

Integration of the new IT in the BESIII experiment

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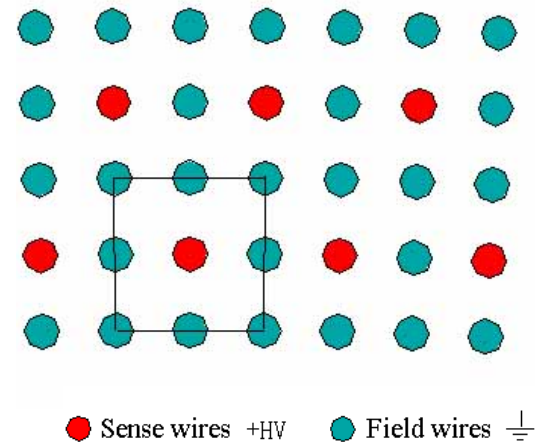
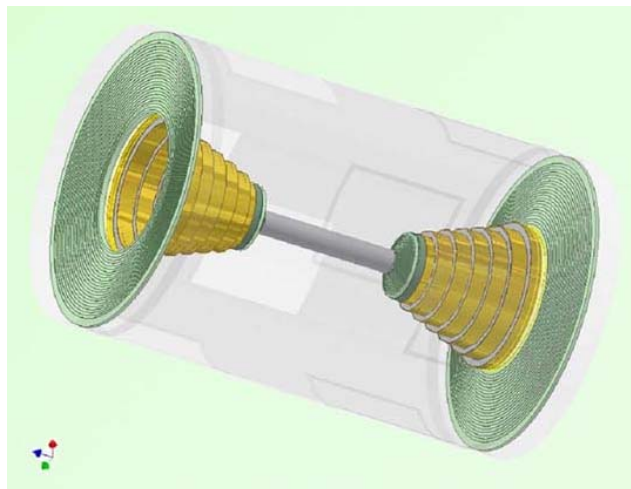
representing the working group

Outline

- Aging problems of MDC
- Status of the new inner drift chamber
- Consideration and preparation for the inner chamber replacement
- Cable routing and other issues for CGEM installation

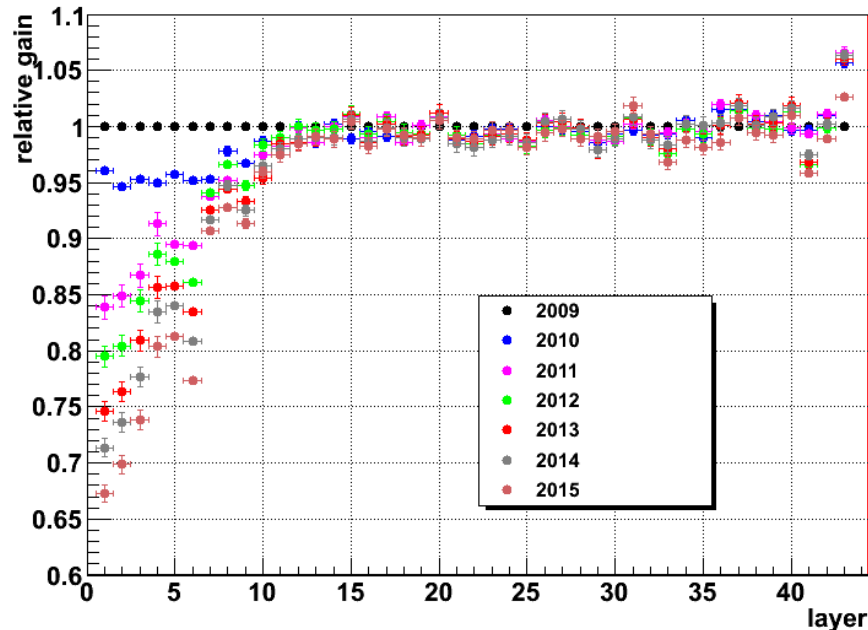
MDC anode aging problems

- The MDC is the main tracking detector of the BESIII
- It consisting of an inner chamber including 8 layers and an outer chamber including 35 layers
- MDC works with a helium based mixture gas ($\text{He} / \text{C}_3\text{H}_8 = 60 : 40$), in a 1 T magnetic field.
- After running for seven years, the gain of the MDC cells shows an obvious decrease, which leads to the SNR becoming bad and results in a reduction of MDC performance



MDC anode aging problems (2)

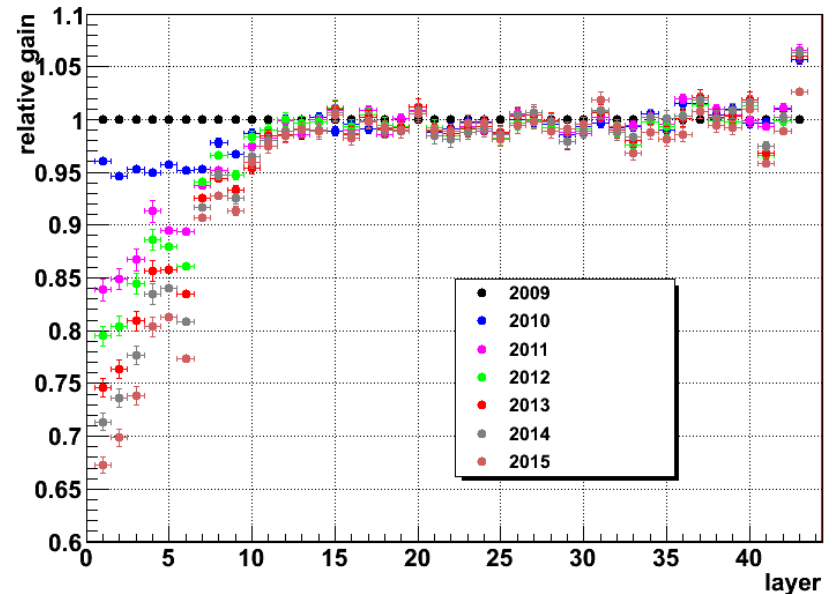
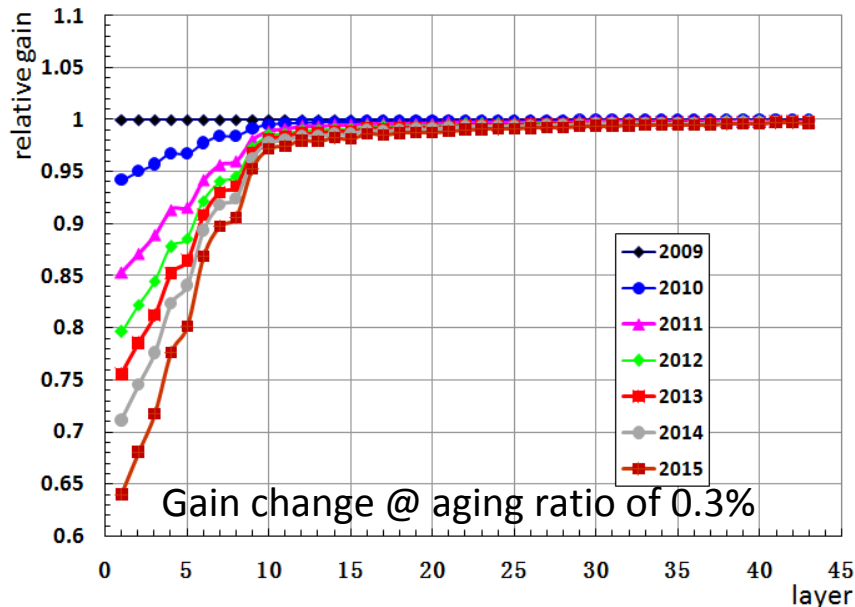
□ The Gain decrease of the cells in each year



- The Q peak change of the cells in each year can be get from Bhabha events, which gives the gain decrease
- The gains of the first 10 layers experience an obvious decrease after 7 years of operation, reaching a maximum decrease of about 33% for the first layer cells, but the gains of the outer layer cells have almost no change

MDC anode aging problems (3)

□ The Gain change by aging ratio



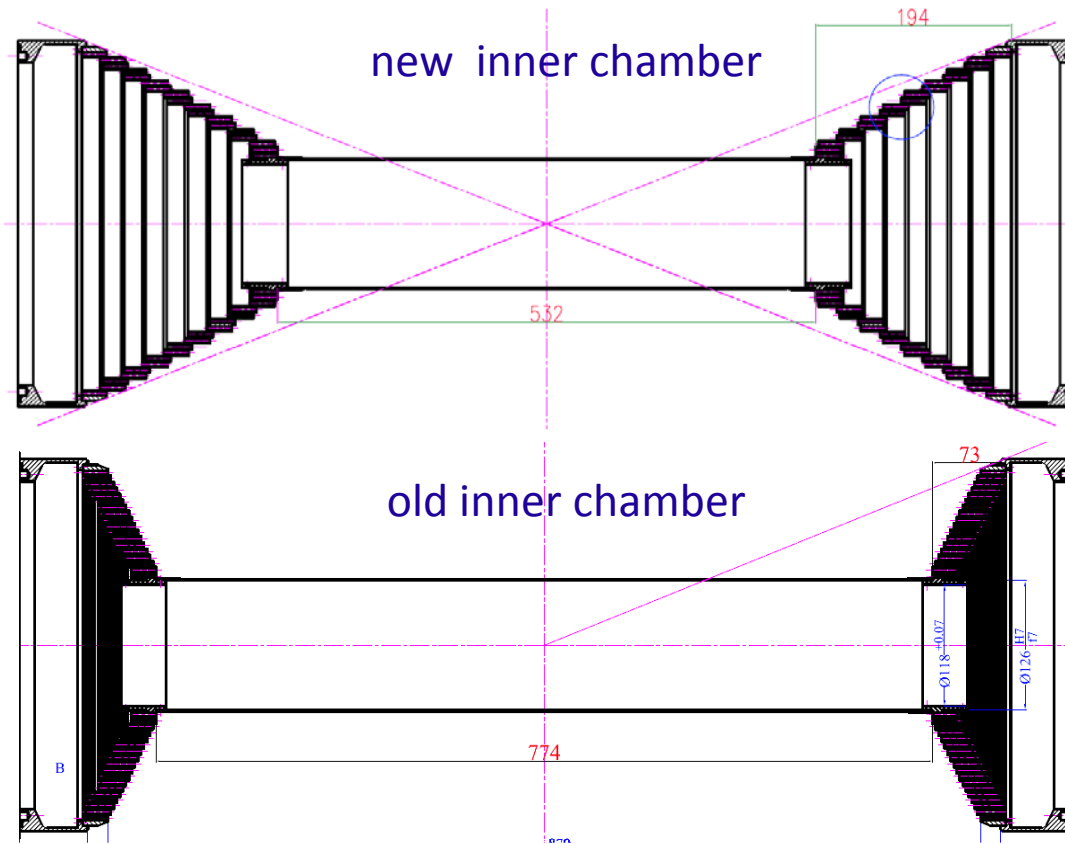
- The gain change of a cell can also be extracted from the accumulated charge and aging ratio
- The result is consistent with the one calculated from Bhabha events before 2014, but in this year, the two results have a little bigger difference
- Considering that the BESIII will work to 202X, we must prepare a new inner tracker to replace the current one

$$R = -\frac{1}{Q} \cdot \frac{\Delta G}{G} \% \bigg/ (mC / cm)$$

$$\frac{\Delta G}{G} \% = -RQ$$

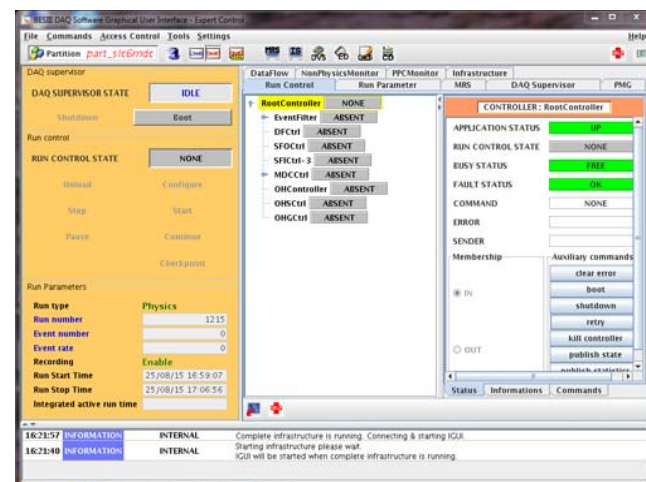
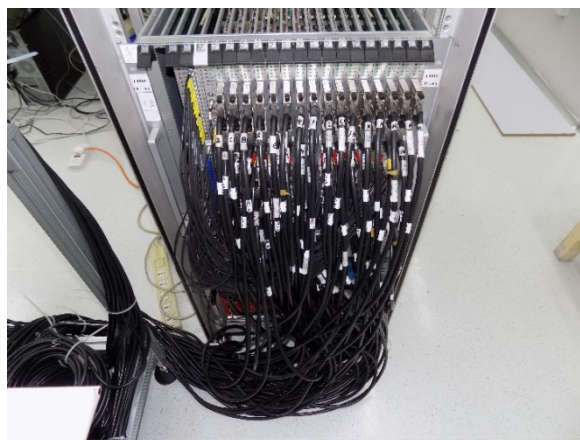
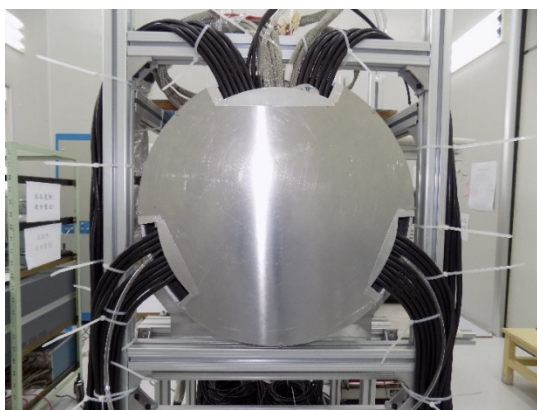
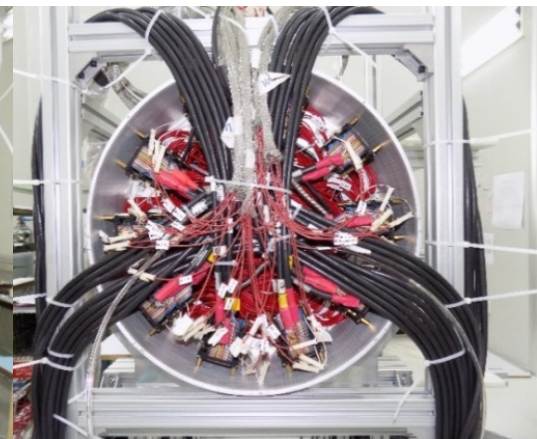
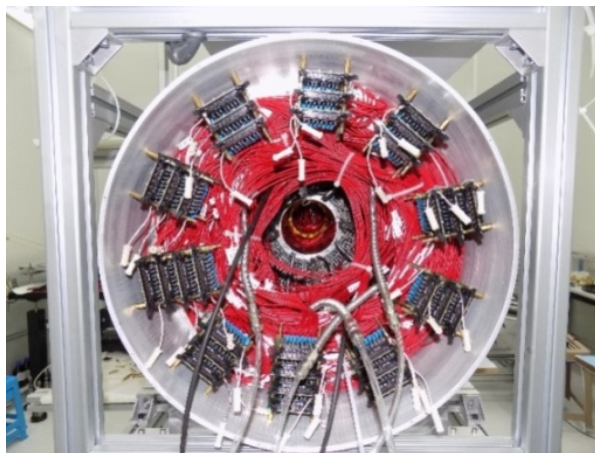
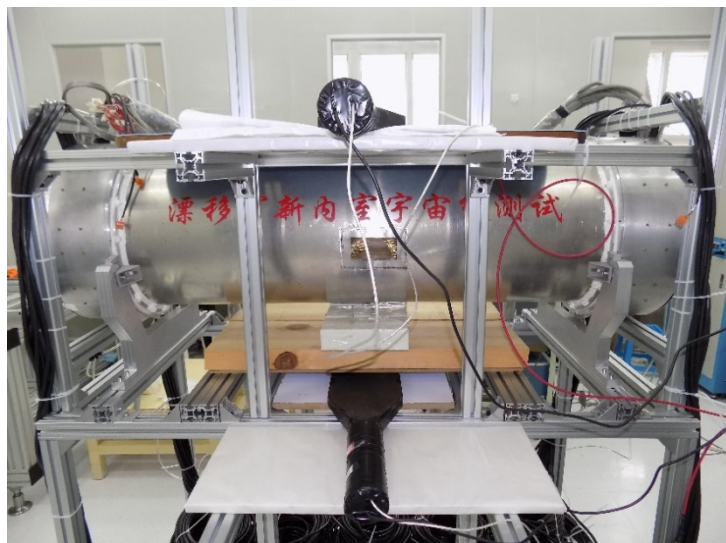
New inner drift chamber

- The construction of a backup new inner drift chamber has been finished by the end of this summer
- Stepped endplates are used to shorten the wire length out of the effective solid angle, which will reduce the dark current of the cells and improve the survival probability of the new chamber working at the big beam induced background



New inner drift chamber (2)

□ Cosmic-ray test



- Cosmic-ray test of the new inner chamber started 2 months ago
- Preliminary result shows that the new inner chamber work well

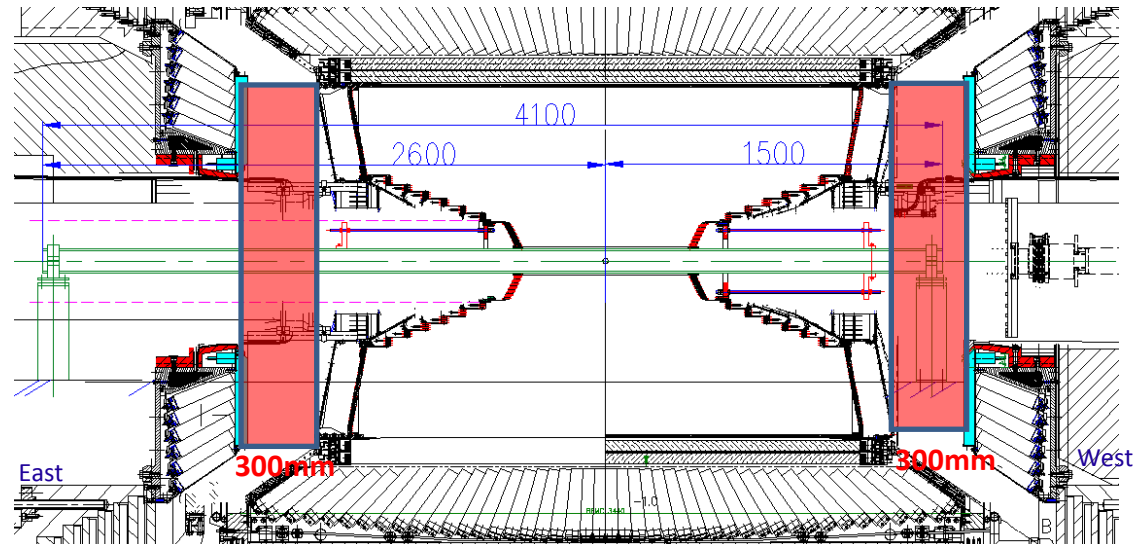
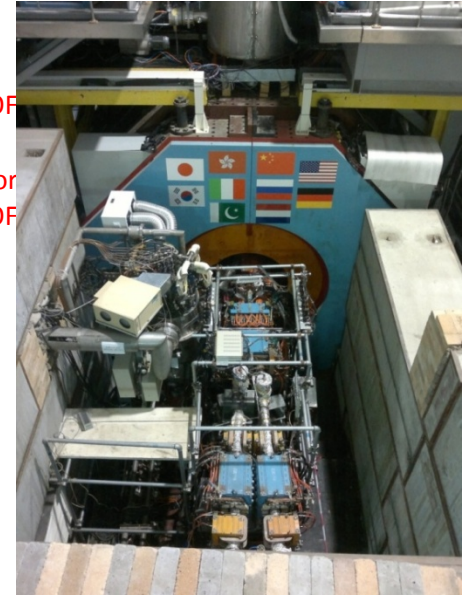
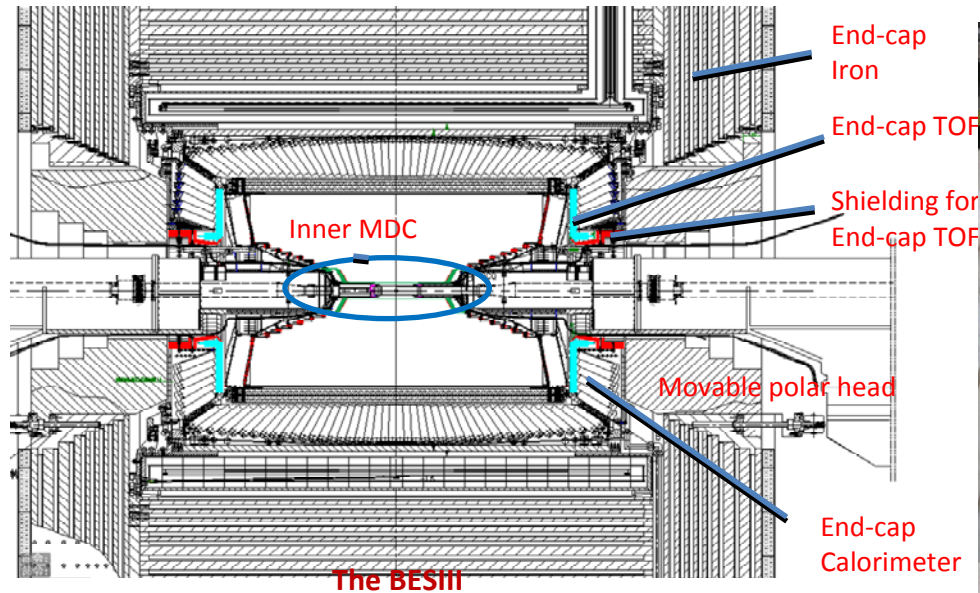
Consideration of the inner chamber replacement

- MDC has no cylinder to separate the inner part and the outer part. The inner chamber and the outer chamber are jointed together at the endplates and sealed with “O” rings and epoxy glue. The replacement of the inner chamber without damaging the feed-throughs and the wires of the out chamber is not easy.
- The inner tracker removal include the follow steps:
 - Remove shieldings, cables and preamplifiers for inner and stepped chamber
 - Clean epoxy glue for inner MDC, flanges and all kinds of screws
 - Install and adjust the removal toolings
 - Remove inner MDC

consideration of the inner chamber replacement (2)

□ The inner chamber is considered to be replaced on-site.

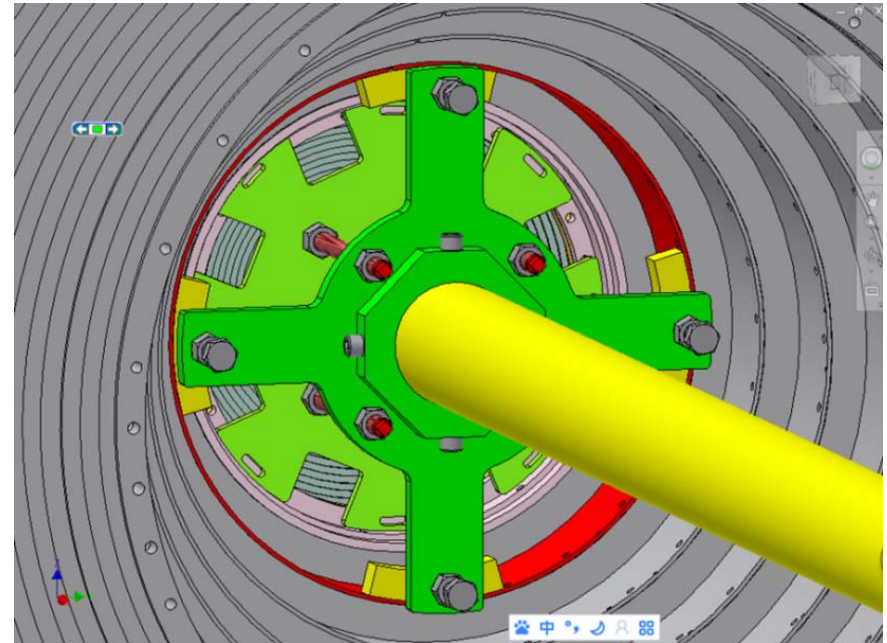
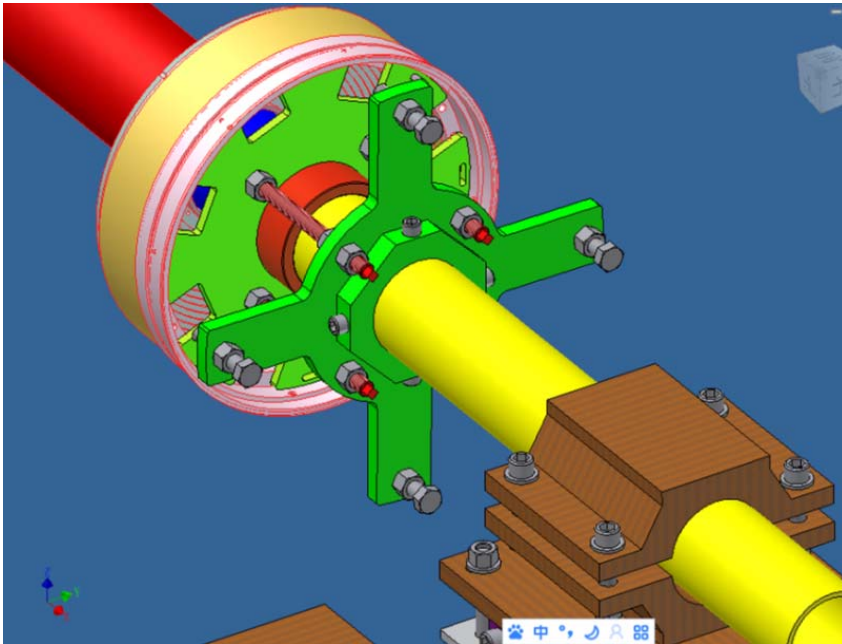
- The below parts need to be removed:
Beam pipe, shielding, SCQ, end-cap calorimeter, cooling pipe, cables
- After end-cap calorimeter be pulled out, there will be only 300mm gap for operating of the replacement
- Need find space to fix the 4.1m long axis for the inner tracker replacement
- The inner chamber will be removed from east end.



consideration of the inner chamber replacement (4)

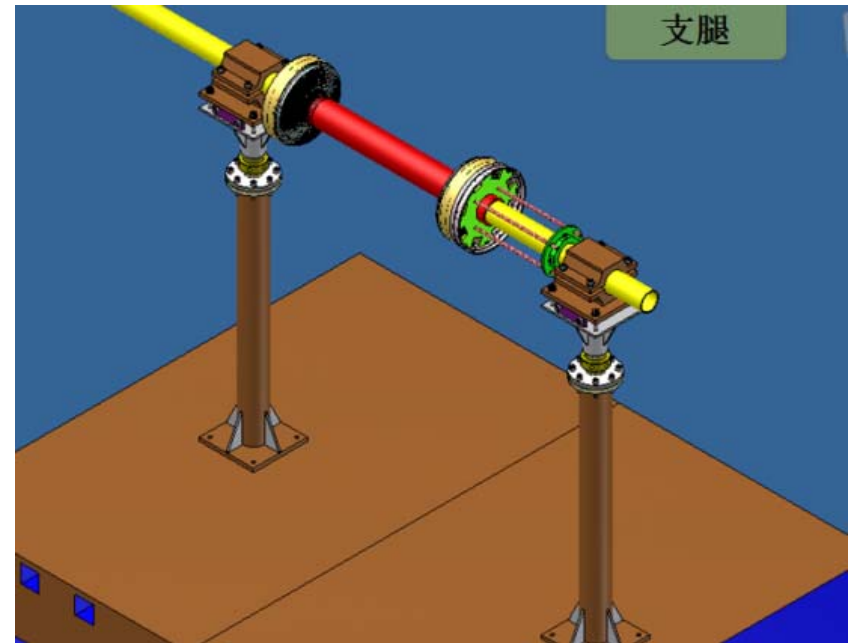
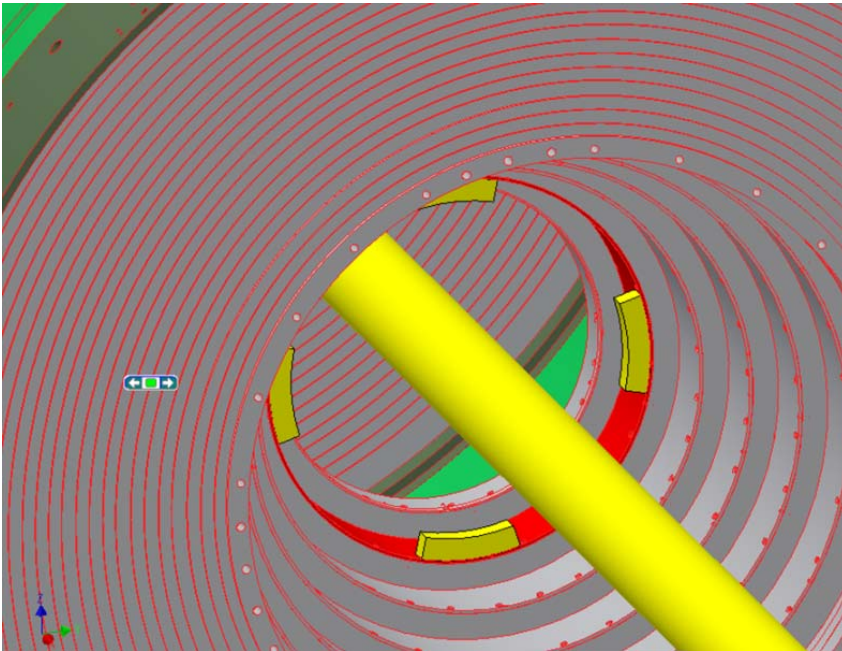
- ▣ Main conclusions of the prototype study for the inner chamber removal
 - The epoxy glue can be cleaned without major problems, but very careful operation needed to protect the feed-throughs and the wires.
 - It is possible to remove the inner chamber out, and a real-time wire tension measurement seems very useful. Wire tension probably changes during the operating but will come back to the normal value after then.

Preparation of the replacement toolings



- Safeguard
 - two inner endplates will be fixed on a sleeve through the mechanical supports to reduce the deformation of the inner chamber
 - two mechanical support will be assembled at the first stepped-plate of each end to reduce the deformation of the outer chamber and avoid damaging the feed-throughs and the wires
 - A real-time wire tension measurement during pulling out the inner chamber will also be done to avoid damaging the wires

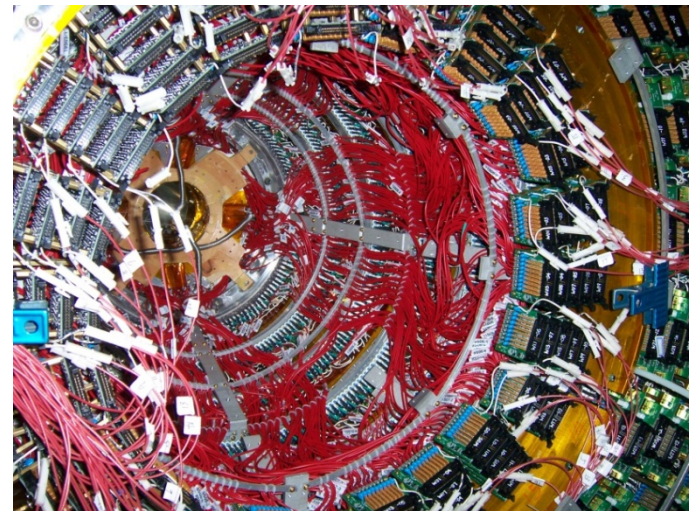
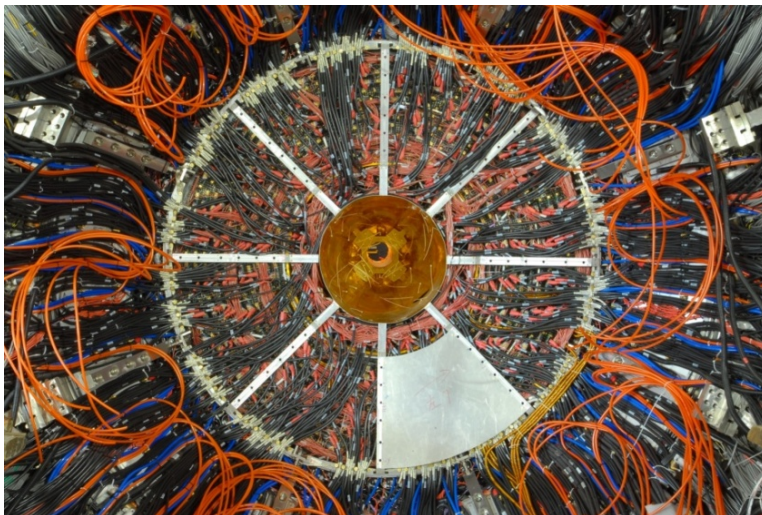
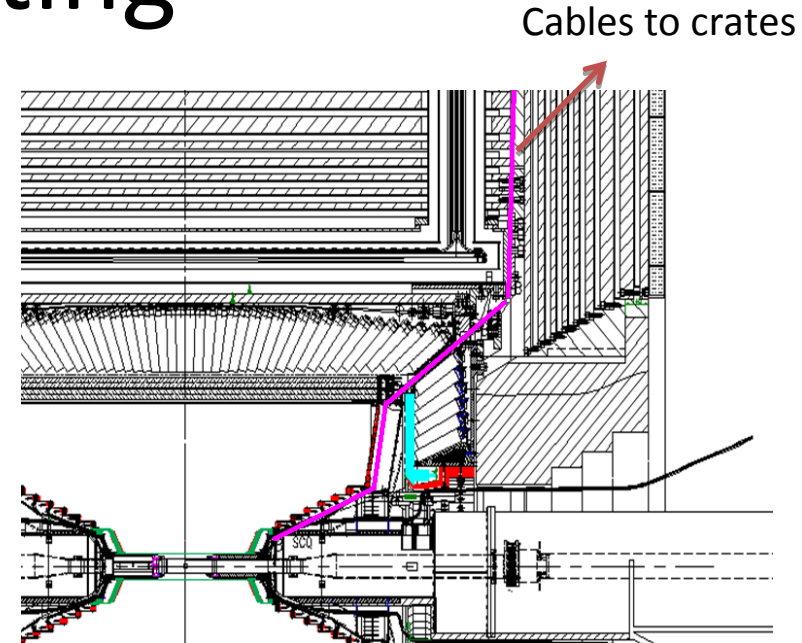
Rough replacement procedure



- install the sleeve and the inner chamber mechanical support at each endplate
- install the out chamber mechanical support at the first stepped-plate of each end
- Fix the main axis
- Fix the pulling rods to the east end of the inner chamber through the mechanical support
- Remove the screws which joint the inner and out chamber together
- Pull out the inner chamber through the pulling rods
- Install the new inner tracker based on the inverse operation of the removal

Cable routing

- All of the BESIII electronics and HV crates are put in the electronics platform in floor 1 to 3 of BESIII. The cables with the length of 18m go out from the detector to the corresponding crates divided by 8 sectors in phi direction, not by layers.
- Firstly, the cables are go out from the detector to the endplates of the MDC, then pass through the endplates of the MDC and the gap between the barrel and end-cap E-Cal to the end-cap of iron, and then go out to the crates.
- The available space for the detector cabling is very limited



Cable routing for the CGEM

- There will be HV distribution crates to connect the HV modules and the CGEM detectors. These distribution crates are required to put near the detector, but there is no space in the detector. Can be put out of the BESIII, one benefit is the capability of fast maintenance.
- For the CGEM HV cables from the detectors to the distribution box, the safety length should be 18m in principle.
- This summer machine maintenance period, we have checked the space on-site, and found few suitable places to put the boxes, which can shorten the length of the cable to about 10m.
 - North side in floor 1 of the BESIII
 - South side in floor 1 of the BESIII
 - Top side in floor 3 of the BESIII
- The signal cables and electronics crates have not been taken into account yet

Gas pipe consideration

- The gas flow into the MDC at east endplate, and flow out of MDC at west endplate
- There are 8 gas pipes at each endplate of MDC (4 pipes for the outer chamber and 4 pipe for the inner chamber). So for the CGEM, the 4 gas pipes are available



Other issues for CGEM installation

- Consideration of using the replacement toolings which will be manufactured. Suitable holes should be reserved in the CGEM mechanical structure to match the toolings for the CGEM installation
- We should pay attention to the electronics noise because of the complex EM environment of the IP . Maybe shielding for the detector should be considered
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Summary

- The gains of the first 10 layers of MDC experience an obvious decrease after 7 years of operation, reaching a maximum decrease of about 33% for the first layer
- The new inner drift chamber has been finished and are under cosmic-ray test
- We have done the experiments of the old inner chamber removal, The prototype studies show that the removal of the inner drift chamber out may be no major problems
- Replacement toolings have been designed and passed the first review, and will be manufactured soon

Thanks for your attention!