EICUG Yellow Report: Calorimetry

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Calorimetry subgroup meeting 2020/02/11

Introduction

- The goal of the Yellow Report
  - Consider the scientific interests of the EIC User Group
  - Develop and study detector concepts and evaluate how well they would meet the scientific requirements
- 6 Physics subgroups, 11 Detector subgroups
- YR Calorimetry subgroup
  - Detector systems:
    - EM calorimeters - the endcaps and the barrel
    - Hadron calorimeters - the endcaps (barrel?)
    - Very forward calorimeters ?
  - Google group: 38 participants at this moment
  - Calorimetry for EIC: a well advanced project. Existing resources:
    - eRD1 - Calorimetry R&D group
      `https://wiki.bnl.gov/conferences/index.php/Meetings`
    - Documents in
      `https://wiki.bnl.gov/eic/index.php/Main_Page`

General Information

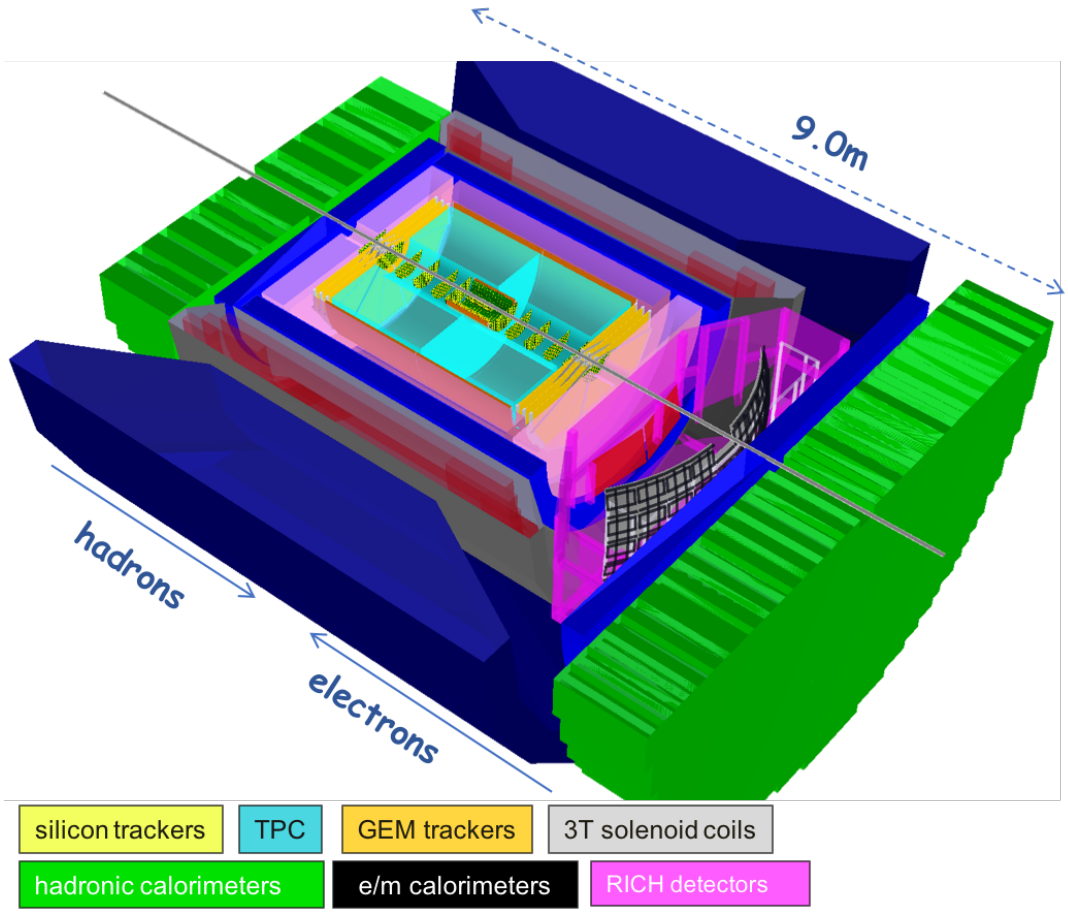
Accelerator:

- 10×275 GeV - $\mathcal{L}_{MAX} = 10^{34}\text{cm}^{-2}\text{s}^{-1}$
- Up to 18×275 GeV
- Crossing angle 25 mrad
- Rep. rate 110 MHz

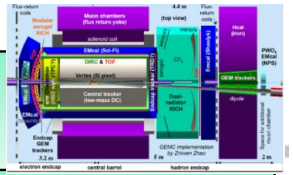
Spectrometer:

- Solenoid ID=300 cm, 3 T ?
- Cherenkov/TRD for e/π separation?
- EM calorimeters in magnetic field

"An Electron-Ion Collider Study" BNL, August 2019



eRD1 Report, July 2018



Regions and Physics Goals	Calorimeter Design
Lepton/backward: EM Cal ○ Resolution driven by need to determine (x, Q^2) kinematics from scattered electron measurement ○ Prefer 1.5%/√E + 0.5%	Inner EM Cal for for $\eta < -2$: ➢ Good resolution in angle to order 1 degree to distinguish between clusters ➢ Energy resolution to order (1.0-1.5 %/√E+0.5%) for measurements of the cluster energy ➢ Ability to withstand radiation down to at least 2-3 degree with respect to the beam line. Outer EM Cal for $-2 < \eta < 1$: ➢ Energy resolution to 7%/√E ➢ Compact readout without degrading energy resolution ➢ Readout segmentation depending on angle
Ion/forward: EM Cal ○ Resolution driven by deep exclusive measurement energy resolution with photon and neutral pion ○ Need to separate single-photon from two-photon events ○ Prefer 6-7%/√E and position resolution < 3 mm	
Barrel/mid: EM Cal ○ Photons and neutral pions from SIDIS and DES in range 1-10 GeV, so absolute energy uncertainty in photon should be 100 MeV ○ Leads to order 10%/√E	Barrel, EM calorimetry ➢ Compact design as space is limited ➢ Energy resolution of at least order 10%/√E, and likely better
Ion/Forward: Hadron Cal ○ Driven by need for x-resolution in high-x measurements ○ Need Δx resolution better than 0.05 ○ For diffractive with ~50 GeV hadron energy, this means 40%/√E	Hadron endcap: ➢ Hadron energy resolution to order 40%/√E, ➢ EM energy resolution to < (2%/√E + 1%) ➢ Jet energy resolution < (50%/√E + 3%)

Information to be collected

Request for information from the physics/simulation groups:

- Expected rates for various position at $\mathcal{L} = 10^{34}$ cm^{-2}s^{-1}
  - Rates/cm^2 of various particles
  - Energy spectra
- Physics groups should provide the requirements, as functions of detector positions
  - Rates, energy range
  - Needed energy, position resolution, granularity
  - Needed e/π descrimination