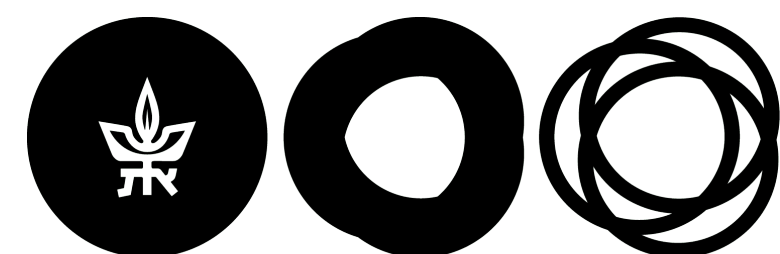


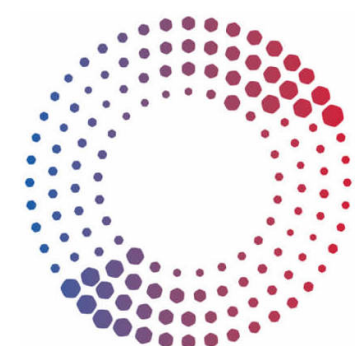
# Charged current reactions at the EIC

Tyler Kutz

(on behalf of ePIC inclusive PWG)



TEL AVIV אוניברסיטת  
UNIVERSITY תל אביב



MORTIMER B.  
**ZUCKERMAN**  
**STEM LEADERSHIP**  
PROGRAM

ePIC collaboration meeting

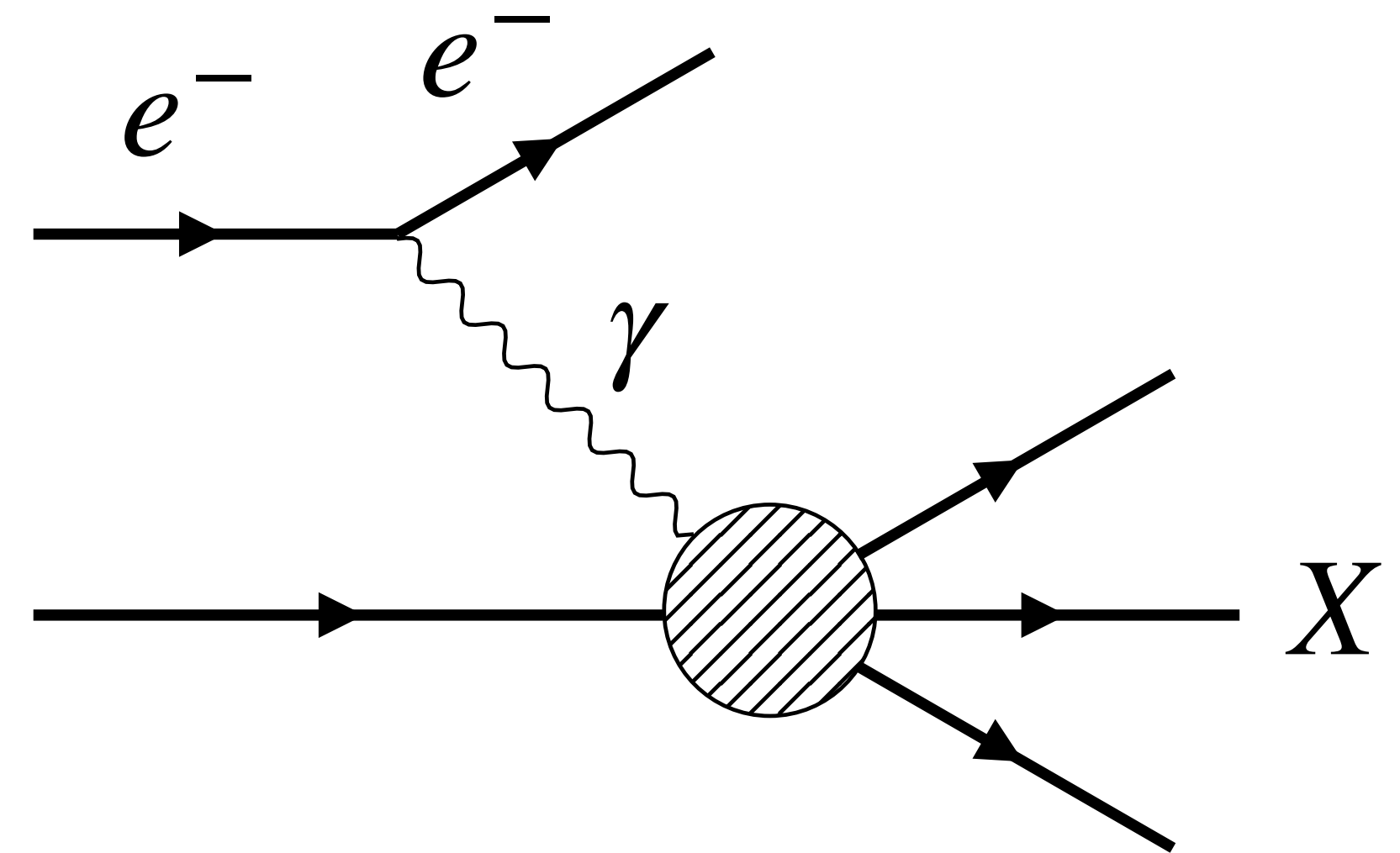
Warsaw, Poland

July 28, 2023



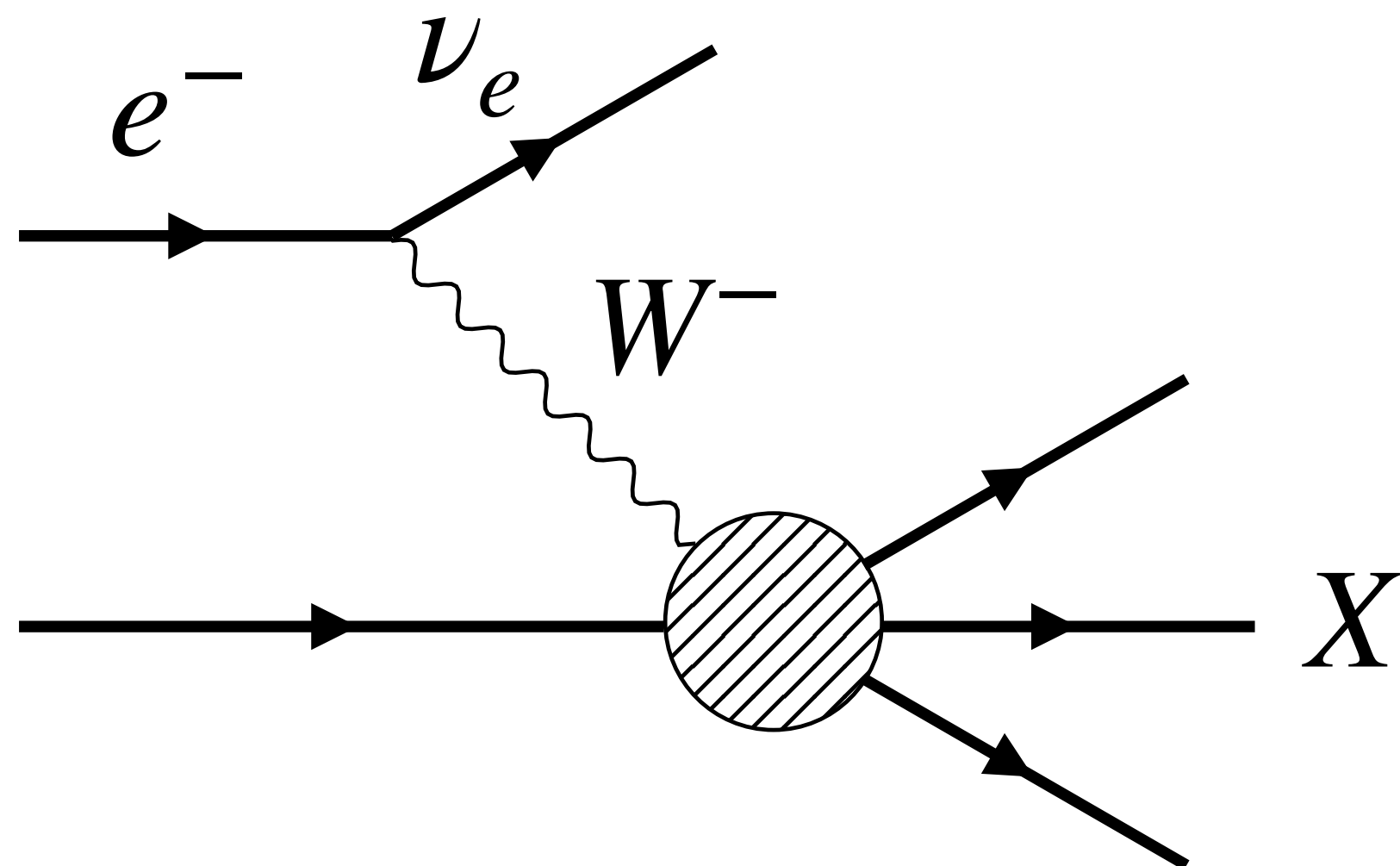
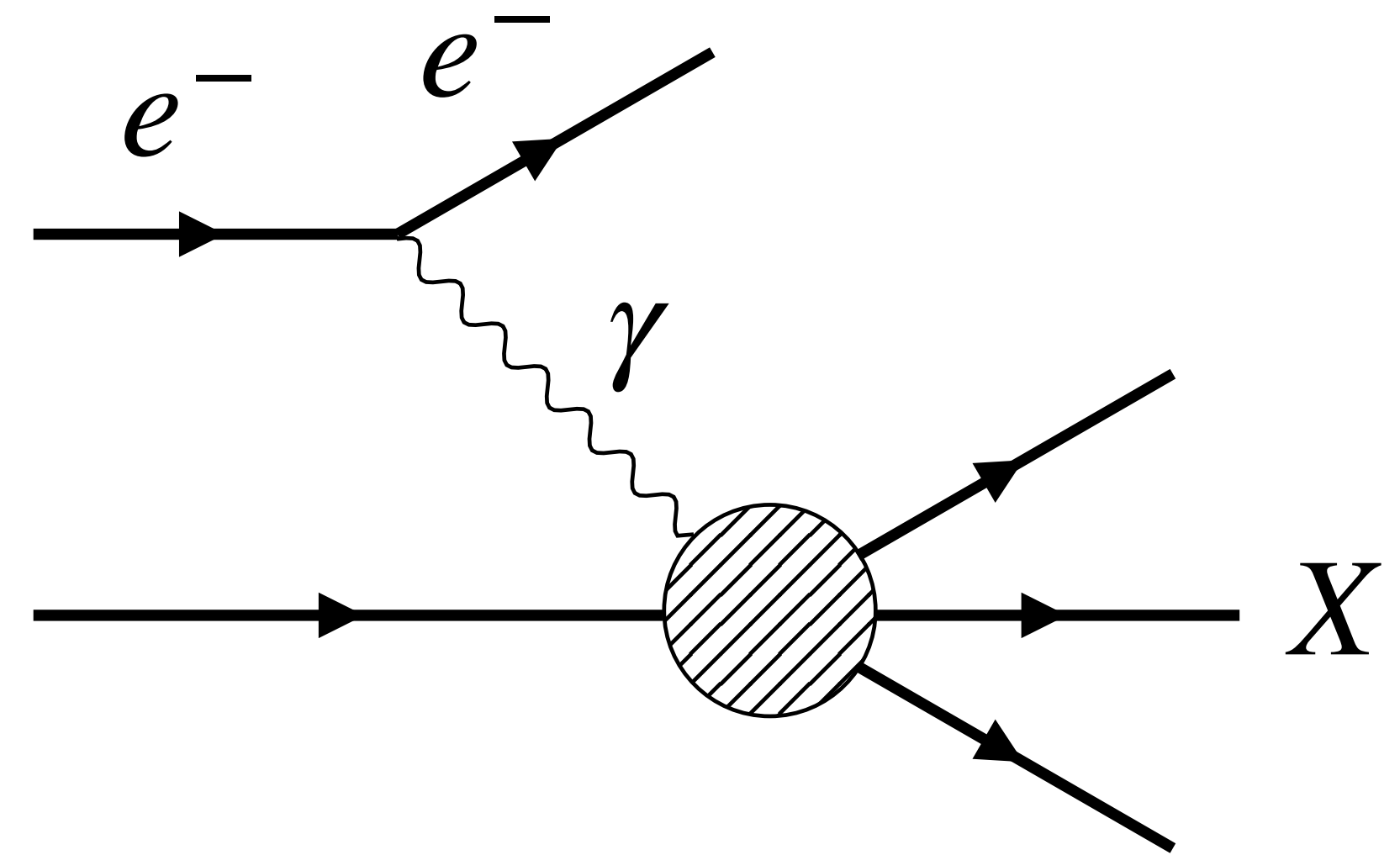
# Inclusive physics isn't just neutral current!

- Lots of focus on neutral current
  - Scattered electron in final state, over-constrained kinematics
  - Unpolarized PDFs, nucleon spin



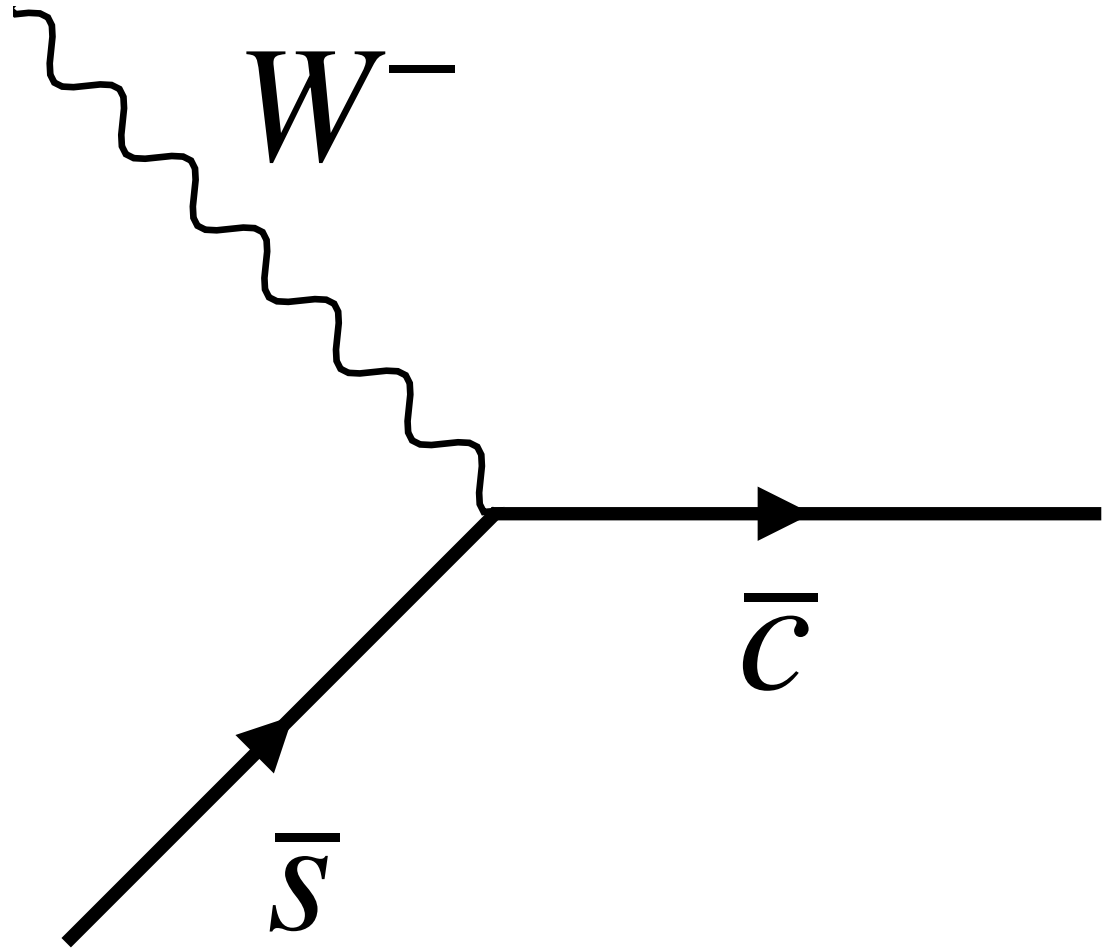
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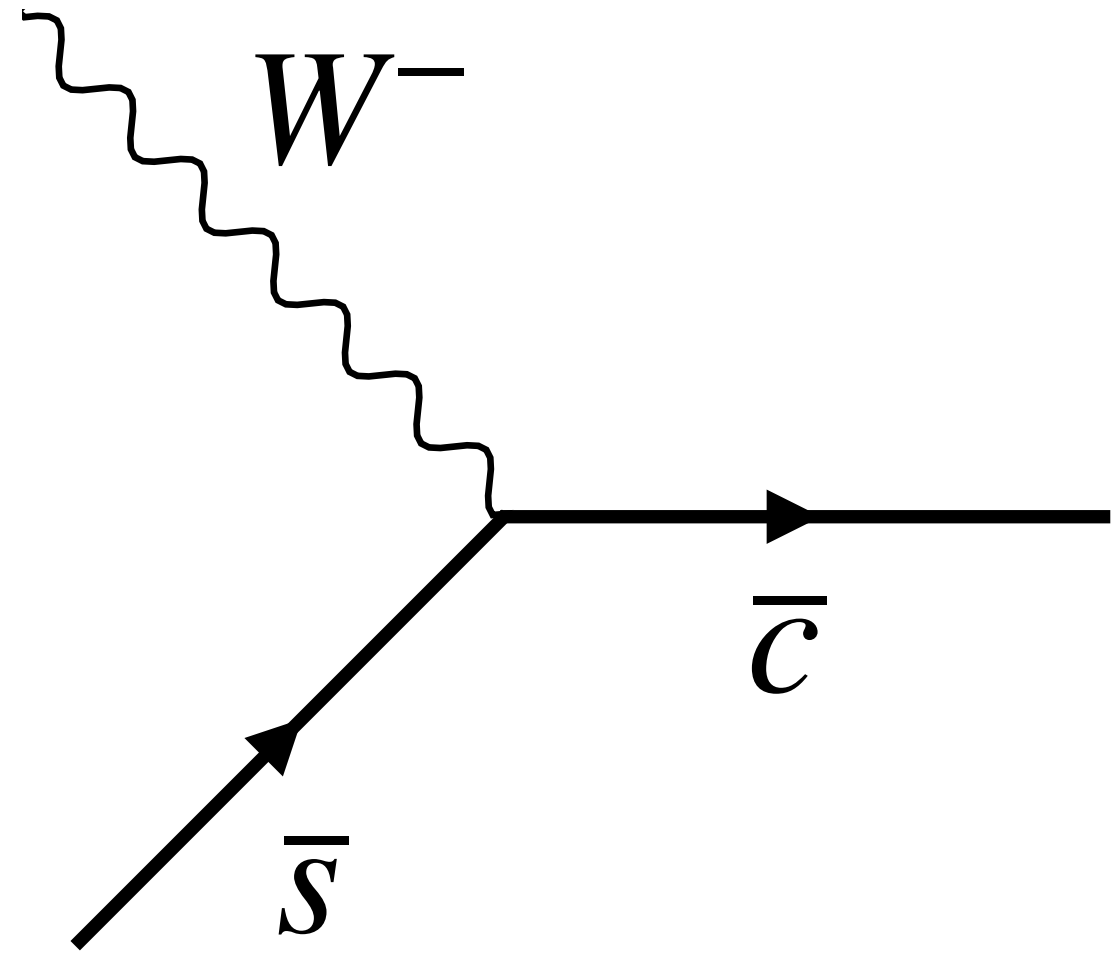


- Can also exchange charged weak boson!
  - Final state lepton is neutrino  
→ must use hadron reconstruction
  - Changes quark flavor

# Charged-current reactions allow flavor separation

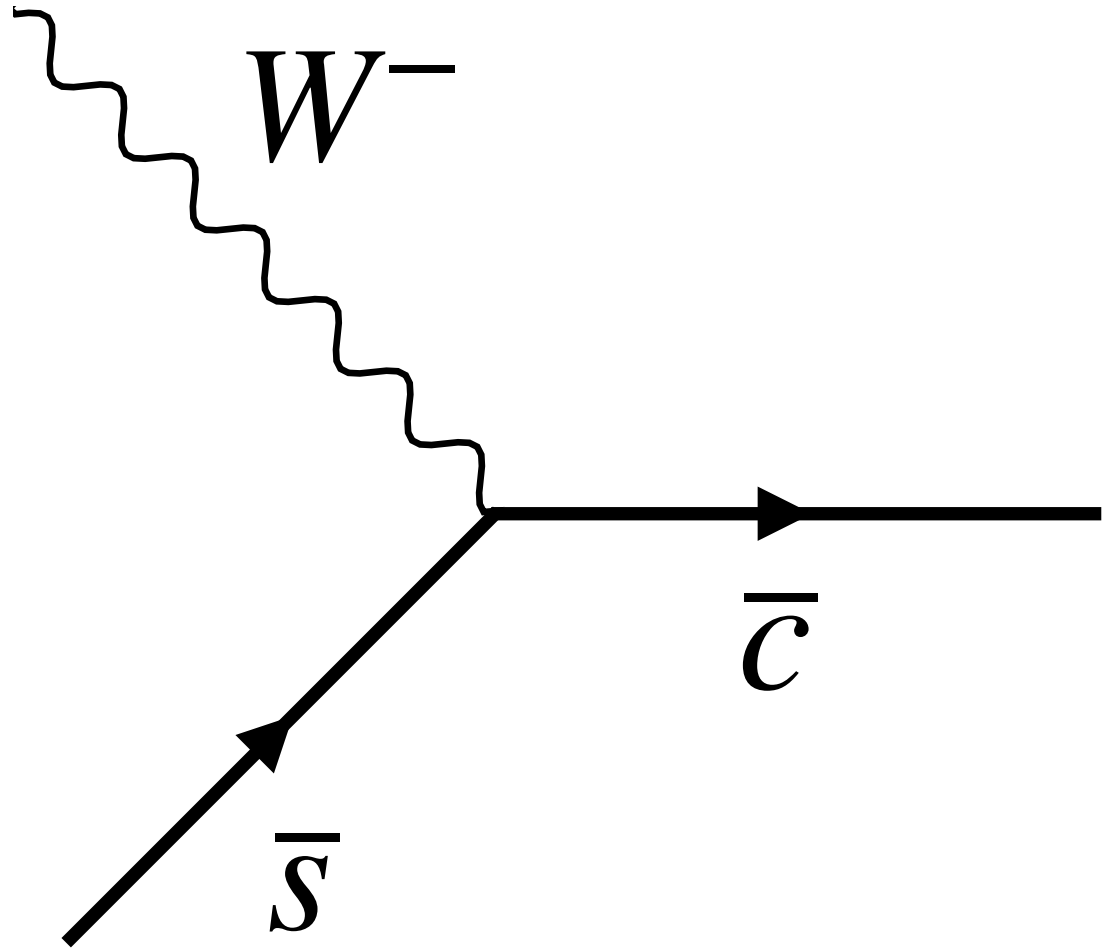


# Charged-current reactions allow flavor separation



- CC reactions flavor-dependent

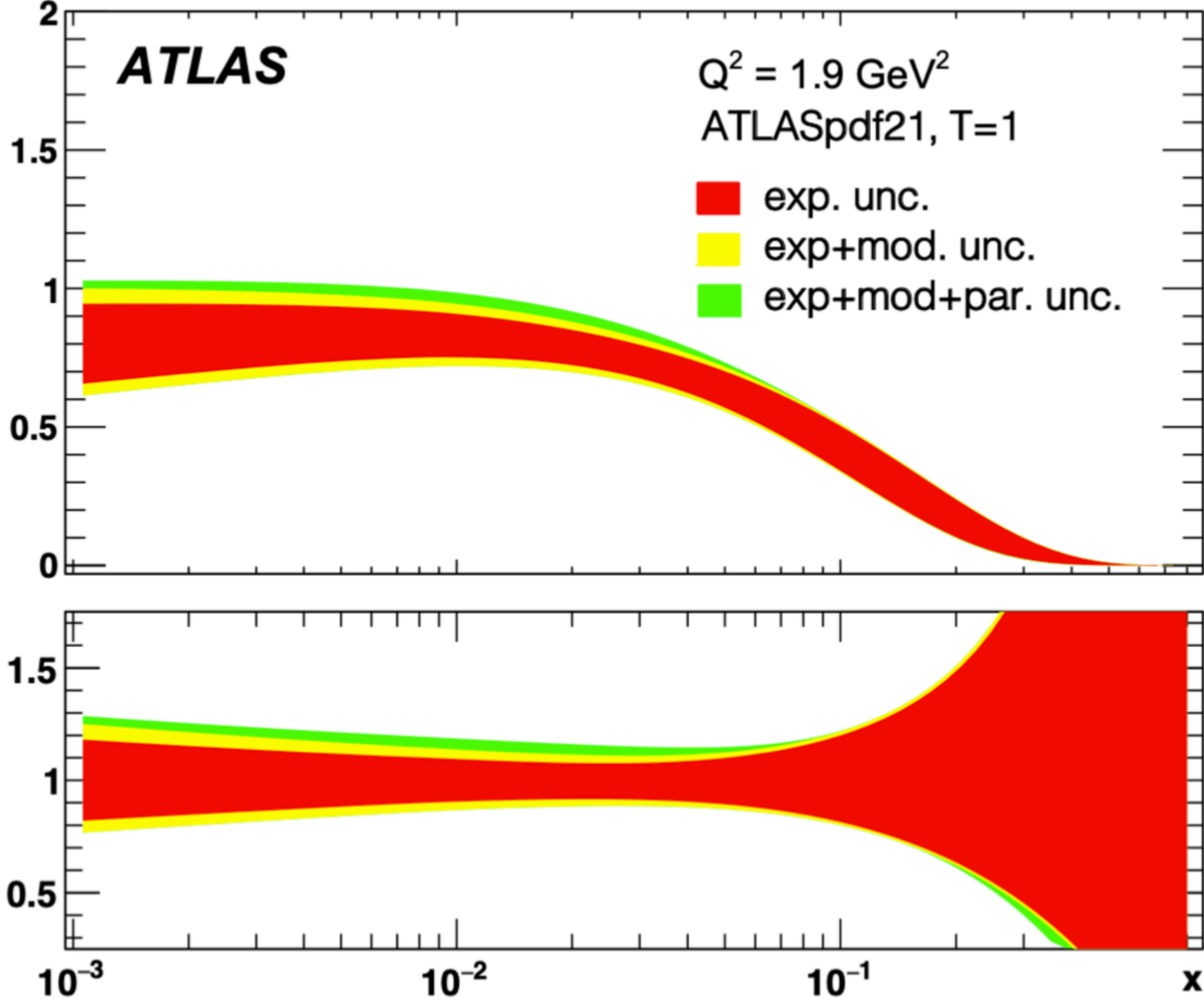
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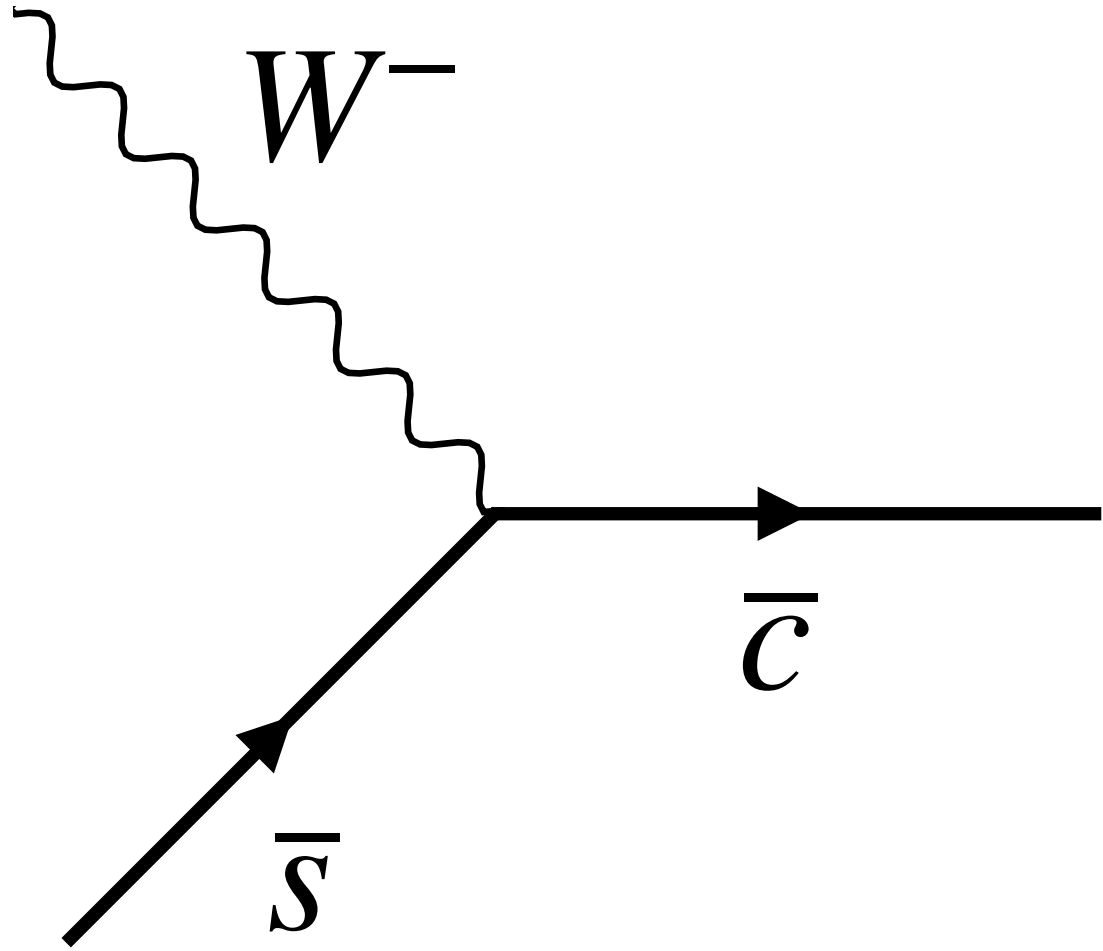
- CC reactions flavor-dependent
- EIC can provide constraints on strange quark content

$$R_s = \frac{x(s + \bar{s})}{x(\bar{d} + \bar{u})}$$

ATLAS collaboration, EPJC 82, 438 (2022)



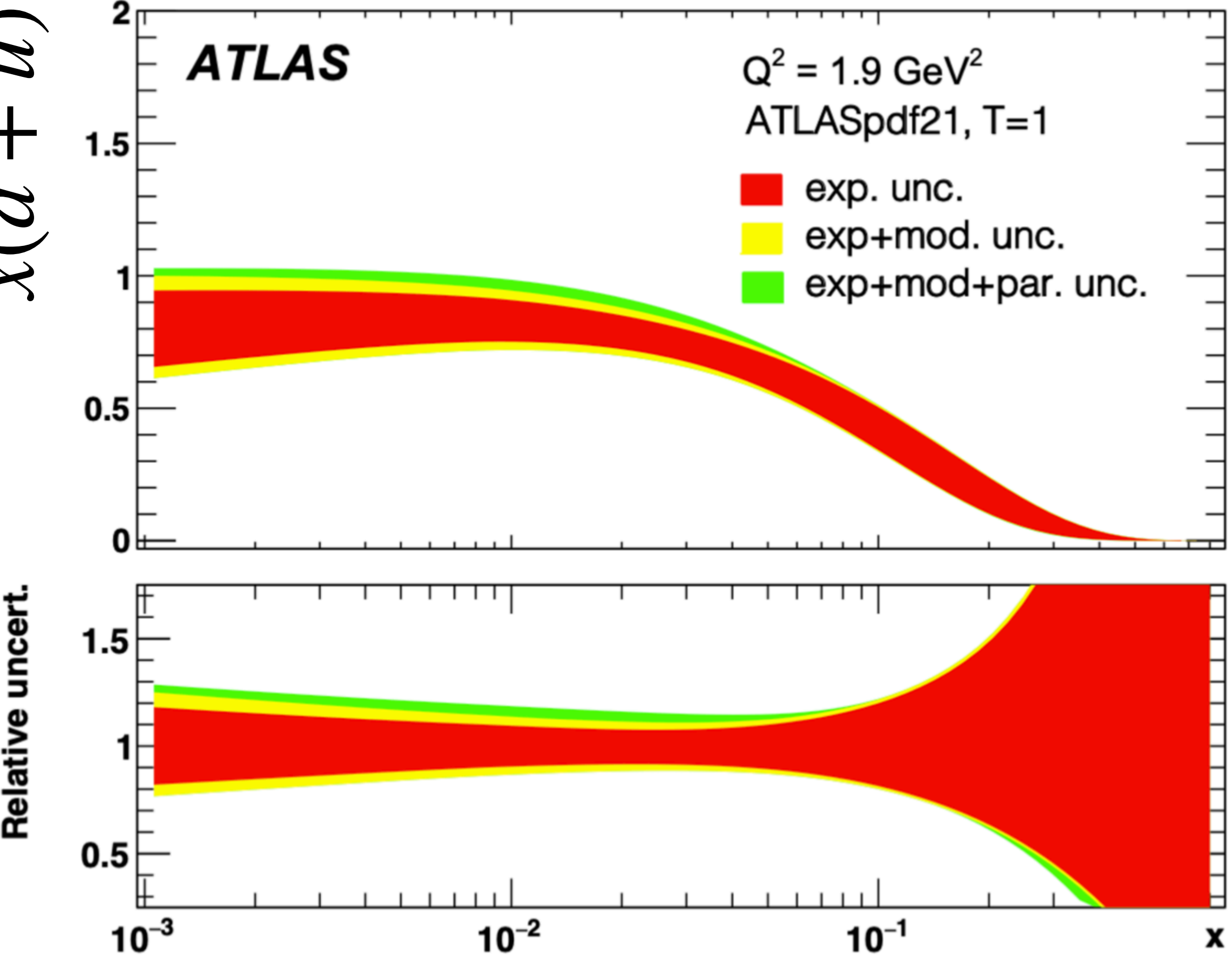
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$$R_s = \frac{x(s + \bar{s})}{x(\bar{d} + \bar{u})}$$

- CC reactions flavor-dependent
- EIC can provide constraints on strange quark content
- Complementary constraints from  $e^+$  beams

ATLAS collaboration, EPJC 82, 438 (2022)



# Jacquet-Blondel required to reconstruct CC events

$$\delta_h = \sum_i (E_i - p_{z,i}) \quad p_{T,h}^2 = \left( \sum_i p_{x,i} \right)^2 + \left( \sum_i p_{y,i} \right)^2$$

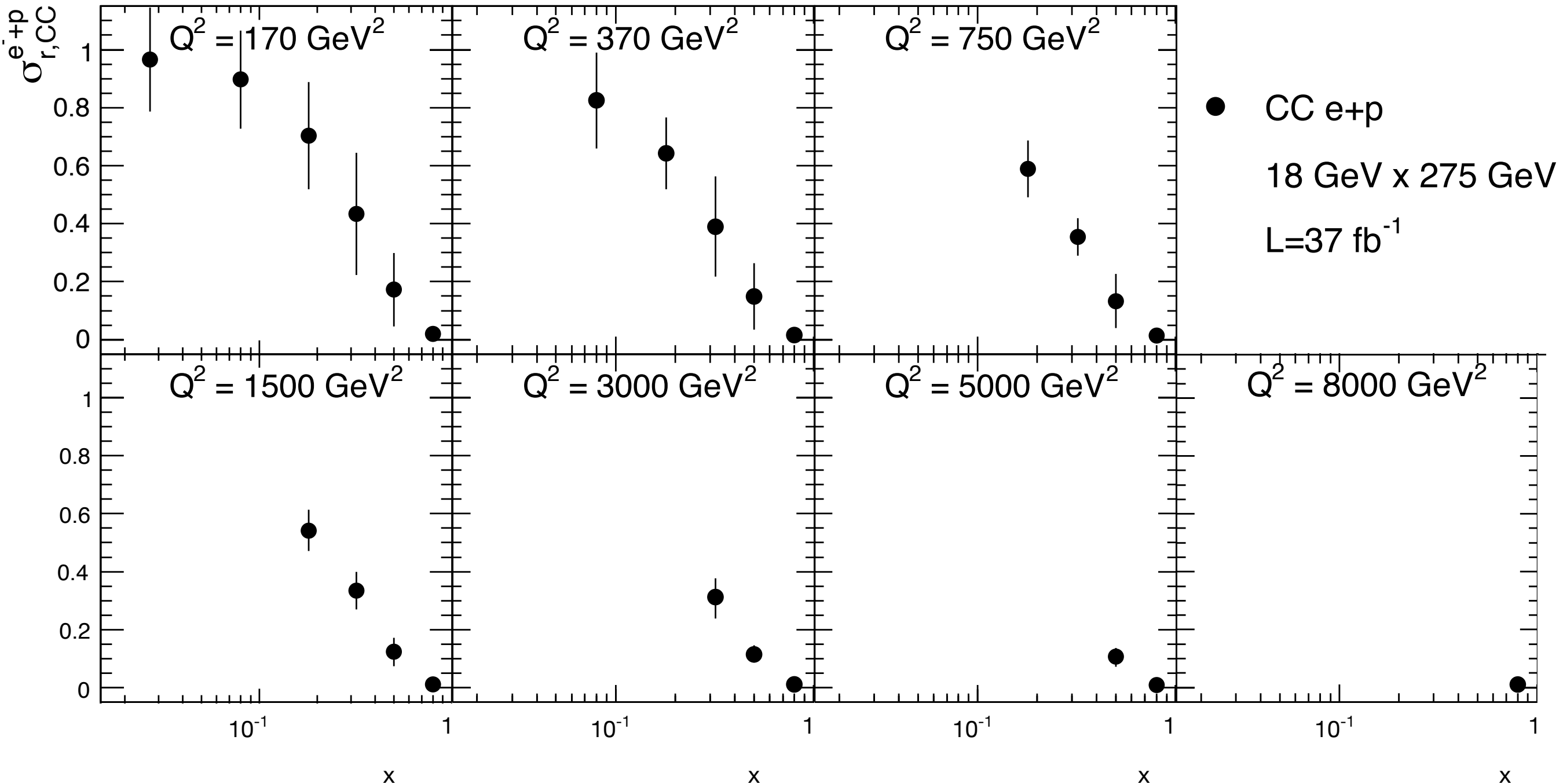
$$y_{JB} = \frac{\delta_h}{2E_e} \quad Q_{JB}^2 = \frac{p_{T,h}^2}{1 - y_{JB}} \quad x_{JB} = \frac{Q_{JB}^2}{s y_{JB}}$$

- High demands on performance of *entire* detector!
- Requires excellent electron ID to veto NC events



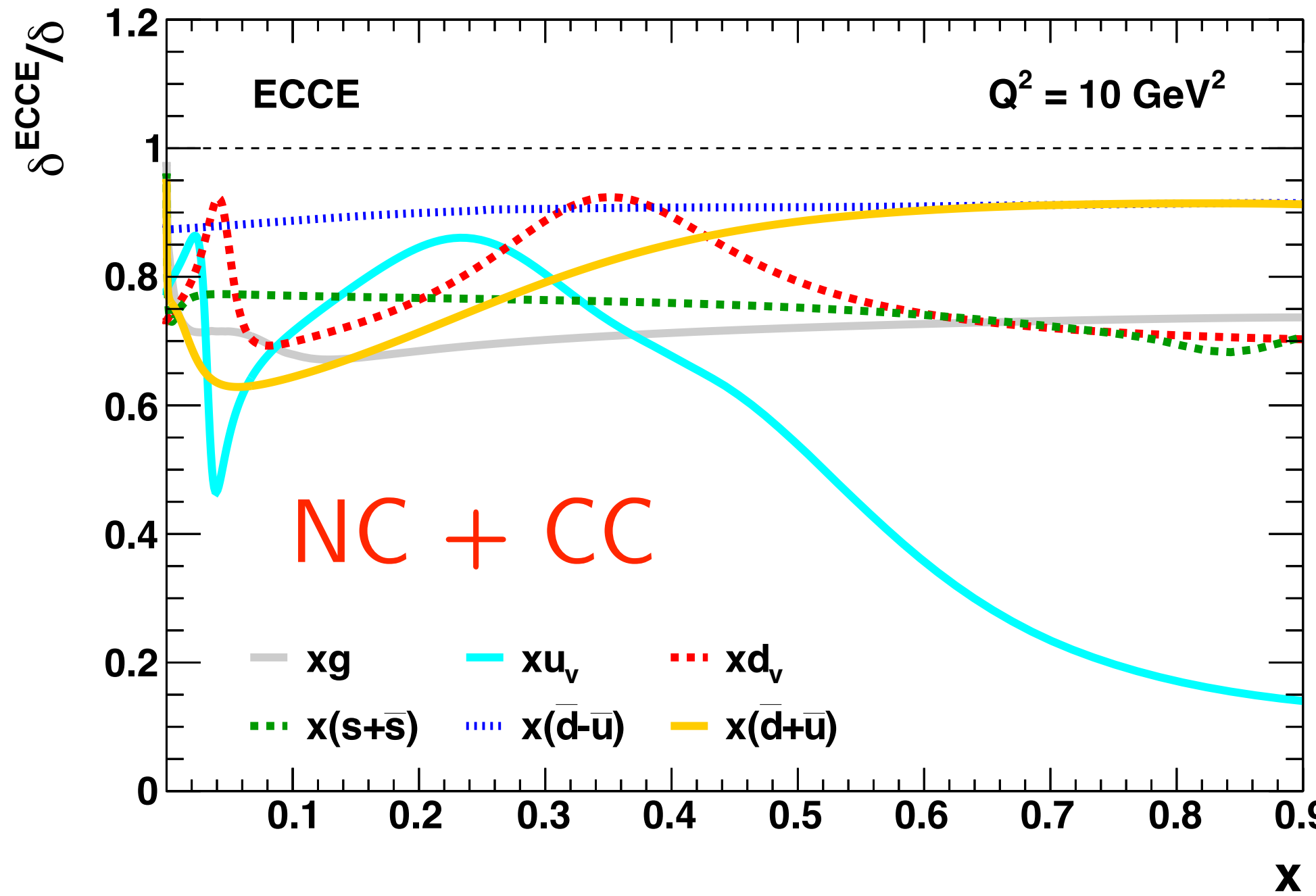
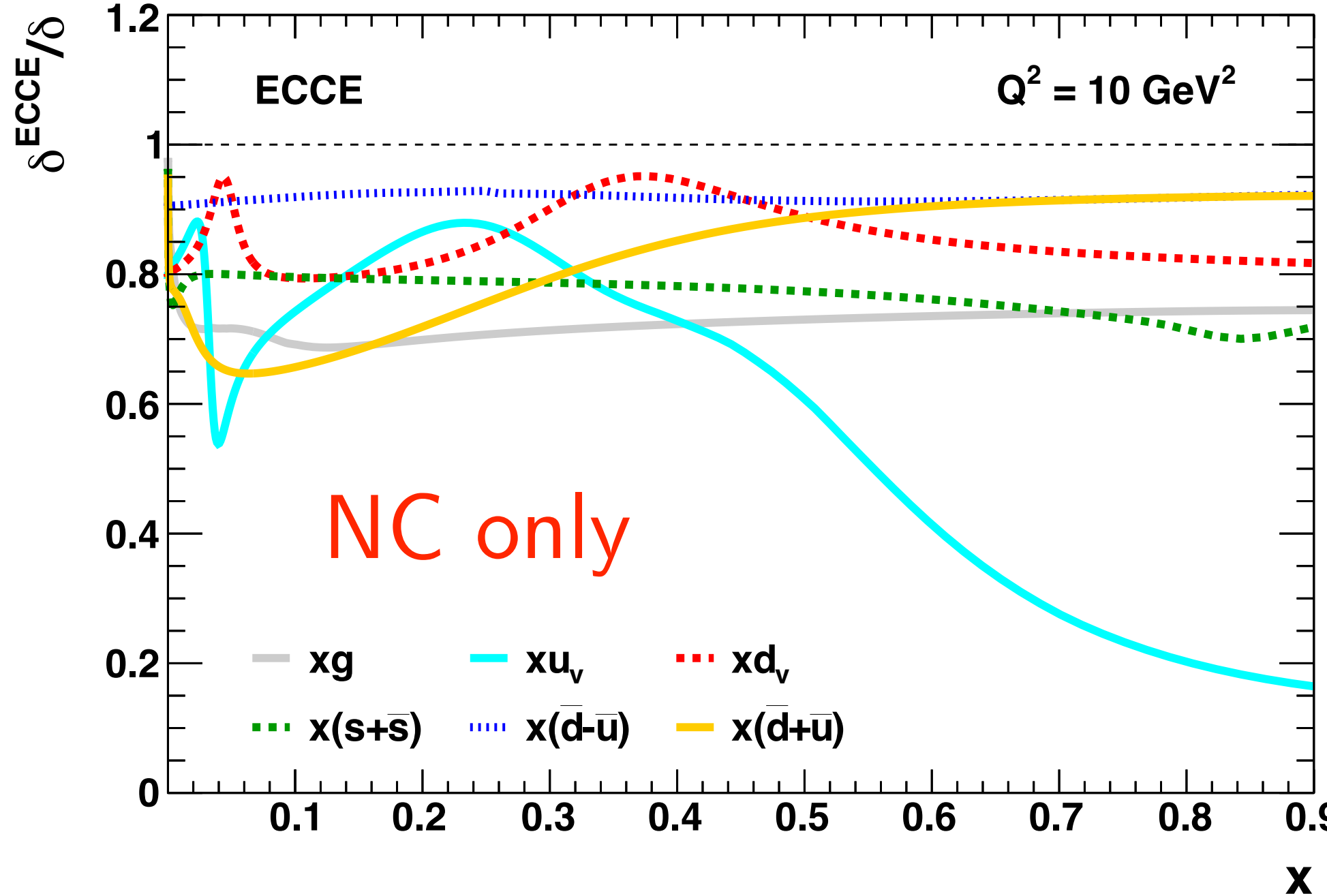
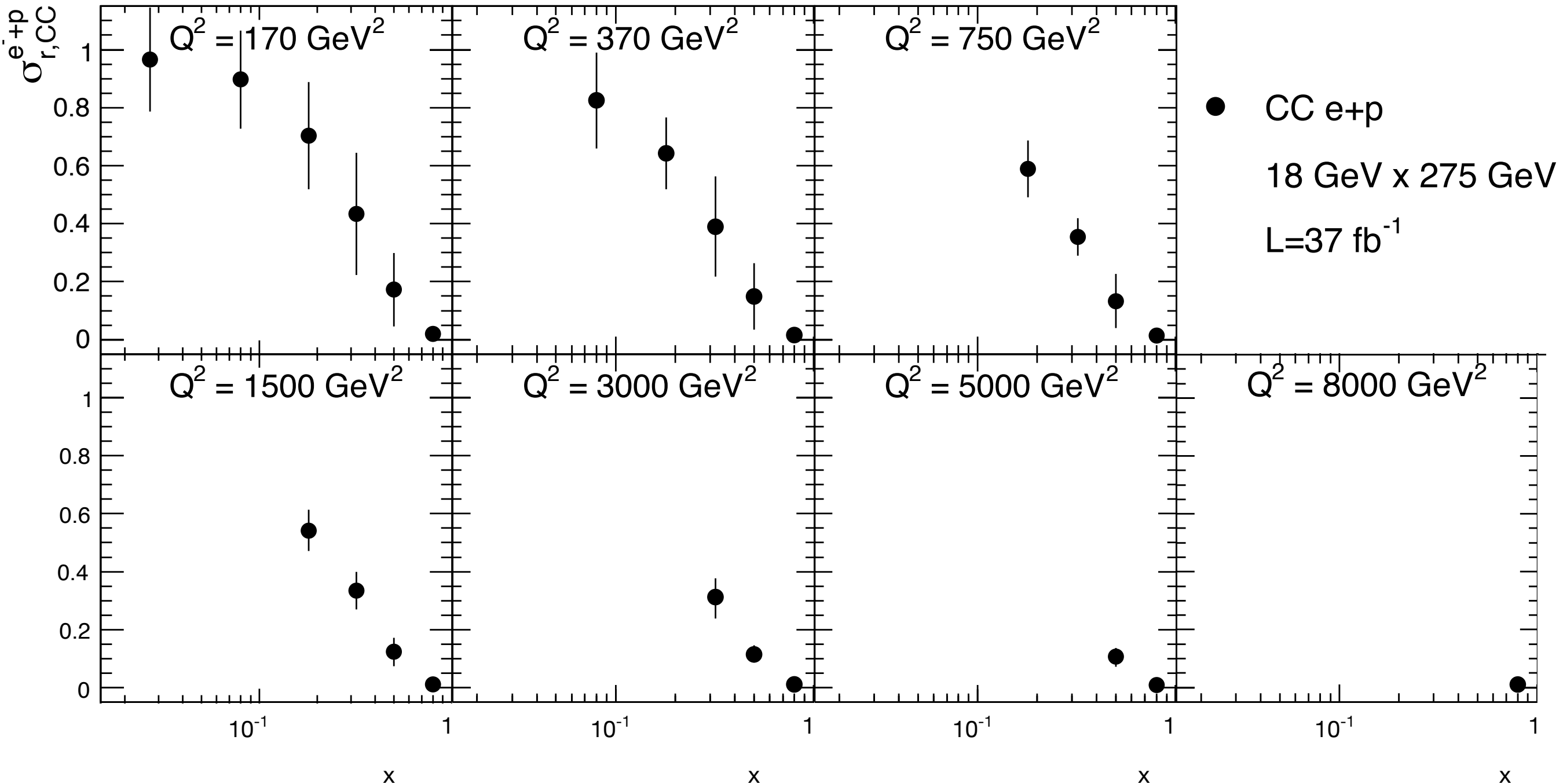
# Reduced CC cross sections

- Projection from ECCE simulation
- Major systematics:
  - Energy resolution
  - Neutral-current contamination



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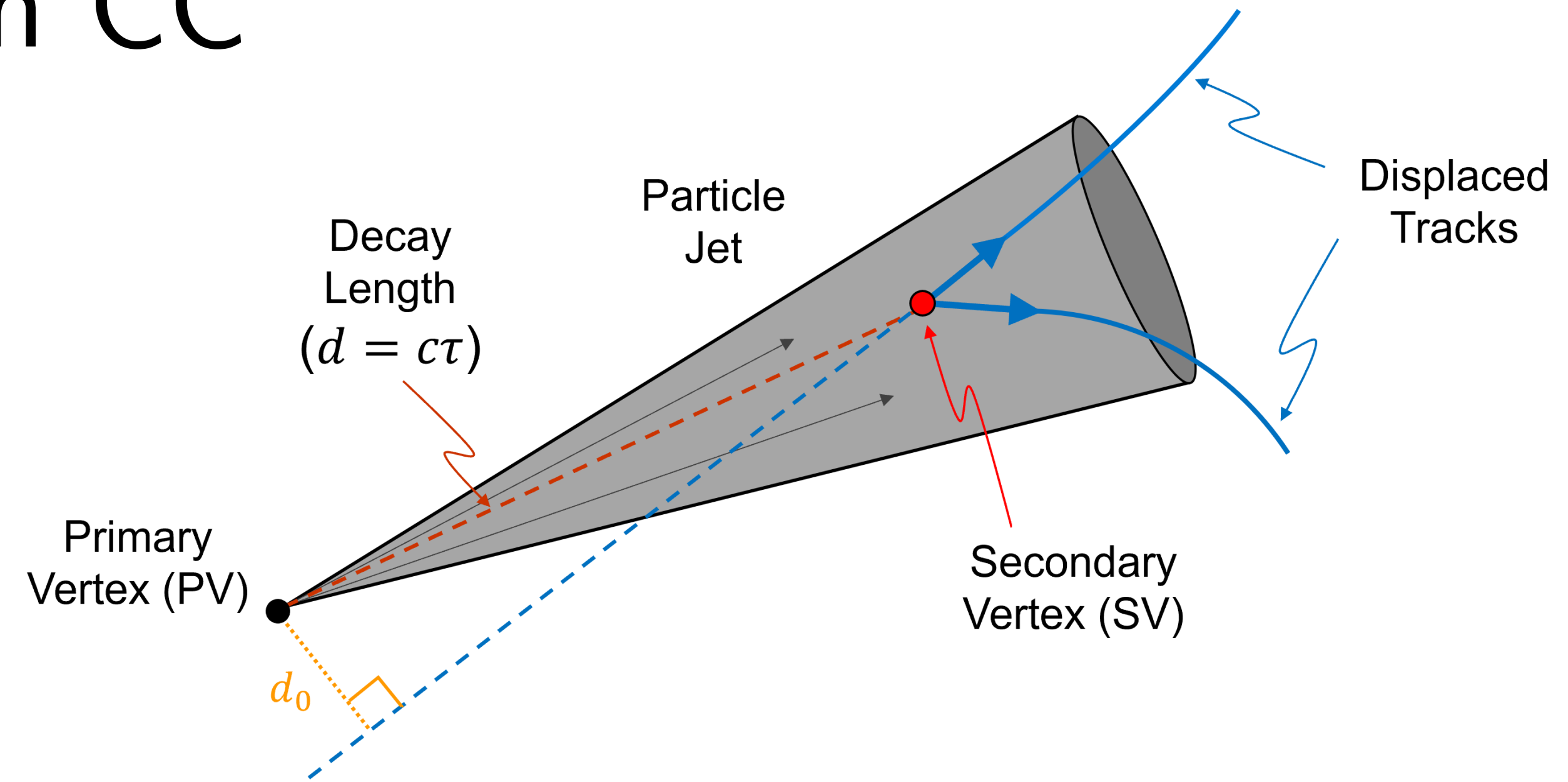
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# Strangeness of the proton with CC

Work by George Williams

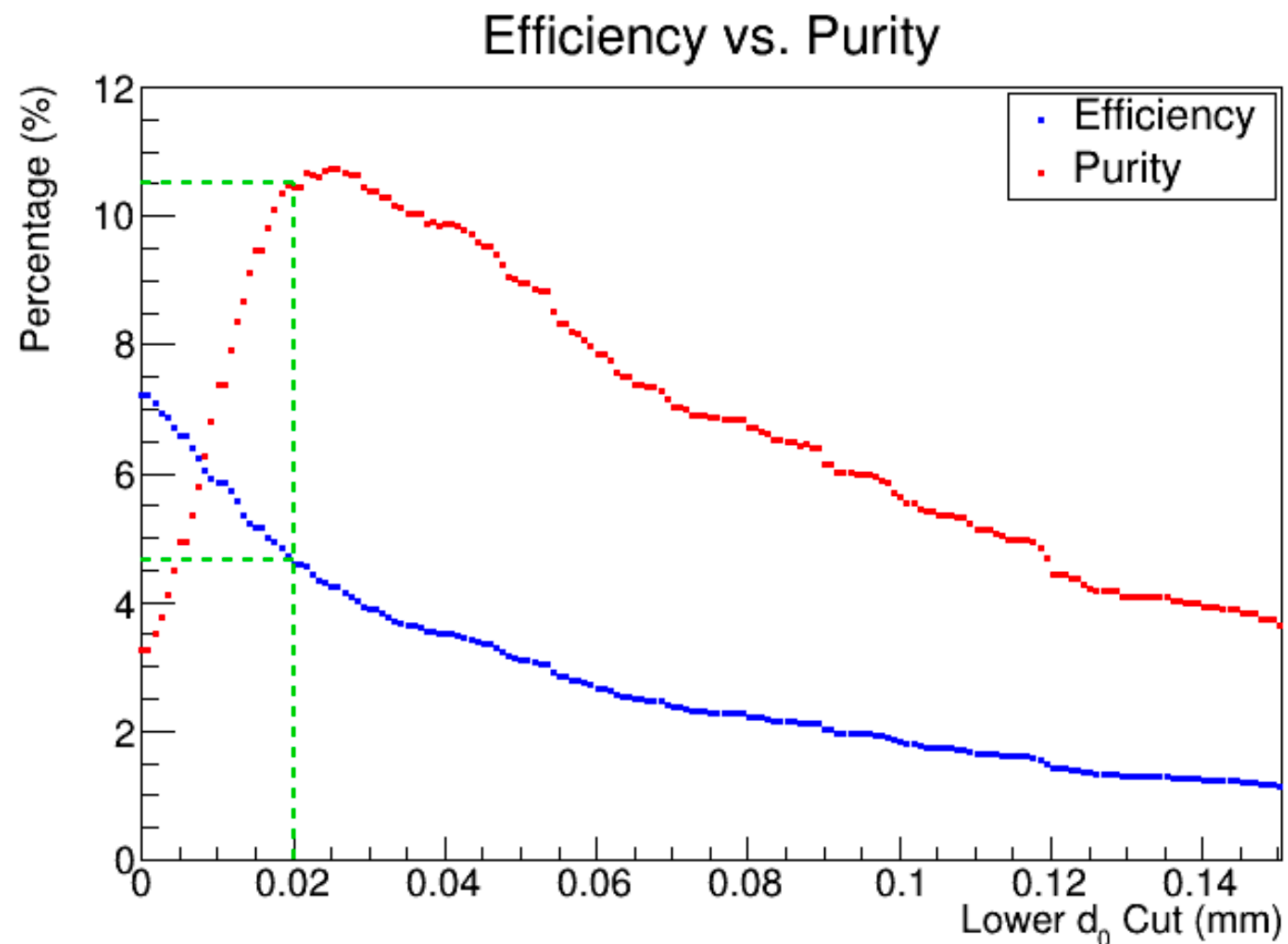
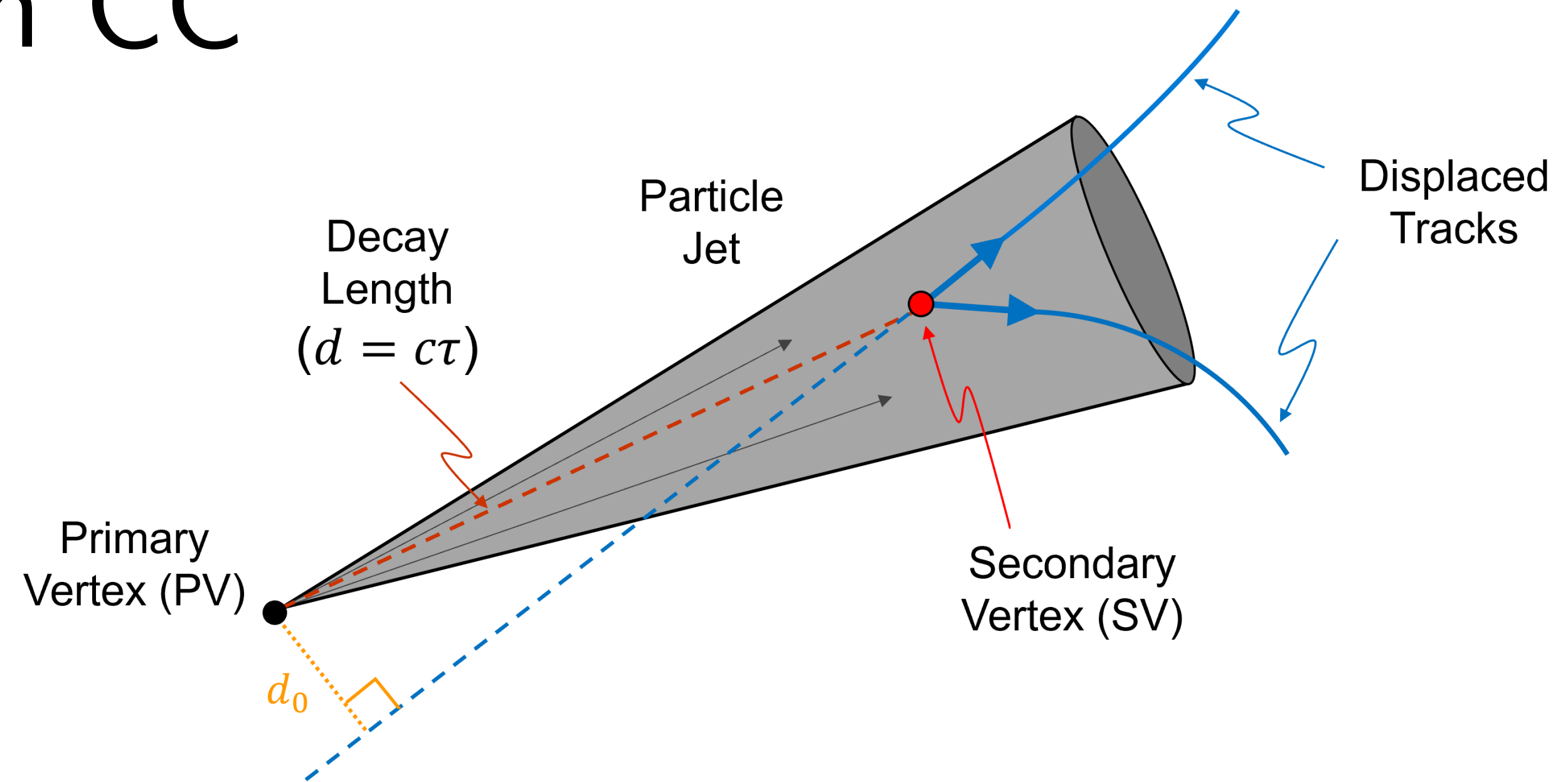
- $W^- + \bar{s} \rightarrow \bar{c}$
- Tag charm via long-lived decay products
- Apply minimum cut on  $d_0 \propto \tau$



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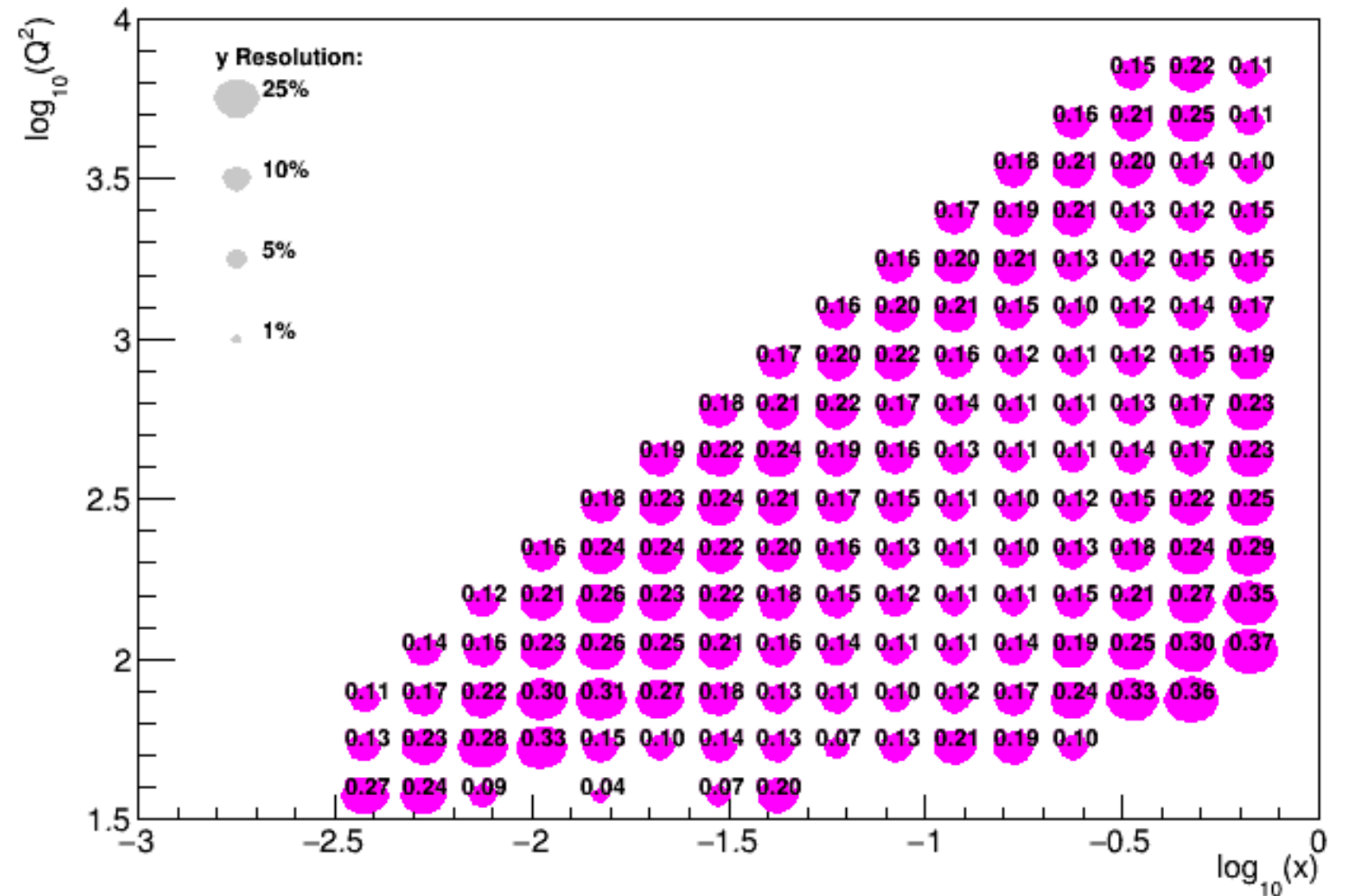
- Optimized  $d_0$  cut with ATHENA simulation (18x275 GeV)
- Projected statistical precision of  $\sigma_c = 1.302 \pm 0.004$  pb ( $100 \text{ fb}^{-1}$ )

# Energy flow for CC reconstruction

Work by Matthew Hellen

- Group calorimeter towers in cone around projected track
- Optimize cone size,  $p_T$  cuts
- Achieved sub-25% resolution in  $y$  across most of phase space

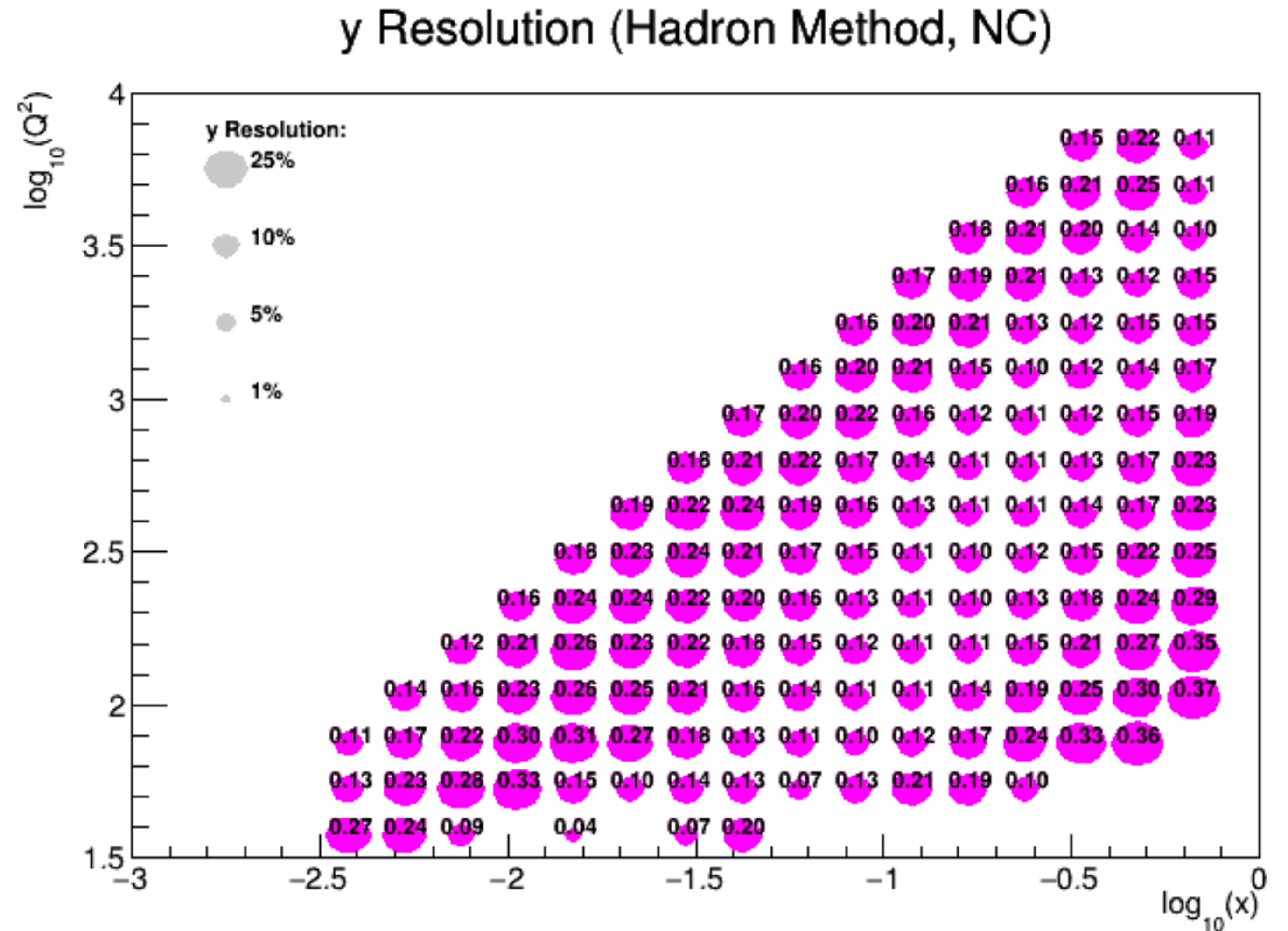
$y$  Resolution (Hadron Method, NC)



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See talk by Daniel Brandenburg on recent particle flow efforts for ePIC

# Summary

- CC reactions, charm tagging can provide flavor separation in the proton
- As with NC reactions, biggest ePIC impact on PDFs at large  $x$
- Resolution, electron ID critical to CC analyses
- Particle-flow efforts underway