

Target fragmentation and diffraction physics with novel processes: Ultrapерipheral, electron-ion, and hadron collisions

Online Workshop, Center for Frontiers in Nuclear Science CFNS, Stony Brook University, Feb 9-11, 2022

[\[Webpage\]](#)

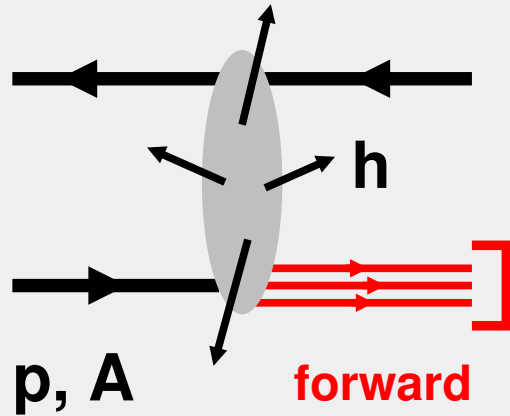
Abhay Deshpande (Stony Brook & BNL), Michael Murray (U. Kansas), Marta Ruspa (INFN Torino & Piemonte Orientale U.), Mark Strikman (Penn State U.), Christian Weiss (JLab), Organizers



- **Welcome**
- **Topic and objectives**
- **Plan of meeting**



Follows 2020 CFNS Workshop
“Target fragmentation physics with EIC”
[\[Webpage\]](#)



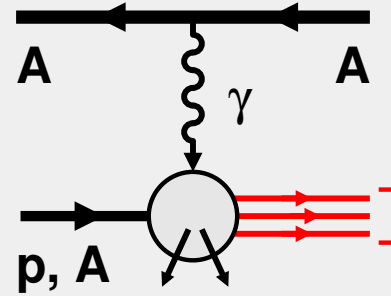
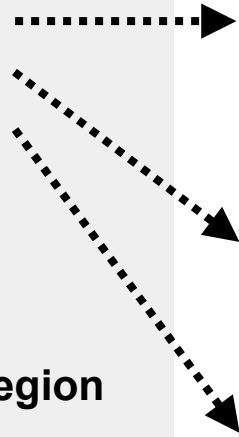
Hadron production in “target” rapidity region

Collider: Forward hadrons close to beam rapidity
 Fixed-target: Slow hadrons in target rest frame

Physics interest: Structure of target, configurations in high-energy process, correlation with central event

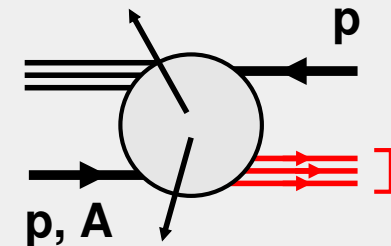
Measured in: Soft or hard processes, inclusive or diffractive events (rapidity gap)

Wide range of physics applications!



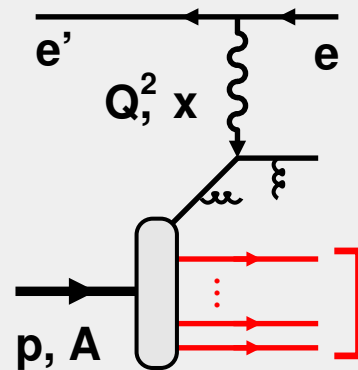
Ultraperipheral AA collisions

LHC, RHIC: High-energy photoproduction
 Hard processes: Jets, heavy flavors
 Diffraction, target fragmentation?



Hadronic pp/pA collisions

LHC, RHIC, Tevatron, ISR, fixed-target
 Hard processes: Jets, heavy flavors
 Forward hadron production



Electron-ion ep/eA collisions

HERA, EIC, COMPASS, JLab12, older fixed-target experiments

DIS: x, Q^2 from electron

Target fragmentation and diffraction in DIS:
 Factorization, fracture functions, diff PDFs

- Review physics of target fragmentation and diffraction in $pp/pA, \gamma p/\gamma A, ep/eA$ at various energies
- Discuss complementarity/synergies between different experiments: Energy, type of probe, final states
- Explore new physics applications of UPCs
- Formulate program for DIS target fragmentation studies at EIC and JLab12: QCD factorization, hadron structure, dynamics
- Discuss nuclear breakup in high-energy processes: Dynamics, models, testing/tuning of simulation tools with UPC data

Wednesday 09 Feb: Ultraperipheral collisions and diffraction

Vector meson production heavy/light, HERA, LHC; theory of diffraction, fluctuations, photon structure; jets in UPC; UPC and forward neutrons

R. McNulty, A. Bruni, S. Klein, B. Schenke, A. Stasto, M. Murray, B. Cole + Discussion

Thursday 10 Feb: Ultraperipheral and pp/pA collisions, forward detectors, DIS target fragmentation

Target fragmentation with UPC and hadronic collisions, ZDC and forward spectrometer plans, leading protons/neutrons in pA. Target fragmentation in DIS, QCD factorization, fracture functions, Soft-Collinear Effective Theory

M. Strikman, P. Tribedy, Q. Wang, Ch. Oppedisano, M. Albrow, C. Weiss, H. Avakian, T. Rogers, Y.-T. Chien + Discussion

Friday 11 Feb: Fragmentation in pA collisions, nuclear breakup in high-energy processes

Fragmentation models, diffractive scattering on nuclei, neutron production, nuclear breakup models, FLUKA, radioactive isotopes at EIC

A. Dumitru, Zh. Tu, A. Larionov, A. Ferrari, B. Schmookler + Discussion

- We will have extensive discussions — after the presentations and in the discussion sessions. Everyone should participate. Speakers of the day should be available for questions. Please suggest topics/questions for discussion!
- We are coming together as researchers from different communities. Do not hesitate to ask basic questions or request explanations. Almost no one is an expert in “target fragmentation”...

Workshop: Wednesday Feb 9

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WEDNESDAY, 9 FEBRUARY

9:00 AM → 9:20 AM **Welcome / Plan of workshop** ⌚ 20m

 cfn22_target_frag...

9:20 AM → 9:50 AM **J/psi production in UPC at LHC** ⌚ 30m

Speaker: Ronan McNulty (University College Dublin (IE))

 jpsi_in_upc.pdf

9:50 AM → 10:20 AM **Diffraction J/psi production at HERA** ⌚ 30m

Speaker: Alessia Bruni (INFN, Bologna (IT))

10:20 AM → 10:50 AM **Rho production in UPC** ⌚ 30m

Speaker: Spencer Klein (LBNL)

10:50 AM → 11:20 AM **Discussion: Diffractive vector meson production in UPC** ⌚ 30m

11:20 AM → 11:30 AM **Break** ⌚ 10m

11:30 AM → 12:00 PM **Diffractive vector meson production and saturation** ⌚ 30m

Speaker: Dr Bjoern Schenke (BNL)

12:00 PM → 12:30 PM **Rapidity gaps in high-energy photoproduction** ⌚ 30m

Speaker: Anna Stasto (Penn State University)

 anna_stasto_rapidi...

12:30 PM → 1:00 PM **Photon structure and energy dependence of diffraction** ⌚ 30m

Speaker: Vadim Guzey (Petersburg Nuclear Physics Institute)

 guzey_sb2022_pho...

1:00 PM → 1:30 PM **Discussion: Diffractive high-energy scattering - QCD description, fluctuations, soft-hard transition** ⌚ 30m

1:30 PM → 2:00 PM **Break** ⌚ 30m

2:00 PM → 2:30 PM **Jets in UPC** ⌚ 30m

Speaker: Vadim Guzey (Petersburg Nuclear Physics Institute)

 guzey_sb2022_jets...

2:30 PM → 2:50 PM **Rapidity gap events in UPC** ⌚ 20m

Speaker: Michael Murray (The University of Kansas (US))

2:50 PM → 3:20 PM **Ultraperipheral collisions and forward neutrons** ⌚ 30m

Speaker: Brian Cole (Columbia University)

3:20 PM → 4:30 PM **Discussion: Diffraction and fragmentation physics with UPC** ⌚ 1h 10m

Hadron production in UPC and pp/pA collisions

Fragmentation studies, baryon asymmetry in UPC, forward baryons in pp/pA, ZDC and forward spectrometer plans

9:00 AM → 9:10 AM **Introduction to topics**

Speaker: Organizers

9:10 AM → 9:40 AM **Fragmentation studies in UPC and pp/pA**

Speaker: Mark Strikman (Penn State University)

9:40 AM → 10:10 AM **Baryon asymmetry in inclusive gamma-A interactions at RHIC**

Speaker: Prithwish Tribedy (BNL)

10:10 AM → 10:40 AM **ZDC capabilities and upgrade plans at CMS and ATLAS**

Speaker: Quan Wang (University of Kansas)

10:40 AM → 10:50 AM

Break

10:50 AM → 11:20 AM **Leading protons and neutrons in pA at ALICE**

Speaker: Chiara Oppedisano (INFN Torino & Cagliari U.)

11:20 AM → 11:50 AM **Forward hadron spectrometer ideas for LHC**

Speaker: Michael Albrow (FNAL)

11:50 AM → 12:20 PM **Discussion: Forward instrumentation / Fragmentation physics in UPC and pp/pA**

12:20 PM → 12:50 PM

Break

Target fragmentation in DIS

Existing data and lessons, JLab12 and beyond, EIC, QCD factorization, SCET

12:50 PM → 1:20 PM **Review of DIS target fragmentation data**

Speaker: Christian Weiss (Jefferson Lab)

1:20 PM → 1:50 PM **Target fragmentation in eN at JLab12 and beyond**

Speaker: Harut Avagyan (Jefferson Lab)

1:50 PM → 2:10 PM **Discussion: Target fragmentation in DIS**

2:10 PM → 2:20 PM

Break

2:20 PM → 2:50 PM **QCD factorization in target fragmentation**

Speaker: Ted Rogers (Old Dominion University/Jefferson Lab)

2:50 PM → 3:20 PM **Soft-Collinear Effective Theory and target fragmentation**

Speaker: Dr Yang-Ting Chien (Georgia State University)

3:20 PM → 4:40 PM **Discussion: Target fragmentation physics in DIS and pp/pA**