Forward physics and QCD with LHC, EIC, and cosmic rays

Jefferson Lab (online), 20-23 Jan 2021, https://indico.cern.ch/event/947406/

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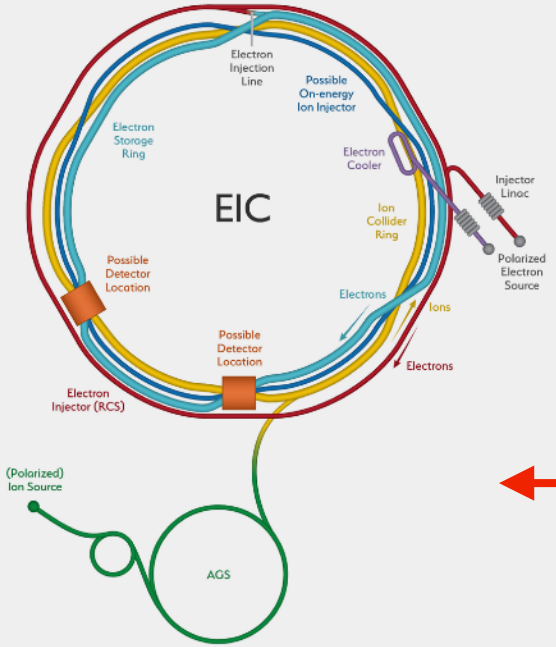
- Welcome
- Physics at forward rapidities
- Plan of workshop

Jefferson Lab

KU THE UNIVERSITY OF KANSAS

Earlier meetings: Nagoya, Japan (2015, 2017), Stony Brook (2018), Guanajuato, Mexico (2019)

Strong interaction physics with high-energy probes



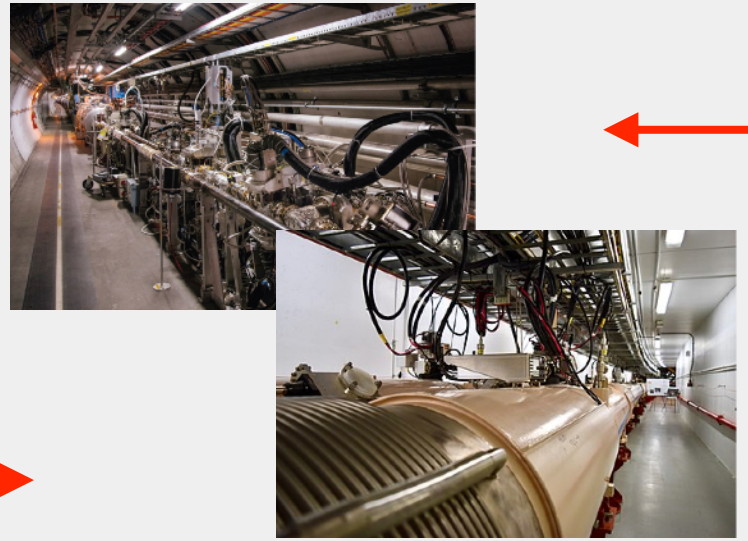
Electron-Ion Collider

US DOE Project, CD0 2019,
CD1 exp. 2021, oper. exp. 2030

ep(pol), eA(light, pol), eA(heavy)
CM energy $s^{1/2}$ = 20-100(140) GeV
Luminosity ~10^{33}-10^{34} cm^{-2} s^{-1}

(HERA: 1992-2007, ep)

Fixed-target: JLab12, COMPASS



Hadron Colliders

LHC: Since 2010, pp/AA/pA
ATLAS, CMS, LHCb, ALICE,
TOTEM, LHCf, MoEDAL, FASER

RHIC: Since 2000, pp(pol)/AA/dA
STAR, PHENIX, PHOBOS,
BRAHMS, PP2PP, sPHENIX

(Tevatron: 1987-2011, pbar-p)

Cosmic Rays

Primary p, A, e
Energy spectrum ~1-10^{11} GeV
Air shower in atmosphere

Detection: Ground based,
satellite, balloon-borne,
many experiments

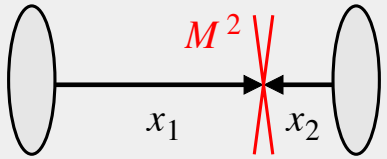
Connections: Physics, detectors, simulation tools

Forward physics: Processes and phenomena

Small x in hard processes

Hard processes in pp with $x_2 << x_1$

High gluon densities, non-linear phenomena, black-disk limit

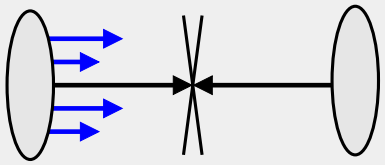


Hard-soft correlations

Soft interactions — hard process

Transverse geometry, centrality

Nucleon fragmentation

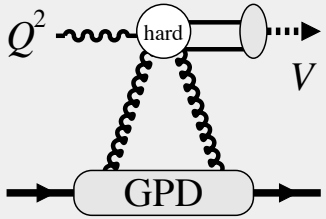


Diffractive and exclusive scattering

pp elastic scattering

Soft and hard diffraction, quantum fluctuations of interaction strength

Exclusive hard processes in ep/γp, generalized parton distributions

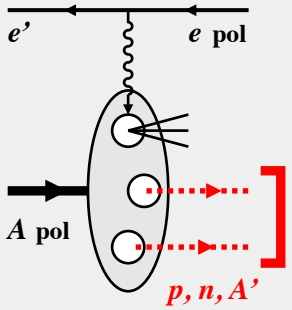


Nuclear breakup and coherent scattering

Spectator nucleon tagging p, n

Nuclear fragmentation, final-state interactions

Coherent nuclear processes A - A'

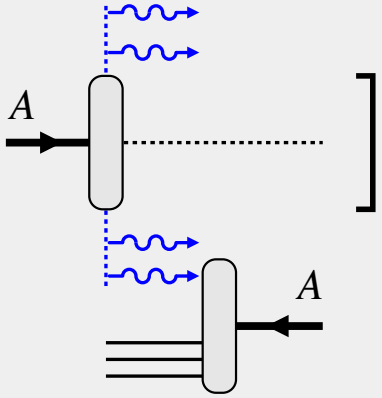


Ultraperipheral pA/AA collisions

Reactions induced by Weizsäcker-Williams photons

Events identified by intact nucleus (breakup veto)

Highest available energies in electromagnetic processes



Forward physics: Workshop agenda

Forward physics in pA and eA
Wed

LHC experimental results
Forward processes in pA and eA
Saturation dynamics, black-disk limit
Complementarity and synergies pA — eA?
Sievert, Massacrier, Murray, Kutak, Strikman + Discussion

Photoinduced reactions γp/γA
Wed

Ultraperipheral collisions pA/AA
Photoproduction at EIC
Complementarity and synergies γA — pA, eA?
Baldenegro Barrera, Tapia Takaki, Gil da Silveira, Stevens + Discussion

Cosmic ray physics
Thu

Experimental data, muon puzzle
pO run at LHC, impact of collider data
Joint physics studies, simulation tool development?
Sako, Dembinski, Pierog + Discussion

Nuclear coherent processes and breakup
Thu

Physics with spectator nucleon tagging p, n
Coherent nuclear scattering, nuclear shadowing
EIC forward detector for p, n, A'
Scopetta, Guzey, Jentsch + Discussion

Diffractive processes in pp/ep/γp
Fri

Experimental results LHC, RHIC, Tevatron
Odderon exchange
Exclusive vector meson production
Cerci, Mulilo, Guryn, Royon + Discussion

Small-x dynamics in hard processes
Fri

TMDs at small x, GPDs in vector meson production
Saturation dynamics, EFT approaches
Hentschinski, Celiberto, Vaidya, H. Liu + Discussion

Forward detector concepts and technologies
Sat

FOCAL, AFP, PPS, timing detectors, forward hadron spectrometer, FASER
Lessons for EIC?
Loizides, J. Liu, Williams, Isidori, Albrow, Kling

Forward physics: Format

- Topics covered by presentations and discussion sessions
- Discussion sessions are essential part
  - Everyone should participate!
  - Speakers should suggest specific points/questions for discussion
  - Survey conducted to collect topics/requests for discussion
- Keep discourse as informal as possible
- Participants from different communities… do not hesitate to ask basic questions!