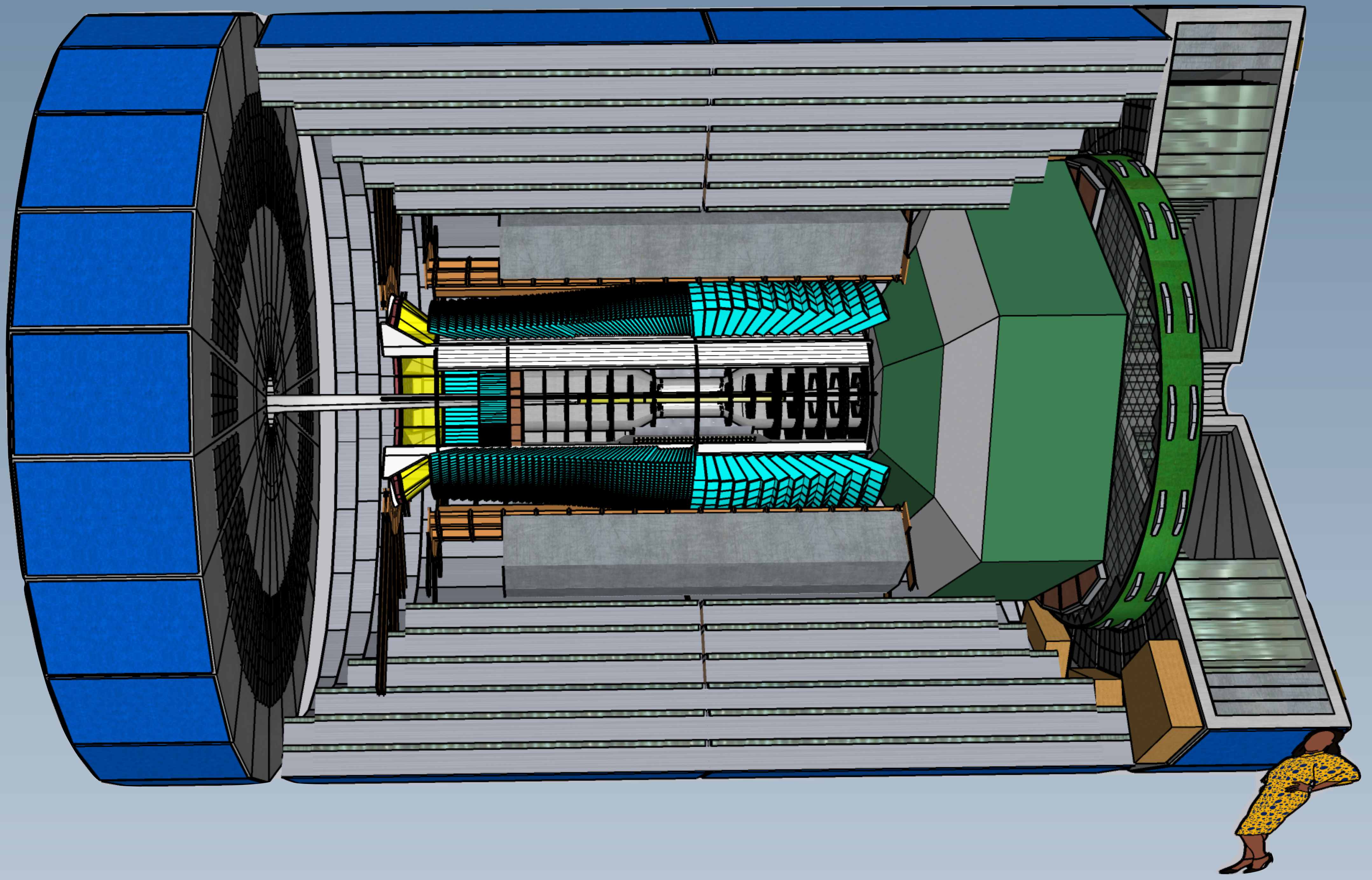
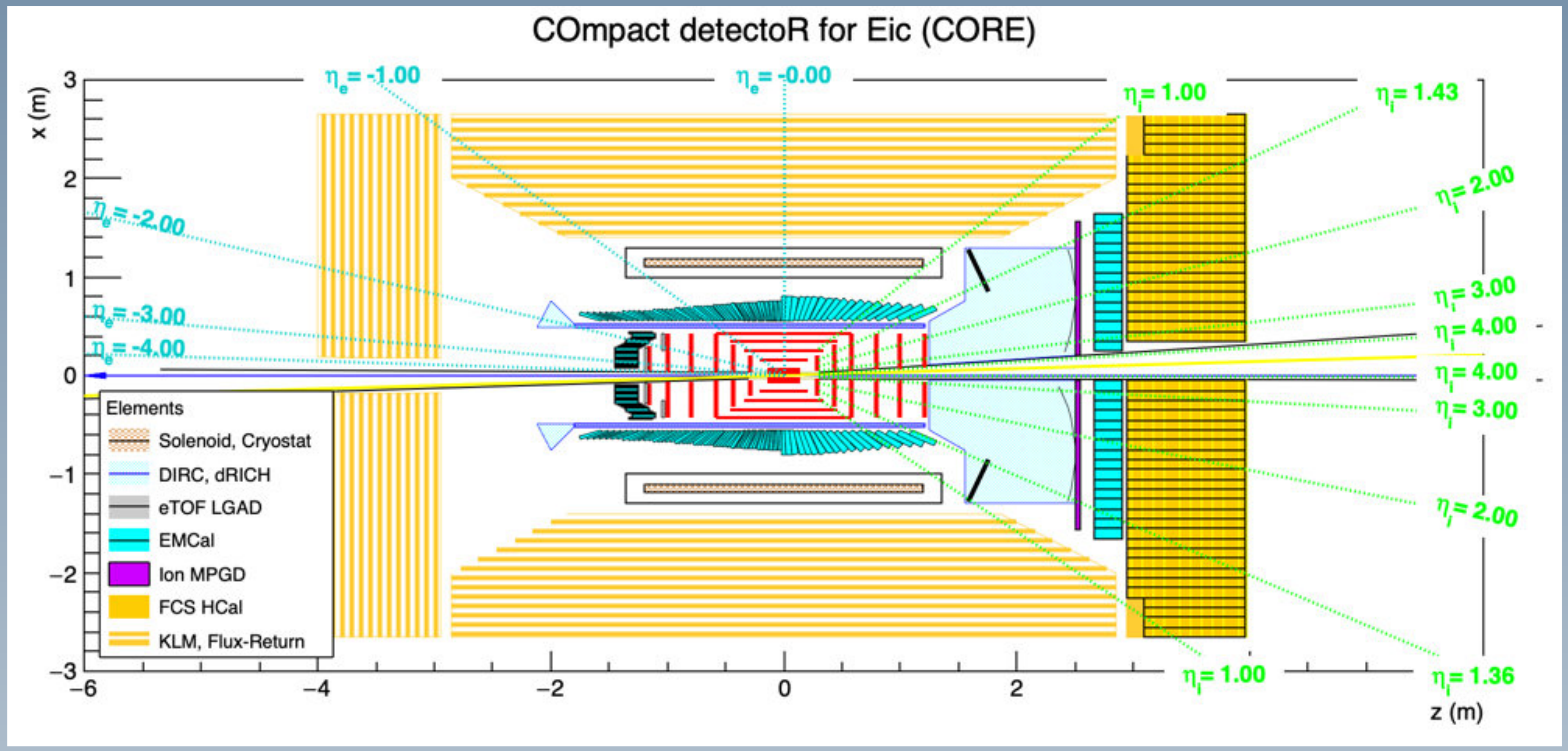




CORE

a Compact Detector for the Electron-Ion Collider

ikerbasque
Basque Foundation for Science

G. Schnell for the CORE proto-collaboration

eman ta zabal zazu
Universidad del País Vasco
Euskal Herriko Unibertsitatea

CORE — an effort of a small but enthusiastic proto-collaboration

CORE - a COmpact detectoR for the EIC

R. Alarcon,[1] M. Baker,[2] V. Baturin,[3] P. Brindza,[3] S. Bueltmann,[3] M. Bukhari,[4] R. Capobianco,[5] E. Christy,[2] S. Diehl,[5,6] M. Dugger,[1] R. Dupré,[7] R. Dzhygadlo,[8] K. Flood,[9] K. Gnanvo,[2] L. Guo,[10] T. Hayward,[5] M. Hattawy,[3] M. Hoballah,[7] M. Hohlmann,[11] C. E. Hyde [a],[3] Y. Ilieva,[12] W. W. Jacobs,[13] K. Joo,[5] G. Kalicy,[14] A. Kim,[5] V. Kubarovsky,[2] A. Lehmann,[15] W. Li,[16] D. Marchand,[7] H. Marukyan,[17] M. J. Murray,[18] H. E. Montgomery,[2] V. Morozov,[19] I. Mostafanezhad,[9] A. Movsisyan,[17] E. Munevar,[20] C. Muñoz Camacho,[7] P. Nadel-Turonski[b],[16] S. Niccolai,[7] K. Peters,[8] A. Prokudin,[2,21] J. Richards,[5] B. G. Ritchie,[1] U. Shrestha,[5] B. Schmookler,[16] G. Schnell,[22] C. Schwarz,[8] J. Schwiening,[8] P. Schweitzer,[5] P. Simmerling,[5] H. Szumila-Vance,[2] S. Tripathi,[23] N. Trotta,[5] G. Varner,[23] A. Vossen,[24] E. Voutier,[7] N. Wickramaarachchi,[14] and N. Zachariou[25]

[1] *Arizona State University, Tempe Arizona 85287*
[2] *Thomas Jefferson National Accelerator Laboratory, Newport News VA 23606*
[3] *Old Dominion University, Norfolk Virginia 23529*
[4] *Jazan University, Gizan 45142, Saudi Arabia*
[5] *University of Connecticut, Storrs Connecticut 06269*
[6] *Justus Liebig Universitaet Giessen, Giessen, Germany*
[7] *Université Paris-Saclay, CNRS/IN2P3, IJCLab, 91405 Orsay, France*
[8] *GSI Helmholtz Centre for Heavy Ion Research, Darmstadt, Germany*
[9] *Nalu Scientific, Honolulu Hawaii 96822*
[10] *Florida International University, Miami Florida 33199*
[11] *Florida Institute of Technology, Melbourne, Florida 32901*
[12] *University of South Carolina, Columbia South Carolina 29208*
[13] *CEEM, Indiana University, Bloomington Indiana 47405*
[14] *Catholic University of America, Washington D.C. 20064*
[15] *Erlangen-Nuremberg University, 91058 Germany*
[16] *CFNS, Stony Brook University, Stony Brook, New York 11794*
[17] *A. Alikhanyan National Science Laboratory (Yerevan Physics Institute) Yerevan Armenia*
[18] *University of Kansas, Lawrence Kansas 66045*
[19] *Oak Ridge National Laboratory, Oak Ridge Tennessee 37830*
[20] *Universidad Distrital Francisco José de Caldas, Bogotá Colombia*
[21] *Penn State University Berks, Reading Pennsylvania 19610*
[22] *University of the Basque Country UPV/EHU & Ikerbasque, Bilbao, Spain*
[23] *University of Hawaii, Honolulu Hawaii 96822*
[24] *Duke University, Durham North Carolina 27708*
[25] *University of York, Heslington, York, YO10 5DD, UK*

(Dated: December 1, 2021)

CORE — an effort of a small but enthusiastic proto-collaboration

CORE - a COmpact detectoR for the EIC

R. Alarcon,[1] M. Baker,[2] V. Baturin,[3] P. Brindza,[3] S. Bueltmann,[3] M. Bukhari,[4] R. Capobianco,[5] E. Christy,[2] S. Diehl,[5,6] M. Dugger,[1] R. Dupré,[7] R. Dzhygadlo,[8] K. Flood,[9] K. Gnanvo,[2] L. Guo,[10] T. Hayward,[5] M. Hattawy,[3] M. Hoballah,[7] M. Hohlmann,[11] C. E. Hyde[a,3] Y. Ilieva,[12] W. W. Jacobs,[13] K. Joo,[5] G. Kalicy,[14] A. Kim,[5] V. Kubarovsky,[2] A. Lehmann,[15] W. Li,[16] D. Marchand,[7] H. Marukyan,[17] M. J. Murray,[18] H. E. Montgomery,[2] V. Morozov,[19] I. Mostafanezhad,[9] A. Movsisyan,[17] E. Munevar,[20] C. Muñoz Camacho,[7] P. Nadel-Turonski[b,16] S. Niccolai,[7] K. Peters,[8] A. Prokudin,[2,21] J. Richards,[5] B. G. Ritchie,[1] U. Shrestha,[5] B. Schmookler,[16] G. Schnell,[22] C. Schwarz,[8] J. Schwiening,[8] P. Schweitzer,[5] P. Simmerling,[5] H. Szumila-Vance,[2] S. Tripathi,[23] N. Trotta,[5] G. Varner,[23] A. Vossen,[24] E. Voutier,[7] N. Wickramaarachchi,[14] and N. Zachariou[25]

[1] *Arizona State University, Tempe Arizona 85287*
[2] *Thomas Jefferson National Accelerator Laboratory, Newport News VA 23606*
[3] *Old Dominion University, Norfolk Virginia 23529*
[4] *Jazan University, Gizan 45142, Saudi Arabia*
[5] *University of Connecticut, Storrs Connecticut 06269*
[6] *Justus Liebig Universitaet Giessen, Giessen, Germany*
[7] *Université Paris-Saclay, CNRS/IN2P3, IJCLab, 91405 Orsay, France*
[8] *GSI Helmholtz Centre for Heavy Ion Research, Darmstadt, Germany*
[9] *Nalu Scientific, Honolulu Hawaii 96822*
[10] *Florida International University, Miami Florida 33199*
[11] *Florida Institute of Technology, Melbourne, Florida 32901*
[12] *University of South Carolina, Columbia South Carolina 29208*
[13] *CEEM, Indiana University, Bloomington Indiana 47405*
[14] *Catholic University of America, Washington D.C. 20064*
[15] *Erlangen-Nuremberg University, 91058 Germany*
[16] *CFNS, Stony Brook University, Stony Brook, New York 11794*
[17] *A. Alikhanyan National Science Laboratory (Yerevan Physics Institute) Yerevan Armenia*
[18] *University of Kansas, Lawrence Kansas 66045*
[19] *Oak Ridge National Laboratory, Oak Ridge Tennessee 37830*
[20] *Universidad Distrital Francisco José de Caldas, Bogotá Colombia*
[21] *Penn State University Berks, Reading Pennsylvania 19610*
[22] *University of the Basque Country UPV/EHU & Ikerbasque, Bilbao, Spain*
[23] *University of Hawaii, Honolulu Hawaii 96822*
[24] *Duke University, Durham North Carolina 27708*
[25] *University of York, Heslington, York, YO10 5DD, UK*

(Dated: December 1, 2021)

CORE — an effort of a small but enthusiastic proto-collaboration

CORE - a COmpact detectoR for the EIC

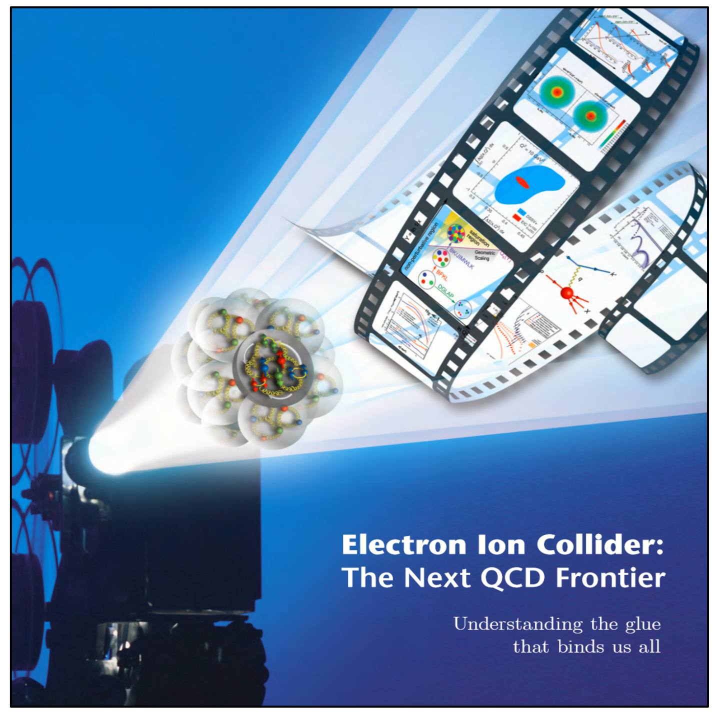
R. Alarcon,[1] M. Baker,[2] V. Baturin,[3] P. Brindza,[3] S. Bueltmann,[3] M. Bukhari,[4] R. Capobianco,[5] E. Christy,[2] S. Diehl,[5,6] M. Dugger,[1] R. Dupré,[7] R. Dzhygadlo,[8] K. Flood,[9] K. Gnanvo,[2] L. Guo,[10] T. Hayward,[5] M. Hattawy,[3] M. Hoballah,[7] M. Hohlmann,[11] C. E. Hyde[a,3] Y. Ilieva,[12] W. W. Jacobs,[13] K. Joo,[5] G. Kalicy,[14] A. Kim,[5] V. Kubarovsky,[2] A. Lehmann,[15] W. Li,[16] D. Marchand,[7] H. Marukyan,[17] M. J. Murray,[18] H. E. Montgomery,[2] V. Morozov,[19] I. Mostafanezhad,[9] A. Movsisyan,[17] E. Munevar,[20] C. Muñoz Camacho,[7] P. Nadel-Turonski[b,16] S. Niccolai,[7] K. Peters,[8] A. Prokudin,[2,21] J. Richards,[5] B. G. Ritchie,[1] U. Shrestha,[5] B. Schmookler,[16] G. Schnell,[22] C. Schwarz,[8] J. Schwiening,[8] P. Schweitzer,[5] P. Simmerling,[5] H. Szumila-Vance,[2] S. Tripathi,[23] N. Trotta,[5] G. Varner,[23] A. Vossen,[24] E. Voutier,[7] N. Wickramaarachchi,[14] and N. Zachariou[25]

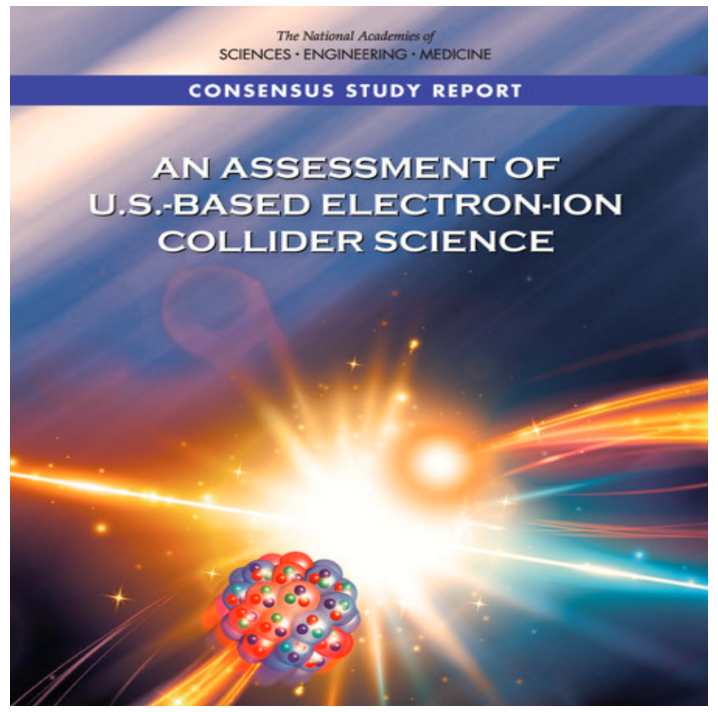
[1] *Arizona State University, Tempe Arizona 85287*
[2] *Thomas Jefferson National Accelerator Laboratory, Newport News VA 23606*
[3] *Old Dominion University, Norfolk Virginia 23529*
[4] *Jazan University, Gizan 45142, Saudi Arabia*
[5] *University of Connecticut, Storrs Connecticut 06269*
[6] *Justus Liebig Universitaet Giessen, Giessen, Germany*
[7] *Université Paris-Saclay, CNRS/IN2P3, IJCLab, 91405 Orsay, France*
[8] *GSI Helmholtz Centre for Heavy Ion Research, Darmstadt, Germany*
[9] *Nalu Scientific, Honolulu Hawaii 96822*
[10] *Florida International University, Miami Florida 33199*
[11] *Florida Institute of Technology, Melbourne, Florida 32901*
[12] *University of South Carolina, Columbia South Carolina 29208*
[13] *CEEM, Indiana University, Bloomington Indiana 47405*
[14] *Catholic University of America, Washington D.C. 20064*
[15] *Erlangen-Nuremberg University, 91058 Germany*
[16] *CFNS, Stony Brook University, Stony Brook, New York 11794*
[17] *A. Alikhanyan National Science Laboratory (Yerevan Physics Institute) Yerevan Armenia*
[18] *University of Kansas, Lawrence Kansas 66045*
[19] *Oak Ridge National Laboratory, Oak Ridge Tennessee 37830*
[20] *Universidad Distrital Francisco José de Caldas, Bogotá Colombia*
[21] *Penn State University Berks, Reading Pennsylvania 19610*
[22] *University of the Basque Country UPV/EHU & Ikerbasque, Bilbao, Spain*
[23] *University of Hawaii, Honolulu Hawaii 96822*
[24] *Duke University, Durham North Carolina 27708*
[25] *University of York, Heslington, York, YO10 5DD, UK*

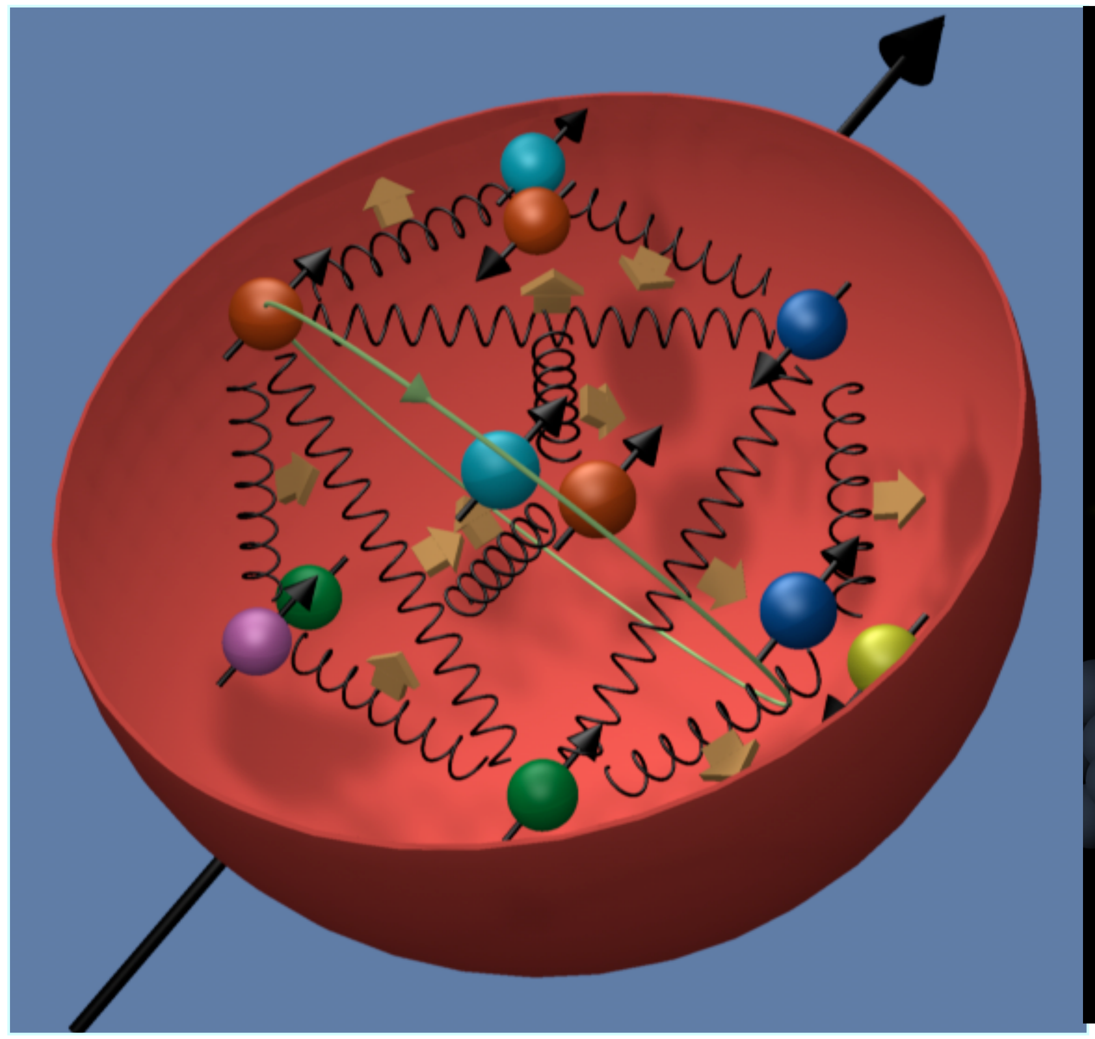
(Dated: December 1, 2021)

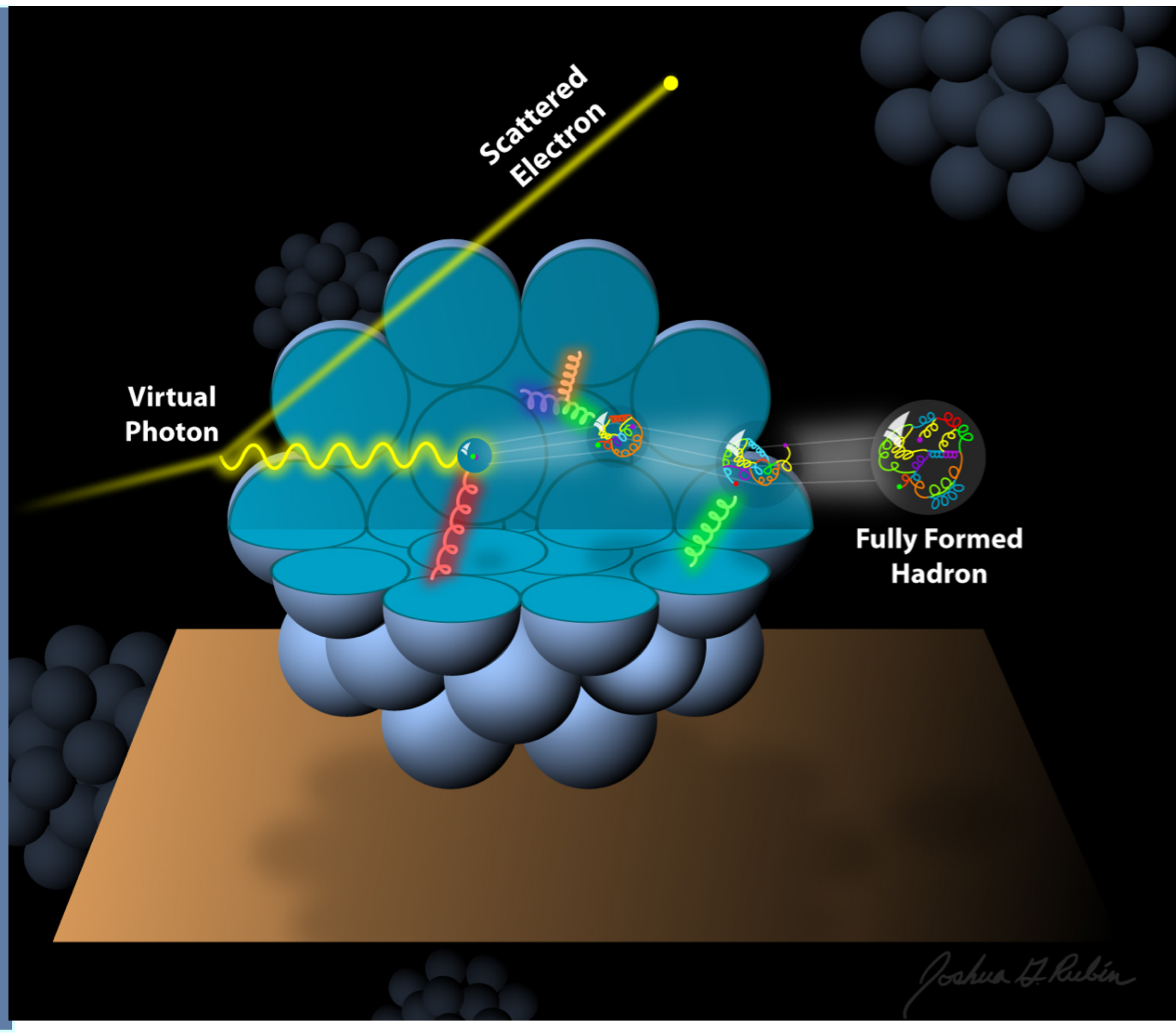
Main EIC physics goals: EIC White Paper

- proton spin: polarized quarks ($\Delta\Sigma$) & gluons (ΔG) ➟ (semi-)inclusive DIS
- 3d imaging
  - transverse-momentum structure: transverse-momentum distributions (TMDs) ➟ semi-inclusive DIS
  - Tomographic (spatial) images of the proton: generalized parton distributions (GPDs) ➟ exclusive reactions
- QCD matter at extreme gluon density
  - coherent diffraction on heavy nuclei
- quark hadronization









Main EIC physics goals: EIC White Paper & NAS EIC Science Case

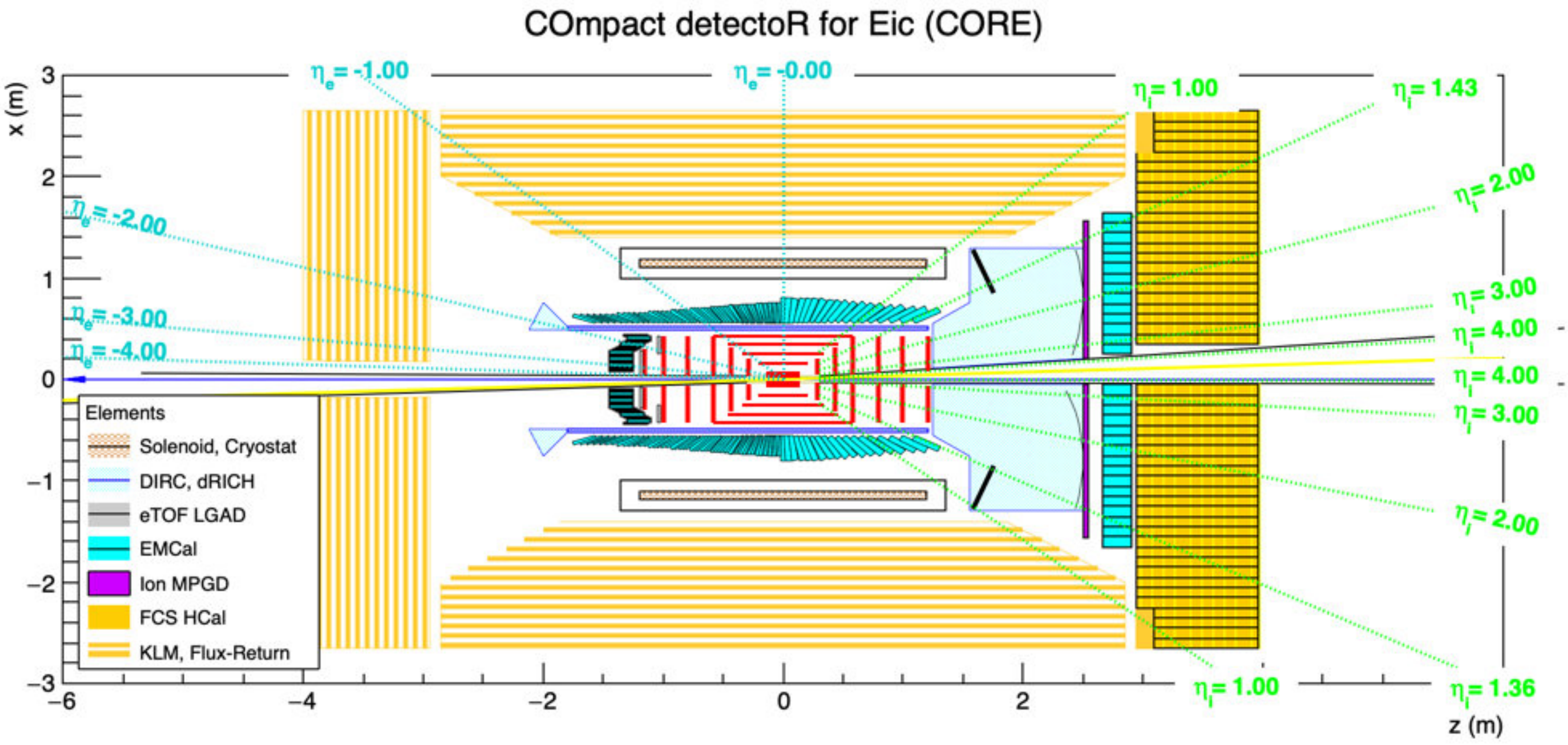
- proton spin: polarized quarks (ΔΣ) & gluons (ΔG) ➟ (semi-)inclusive DIS
- 3d imaging
  - transverse-momentum structure: transverse-momentum distributions (TMDs) ➟ semi-inclusive DIS
  - Tomographic (spatial) images of the proton: generalized parton distributions (GPDs) ➟ exclusive reactions
- QCD matter at extreme gluon density
  - coherent diffraction on heavy nuclei
- quark hadronization

- origin of mass:
  - spatial distribution of energy density and pressure
- origin of spin:
  - gluon spin
  - quark and gluon orbital angular momentum
- gluons in nuclei:
  - gluons and nuclear binding
  - gluon saturation in nuclei
  - coherent diffraction off heavy nuclei

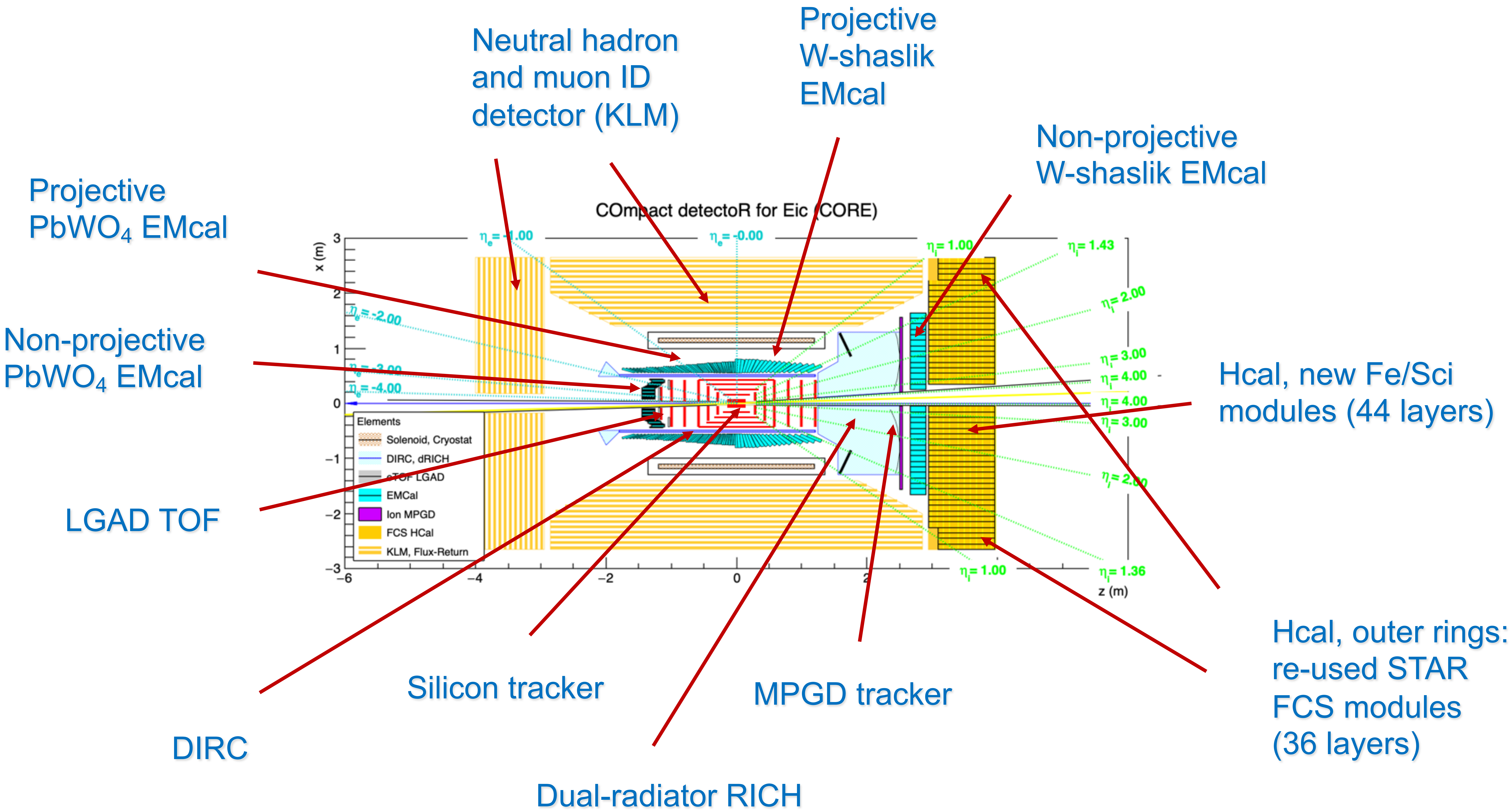
CORE & call for EIC detector proposals

- general **call for detector proposals** (deadline 12/2021); review report in 03/2022
- CORE addresses the EIC White Paper & NAS Report science case, and meets/exceeds design requirements of Yellow Report (YR) [Tab. 3.1 of https://physdiv.jlab.org/DetectorMatrix]
  - CORE physics program would thus match the physics performance of any simulation based on these requirements, e.g., presented in the YR
- central CORE detector is compatible with either the IR layout of the EIC CDR
  - can be placed at IR6 or IR8
  - CORE only requires a magnet-free space of 4m ☞ increase in luminosity, forward acceptance and decrease in chromaticity compared to CDR (assumes 4.5 m)
  - CORE is synergetic with a secondary focus at IR8
- CORE with distinct complementarity to the YR reference detector: offers unique opportunities for science beyond the EIC White Paper

CORE detector at a glance



CORE detector at a glance



CORE: some notable features

- **compact, high-field** (3T) solenoid: coil length 2.5m with 1m inner radius
  - enables high-resolution tracking together w/ all-Si tracker, and a higher luminosity
  - size makes it cost effective with ample space for supports and services
  - affordable to use the best possible EM calorimetry in the barrel region

CORE: some notable features

- **compact, high-field** (3T) solenoid: coil length 2.5m with 1m inner radius
  - enables high-resolution tracking together w/ all-Si tracker, and a higher luminosity
  - size makes it cost effective with ample space for supports and services
  - affordable to use the best possible EM calorimetry in the barrel region
- hermetic detector, in particular, full EM calorimetry within $-4 < \eta < 4$
  - W vs. Pb shashlik EMcal considerably improves resolution (esp. for exclusive processes)

CORE: some notable features

- **compact, high-field** (3T) solenoid: coil length 2.5m with 1m inner radius
  - enables high-resolution tracking together w/ all-Si tracker, and a higher luminosity
  - size makes it cost effective with ample space for supports and services
  - affordable to use the best possible EM calorimetry in the barrel region
- hermetic detector, in particular, full EM calorimetry within $-4 < \eta < 4$
  - W vs. Pb shashlik EMcal considerably improves resolution (esp. for exclusive processes)
- DIRC for barrel PID & TOF PID for electron endcap

CORE: some notable features

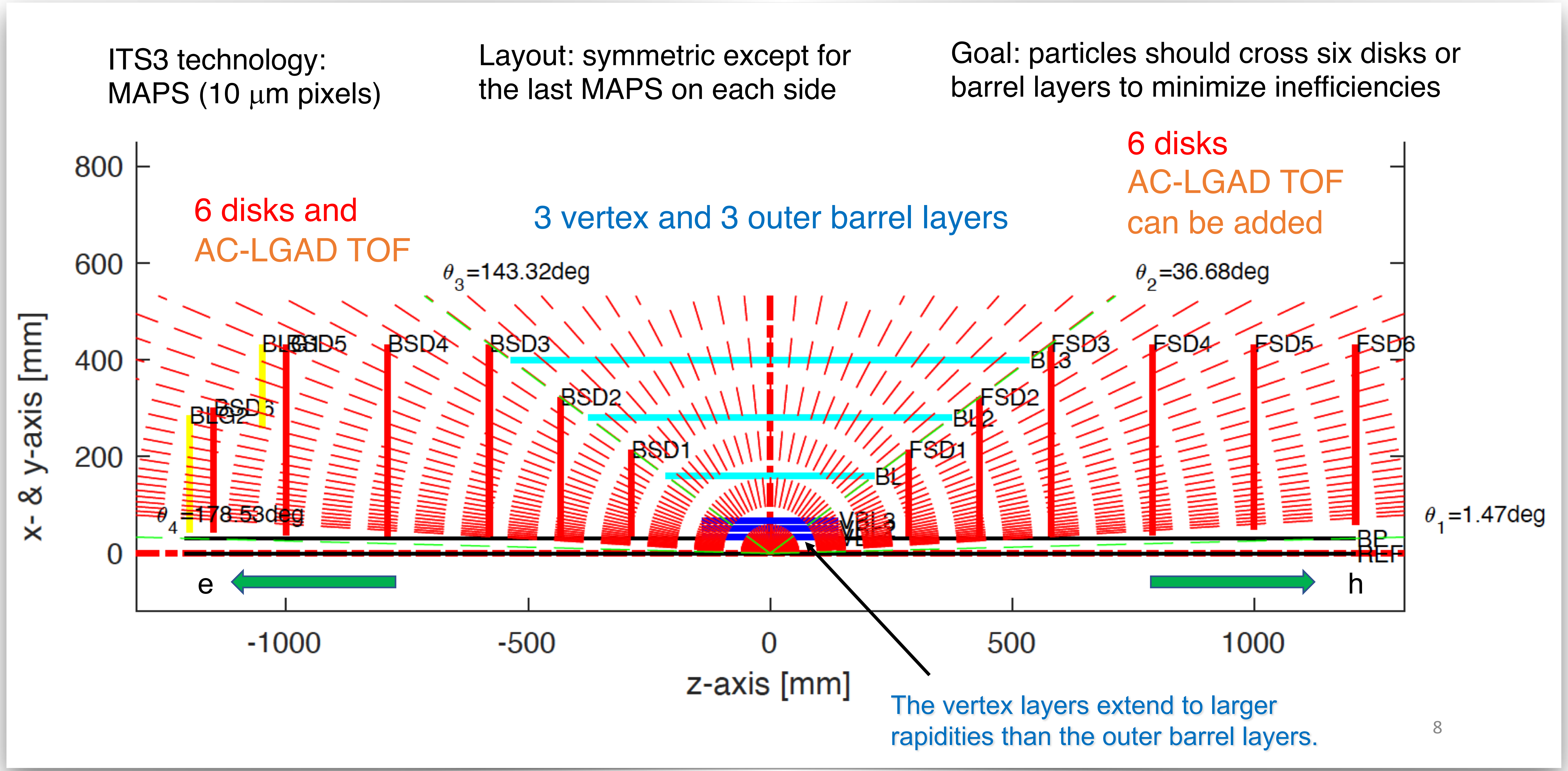
- **compact, high-field** (3T) solenoid: coil length 2.5m with 1m inner radius
  - enables high-resolution tracking together w/ all-Si tracker, and a higher luminosity
  - size makes it cost effective with ample space for supports and services
  - affordable to use the best possible EM calorimetry in the barrel region
- hermetic detector, in particular, full EM calorimetry within $-4 < \eta < 4$
  - W vs. Pb shashlik EMcal considerably improves resolution (esp. for exclusive processes)
- DIRC for barrel PID & TOF PID for electron endcap
- Belle-II-like K_L—μ (KLM) system in flux return for neutral-hadron and muon ID
  - beneficial for, e.g., jets reconstructed from individual particles

CORE: some notable features

- **compact, high-field** (3T) solenoid: coil length 2.5m with 1m inner radius
  - enables high-resolution tracking together w/ all-Si tracker, and a higher luminosity
  - size makes it cost effective with ample space for supports and services
  - affordable to use the best possible EM calorimetry in the barrel region
- hermetic detector, in particular, full EM calorimetry within $-4 < \eta < 4$
  - W vs. Pb shashlik EMcal considerably improves resolution (esp. for exclusive processes)
- DIRC for barrel PID & TOF PID for electron endcap
- Belle-II-like K_L—μ (KLM) system in flux return for neutral-hadron and muon ID
  - beneficial for, e.g., jets reconstructed from individual particles
- in general, mostly **low-risk and cost-efficient solutions** without compromising physics goals but rather **extending physics reach of YR reference detector**

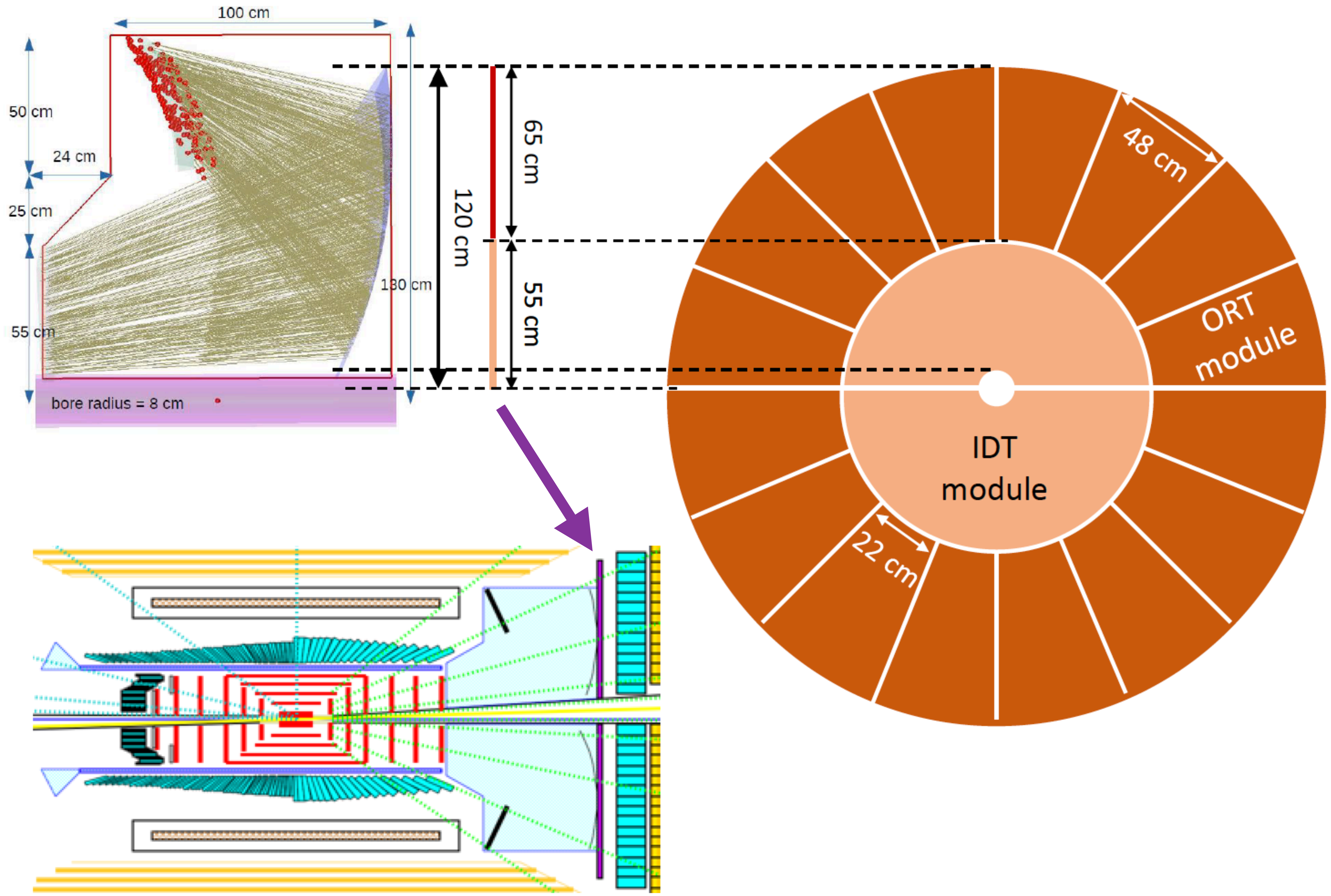
CORE: some notable features — tracking

- **compact, high-field** (3T) solenoid: coil length 2.5m with 1m inner radius
  - enables high-resolution tracking together w/ **all-Si tracker**



CORE: some notable features — tracking

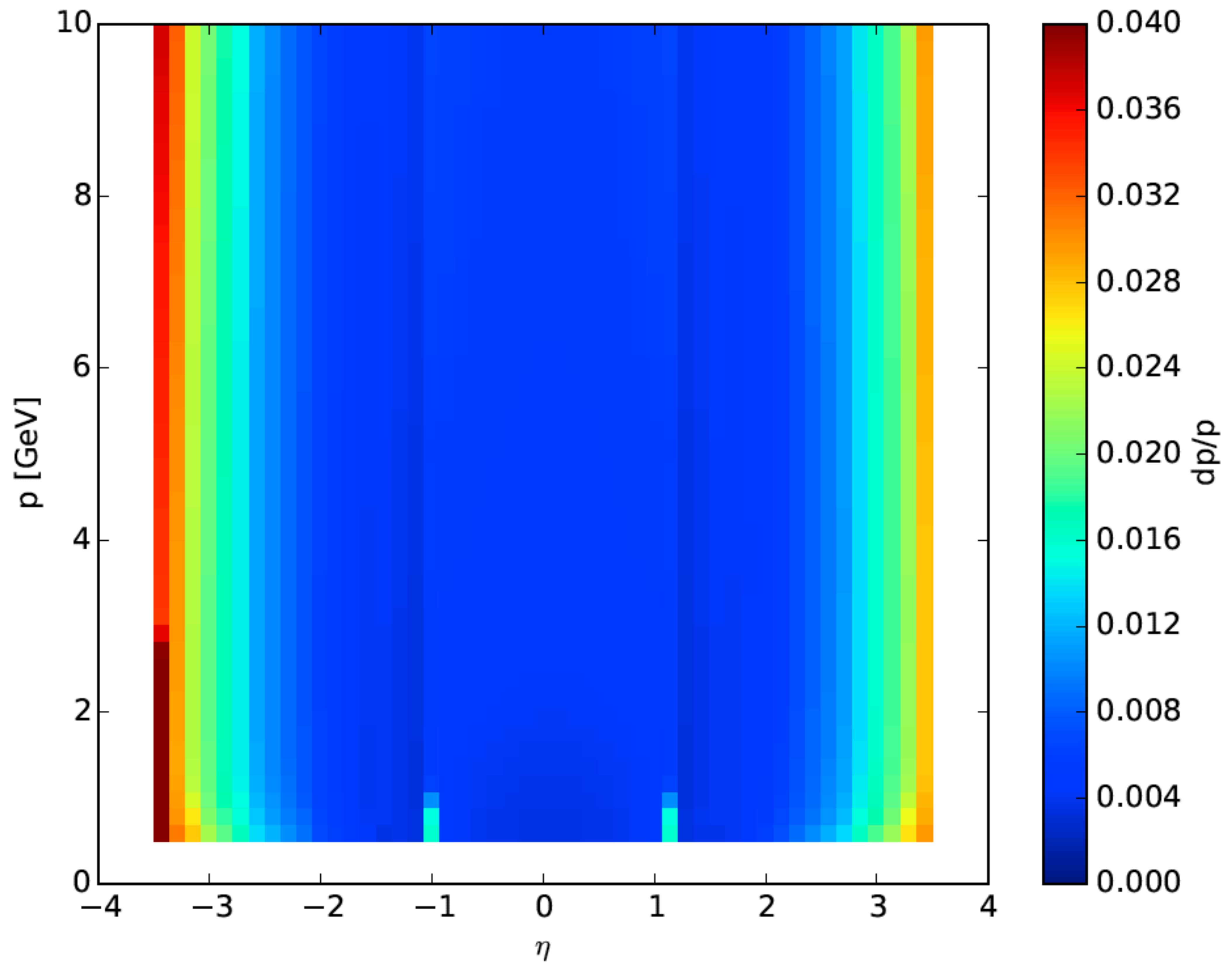
- **compact, high-field** (3T) solenoid: coil length 2.5m with 1m inner radius
  - enables high-resolution tracking together w/ all-Si tracker
  - central tracking complemented with forward tracker behind dRICH

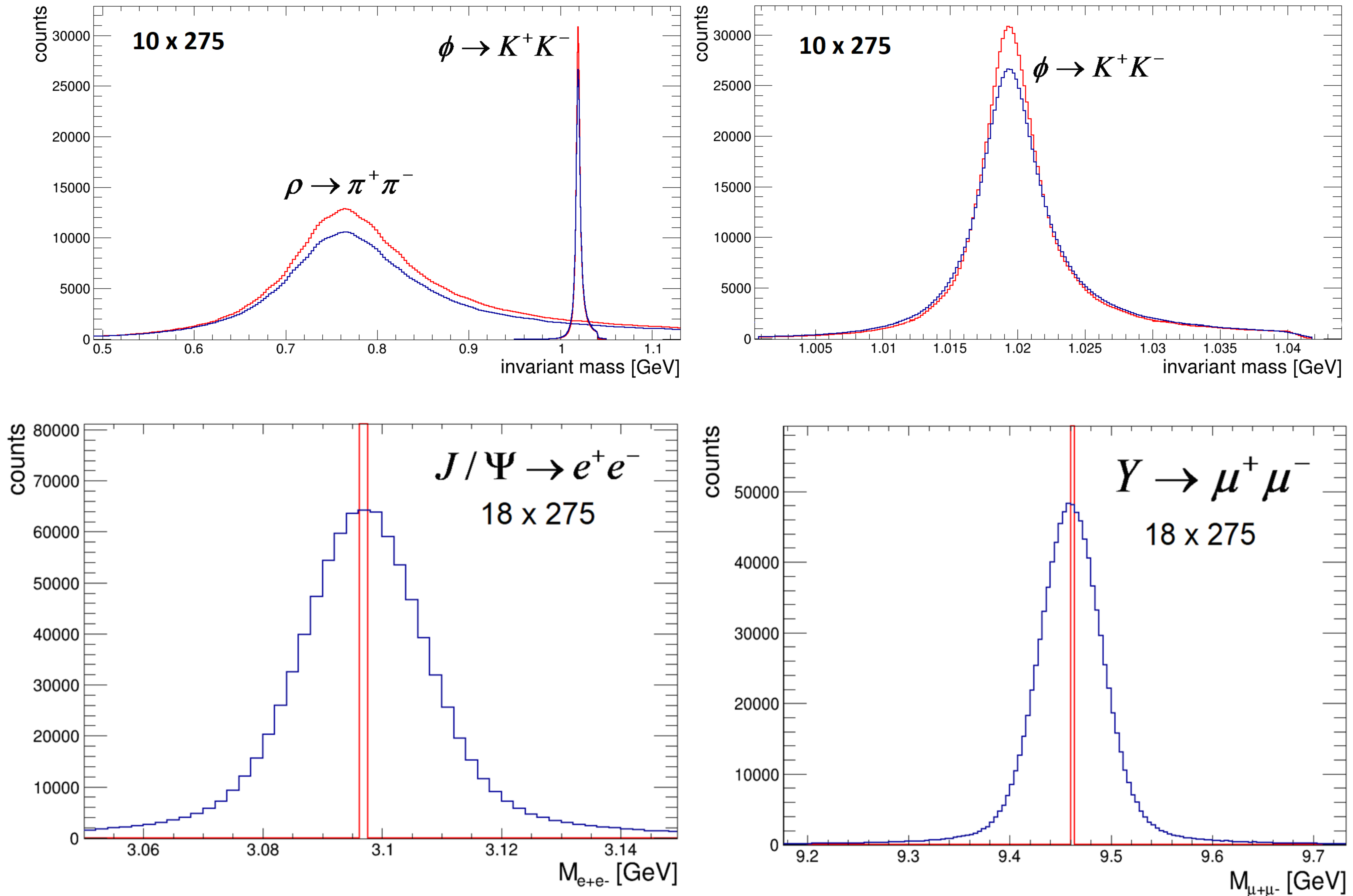


- primary purpose: assist dRICH ring finder
- large distance to IP:
  - great lever arm for large-η particle tracking
    ➥ improved momentum resolution
  - inner disk tracker (IDT) to increase acceptance

CORE: some notable features — tracking

- **compact, high-field** (3T) solenoid: coil length 2.5m with 1m inner radius
  - enables high-resolution tracking together w/ all-Si tracker
    ➥ (sub-)%-level momentum resolution in most of η coverage

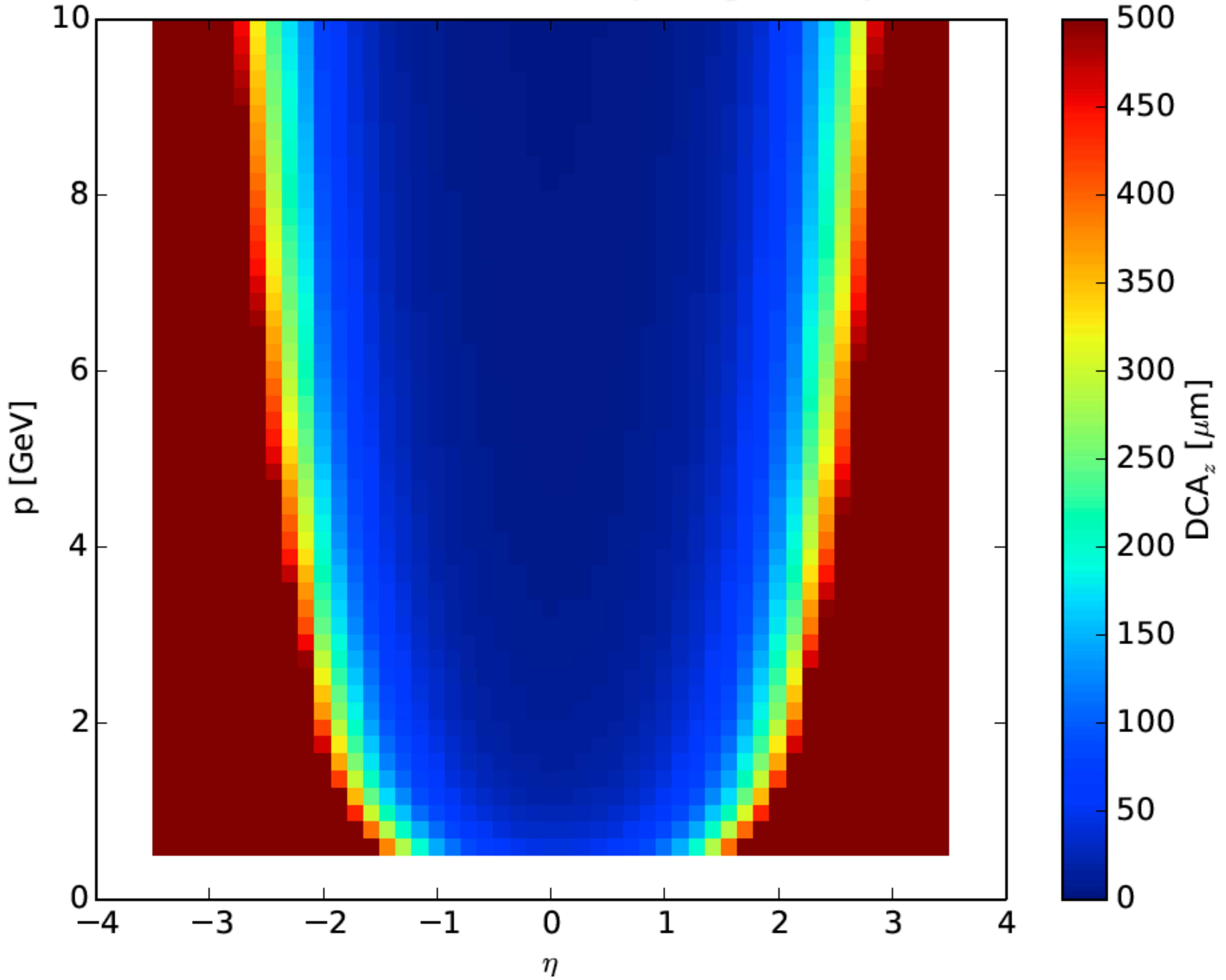




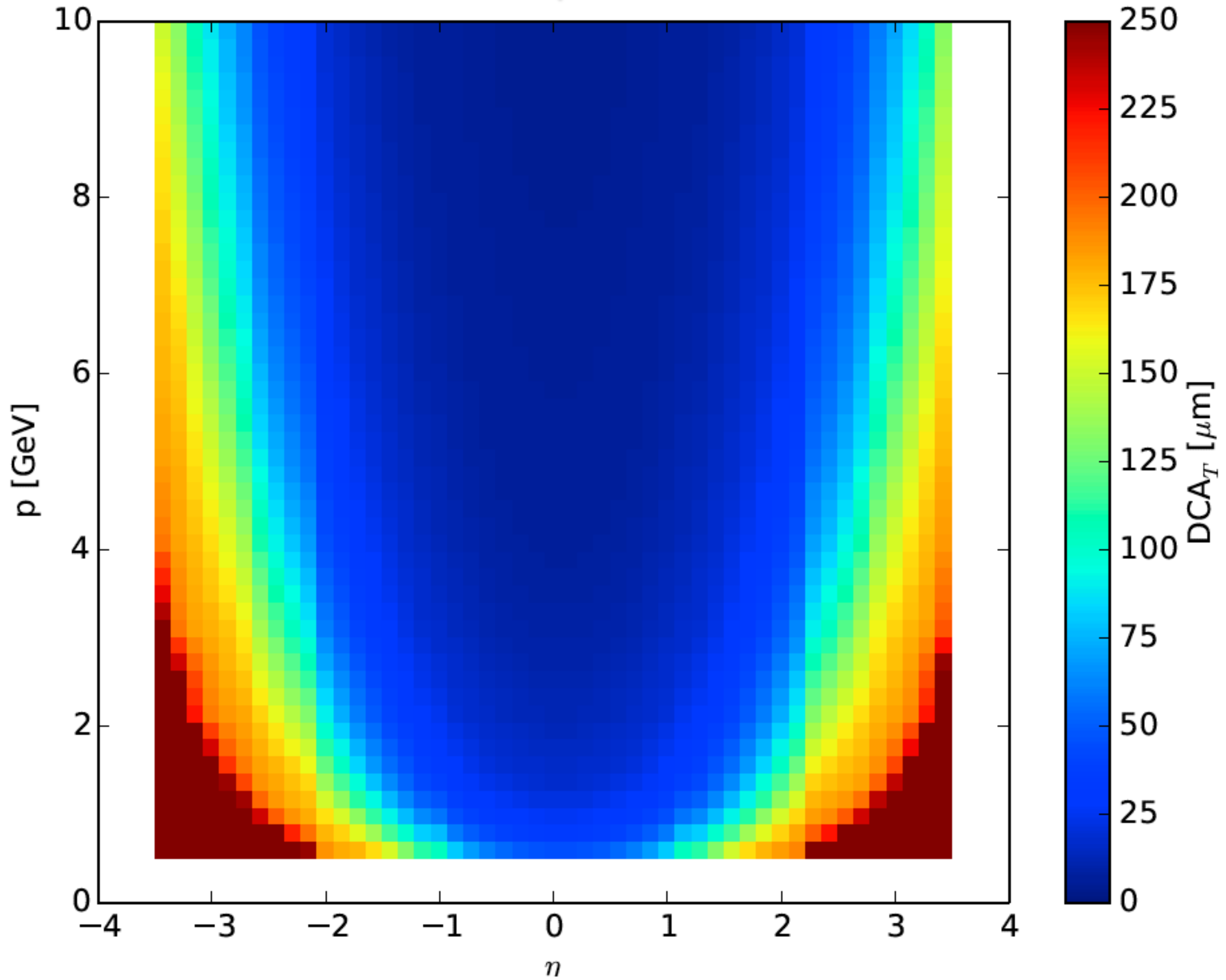
CORE: some notable features — tracking

- **compact, high-field** (3T) solenoid: coil length 2.5m with 1m inner radius
  - enables high-resolution tracking together w/ all-Si tracker
    ➥ sufficient vertex resolution to tag charm

longitudinal



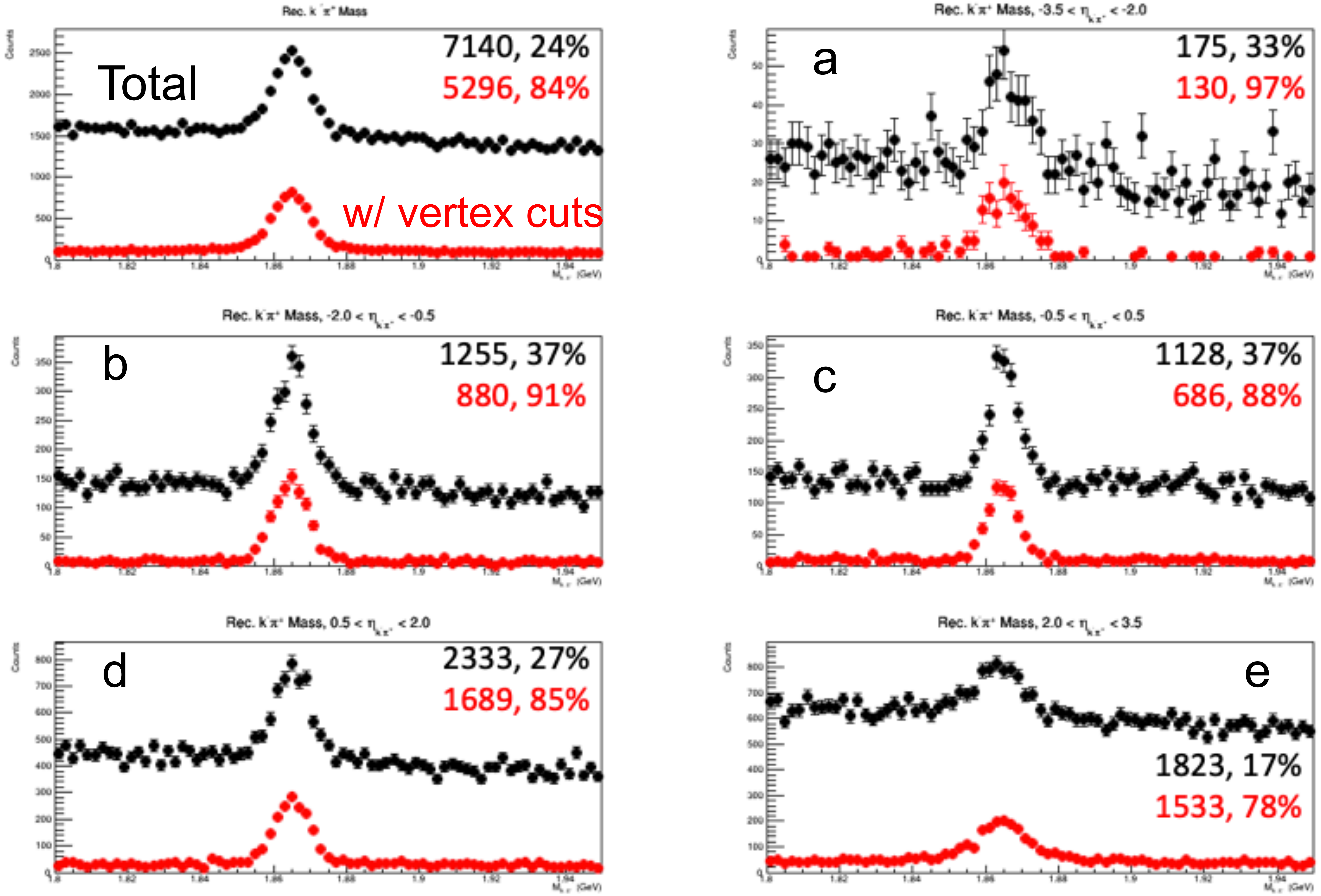
transverse

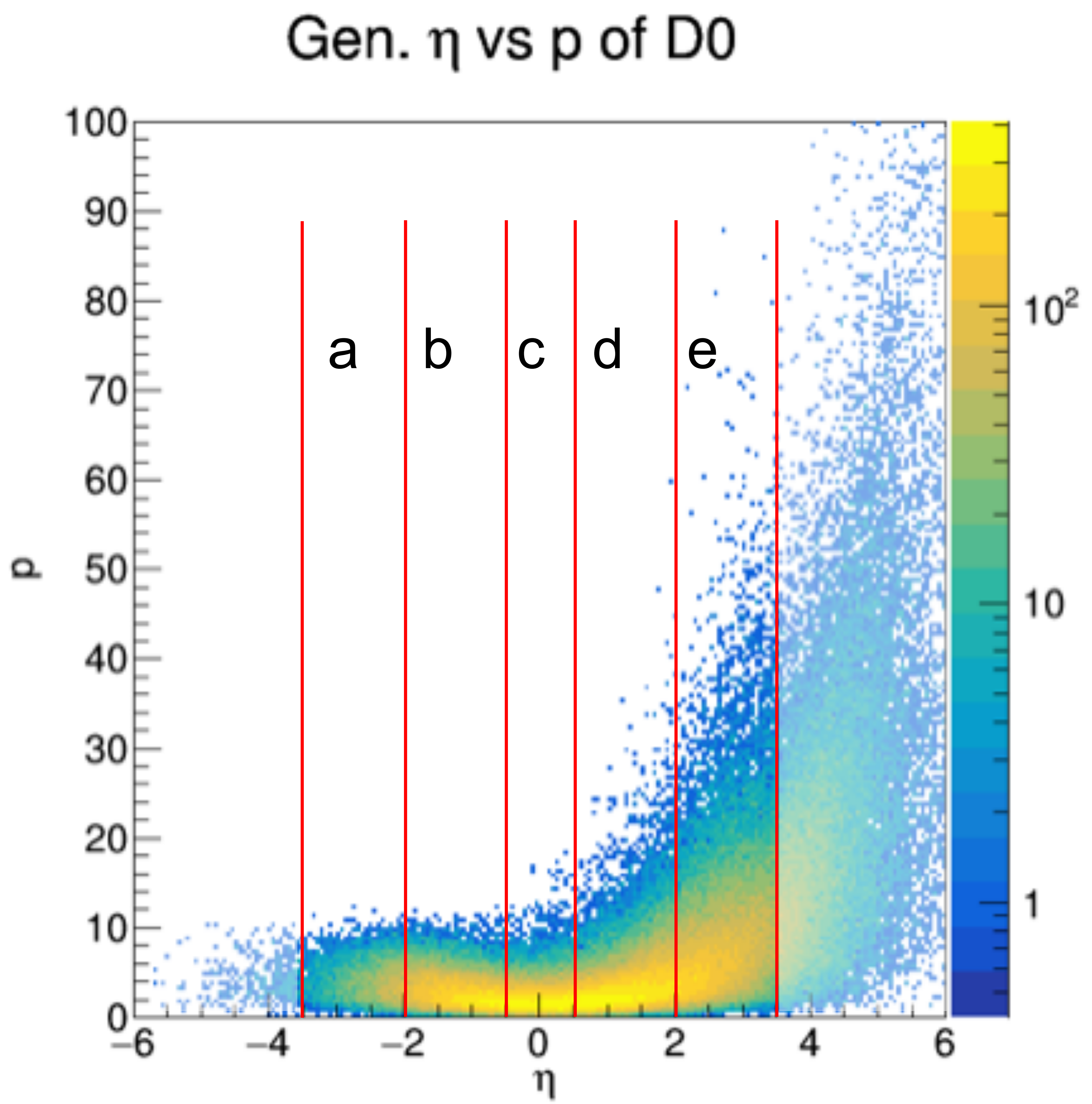


CORE: some notable features — tracking

- **compact, high-field** (3T) solenoid: coil length 2.5m with 1m inner radius
  - enables high-resolution tracking together w/ all-Si tracker
    ➥ sufficient vertex resolution to tag charm

18 x 275 GeV

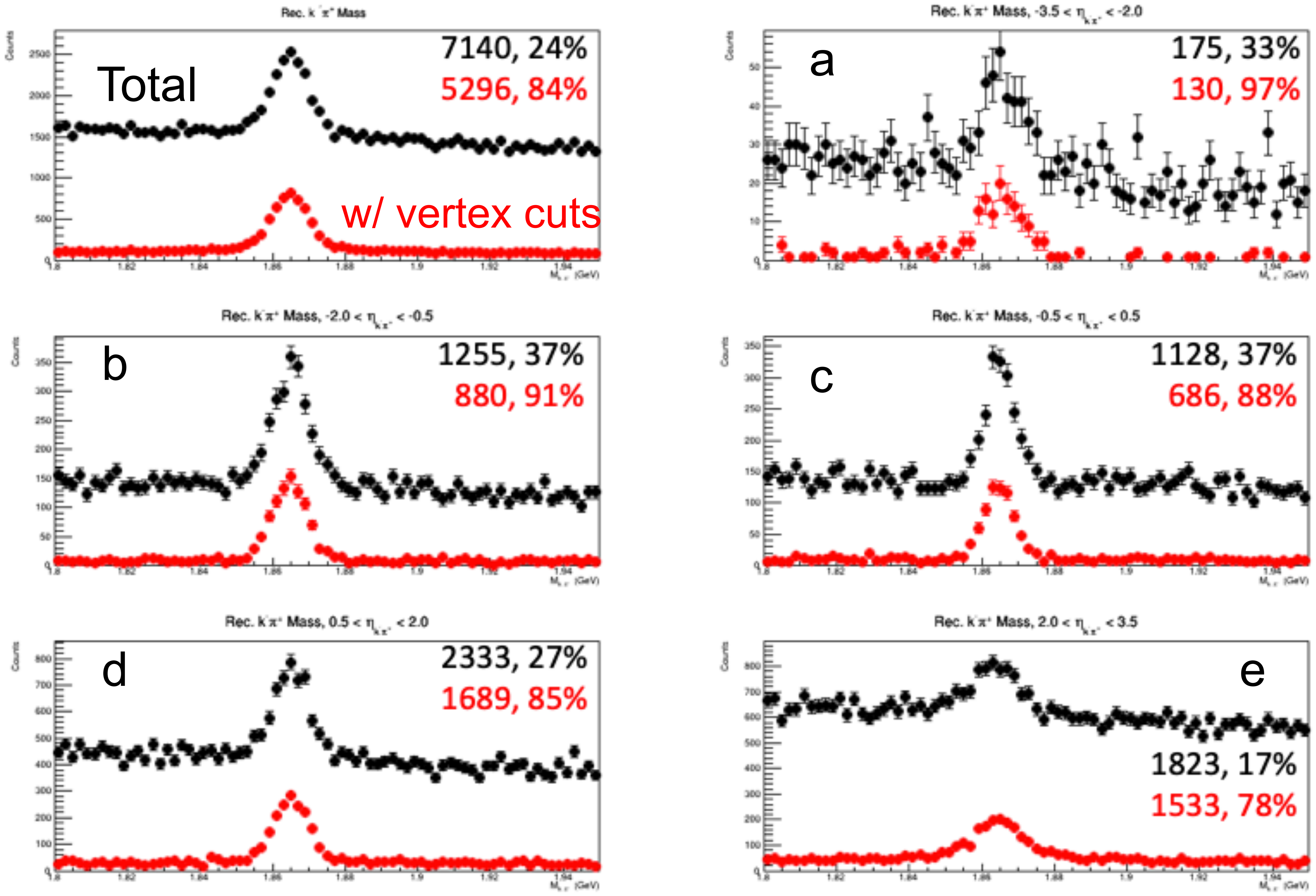




CORE: some notable features — tracking

- **compact, high-field** (3T) solenoid: coil length 2.5m with 1m inner radius
  - enables high-resolution tracking together w/ all-Si tracker
    ➥ sufficient vertex resolution to tag charm

18 x 275 GeV



number of D^0, purity of D^0 sample before / after vertex constraints:

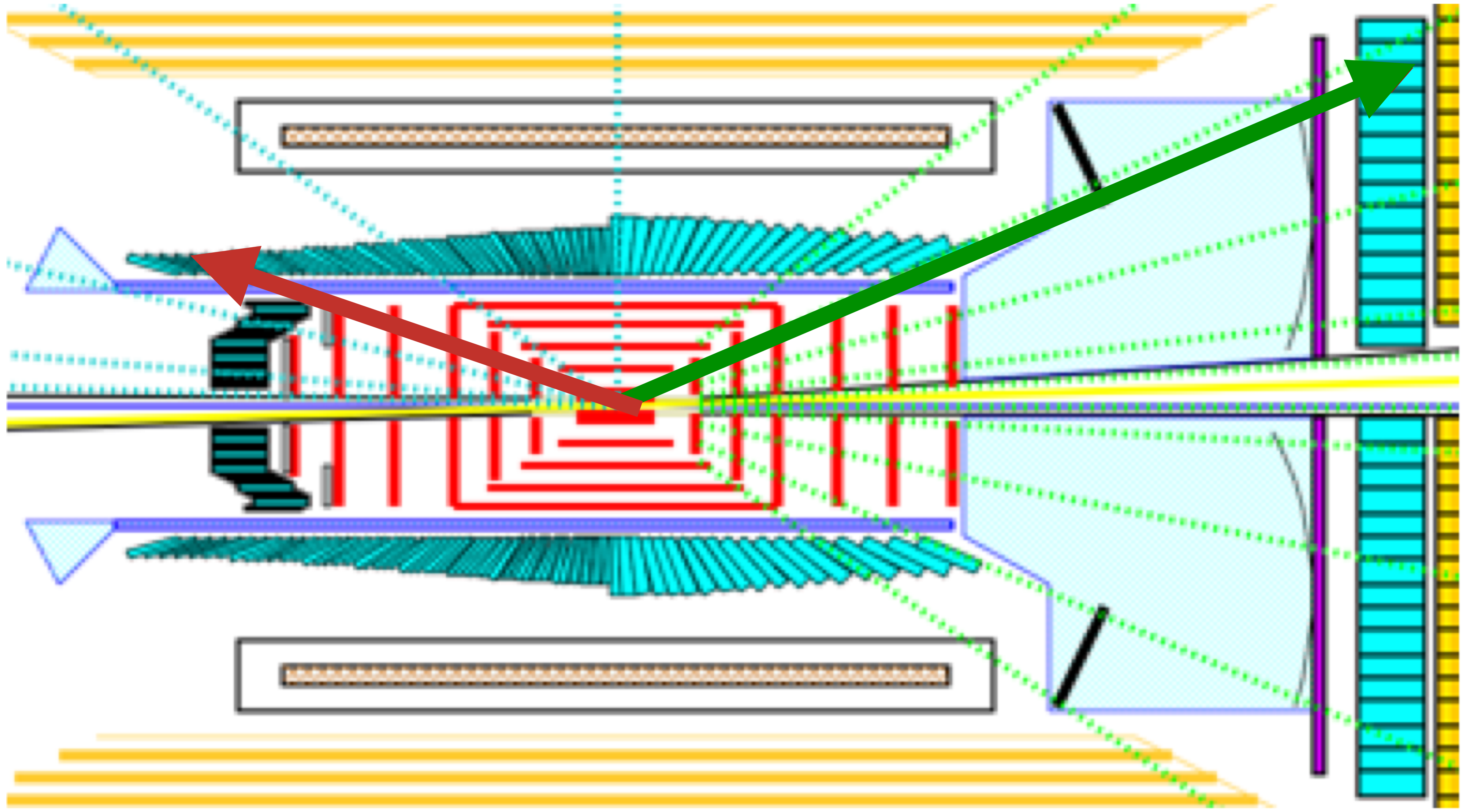
$|v_K - v_\pi| < 50\mu m$, $|v_e - v_\pi| > 50\mu m$

Already with simple vertex constraints a rather clean D^0 sample (purity of 87–97%) with high efficiency can be achieved. Performance is sufficient for both asymmetry and cross-section measurements.

Further improvements from refined analysis, e.g., K/π-momentum ranking for higher-momenta D^0, easily possible.

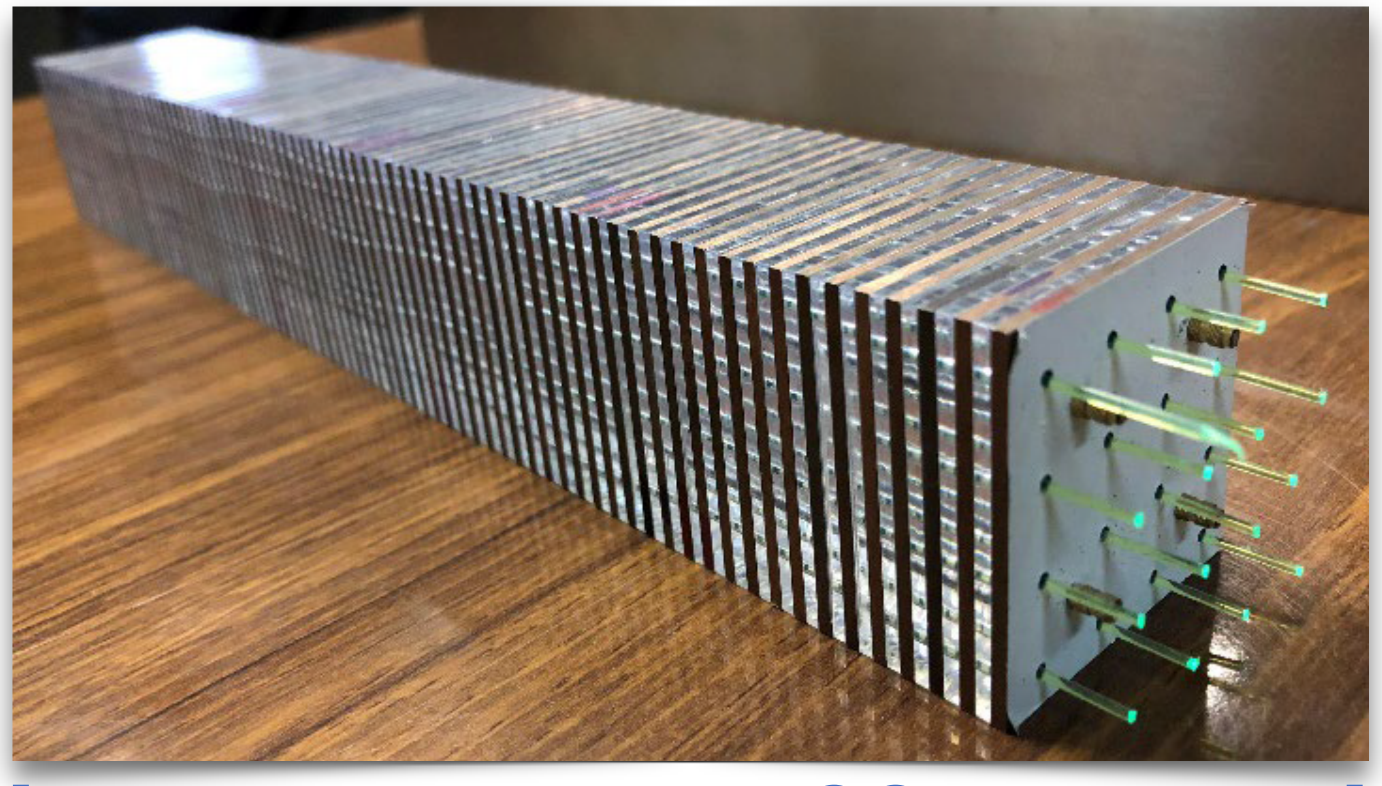
CORE: some notable features — EM calorimetry

- **electron hemisphere ($\eta < 0$)**
  - best EMcal for e/π ID is PbWO (2%√E + 1%)
    ➥ used to cover full electron hemisphere
  - endcap: non-projective & barrel: projective
  - endcap EMcal is small & light
    ➥ can be cantilevered from behind to reduce supports, improving hermeticity
- **hadron hemisphere ($\eta > 0$)**
  - W-shashlik (6%√E + 2%)
  - hadron endcap: 20 X_0 non-projective
    forward part of the barrel: 25 X_0 projective
  - excellent position resolution (γ/π^0 at high E)



CORE: some notable features — EM calorimetry

- **electron hemisphere ($\eta < 0$)**
  - best EMcal for e/π ID is PbWO ($2\%\sqrt{E} + 1\%$)
    ➥ used to cover full electron hemisphere
  - endcap: non-projective & barrel: projective
  - endcap EMcal is small & light
    ➥ can be cantilevered from behind to reduce supports, improving hermeticity
- **hadron hemisphere ($\eta > 0$)**
  - W-shashlik ($6\%\sqrt{E} + 2\%$)
  - hadron endcap: 20 X_0 non-projective
    forward part of the barrel: 25 X_0 projective
  - excellent position resolution (γ/π^0 at high E)

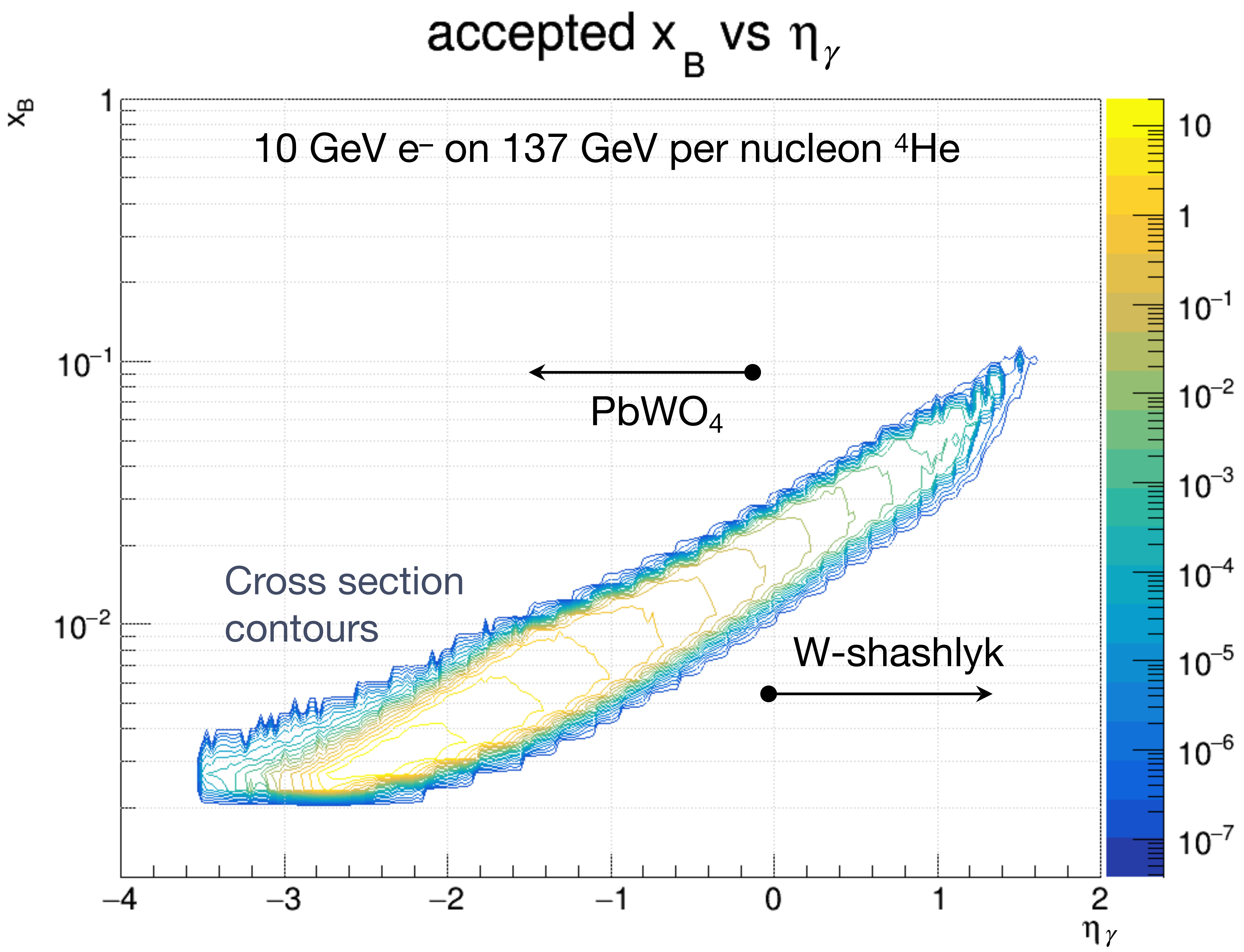


[example, not actual CORE module]

- W-shashlik with interleaved layers of
  - 1.25mm W/Cu alloy (80% / 20%)
  - 2mm scintillator

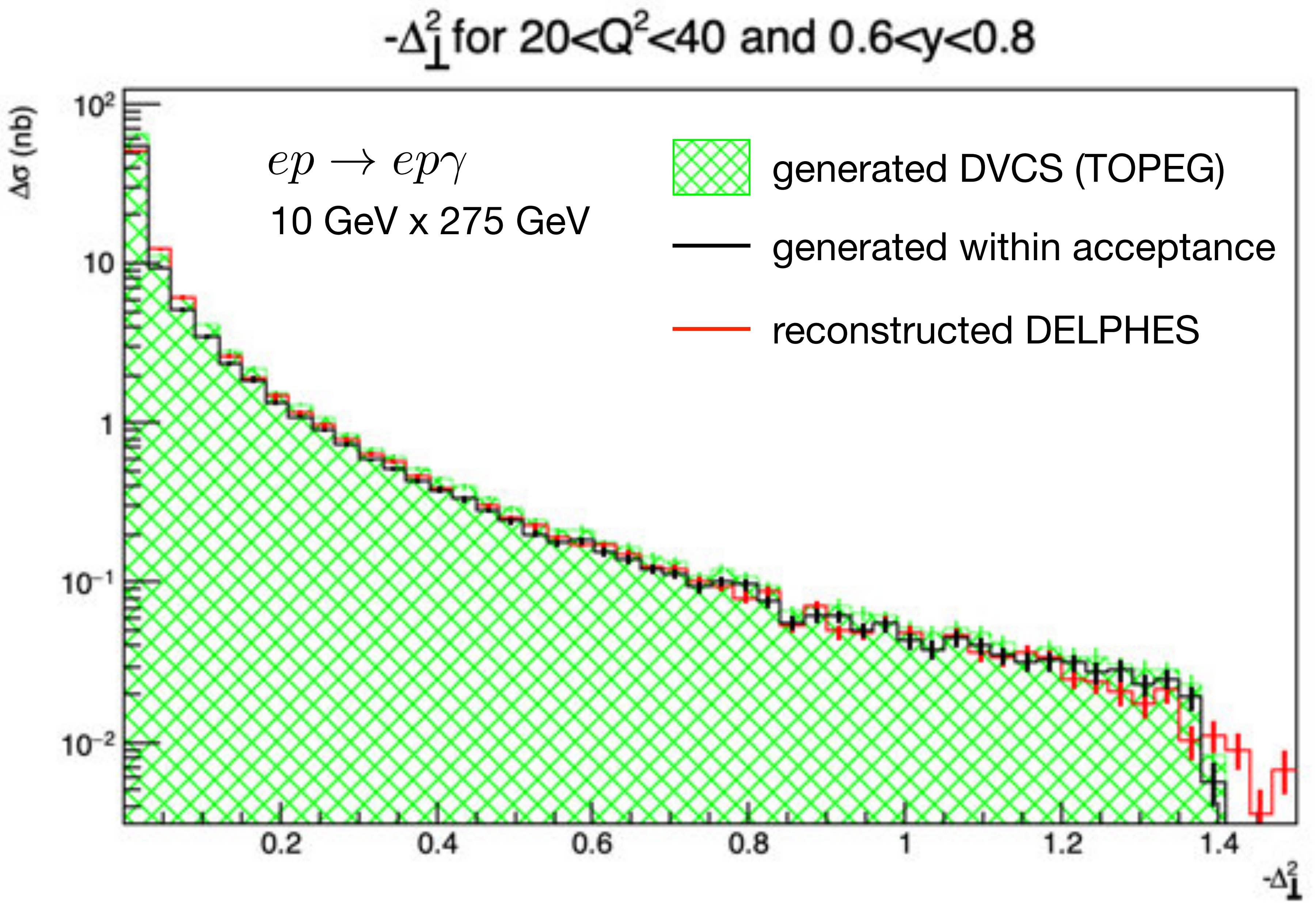
CORE: some notable features — EM calorimetry

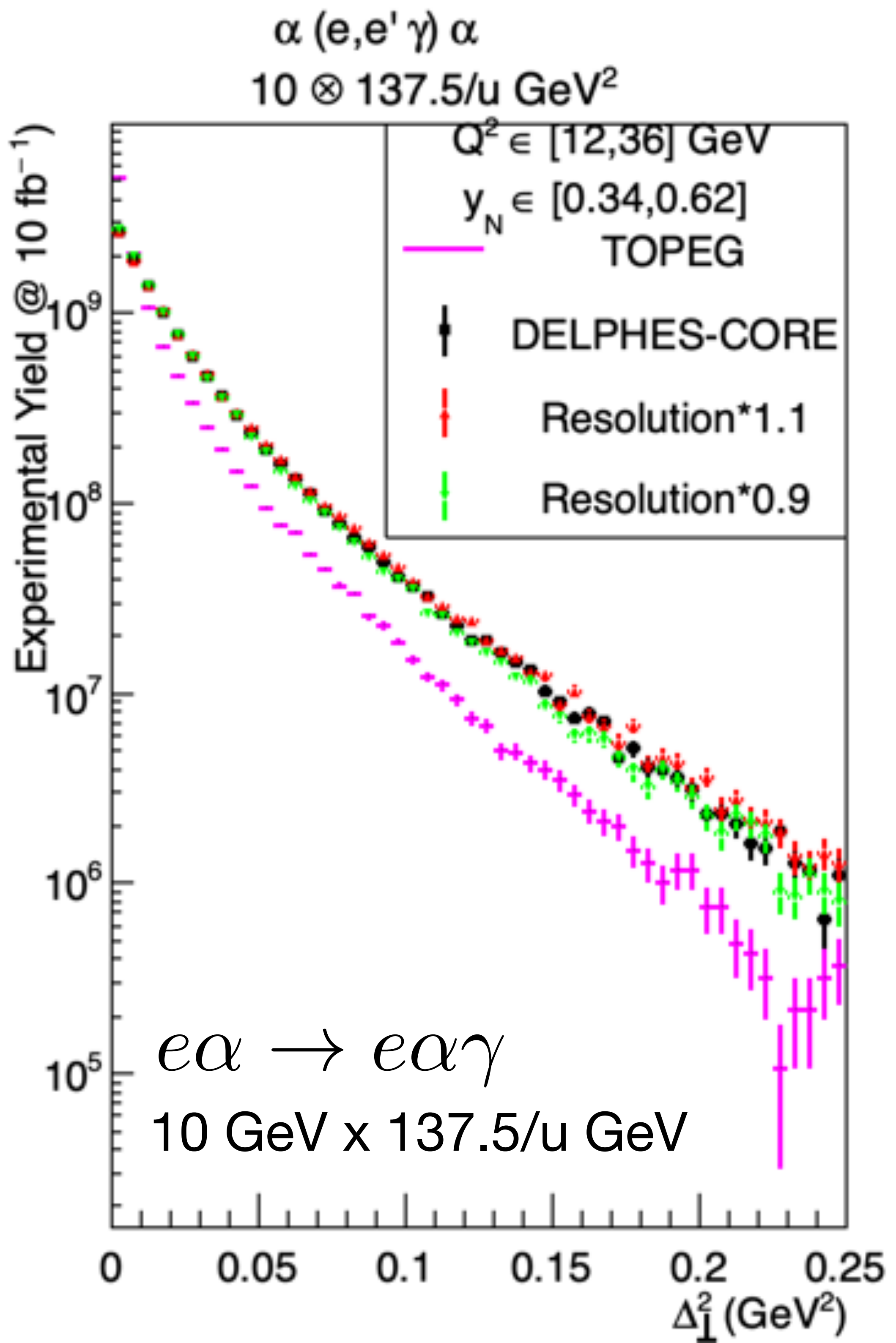
- deeply virtual Compton scattering (DVCS): e A → e γ A
  - transverse momentum transfer essential for transverse imaging
  - can infer momentum transfer from scattered proton (nucleus) in far-forward detectors ("Roman pots")
    ➥ limitations from hadron-beam effects
  - OR: use **well reconstructed e & γ kinematics**; with equal or even better resolution at CORE compared to YR
    ➥ forward hadron detection in addition improves exclusivity / BG suppression

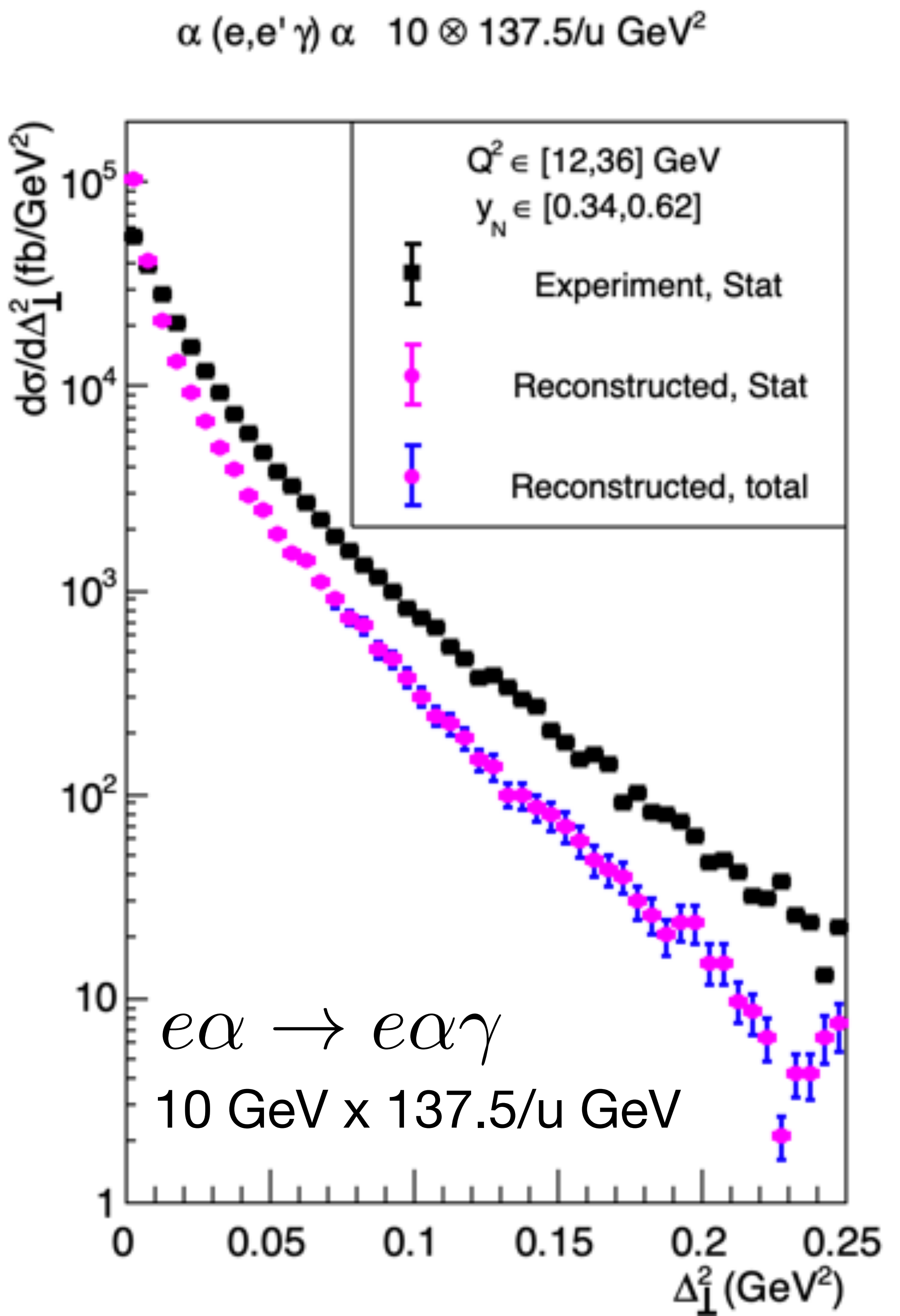


CORE: some notable features — EM calorimetry

- deeply virtual Compton scattering (DVCS): e A → e γ A
  - transverse momentum transfer essential for transverse imaging
  - can infer momentum transfer from scattered proton (nucleus) in far-forward detectors (“Roman pots”)
    ➥ limitations from hadron-beam effects
  - OR: use **well reconstructed e & γ kinematics**; with equal or even better resolution at CORE compared to YR
    ➥ forward hadron detection in addition improves exclusivity / BG suppression



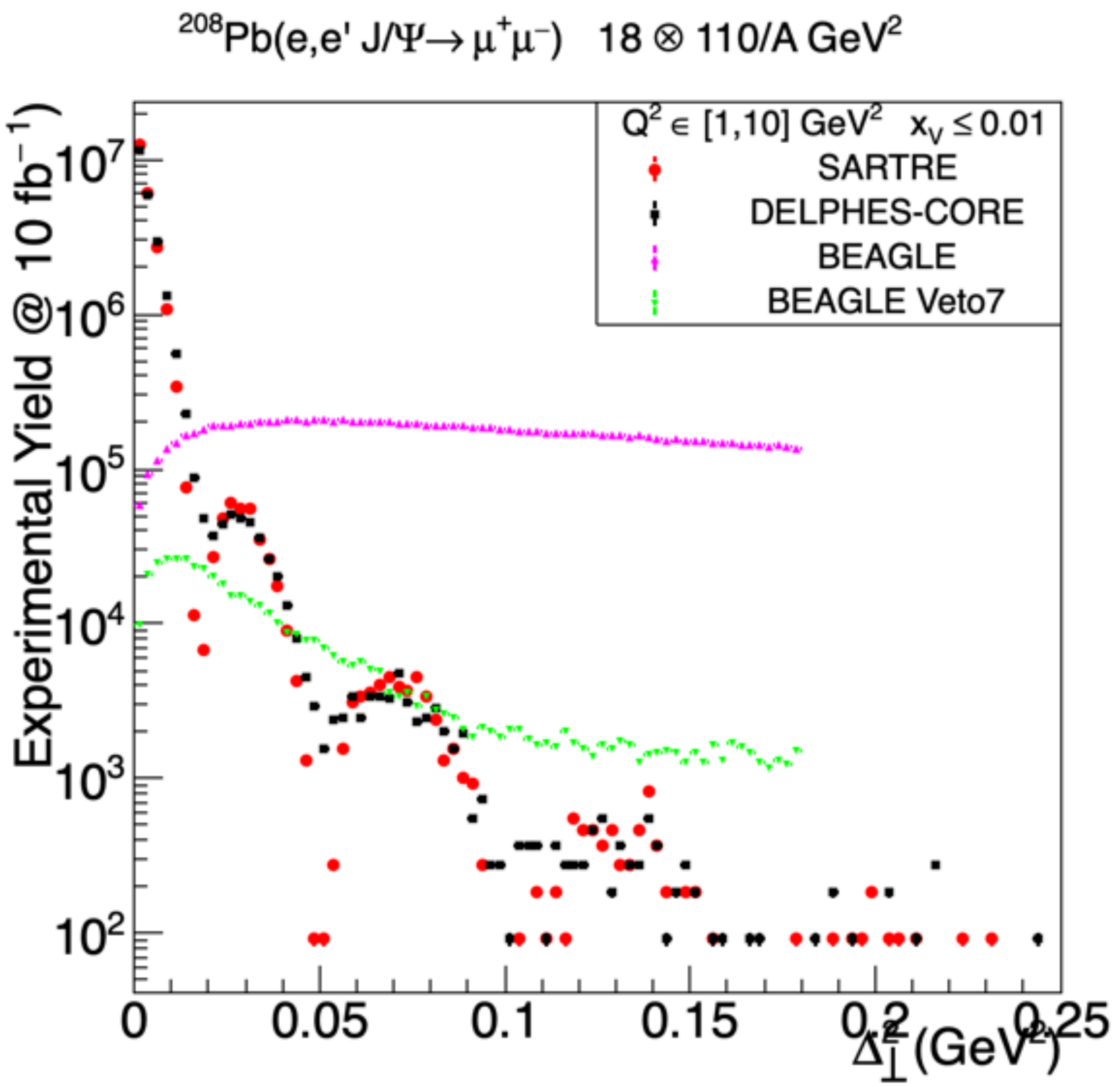




☞ C. Hyde's WG6 talk on We

CORE: some notable features — EM calorimetry

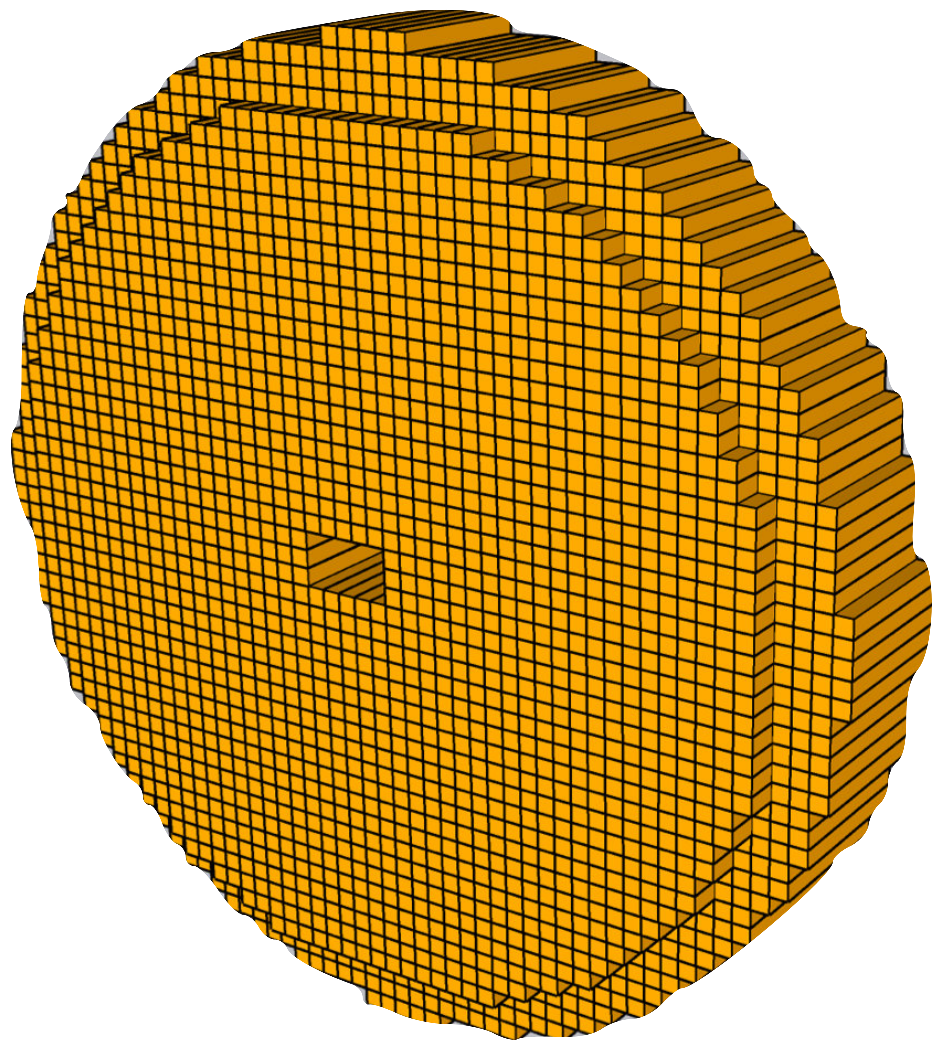
- deeply virtual Compton scattering (DVCS): e A → e γ A
  - transverse momentum transfer essential for transverse imaging
  - can infer momentum transfer from scattered proton (nucleus) in far-forward detectors (“Roman pots”)
    ➥ limitations from hadron-beam effects
  - OR: use **well reconstructed e & γ kinematics**; with equal or even better resolution at CORE compared to YR
    ➥ forward hadron detection in addition improves exclusivity / BG suppression
- similar arguments for exclusive meson production



➥ Diffraction maxima up to 0.075 GeV² will be visible (in IR6)

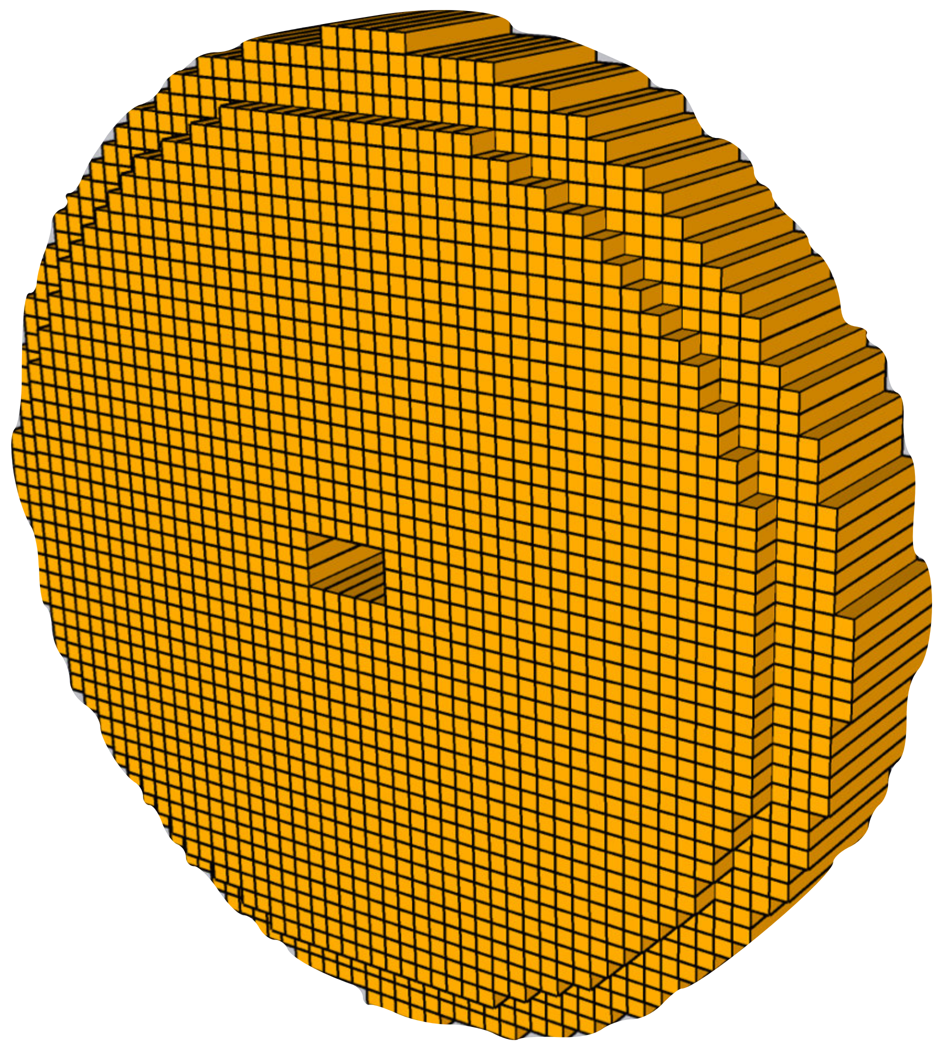
CORE: some notable features — hadron calorimetry & muons

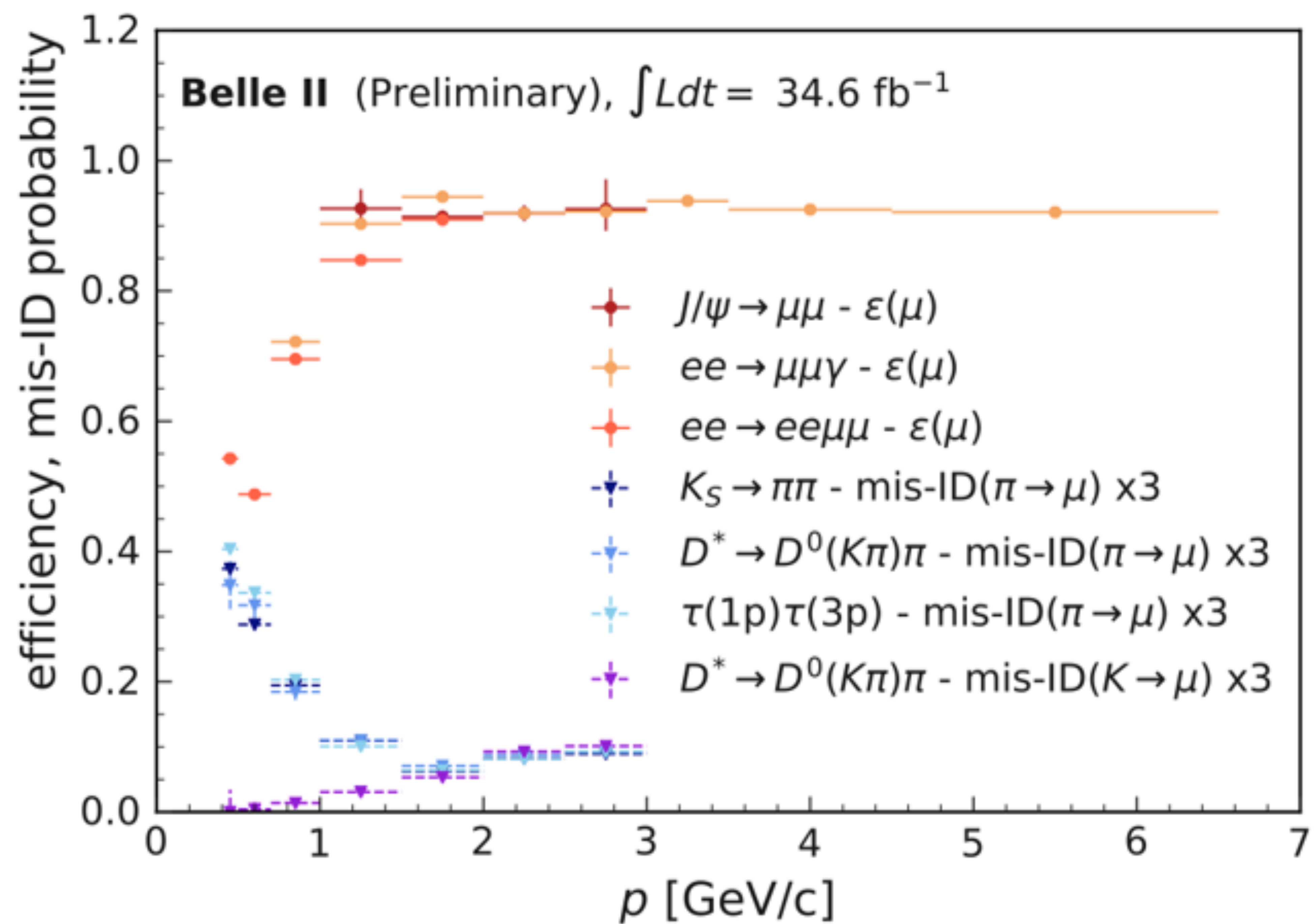
- η > 1.2 : Hcal based on STAR FCS
  - 520 STAR FCS modules are re-used for the outer ring
  - original STAR FCS has 36 Fe/Sci layers (20+3 mm); new modules will have 44
  - divided into two parts that can be moved out to the sides



CORE: some notable features — hadron calorimetry & muons

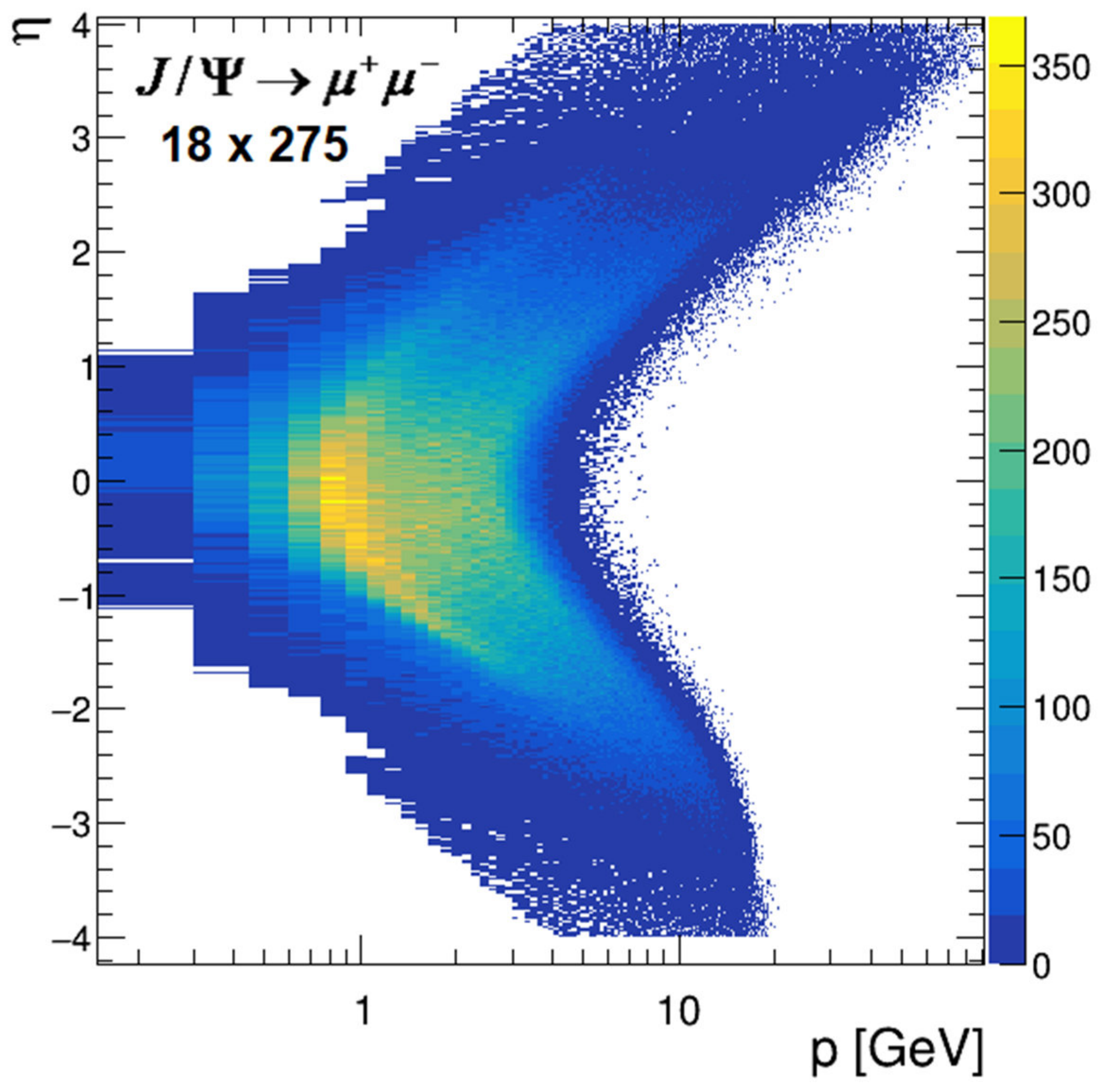
- $\eta > 1.2$: Hcal based on STAR FCS
  - 520 STAR FCS modules are re-used for the outer ring
  - original STAR FCS has 36 Fe/Sci layers (20+3 mm); new modules will have 44
  - divided into two parts that can be moved out to the sides
- $\eta < 1.2$: neutral hadron and muon ID detector based on the Belle II KLM
  - layers of orthogonal scintillator readout strips interleaved with the solenoid return steel
  - high detection efficiency and good angular resolution

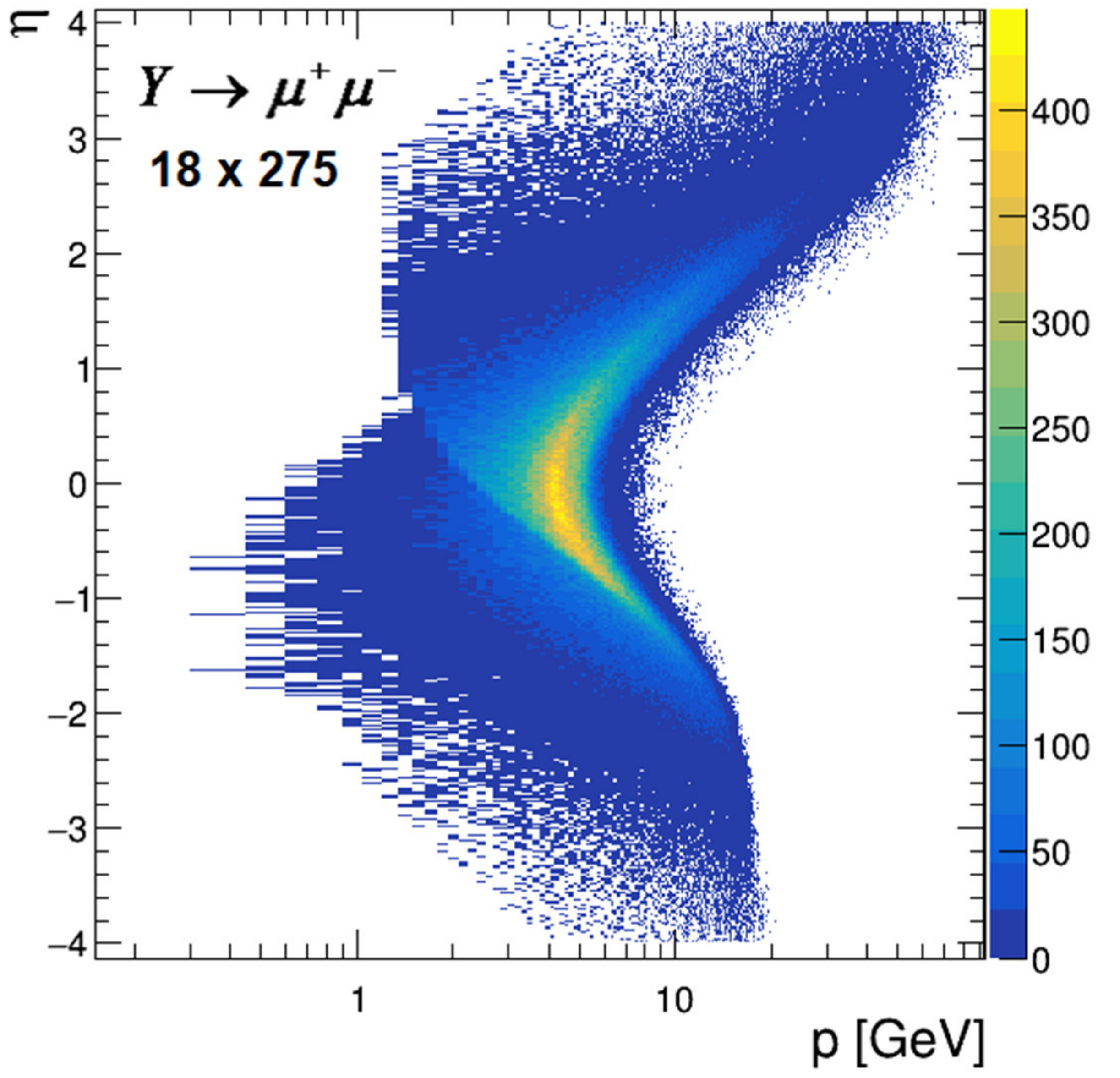


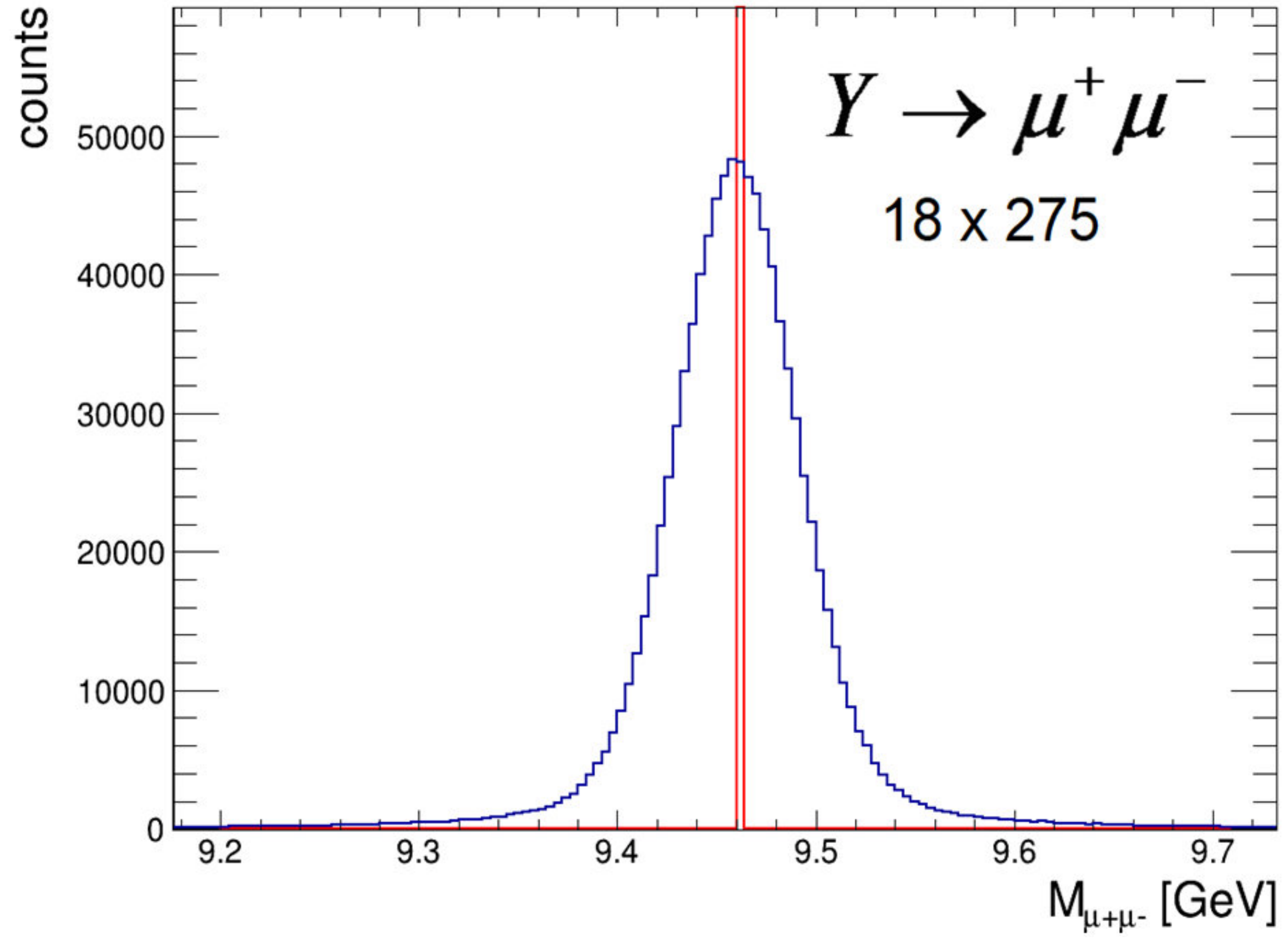


CORE: some notable features — hadron calorimetry & muons

- $\eta > 1.2$: Hcal based on STAR FCS
  - 520 STAR FCS modules are re-used for the outer ring
  - original STAR FCS has 36 Fe/Sci layers (20+3 mm); new modules will have 44
  - divided into two parts that can be moved out to the sides
- $\eta < 1.2$: neutral hadron and muon ID detector based on the Belle II KLM
  - layers of orthogonal scintillator readout strips interleaved with the solenoid return steel
  - high detection efficiency and good angular resolution

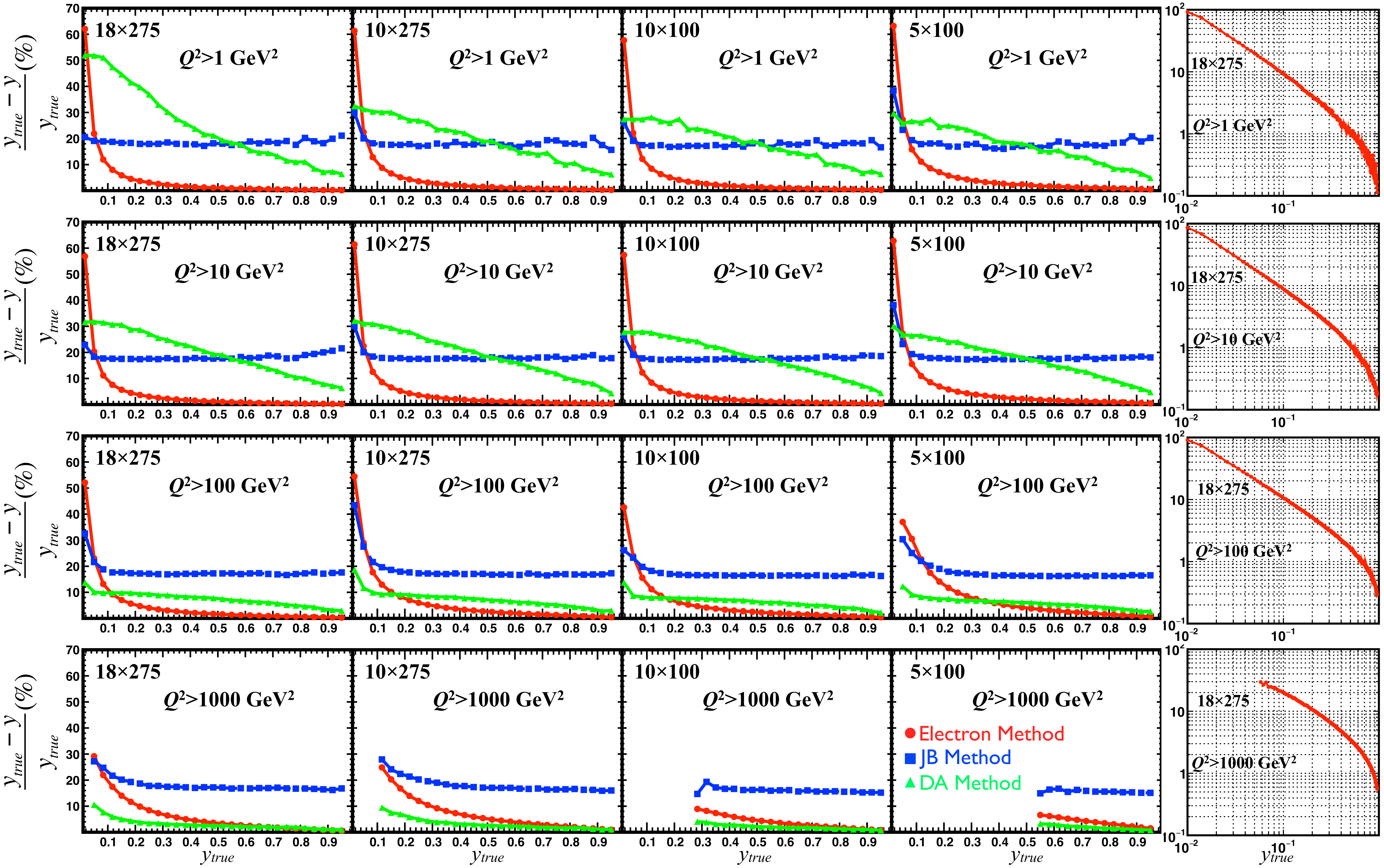






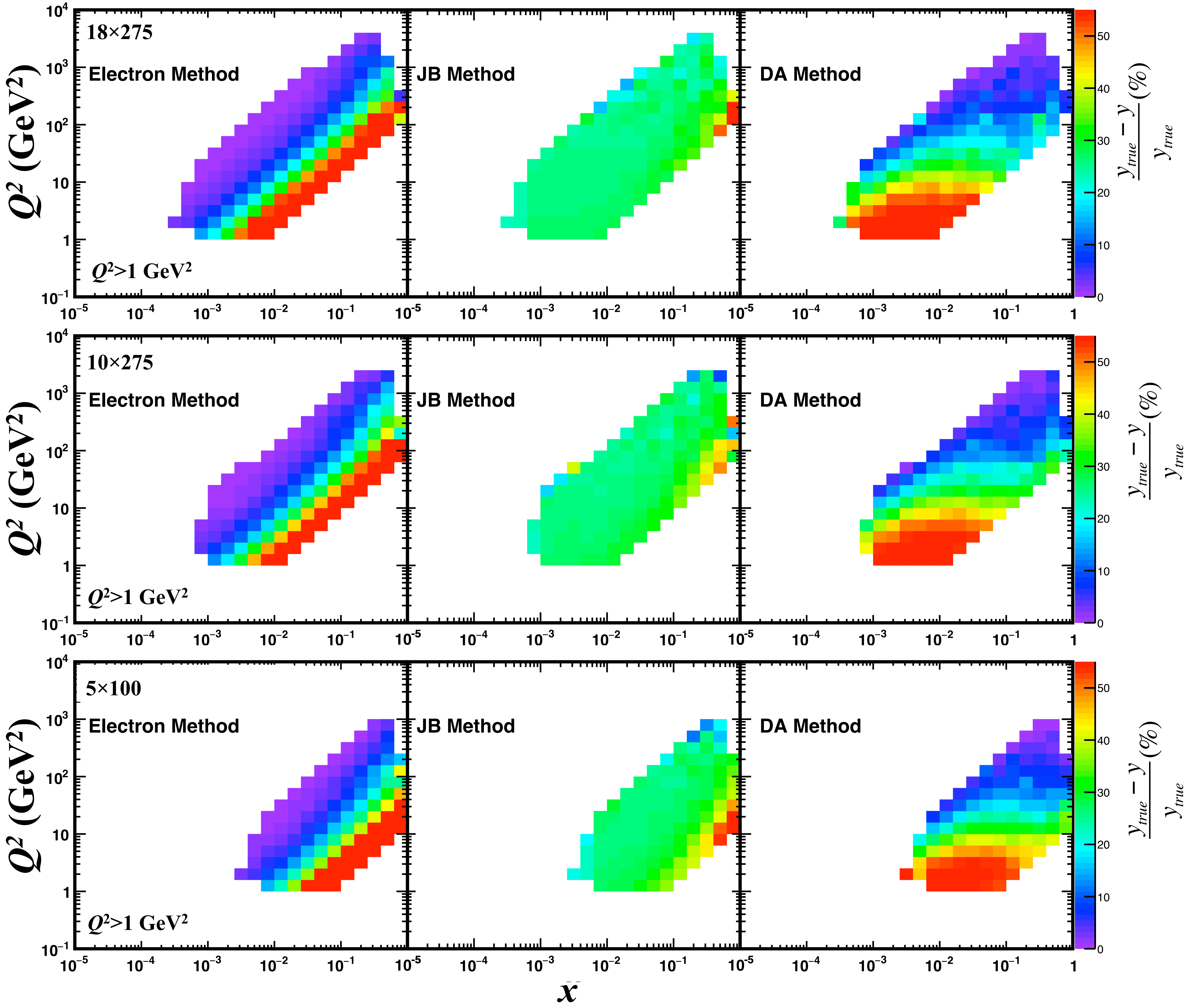
CORE: electron kinematics

- high-resolution calorimetry allows for precision DIS on protons and nuclei
  - electron method sufficient for most
    y=(q•P)/(k•P)
    q … virtual photon
    k … incoming lepton
    P … incoming proton
  - only at low y, need alternative methods like Jaquet-Blondel (JB) or double-angle (DA) method
- low-x region (large y) with %-level precision



CORE: electron kinematics

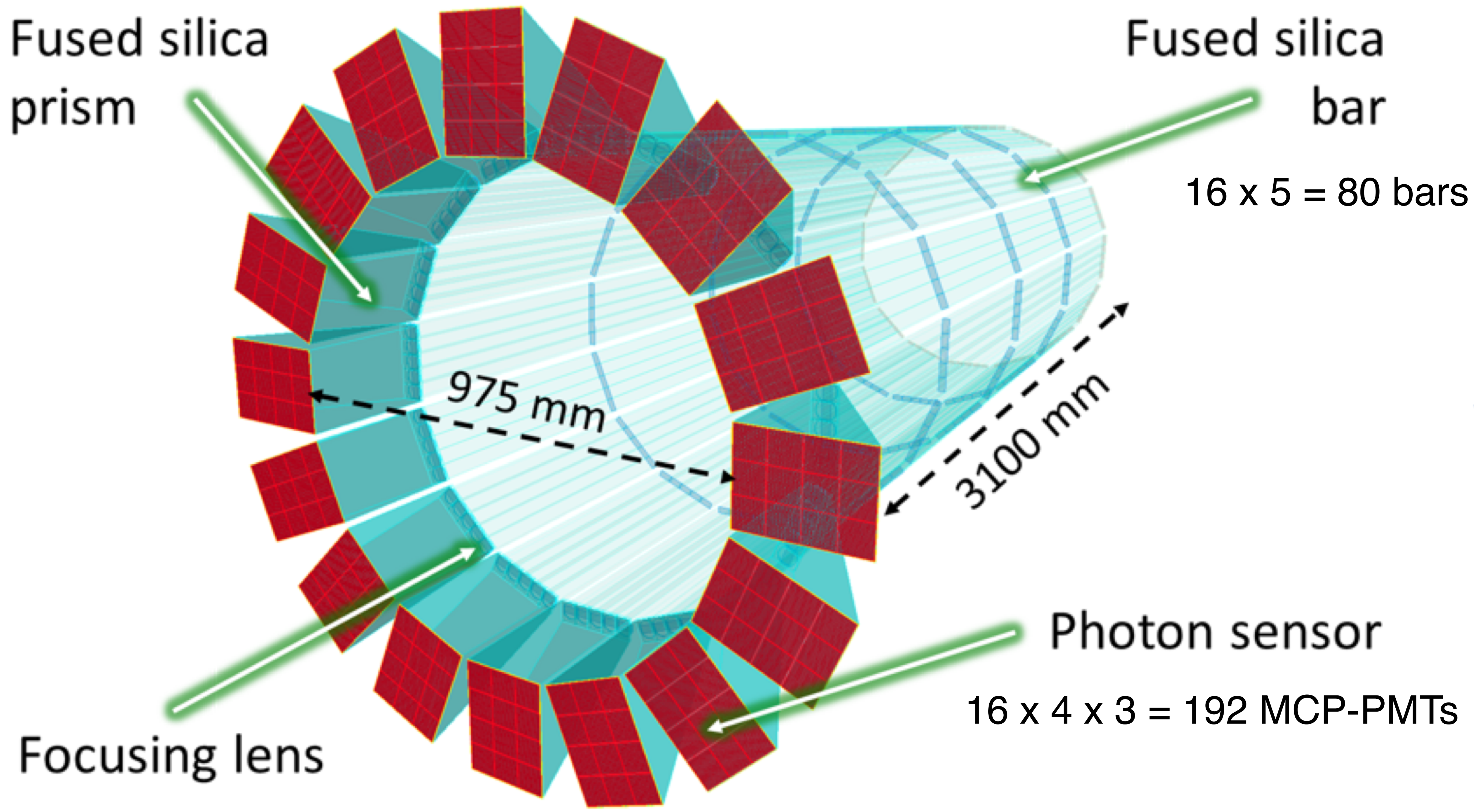
- high-resolution calorimetry allows for precision DIS on protons and nuclei
  - electron method sufficient for most
    y=(q•P)/(k•P)
    q … virtual photon
    k … incoming lepton
    P … incoming proton
  - only at low y, need alternative methods like Jaquet-Blondel (JB) or double-angle (DA) method
- low-x region (large y) with %-level precision

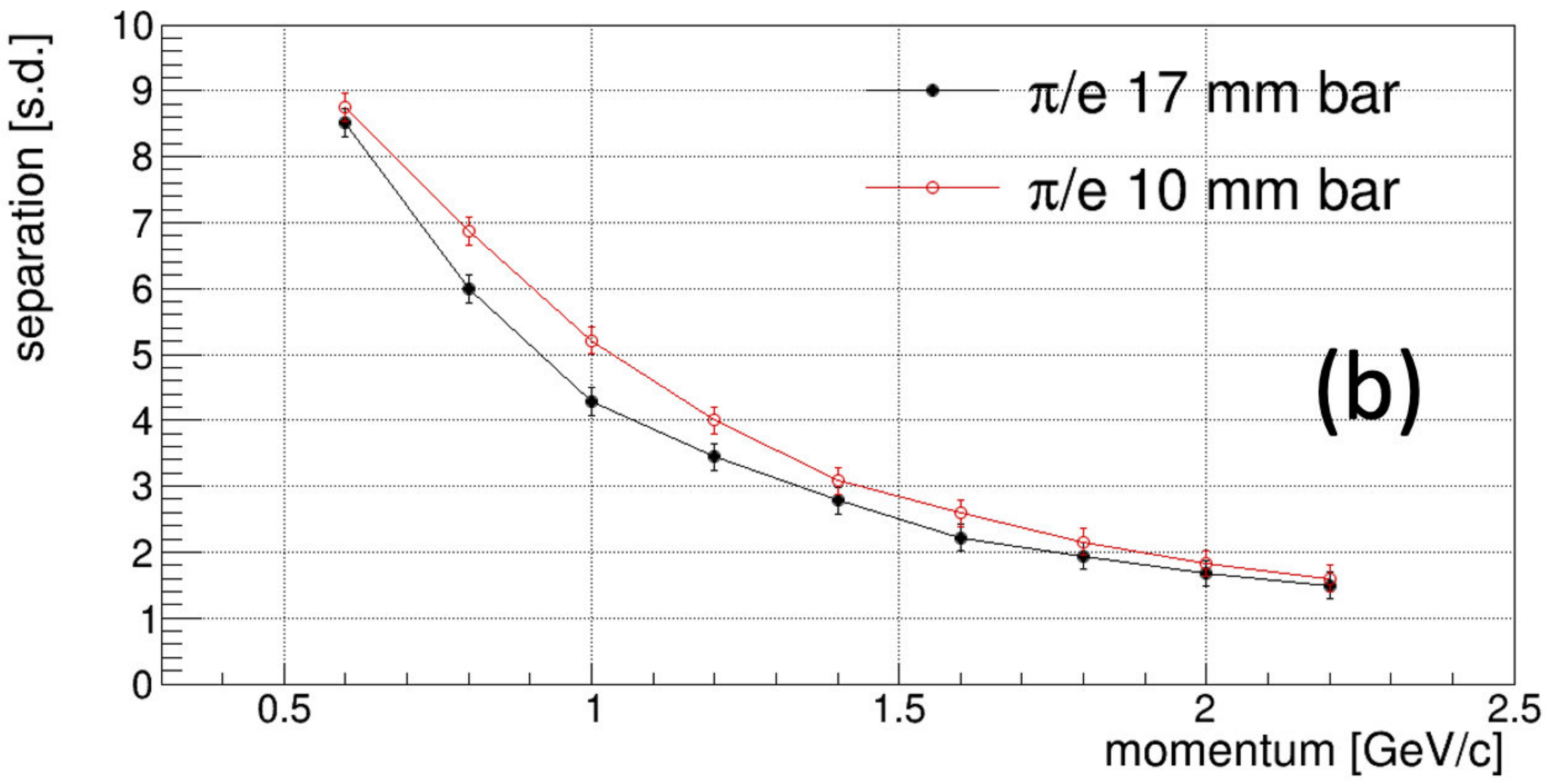


CORE: some notable features — PID

- dual-radiator RICH (aerogel+gas) in hadron endcap
  - smaller version of the eRD14 design (most dimensions scaled by a factor 2, though length of the gas along the beam only reduced from 1.6 m to 1.2 m)
- high-performance DIRC in the barrel
  - can re-use bars from BaBar
  - thanks to small size of DIRC, affordable to build new (thinner) bars ➥ significant reduction of multiple scattering and radiator material (by ~40%)
- time-of-flight (TOF) for electron endcap
  - most hadrons have small momentum ➥TOF system sufficient, while highly compact, radiation hard & B-field tolerant

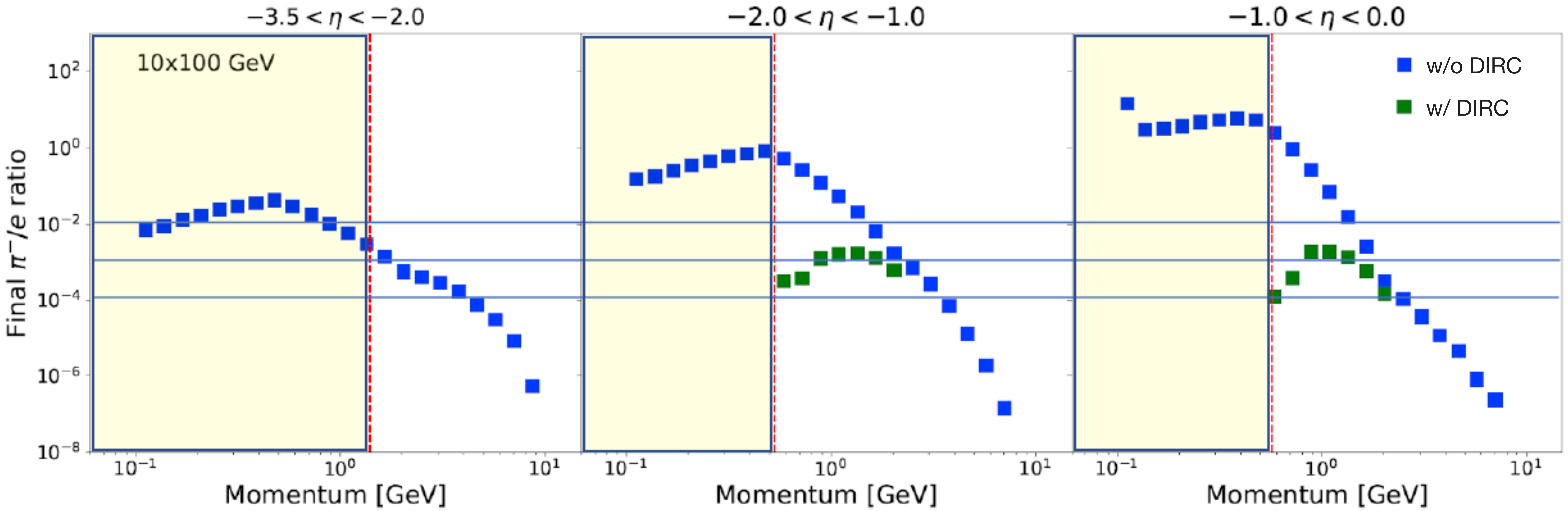
DIRC





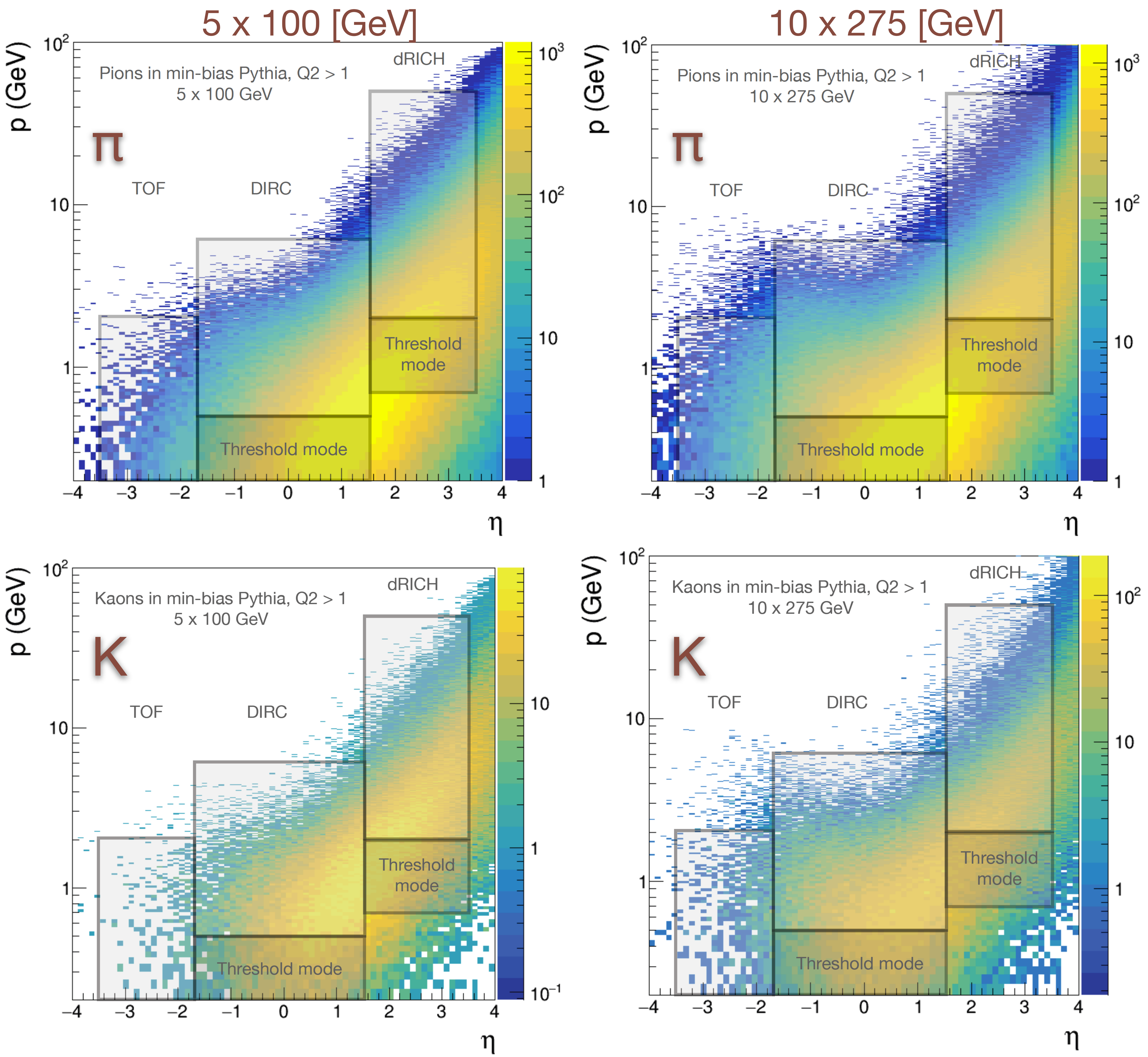
CORE: some notable features — PID

- combination of electron and hadron PID provides **substantial pion suppression**



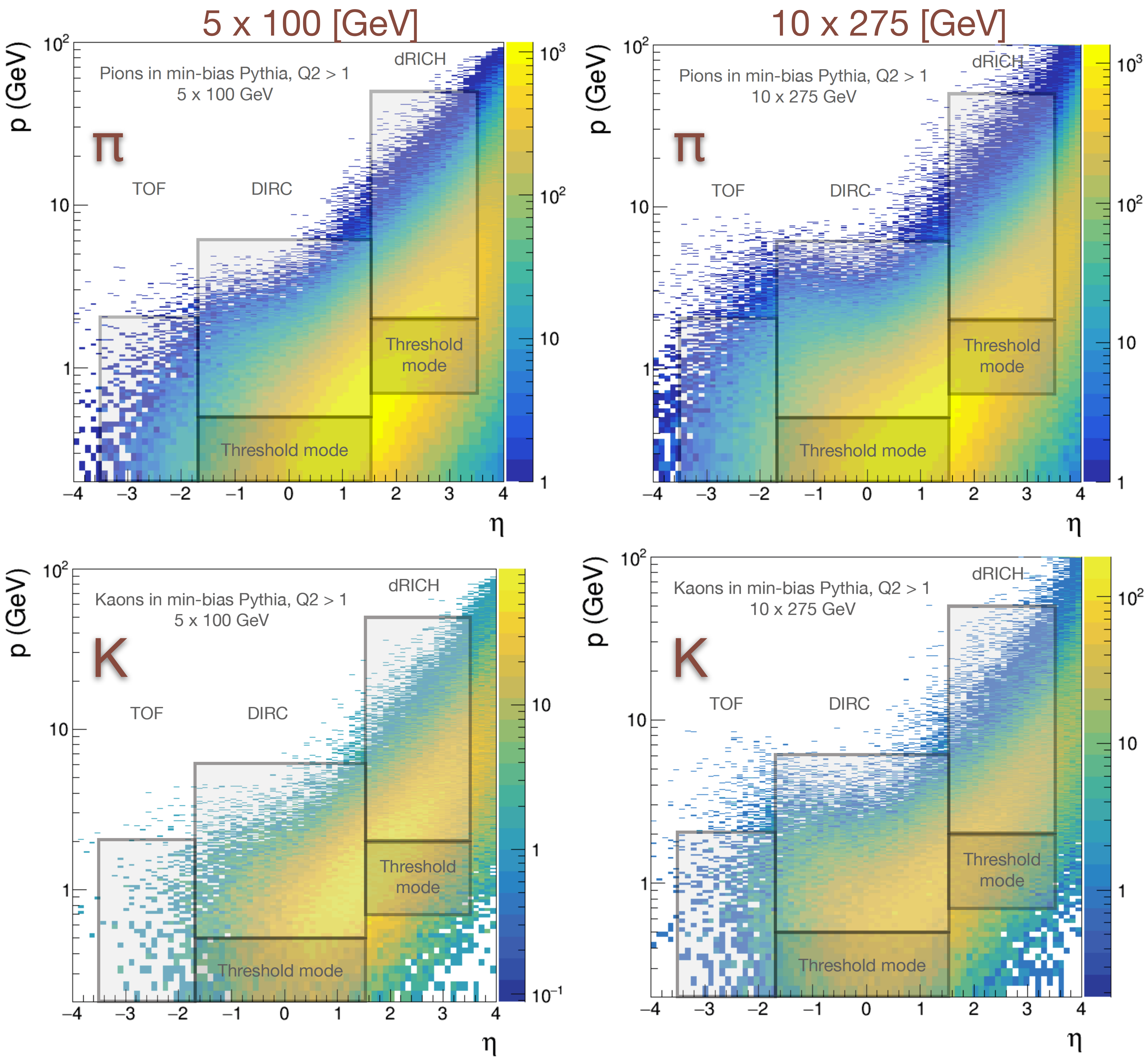
  - remaining pion / electron ratio is at the level of 0.1% or better for standard DIS kinematics
  - emphasizes purity of electron reconstruction; important for, e.g., parity-violating DIS
  - complementarity between EIC detectors

CORE: some notable features — PID (for semi-inclusive DIS)



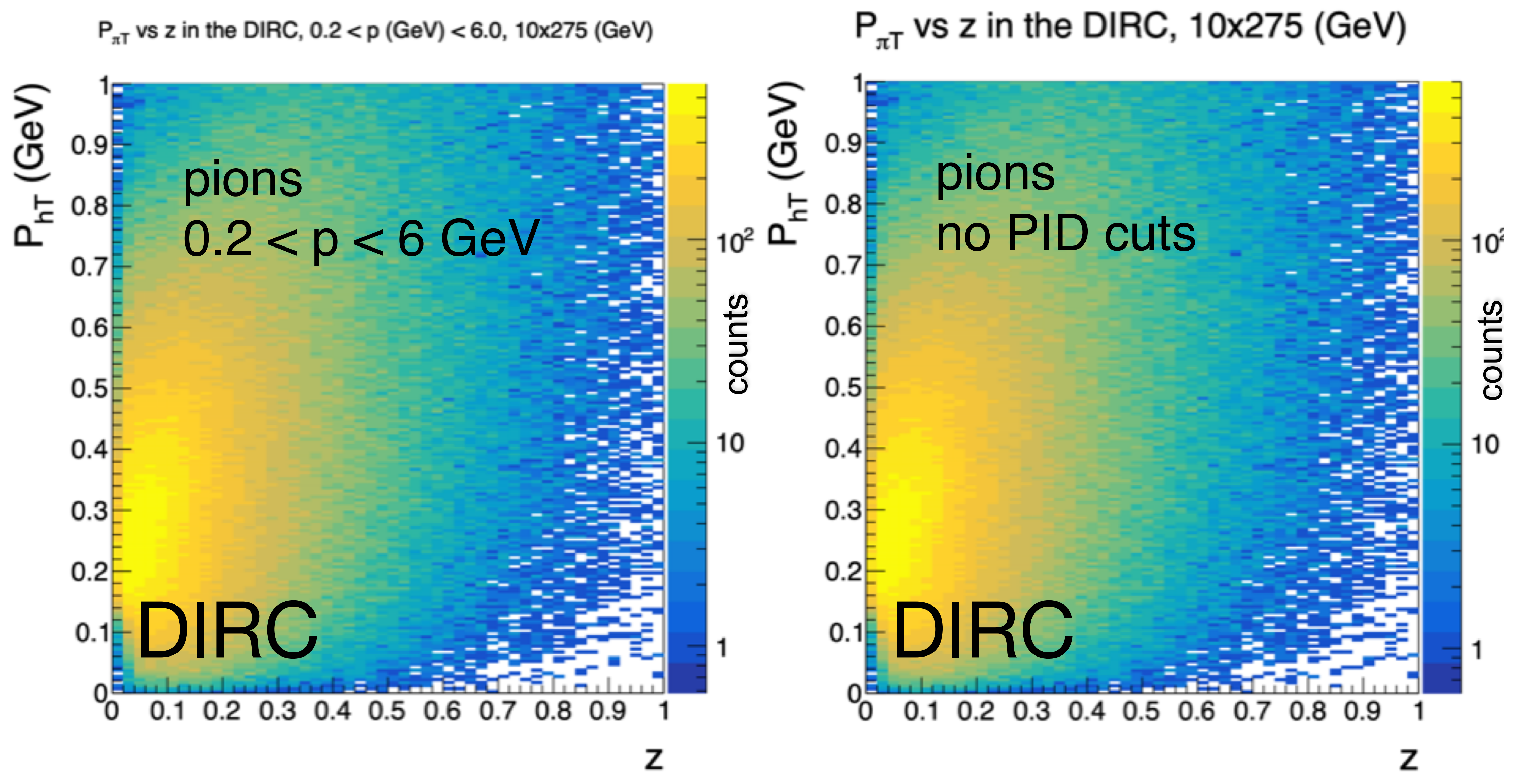
- hadron PID system covers important part of phase space for semi-inclusive DIS

CORE: some notable features — PID (for semi-inclusive DIS)



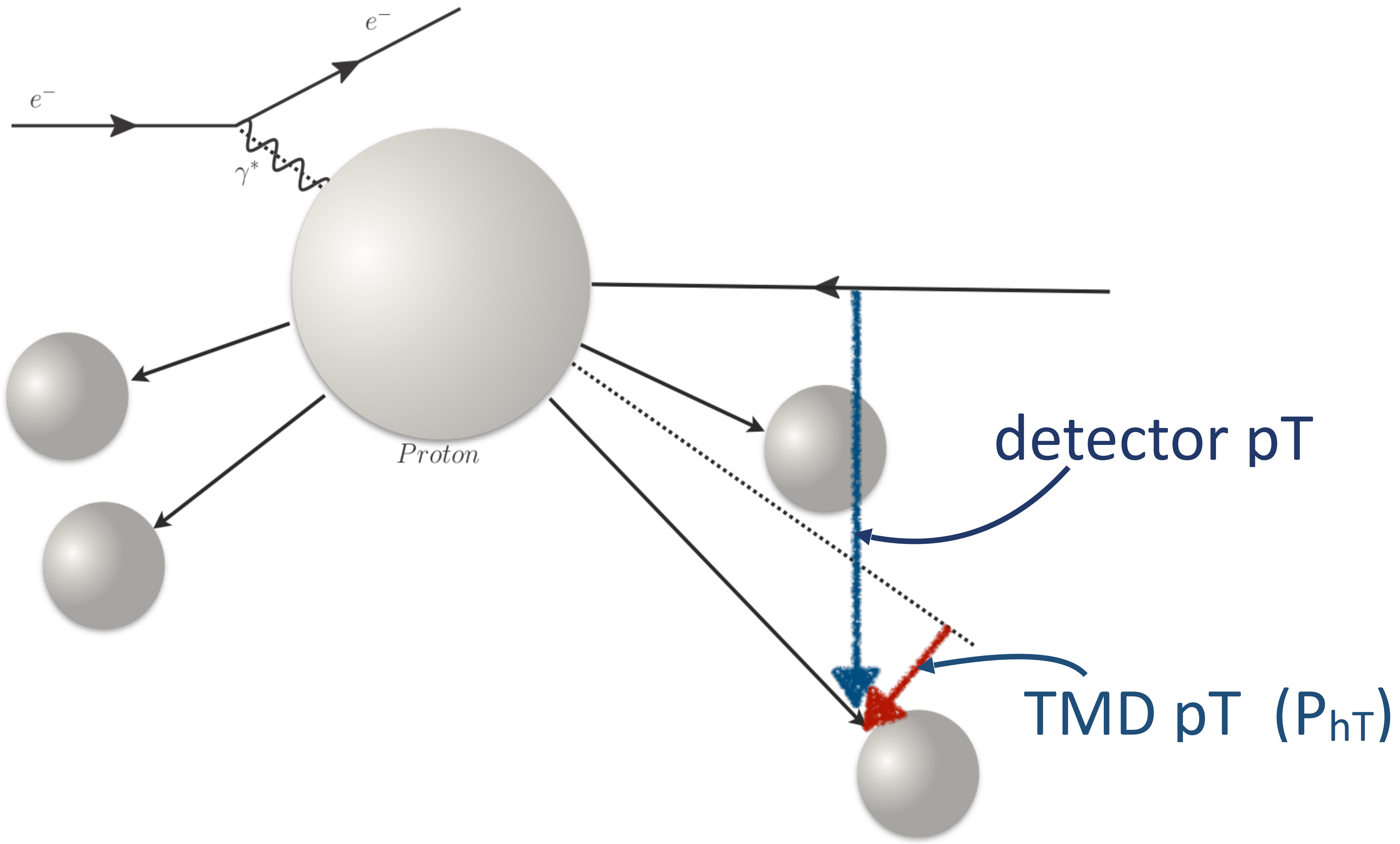
- hadron PID system covers important part of phase space for semi-inclusive DIS
  - no obvious gaps in phase space

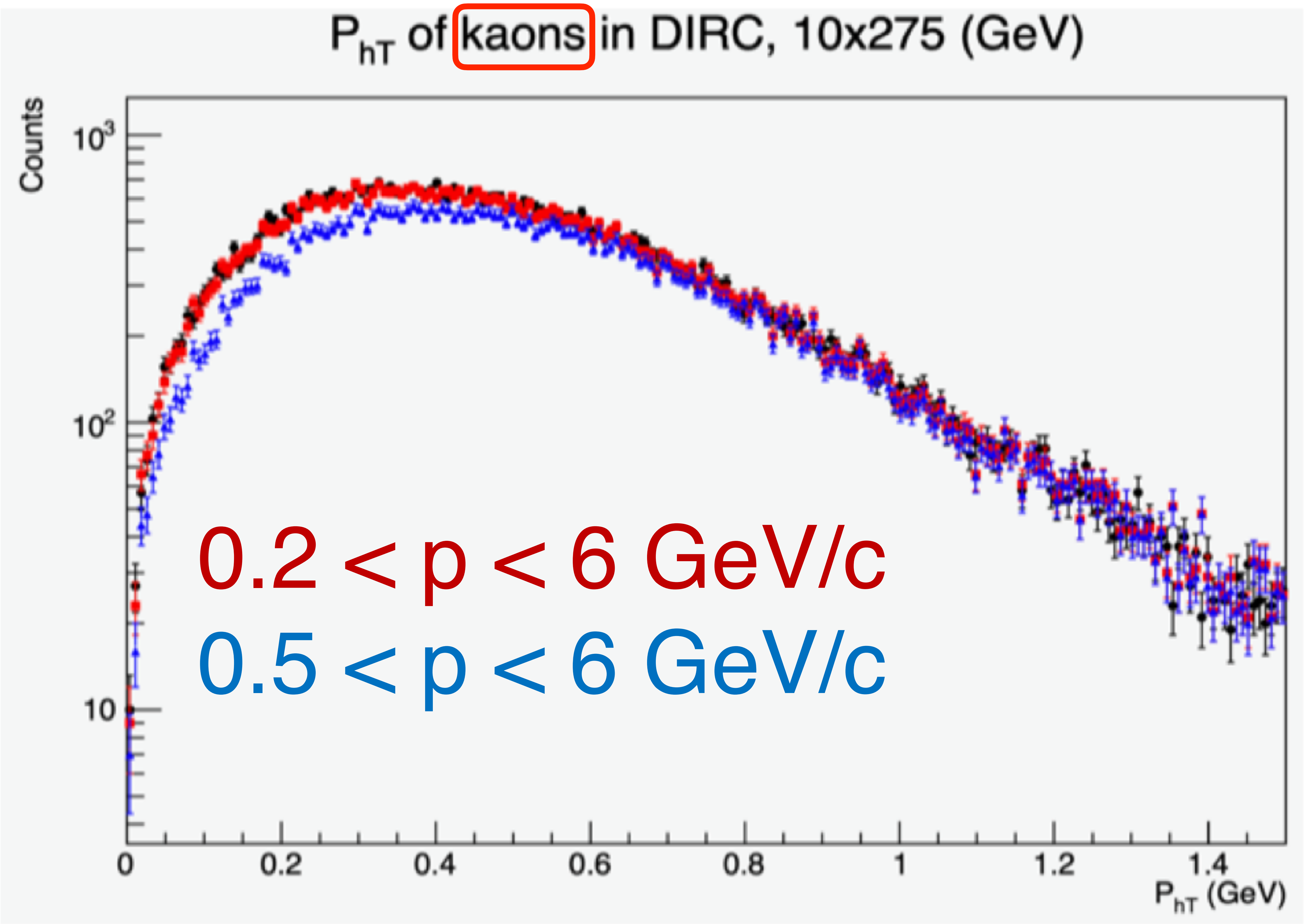
    [e.g., P_{hT} vs. $z=(p_h \cdot P)/(q \cdot P)$]:



CORE: some notable features — PID (for semi-inclusive DIS)

- for TMD physics, it is not the transverse momentum in lab frame that matters!



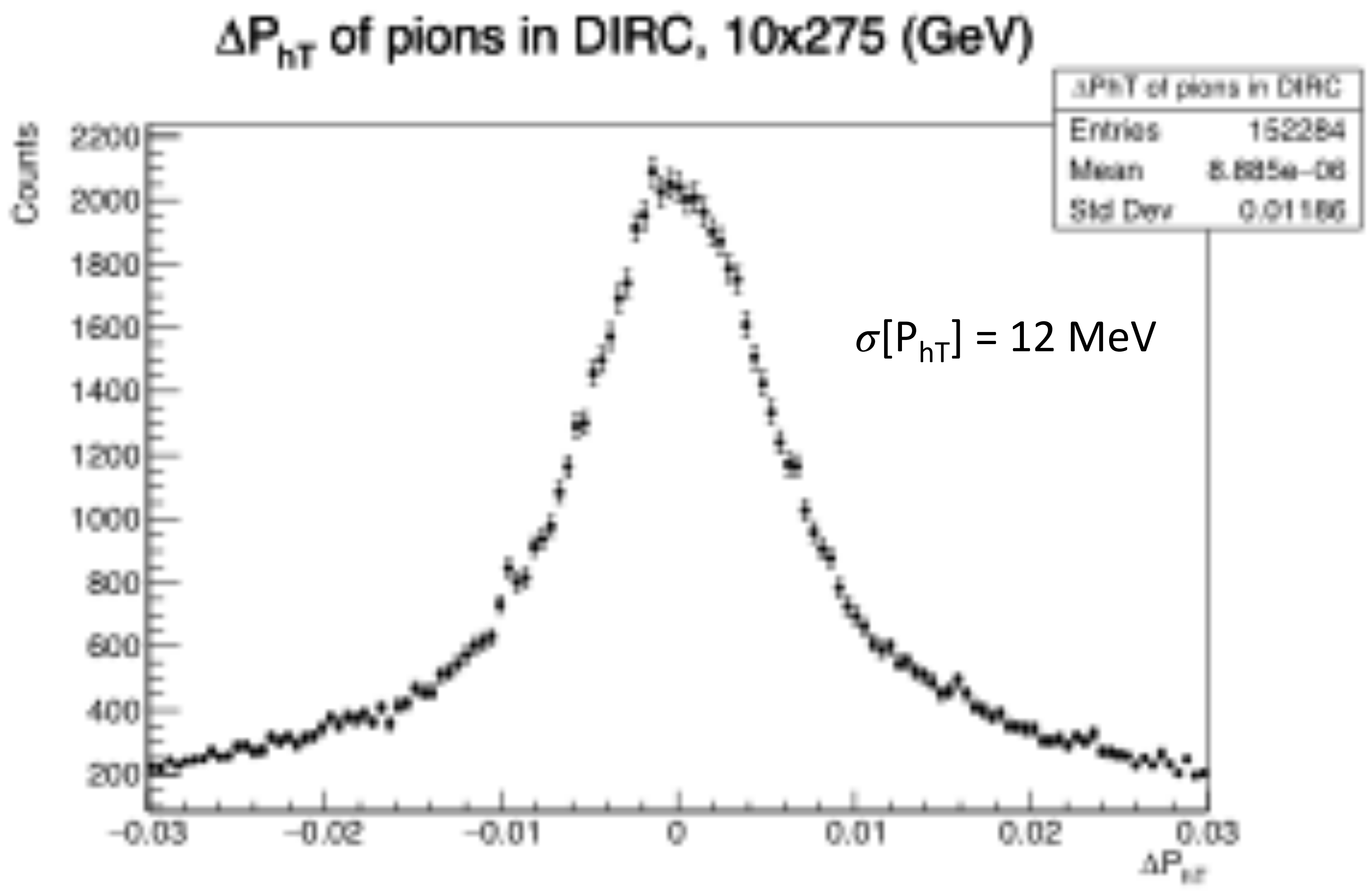


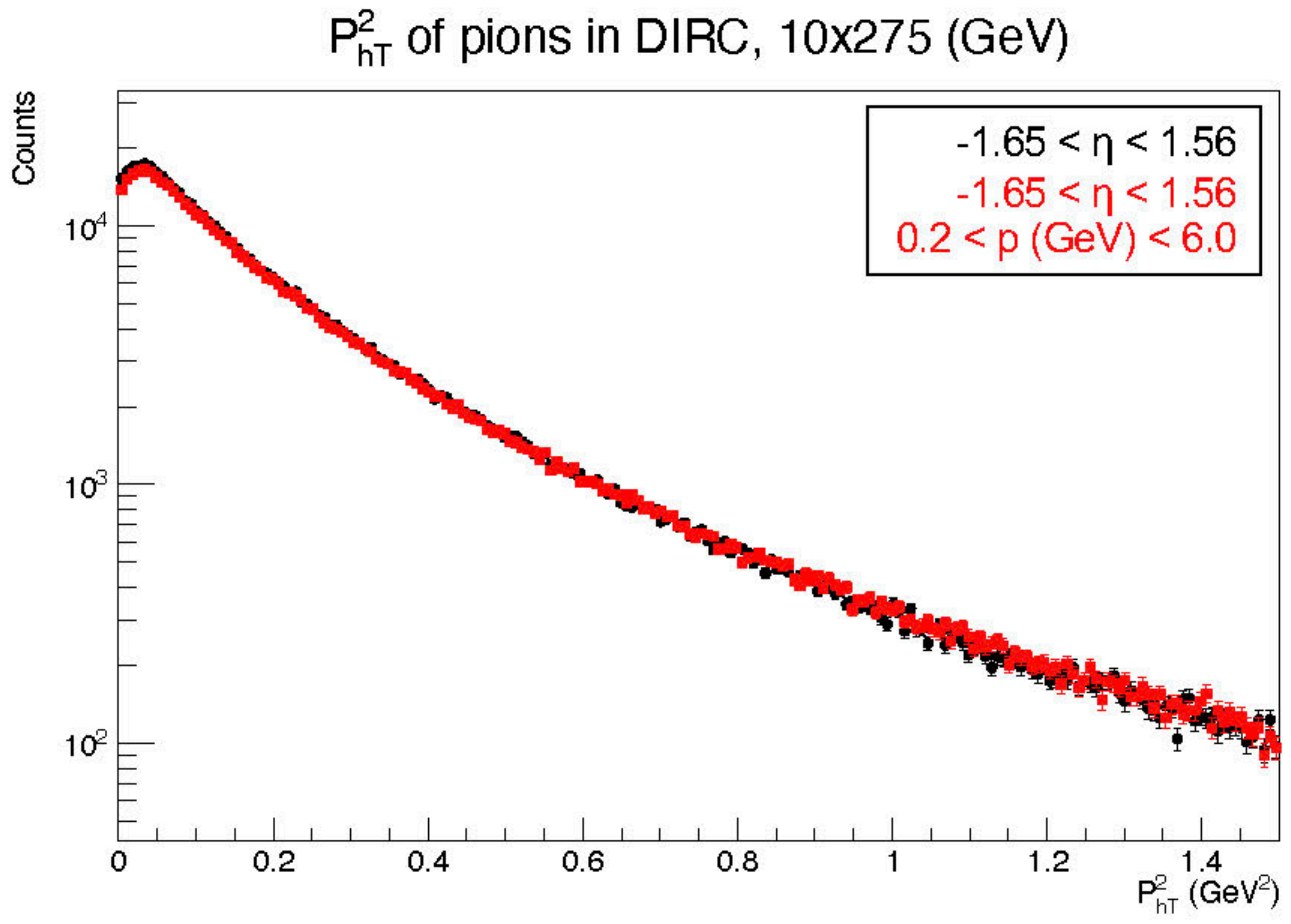
➥ momentum coverage in DIRC does not seriously impact P_{hT} coverage

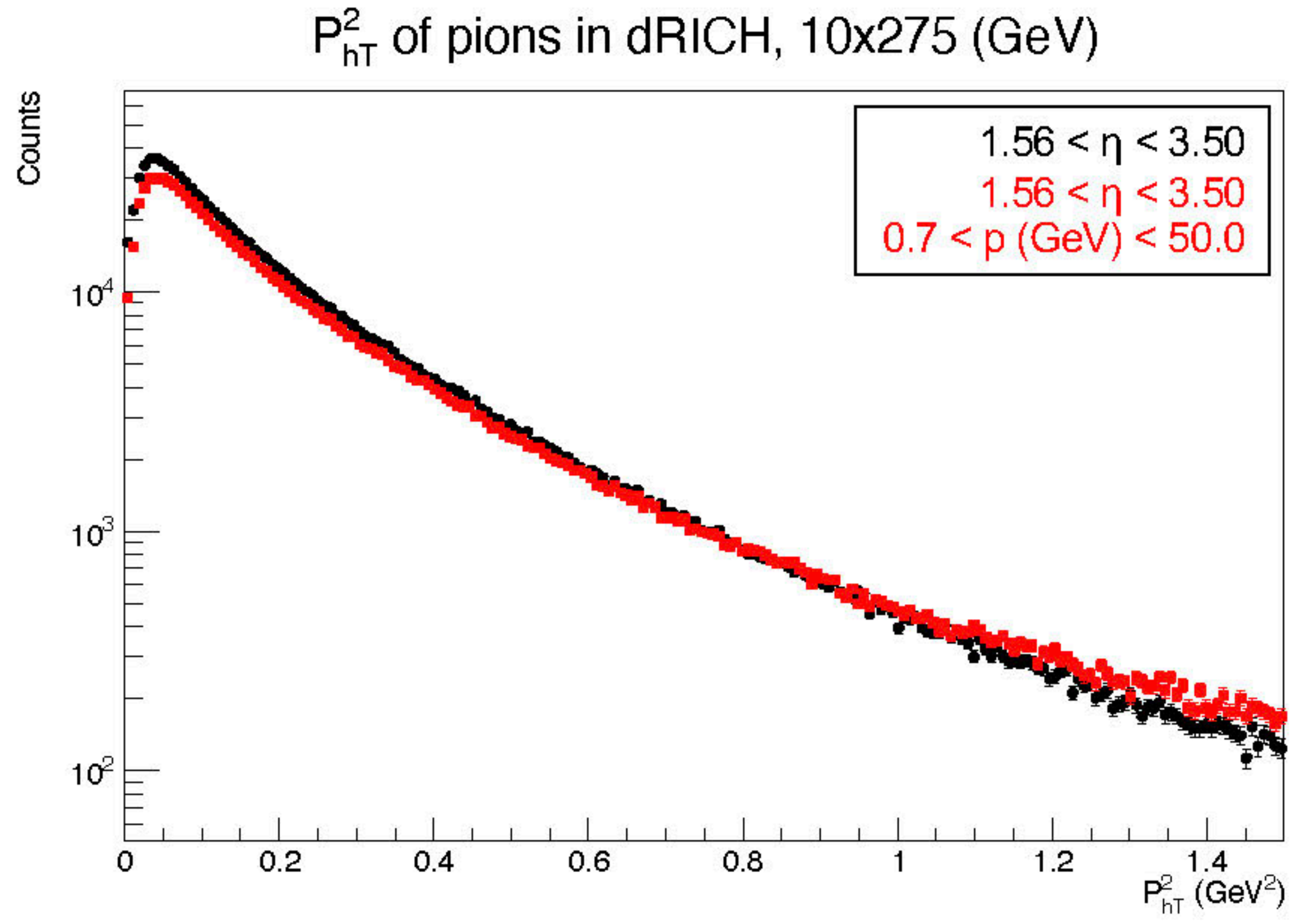
➥ very low P_{hT} even for kaons

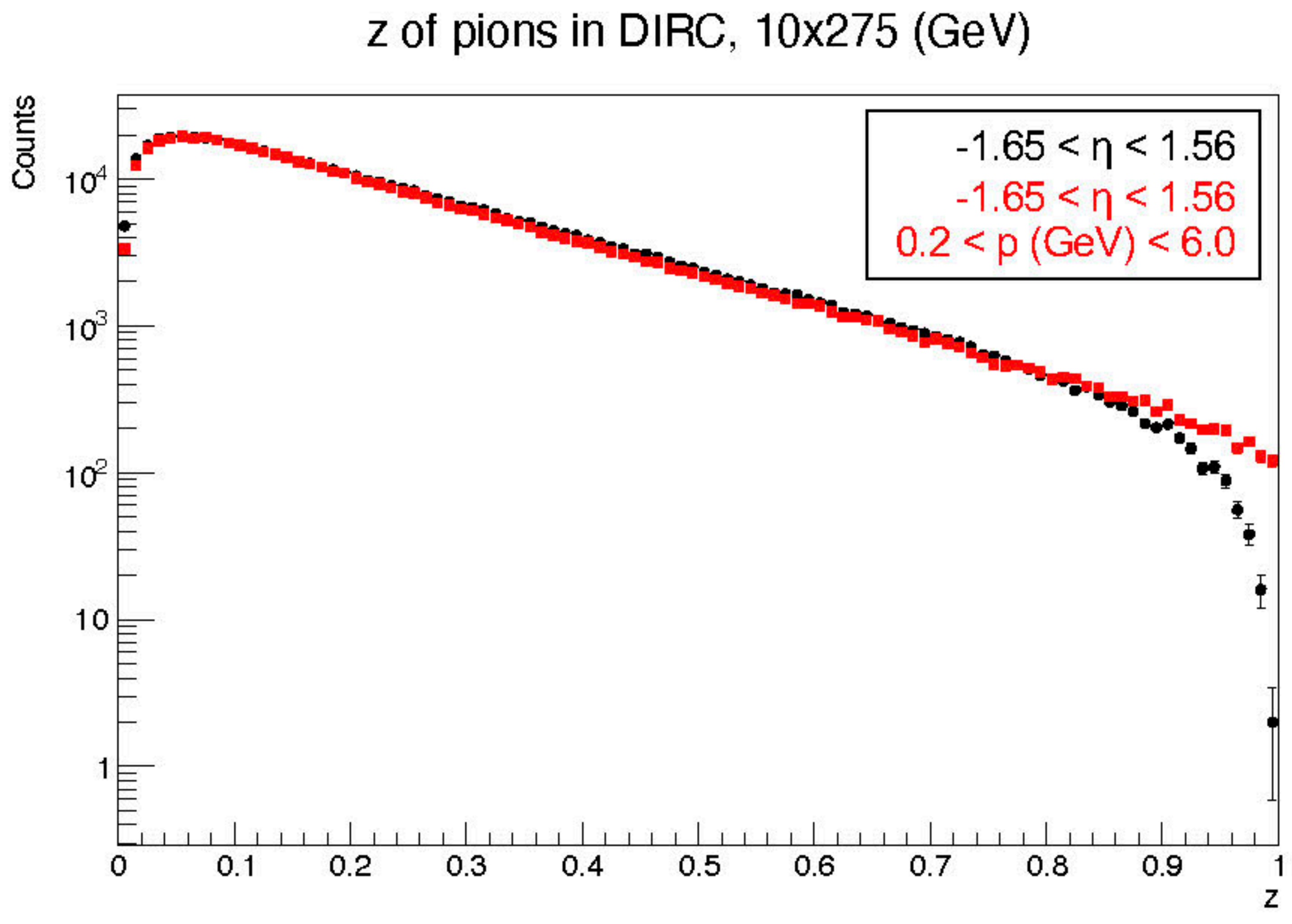
CORE: some notable features — PID (for semi-inclusive DIS)

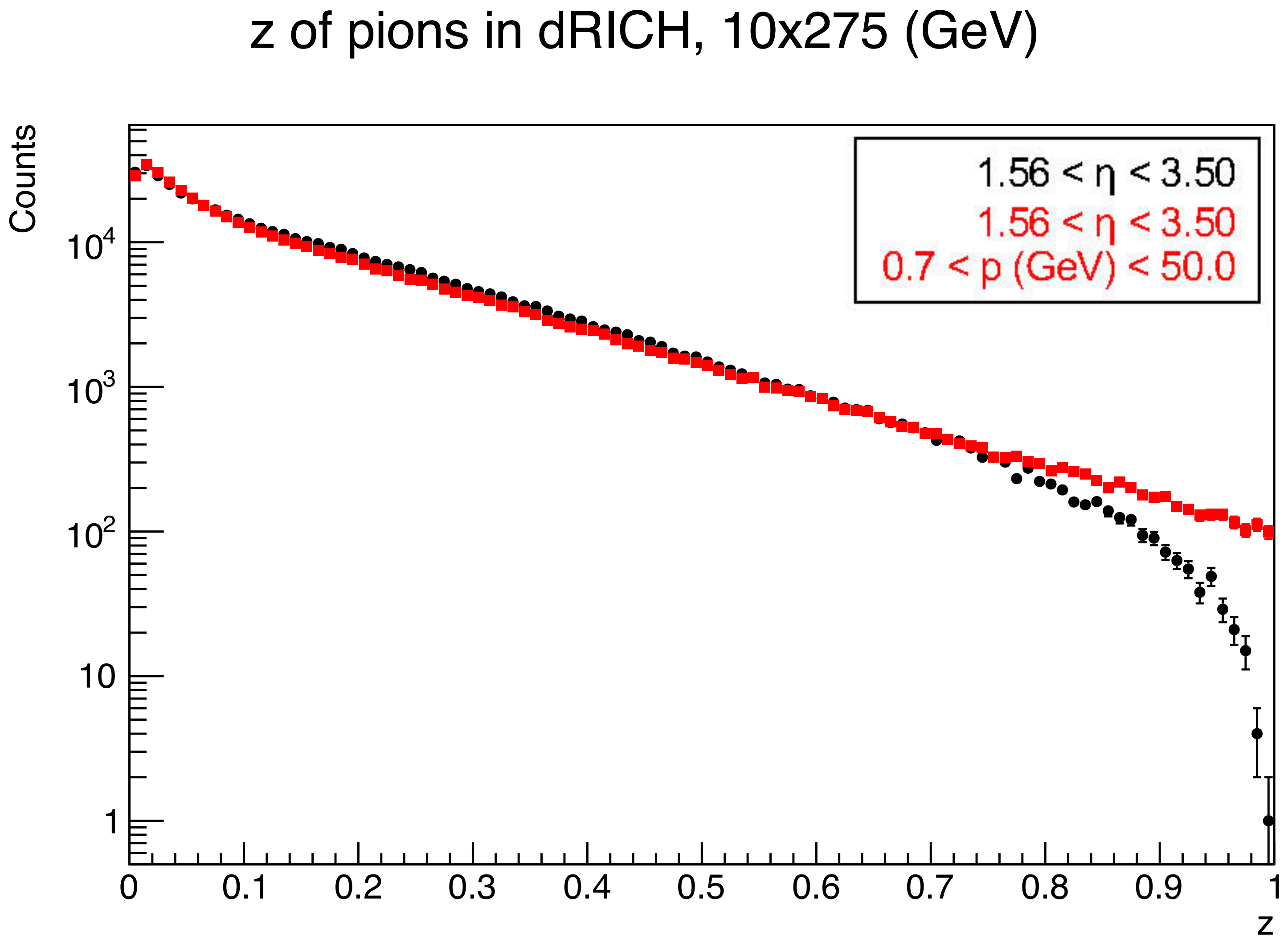
- excellent coverage both in P_{hT} and z (here shown for pions)
- with very competitive resolution





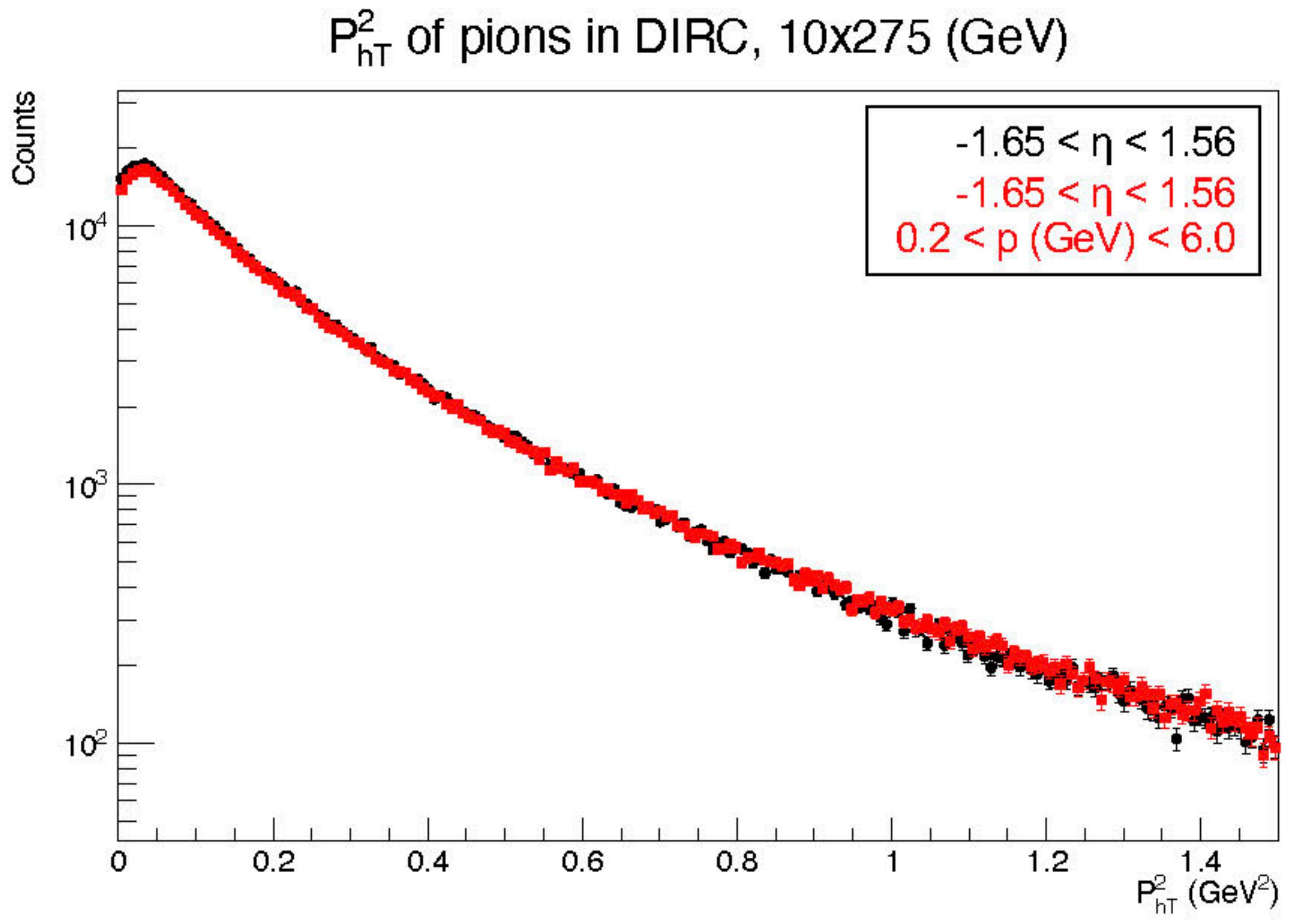


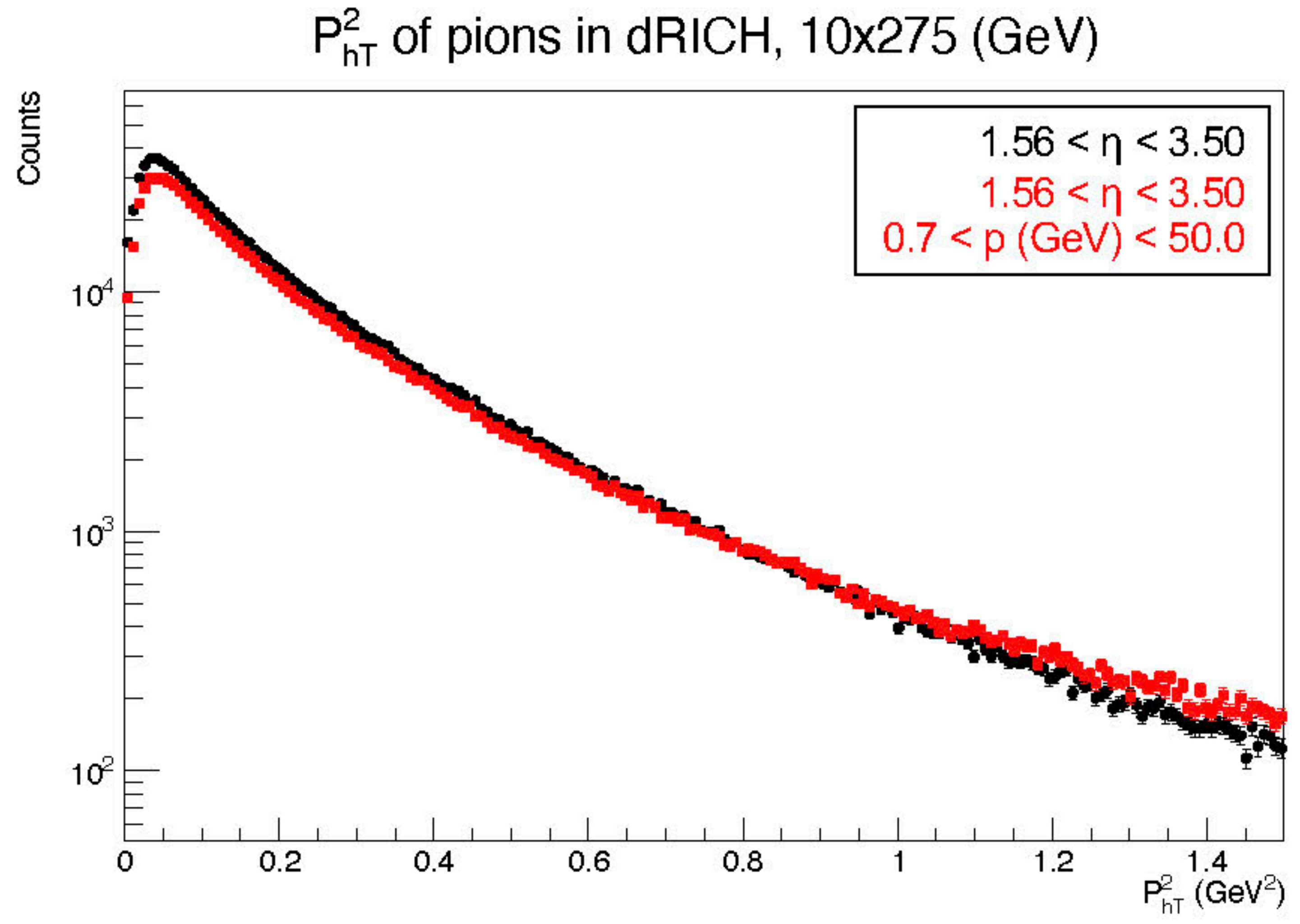


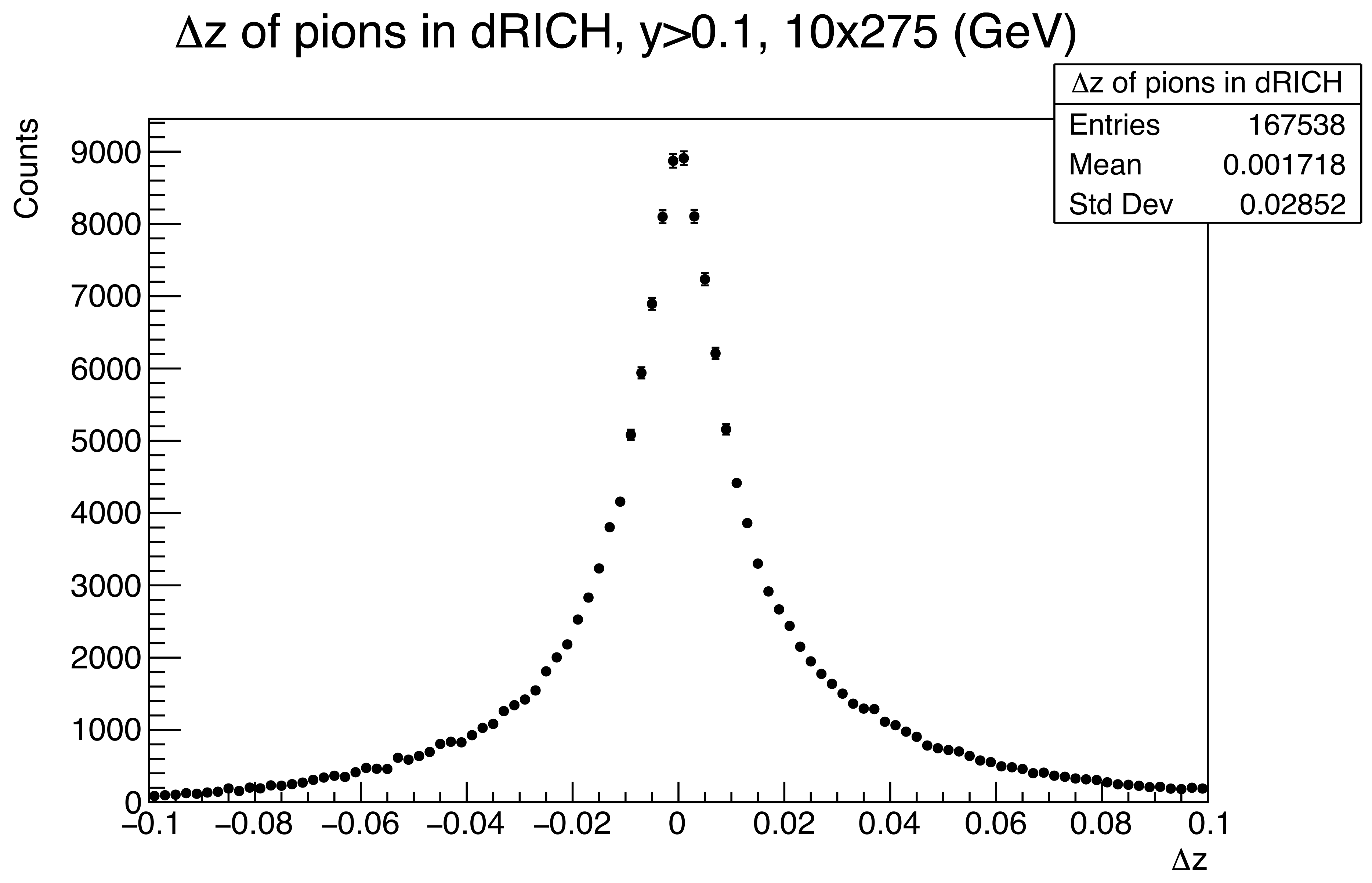


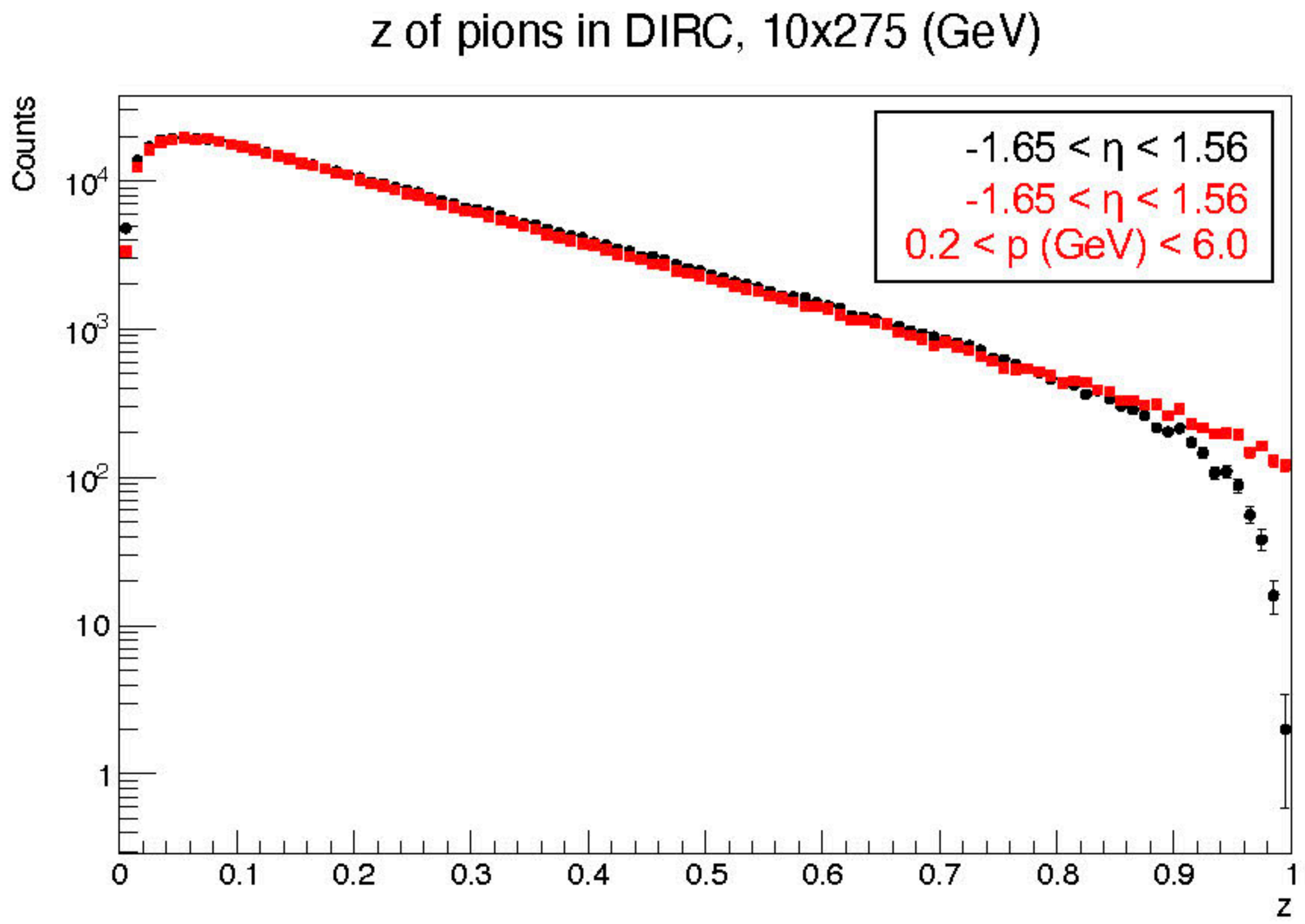
CORE: some notable features — PID (for semi-inclusive DIS)

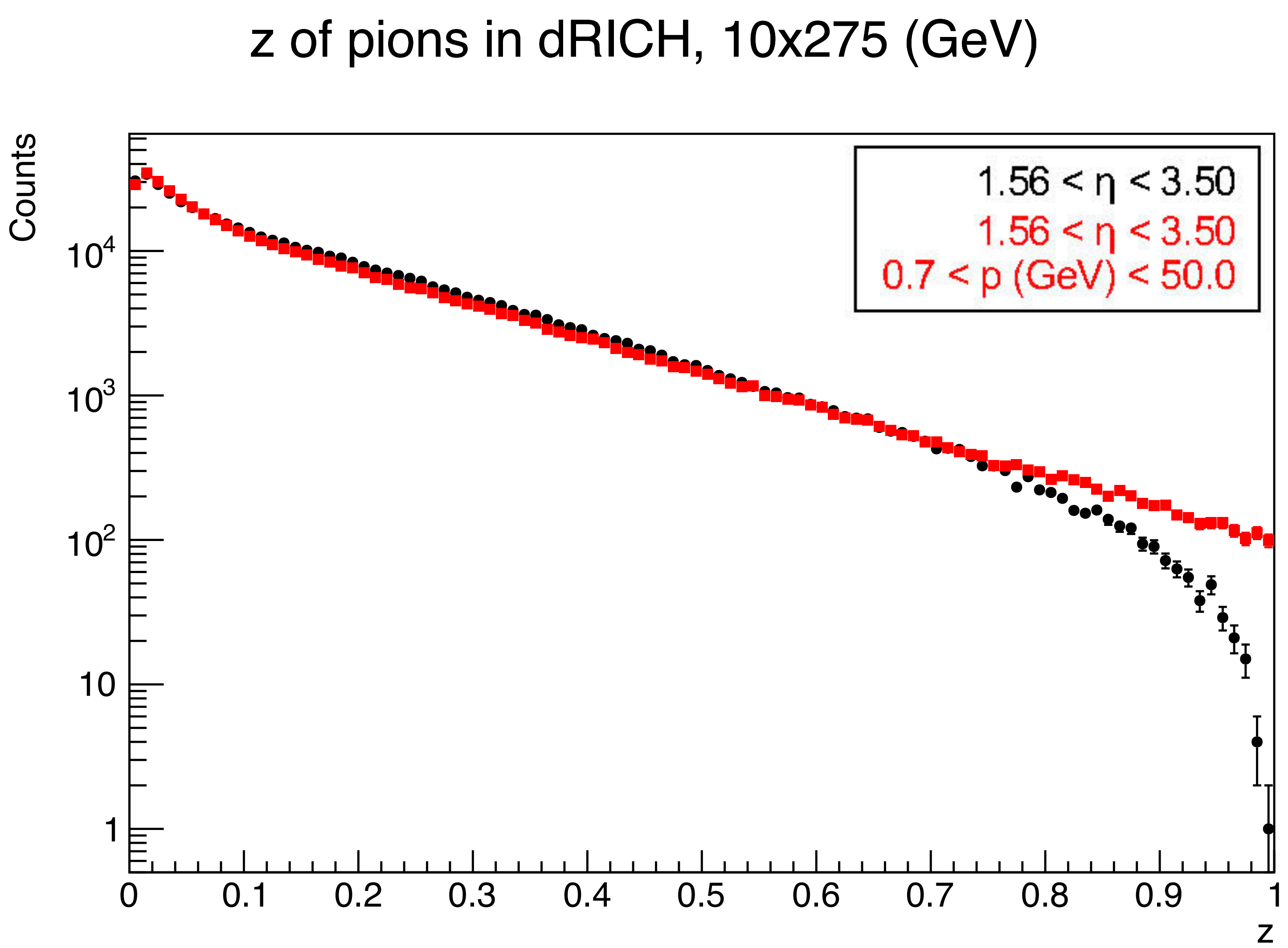
- excellent coverage both in P_{hT} and z (here shown for pions)
- with very competitive resolution



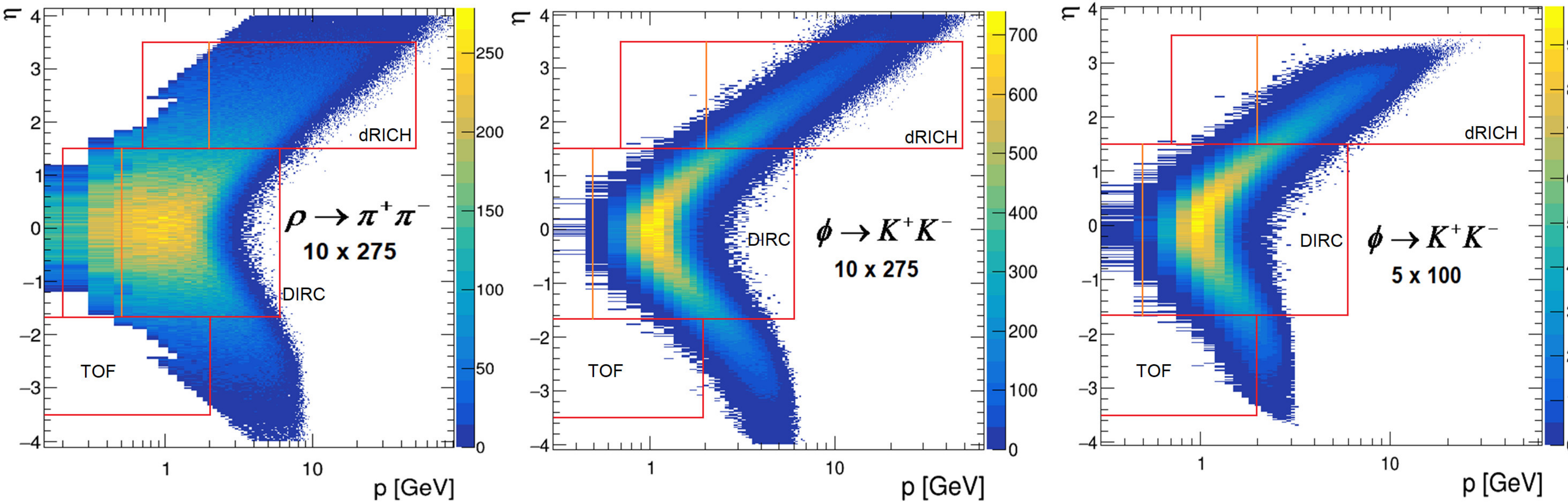






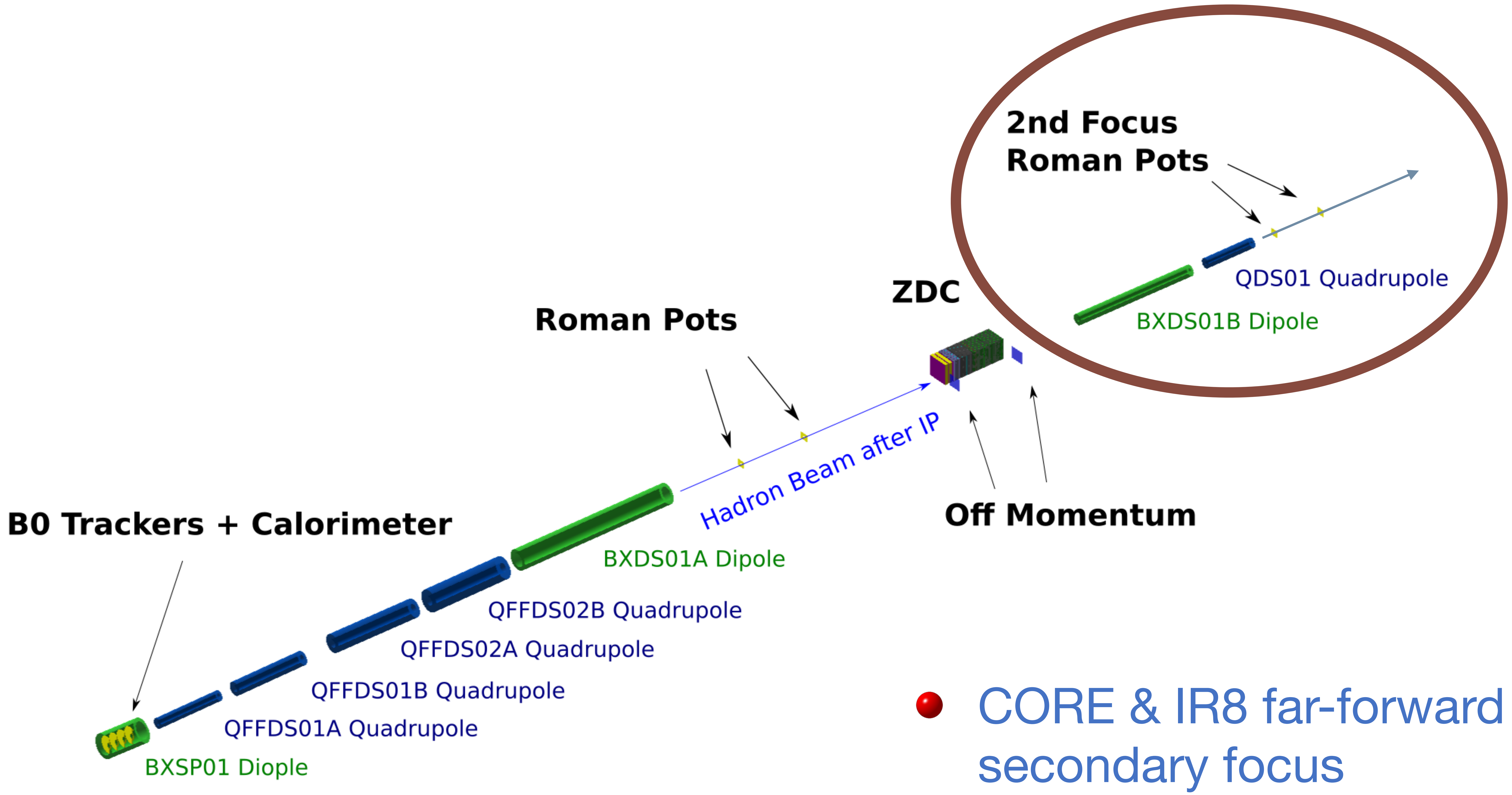


CORE: some notable features — PID (for exclusive processes)



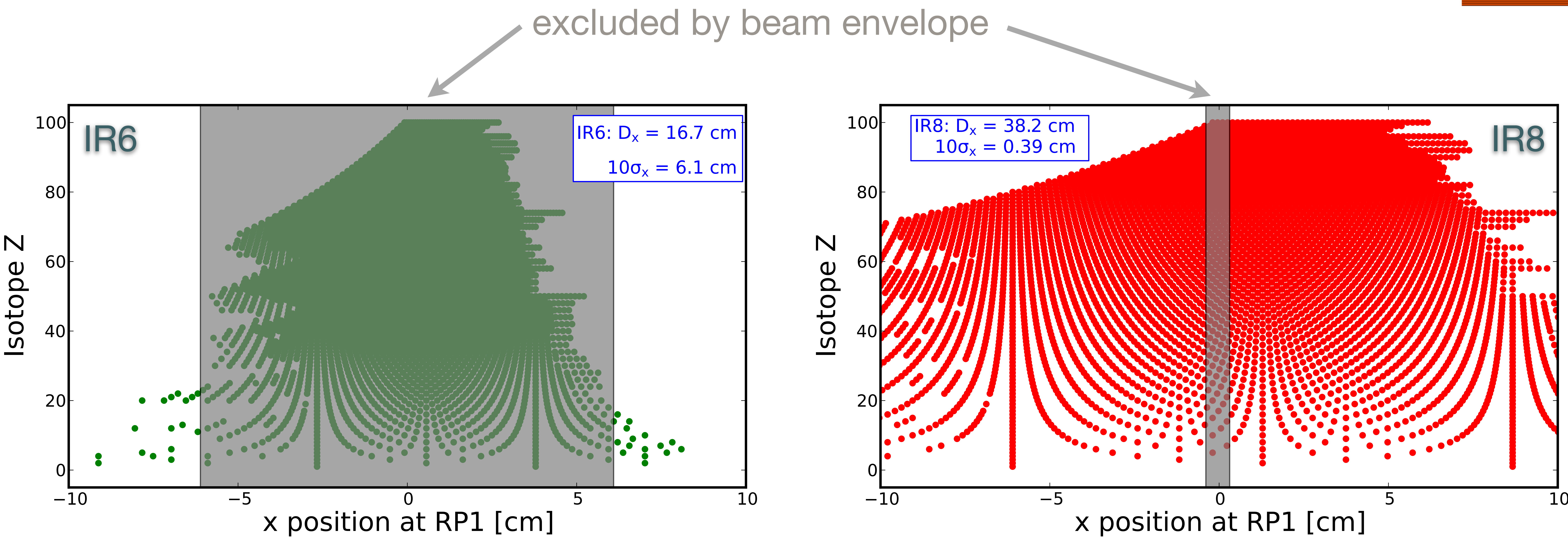
- exclusively produced hadrons in general more energetic
  ➥ decay products well covered by PID acceptance
- in electron endcap, TOF covers the kaons only at lowest electron beam energies
  ➥ with the excellent invariant-mass resolution of the tracker, the ϕ yield can be extracted using sideband subtraction

Secondary focus at IR8



- CORE & IR8 far-forward region compatible with secondary focus
  - much improved tagging of target remnants
  - new physics opportunities

Secondary focus at IR8



- basically all daughter nuclei from ^{238}U can be detected & identified with IR8 secondary focus
- spectroscopy of short-lived rare isotopes from boosted photons in ZDC (w/ sufficient resol.)

instead of summary: CORE — what next?

- March 21, 2022: Report from the EIC Detector Proposal Advisory Panel (DPAP)
  - ECCE-like detector as “EIC Detector 1”
  - panel also supports a second detector at IR8:
    - “an IR with a secondary focus can significantly broaden the physics scope and output of the EIC”
    - “a second detector could also be more specialized towards a particular physics area”

    ➥ **CORE is a strong contender of being first choice for second detector**

instead of summary: CORE — what next?

- March 21, 2022: Report from the EIC Detector Proposal Advisory Panel (DPAP)
  - ECCE-like detector as “EIC Detector 1”
  - panel also supports a second detector at IR8:
    - “an IR with a secondary focus can significantly broaden the physics scope and output of the EIC”
    - “a second detector could also be more specialized towards a particular physics area”

    ➥ **CORE is a strong contender of being first choice for second detector**

- a CORE study group for a 2nd detector formed
  - open to everyone’s participation
  - clearly ample opportunity to take leading roles

instead of summary: CORE — what next?

- March 21, 2022: Report from the EIC Detector Proposal Advisory Panel (DPAP)
  - ECCE-like detector as “EIC Detector 1”
  - panel also supports a second detector at IR8:
    - “an IR with a secondary focus can significantly broaden the physics scope and output of the EIC”
    - “a second detector could also be more specialized towards a particular physics area”

➥ **CORE is a strong contender of being first choice for second detector**

- a CORE study group for a 2nd detector formed
  - open to everyone’s participation
  - clearly ample opportunity to take leading roles

Key aspects of a compact detector

- Lower cost (without compromising any physics capabilities)
  - performance of many subsystems (DIRC, EMcal, etc) does not depend on overall system size or location
  - compact detector simply has fewer modules, making it more cost-effective
- Lower risk
  - a smaller new solenoid is not only less expensive but has lower technical and schedule risks
  - a shorter detector is easier to integrate into the IR, as it leaves more space for accelerator infrastructure near the collision point and reduces challenges related to solenoid compensation
- Synergies with IR8 (and the physics opportunities enabled by a secondary focus)
  - lower cost equivalent subsystems makes it affordable to invest in key capabilities
  - an example is a $PbWO_4$ EMcal for eta < 0, which makes it possible to reconstruct DVCS kinematics using the photon, while only tagging the proton or ion (fragments) in the Roman pots
    ➠ in combination with the low-pT acceptance with a 2nd focus creates new opportunities for imaging of ions beyond He
- Complementarity
  - a compact 3 T solenoid can in combination with an all-Si tracker provide excellent tracking resolution, and is technologically complementary to the hybrid tracker in a 1.5 T BaBar solenoid in Detector 1