

ePIC Detector Requirements

Discrepancy Report: Chapter 2 preTDR vs. Official EIC Requirements

April 29, 2026 | Prepared with Claude Code

This report documents discrepancies identified in *Chapter 2 (Detector Requirements), Revised Version, April 2026* of the ePIC preTDR. Two classes of discrepancy are reported: **internal** inconsistencies (within the chapter itself) and **external** inconsistencies (between the chapter and the official EIC Detector System Requirements maintained at eic.jlab.org/Detector/, requirement set accessed April 29, 2026).

Internal Discrepancies (within Chapter 2)

D-INT-1 Central Detector η coverage (acknowledged by authors)

Location	Chapter 2 body text, p. 4, line 27–28
Statement in text	“covering the pseudorapidity range $(-3.5, 3.5)$ ”
Conflicting statement	Blue NOTE immediately following: “ <i>in the Project Requirement table the range is -4 to 4</i> ”
Severity	High — scope of the central detector
Notes	The authors have explicitly flagged this as unresolved. The summary table (Fig. 2.1) uses $\eta \in (-4, 4)$ row structure, consistent with the official requirement. The body text must be updated.

D-INT-2 Backward PID momentum reach (text vs. summary table)

Location	Section 2.1.4 text vs. Figure 2.1 summary table
Statement in text	“ $p \lesssim 10$ GeV/ c in the backward region”
Statement in table	Backward $\pi/K/p$ separation momentum range: 1–7 GeV/ c
Severity	Medium — the text overstates the backward PID reach by ~ 3 GeV/ c relative to the chapter’s own summary table
Notes	The 7 GeV/ c figure in the table is also consistent with the pFRICH technology described in Section 2.1.4 (proximity-focused RICH with aerogel radiator). The 10 GeV/ c figure in the text appears to be an error.

External Discrepancies (Chapter 2 vs. Official EIC Requirements)

Official requirements are from the EIC Detector System Requirements document (eic.jlab.org/Requirements/DE) which is maintained by the EIC Systems Engineering Group and represents the approved project baseline.

D-EXT-1 Central Detector η coverage

Official requirement	G-DET.5: Central detector covers $\eta \in (-4, +4)$
Chapter 2 text	$\eta \in (-3.5, +3.5)$
Severity	High — same as D-INT-1; the official requirement is the authoritative source
Resolution	Update Chapter 2 body text to $\eta \in (-4, +4)$ throughout

D-EXT-2 Backward PID momentum reach

Official requirement	Backward RICH: $3\sigma \pi/K$ separation up to 7 GeV/c
Chapter 2 text	Section 2.1.4: “ $p \lesssim 10$ GeV/c”
Chapter 2 table	Fig. 2.1: 1–7 GeV/c (consistent with official)
Severity	Medium — narrative text conflicts with both the official requirement and the chapter’s own table
Resolution	Correct Section 2.1.4 text to read “ $p \lesssim 7$ GeV/c”

D-EXT-3 Backward EM calorimetry sampling term

Official requirement	$\sigma_E/E \sim (2-3)\%/\sqrt{E} \oplus (1-2)\%$
Chapter 2 text	$\sigma_E/E \approx 2\%/\sqrt{E} \oplus (1-2)\%$
Severity	Low — the chapter pins the sampling term at 2% rather than the official range of 2–3%; it is more demanding than the official floor
Notes	This may intentionally reflect the chosen PbWO ₄ crystal technology, which exceeds the minimum spec. If so, the chapter should note this explicitly.

D-EXT-4 Barrel/forward EM calorimetry constant term

Official requirement	$\sigma_E/E \sim 10\%/\sqrt{E} \oplus (1-3)\%$
Chapter 2 text	Barrel: $10\%/\sqrt{E} \oplus (2-3)\%$; Forward: $(10-12)\%/\sqrt{E} \oplus (2-3)\%$
Severity	Low — the chapter requires a constant term of at least 2%, while the official spec allows as low as 1%
Notes	As with D-EXT-3, this may reflect technology-driven precision beyond the official minimum. No action required unless the 1% floor is intentional in the official spec (e.g., for a future upgrade scenario).

D-EXT-5 Pion suppression factor — present in preTDR, absent from official requirements

Official requirement	Not present. The closest entries are qualitative: P-DET-ECAL-BCK.3 “high power for e/π separation down to 1 GeV/ c ”; F-DET-ECAL-BCK.3 “strong eID capabilities down to 1 GeV/ c ”; P-DET.9 “electron-hadron separation with efficiency $> 90\%$ and purity $> 80\%$ ”. None specifies a suppression factor.
Chapter 2 text	Section 2.1.2: “The requested suppression factor is up to 10^4 , a requirement for the backward region.” Also shown as a PID column entry (π suppression up to 10^4) in Fig. 2.1 for the backward endcap.
Severity	Medium — a quantitative, physics-driven requirement present in the preTDR has no traceable counterpart in the formal project requirements database
Notes	This is a requirements-capture gap, not a numerical conflict. The 10^4 suppression factor cannot be formally verified or tracked through the EIC Systems Engineering process until it is entered into the Visure database. The qualitative entries in the spreadsheet (P-DET-ECAL-BCK.3, P-DET.9) should be replaced or supplemented with a quantitative performance requirement.

D-EXT-6 EM calorimeter timing — absent from Section 2.1.2

Official requirement	F-DET-ECAL.6: “Must provide timing sufficient to discriminate between different bunch crossings.”
Chapter 2 text	Section 2.1.2 contains no timing requirement for the EM calorimeters.
Severity	Medium — a formal functional requirement on all EM calorimeter subsystems is entirely absent from the chapter’s calorimetry section
Notes	The 10 ns bunch-crossing discrimination requirement applies to the backward PbWO ₄ crystal calorimeter, the central SciFi-Pb sampling calorimeter, and the forward W-SciFi calorimeter. Section 2.1.2 should include a statement that all central EM calorimeters must resolve the 10 ns beam crossing frequency.

D-EXT-7 Luminosity detector timing — absent from Section 2.1.5

Official requirement	P-DET-ANC-LUMI.2: “The PS CALs, direct CAL, and trackers shall all provide timing resolution sufficient to resolve 10 ns beam buckets.”
Chapter 2 text	Section 2.1.5 (lines 249–251) states only the absolute ($\delta L/L \leq 1\%$) and relative (10^{-4}) luminosity accuracy requirements. No timing requirement is given for the luminosity system.
Severity	Low — the general “all far detectors must resolve 10 ns beam crossings” statement in Sec. 2.1.5 (line 231) arguably covers the luminosity system, but the spreadsheet calls it out explicitly and the chapter does not
Notes	Adding an explicit statement for the luminosity system components would improve traceability between the chapter and P-DET-ANC-LUMI.2.

D-EXT-8 Polarimeter timing — absent from Chapter 2

Official requirements	P-DET-POL-EPOL-ESR.6: electron polarimeter detectors “sufficient to resolve beam bunch (< 10 ns)”; P-DET-POL-HPOL.3: hadron polarimeter waveform digitizers ≤ 0.5 ns time resolution.
Chapter 2 text	Lines 56–58 note that polarimetry detectors “shall measure the electron and proton beam polarization” and refer to Secs. 3.2.9 and 3.2.8.1. No timing requirement is stated for either polarimeter.
Severity	<i>Low</i> — polarimeter specifications are detailed in Chapter 3; the absence in Chapter 2 may be intentional. However, the hadron polarimeter 0.5 ns digitizer requirement is notably more stringent than the generic 10 ns bunch-crossing floor and has no mention anywhere in Chapter 2.
Notes	At minimum, the 0.5 ns hadron polarimeter timing requirement (P-DET-POL-HPOL.3) should be cited or cross-referenced in the summary table (Fig. 2.1) if the polarimetry system is listed there, to ensure it is visible to readers of Chapter 2.

Summary Table

ID	Type	Parameter	Severity
D-INT-1	Internal	Central detector η coverage (-3.5 vs. -4 to 4)	High
D-INT-2	Internal	Backward PID reach (10 vs. 7 GeV/ c , text vs. table)	Medium
D-EXT-1	External	Central detector η coverage vs. G-DET.5	High
D-EXT-2	External	Backward PID reach vs. official 7 GeV/ c	Medium
D-EXT-3	External	Backward ECAL sampling term (2% vs. 2 – 3%)	<i>Low</i>
D-EXT-4	External	Barrel/fwd ECAL constant term (2 – 3% vs. 1 – 3%)	<i>Low</i>
D-EXT-5	External	Pion suppression 10^4 in preTDR — absent from official requirements	Medium
D-EXT-6	External	ECAL bunch-crossing timing (F-DET-ECAL.6) absent from Sec. 2.1.2	Medium
D-EXT-7	External	Luminosity detector timing (P-DET-ANC-LUMI.2) absent from Sec. 2.1.5	<i>Low</i>
D-EXT-8	External	Polarimeter timing (EPOL < 10 ns, HPOL ≤ 0.5 ns) absent from Ch. 2	<i>Low</i>

Recommended actions:

- (High priority)** Update the Chapter 2 body text to use $\eta \in (-4, +4)$ for the Central Detector coverage, consistent with G-DET.5 and the chapter’s own summary table (D-INT-1 / D-EXT-1).
- (Medium priority)** Correct Section 2.1.4 to read “ $p \lesssim 7$ GeV/ c ” for backward PID, consistent with the official requirement and Fig. 2.1 (D-INT-2 / D-EXT-2).
- (Medium priority)** Add a quantitative pion suppression requirement ($\leq 10^{-4}$ pion contamination in the backward region) to the official EIC requirements database (Visure), referencing P-DET-ECAL-BCK.3 as the parent functional requirement (D-EXT-5).

4. **(Medium priority)** Add a timing requirement to Section 2.1.2 stating that all central EM calorimeters must resolve the 10 ns beam crossing frequency, consistent with F-DET-ECAL.6 (D-EXT-6).
5. **(Low priority)** Add an explicit timing statement for the luminosity system components in Section 2.1.5 to match P-DET-ANC-LUMI.2 (D-EXT-7).
6. **(Low priority)** Cross-reference or cite the polarimeter timing requirements ($E_{POL} < 10$ ns; $H_{POL} \leq 0.5$ ns) in Chapter 2, or note explicitly that these are deferred to the Chapter 3 subsystem descriptions (D-EXT-8).
7. **(Low priority)** Clarify whether D-EXT-3 and D-EXT-4 represent intentional technology-driven tightening of the official spec, and if so, add an explanatory note in the chapter.

Sources: *Chapter 2, ePIC preTDR, Revised April 2026*; EIC Detector System Requirements, <https://eic.jlab.org/Requirements>, accessed April 29, 2026.