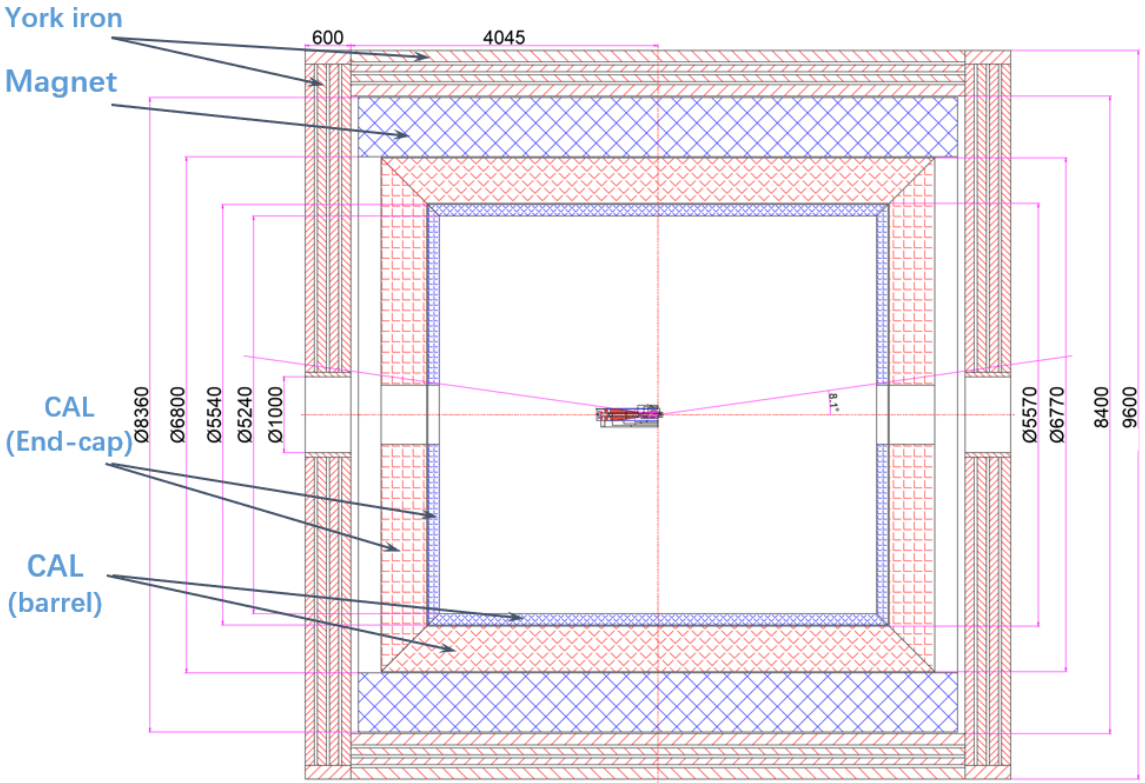
Progress in overall mechanical design of CEPC Detector

Ji Quan
January 20, 2021

1. Review and summary of work in 2020

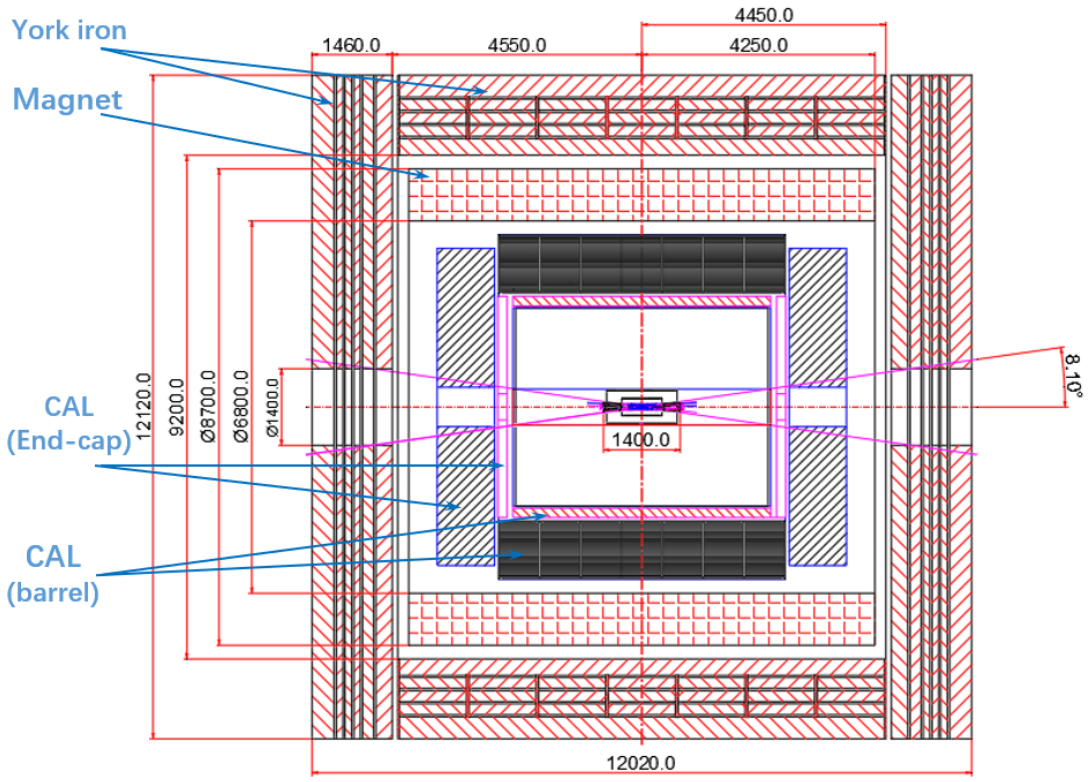
1) General layout design --- **According to CDR, three versions of general layout are completed**

Layout 1



June 29, 2019

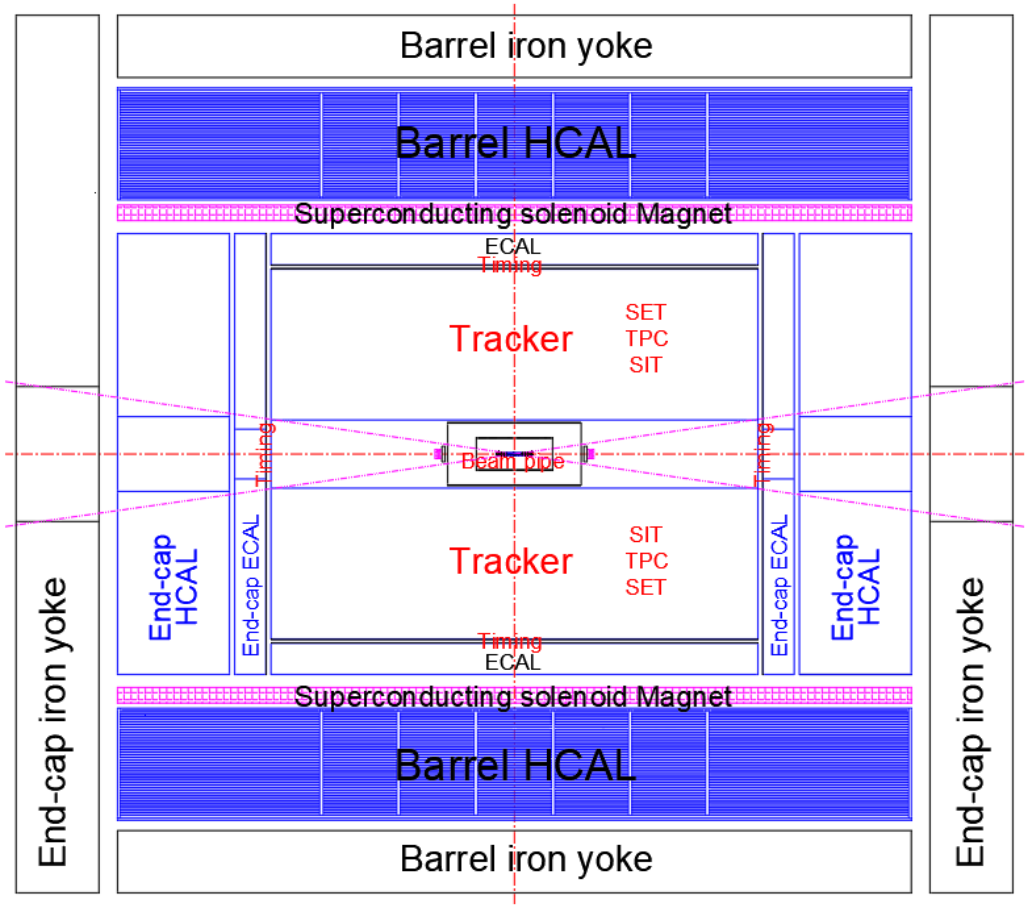
Layout 2



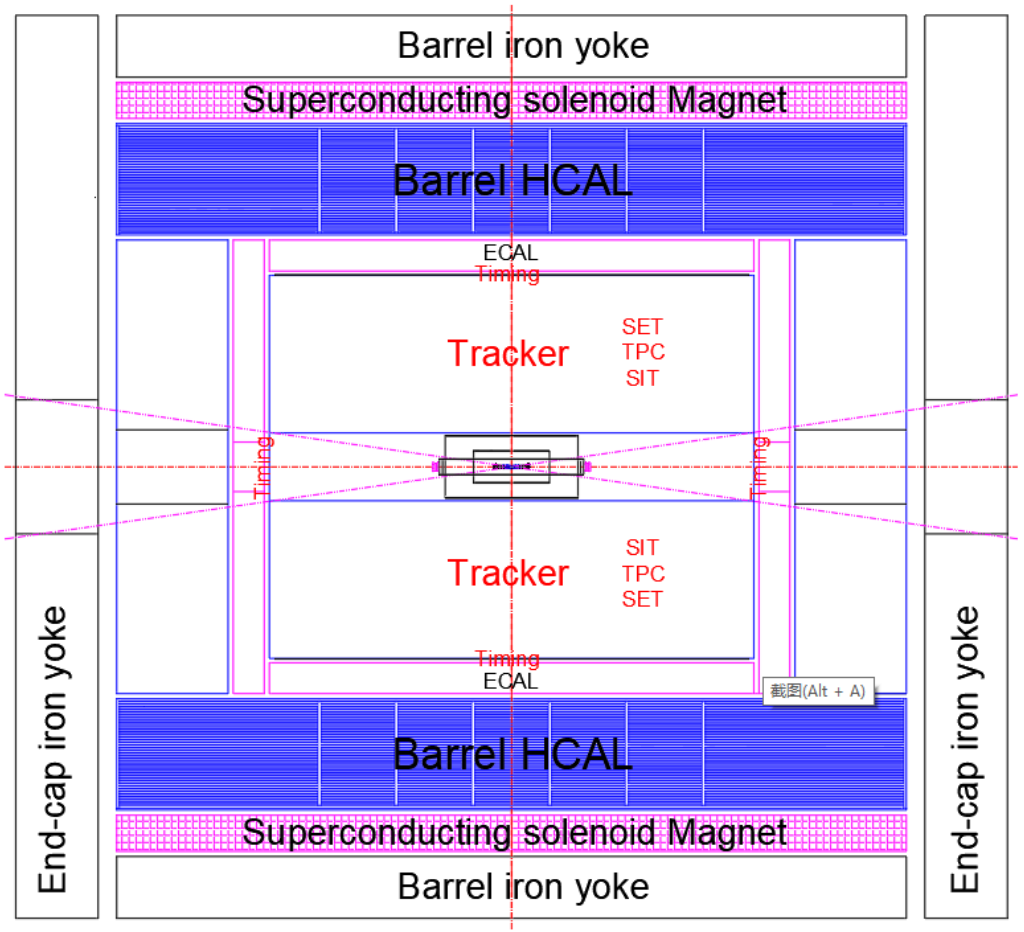
January 16, 2020

Note: **both layout1 and lauout2 are not perfect, so we didn't design in depth**

Layout 3-A



Layout 3-B

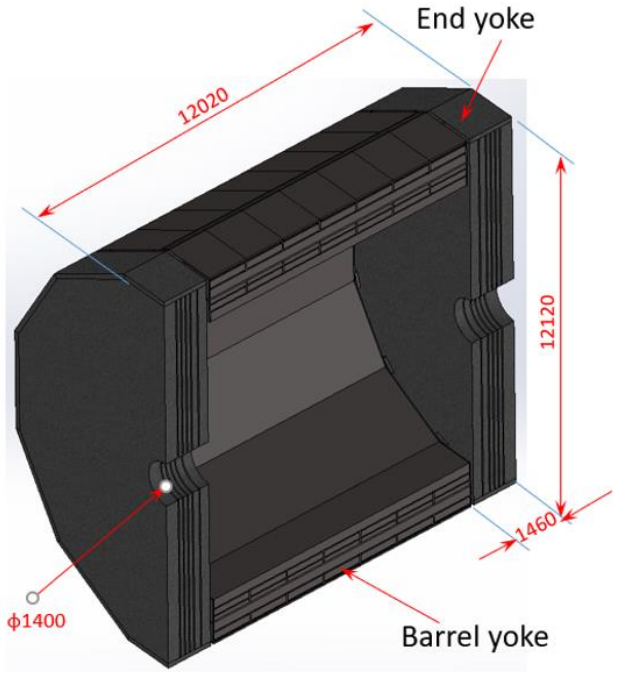


December 16, 2020

Note: ---layout 3 has two options: A and B

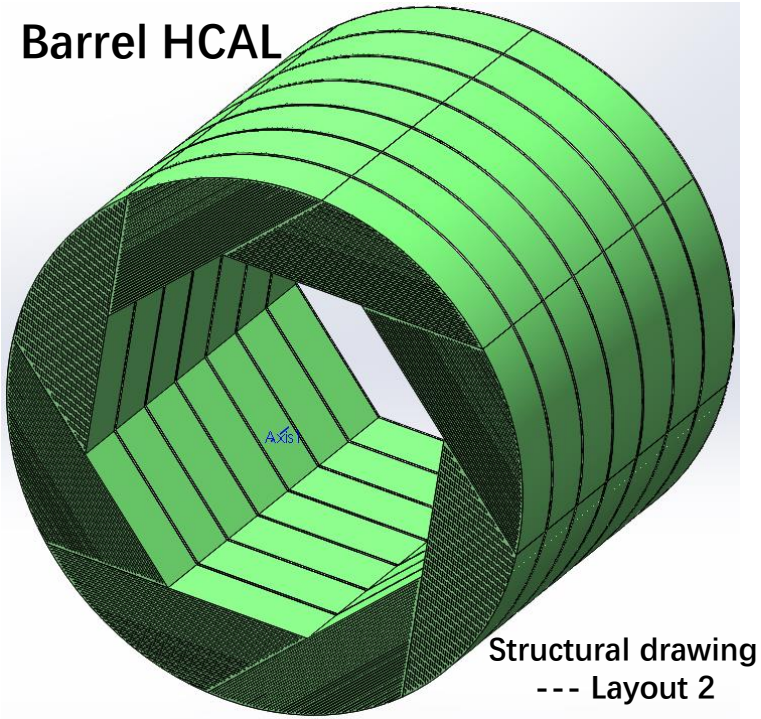
1. The difference between layout 3-A and layout 3-B is the position of superconducting solenoid and HCAL in spectrometer
2. Layout 3 is basically recognized by the majority

2) Sub detector design---Yoke, HCAL, SIT, Beampipe(Vertex) are designed and simulation calculated



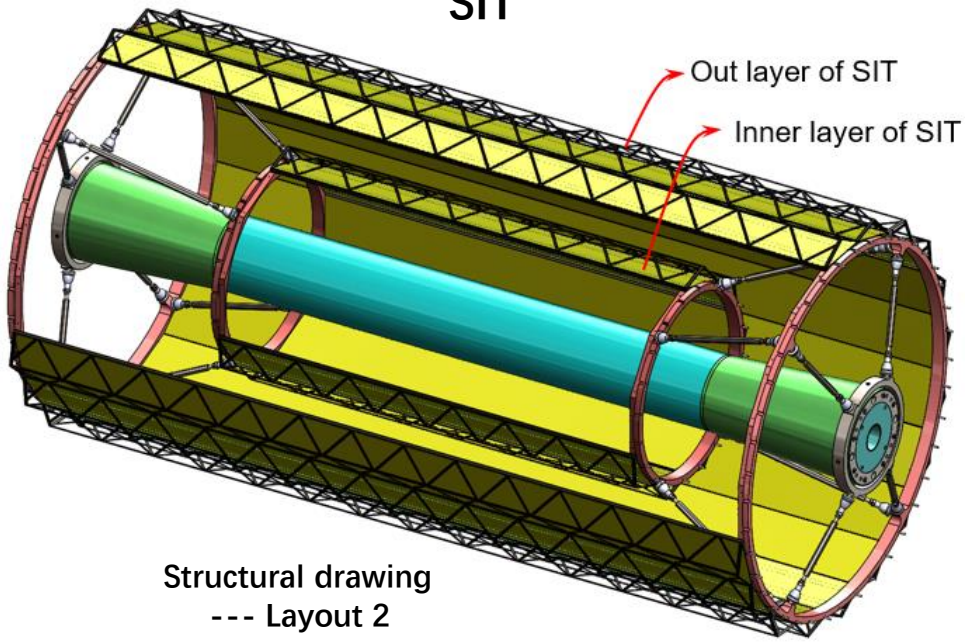
Structural drawing --- Layout 2

Barrel HCAL

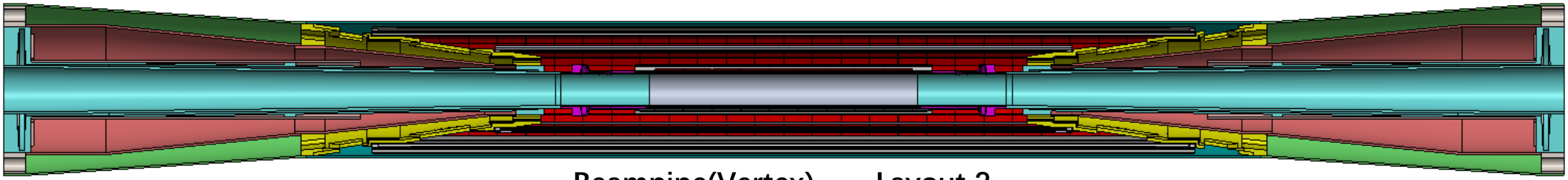


Structural drawing
--- Layout 2

SIT



Structural drawing
--- Layout 2



Beampipe(Vertex) --- Layout 2

Note: The design of these sub detectors are very helpful to the design of Layout 3

3) Summary (2020)

a) Not all sub detectors have been designed
b) The sub detectors that have been designed need to be refined
c) Only completed partial TDR mechanical design

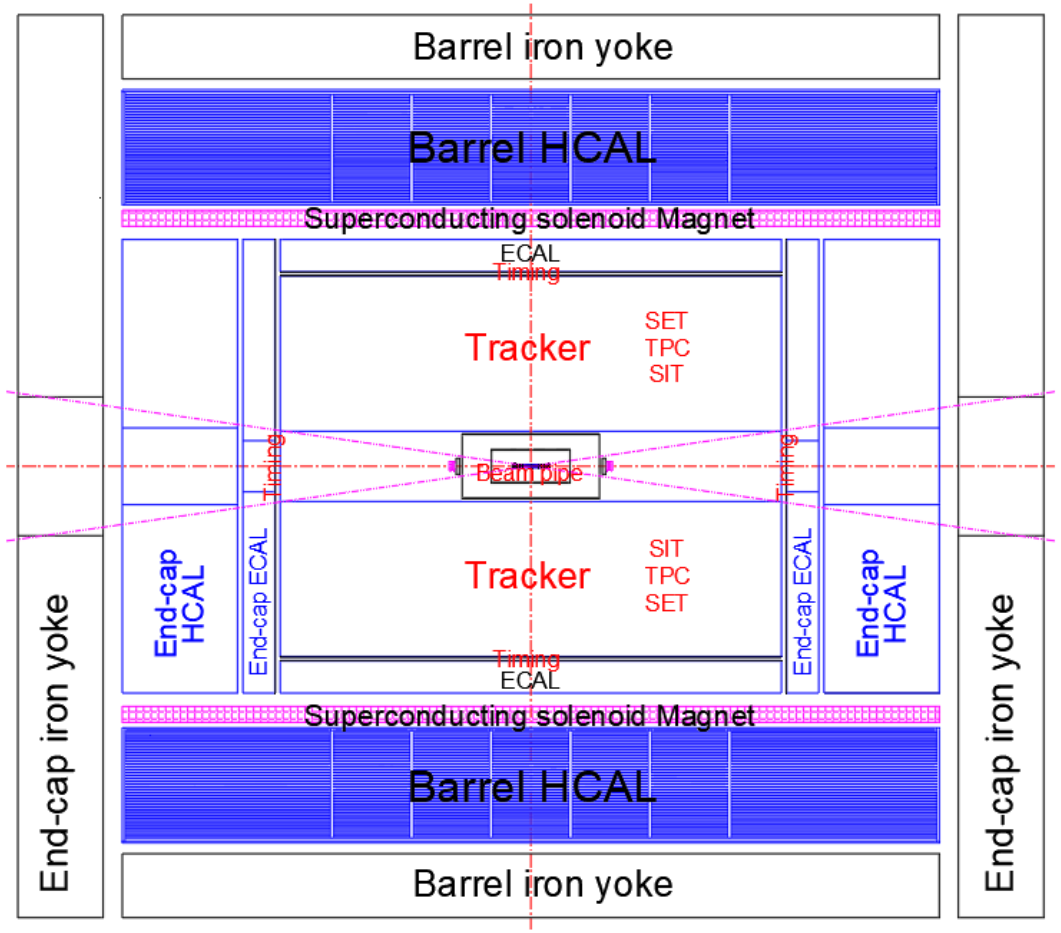
Expected target (2021):

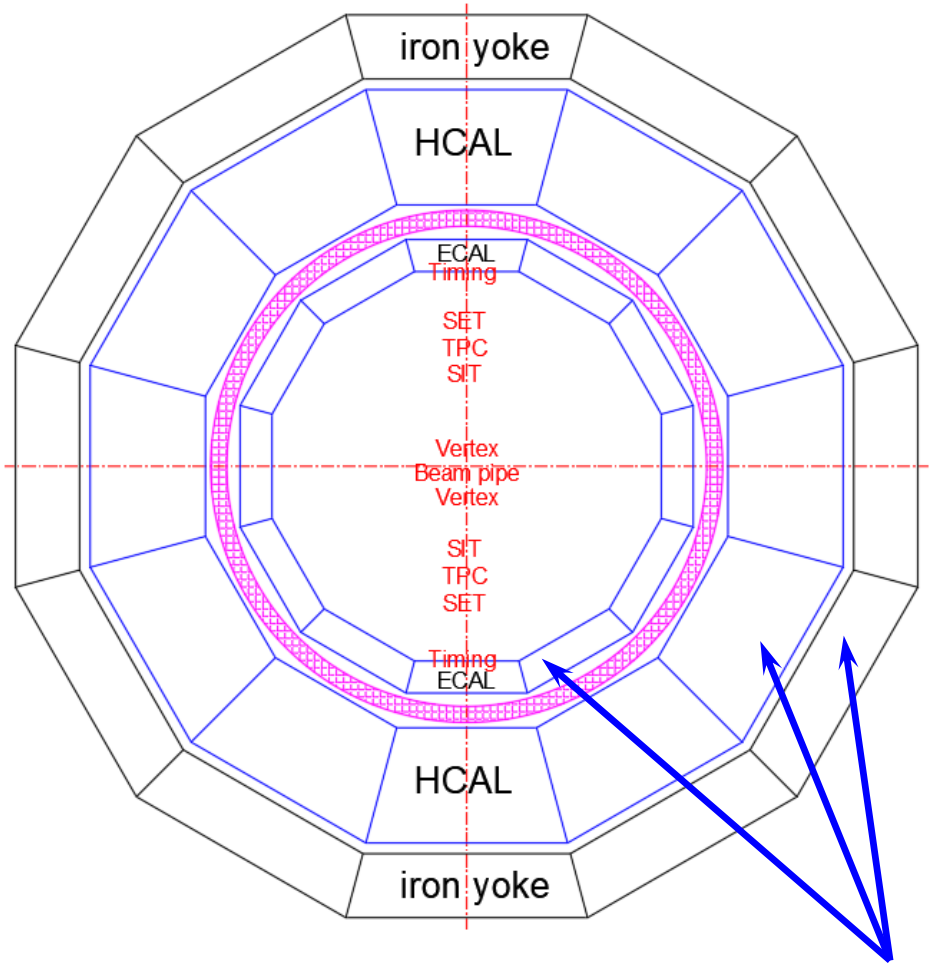
Have to make a complete version of TDR mechanical design

2. Initial scheme selection of TDR design

⬅ **Clear goal, easy to carry out the work**

1) Selection of detector layout ---**Layout 3-A**





Note.

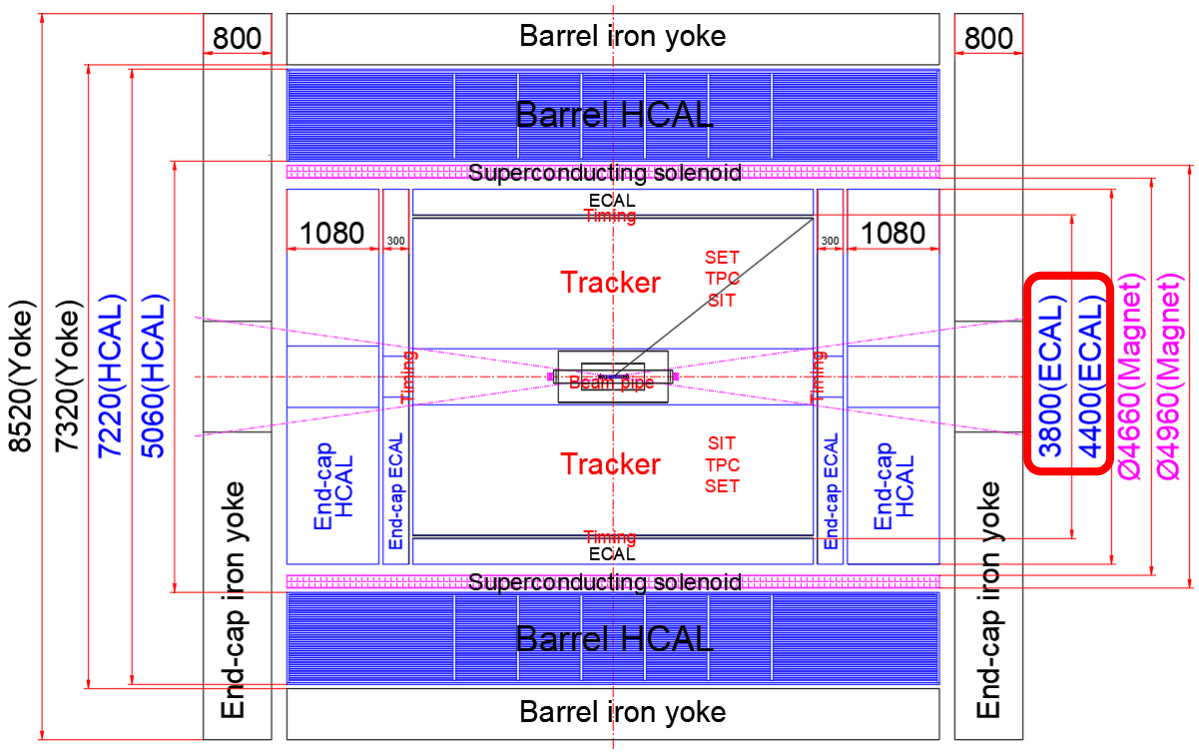
1. **The superconducting solenoid is placed inside the HCAL**
2. **HCAL** and **ECAL** is optimized from octagon to dodecagon(***Ruan manqi , Liu yong***)

Structural design 1:
Symmetrical polygon

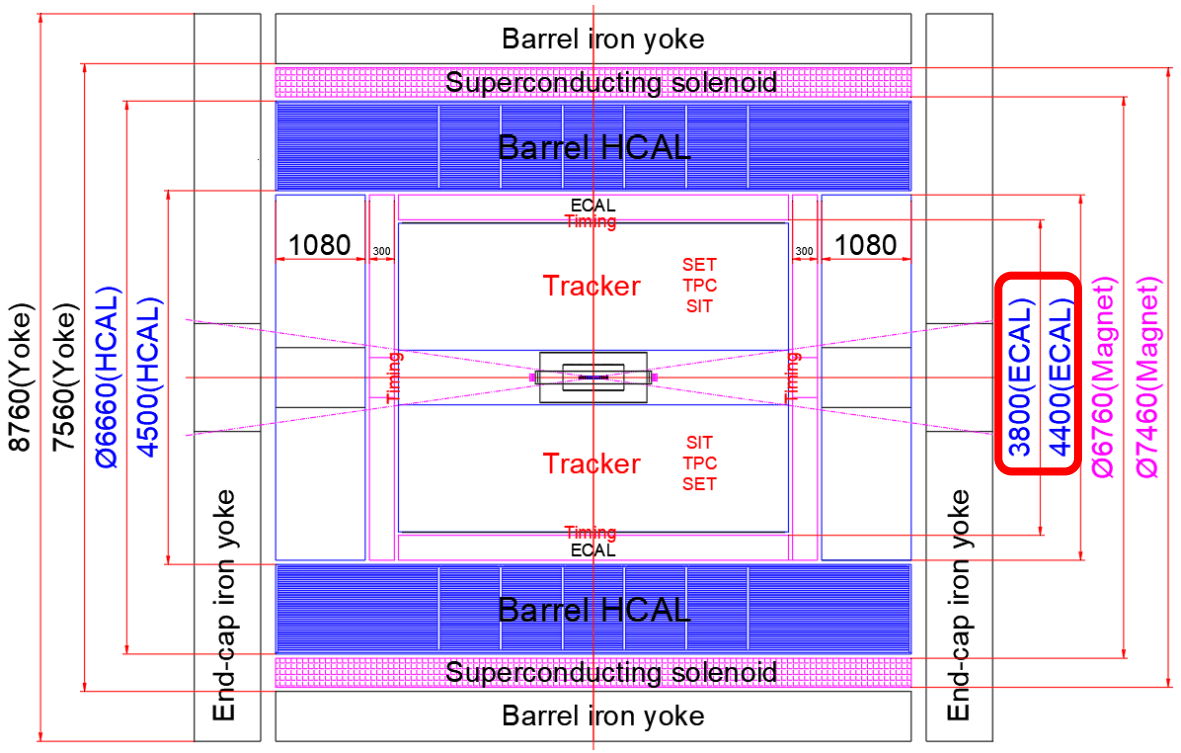
Plan to start detailed design based on layout 3-A

Common between the Layout 3-A and Layout 3-B:

Layout 3-A



Layout 3-B



Layout 3-A and Layout 3-B have the same detector size boundaries in ECAL,
In the future, the workload of design can be greatly reduced if multiple schemes are compared.

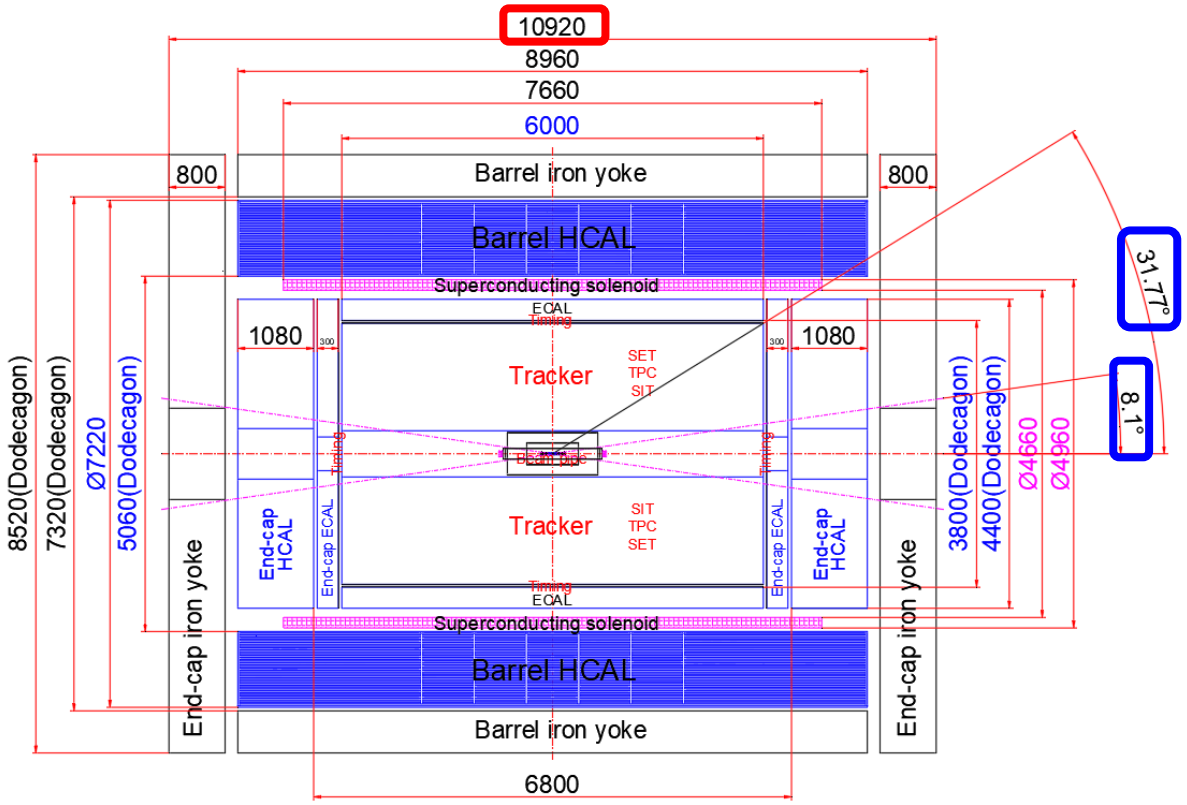
2) Selection of detection angle ---

Tracker detection angle :

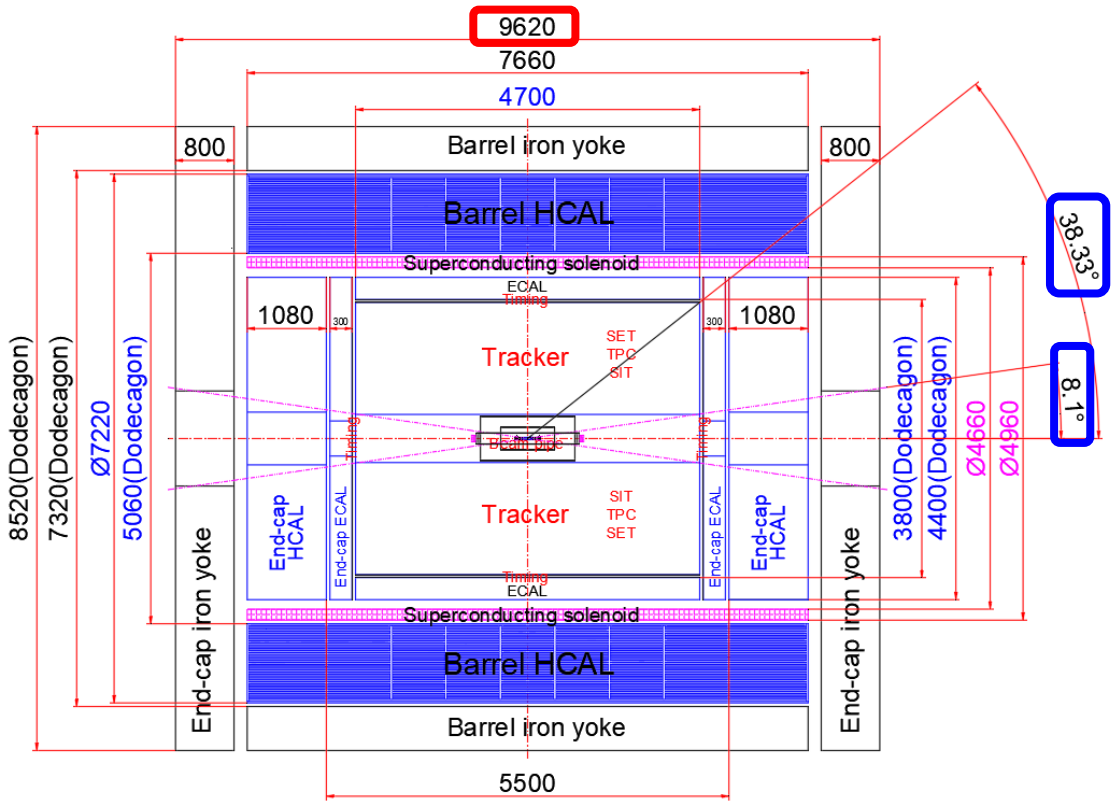
Layout 3-A-1 --- 31.77° (arccos0.85)

Layout 3-A-2 --- 38.33° (arccos0.78)

Layout 3-A-1



Layout 3-A-2



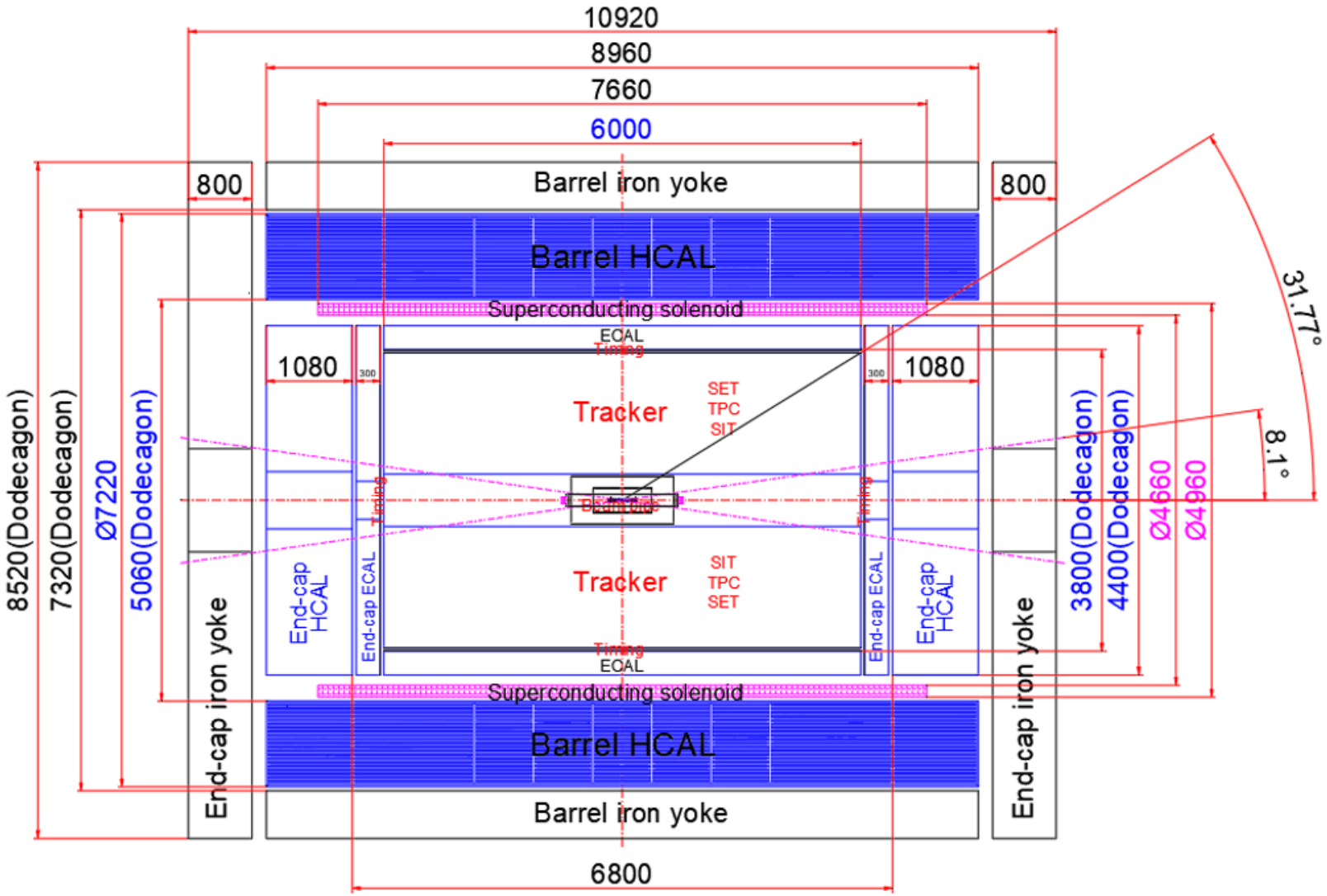
Note:

1. For the design of layout 3-A-1, the detection area covered is larger, the length of barrel detector is longer.
2. From the perspective of mechanical design, if the length of barrel detector is longer, the design is more difficult. On the contrary, it is easier.

Choose the scheme Layout 3-A-1 to design

3) Boundary optimization --- **Size distribution**

Layout 3-A-1



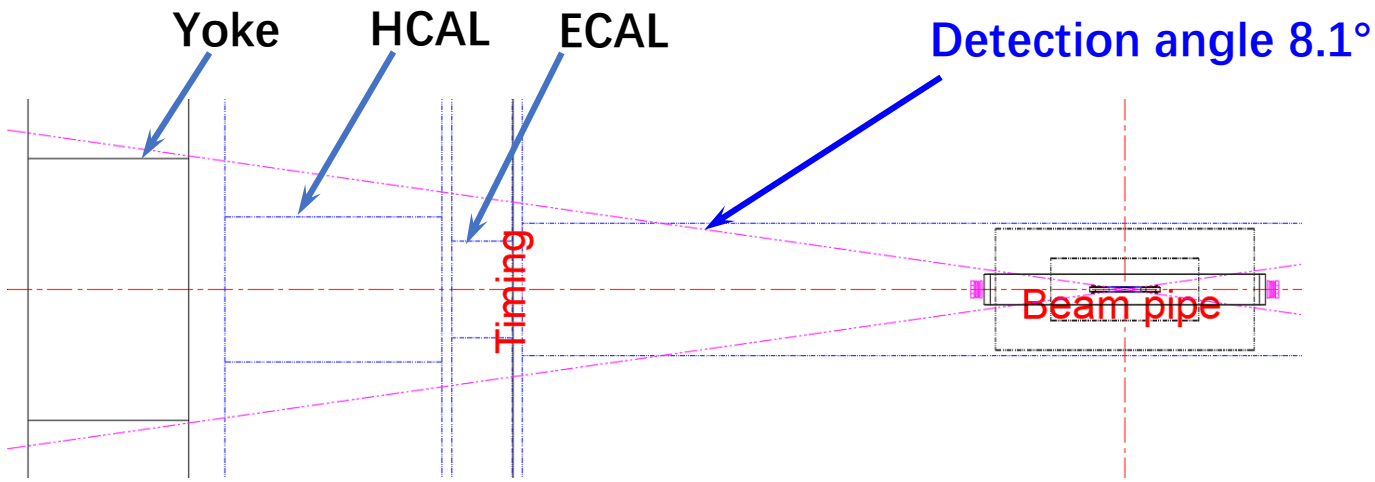
The size boundary of yoke, superconducting magnet and HCAL are given here.

The size boundary of other sub detectors is still under optimization.

4) Boundary optimization --- **Boundary form**

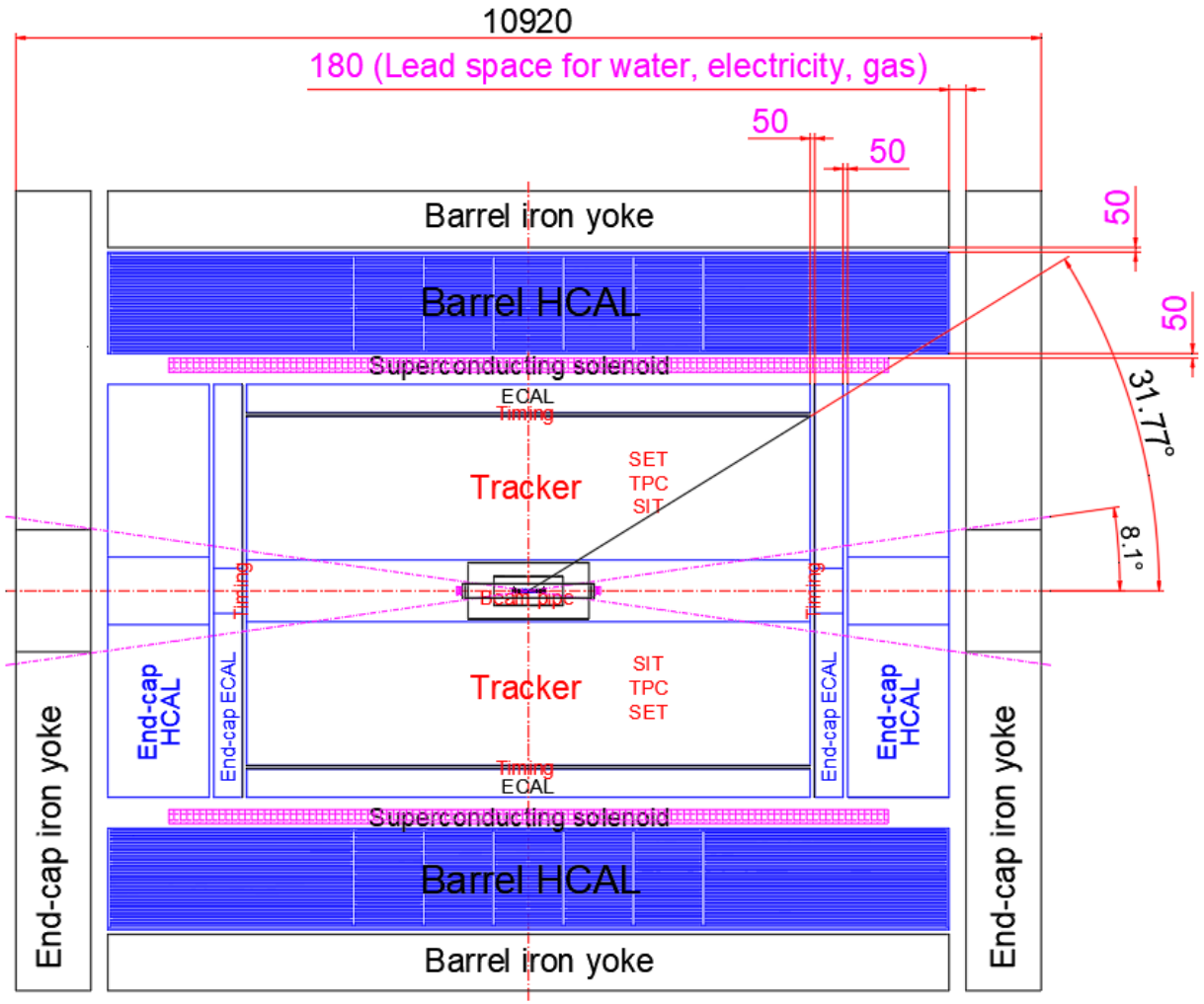
Step cylinder

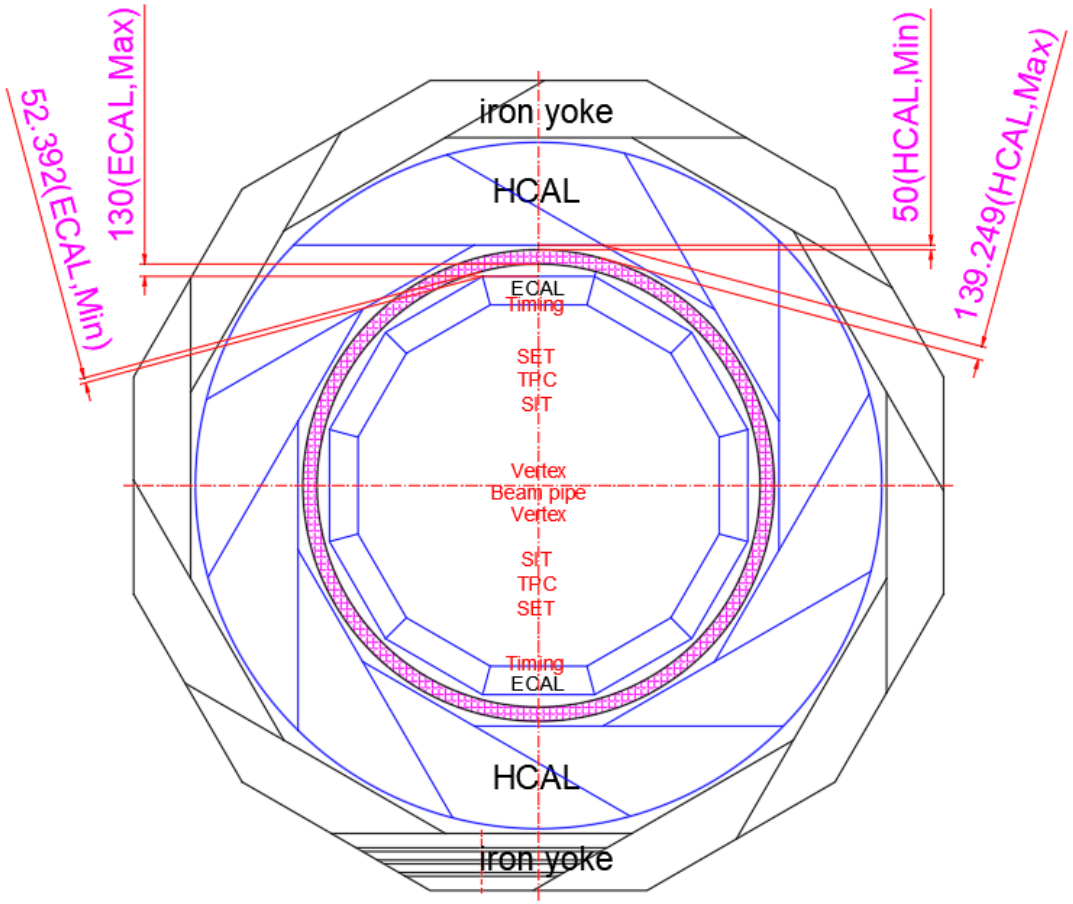
Smooth cone



The boundary form should be optimized as a cone shape extending the direction of the detection angle, which can maximize the space utilization.

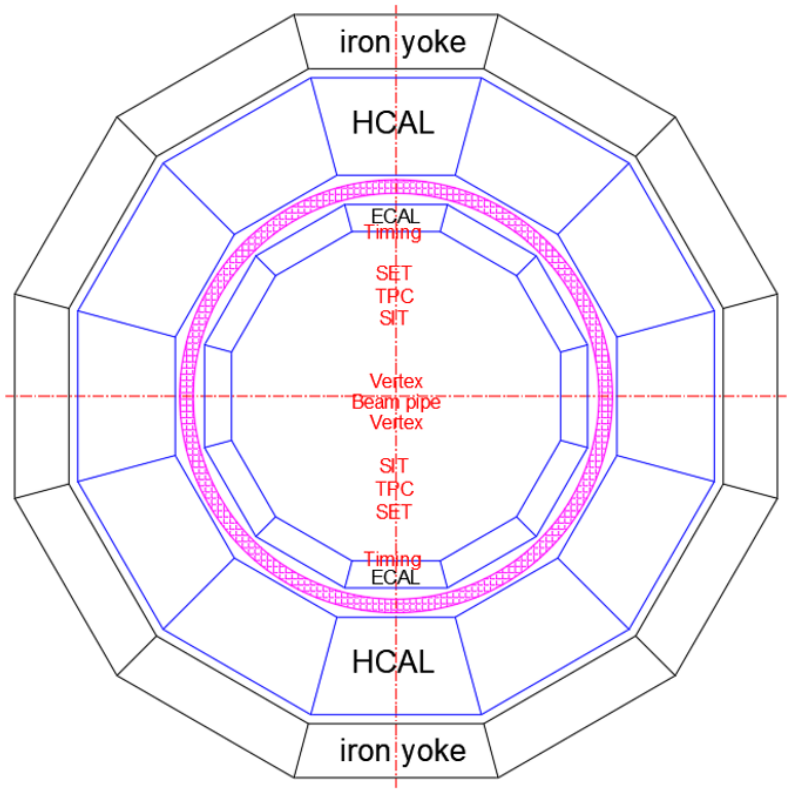
5) Optimal choice of the gap --- **the smaller the gap, the better**



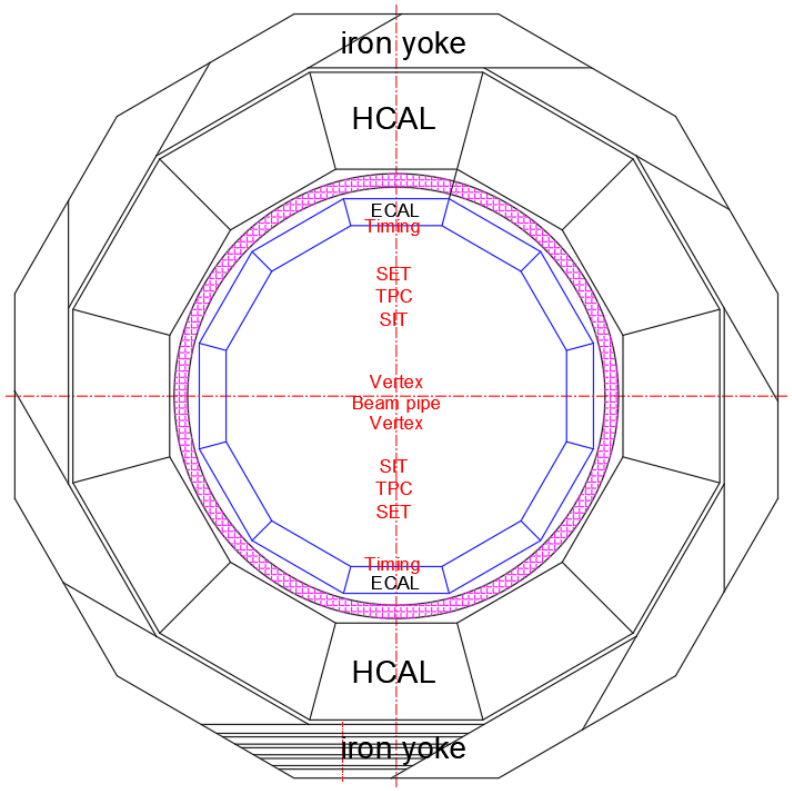


We tentatively set the gap between each sub-detector as 50mm, which will be optimized and adjusted according to the specific design in the future.

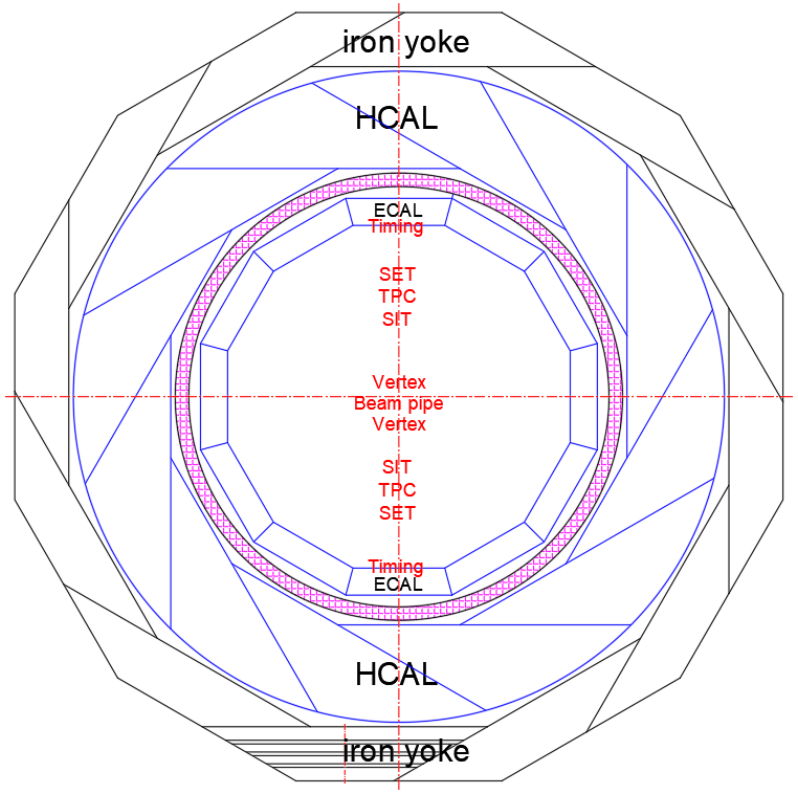
6) Selection of mechanical structure--- **Spiral or Symmetrical polygon**



Structural design 1:
Symmetrical polygon
(**Yoke, HCAL, ECAL**)



Structural design 2:
Spiral structure (**Yoke**)
Symmetrical polygon (**HCAL, ECAL**)



Structural design 3:
Spiral structure (**Yoke, HCAL**)
Symmetrical polygon (**ECAL**)

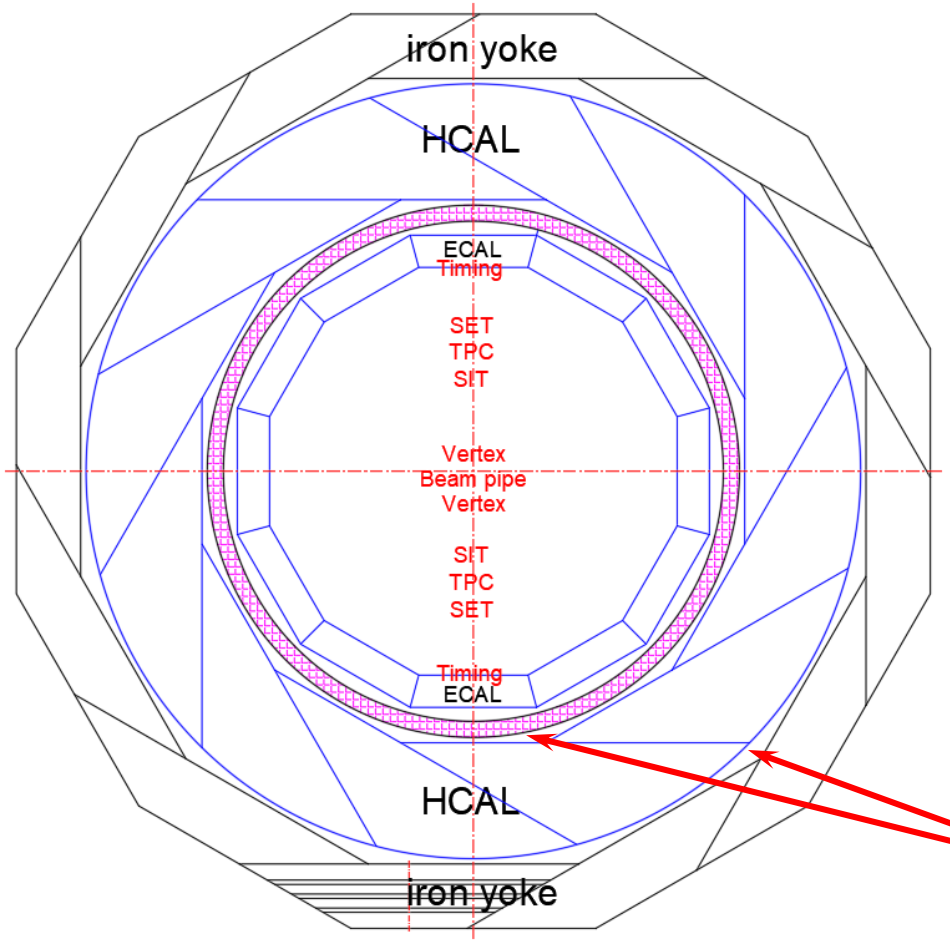
Pros of the spiral structure:
Avoid detection blind area

Pros of the symmetrical polygon:
Better mechanical strength

For the design structure of polygon, we choose the scheme of **structural design 3**

3. Work plan --- Can't just do the mechanical design of the detector itself

1) The locking and adjusting structure of each sub detector is designed in detail



Design requirement:

Position accuracy : ?

Locking structure

adjusting structure

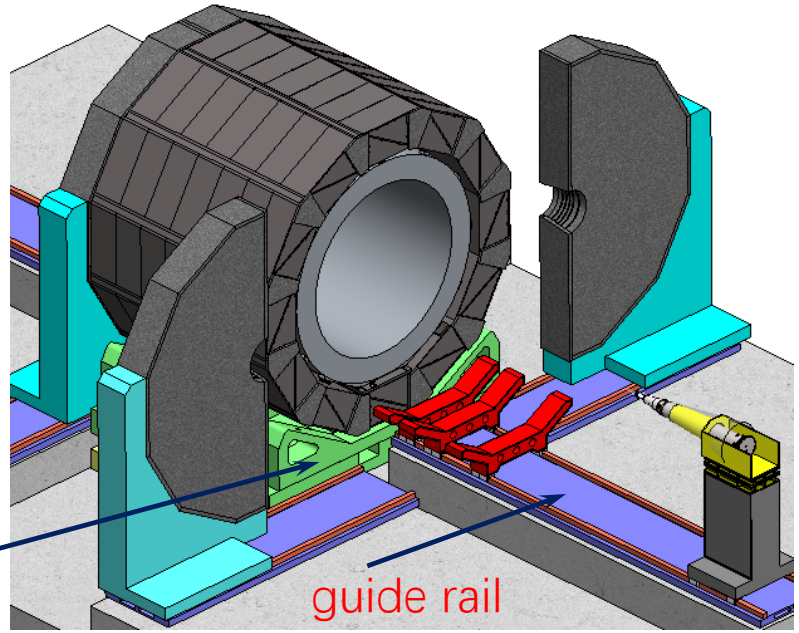
Installation requirements:

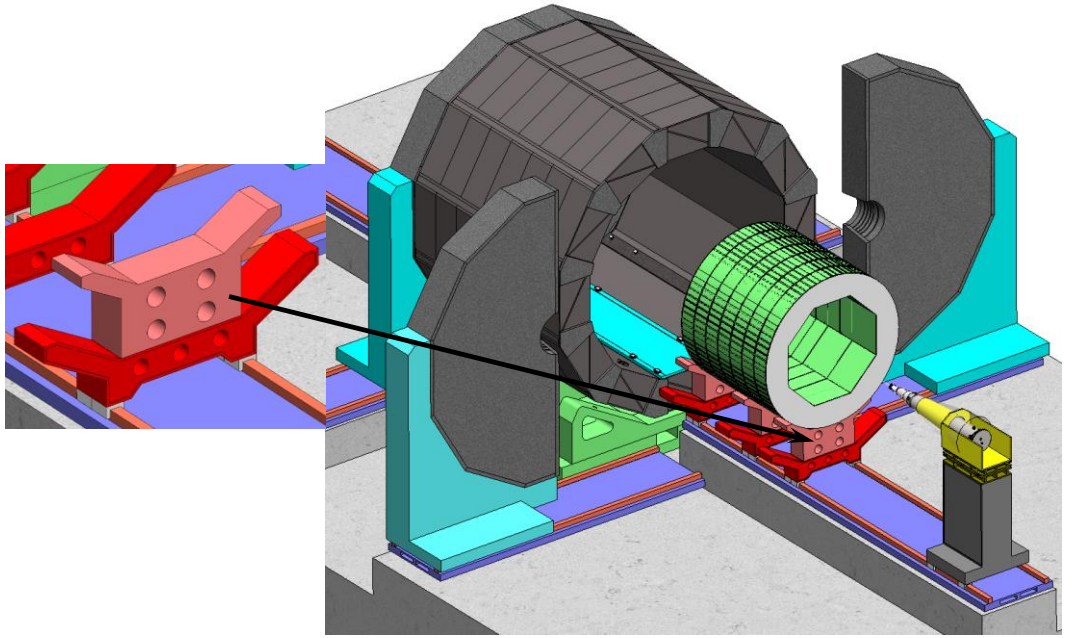
Quick installation and removal

Using sharp corners and detecting dead corners

Only through design and calculation can we know whether it can meet the design requirements of positioning accuracy and rapid installation

2) The installation scheme of sub detector is designed in detail





For installing coaxial components, the combination design of common guide rail and various V-blocks is one of the effective methods to achieve rapid installation

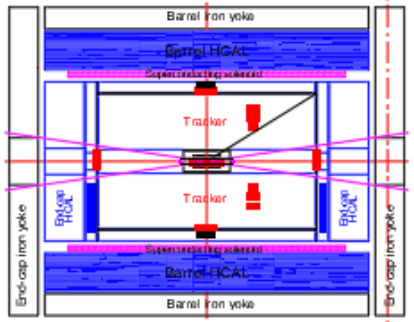
- Save a lot of installation tooling
- Save storage space of installation tooling
- Save alignment time

In order to realize this idea, all parties need to work together, with heavy workload, great difficulty and more specialties, including physics, detector, machinery, technology, architecture, etc.

3) The design of the underground experiment hall is designed in detail

50000

30000



The installation design of sub detector

is closely related to

the design of underground experiment hall

experiment hall

Design

of Ground hall

Promoting

TDR design

in an all round way

2021 is a challenging year !!!

Thanks!