

# First European School on the Physics of the Electron-Ion Collider



## Report of Contributions

Contribution ID: 1

Type: **not specified**

## **Welcome, overview of the EIC project and of the school program**

Overview of the school program

EIC Project:

- series of INT workshops at Seattle => EIC White Paper
- the EIC as a unique machine in the coming years
- NSAC recommendation, NAS report, DOE CD approvals
- the EIC timeline

**Presenters:** DESHPANDE, Abhay (Stony Brook University); ANTONIOLI, Pietro (Istituto Nazionale di Fisica Nucleare)

Contribution ID: 4

Type: **not specified**

# Collinear proton PDFs from past, present and future data

*Monday, 19 June 2023 08:30 (2 hours)*

**Presenter:** TASSI, Enrico (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Morning Lectures

Contribution ID: 5

Type: **not specified**

## **Theory of Transverse-momentum dependent distributions (TMD)**

*Monday, 19 June 2023 11:00 (2 hours)*

Recap of inclusive DIS, factorization and extraction of PDFs.

Evidence of non collinear motion of partons.

SIDIS: kinematics and definitions, factorization of cross section.

Classification of TMDs and their main features, evolution equations and CSS formalism.

**Presenter:** BACCHETTA, Alessandro (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Morning Lectures

Contribution ID: 6

Type: **not specified**

## **Theory of Transverse-momentum dependent distributions (TMD)**

*Monday, 19 June 2023 14:30 (1 hour)*

Gauge link and color-gauge invariance.

Universality of TMDs, naive T-odd TMDs and the problem of sign change.

**Presenter:** BACCHETTA, Alessandro (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Afternoon Lectures

Contribution ID: 7

Type: **not specified**

## Gluon TMDs

*Monday, 19 June 2023 15:30 (1 hour)*

Differences with quark TMDs.

Gauge link and (non)universality.

Best channels for extraction of gluon TMDs: heavy flavor production in SIDIS, factorization, LDME and Shape Functions.

**Presenter:** CELIBERTO, Francesco Giovanni (University of Pavia and INFN)

**Session Classification:** Afternoon Lectures

Contribution ID: 8

Type: **not specified**

## **The case for ions: the physics of nuclear PDF and hadronization studies**

*Monday, 19 June 2023 16:30 (1 hour)*

Definitions, observables ( $R_A$ ), EMC effect, anti-shadowing..

**Presenter:** Dr ZURITA, Pia (Regensburg University)

**Session Classification:** Afternoon Lectures

Contribution ID: 9

Type: **not specified**

## Facilities and Experiments for TMD studies

*Tuesday, 20 June 2023 08:30 (1 hour)*

Polarised beams and targets. Experiments with lepton beams (Hermes, Compass, JLab)

**Presenter:** DALLA TORRE, Silvia (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Morning Lectures



Contribution ID: **10**

Type: **not specified**

## **Overview of the physics case for the EIC**

*Tuesday, 20 June 2023 11:00 (2 hours)*

Potential impact of the EIC on the panorama of results described in previous lectures.  
If time permits, some hints on the accelerator.

**Presenter:** DESHPANDE, Abhay (Stony Brook University)

**Session Classification:** Morning Lectures

Contribution ID: 11

Type: **not specified**

## **Cooking show: how to extract a TMD from a global fit**

*Tuesday, 20 June 2023 14:30 (2 hours)*

**Presenter:** CERUTTI, Matteo (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Afternoon Lectures

Contribution ID: 12

Type: **not specified**

## **The case for ions: the physics of nuclear PDF and hadronization studies**

*Tuesday, 20 June 2023 16:30 (1 hour)*

Overview of existing parametrizations for nuclear PDFs.  
Impact of the EIC on current uncertainties.

**Presenter:** ZURITA, Pia (Regensburg University)

**Session Classification:** Afternoon Lectures

Contribution ID: 13

Type: **not specified**

## **Introduction to Machine Learning techniques**

*Wednesday, 21 June 2023 08:30 (2 hours)*

**Presenter:** MINIELLO, Giorgia (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Morning Lectures

Contribution ID: 14

Type: **not specified**

## Overview on spectroscopy

*Wednesday, 21 June 2023 11:00 (2 hours)*

Overview of main results and current panorama.

Discussion of potential impact of the EIC and applications of Machine Learning techniques.

**Presenter:** D'ANGELO, Annalisa (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Morning Lectures

Contribution ID: 15

Type: **not specified**

## **Hands-on session on QCD DGLAP analyses for PDFs determination**

*Wednesday, 21 June 2023 14:00 (3 hours)*

Extraction of PDFs practicing xFitter framework

**Presenter:** TASSI, Enrico (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Afternoon Lectures

Contribution ID: 16

Type: **not specified**

## **The Italian contribution to the EIC**

**Presenter:** ANTONIOLI, Pietro (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Afternoon Lectures

Contribution ID: 17

Type: **not specified**

## Experimental results on TMD

*Thursday, 22 June 2023 08:30 (1 hour)*

**Presenter:** BRESSAN, Andrea (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Morning Lectures



Contribution ID: **18**

Type: **not specified**

## **The Italian contribution to the EIC**

*Thursday, 22 June 2023 09:30 (1 hour)*

**Presenter:** ANTONIOLI, Pietro (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Morning Lectures

Contribution ID: 19

Type: **not specified**

## Monte Carlo Event Generators for EIC

*Thursday, 22 June 2023 11:00 (2 hours)*

**Presenter:** BRESSAN, Andrea (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Morning Lectures

Contribution ID: 20

Type: **not specified**

# Introduction to Deep Inelastic Scattering

**Presenter:** TASSI, Enrico (Istituto Nazionale di Fisica Nucleare)

Contribution ID: 21

Type: **not specified**

## **Welcome, overview of the school program**

*Sunday, 18 June 2023 16:00 (15 minutes)*

**Presenter:** ANTONIOLI, Pietro (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Afternoon Lectures

Contribution ID: 22

Type: **not specified**

# Introduction to Deep Inelastic Scattering

*Sunday, 18 June 2023 17:00 (2 hours)*

**Presenter:** TASSI, Enrico (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Afternoon Lectures

Contribution ID: 23

Type: **not specified**

## **Combined session with the Summer meeting of the INFN's "EIC\_NET".**

*Thursday, 22 June 2023 14:30 (2 hours)*

**Session Classification:** Summer meeting of the INFN project EIC\_NET / Departures

Contribution ID: 24

Type: **not specified**

## Departures

**Session Classification:** Summer meeting of the INFN project EIC\_NET / Departures

Contribution ID: 25

Type: **not specified**

## **The Electron-Ion Collider: from an idea to reality**

*Sunday, 18 June 2023 16:15 (45 minutes)*

**Presenter:** DESHPANDE, Abhay (Stony Brook University)

**Session Classification:** Afternoon Lectures



Contribution ID: 31

Type: **Poster**

## Accessing linearly polarized and Sivers gluon TMD in back-to-back $D$ -Meson and jet production at the EIC

We study the azimuthal asymmetries in the lepton production of  $D$ -meson and jet to probe the gluon TMDs in electron and unpolarized-transversely polarized proton scattering at the EIC kinematics. We give predictions for unpolarized cross-sections within the TMD factorization framework. Furthermore, we also present estimates of the upper bound on the azimuthal asymmetry with the saturation of positivity bounds. Further, we evaluate the asymmetries using the Gaussian parametrization of TMDs.

**Primary authors:** PAWAR, AMOL (Indian Institute of technology Bombay); Prof. MUKHERJEE, Asmita (IIT Bombay); Dr SHAIKH, Khatiza (IIT Bombay); Dr RAJESH, Sangem (INFN, Perugia)

Contribution ID: 32

Type: **Poster**

## **Gluon Transverse Momentum Distributions in a spectator model**

We develop a light-front spectator model for a proton that incorporates the gluonic degree of freedom, where the active parton is a gluon, and the remaining is seen as a spin- $\frac{1}{2}$  spectator of an effective mass. The light front wave functions of the proton state are built using a soft wall AdS/QCD prediction and parameterized by fitting the gluon unpolarized parton distribution function to the NNPDF3.0nlo data set. Further we calculate the T-even gluon transverse momentum dependent parton distributions (TMDs) by using the overlap representation of the LFWFs.

**Primary author:** GURJAR, Bheemsehan (Indian Institute of Technology Kanpur)

Contribution ID: 33

Type: **Poster**

## AEROGEL CHARACTERIZATION FOR RICH APPLICATIONS

The interest into silica aerogel arises from the need to partially cover the refractive index gap between gases at high pressure and unmanageable liquified radiators, especially when used as radiator in RICH (Ring Imaging Cherenkov) detectors.

In this poster, the optical parameters of recently produced hydrophobic silica aerogel tiles with various refractive indices in the range 1.005 –1.05 will be presented. Each tile has been characterized at different positions in terms of transmittance, scattering, absorption and transmission lengths. Optical properties of two aerogel tiles produced in 2000 have also been investigated.

The results show how low refractive index aerogel exhibits higher transmittance and transmission length than the other tiles. The contribution of the absorption is also investigated and it is found to be negligible if compared to the Rayleigh scattering process.

**Primary author:** Ms ALTAMURA, Anna Rita (INFN - Bari)

Contribution ID: 34

Type: **not specified**

## **The next nucleon microscope: the ePIC detector at EIC**

*Tuesday, 20 June 2023 09:30 (1 hour)*

**Presenter:** DALLA TORRE, Silvia (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Morning Lectures

Contribution ID: 35

Type: **Poster**

## CHARACTERIZATION OF SiPM SENSORS FOR THE dRICH DETECTOR AT THE ePIC EXPERIMENT

We report on the characterization of different types of Silicon Photomultipliers (SiPMs). SiPMs can detect and resolve single photons. They are considered as the baseline technology of choice to equip the dual RICH detector (dRICH) at the ePIC experiment at the future Electron-Ion Collider. One of the downsides of SiPMs is the presence of a Dark Count Rate (DCR) caused by thermal electrons which also depends on the bias voltage applied to the sensor. Such an effect can be minimized by lowering the temperature of the sensors. We will show results from current-voltage (IV) and DCR scans at different temperatures (-20°C, -25°C, -30°C). These measurements are critical to understanding how best to “control” the DCR, maintaining an optimal dRICH detector performance over a long period of time and, in fact, making sure that the SiPMs are the best sensors to use.

**Primary author:** OCCHIUTO, Luisa Rosa Maria (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Poster by night

Contribution ID: 36

Type: **Poster**

## Studying gluon saturation effects in forward photon+jet production in proton-proton and proton-lead collisions

In this study, we employ the small- $x$  Improved Transverse Momentum Dependent (ITMD) factorization framework to investigate the gluon saturation in the production of photon+jet in pp and pPb collisions. The ITMD factorization framework is based on the Color Glass Condensate theory and is suitable for particle production at relatively large transverse momenta, still being sensitive to saturation effects. We analyze the transverse momentum distributions, azimuthal correlations, and other key observables at varying center-of-mass energies. The ITMD factorization framework implemented in the Monte Carlo tool KaTie serves as a powerful tool and the findings from this study contribute to our understanding of gluon saturation, shedding light on the fundamental aspects of Quantum Chromodynamics (QCD) at high energies.

**Primary author:** GANGULI, Ishita (AGH University of Science and Technology)

**Co-authors:** Dr VAN HAMEREN, Andreas (Institute of Nuclear Physics of the Polish Academy of Sciences); Prof. KUTAK, Krzysztof (Institute of Nuclear Physics of the Polish Academy of Sciences); Dr KOTKO, Piotr (AGH University of Science and Technology)

Contribution ID: 37

Type: **Poster**

## **RIVET developments in ALICE**

RIVET developments in ALICE

**Primary author:** GIACALONE, Marco (Istituto Nazionale di Fisica Nucleare)

Contribution ID: 39

Type: **not specified**

## **Gluon Transverse Momentum Distributions in a spectator model**

*Tuesday, 20 June 2023 21:15 (1 minute)*

**Presenter:** GUJAR, Bheemsehan

**Session Classification:** Poster by night



Contribution ID: 40

Type: **not specified**

## **Azimuthal asymmetries in D-meson and jet production at the EIC**

*Tuesday, 20 June 2023 21:16 (1 minute)*

**Presenter:** PAWAR, Amol

**Session Classification:** Poster by night

Contribution ID: 41

Type: **not specified**

## Rivet developments in ALICE

*Tuesday, 20 June 2023 21:17 (1 minute)*

**Presenter:** GIACALONE, Marco (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Poster by night

Contribution ID: 42

Type: **not specified**

## **Characterization of the electronics read-out for the SiPM photon detection system of the dRICH**

*Tuesday, 20 June 2023 21:18 (1 minute)*

**Presenter:** SULLUCHUCO HUAMAN, Daniel Morris (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Poster by night

Contribution ID: 43

Type: **not specified**

## **Measurement of antiproton production cross sections for dark matter search @AMBER (CERN)**

*Tuesday, 20 June 2023 21:19 (1 minute)*

**Presenter:** GIORDANO, Davide (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Poster by night

Contribution ID: 44

Type: **not specified**

## **$\Lambda_c$ production in pp collisions at $\sqrt{s} = 13\text{TeV}$ with ALICE at the LHC**

*Tuesday, 20 June 2023 21:20 (1 minute)*

**Presenter:** DELLO STRITTO, Luigi (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Poster by night

Contribution ID: 45

Type: **not specified**

## High Rate Picosecond Photon Detector for EIC/ePIC

*Tuesday, 20 June 2023 21:21 (1 minute)*

**Presenter:** BHATTACHARYA, Deb Sankar (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Poster by night

Contribution ID: 46

Type: **not specified**

## **SiPM response to radiation damage and annealing treatment for the EIC dual-radiator RICH**

*Tuesday, 20 June 2023 21:22 (1 minute)*

**Presenter:** RUBINI, Nicola (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Poster by night

Contribution ID: 47

Type: **not specified**

## **Exploring light flavor particle production as a function of event shape classifiers in small systems with ALICE at the LHC**

*Tuesday, 20 June 2023 21:23 (1 minute)*

**Presenter:** RATH, Rutuparna (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Poster by night