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Electron-Ion Collider, Brookhaven National Laboratory and Thomas Jefferson National Accelerator Facility			
Doc No. EIC-SEG-RSI-167	Author: T. Russo	Effective Date: January 6, 2026	Review Frequency: 5 years
Requirements, Specifications, and Interfaces: EIC Subproject Interface Control Document			Revision: 00

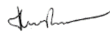
Electron-Ion Collider Requirements, Specifications, and Interfaces

EIC Subproject Interface Control Document

January 6, 2026

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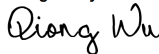


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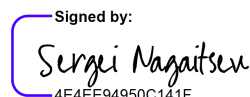


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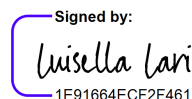


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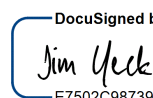
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REVISION HISTORY

Revision #	Effective Date	List of Reviewers	Summary of Change
00	January 6, 2026		Initial release

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List of Acronyms

ASR	Accelerator Storage Ring
CAD	Collider-Accelerator Department
CNI	Coulomb-Nuclear Interference
DET	Detector
EIC	Electron-Ion Collider
EIN	Electron Injector
ELR	Energy and Luminosity Ramp-up
ESR	Electron Storage Ring
HSR	Hadron Storage Ring
IP	Interaction Point
IPO	Integrated Project Office & Beam Commissioning
IR	Interaction Region
LEC	Low Energy Cooler
LINAC	Linear Accelerator
LLRF	Low-Level RF
RCS	Rapid Cycling Synchrotron
RF	Radio Frequency
RHIC	Relativistic Heavy Ion Collider
SEG	Systems Engineering Group
SRF	Superconducting Radio Frequency
TBD	To Be Determined
WBS	Work Breakdown Structure
ZDC	Zero Degree Calorimeter

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Electron-Ion Collider Subproject Interface Control Document

1. PURPOSE AND SCOPE

The purpose of this document is to define the interfaces between the Subprojects of the Electron-Ion Collider (EIC) project. This document does not define scope or requirements of the Subprojects but is intended to clarify interface details of where one Subproject ends and others begin.

Interfaces that derive from higher level requirements, following the standard Systems Engineering process [4.1], are not included.

Long Lead Procurements, although a separate Subproject, are not included as interfaces in this document since the scope of the procurements is within individual Subprojects themselves.

2. SUBPROJECTS

The following EIC Subprojects have interfaces with one another:

- Accelerator Storage Rings (ASR): includes HSR and ESR
- Interaction Region (IR)
- Detectors (DET)
- Electron Injector (EIN): includes LINAC, BAR and RCS
- Energy and Luminosity Ramp-up (ELR): includes LEC, RF, SRF and cryogenic systems
- Integrated Project Office & Beam Commissioning (IPO)

Most Subprojects include technical scope, infrastructure, and integration. Refer to the EIC WBS for detailed scope definitions.

The following section identifies and defines the interfaces between individual Subprojects to define the physical breakpoint between them and to clarify scope responsibility at those interfaces.

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3. INTERFACES

The Subproject interfaces are listed in the table below, with references to the later sections that contain interface definitions.

	ASR	IR	DET	EIN	ELR	IPO
ASR		3.1	3.2	3.3	3.4	3.5
IR			3.66	3.7	3.8	3.9
DET				3.10	3.11	3.12
EIN					3.13	3.14
ELR						3.15
IPO						

Note: sections in gray italics indicate that there are currently no interfaces defined between these Subprojects.

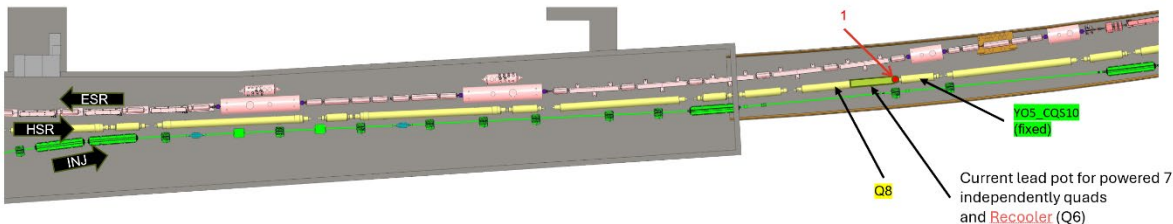
3.1. ASR-IR

The following sections describe the interfaces between the Accelerator Storage Rings (ASR) Subproject and the Interaction Region (IR) Subproject.

3.1.1. HSR-IR

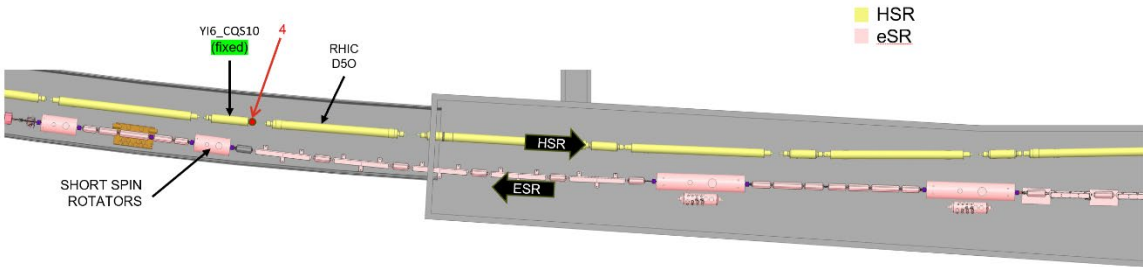
The HSR interface with the 1006 IR (west) is at the exit flange of magnet YO5_CQS10.
The HSR interface with the 1006 IR (east) is at the exit flange of magnet YI6_CQS10.
The coordinates of the interface points are listed in the table below, followed by figures showing their location. These coordinates are for reference and are subject to change slightly as the design matures.
The ASR Subproject provides the blank flanges, so the HSR can be brought under vacuum.

X	Z	Description
-587.565951	154.640430	5 o'clock, mating face between YO5_CQS10 and IP6 side interconnect
-586.670046	-154.554669	6 o'clock, mating face between YI6_CQS10 and IP6 side interconnect



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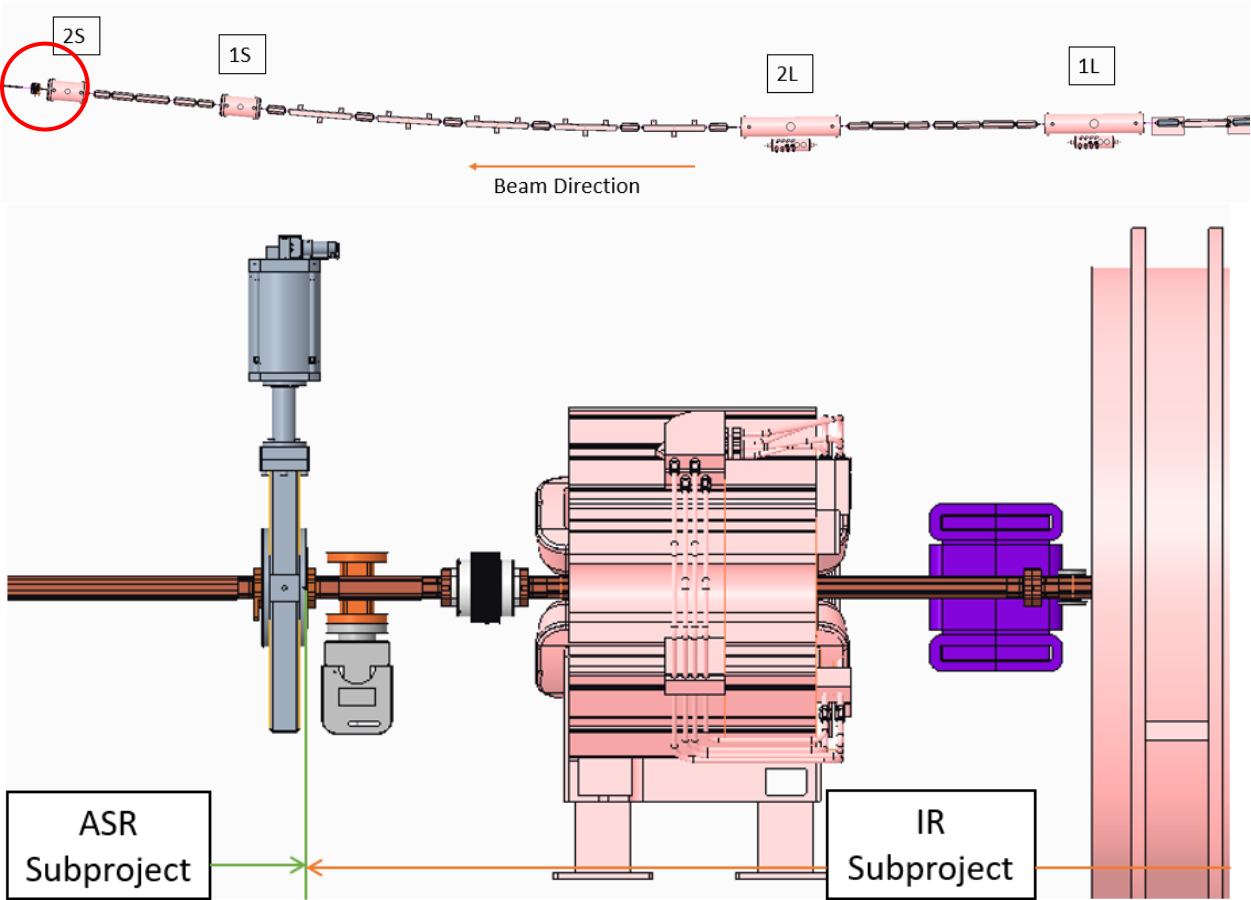
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3.1.2. ESR-IR

The ESR interface with the 1006 IR (west) is at the upstream vacuum gate valve flange on the east end of drift pipe es6-dt173.1 (clock HH:MM:SS = 06:32:12). The drift pipe RHIC coordinates are: (x = -586.41834624166, y = 0, z = -171.70927439534). These coordinates are for reference and are subject to change slightly as the design matures.

The ASR Subproject provides the gate valve and blank flange. This interface is shown in the figures below.

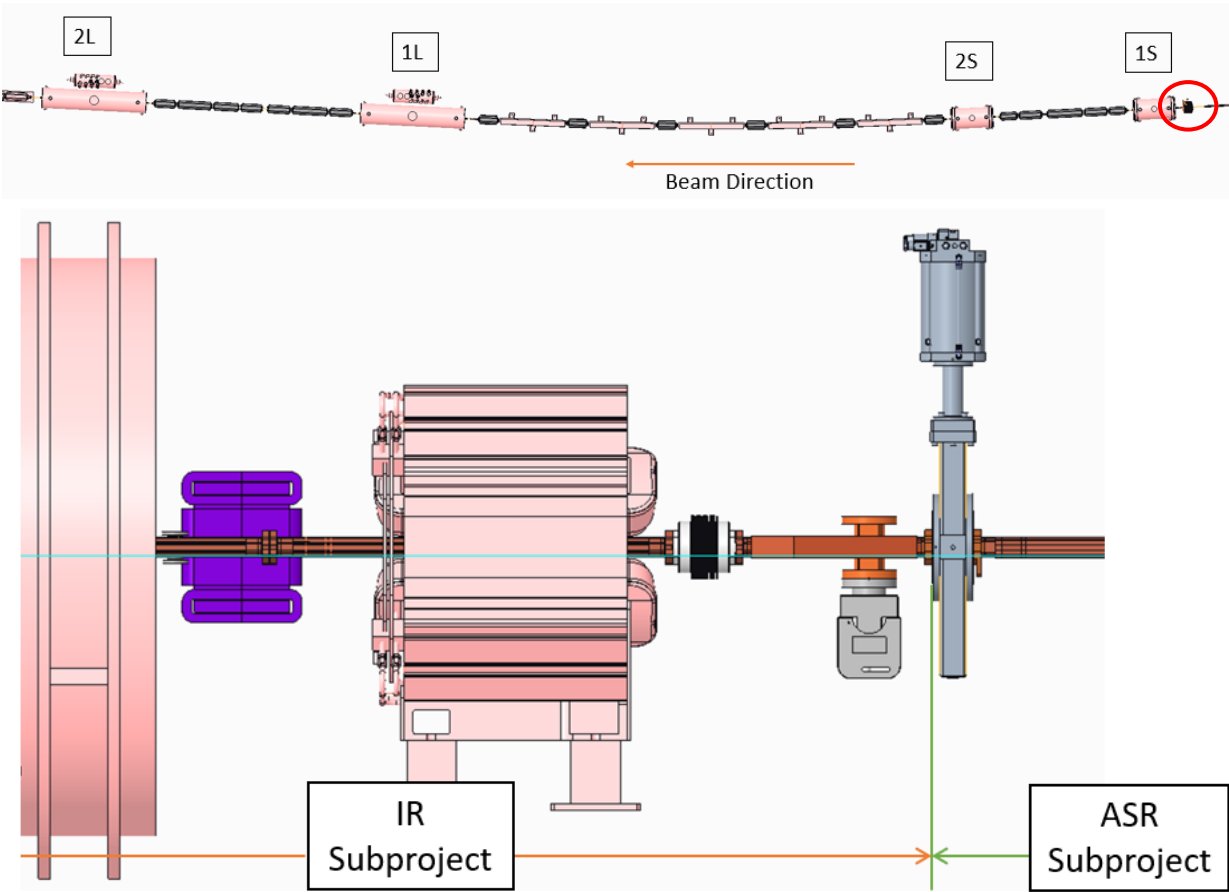


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The ESR interface with the 1006 IR (east) is at the downstream vacuum gate valve flange on the west end of drift pipe es5-dt176 (clock HH:MM:SS = 05:25:48). The drift pipe RHIC coordinates are: (x = -583.62507929889, y= 0, z = 170.14629197821). These coordinates are for reference and are subject to change slightly as the design matures.

The ASR Subproject provides the gate valve and blank flange.
This interface is shown in the figures below.



3.2. ASR-DET

The following sections describe the interfaces between the Accelerator Storage Rings (ASR) Subproject and the Detector (DET) Subproject.

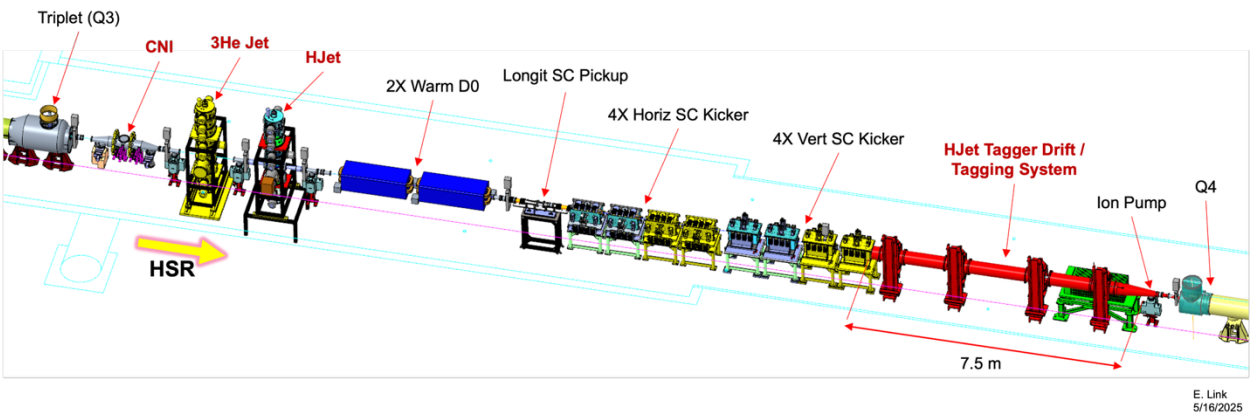
3.2.1. Detectors Sector 3

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The CNI, 3He Jet, and HJet (listed in red in the figure below) belong to the DET Subproject. Drift tubes in the HSR will be installed by the ASR Subproject in place of these devices. The DET Subproject will replace the drift tubes with these devices as part of the DET Subproject.

The interfaces are at the gate valve right after the Q3-Triplet and the gate valve right after the H-Jet. There will be silicon detectors and a zero-degree calorimeter at the end of what is labeled drift space, they will have interfaces with the HSR and ESR nearby. The ASR Subproject provides the gate valves and blank flanges.



X	Z	Description
530.534766	261.805174	Location of gate valve (DS flange) after the Q3-Triplet in sector 3
534.025695	255.654034	Location of gate valve (DS flange) after the H-jet in sector 3
542.950693	240.039827	Location of tracking system to tag break up products from polarimeters (start of tagger drift)
546.737352	233.425137	Location of calorimeter to tag neutral break up products from polarimeters (end of ZDC / start of ion pump bellows)

3.3. ASR-EIN

The following sections describe the interfaces between the Accelerator Storage Rings (ASR) Subproject and the Electron Injector (EIN) Subproject.

3.3.1. ESR-EIN

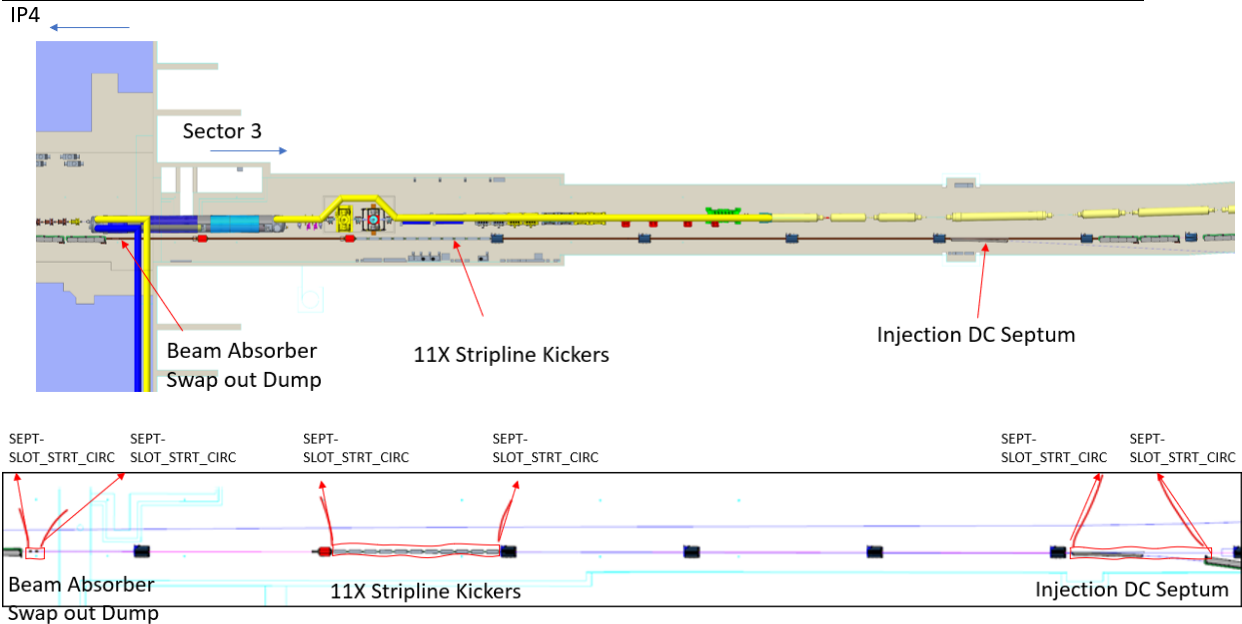
The interfaces are at the end flanges of the ESR Injection Septum, Strip line Kicker string, and swap out dump. Initially installed Spool pieces (provided by ASR Subproject) at these three slots will be replaced by

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actual devices (EIN Subproject). The end flange’s locations are described as follows. Note: Any changes to RCS to ESR Injection transfer line and RCS ring position changes will warrant update of the coordinates.

RCS to ESR Injection				
CAD Model pts (measured from CSYS_RHIC-CTR)				
ID	Description	X	Y	Z
SEPT-SLOT_STRT_CIRC	Septum upstream flange	559.841148	0.121069	213.754376
SEPT-SLOT_END_CIRC	Septum Downstream flange	555.589728	0.119368	221.118052
KCKR-STRING_STRT	Kickers upstream flange	538.685468	0.112607	250.397089
KCKR-STRING_END	Kickers downstream flange	533.950121	0.110713	258.598951
TFER-ABS_STRT	Swap out dump upstream flange	525.858743	0.107476	272.613629
TFER-ABS_END	Swap out dump downstream flange	525.577248	0.107363	273.106477



3.4. ASR-ELR

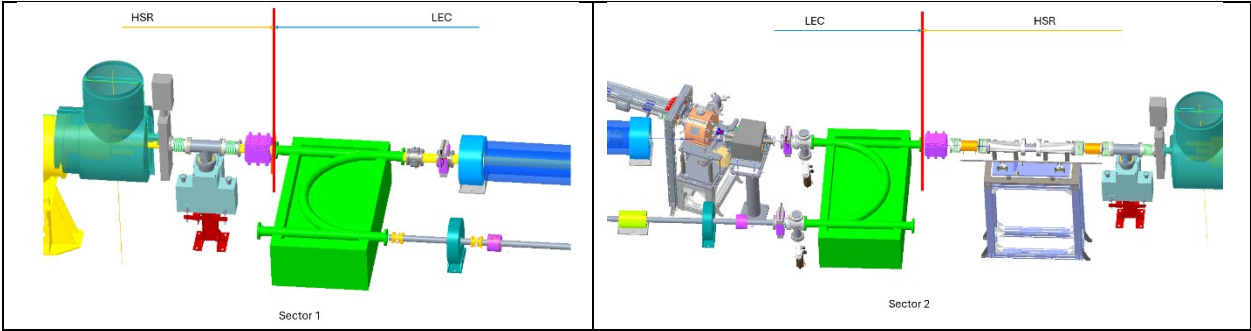
The following sections describe the interfaces between the Accelerator Storage Rings (ASR) and the Energy and Luminosity Ramp-up (ELR) Subproject.

3.4.1. HSR-LEC

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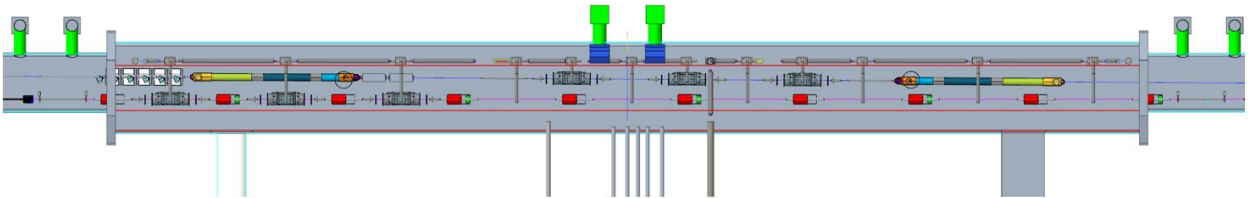
The HSR interface with the LEC is the external surface of the vacuum flange of the 180 degree dipole, on the sector1 side as well as on the sector 2 side (see images below). The dipole is part of the LEC Subproject.



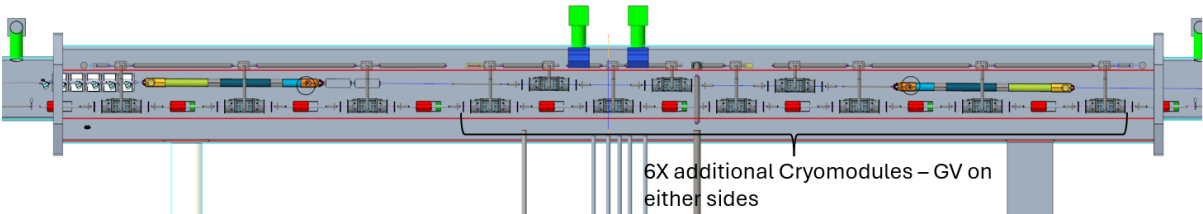
3.4.2. ESR- SRF

Additional 6 cryomodules will be added as part of Energy ramp up in IR 10. The interface will be at gate valves on either side of the cryomodules.

Day one



High Energy



3.4.3. RF Power Upgrade at 1010
TBD

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3.5. ASR-IPO

The following sections describe the interfaces between the Accelerator Storage Rings (ASR) Subproject and the Integrated Project Office & Beam Commissioning (IPO) Subproject.

3.5.1. TBD

3.6. IR-DET

The following sections describe the interfaces between the Interaction Region (IR) Subproject and the Detector (DET) Subproject.

General interface requirements:

Positioning of the detector and the accelerator magnets around the IP and their apertures constitute a major interface between accelerator and detector systems.

- a) Longitudinal Space for the central detector: The final focus systems on the forward side are installed no closer than 6.0 m from the interaction point (IP). On the rear side, the accelerator elements are no closer than 5.0 m from the IP
- b) The forward proton magnet aperture will accommodate a 4 mrad cone of scattered neutrons
- c) The forward proton magnets apertures accommodate scattered hadrons with a transverse momentum of at least 150 MeV to 1.3 GeV.
- d) The forward proton dipole magnets B1pF and B1ApF are sufficiently strong bend the hadron beam away from the Zero-Degree Calorimeter (ZDC) at 35 m from the IP in forward direction.
- e) The rear electron dipole B2eR dipole magnets are sufficiently strong to bend the circulating and scattered electron beams radially outward to provide space for the exit windows for gamma radiation that is generated by electron-proton scattering in the IP (Bethe-Heitler process) at 18?m (TBD) from the IP in the rear direction as well as the parts of the luminosity detector to follow the window. It is very important the SR impinging the luminosity window generated by the B2eR magnets is kept as low as possible.
- f) The detector solenoid axis will be aligned in the direction of the electron beam orbit in the IP.

Interface Description: The superconducting magnets next to the detector end-caps will be protected against magnetic stray fields > 5 gauss by passive magnetic shielding. Part of the interface is the measurement equipment of the residual magnetic field. The magnetic shielding and measurement equipment will be provided by DET.

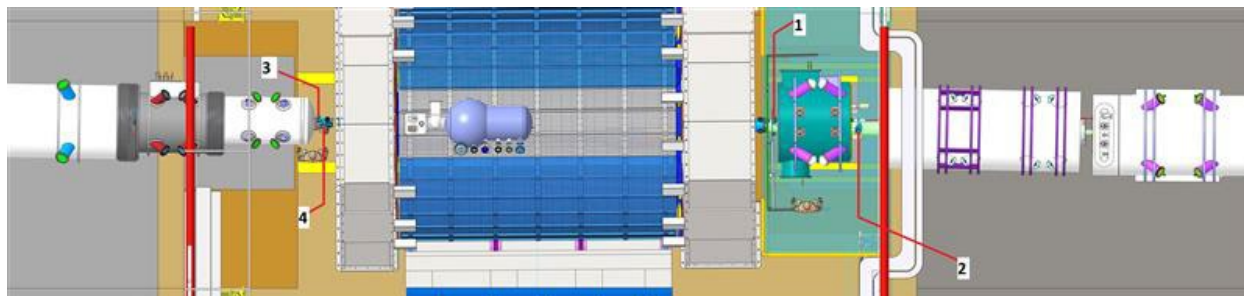
The uncompensated detector solenoid field has an impact on the performance of the EIC beams. The electron beam with its lower beam energy is very sensitive to the detector solenoid field. DET shall ensure that detector solenoid magnet parameters are measured and provided to the IR manager. IR is responsible for the design of and appropriate compensation scheme.

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3.6.1. Epic Detector- IR

The detector region spans 6m from the IP in the forward direction and 5 m in the rear. This region must stay empty of any accelerator equipment to allow installation of the detector.



Interfaces:

1 is the ESR gate valve forward (direction of beam), sector 5 side

2 is the HSR gate valve forward, sector 5 side

3 is the HSR gate valve rear, sector 6 side

4 is the ESR gate valve rear, sector 6 side

X	Z	Description
-589.558074	5.445576	Location of ESR gate valve forward direction (1) sector 5
-589.728065	7.386458	Location of HSR gate valve forward direction (2) sector 5
-589.516728	-5.030422	Location of ESR gate valve rear direction (3) sector 6
-589.640986	-4.918318	Location of HSR gate valve rear direction (4) sector 6

The IR Subproject provides the gate valves and blank flanges, so the IR can be brought under vacuum before the detector is installed.

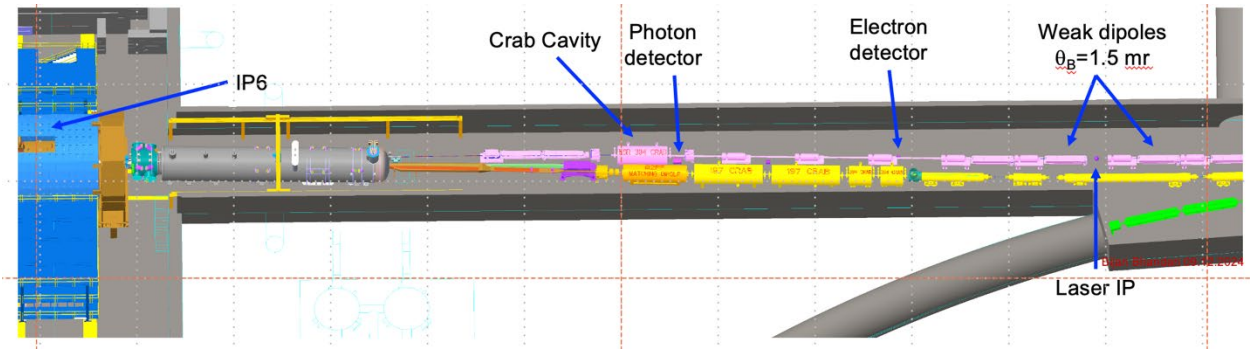
3.6.2. Detector devices- Sector 5

There are several interfaces between the IR and the Auxiliary detector subsystems in Sector 5, they and their position are listed below:

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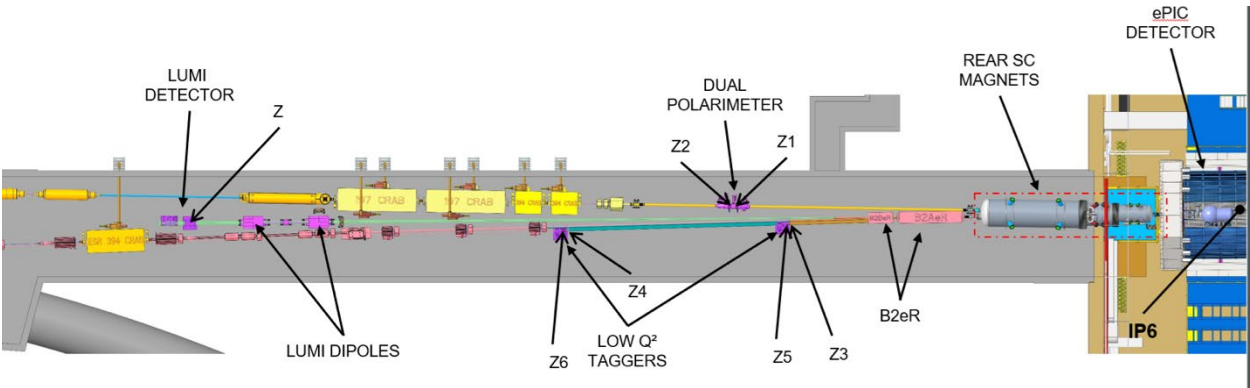
- Off momentum detectors: Interface at 25.45m and 26.95m from IP6 33.56m and 35.06m from IP6
- Zero Degree Calorimeter (ZDC) interface at window located after roman pots at X= -590.210210, Y=0, Z=35.794827; The ZDC is approximately 1.85m long, 0.6 wide and 0.6m high
- The laser-IP: a special flange is required to allow the laser to enter and exit the beam pipe from X to Y (Laser IP coordinates X=-589.884427, Y=0.007485, Z=75.368925)
- The Electron detector: it requires a special beampipe with an exit window on the north side of the electron beampipe at Z=60.39. The electron detector sits at Z=60.32 The photon detector: it needs a special beam pipe with exit window at z=63m passing thorough the following magnets: D4EF_6, Q8EF_6, SQ8EF_6, D3EF_6, Q7EF_6, SQ7EF_6. The photon detector sits at Z=43.869676 between the crab cavity and Q3EF_6.



3.6.3. Detector devices- Sector 6

There are several interfaces between the IR and the Auxiliary detector subsystems in Sector 6, they and their position are listed below.

- Lumi Calorimeter: Interface at lumi window located after B2BeR at Z=63.79
- Dual Polarimeter : Interface GV on either side interfaces are at z1=30.43 and z2=30.94
- Low-Q² Tagger: this subsystem needs a specialized beampipe with exit windows spanning from z3=27.24 to z4=40.73 and the detector systems sitting at z5=27.35m and z6=40.93



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3.7. IR-EIN

There are currently no identified interfaces between the Interaction Region (IR) and Electron Injector (EIN) Subprojects.

3.8. IR-ELR

The following sections describe the interfaces between the Interaction Region (IR) Subproject and the Energy and Luminosity Ramp-up (ELR) Subproject.

3.8.1. TBD

3.9. IR-IPO

The following sections describe the interfaces between the Interaction Region (IR) Subproject and the Integrated Project Office & Beam Commissioning (IPO) Subproject.

3.9.1. TBD

3.10. DET-EIN

The following section describes the interfaces between the Detector (DET) and the Electron Injector (EIN) Subproject.

The interfaces are between the Compton polarimeter located between z1 and z2 in the RCS right before the extraction to the ESR.

3.11. DET-ELR

There are currently no identified interfaces between the Detector (DET) Subproject and the Energy and Luminosity Ramp-up (ELR) Subproject.

3.12. DET-IPO

The following section describes the interfaces between the Detector (DET) Subproject and the Integrated Project Office & Beam Commissioning (IPO) Subproject.

3.12.1. TBD

3.13. EIN-ELR

The following section describes the interfaces between the Electron Injector (EIN) Subproject and the Energy and Luminosity Ramp-up (ELR) Subproject.

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Electron-Ion Collider, Brookhaven National Laboratory and Thomas Jefferson National Accelerator Facility			
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3.13.1. RCS SRF Systems

The ELR Subproject will replace six (6) spool pieces in the RCS RF straight section with six SRF cryomodules. These spool pieces are installed and owned by the EIN Subproject. The replacement interfaces are the end flanges of the six spool pieces at the following coordinates measured from EIC Mechanical Center Coordinate frame:

X	Z	Description
650.2571136	70.4395813	Spool piece 1 upstream flange
647.7571136	74.7697083	Spool piece 1 downstream flange
646.8571136	76.328554	Spool piece 2 upstream flange
644.3571136	80.658681	Spool piece 2 downstream flange
643.4571136	82.2175267	Spool piece 3 upstream flange
640.9571136	86.5476538	Spool piece 3 downstream flange
640.0571136	88.1064995	Spool piece 4 upstream flange
637.5571136	92.4366265	Spool piece 4 downstream flange
636.6571136	93.9954722	Spool piece 5 upstream flange
634.1571136	98.3255993	Spool piece 5 downstream flange
633.2571136	99.884445	Spool piece 6 upstream flange
630.7571136	104.214572	Spool piece 6 downstream flange

To support the SRF operation, ELR will install six sets of RF amplifier units and low-level RF (LLRF) control units, one set for each cryomodule, within the RF service building. The RF service building is within the scope of EIN, and adequate space has been reserved to accommodate the six additional RF and LLRF units to be installed by ELR.

3.13.2. RCS Cryogenic Plant

The cryogenic plant building, including its foundation and external walls, is constructed and owned by EIN. ELR is responsible for installing the utility and cryogenic equipment within the plant to enable 2 K cryogenic operation for the RCS.

There are two cryogenic distribution line interface points between EIN and ELR:

- **Tunnel Interface:** At both ends of the RCS header line inside the RCS tunnel. The two ends of the header are located at the following coordinates measurement from EIC Mechanical Center Coordinate frame:

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X	Z	Description
TBD	TBD	Upstream end of the RCS header
TBD	TBD	Downstream of the RCS header after

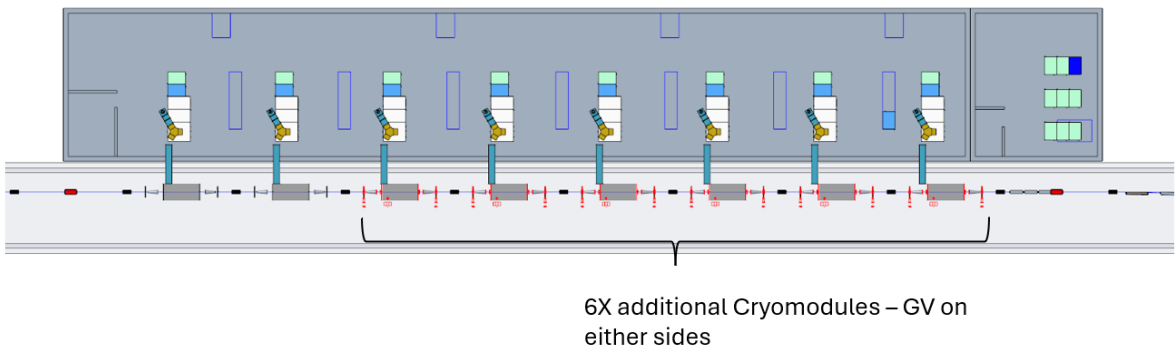
- Above-Ground Interface: At the 4 K supply line T-joint located above ground, between the RCS tunnel and the RHIC tunnel. This T-joint is within EIN’s scope. From this point, ELR will extend the 4 K supply line to the RCS cryogenic plant.

3.13.3. Interface with SRF Cryomodules

Six additional cryomodules will be added. Interfaces are at the gate valves on either side of each cryomodule.



High Energy



3.14. EIN-IPO

The following sections describe the interfaces between the Electron Injector (EIN) Subproject and the Integrated Project Office & Beam Commissioning (IPO) Subproject.

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3.14.1. TBD

3.15. ELR-IPO

The following sections describe the interfaces between the Energy and Luminosity Ramp-up (ELR) Subproject and the Integrated Project Office & Beam Commissioning (IPO) Subproject.

3.15.1. TBD

4. REFERENCES

4.1. EIC-SEG-PLN-022, EIC Systems Engineering Management Plan