

'EIC Yellow Report' kick-off meeting Physics/detector working group



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Introduction

- The EIC covers a wide range of physics topics !
As described in EIC White Paper and NAS report, plus additions
- The goal is to provide input for detector design
- Physics topics → processes → detector requirements
- These slides are intended to start the discussion
- We anticipate further input from the SC, conveners of detector/physics WG, sub-conveners, this meeting, and the community

Physics/detector WG - parallel session

Thu 2:00pm — 3:45pm: gathering input from participants!
physics topics, processes / measurements,
detector requirements,
sub-conveners

3:45pm — 4:45pm: session for Physics-WG conveners
summarize input/discussion to present it at the plenary session

Physics/detector WG - organization

- Composed of multiple sub-groups led by sub-conveners (experts)
- Organized by physics topics or processes
as mentioned in EIC White Paper and NAS report + additions
- We assume several sub-conveners per group

1. **Global properties and parton structure of hadrons**
 - a. **Spin structure of proton & neutron** (spin sum rule, helicity distributions, transversity)
 - b. **Mass of the nucleon** and mesons
 - c. Multi-parton correlations (structure function g_2)
 - d. (Inclusive) diffraction

2. **Multi-dimensional imaging of hadrons**
 - a. **GPDs and 3D-imaging** (includes also J_i 's sum rule, pressure and shear distributions)
 - b. **TMDs and 3D-imaging**
 - c. Wigner functions (includes, in particular, orbital angular momentum)
 - d. Form factors and 2D-imaging in position space

3. The Nucleus: A Laboratory for QCD

- a. High parton densities and Saturation
- b. Diffraction
- c. Particle propagation through matter, energy loss
- d. Collective effects (shadowing, anti-shadowing, ridge effect, other emergent phenomena)
- e. Special opportunities with jets and heavy quarks
- f. Short-range correlations, origin of nuclear force
- g. Structure of light (polarized) nuclei

4. Understanding hadronization

- a. Hadronization in the nuclear environment
- b. Hadronization in the vacuum
- c. Particle production for identified hadron species
- d. Production mechanism for quarkonia and exotic states
- e. Spectroscopy

5. Connections with other fields

- a. Electro-weak physics (e.g. scale dependence of Weinberg angle)
- b. Neutrino physics
- c. Cosmic-ray / astroparticle physics
- d. BSM physics (e.g. lepton flavor violation)
- e. Other connections to pp/pA/AA
- f. Lattice QCD

Physics topics linked to processes & measurements

White Paper & NAS measurements

Processes → ↓ Topics	Inclusive	Semi-Inclusive	Jets, Heavy Flavor	Exclusive, Diffractive, Forward Tagging
Global properties and parton structure	Incl. SF	h, hh	j, Q	Incl. diffr., <i>excl.</i> $J/\psi, Y$, tagged DIS on pol. D/He
Imaging		h	$j, jj, j+h, Q+Q\bar{q},$ [$QQ\bar{q}$]	<i>Excl-DIS: DVCS, DVMP</i> ($J/\psi, Y, \rho^0, \phi, \pi^+, K, \rho^+,$ $K^* \dots$), Elastic scattering
Nucleus	Incl. SF	h, hh	$j, jj, Q, [QQ\bar{q}]$	<i>Diffr. SF, coh. & incoh.</i> <i>VM, jj, h, hh</i> D/He FF, nucl. fragments
Hadronization		$h, hh, j+h$	j, Q	
Other fields		CC DIS, γ -A total X- sec		γ -A diffr. X-sec γ -A elast. X-sec

Processes & detector requirements

Different science sub-groups may have similar detector requirements, e.g.

- (Semi-) Inclusive DIS:

PID up to high p_T , tracking, wide rapidity coverage (dihadron and dijet)
(x, Q^2, y) determination and resolutions, e-calorimetry (forward-e, barrel & forward-h) and h-calorimetry (barrel & forward-h)

- Jets and Heavy Flavors:

Vertex requirements & resolutions, barrel calorimetry, h-calorimetry, tracking to low p_T , PID

- Forward Tagging (deep exclusive, diffractive, tagging):

Centrality resolution, ZDC, roman pots, other forward detectors and forward-hadron tracking requirements, forward-hadron and barrel calorimetry segmentation

Goals during this meeting

- Discuss and setup the working group structure (by physics topics, by processes)
- Discuss the charge of the different working groups
- Gather input on people interested to join the different working groups
- Discuss a work plan:
 - Regular independent WG meetings, common meetings, etc
 - Milestones, (realistic) deliverables and timeline

Proposed physics WG organization:

Subgroups:

- Inclusive DIS
- h SIDIS
- Jets, heavy quarks
- Deep exclusive
- Diffractive & Tagging

15-20 subgroup conveners
Aimed at covering all relevant physics topics