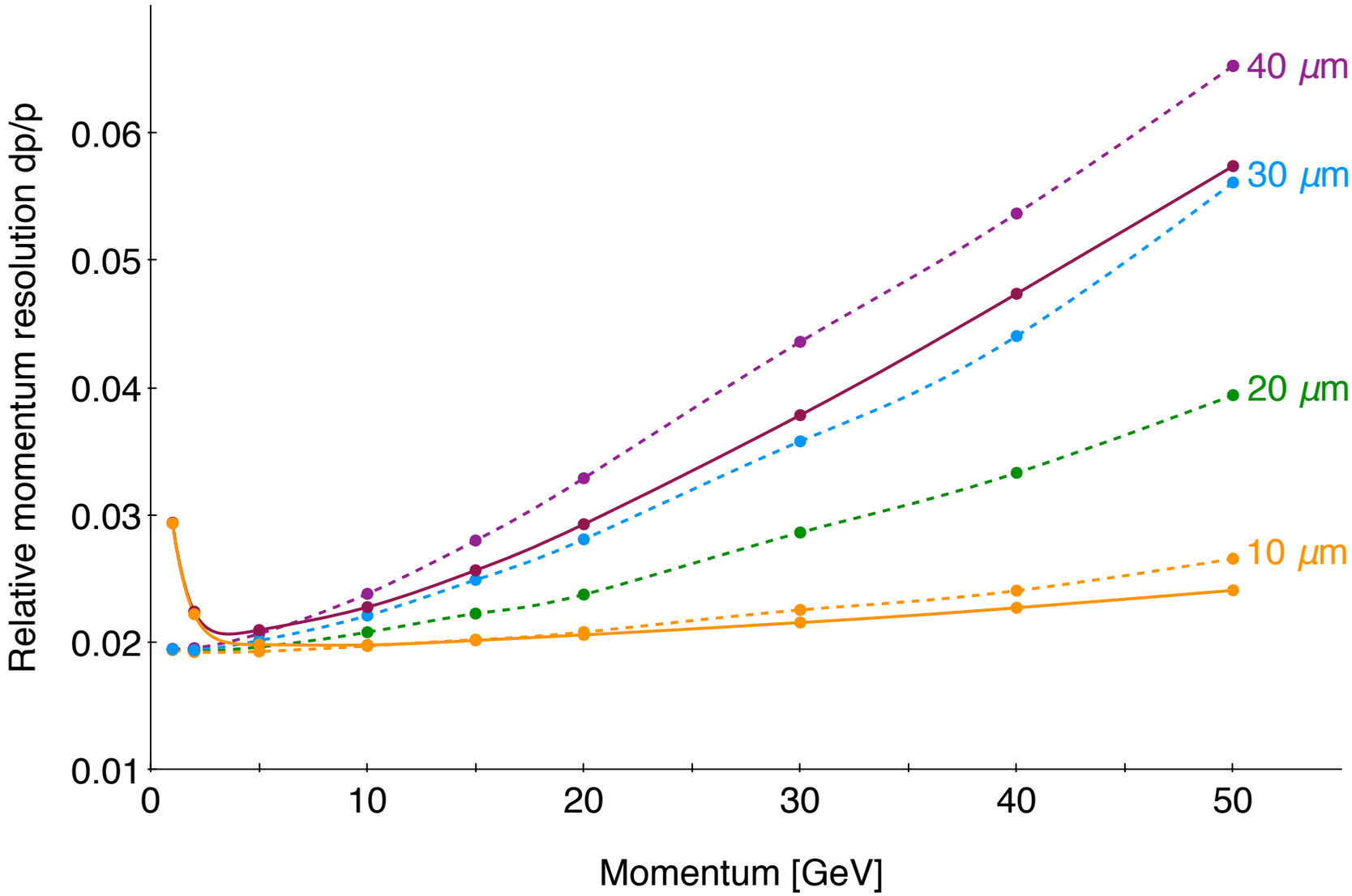
Deep-inelastic scattering pions,



likewise require large (tracking) acceptance. EIC-WP, figure 5.2

PID *really* matters at EIC. ToF *may* have *a* role in *part* of the phase-space.

Forward/backward Tracking - Requirements



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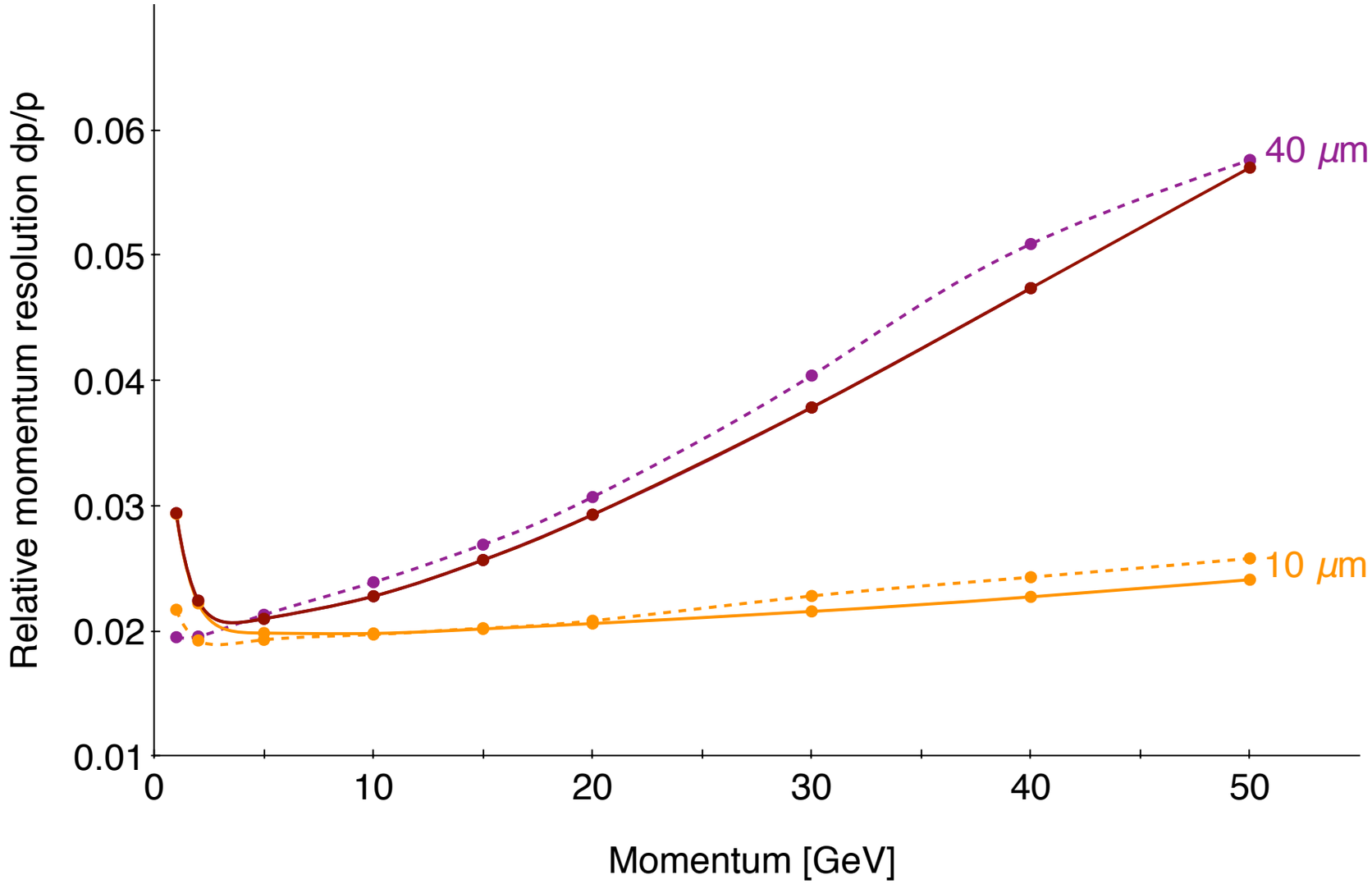


A number of sensor requirements are well-understood, from multiple simulation tools.

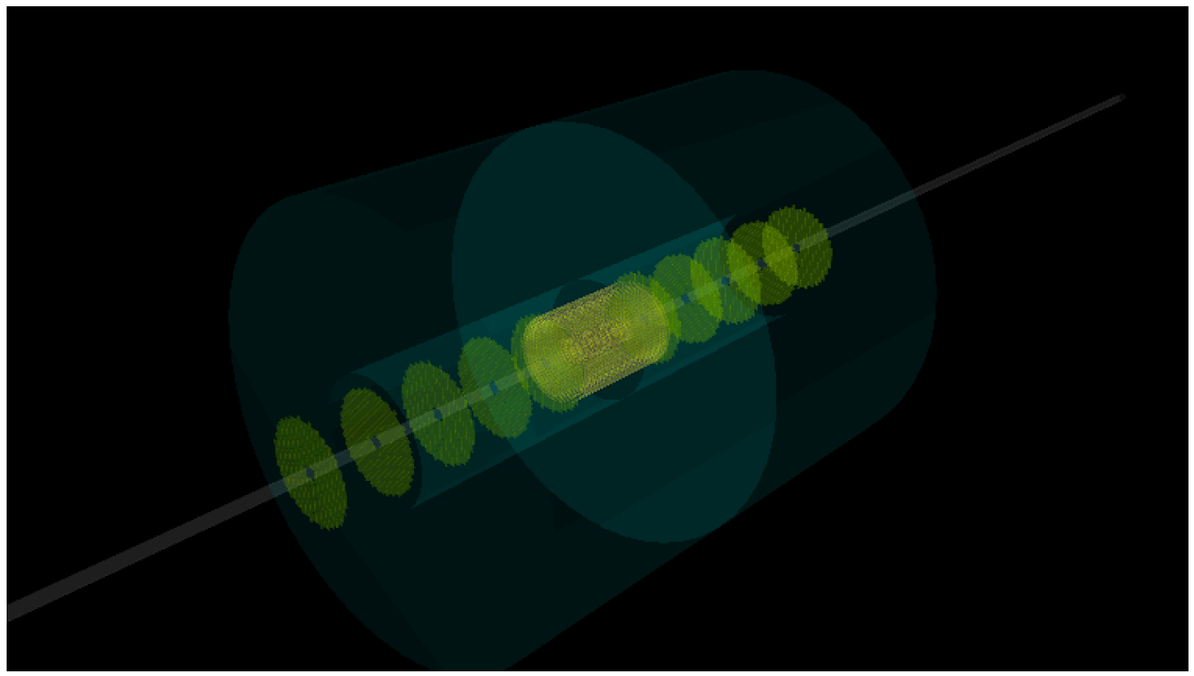
eRD16 - Simulations

- Past January, we reported our results from initial studies based on LDT fast simulations on an all-silicon tracker concept;

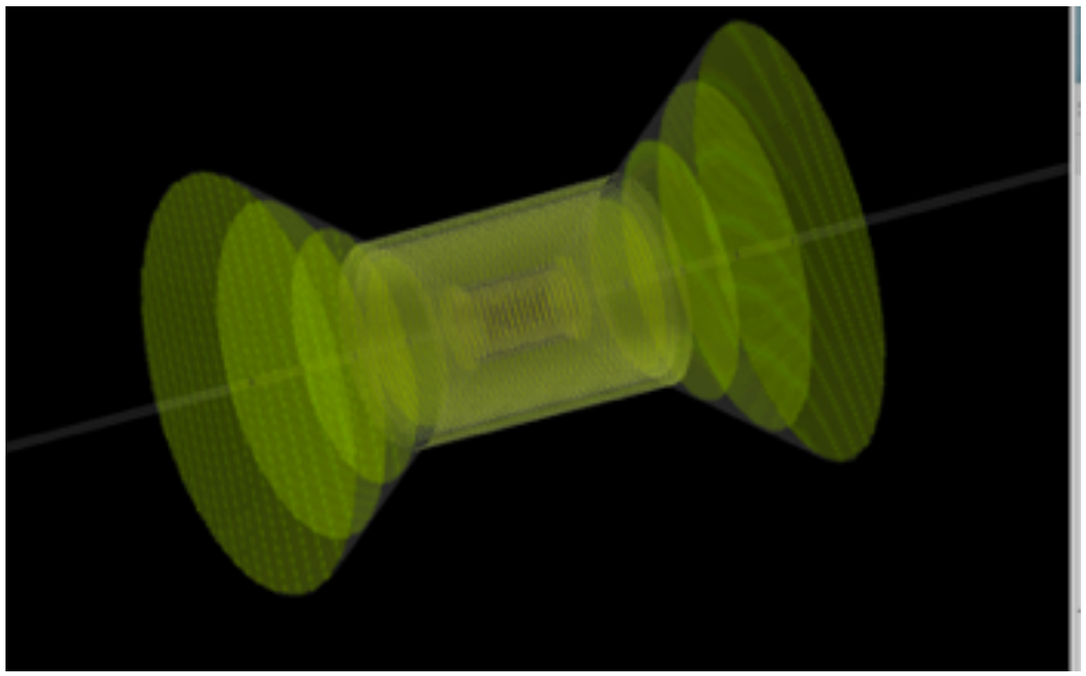
  The main outcome was that such a concept has potential to achieve similar momentum resolution and have smaller radius;

  This may be attractive: space for PID, non-uniform B-field, etc.

  We have now made a start in EICroot simulations of such a configuration, starting by reproducing the TPC+Si performance.



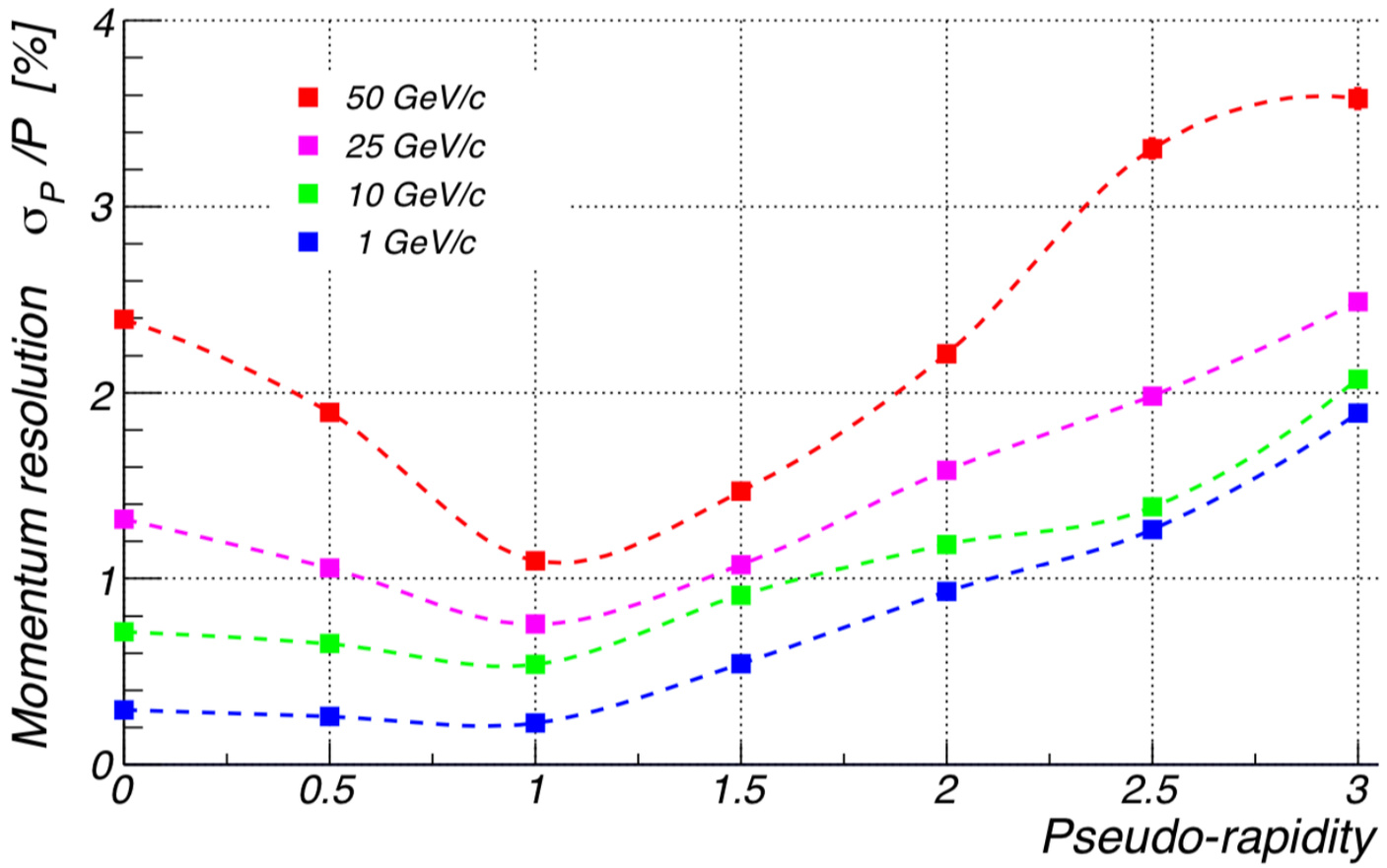
Beast(-like) TPC+Si configuration



All Si configuration, same z-extent smaller barrel radius of ~43 cm.

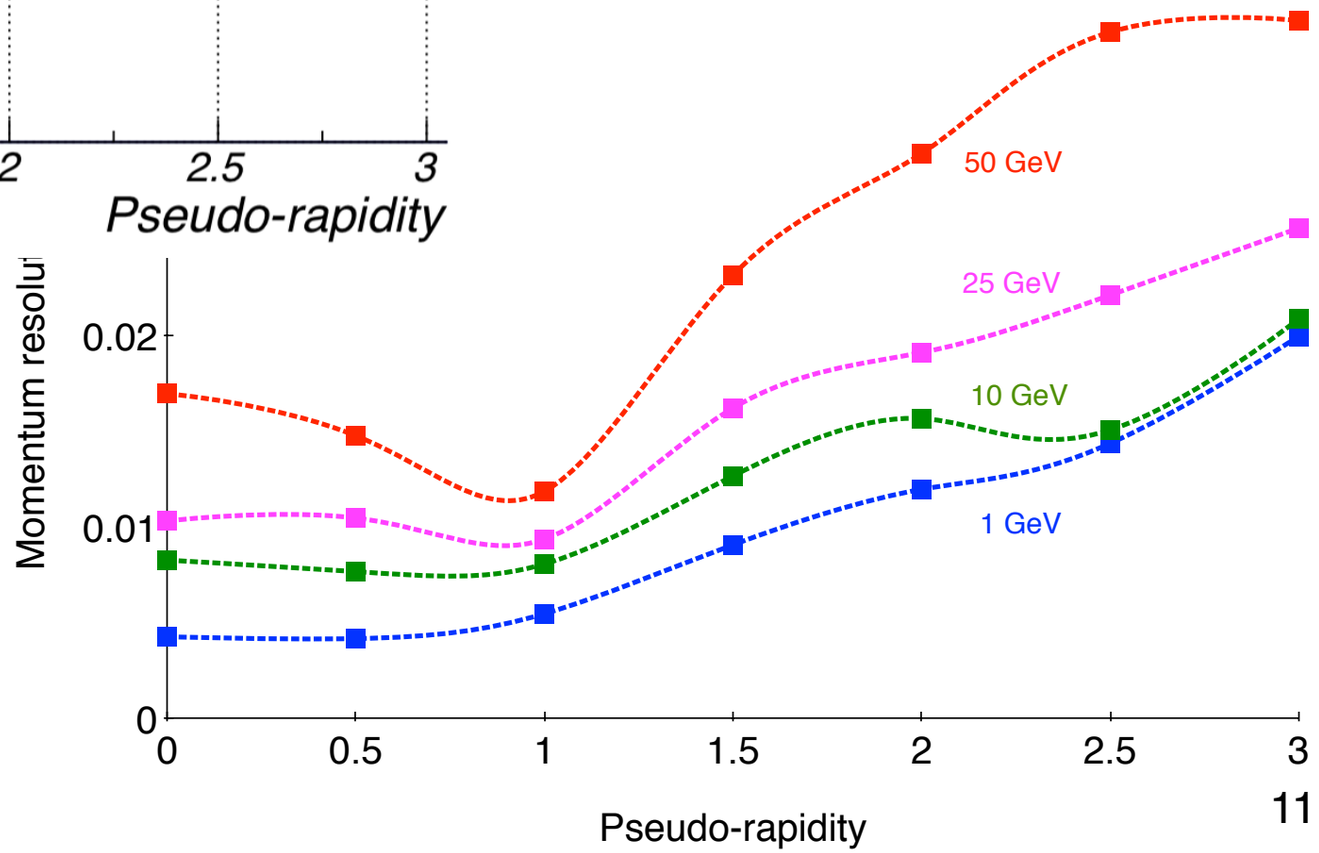
eRD16 - Simulations

- BeAST TPC+Si tracker



← E.C. Aschenauer et al, eRHIC design study, ArXiv:1409.1633, figure 4.8

eRD16 simulation →



eRD16 - Simulations

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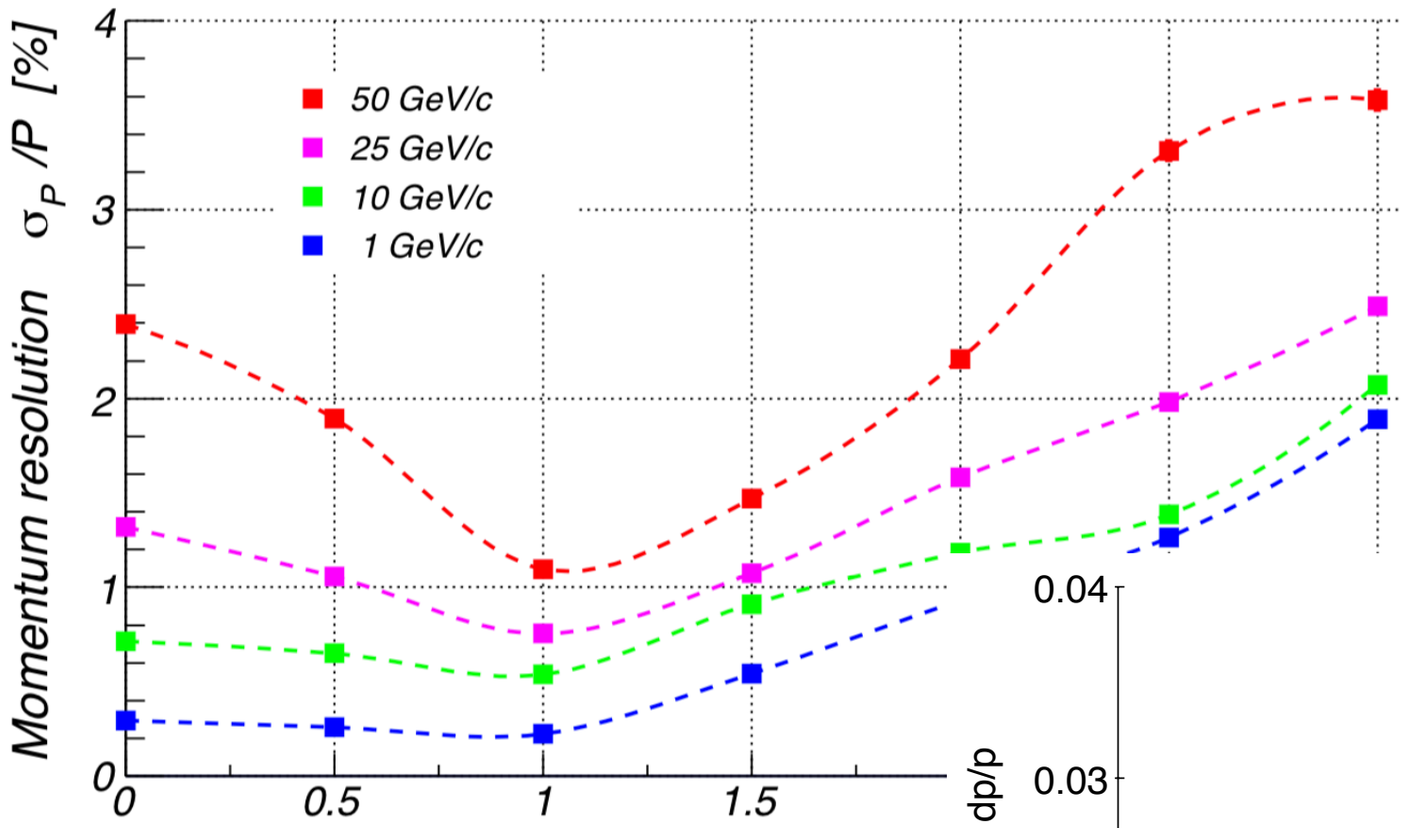

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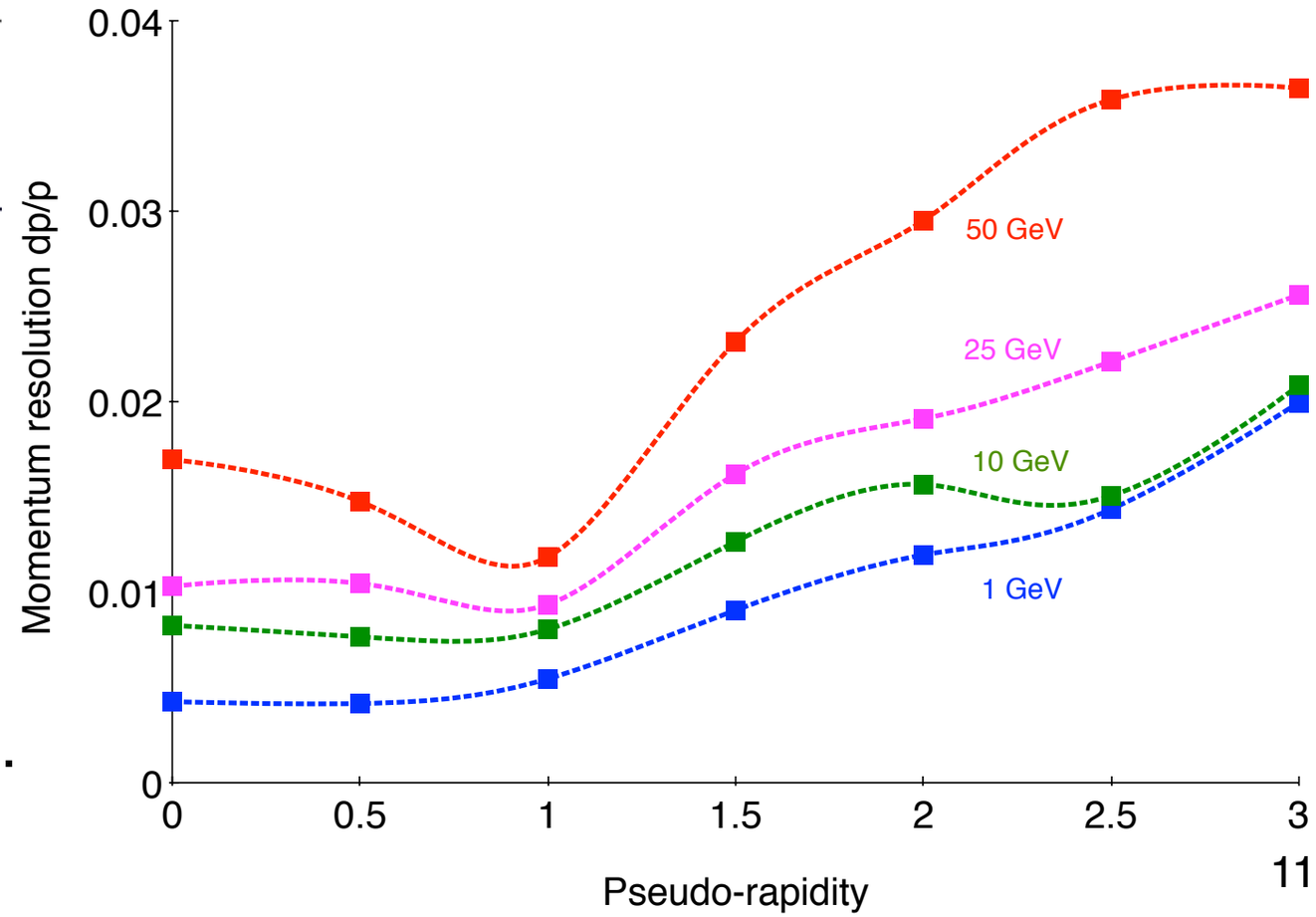
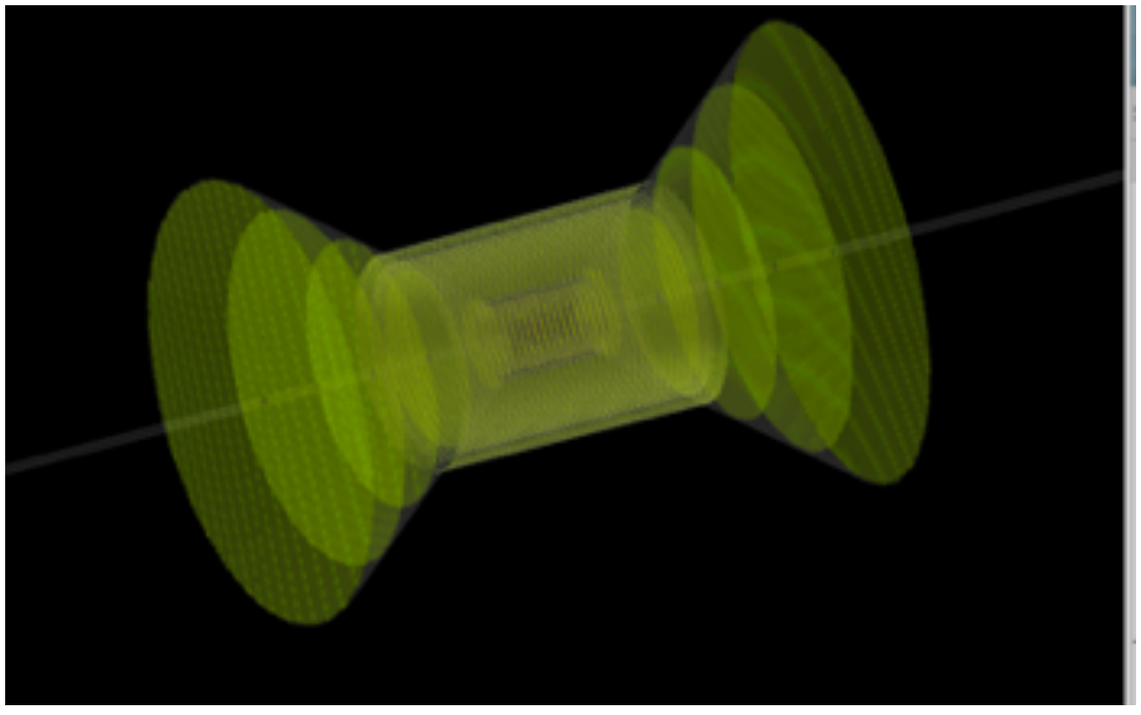
eRD16 simulation →

Baseline for what follows.

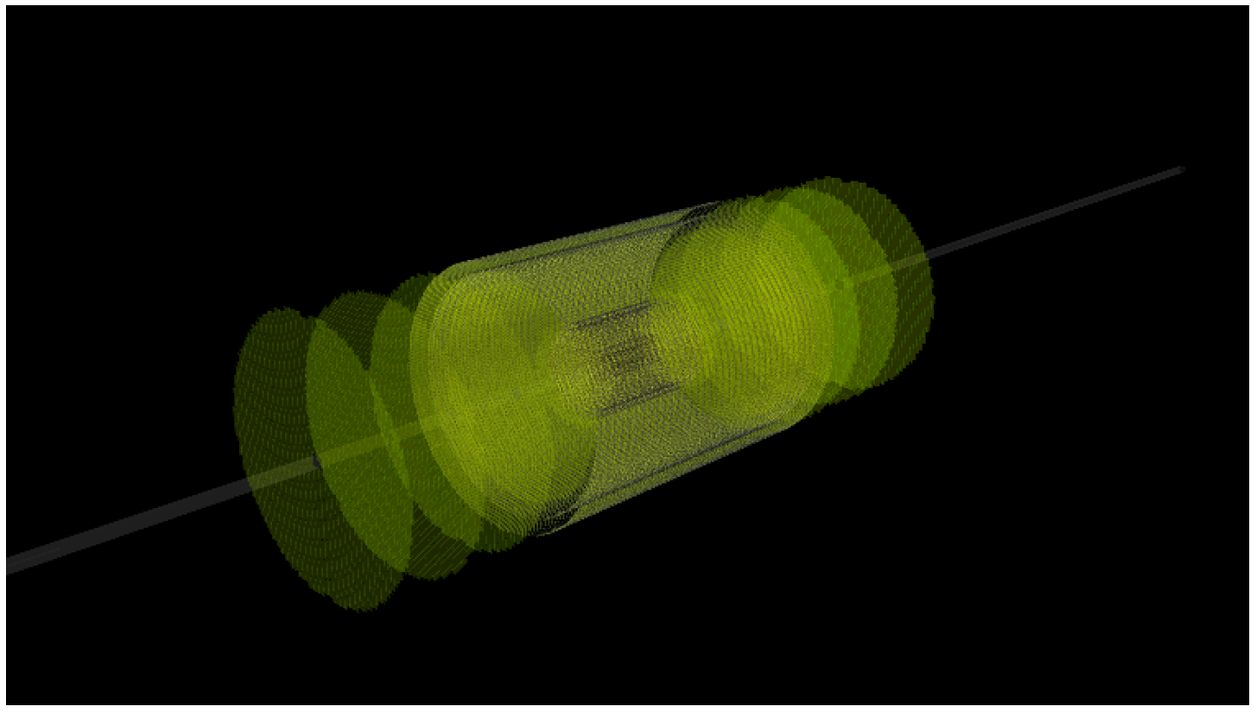


eRD16 - Simulations

- Since radial compactness is potentially attractive, we considered also a variant with restricted outer disk radii, similar to the fast-simulation configuration reported past January (20 x 20um MAPS).



all-Si configuration



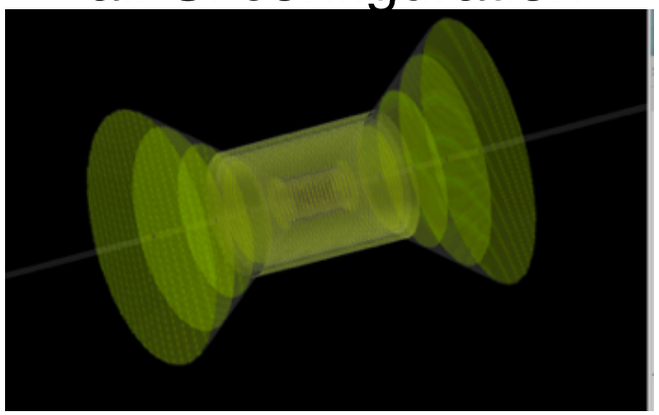
tapered all-Si configuration, r ~ 43cm

Identical barrel configurations, identical in length (*z*) to BeAST.

Material cones/cylinders surrounding the disks were implemented to make a start on the effects associated with support structures, read-out infrastructure, etc.; studies started/in progress.

eRD16 - Simulations

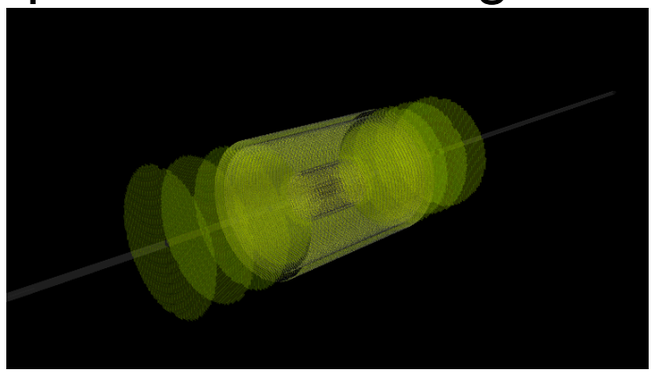
all-Si configuration



Resolution near ~1.5 results from large r disks; likely overkill.

eRD16 - Simulations

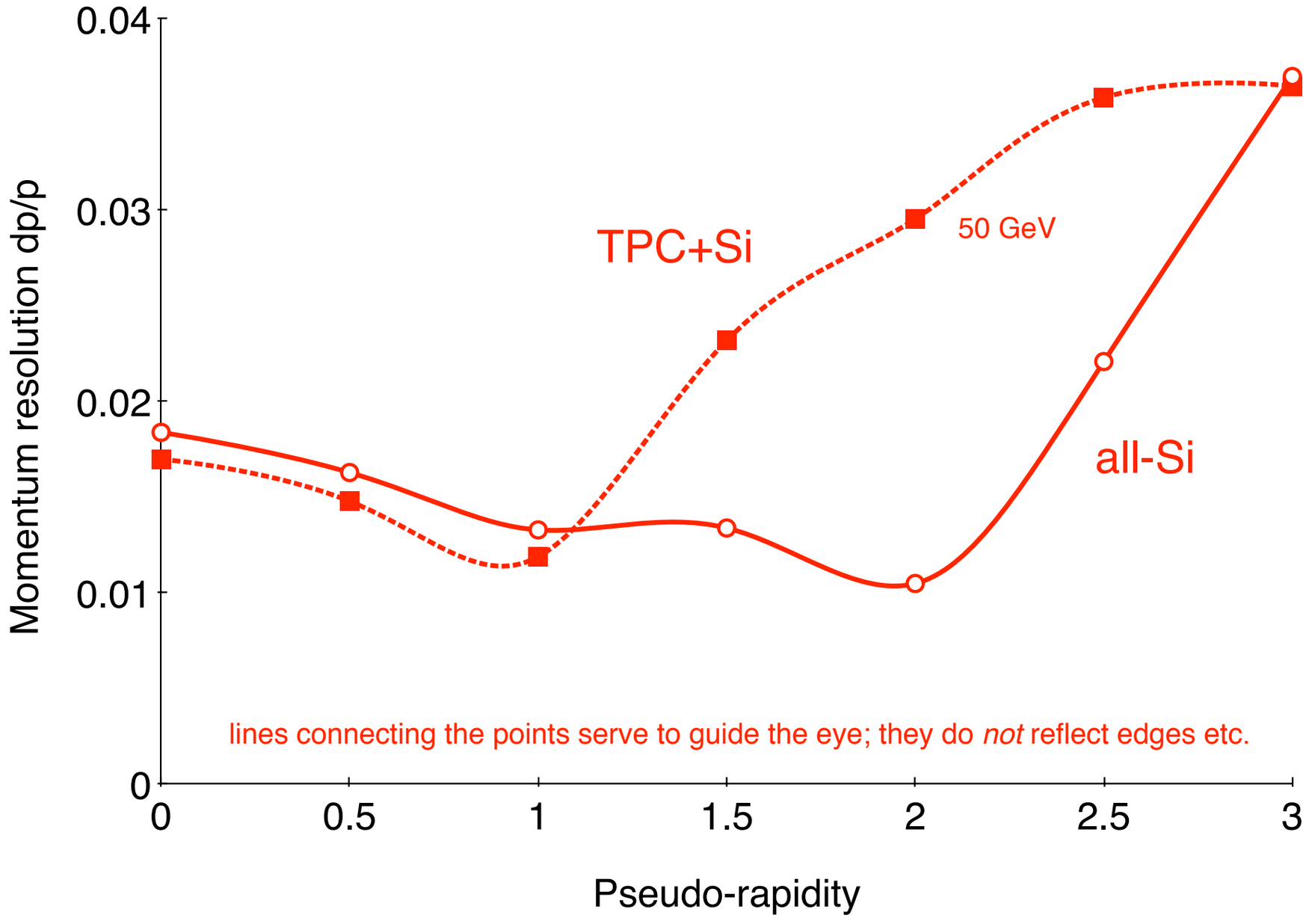
tapered all-Si configuration



There is a lot in these plots.

eRD16 - Simulations

- Resolution comparison with BeAST TPC+Si tracker



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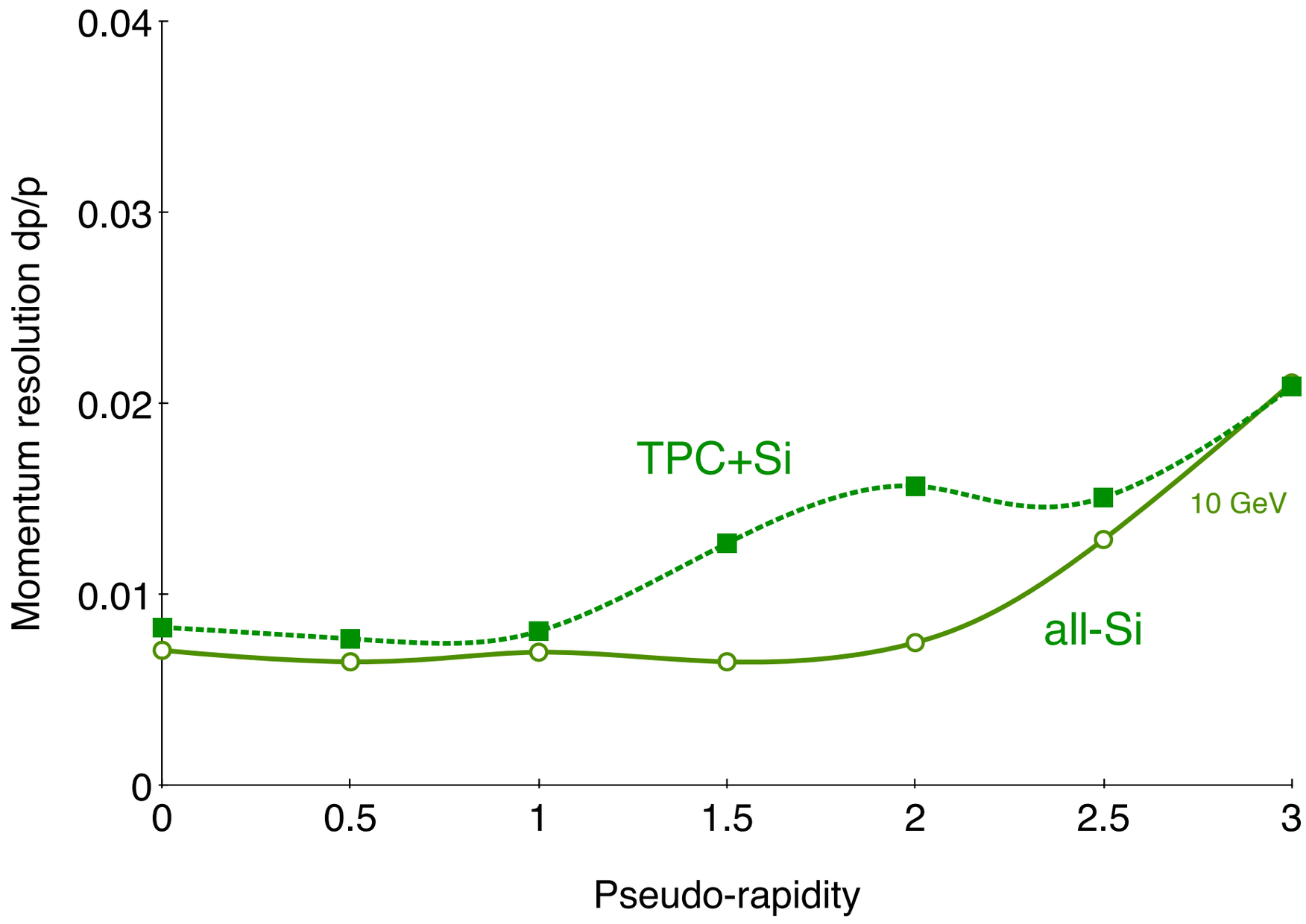

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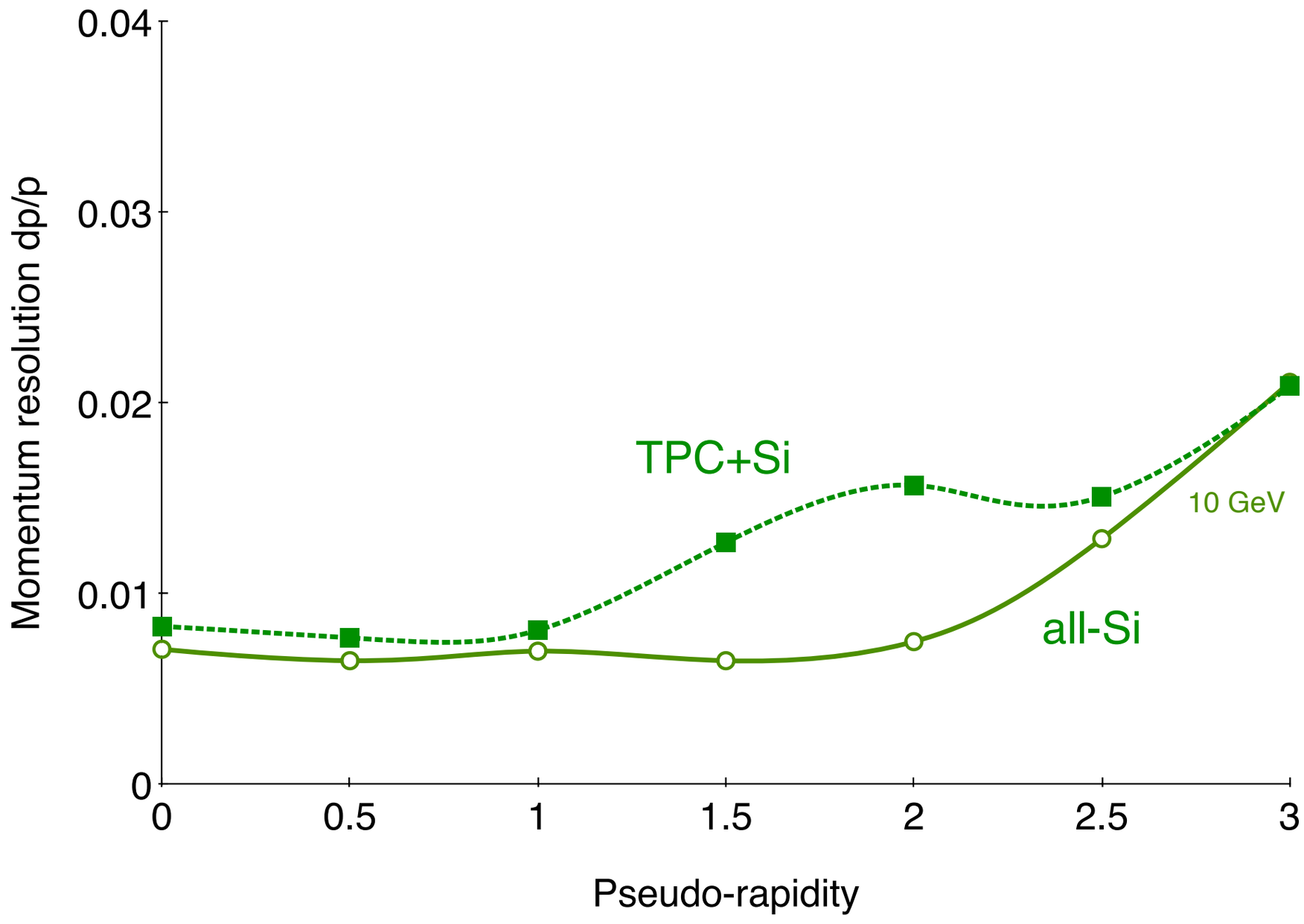

Opportunity for an *all* silicon tracker

LBNL EIC past involvement:

1. Make and establish EIC science case (Feng, Ernst),
2. Forward/backward tracking (Barbara, Ernst, Yue Shi, students),
3. One LBNL supported LDRD (Spencer et al.),
    - STAR-light evolved to eSTAR-light,
    - some effort related to Si-based tracking, jet-studies,
4. eRD16 (Barbara, Ernst, Yue Shi)
5. EIC User Group roles (Barbara, Ernst)

My take on current status:

1. Some EIC timelines will be much sooner than many have internalized,
2. Real opportunity to “think big” in terms of tracking,

Near-term plans:

1. eRD16 effort will simulate all-Si tracker performance,
    - (some) overlap with SIDIS and jet studies, displaced vertices,
2. eSTAR-light and related effort will continue,
3. Stated interest in fast-sensor development,
4. Real need (and strengths) for integration,
5. Future EICUG roles to be seen.