ECCE Physics Benchmarks Team IB Meeting Report

November 22nd, 2021

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Analysis Notes

ECCE ID	Topic	Responsible
ecce-note-phys-2021-01	Jet performance note	Tristan Protzman
ecce-note-phys-2021-02	Diffractive and tagging group note	Bill Li, Axel Schmidt
ecce-note-phys-2021-03	Exclusive processes group note	Julie Roche, Rachel Montgomery
ecce-note-phys-2021-04	ReA for D&B	Xuan Li
ecce-note-phys-2021-05	SIDIS kinematics	Ralf Seidl & Charlotte van Hulse
ecce-note-phys-2021-06	SIDIS spin asymmetries with single hadrons	Ralf Seidl & Charlotte van Hulse
ecce-note-phys-2021-07	SIDIS unpolarized TMD measurements	Ralf Seidl & Charlotte van Hulse
ecce-note-phys-2021-08	Jet ReA	Raymond Ehlers
ecce-note-phys-2021-09	Inclusive processes group note	Tyler Kutz & Claire Gwenlan
ecce-note-phys-2021-10	Centauro jets (JL)	John Lajoie
ecce-note-phys-2021-11	SIDIS (A_LL)	Ralf Seidl & Charlotte van Hulse
ecce-note-phys-2021-12	Spectroscopy	Derek.Glazier@glasgow.ac.uk
ecce-note-phys-2021-13	Dihadrons	Nathan grau
ecce-note-phys-2021-14	BSM group note	xiaochao@jlab.org
ecce-note-phys-2021-15	Quarkonium note	Xinbai Li
ecce-note-phys-2021-16	3T vs. 1.4T comparison	Or Hen

Analysis Notes

- All Physics notes have had at least one official release
  - Notes written in Overleaf → Version Control in github
  - Reviewers commented on nearly all notes
- Second release in response to reviewers for most notes
  - Goal is for notes to be finished by the Dec 1st proposal deadline

Simulation WG

- All simulation production requests are either complete or finishing the last few events!
- As proposal is due next week, there will be no more simulations for that
  - We will start thinking about “homework” productions for December
- For writers, there are 2 computing notes (out of 3) that can be cited for simulation and reconstruction descriptions. Link to DRAFTs are here

Large Scale Sim Description

```
@misc{ecce-note-comp-2021-01,
        title={{ECCE Computing Plan}},
        note={\url{https://TBD}},
        year={2021}
}
```

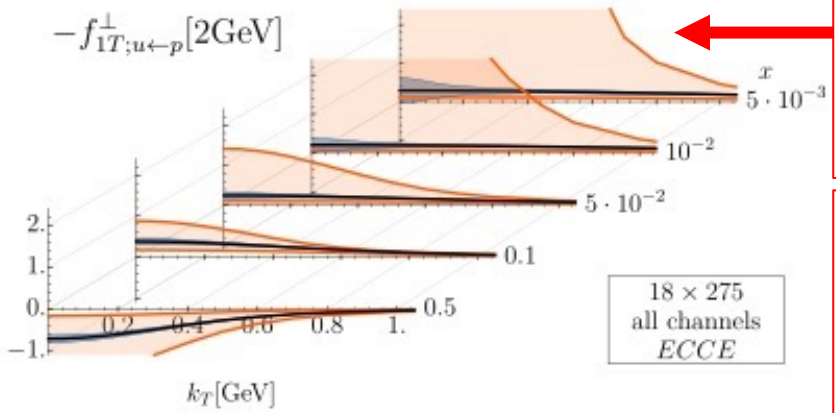
Sim Campaign Layout and Reconstruction

```
@misc{ecce-note-comp-2021-02,
        title={{ECCE Software and Simulations for the Detector Proposal}},
        note={\url{https://TBD}},
        year={2021}
}
```

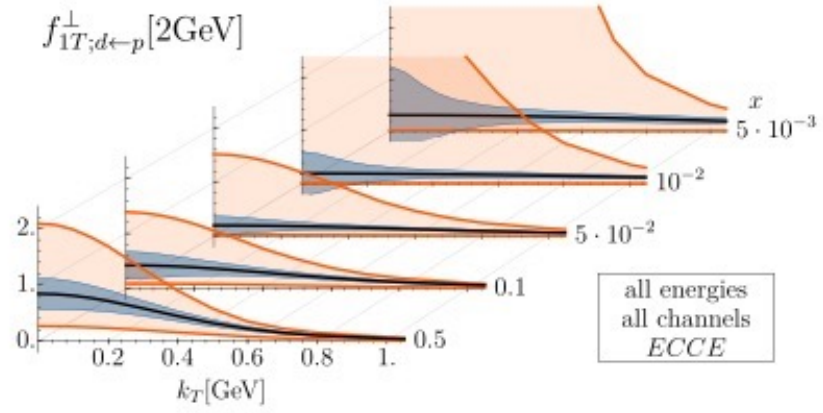
SIDIS WG

Sivers function

Up



Down

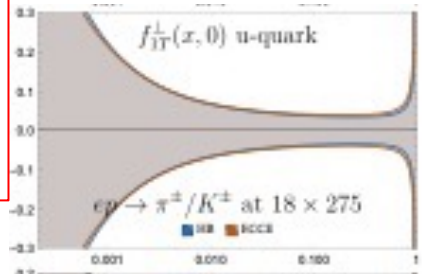


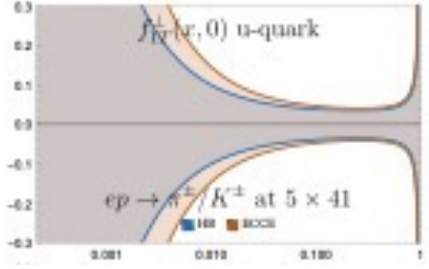
Impact studies of the Sivers functions vs *kt* and x

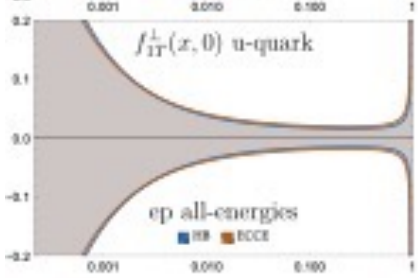
- **Current Uncertainties**
- **Uncertainties w/ECCE**
- Central lines fixed to the current data extraction

Impact on the **up** Sivers functions vs Energy

- **ECCE Uncertainties**
- **YR Uncertainties**
- Results are very similar

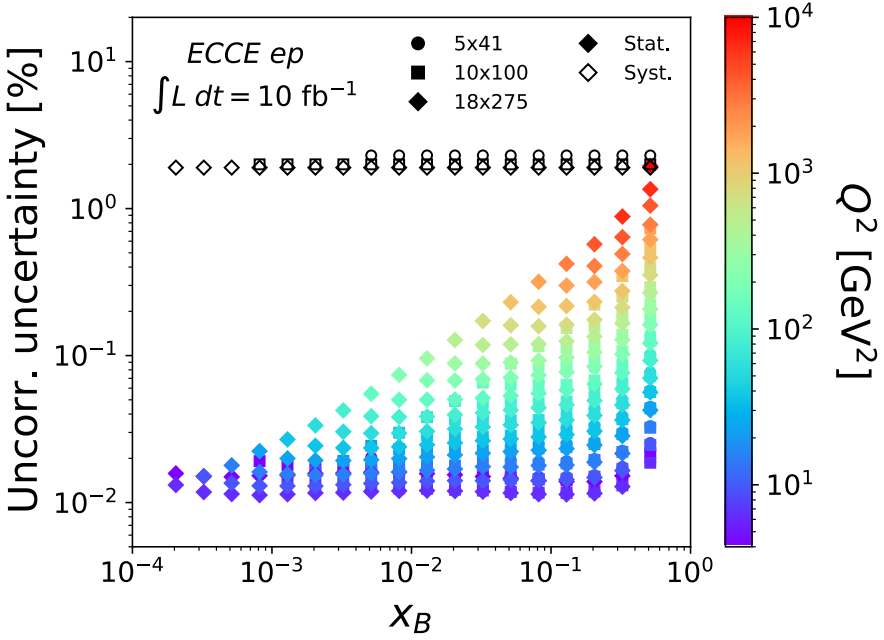






Inclusive WG

Inclusive NC reactions: uncorrelated uncertainties

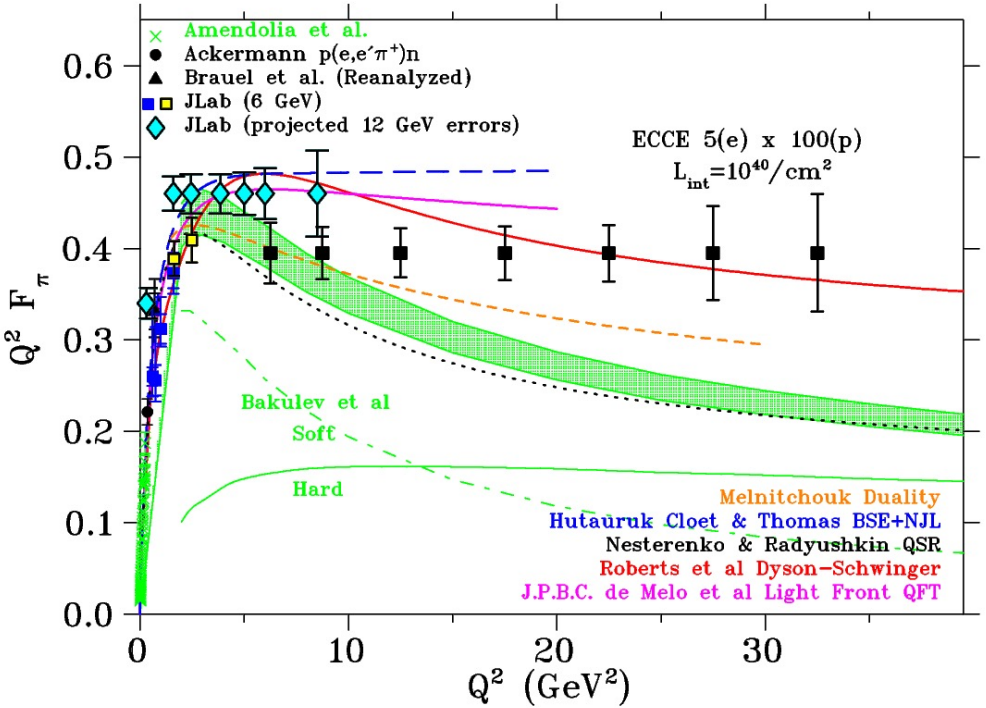


Total uncorrelated systematics
1.9-2.3% (consistent with YR)

- Pion background uncertainty from simulated π/e ratio + pion rejection from calorimetry
- Resolution/acceptance uncertainty as fraction of difference between Born/ reconstructed cross sections
- Assume same radiative corrections/bin centering uncertainty as YR
- Estimate eA statistics by scaling ep by F^{d}_{2}/F^{p}_{2}, F^{A}_{2}/F^{d}_{2}

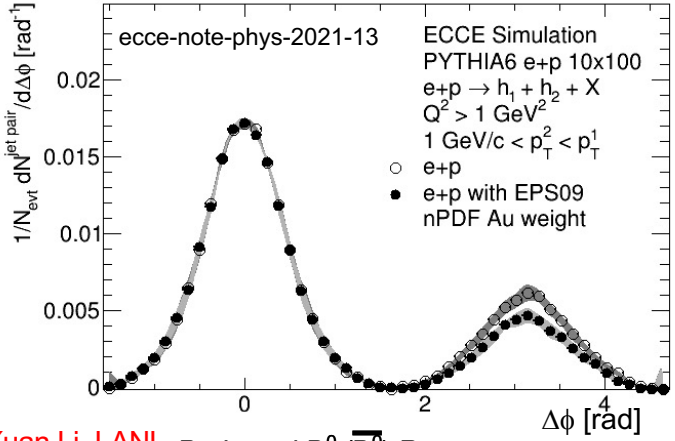
Diffractive and Tagging WG

Pion Form Factor, F_π



- F_π → insight into Dynamical Chiral Symmetry Breaking, transition between non-perturbative regimes+ origin of hadron mass
- Plot shows reach for 10^{40} cm^{-2} of 5x100, determined from
  - $ep \rightarrow e'\pi^+n$
- Requires the central detector (barrel + hadron end-cap) w/n tagged in the ZDC
- ZDC performance is critical for separating exclusive events from background + t reconstruction.

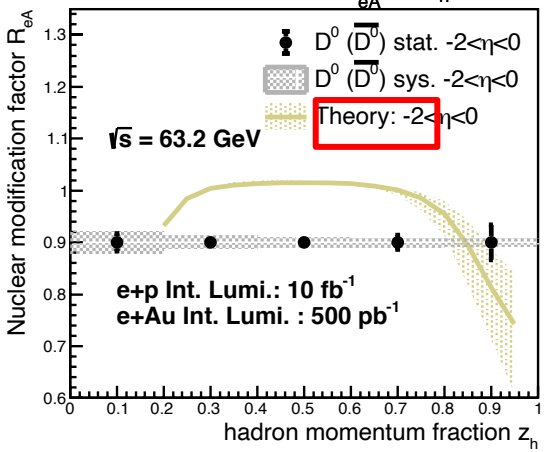
Jets and HF WG

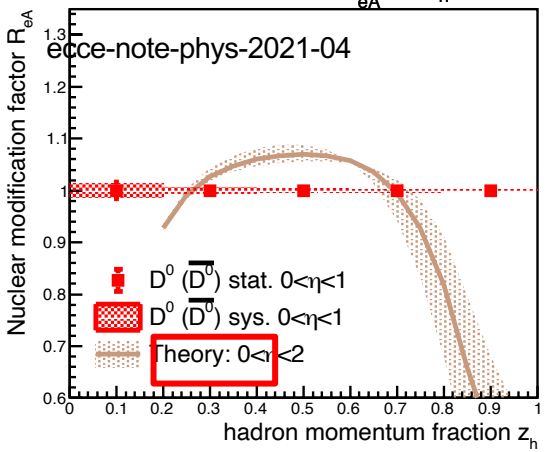


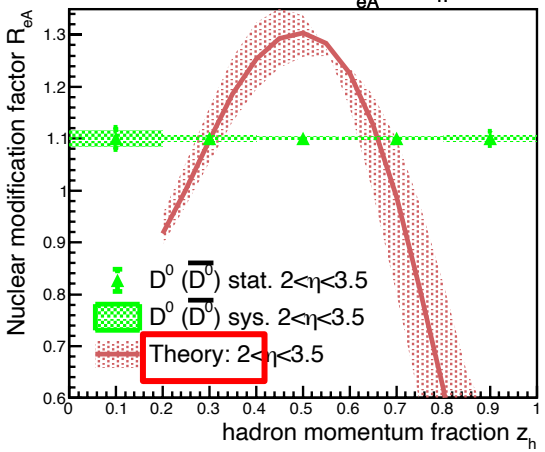
Nathan Grau, Augustana U

- Dihadron correlations allow a determination of the saturation scale
- HF jet analysis used PYTHIA8 + ECCE detector conceptual design for 10x100 GeV^2
  - Study the hadronization process

Xuan Li, LANL

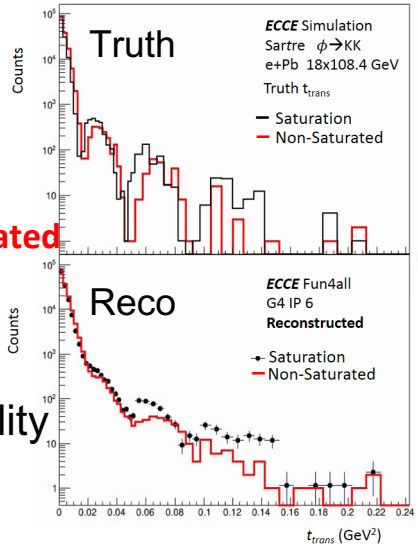


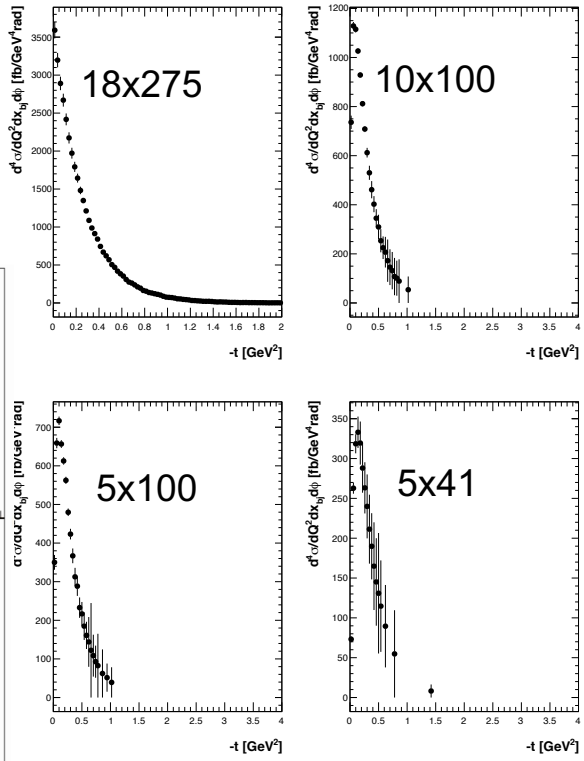


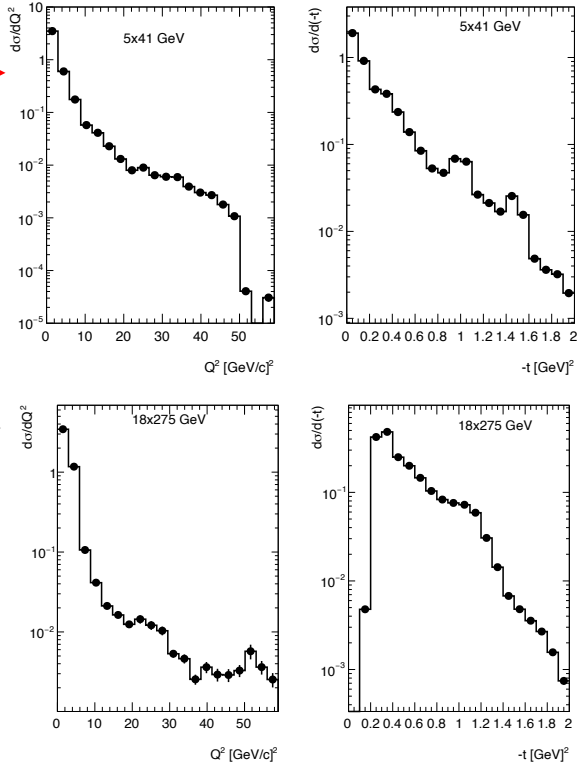


Exclusive Working Group

- DVCS cross-section vs Q^2,−t MILOU3D causes “bumps”
- J/ψ differential cross-section
  - Roman Pot acceptance limit:
  - Outer edge for 18x275
  - Inner edge for 5x41
- Sartre t_{trans} distributions
  - **Saturated**
  - **Non-saturated**
- Interesting distinguishability







Luminosity assume to be 10 fb^{-1}

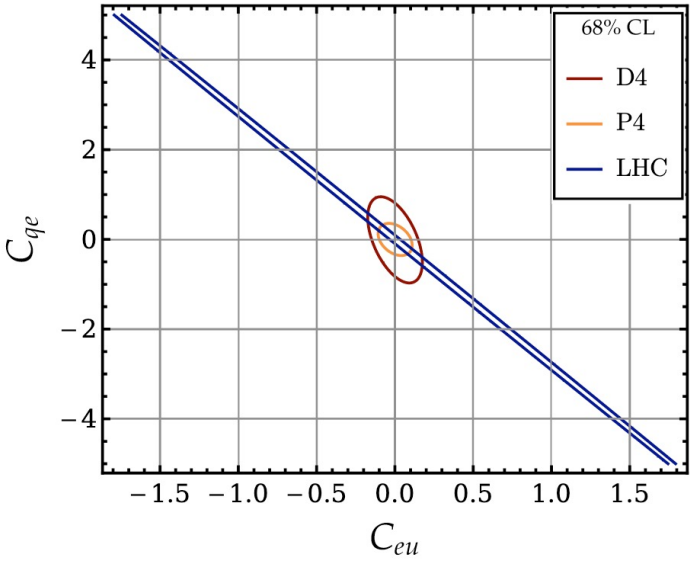
EW/BSM WG

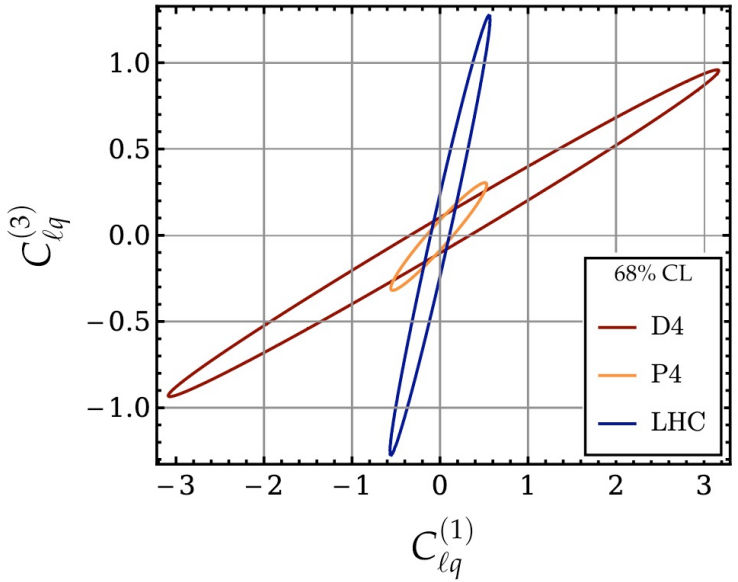
Update – SMEFTs

$$L = L_{SM} + \sum_i C_i O_i + \ldots\ldots$$

$\mathcal{O}_{\ell q}^{(1)}$	$(\bar{\ell}\gamma^\mu \ell)(\bar{q}\gamma_\mu q)$	$\mathcal{O}_{\ell u}$	$(\bar{\ell}\gamma^\mu \ell)(\bar{u}\gamma_\mu u)$
$\mathcal{O}_{\ell q}^{(3)}$	$(\bar{\ell}\gamma^\mu \tau^I \ell)(\bar{q}\gamma_\mu \tau^I q)$	$\mathcal{O}_{\ell d}$	$(\bar{\ell}\gamma^\mu \ell)(\bar{d}\gamma_\mu d)$
$\mathcal{O}_{eu}$	$(\bar{e}\gamma^\mu e)(\bar{u}\gamma_\mu u)$	$\mathcal{O}_{qe}$	$(\bar{q}\gamma^\mu q)(\bar{e}\gamma_\mu e)$
$\mathcal{O}_{ed}$	$(\bar{e}\gamma^\mu e)(\bar{d}\gamma_\mu d)$		

- with the projected data on PVDIS asymmetries:
  P4: ep 10x275 GeV 100 fb^{-1}; D4: eD 10x137 GeV 100 fb^{-1}





Radja Boughezal, Frank Petriello, Daniel Wiegand https://arxiv.org/abs/2004.00748

"Removing flat directions in SMEFT fits: how polarized electron-ion collider data can complement the LHC"

Conclusions/Outlook

- Analysis Notes nearly done with the review process → Likely further edits needed after proposal comments and reviews
- Discussion on methodology for releasing some (all?) notes once review process is complete is needed
- Many thanks to all our WG conveners for this process!
- Simulation requests are essentially done until we have ”homework”
- First priority is ensuring proposal plots are in the shape that they need to be

Back-Up

Reminder: Top Physics Priorities

Inclusive
- F2A @ low-x [Saturation, nuclei]
- A1p vs. x [Spin & Flavor, nucleon]
- A1n vs. x [Spin & Flavor, nucleon]
- Twist-3 gTq vs. x [Spin & Flavor]

SIDIS
- Quark Sivers function [Momentum imaging, nucleon]
- Sea quark helicities via SIDIS A1 A_{LL} measurements [Spin & Flavor, nucleon]

Electroweak and BSM
- Parity violating asymmetries
- Charged Lepton Flavor Violation

Heavy Flavors and Jets
- In medium correction for heavy flavor [Hadronization, nuclei]
- Di-hadron correlations [Saturation, nuclei]

Exclusive
- DVCS ep [Position Imaging, nucleon]
- DVCS eA [Position Imaging, nuclei]
- J/ψ production in ep [Position Imaging, nucleon]

Diffractive & Tagging
- A1n from double tagged ^{3}He [Spin & Flavor]
- Diffractive meson (J/ψ) production [Saturation]
- Pion structure [Mass]
- Kaon FF [Mass]