Simulation tasks for the review

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Please use the official simulation framework. Please tag all software (sim., reco., and analysis) used in these studies.

a. Key plots to be shown:
   i. Photon and electron energy resolution σ/E as a function of E (0-18GeV) at η=0, 0.5, 1. Consider a minimum energy of 50 MeV.
      1. For each point, please extract FWHM and percentage of gammas/electrons within a cut window of |E/p-1| < 1x FWHM. Please provide the E/p lineshape in the backup material.
   ii. Photon angular resolution (ϕ, η) as a function of E (0-18 GeV) at η=0, 0.5, 1
   iii. Pion rejection as a function of p (0-18 GeV/c) at 95% e-efficiency at η=0, 0.5, 1
   iv. Pion rejection versus e-efficiency at p = 1, 5, 10 GeV/c at η=0, 0.5, 1
   v. Separation of gamma from π^0 decay: separation probability as a function of p at η=0, 0.5, 1
   vi. Measured cluster energy response to E= 8 GeV single electron vs η & ϕ in the full acceptance

b. Comparison of the **present assessment of the detector performance compared with the YR requirements**?

c. In coordination with the inclusive PWG, show the performance of key high-level physics observables, g_1 and F_2 (possibly F_L), on both statistical reach and systematic uncertainty.

d. Performance perspectives **beyond the YR requirements, if any** ?

E.g.:

- **Hadronic response (SciFi/Pb as an inner HCal)**
- Muon Identification
- …

Needed Samples:

Single particle electron/pion:

- η = 0, 0.5, 1
  E = 0.05, 0.1, 0.2, **0.5, 1**, **2**, 3**, 5**, 8, **10, 15,** 18
  # events
  e: separation: 100K , E res: 10K,
  pi: 10 x e separation
- electron: η = (-1.5, 1.2), E = 8 GeV
  (# events: 100K)

Single particle γ:

- η = 0, 0.5, 1
  E = 0.05, 0.1, 0.2, 0.5, 1, 2, 3, 5, 8, 10, 15, 18
  (E res: 10K, separation: 100K)

Single particle π0:

- η = 0, 0.5, 1
  E = 1, 2, 3, 5, 8, 10, 15, 18 (100K)

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Detector configurations, etc:

Everything should be run w/ detail SciFi/Pb Matrix with cladding

- this changes also sampling fraction in EICrecon

Layer configuration

- All 6 layers
- w/o 1st layer
- w/ 6th layer shifted more towards the tail
- 4 layers (1st, preshower, shower max, postshower)

Birks Constant:

- Nominal 0.126 mm/MeV (citation)
- 0.079 mm/MeV (to confirm)

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What tests to run:

1. Energy resolution
2. Position resolution

3. *electron/pion separation based on ML with different samples, geometries and kB* ***(pipeline development, computing resources)***
4. *gamma/pion separation based on ML*

5. Single clustering for electrons
   a. w/ cluster matching (test how well it works)
   b. parameters optimization
   c. z position from SciFi/Pb
   d. Energy calibration (fsam)

6. Full DIS event reconstruction (Pythia8 NC DIS) - **Physics Samples (18x270 and 5x41)** ***(reconstruction developments, make the whole chain works)***
   a. Cluster reconstructions
   b. SciFi/Pb z position smearing
   c. **Cluster matching** (AstroPix + SciFi/Pb)
   d. **Cluster splitting in SciFi/Pb** (for best efficiencies)
   e. **Energy calibration** (SciFi and AstroPix, E_true vs E_cluster calibration curve)
   f. **Physics Analysis**: Estimation of stat precision, pion bckgs, reconstruction of x, Q2, etc.
   g. **Particle classification** w/ NN

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Benchmarking with data

1. Energy resolution cross check with GlueX (prototype) sample
2. Pion response benchmarking (GlueX data)
3. AstroPix beamtest data???

Extra tests:

1. ***Hadronic response together with HCal (pions/protons: e/h, energy response/resolution with HCAL)***
2. PID for muons (w/ HCal), muon/pion separation with ML
3. Cluster directionality
4. Anything else?