Physics activities and 2025 budget requests

Salvatore Fazio

Università della Calabria & INFN Cosenza

ePIC Italia meeting with the referees

Bologna - July 16st , 2024

UNIVERSITÀ DELLA CALABRIA

Dipartimento di FISICA

INFN Gruppo Collegato di Cosenza

Istituto Nazionale di Fisica Nucleare

Structure of Physics Working Groups

- **INFN has one of the two Analysis Coordinators (ACs)**
  - **8k€ requested (CS) to support AC's travel:**
    - ePIC Collab Meetings (summer + winter)
    - TDR preparation meetings + networking meetings

ANALYSIS COORDINATORS
Salvatore Fazio (Cosenza)
Rosi Reed (Lehigh)

INCLUSIVE PHYSICS
Tyler Kutz (MIT)
Claire Gwenlan (Oxford)

Meeting time: Mondays (biweekly) at 12pm ET
Mailing list: eic-projdet-Inclusive-l@lists.bnl.gov
Indico: https://indico.bnl.gov/category/417/

SEMI-INCLUSIVE PHYSICS
Charlotte Van Hulse (Alcala)
Stefan Diehl (UConn)

Meeting time: Tuesdays (biweekly) at 8:30am ET
Mailing list: eic-projdet-semiincl-l@lists.bnl.gov
Indico: https://indico.bnl.gov/category/418/

JETS AND HEAVY FLAVOR
Brian Page (BNL)
Olga Evdokimov (UIC)

Meeting time: Wednesdays (biweekly) at 12:00pm ET
Mailing list: eic-projdet-jethf-l@lists.bnl.gov
Indico: https://indico.bnl.gov/category/420/

EXCLUSIVE, DIFFRACTION AND TAGGING
Raphael Dupre (Orsay)
Rachel Montgomery (Glasgow)

Meeting time: Mondays (biweekly) at 12pm ET
Mailing list: eic-projdet-excldiff-l@lists.bnl.gov
Indico: https://indico.bnl.gov/category/419/

INFN people's involvement

BSM AND PRECISION EW
Ciprian Gal (JLab)
Michael Nycz (Virginia)

Meeting time: Tuesdays (biweekly) at 8:30am ET (together with Inclusive PWG)
Mailing list: eic-projdet-semiincl-l@lists.bnl.gov
Indico: https://indico.bnl.gov/category/421/

Physics in TDR & companion paper

pre–TDR (60% design completion) ⟹ early 2025

TDR (90% design completion) ⟹ ~ early 2026

- (pre)TDR are a deliverable of the EIC Project (project manager acts as editor)
  - describe the accelerator + ePIC experiment
  - Chapter 8: (hundreds pages) focus on the ePIC Detector Description, basic performance, Software, and data preservation
  - Chapter 2: (~60 pager) focus on holistic detector performance, physics performance and science reach
    - Holistic detector performance → Technical Coordinator office acts as editor
    - Physics and science reach → Analysis Coordinators act as editors
    - We envision a **couple of performance plots per PWG**

ePIC Physics “White Paper”

Delivered by ~ (early?) 2026 aligned with the final TDR

- The Physics WP is a deliverable of the ePIC Collaboration
- To be published on a scientific peer-reviewed journal (such as PRC or similar)
  - **Extended description** of the physics performance and science reach at ePIC
    - Holistic detector performance → Technical Coordinator office acts as editor
    - Physics and science reach → Analysis Coordinators act as editors
  - Gives full details on physics studies and performance plots
  - Includes physics impact studies (extraction of physics, e.g. PDFs, GPDs, TMDs)
- Authorship regulated by ePIC membership and publication policies

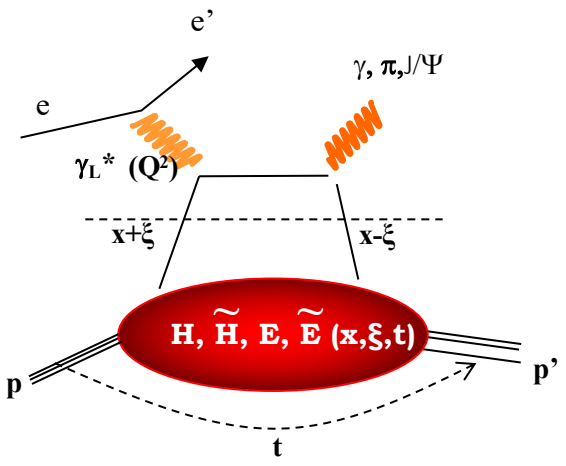
❖ Spin-off papers can also be published by individual study groups **(theorists included)**

How can we help?

- **Italy has some potential to exploit (and help with the TDR cause):**
  - Leading experience with TMDs and SIDIS (3D imaging in momentum space)
  - Leading experience with diffractive PDFs at HERA (onset of gluon saturation)
  - Leading experience with exclusive processes and GPDs (partonic spatial tomography)
  - High Performance Computing -> via OSC

- Opportunity for M.Sc. and Ph.D. students -> make plots out of reconstructed root trees
- Opportunity for experienced Ph.D.s and postdocs
  - Holistic detector performance
  - join efforts with reconstruction
  - impact studies for the enlarged physics paper

GPDs impact studies – exclusive+diff+tag PWG



- **INFN Institutes: Cosenza (S. Fazio) - Milestone y23**
- Longstanding experience with partonic imaging: ZEUS@HERA, STAR@RHIC
- Collaborators: BNL, Saclay, Warsaw, Mainz, Zagreb
- Aim at performing impact studies for GPDs, similarly to [E.C. Aschenauer, S.F., K. Kumericki et al. - JHEP09(2013)093], now with:
  - ePIC full simulation and realistic event reconstruction
  - state of art models (GK and KM20) and radiative effects

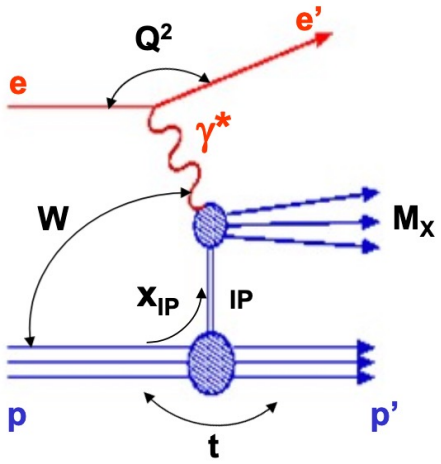
✓ INFN Milestone y23 [100%]: Use the novel E*p*IC generator [Eur. Phys. J. C 82 (2022) 9, 819] to produce DVCS, TCS and mesons physics benchmarks

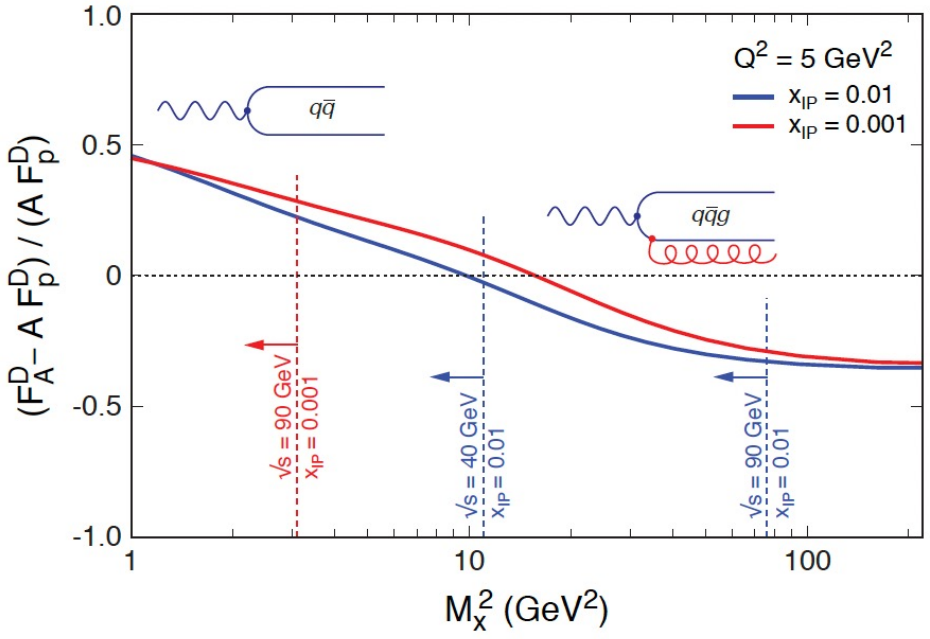
❑ Goals y24 [90%]: Extract GPDs by performing global NLO fits of various models in order to quantify the impact of ePIC in constraining CFFs and GPDs, from DVCS and TCS measurements -> paper in final editing stage

❑ Future Goal: Add mesons and explore the possibility of disentangling flavor contribution to GPDs

No budget requests specific for this activity

Diffractive PDFs - exclusive+diff+tag PWG

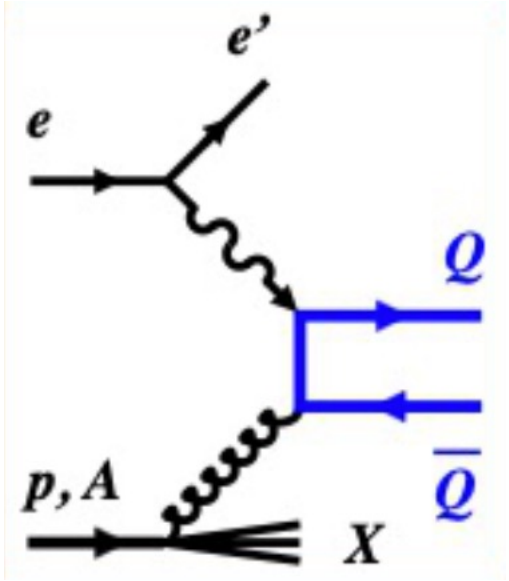




E.C. Aschenauer, S. F., J.H. Lee, *et al.* [*Rept.Prog.Phys.* 82 (2019) 2, 024301]

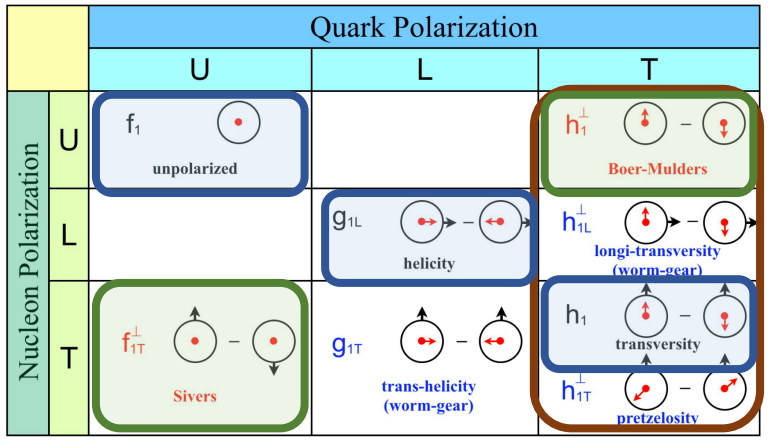
- **INFN Institutes: Torino (M. Ruspa), Cosenza (M. Capua, S. Fazio, H. Hashamipour, E. Tassi)**
- **Proton DPDFs not yet exploited for the EIC!**
  - good constrain on the gluon densities though scaling violation
- **A DPDF fit releasing the assumption or Regge factorization was never done**
  - though the HERA data might suggest a breaking.
- **PLAN: Evaluate ePIC's capability to:**
  - Investigate the transition into saturation regime **[Critical for the Collaboration!]**
  - Disentangle to which extent Regge factorization holds
- ❑ **1.5 k€ each, requested by TO and CS to support this activity**
  - hands-on work meetings between TO and early career collaborators at CS

Heavy Flavor Tagging – jets+HF PWG



- **INFN Institutes: Bari (S. Kumar, A. Mastropietro), Pavia (G. Boca)**
- **Secondary vertex ID not yet developed at ePIC!**
  - One of the four **reconstruction priorities** defined at the Warsaw Collab. meeting
- **PLAN:**
  - Quantify the impact for the tracker into heavy flavor physics
  - Develop secondary vertex reconstruction for heavy flavor tagging
- Activity in close cooperation with ePIC Software & Computing
- ❑ No budget requests to support this activity

TMDs - SIDIS PWG



TMDs surviving integration over k_T

Time-reversal odd TMDs describing **strength of spin-orbit correlations**

Chiral odd TMDs

- **INFN Institutes: Bologna (F. Bellini, L. Polizzi), Cosenza (S. Fazio, L. Occhiuto), Pavia (S. Costanza, N. Valle), Salerno (A. De Caro, C. Rivoli), Torino (M. Chiosso, D. Giordano, U. Tamponi), Trieste (A. Bressan)**
  - 6 Institutions, 12 people (of which 6 early career)
- **Close collaboration with theorists in PV (M. Radici's group)**
- **Close ties with the INFN's lead in the construction of the dRICH**
  - Aim at seeding an INFN leadership in the SIDIS
- **PLAN:**
  - investigate the need for PID in the different kinematic regions
  - quantify the impact of the acceptance on the extraction of TMDs

Proposed Milestone 2025

"Realizzazione di studi di performance dei PID detectors nella estrazione delle TMDs"

- **In-person meetings** planned, especially during the startup phase

❑ **€2000 requested by each group to support this activity [4 national trips for tutorial and hands on work]**

Summary

Involvement of INFN groups in physics and analysis at ePIC is rapidly growing

- **One analysis coordinator and several people involved with SIDIS, jets+HF and exclusive+diff+tag PWGs**
- **Milestone 2025: "Realizzazione di studi di performance dei PID detectors nella estrazione delle TMDs"**
- Budget requests for year 2025 are as follows:
  - CS: **8 k€ to support Analysis Coordinator's activity**
  - TO, CS: **1.5 k€ each, to support the new activity on diffractive-PDFs**
  - BO, CS, PV, SA, TO, TS: **2.0 k€ each, to support new y25 milestone on TMDs**
  - **TOTAL for physics and analysis: 21.5 k€**