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Design for the Spiral Barrel Yoke of CEPC Detector: A Self-Supporting Installation Scheme

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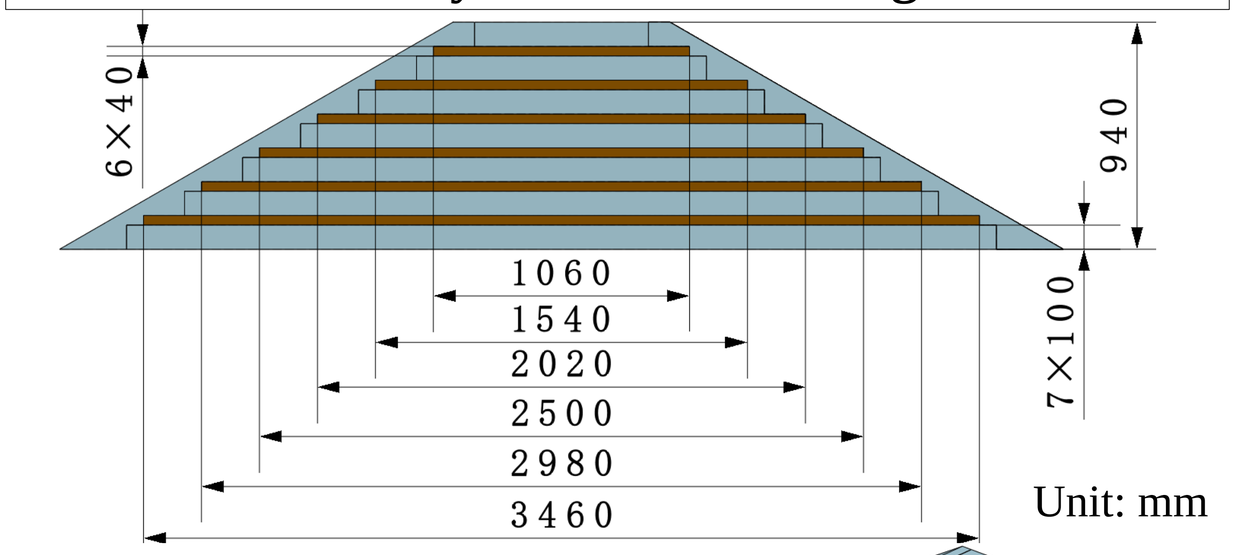
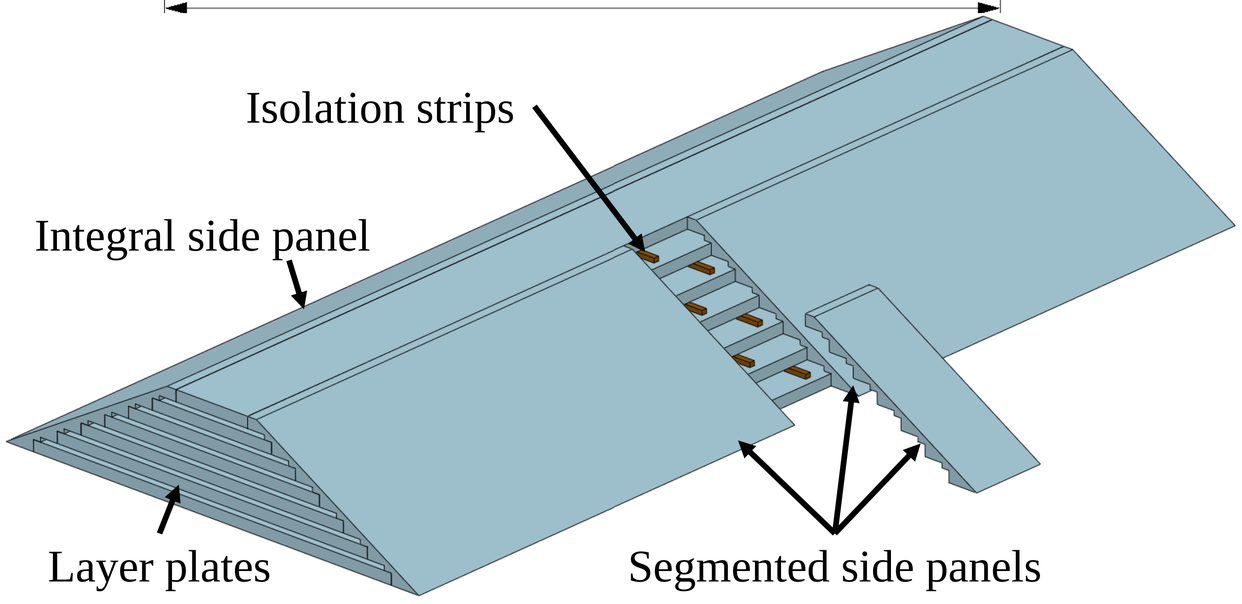
Abstract

Leveraging the spiral structure of the CEPC detector barrel yoke, we have designed an innovative installation scheme. This scheme comprises three primary parts: the barrel yoke module, end flange, and barrel yoke support structure. By dispensing with the auxiliary installation structure traditionally used, the barrel yoke can be installed utilizing its own end flange, thereb y streamlining the installation process. The design of the end flange also significantly enhances the structural strength of the barrel yoke. Furthermore, this installation scheme minimizes material waste and optimizes the use of underground space.

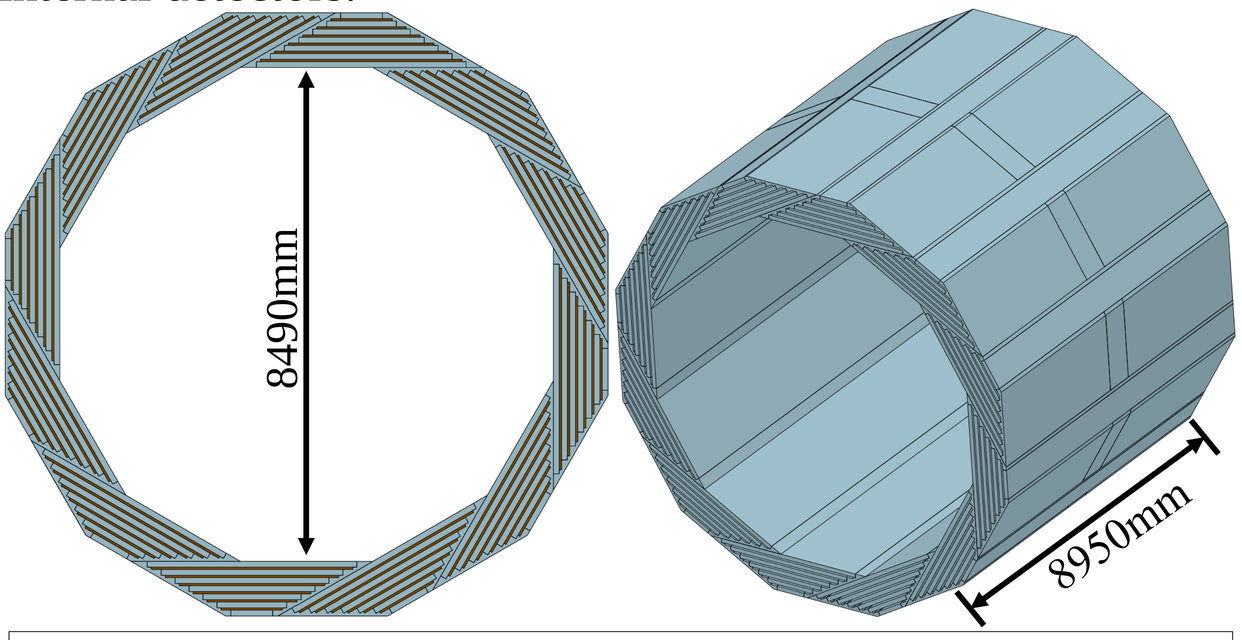
Detailed Structure

Barrel yoke structure design

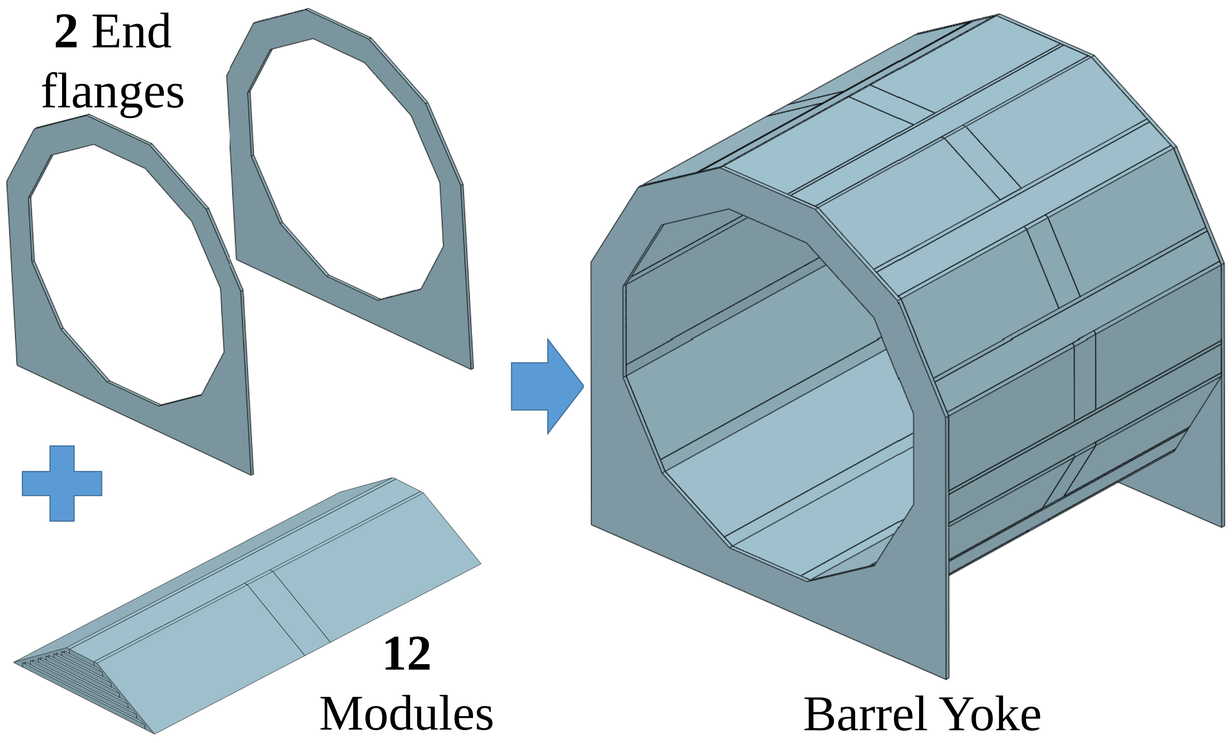


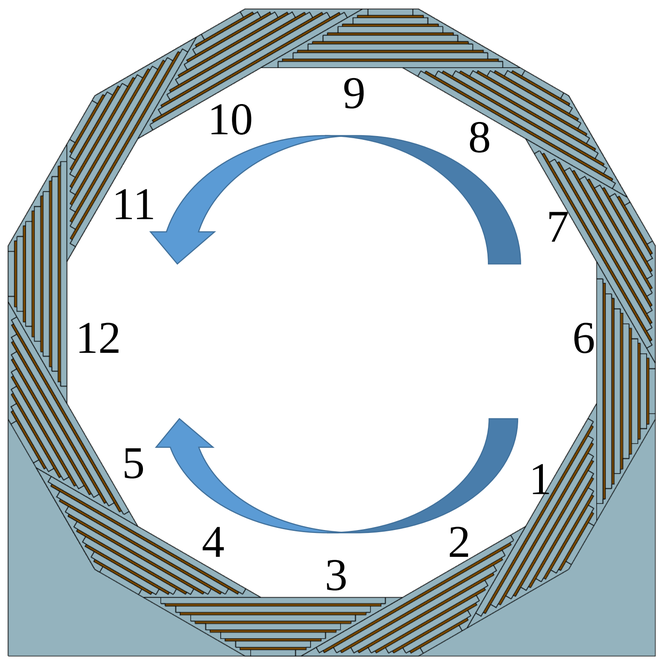


Design: dodecagon structure with 12 modules
Layer plates: 7 layers, 100mm / each
Muon detector space: 6 layers, 40mm / each
Feature: The width of the spiral module is gradually reduced from the inside to the outside of the barrel yoke. The spiral module can open the segmented side panels for installation and maintenance of the muon detectors without disturbing the internal detectors.



Barrel yoke installation design



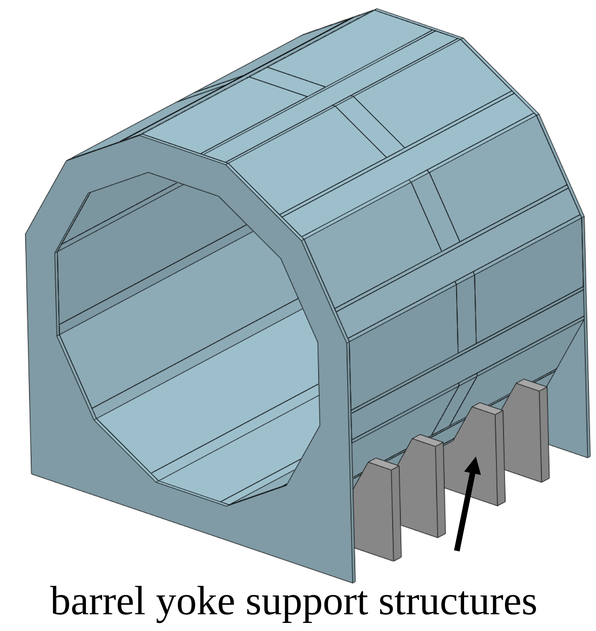


Installation method:
Both ends of module can be fix ed to end flanges. Then comple te the installation of the barrel yoke module according to the installation sequence shown on the left. The end flanges is part of the barrel yoke, which does not need to be removed, nor do es it require additional auxiliar y installation structure, and no material waste.

Barrel yoke simulation & optimization

Deformation of end flanges of gravity — Unit: mm

Sequence	1	2	3	4	5	6	7	8	9	10	11	12
Flange deformation	0.12	0.12	0.12	0.12	0.18	0.26	0.32	0.66	1.13	1.27	1.29	1.07



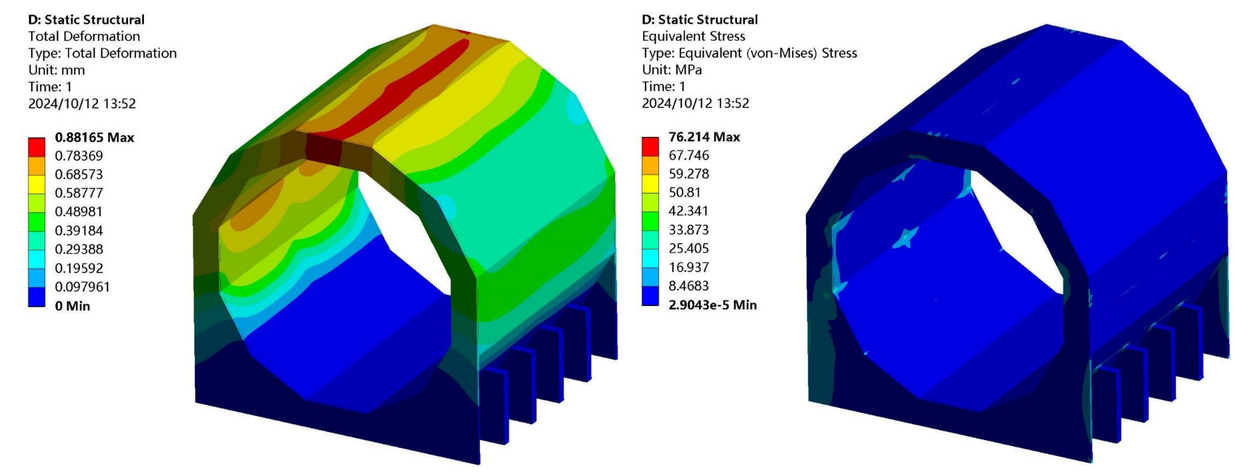
barrel yoke support structures

Key: The end flanges will be deformed during the installation of module. When the top modul es of the barrel yoke is installed, the deformation is large, which may affect the installation of subsequent module.
Optimization: Support the bottom modules to reduce end flanges deformation.

Deformation of end flanges of gravity (optimized) — Unit: mm

Sequence	1	2	3	4	5	6	7	8	9	10	11	12
Flange deformation	0.11	0.11	0.11	0.11	0.11	0.13	0.15	0.45	0.88	1.01	1.02	0.80

Barrel yoke simulation results of self-weight



Deformation max
0.88mm

Equivalent Stress max
76.21MPa

Conclusion: After supporting the bottom modules of the barrel yoke, deformation of the end flanges is reduced during the module installation. The addition of barrel yoke support structures is more conducive to the installation of the barrel yoke module. It also increases the strength of the barrel yoke. From the simulation result, we can also enhance the accuracy of installation and minimize the risks associated with installa tion. Subsequently, the barrel yoke support structure and end flange structure will be optimized continually.