

Impact of the Electron Ion Collider on particle physics at the Energy Frontier

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Who are the authors & Plans



- Theorists (ANL, Northwestern Univ, SMU) and experimentalists (HEP /ANL)
- Experimentalists:
 - Expertise in HEP (ep at ZEUS/HERA) and medium energy physics
 - Participating in the ATLAS/LHC, NovA, DUNE, etc.
- Theorists:
 - Expertise in PDF, multiquarks states, fragmentation, heavy-flavor, Standard Model cross sections, BSM physics, jet physics



Northwestern
University



SMU

Interested to contribute? Please contact us.

Goal of this contribution:

Overview of science cases at the EIC experiment which are traditional to general particle physics, with a particular emphasis on the connections to the physics at the energy frontier (HEP)

**Snowmass21 contributed paper will be finished by Spring 2021.
Then it will be submitted to a journal**



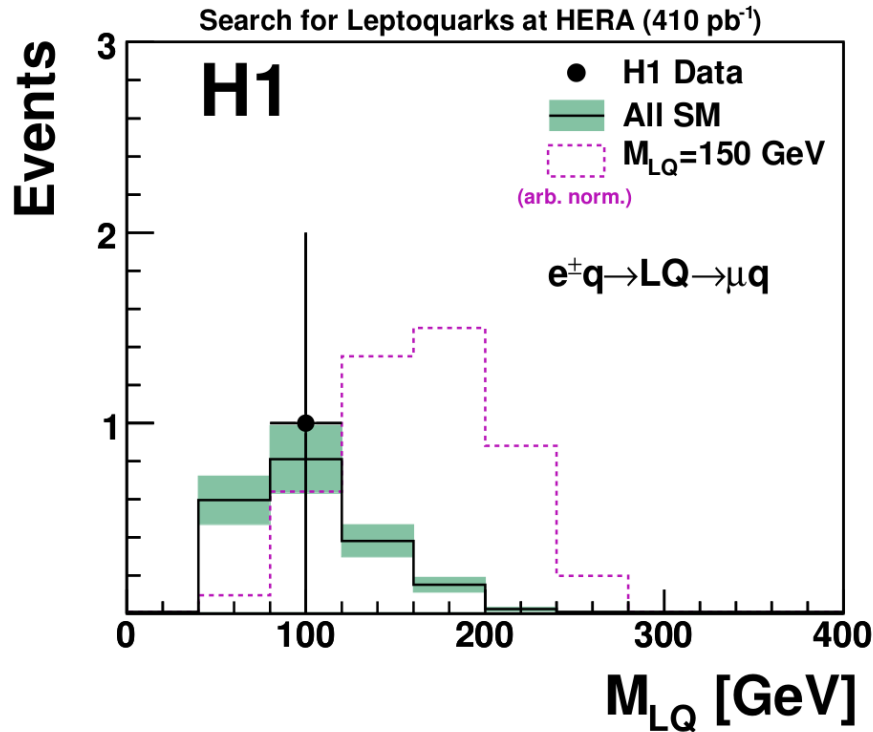
Structure of this Snowmass21 contribution



- Paper draft in Overleaf
- Contains a mix of original research and short summaries of published theoretical results by the authors
- Many studies anchored to H1+ZEUS results from HERA, TEVATRON and LHC results
- Sections:
 - 1) Parton distributions functions
 - 2) Beauty and charm production cross sections
 - 3) Fragmentation
 - Baryon-antibaryon asymmetry
 - Compound and multiquark states
 - 4) Hadronic Final States studies
 - Jets, forward physics and BFKL
 - 5) Topics Beyond the Standard Model (BSM) physics
 - 6) Search for Lepton Flavour Violation



Representative example: *Search for Charged Lepton Flavor Violation (CLFV)*

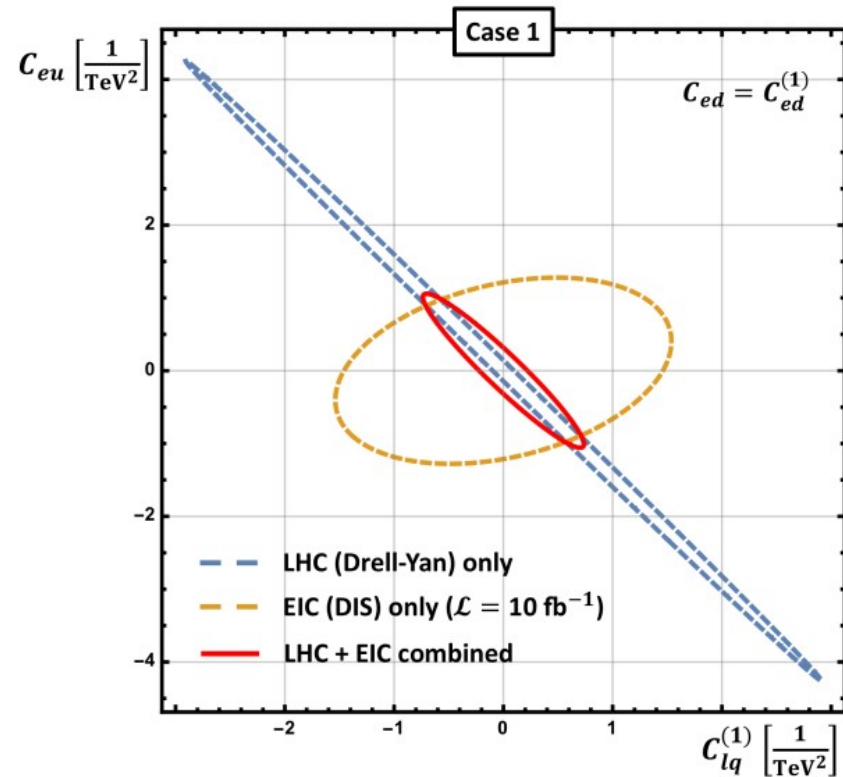


(a) Charm cross section

- $ep \rightarrow \mu X$ (1 event!)
- LHC experiments typically focus on μ +tau decays of Higgs, Z-bosons, LFV in top decays
- Also Discussed by A. Deshpande (link) and Y.Furletova (link) for EIC
- More recent H1 combination and interpretation in the context of LQ

H1 Collaboration, F. Aaron, et al., Search for Lepton Flavour Violation at HERA
Phys. Lett. B 701 (2011) 20
arXiv:1103.4938

Probing SMEFT at the EIC



- The Standard Model Effective Field Theory is a general framework for heavy BSM physics

$$\mathcal{L}_{SMEFT} = \frac{1}{\Lambda^2} \sum_i C_i \mathcal{O}_i$$

- The LHC is not sensitive to certain directions in SMEFT parameter space
- Because of polarization, the EIC is!

Polarization at the EIC makes it a powerful probe of BSM theories; complementary to LHC data

Boughezal, Petriello, Wiegand PRD (2020)

Thanks!