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Status of CEPC ref-TDR Chapter06

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On behalf of the gaseous tracker group

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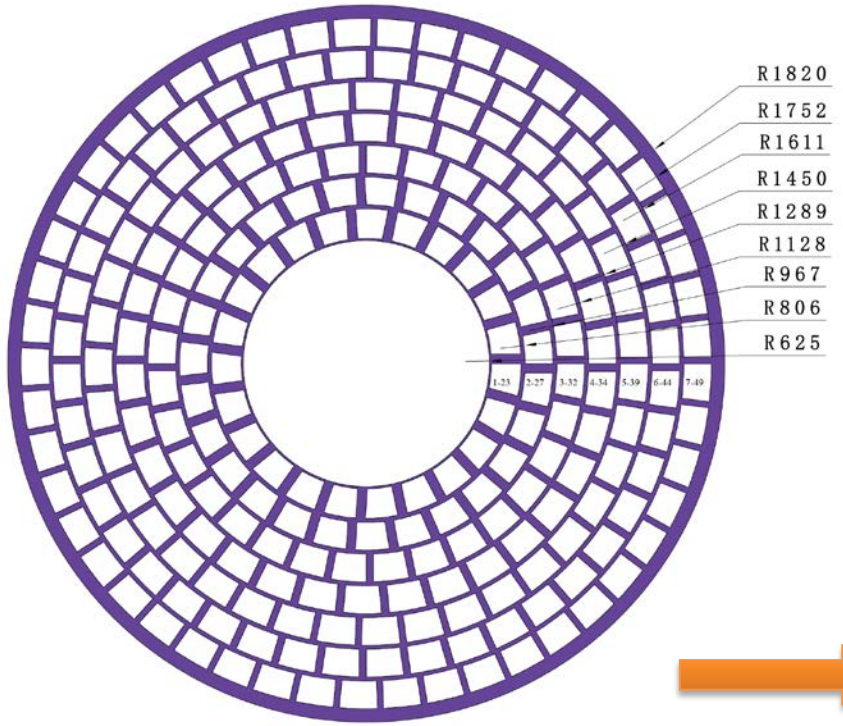
Content

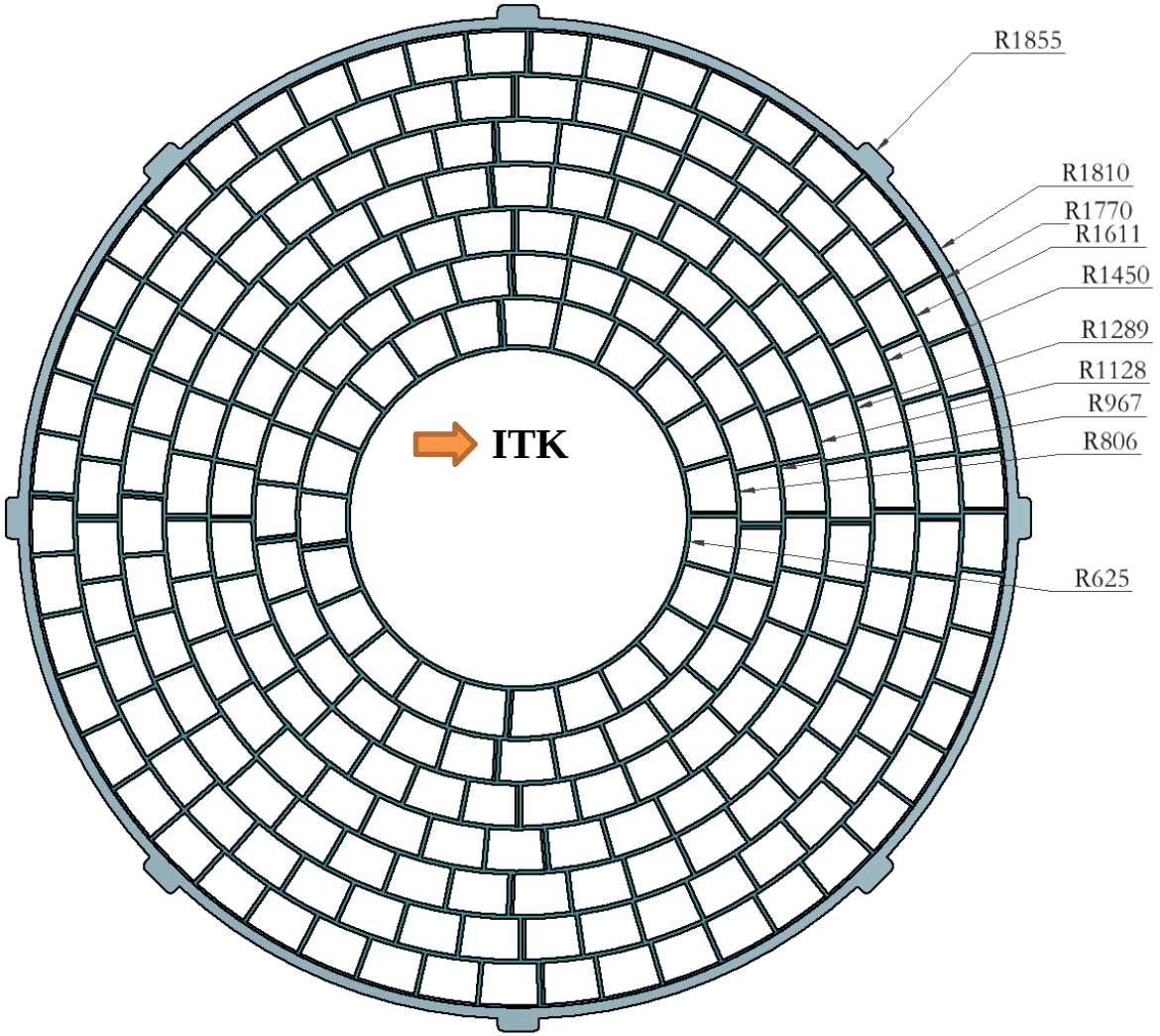
- **Update design of TPC**
- **BG source and estimation**
- **Status of Chapter6**

Update design of TPC endplate

TPC detector	Key Parameters
Modules per endcap	248 modules /endplate
Module size	206mm×224mm×161mm
Geometry of layout	Inner: 1.2m Outer: 3.6m Length: 5.9m
Potential at cathode	- 62,000 V
Gas mixture	T2K: Ar/CF4/iC4H10=95/3/2
Maximum drift time	34μs @ 2.75m
Detector modules	Pixelated Micromegas



OTK ⇦ ⇨ ITK

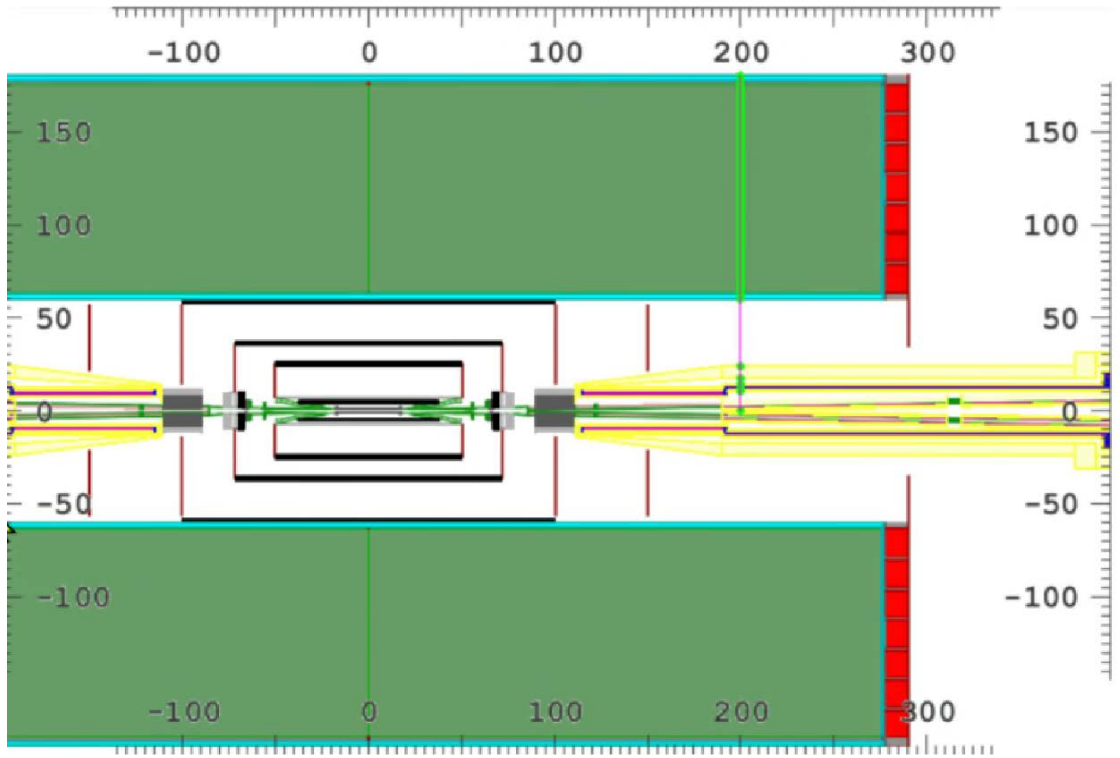


⇨ **Detector Module Water Cooling Design**

Background Sources at Higgs/ Low luminosity Z @3T

- Higgs/Z background sources
  - I. Pair production (Luminosity related)
  - II. Single Beam (BGB, BGH,Touschek Scatter…)
  - III. Synchrotron Radiation
  - IV. Injection background

Bkg type	Space charge density(steady)	Remark	Optimization strategy
Pair + Single Beam	ρ_{sc0} ~ 0.04nC/m^3 (R=60cm) 8um, 2.75m Drift Length @ inner radius	Without low P_T e^-/e^+ (<10MeV) in TPC caused by ~MeV γ	**Acceptable**
Pair + **Single Beam**	ρ_{sc1} ~ 60×ρ_{sc0}	With low P_T e^-/e^+ (<10MeV) in TPC caused by ~MeV γ	Analysis initial position distribution of ~MeV γ (Main contributions) and Add shielding

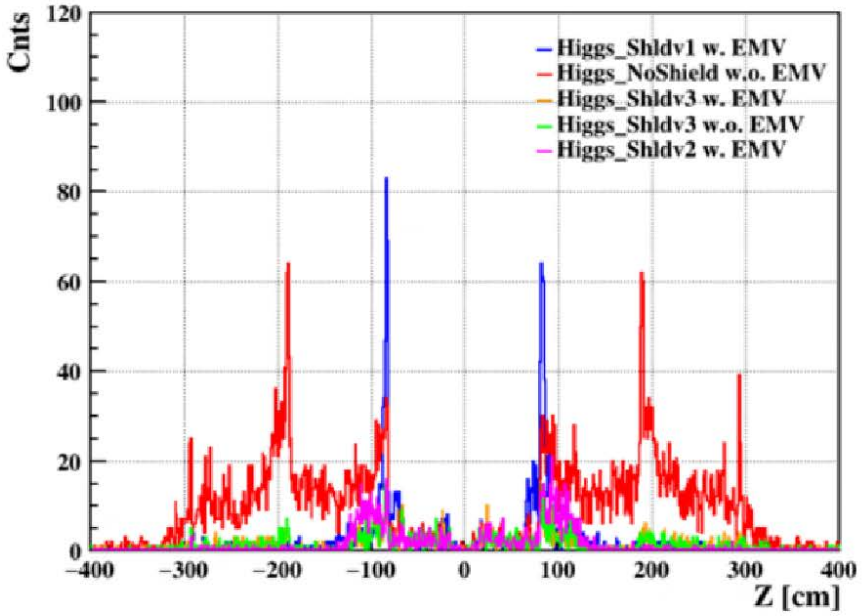


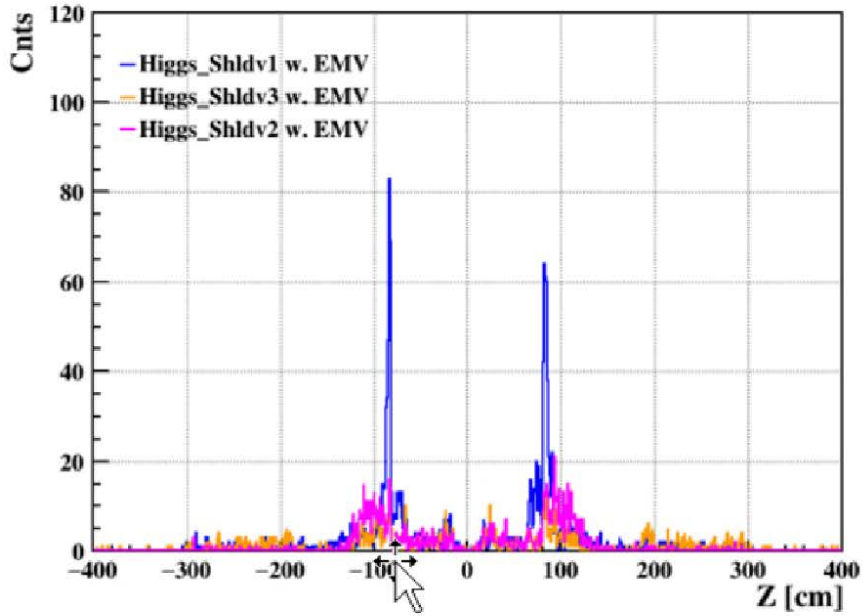
Material	D [cm]	X0 [cm]	D/X0 [%]
Air	10.5000	30392.1242	0.0345
stainless_steel	0.5000	1.7658	28.3158
liHe	1.0000	754.5867	0.1325
CrZrCu18150	1.0000	1.4974	66.7840
liHe	1.0000	754.5867	0.1325
stainless_steel	0.5000	1.7658	28.3158
Air	3.0000	30392.1242	0.0099
stainless_steel	6.5000	1.7658	368.1055
Air	36.0000	30392.1242	0.1185
G4_Cu	0.0010	1.4356	0.0697
CarbonFiber	0.0100	28.6083	0.0350
G4_Cu	0.0030	1.4356	0.2090
Polyimide	0.0050	29.4030	0.0170
G4_Cu	0.0030	1.4356	0.2090
CarbonFiber	0.0100	28.6083	0.0350
T2KGas1	117.4680	11764.8276	0.9985
CarbonFiber	0.0100	28.6083	0.0350
G4_Cu	0.0030	1.4356	0.2090
Polyimide	0.0050	29.4030	0.0170
G4_Cu	0.0030	1.4356	0.2090
CarbonFiber	0.0100	28.6083	0.0350
G4_Cu	0.0010	1.4356	0.0697
T2KGas1	2.4680	11764.8276	0.0210
Summary	totalDistance = 180.0000 [cm]		total material budget = 494.1175[%]

TPC region

Comparison of the optimization geometry

- **Different Geo Models:**
  - NoShield 几何(分段Lumi, 低温恒温器外部仅有0.3cmTi)，低能γ产生位置，沿束流管分叉往后100cm<|Z|<300cm区域，|Z|=200cm处？？？
  - Shldv1 几何(分段Lumi, 低温恒温器外部包括7cm不锈钢)，低能γ产生位置主要在两段LumiCal之间
  - Shldv2 几何(紧凑Lumi, 低温恒温器外部包括7cm不锈钢和1cm钨)，低能γ产生位置主要在束流管分叉处，Lumi可以阻挡部分γ，|Z|>150cm后基本产生的低能γ基本不进入TPC
  - Shldv3 几何(紧凑Lumi,低温恒温器外部为0.3cmTi和1cm钨)，低能γ产生位置主要在束流管分叉处，Lumi可以阻挡部分γ，|Z|>150cm后有少量低能γ进入TPC

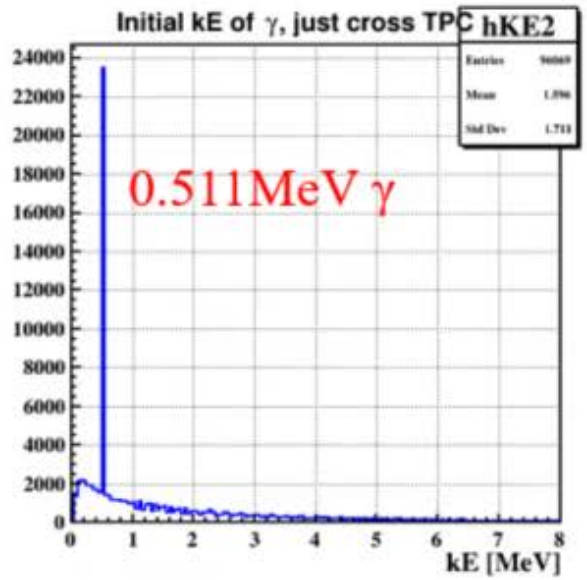


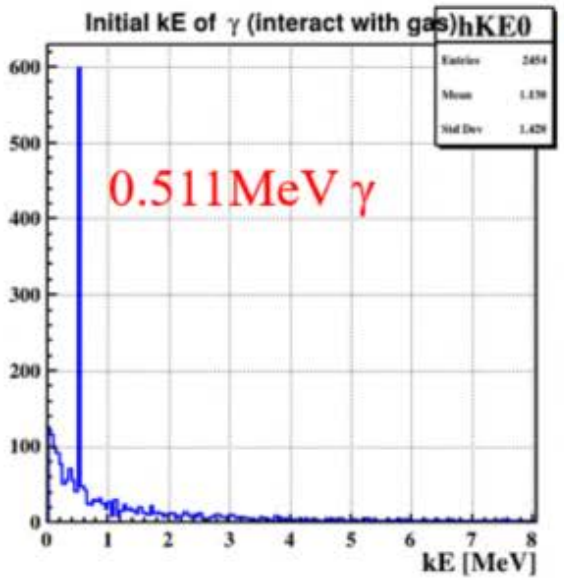


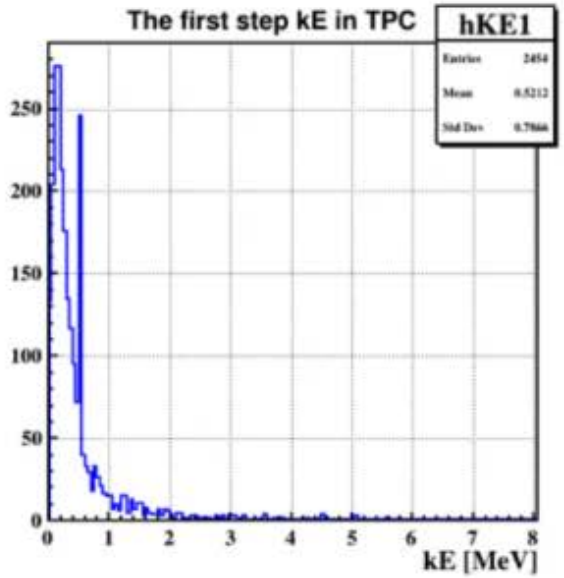
γ initial position distribution

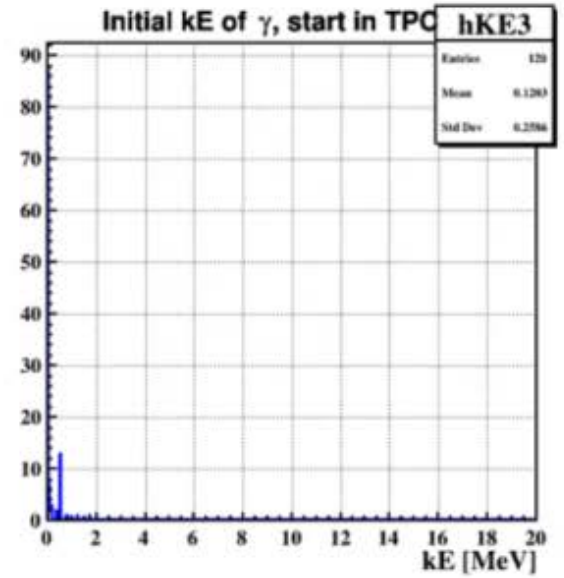
Optimization with the shield

Gamma (<10MeV) events at low luminosity Z @3T





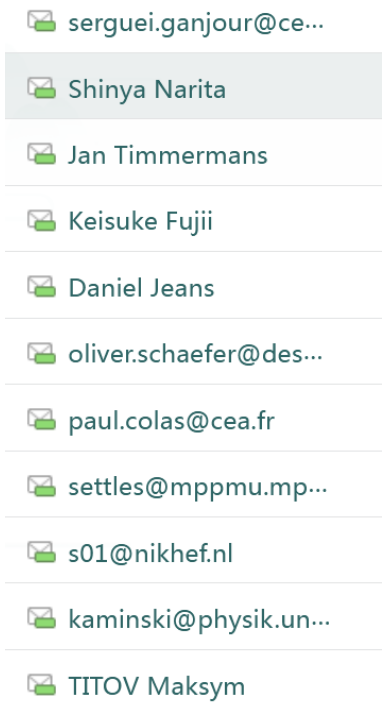




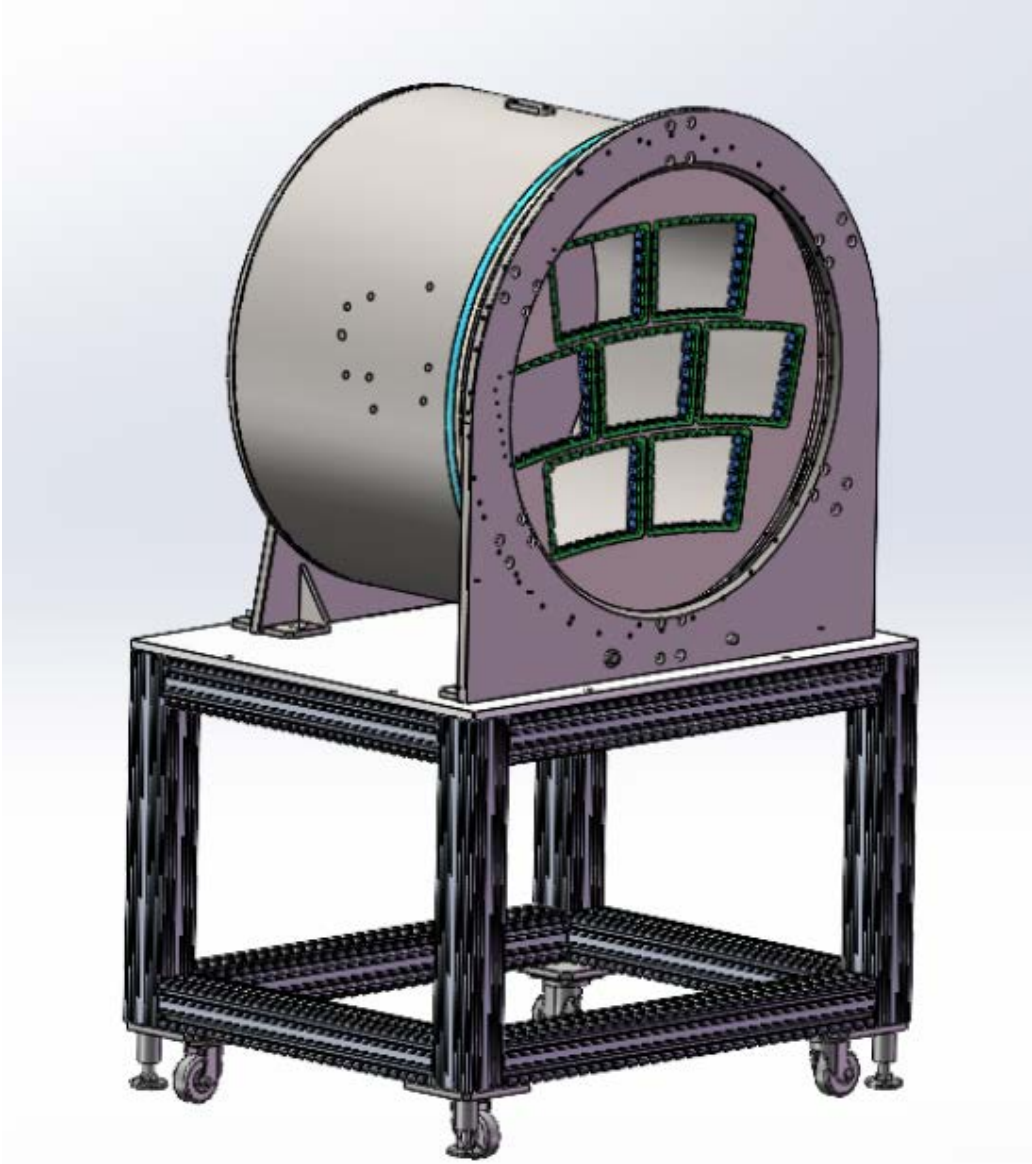
- **γ energy distribution (10BX WholeLZ241204 log)**
  - 1.2e+7 tracks (γ,e-,e+...) in total
  - 8.4e+6 γ tracks (~70.0%)
  - 9.9e+4 γ will cross TPC and ~2454 γ will interact with T2K gas through "compt, phot, conv" process, 96096 γ just cross TPC without energy deposit
  - ~1.3% γ energy > 10 MeV
  - Large number of 0.511 MeV γ (through e+ annihilation)
  - Average energy deposit： 27.12 MeV/BX by sum all secondary e- dE, small less than the result from .root file (32.3 MeV/BX)
  - **So, low energy γ is the main contributions of beam background for TPC, similar to Higgs mode.**

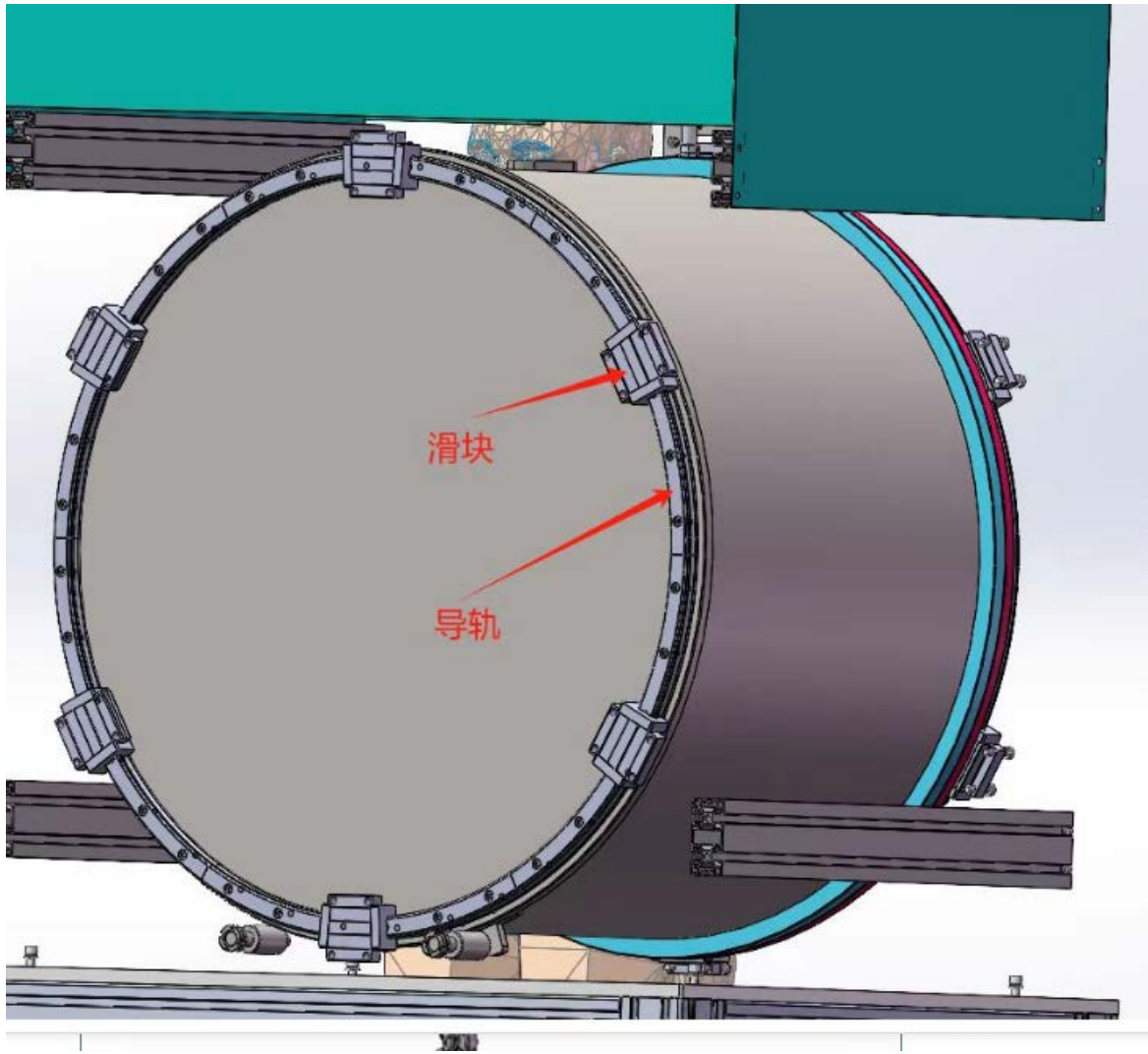
Status of Chapter6

- **整体文档基本完成**
- **已整合入IHEP Overleaf文本内**
- **下周计划（Draft version 0）**
- **Shared with 11 members of ILD and LCTPC collaboration**



Prototype of TPC





Many thanks!