

CAD

EIC Project ↔ ePIC Collaboration

Full Geometry Exchange, Both Ways

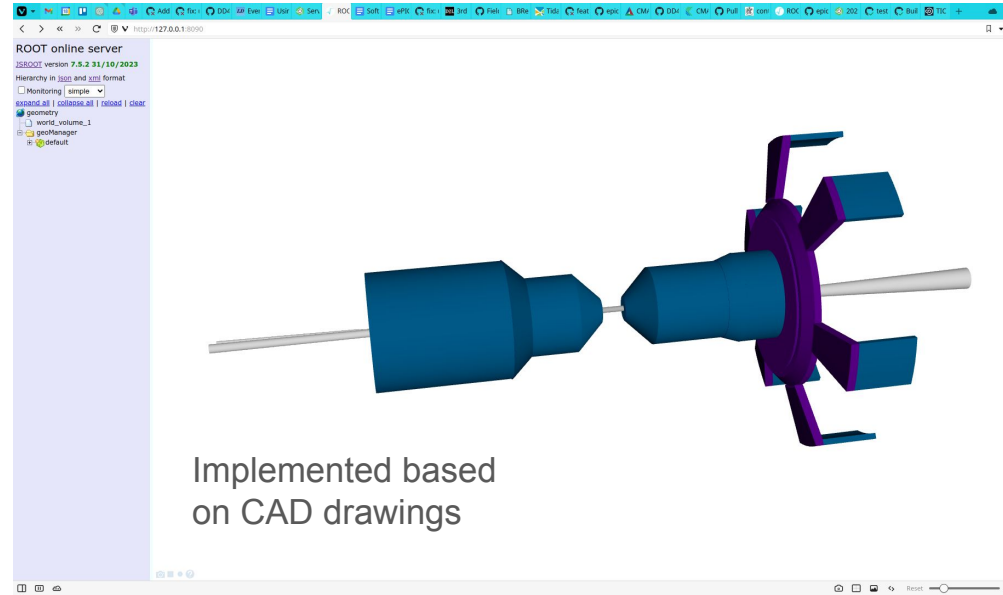
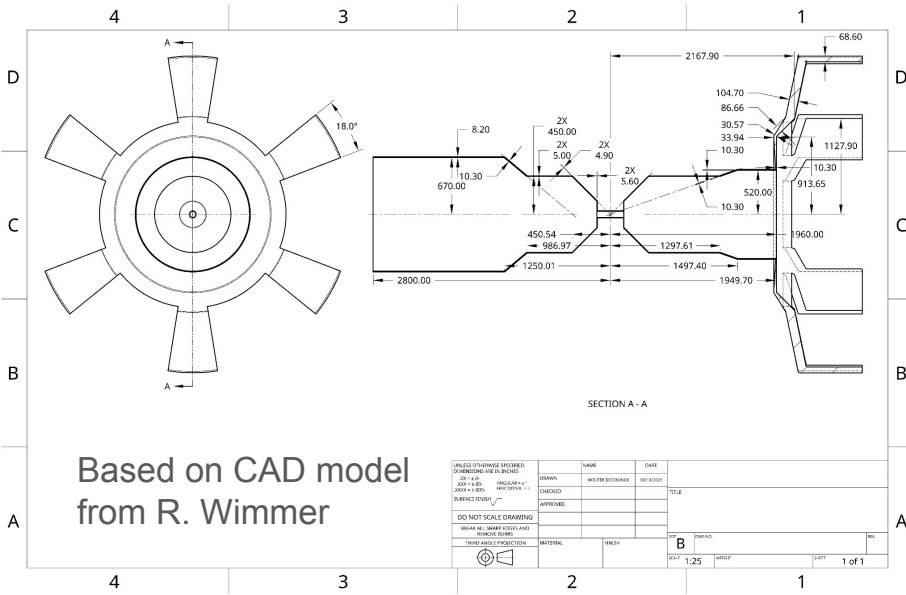
Detector Parameter Table

- Contains **envelope volumes** (not detailed geometry)
 - nothing about beamline, far-forward, far-backward,
 - nothing about support and service routing.
- Insufficient information for level of simulation detail required for TDR.
- Updated at ~quarterly intervals after validation by Tanja and Walt.

Region	Component	Sub-Component	WBS	Length (cm)	Inner Radius (cm)	Outer Radius (cm)	Offset from Center (cm)	Physical Start (cm)	Physical End (cm)	Volume (m ³)	Weight (kg)	Technology	Notes
HADRON DIRECTION END CAP	HD Flux Return (Collar)			170	269	326.2	414.6	329.6	499.6	18.18	142,679	Iron	Offset: measured from center. Weight estimated as 100% iron.
	Hadron Calorimeter		6.10.06	140	17.5	267	359.6	359.6	499.6	31.22	199,896	FeSc, WSc last segment	Tower size: 5cm x 5cm x 140cm including 10cm readout Offset: measured from face nearest to interaction point Weight: estimated as 79% iron and 21% plastic
	HD Flux Return (Oculus)			22.2	195	267	340.7	329.6	351.8	2.32	18,205	Iron	Offset: measured from center. Weight estimated as 100% iron.
	Electromagnetic Calorimeter		6.10.05	30	14.0	195	329.6	329.6	359.6	3.57	23,048	Pb/Sc	Tower size: 2.5 cm x 2.5 cm x 30 cm including readout 10cm Offset: measured from face nearest to interaction point Weight: estimated as 85% lead glass and 15% steel

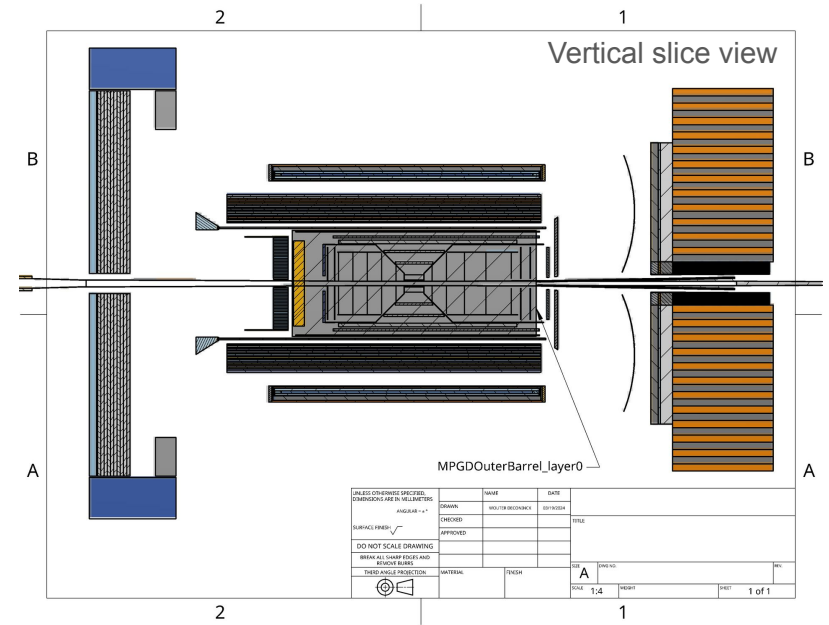
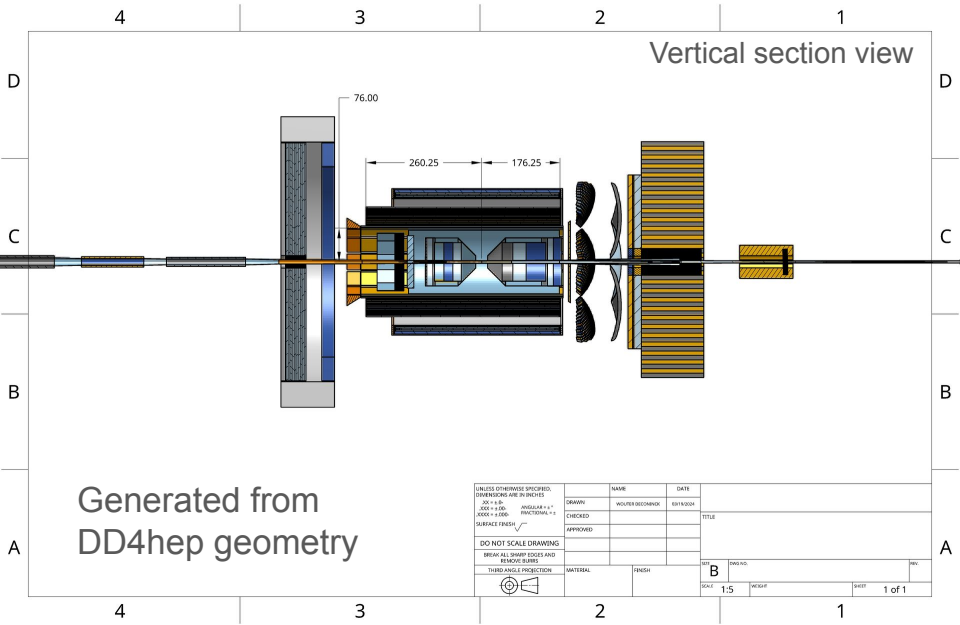
EIC Project to ePIC: CAD Model Snapshots

- **Useful primary source** of dimensions not captured in parameter tables.
- EIC Project CAD models turned into **dimensioned drawings** by ePIC, with relevant dimensions indicated; documentation for geometry implementation.

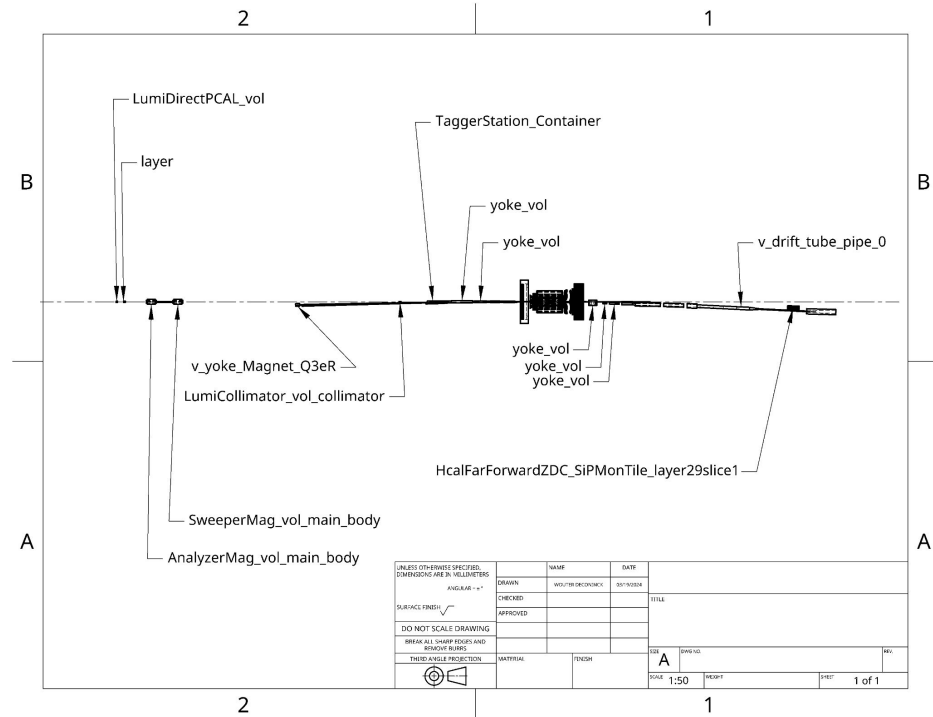
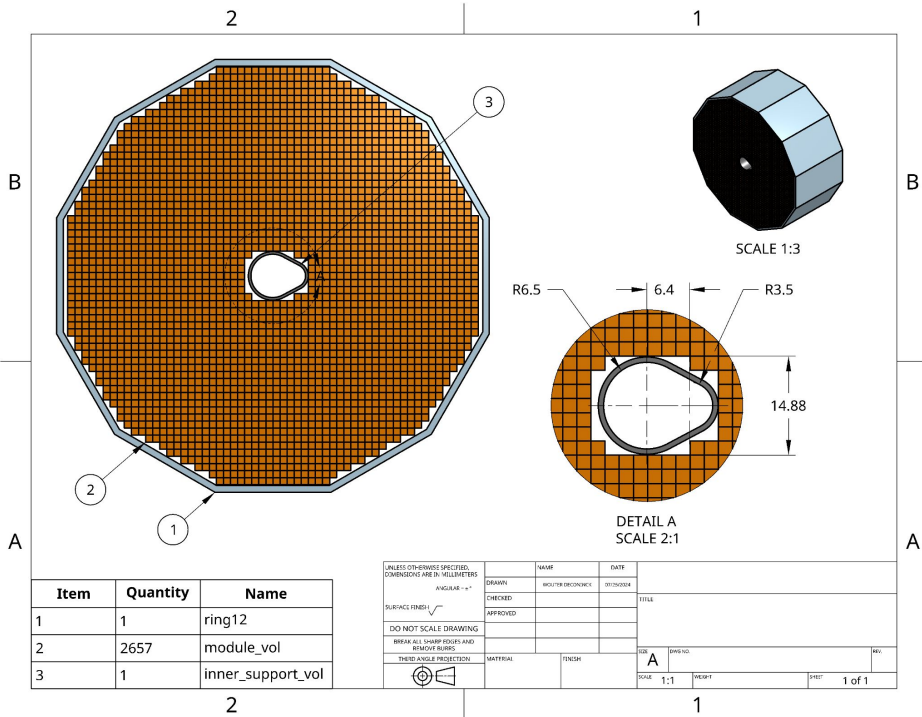


ePIC to EIC Project: Simulation CAD and Drawings

- Reverse direction: ePIC generates CAD models of implemented geometry, which can be turned into dimensioned drawings for the project (verification).
- EIC Project engineers can instantly see our (mis)understanding of geometry.



ePIC to EIC Project: Simulation CAD and Drawings



Physics and Engineers use CAD differently

Engineers

- Sketch & feature-based geometry
- All parts are 'material' objects
 - no inclusion of air/helium/vacuum volumes
- Inclusion of details down to fasteners
- Assembly/installation sequence
- Envelopes for subsystems

Physicists

- Focus on overall material volume (maximum material conditions preferred)
- Layered geometries are used: volumes in volumes in volumes
- Desire for high computational performance of simple volumes (cylinder, box, trapezoid)
- Avoid tessellations in automatic exports

Joint Uses of CAD

- Avoid for overlaps/interferences between and within subsystems
- Dimensional accuracy not affected by approximations inherent in tessellations
- Ability to refer to versioned reference information (e.g. drawing number, release version)

Discussion Starting Point for EIC Project Process

- **What is required?**
 - Regular release of versioned CAD files as reference, in order to include service and support structures in TDR and production simulation campaigns
- **Scope:** current design to the extent it affects signal and background rates:
 - Beamlines, including far-backward to far-forward
 - Central detector geometries, up to flux return barrel and endcaps
 - Support structures inside central detector
 - Not required: cradle, accelerator tunnel, etc.
- **What is missing?**
 - Process for EIC Project approval before versioned CAD files are shared with ePIC

Discussion Starting Point for EIC Project Process

- **Regular process of EIC Project internal collection and validation of CAD:**
 - Coordinated by EIC Project - Detector co-leads, Elke Aschenauer and Rolf Ent
 - decide jointly with ePIC leadership on maximum time between releases
 - decide on next release date in light of EIC Project review schedule
 - Executed by EIC Project engineer
 - Published as versioned collection of CAD files (STEP format) onto a repository accessible to ePIC, possibly with BNL login requirement (e.g. vault, detector parameter table, sharepoint)

ePIC to EIC Project: Simulation CAD and Drawings

Remaining issues with CAD export from simulation:

- No support for TGeoTessellation export (prevents running on geometries with HcalBarrel, even if not included in export).
- Some geometry elements exported incorrectly (may be limited to $r_{min} = 0$ cylinders, primarily vacuum beamline volumes).
- Models can be large, especially for some geometries which are not constructed in a balanced way.
- Embedded volume hierarchies in DD4hep don't translate to parts in CAD context, so gas vessels in RICH detectors may appear to be missing.