Geometry exchange between Simulations & Engineers

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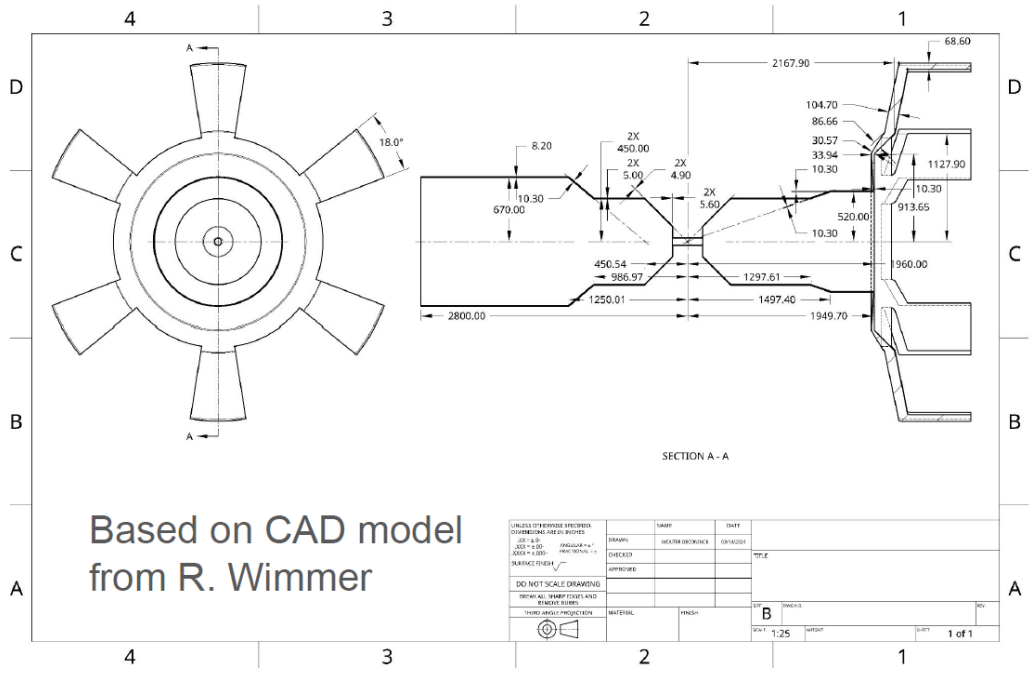
ePIC Physics and Detector Simulation WG

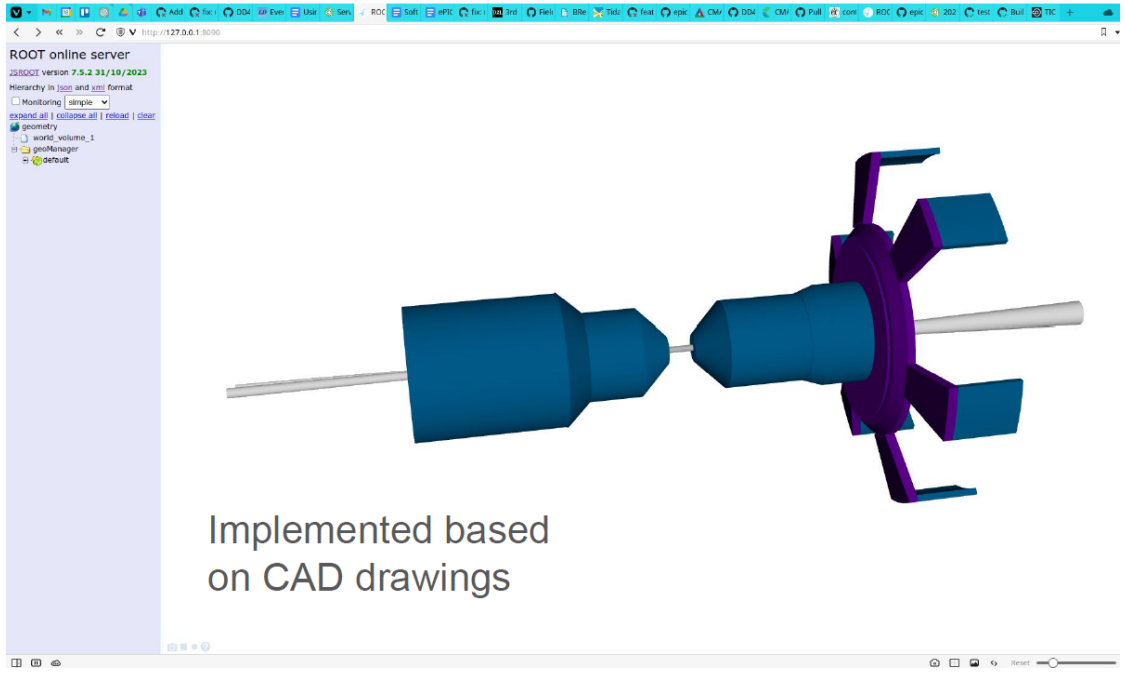
Jan-21-2025

Integration Workfest, ePIC Collaboration Meeting 2025/01

Geometry Exchange

- A joint efforts between ePIC and EIC project
  - CAD model provided by project engineers
  - Implemented simulation geometries in DD4Hep





Evaluation of Simulation Geometries

- Previously done with geometry parameter tables (updated by Tanja and Walt)
  - Insufficient geometry information: Envelope volumes; no support and service routing geometries; no beamline, far forward, and far backward

EIC DETECTOR GEOMETRY

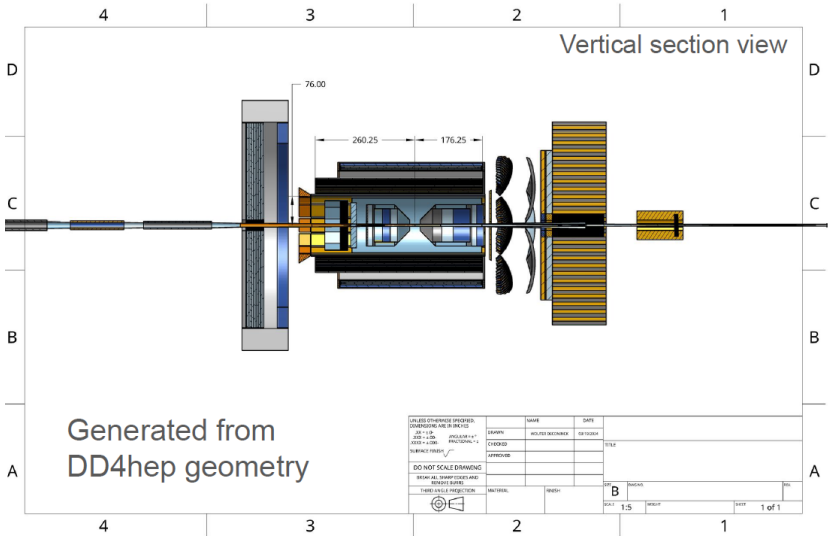
INTERACTION POINT 6

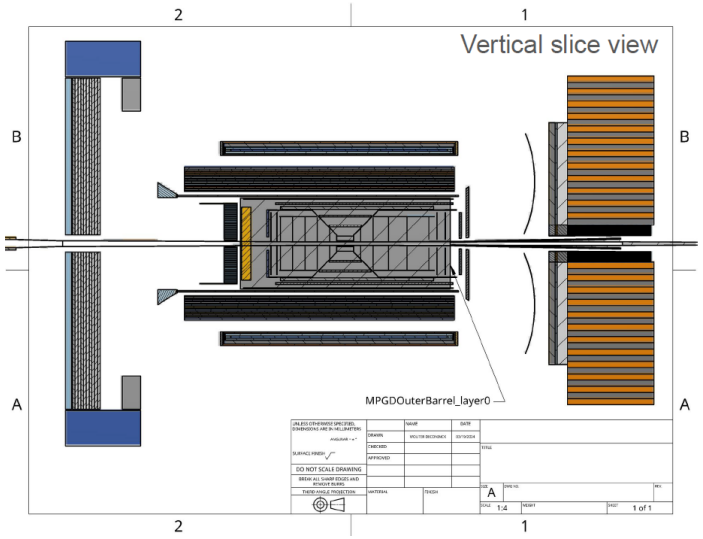
Region	Component	Sub-Component	WBS	Length (cm)	Inner Radius (cm)	Outer Radius (cm)	Offset from Center (cm)	Physical Start (cm)	Physical End (cm)	Volume (m^3)	Weight (kg)	Technology	Notes
HADRON DIRECTION END CAP	HD Flux Return (Collar)			170	269	326.2	414.6	329.6	499.6	18.18	142,679	Iron	Offset: measured from center. Weight estimated as 100% iron.
	Hadron Calorimeter		6.10.06	140	27.5	267	359.6	359.6	499.6	31.02	198,628	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 Inner radius is driven by the size and shape of the beam pipe.
	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	20.5	195	329.6	329.6	359.6	3.54	22,911	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 Inner radius is driven by the size and shape of the beam pipe.
	Service Gap			9.6			320	320	329.6				Offset: measured from location nearest to interaction point

https://agenda.infn.it/event/43344/sessions/31803/#20250121

CAD Model and Drawings from Simulation

- ePIC generates CAD models of implemented sim. Geometries
  - Drawings from the CAD models
  - Annotations for dimensions
  - Provided to EIC project engineers for verification
- Initiated by Wouter, now work in progress by the Physics and Detector Simulation WG (Chao & Sakib)

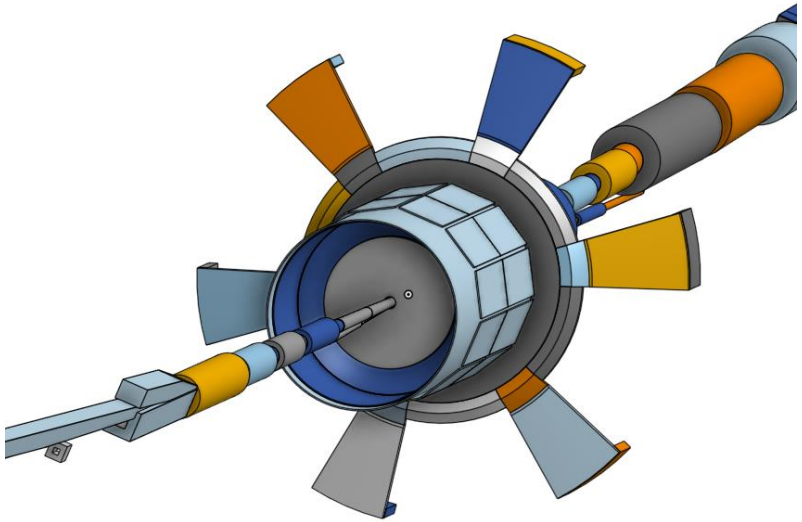


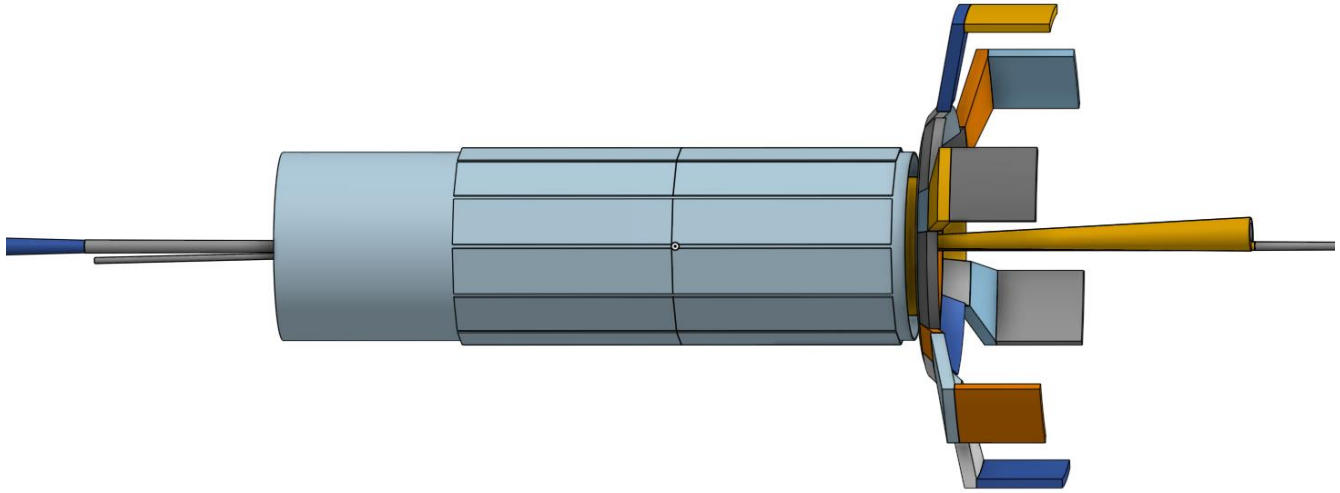


Current Status of the Exchange

- Subsystems are separated into several groups
  - **Tracking, PID**, ECal, HCal, far forward, far backward
  - Drawings for the individual subsystem and the whole group
  - Beamline and support/service routing geometries will be provided along with the corresponding groups
- CAD model conversion using OpenCascade interface
  - Originally from ROOT, but deprecated recently
  - Now a NPSIM tool maintained by the ePIC software team
- CAD drawings
  - Initial drawing package generated **manually** with OnShape, eventually planned for an **automated process**
  - **Waiting** for feedbacks from project engineers

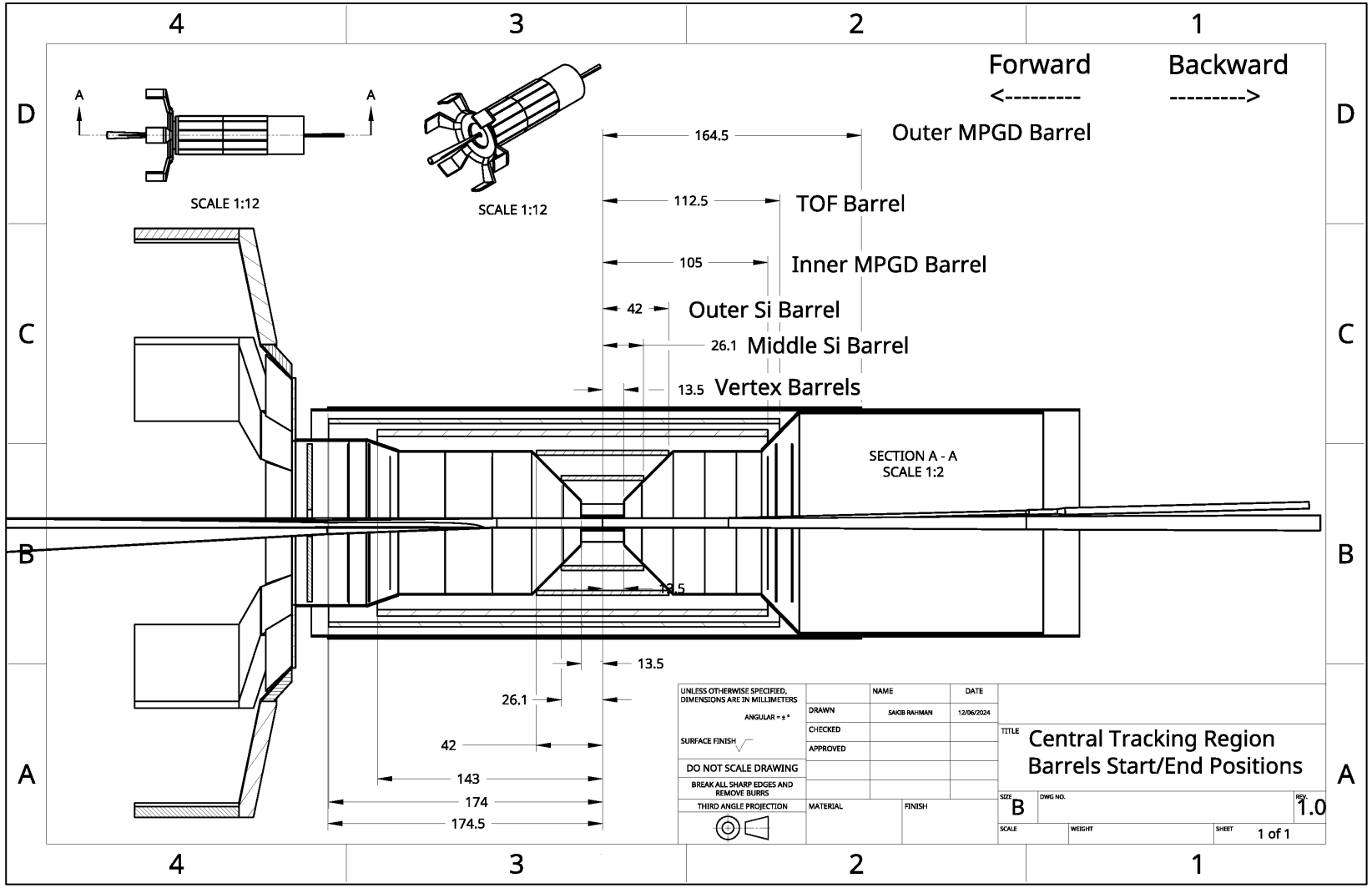
Converted CAD Model for Tracking





Work by Sakib

CAD Drawing for Tracking



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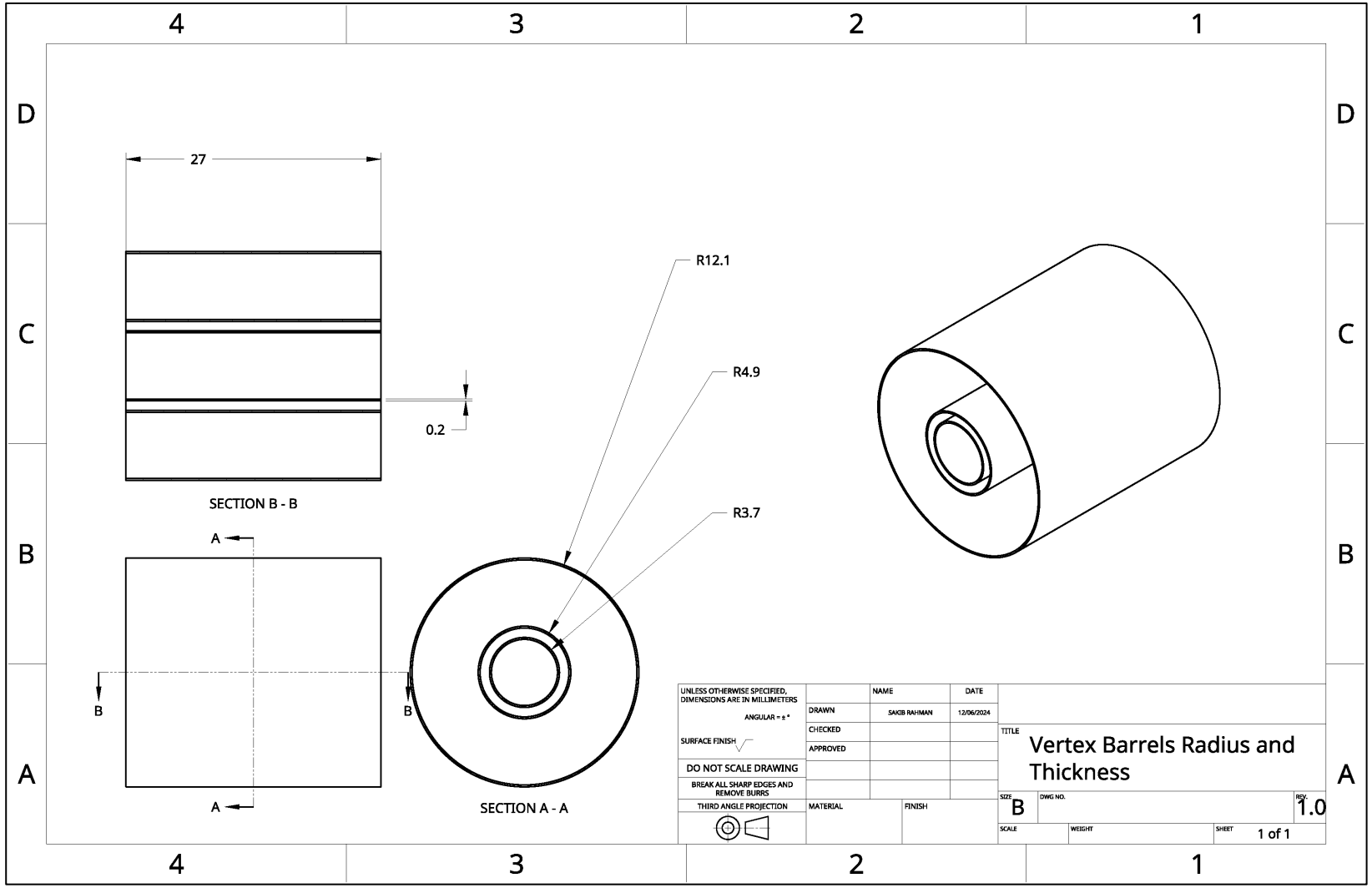
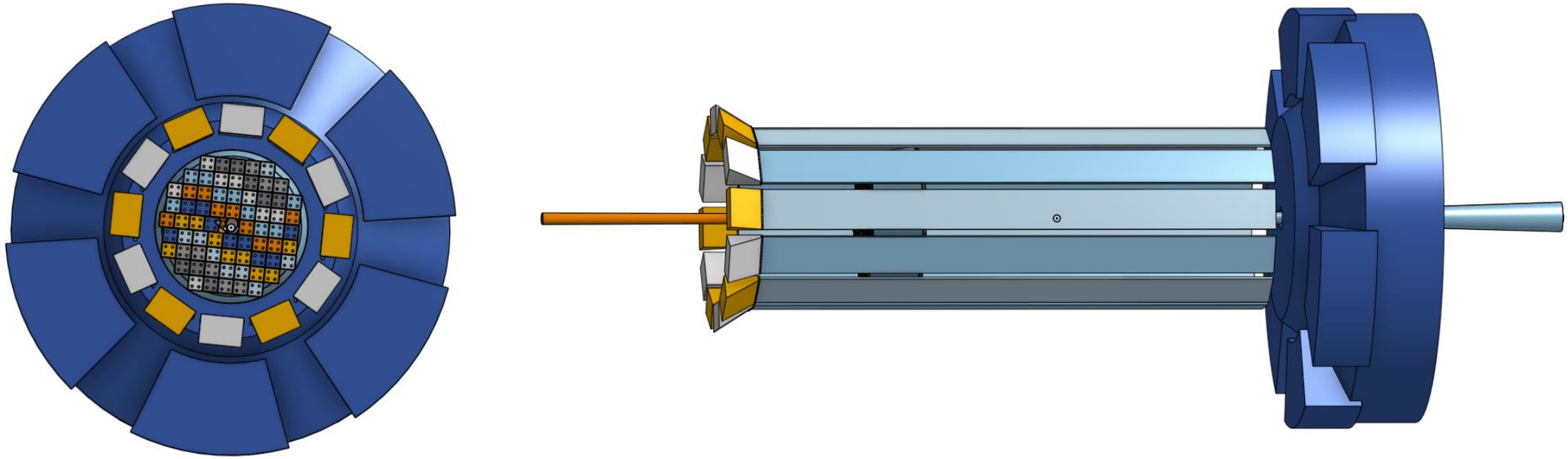
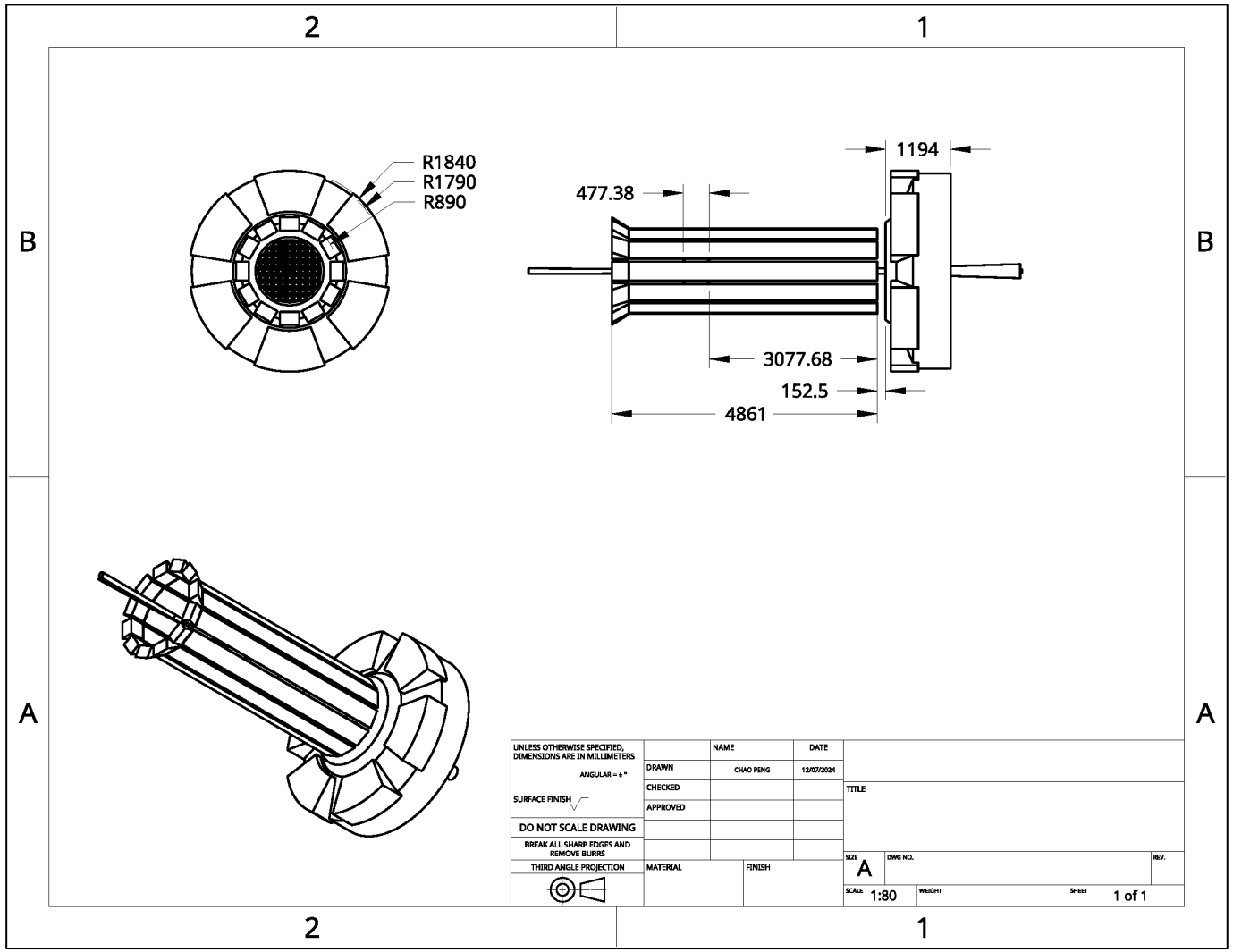


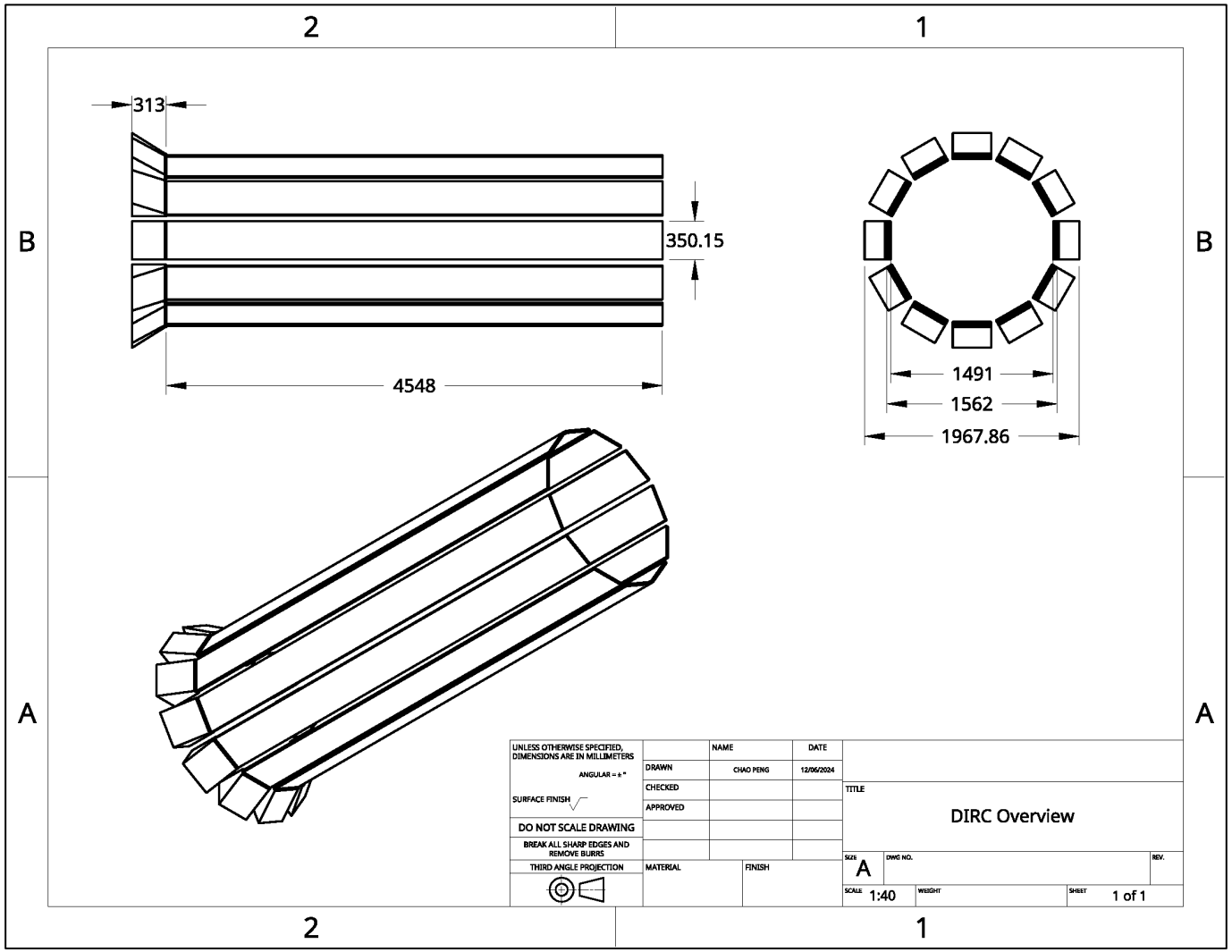
Converted CAD Model for PID



CAD Drawing for PID



CAD Drawing for PID - DIRC



Summary

- Evaluation of simulation and engineering designs started
  - First draft of CAD drawings for tracking and PID
  - Waiting for feedbacks from project engineers (to finalize the drawings)
- CAD drawings for all subsystems
  - Currently a manual work
  - Planned for an automated process (using OnShape API) in the CI
- Remaining issues
  - model conversion: lack of support for TGeoTessellation; export errors; performance issue; embedded volume hierarchies (only a single level translated)
  - Workforce needed