

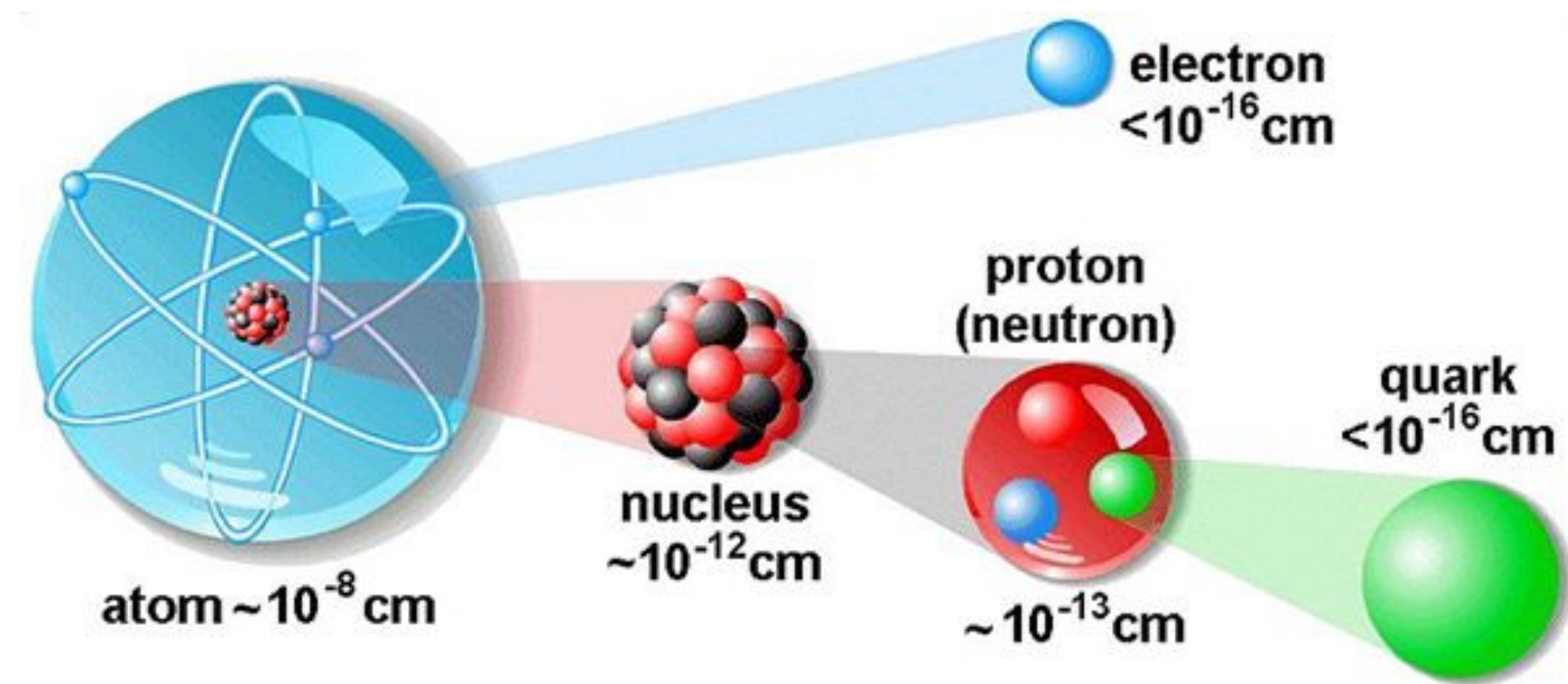
Probing Nuclear Structure and Dynamics at the Electron-Ion Collider

Simulating the 1-Jettiness global event shape for DIS

| Rebecca Corley | Sonny Mantry | Suzanne Steel |



What is Particle Physics?



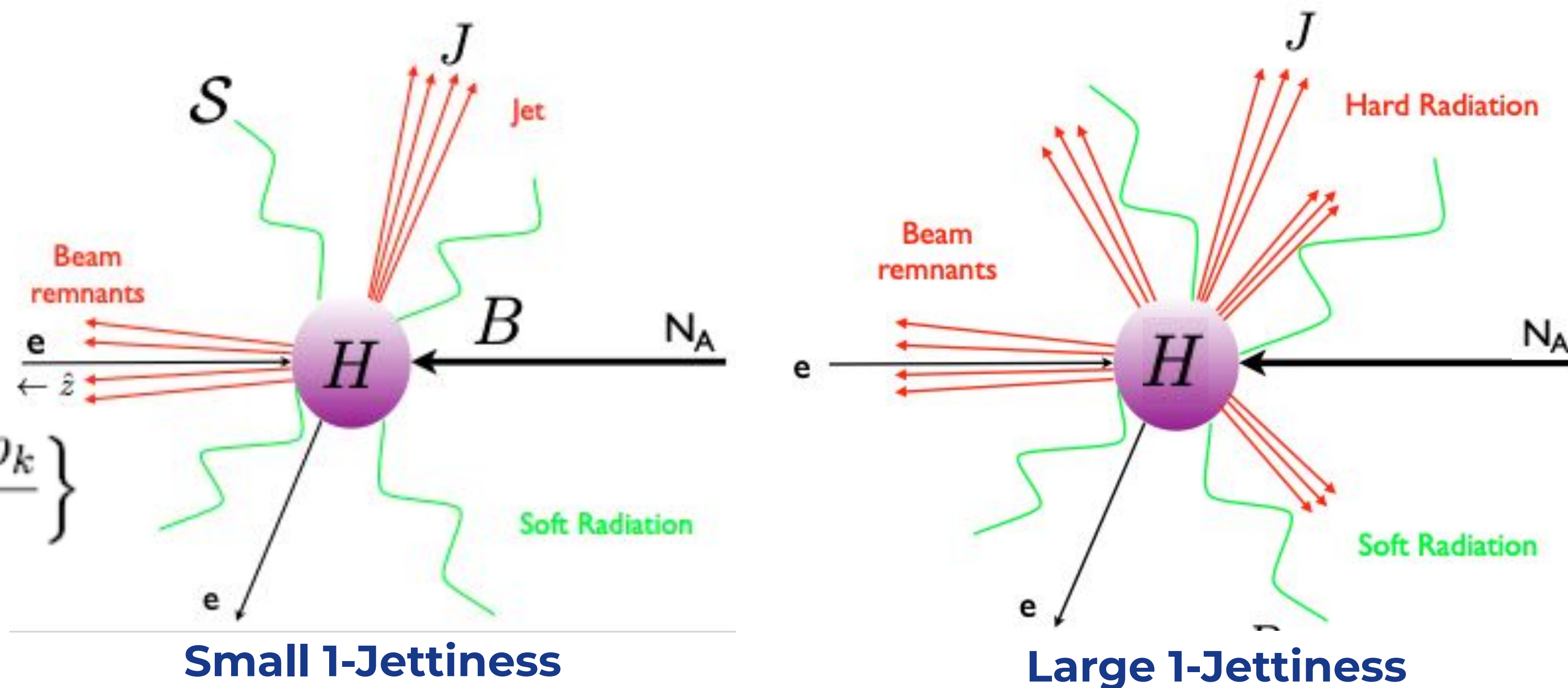
Particle Physics is the study of the most fundamental constituents of matter and the interactions between them.

Image Credit: University of Toronto

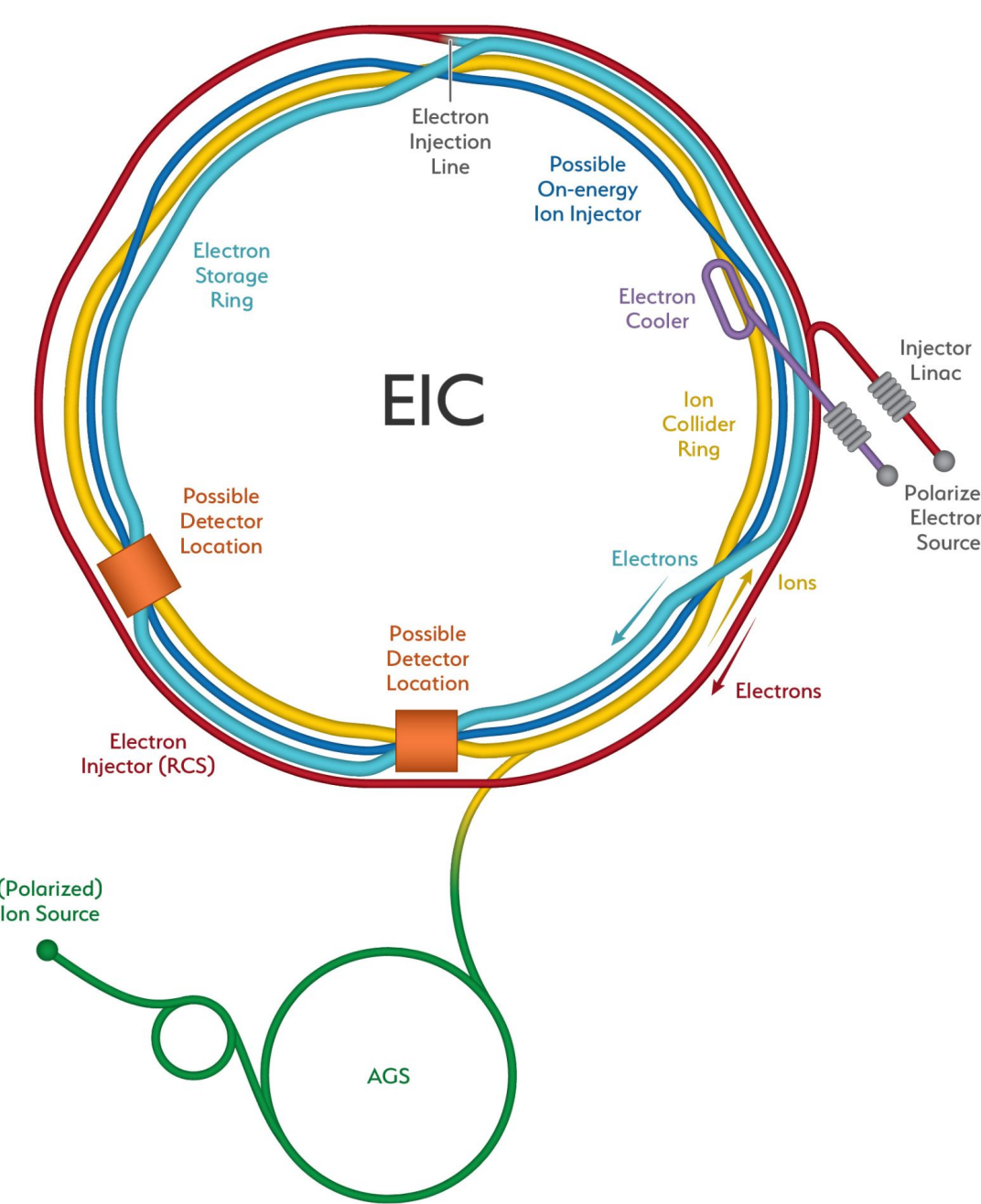
1-Jettiness Observable: A Global Event Shape

The 1-Jettiness observable quantifies the pattern of radiation (particle debris) given off from particle collisions.

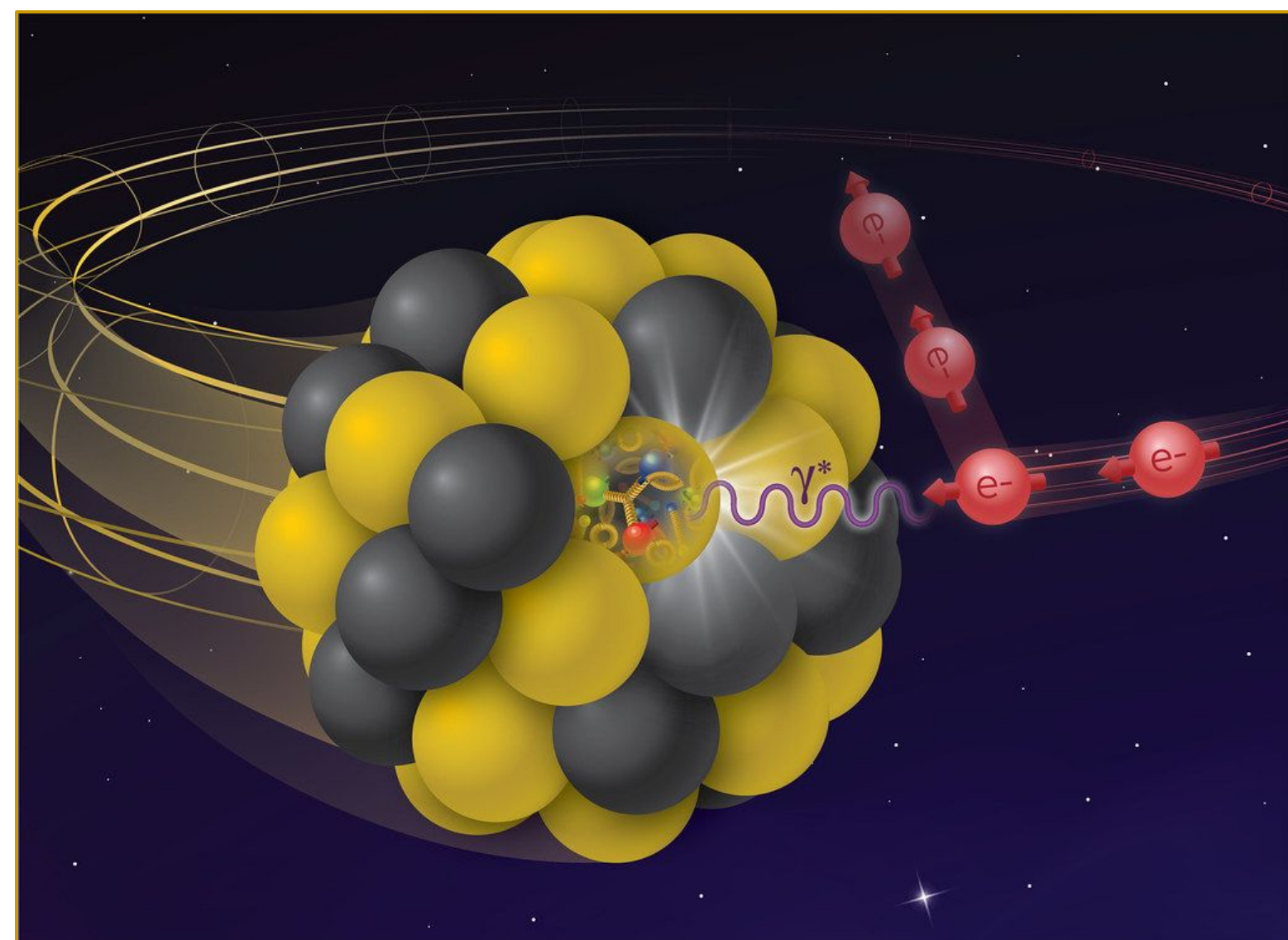
$$\tau_1 = \sum_k \min \left\{ \frac{2q_A \cdot p_k}{Q_A}, \frac{2q_J \cdot p_k}{Q_J} \right\}$$



Electron-Ion Collider (EIC)



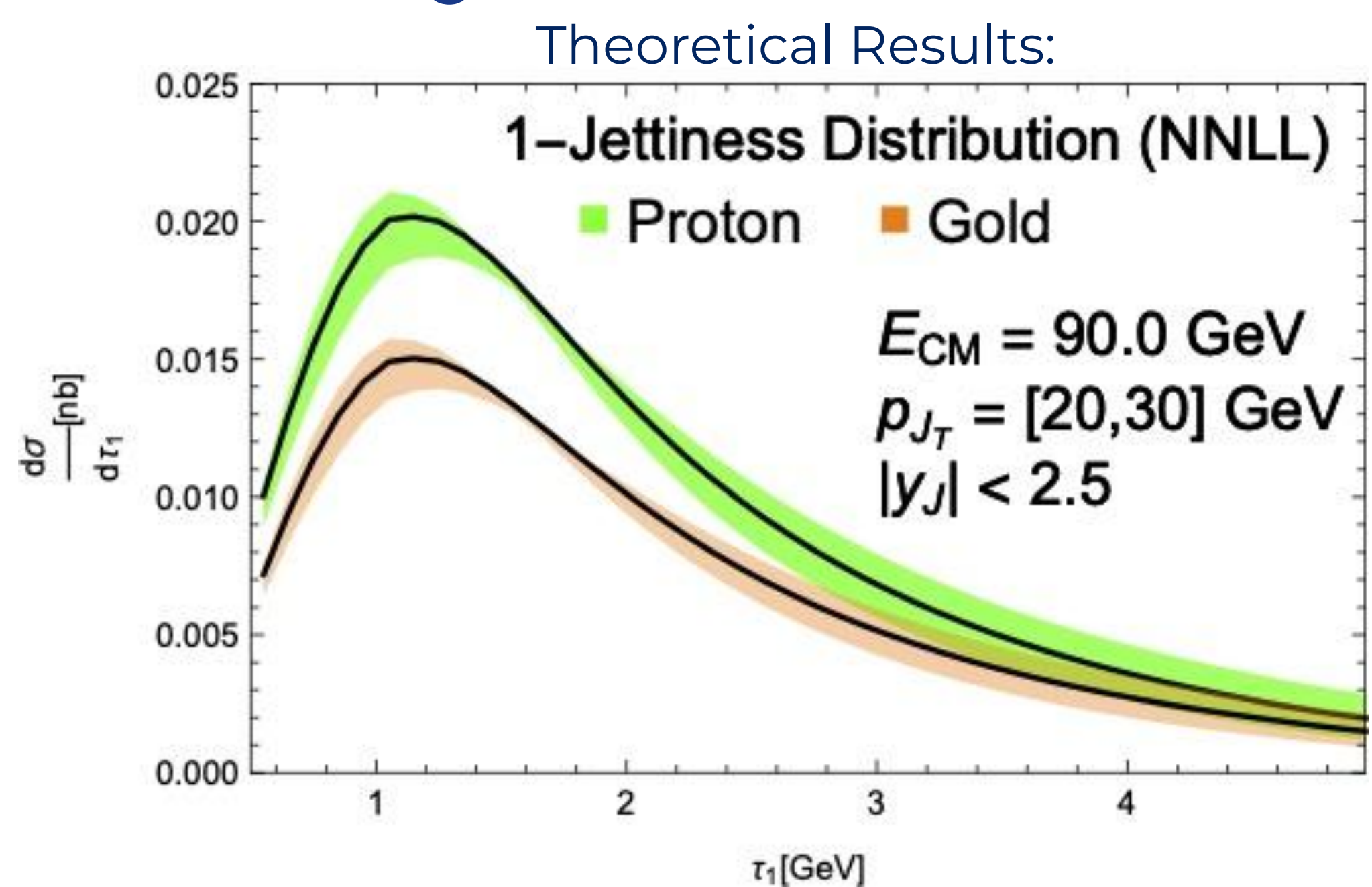
- Center of Mass Energy: 30 - 140 GeV
- Luminosity: $10^{34} \text{ cm}^{-2} \text{ s}^{-1}$
- Hadron and electron beams are polarizable



- Will be the only major collider facility operating in the US in the next decade
- Precision 3D imaging of nuclei
- Ability to study a variety of nuclear targets
- Probe Nuclear Medium Effects

Image Credits: BNL

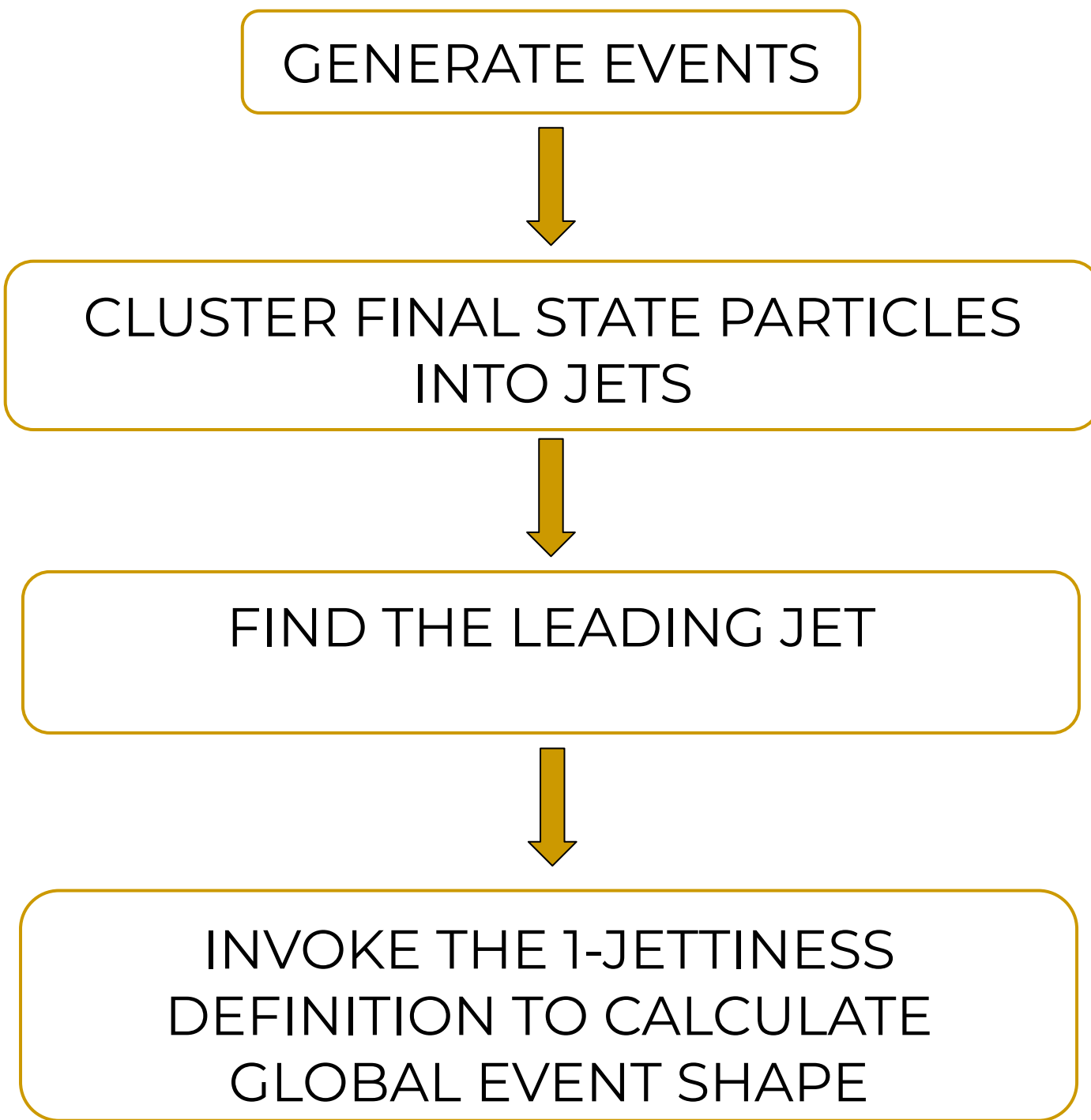
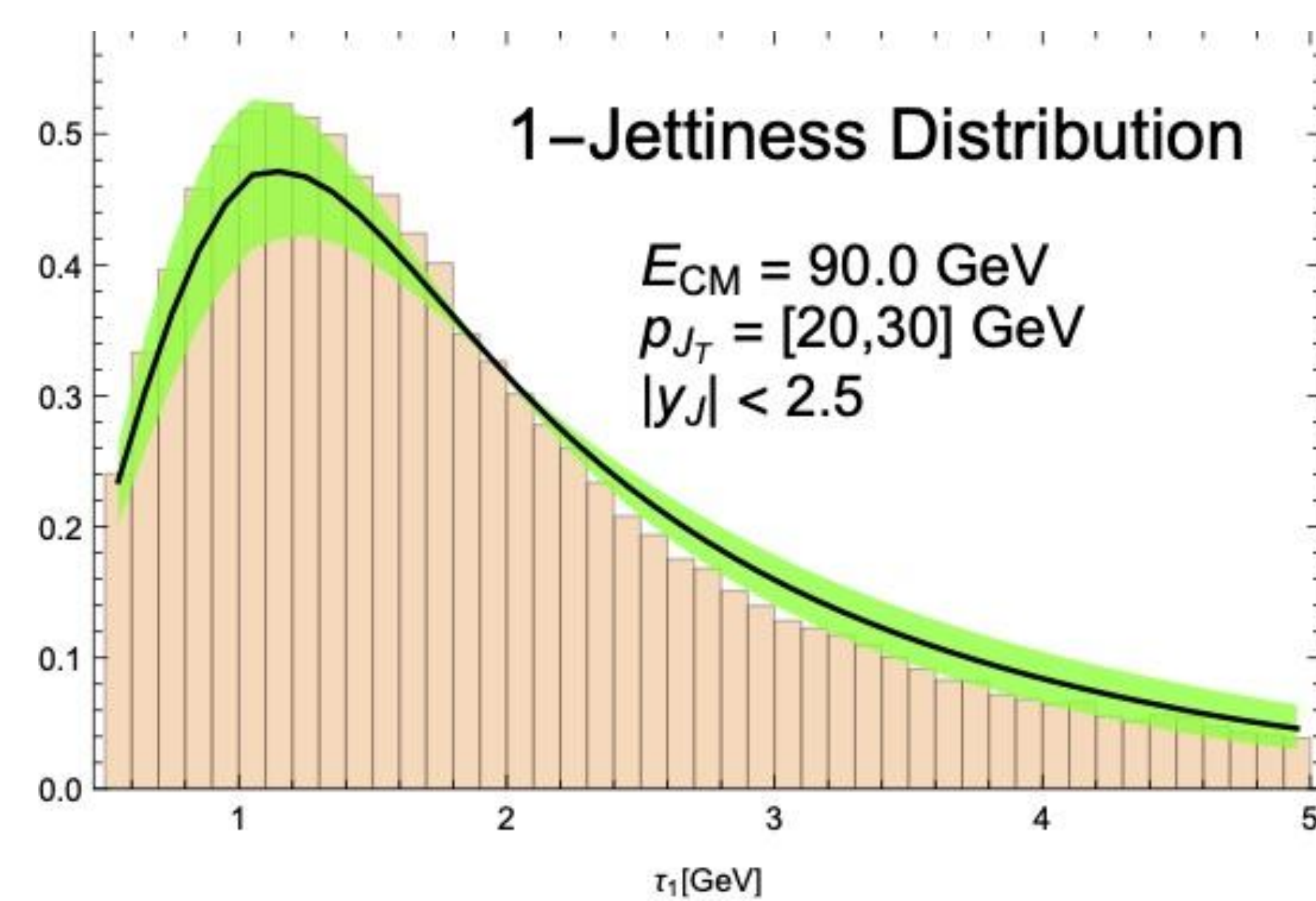
Comparing Simulated Data with Theory



Simulation Program:

- Pythia 8.3.03
- Number of Simulated Events: 1,000,000

Theoretical Prediction vs. Simulated Data:



Probing Nuclear Physics at the EIC

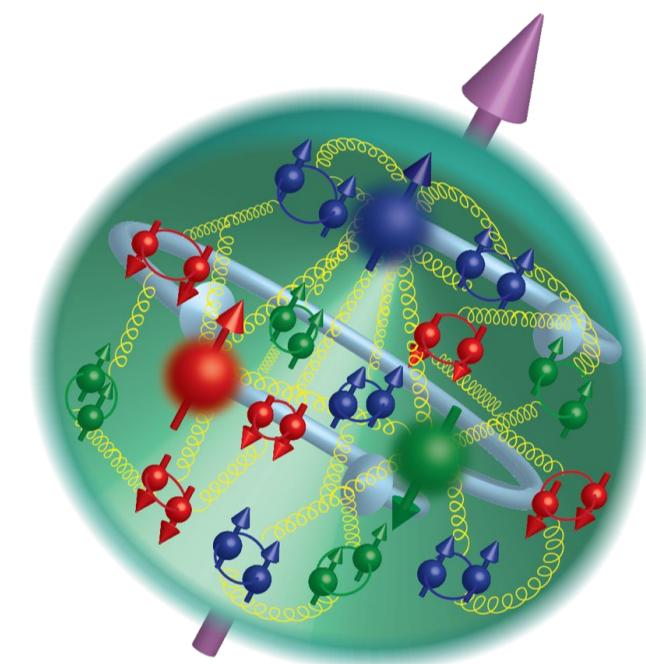
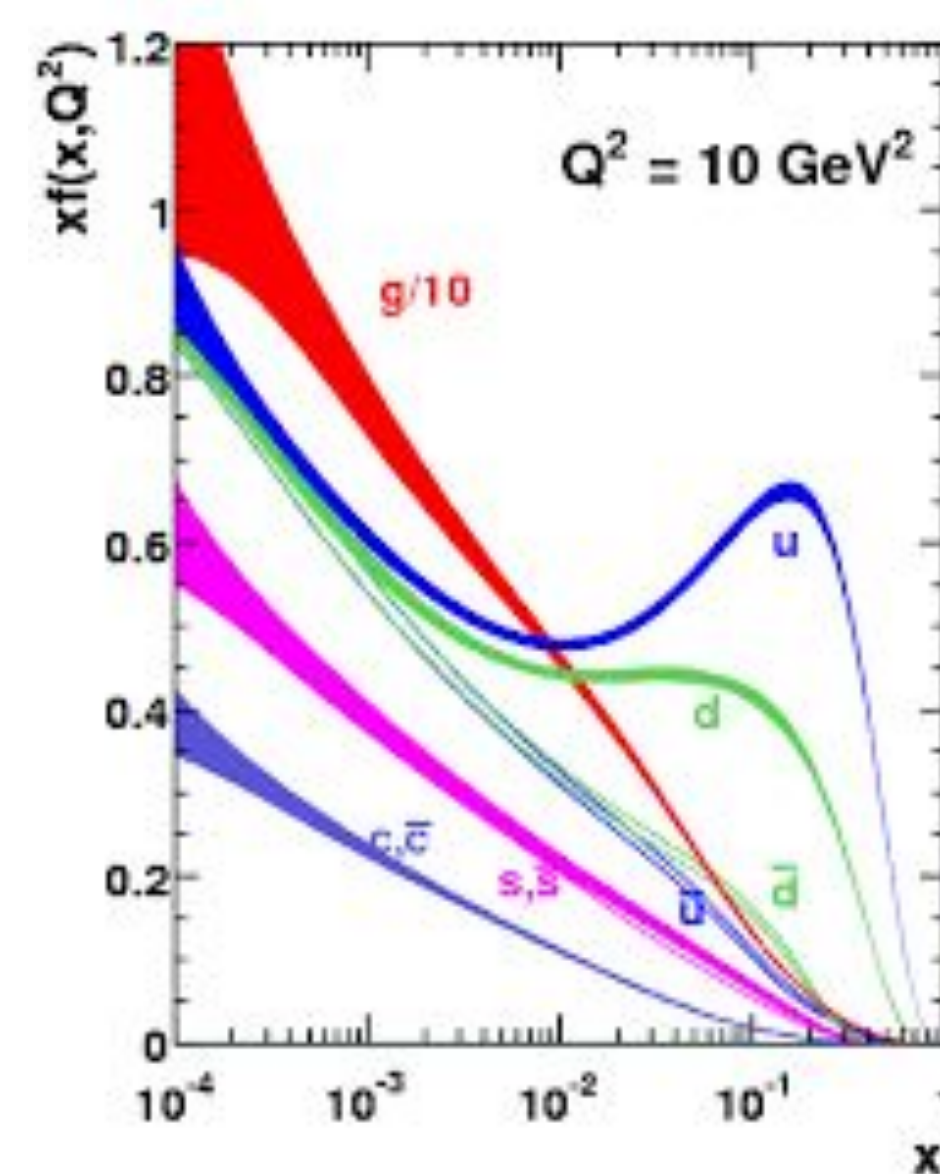
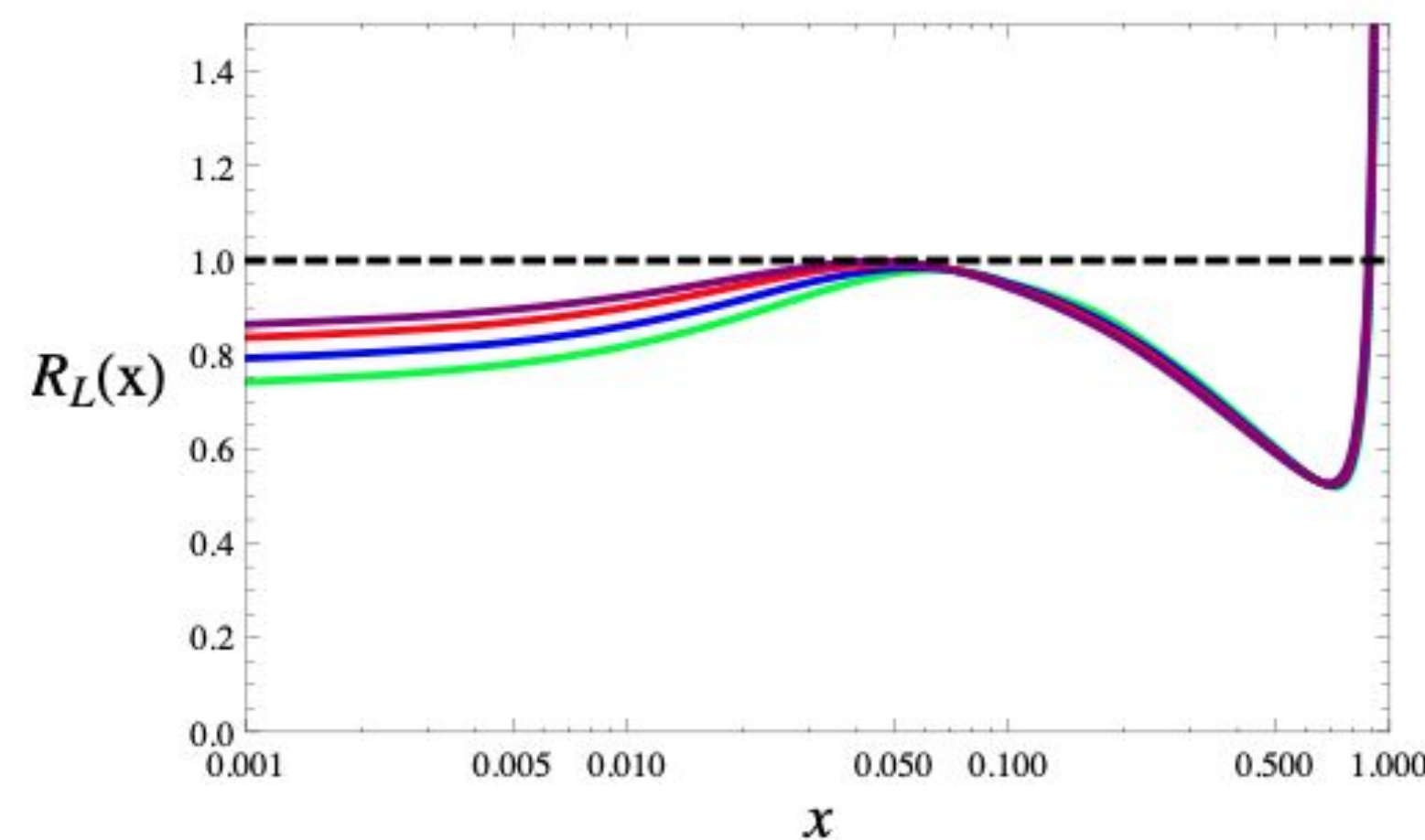


Image Credits: CERN, JLab

Parton Distribution Functions (PDFs) describe the momentum distributions of quarks and gluons within protons and neutrons.

Ratio of Proton & Nuclear Structure Functions:



$$R \sim \frac{\sigma_A}{A\sigma_p}$$

A comparison between a free proton and a gold target depicts differences in nuclear environment.

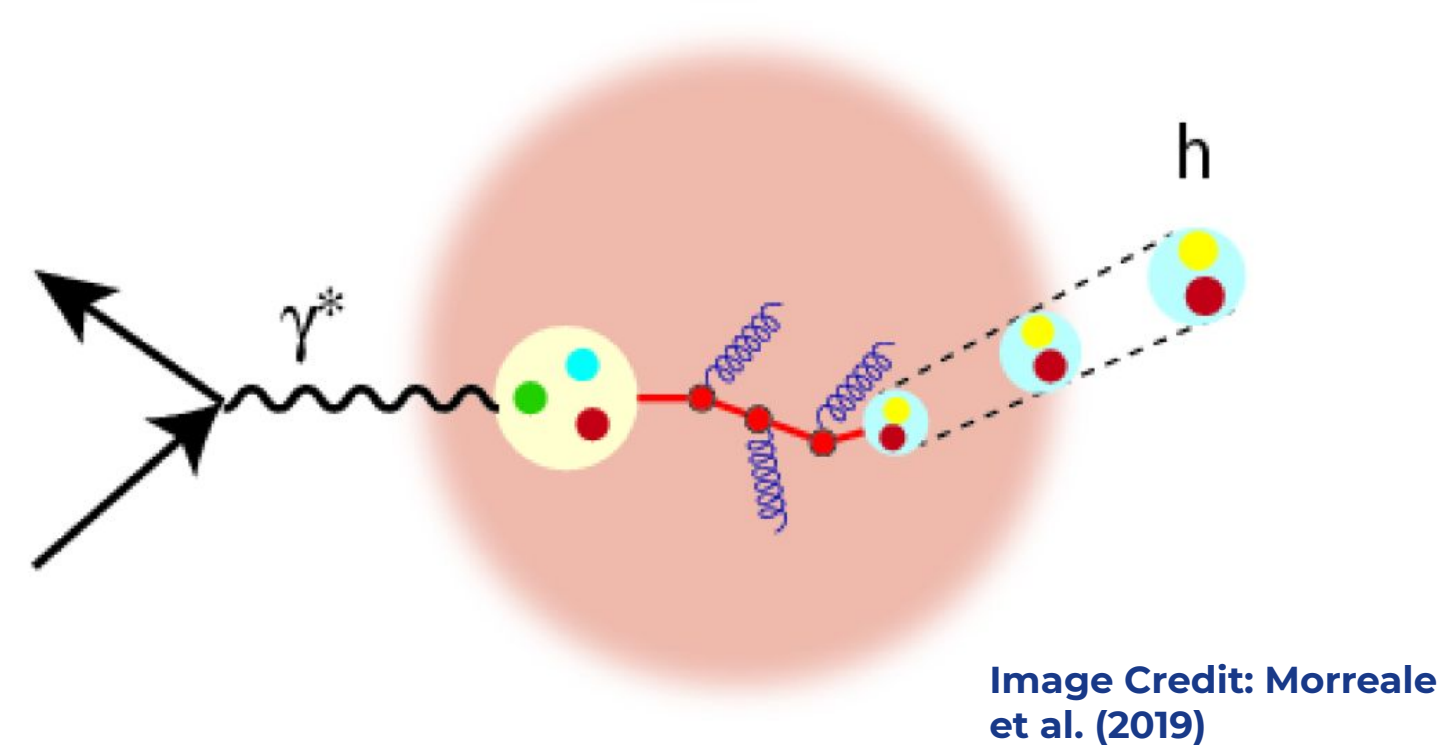


Image Credit: Morreale et al. (2019)

Parton propagation through Cold Nuclear Medium effects

Future Work

Our next steps in this work are to:

- Incorporate nuclear medium effects using the Jewel simulator, a Monte Carlo event generator that simulates QCD jet evolution in heavy-ion collisions
- Perform a detailed analysis to construct theory parameters using simulation data

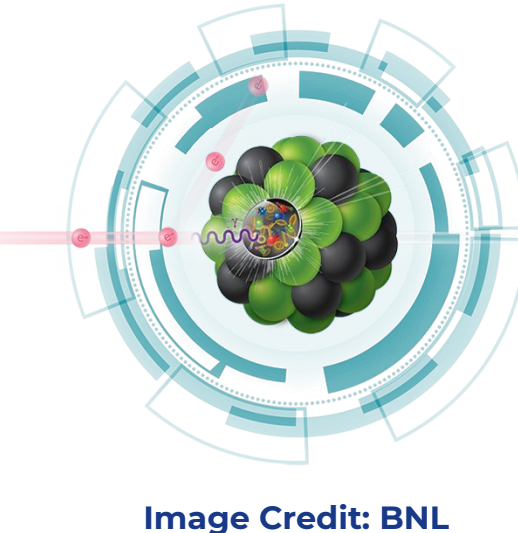


Image Credit: BNL

Acknowledgements

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