Beam Background Challenges for the ePIC Subsystems

TC-Office

TIC meeting, February 23rd 2026

MOTIVATIONS to assess the challenges

1. **Subsystem performance presented in preTDR are largely obtained from simulation studies not including the beam background**
   - This is due to the late availability of “background files”
   - Also requested in Reviews, example from the Director's Review of the EIC Detector (ePIC) Subproject to Assess Baseline Readiness (3-5 February 2026)
     - *“MPGDs … Simulation studies (physics and background) remain an important element to further consolidate the evaluation of detector requirements and operating conditions.”*

2. **The project needs a feedback about the current scheme of collimation and shielding**
   - Elke’s talk at the ePIC Coll. Meeting, Jan 2026 (https://indico.bnl.gov/event/30532/contributions/119167/attachments/67779/116450/EIC_ePIC_UsersGroup_Slides.pptx)
   - A need also identified in the Director's Review of the EIC Detector (ePIC) Subproject to Assess Baseline Readiness (3-5 February 2026)

Charge Question #2c Is the scope integrated into the EIC subproject structure such that future design evolution of complementary scope in other subprojects will not cause excessive rework or costly redesigns? **Response:** **Unclear; there is a dependence on the IR. For example, the thickness of the Au layer impacts backgrounds in the tracker.**
Charge Question #2d Are interfaces clearly defined and controlled? **Response:** **In general, yes but integration interfaces require additional development.**

Closeout
February 5, 2026
S. Nahn & A. White

MOTIVATIONS to address the challenges

1. **Subsystem performance presented in preTDR are largely ob**
   including the beam background
   - This is due to th

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Addressing the beam background challenges is an effort to face two needs towards readiness for CD2

What follows is agreed upon with the Coordination Office and takes advantages of the inputs from the whole Office

Are interfaces clearly defined and controlled?

Response: **In general, yes but integration interfaces require additional development.**

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How to proceed in addressing the background challenges

Answering to 3 families of questions:

a) Impact on detector performance;

b) Impact on data flow, requested bandwidth and potential dead-time;

c) radiation/fluence damages.

Using data from simulation campaigns

Using radiation maps with DIS + background

a) Impact on detector performance

DSC responsibility

- **Progressing in two steps**

1. **Make use of what is at hand**, namely the Feb. 2026 simulation campaign (10 x 100) and related simulation background (probably optimistic concerning beam-gas rates as vacuum after 10000 A-h of running is assumed)
    - Events with background (10μm gold coating on the beampipe): /volatile/eic/EPIC/RECO/26.02.0/epic_craterlake/Bkg_Exact1S_2us/GoldCt/10um/DIS/NC/10x100/minQ2=1/
    - *Events without background*: /volatile/eic/EPIC/RECO/26.02.0/epic_craterlake/DIS/NC/10x100/minQ2=1/

    - **Obtain subsystem performance**(*) from DIS + the background
    - **Compare the performance** with / without background

2. **Challenge the subsystems with increased background rates**
    - Premature to give now a recipe for the increased background: the outcome of the first step will provide suggestions

About subsystem performance

- **The following is a list of suggestions, probably minimal**
  - DSCs of **subsystems in CD and FF&FB** are invited to enrich and improved the parameters to be checked

All DSCs

Occupancy maps

TRACKING

efficiency and purity (CD: vs. η)
p, p_T resolution (CD: vs. η and versus p)
space resolution of the reconstructed primary vertex (CD only)
angular resolution for the DIRC (CD only)

ECals

E-resolution (CD: vs p)
efficiency (CD: vs η, p)
π/e separation (CD only: vs p)
angular resolution (CD only)

HCals

energy resolution (CD: vs E, η)
efficiency vs E (CD: also vs. η)
efficiency in neutron detection/identification vs E
space resolution vs E (CD only)

PID

π/κ separation vs η, p
e/π separation vs η, p
PID efficiency and purity vs η, p

- Possible only later, when PID reconstruction for multiparticle event in EICRecon is made available.
- Therefore, PID DSCs should continue to focus their effort on event reconstruction in EICRecon. Once this is in place, performance studies can follow.

b) Impact on data flow, requested bandwidth and potential dead-time

el/R-O/DAQ CC WG responsibility

- for each subsystem **comparison of data flow with background respect to the maximum data flow** that the r-o chain can manage

  - Compare average data flow values and hottest regions
  - Compare data flow at all relevant R-O chain stages: FEE ASIC, RDO, DAM board
  - Ultimate goal: define rate safety factors

  - DSC role:
    - Assist el/R-O/DAQ CC WG; examples:
      - Provide the occupancy maps from a);
      - Provide the R-O configuration

c) radiation/fluence damages

- *Ionizing dose/neutron fluence maps including background are needed:*

→ *NEW (since a few days): summed radiation maps*

- From Alex Jentsch

" The "summed" radiation maps, which also contain the geometry version used for the current preTDR are uploaded to the Wiki page ...
I have reduced things to **two plots** – total ionizing dose (from all sources) and 1 MEQ fluence (from both protons and neutrons)."

> These studies come from a sum Pythia6 e+p at 10x275 GeV, $Q^2 < 1\ \mathrm{GeV}^2$ assuming a nominal luminosity of $1.0 \times 10^{34} cm^{-2} s^{-1}$ (from EIC CDR Table 3.3), which leads to an event rate of ~ 500 kHz, plus 35 kHz hadron beam+gas and ~ 3.2 MHz electron beam+gas.
>
> All fluences and radiation doses are normalized per fb^{-1}.

Wiki page:
https://wiki.bnl.gov/EPIC/index.php?title=Radiation_Doses

c) radiation/fluence damages

DSC responsibility

- **Re-evaluate the ionizing dose and neutron fluence** on your detector (average, hottest zone) by integration over 150 fb using the summed maps;
- Compare these doses/fluences with the safety doses/fluences for your sensors;
- Estimate the damage in terms of decreased performance (performance as discussed above) after 150 fb

c) radiation/fluence damages

DSC responsibility

- **Special case: HRPPDs**
  - Re-evaluate the photon fluence (average, hottest region) for 1 nominal year (beam conditions as above);
  - Compare these values with safety fluence for HRPPD estimating the damage in term of PDE loss (convolution of reduced QE and reduced gain) after 5 years.
  - *No new maps are needed here: simulation campaign to be used*

REQUESTS

Feedback on progress by a set of slides to be present at TIC within 1 month:

a) DSCs: Impact on detector performance (PID postponed); step 1

b) El/R-O/DAQ CC WG: Impact on data flow, requested bandwidth and potential dead-time; step1

c) DSCs: radiation/fluence damages; using the new summed maps
   - HRPPDs, photon fluence from simulation files