Input from the Exclusive, Diffractive and Tagging PWG

Analysis TDR Kick-Off Meeting

Raphael Dupré and Rachel Montgomery

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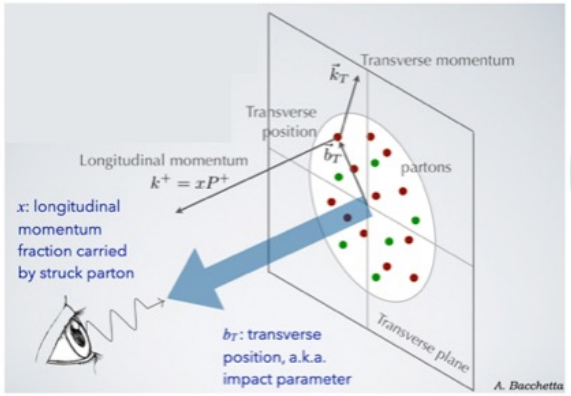
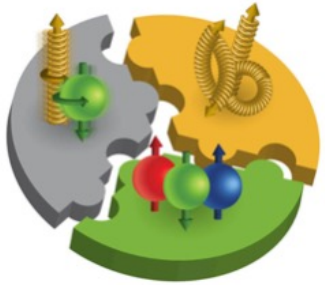
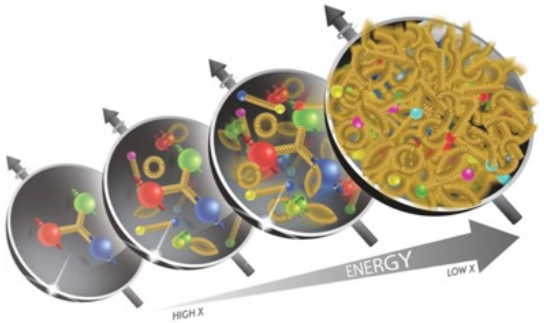
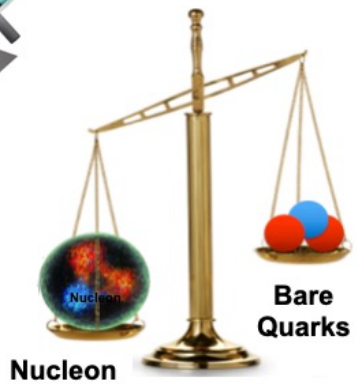
Scope of the Group









- Group encompasses ***numerous*** different reactions
  - Many previous, current, and future studies
  - Many different physics topics

- Our group can contribute to all 3 NAS questions based on material published in detector proposals:
  - How does the mass of the nucleon arise?
  - How does the spin of the nucleon arise?
  - What are the emergent properties of dense systems of gluons?

- Open/welcoming to any science beyond this and to extending the scope to more topics…!

Some Example Topics from Previous Detector Proposals

- Nucleon Mass
  - Heavy quark threshold production (eg Υ or J/Ψ), meson structure studies
- Nucleon spin and tomography
  - Double spectator proton far forward tagging in e^3He for neutron A_1^n
  - Orbital Angular Momentum via GPD topics and hard exclusive reactions eg DVCS/TCS/DVMP
  - 3D structure of nucleons and nuclei - quark and gluon tomography - via hard exclusive reactions
- Dense systems of gluons
  - Measurements of heavy nuclei in kinematics relevant for parton saturation studies and gluon structure of nuclei (eg density profiles) - diffractive vector meson production
- Beyond NAS Report
  - XYZ Spectroscopy - spectroscopy of mesons with charm quarks
  - U-channel DVCS and DVMP (π^0)

Roadmap

- We need to review past and existing efforts
  - We started the discussion at the Argonne coll. meeting workfest
  - Reviewed previously studied channels and plots

- Update a current list of topics and associated people
  - Produced a list of topics for TDR and contact people for those topics
  - n.b. some contact people still to be confirmed and some to be identified
  - All topics are still open for anyone else interested to join the efforts on any topic !

- We will need to prioritize some of the effort
  - Some topics are needed in the TDR to address the NAS questions
  - Some processes important to illustrate the detector performances

- We really want to push analysis beyond the level of previous documents
  - It is important to advance toward more realistic analyses
  - Allow to better understand the critical detector properties for a given physics analysis

Process list for the TDR and beyond (live table)

If you are interested or can help in **ANY** topic please get in touch

Process	Previous simulation	Generator(s)	Needed figures/tasks	Detectors needed now	Interested parties (currently)
DVCS (e+p)	ECCE full ATHENA full	MILOU ECCE EpIC ATHENA	t-distributions, gamma/pi0 separation	ePIC main detector; Roman pots, B0 tracker	Oliver Jevons
DVCS on neutron with tagging	Not previously done	TOPEG (need upgrade)	t-distributions, gamma/pi0 separation	ePIC main detector; Roman pots, OMD, B0 tracker	Raphael Dupré
Timelike Compton scattering	ATHENA full ECCE full	EpIC	TSSA (A_UT)	Low-Q2 tagger + RP + ePIC main	Kayleigh Gates
U-channel DVCS/DVMP (pi0, rho, omega, etc.)	Not previously done	eSTARLIGHT	Differential cross section; missing mass	B0 + ZDC	Zach Sweger
DVMP of Pi0 on p	Not previously done	EpIC	Overlap with DVCS	ePIC main detector; Roman pots, B0 tracker	Hao Jiang
DVCS on He4	ECCE full	TOPEG	Differential cross section	RP	Gary Penman, Rachel Montgomery
Coherent VMP on light nuclei	Not previously done	?	t-distribution	ePIC main detector; RP	Whitney Armstrong, Sangbaek Lee
J/Psi & Phi production (Au)	ATHENA full ECCE full	BeAGLE and SARTRE	t-distribution	ePIC main; full FF	Kong Tu (Phi), Peter Steinberg (J/psi)
J/Psi DVMP (proton)	ECCE full ATHENA?	LAGER	t-distributions in x_v bins	Main detector; full FF	Nathaly Santiesteban
Heavy quark threshold production	ATHENA	LAGER			Sylvester Joosten
Upsilon production (3 state separation)	ATHENA full CORE??	eSTARLIGHT RAPGAP for e+p	t-distributions; mass resolution for states	ePIC main	Mingjung Kim, Saeahram Yoo
XYZ Spectroscopy	ECCE full	eLSPeCTRo	Invariant mass distributions	Low-Q2 tagger + ePIC main + full FF	Derek Glazier, Peter Hurck
Pion Form factor/Kaon Form factor	ECCE	DEMPgen	Cross section, form factor as function of Q2; Lambda/Sigma reco.	ePIC main; ZDC & B0 tracker/EMCAL primarily	Garth Huber, Stephen Kay, Love Preet
Tagged DIS (deuteron)	Yellow report full (far-forward)	BeAGLE	Tagged cross section	B0 + OMD	Alex Jentsch
Tagged DIS (He3)	Yellow report full (far-forward); ECCE hybrid (real acceptance; fast reco)	CLASDIS	Tagged cross section; spin asymmetry	RP + OMD	Tyler Hague, Dien (TBD)
Sullivan Process meson SF	ECCE full	R Trotta's EIC Event Gen	Cross section, t distribution, impact on PDF uncertainty	ePIC main, FF entire	Tyler Hague, Richard Trotta, Rachel Montgomery
Diffractive Structure functions (slightly longer term)		SARTRE? RAPGAP?			Marta Ruspa, Thomas Ullrich, Tobias Toll, Anna Stasto
Elastic e+p					Barak Schmookler? Douglas Higinbotham
A process which leverages muon reconstruction					

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These names are not exclusive/final
This is a live table created during discussion
Any one is more than welcome to join any topic – get in touch

Process list for the TDR and beyond (live table)

- Several analyses are active and reporting progress, eg:
  - DVCS ep; DVCS eHe; u-channel meson production; coherent and incoherent VMP on eA; meson form factors
- Several other analyses we are aware have started recently or could be underway soon/quickly to be on track, e.g.
  - DVMP π^0 (ep); DVMP J/Ψ (ep); Meson SF; TCS; XYZ spectroscopy
- For the other channels, our next step is to discuss further with the contact people to understand timelines
- Analyses with strong possibility that they would not be ready in time for TDR (others may appear here after discussions)
  - Diffractive SF
- Many reactions already have generators and/or generated files in place
  - For entries with question marks or no generators we need to discuss with contact people/other experts
  - We need to finalise on the different configurations for different reactions
  - We need to coordinate with production team on the monthly sets
- *We need to discuss further with the contact people and the working group*

Prioritizing the topics for the TDR

- Answering the NAS questions
  - ϒ channels, J/Ψ near threshold and meson SF to understand the mass of the nucleon
  - DVCS measurements to access the spin of the nucleon
  - Diffractive process to probe the dense system of gluons

- Some channels are key to check on detector performances
  - Nuclear breakup photons in the ZDC
  - Backward ρ^0 and ω for the B0
  - Differentiate π^0 and ɣ in EM calorimeters
  - Differentiating ϒ states checks tracking precision
  - …

- Some of these could be included in the detector parts
  - Developing every analysis would take a lot of space
  - They are the eventual goal of the detectors

Aiming for more …

- We would like to go beyond what was done in YR and proposals

- e.g. Relating the DVCS measurements to the spin of the nucleon
  - Necessitate to measure the right processes (transverse target asymmetry, and neutron DVCS)
  - Make sure we can separate or subtract properly π^0 contamination
  - Include several channels in our final figure

- We need to include backgrounds and resolution
  - Right now, it makes some of the diffractive channels challenging
  - We are still thinking on what channel should be put forward for saturation physics

Conclusion

- We already made progress at the collaboration meeting
  - We have a roadmap that is tight but clear
  - We have a large group of people identified for our channels
- We still need to clarify priorities
  - Important to orient the work force toward these priorities
  - Discuss with the working group, likely will get many who want to get in the TDR 50p
  - Looking to figure out where to place detector related figures
- We need to get the work going !