



Toward a TPC for CEPC TDR

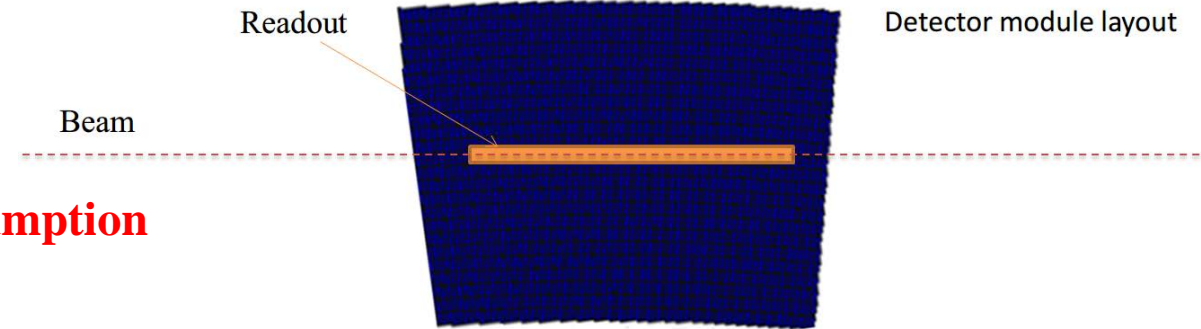
- Beam test at DESY

Huirong Qi

Weekly meeting of CEPC TPC Group, August 28, 2024

Some critical simulation and validation

- Pixelated readout TPC can be as a **realistic and promised** track detector in CEPC TDR, some key issues will be simulated and validated.
 - Material budget at endcap/barrel
 - Occupancy and hit density
 - **Improved $dE/dx+dN/dx$**
 - Ion backflow suppression
 - **Reasonable channels and power consumption**
 - Running at 2 Tesla
 - Beamstrahlung and distortion
 - **Cost estimation**
- LCTPC (Lepton Collider Time Projection Chamber) collaboration will continue to push this technology to $e+e-$ collider.

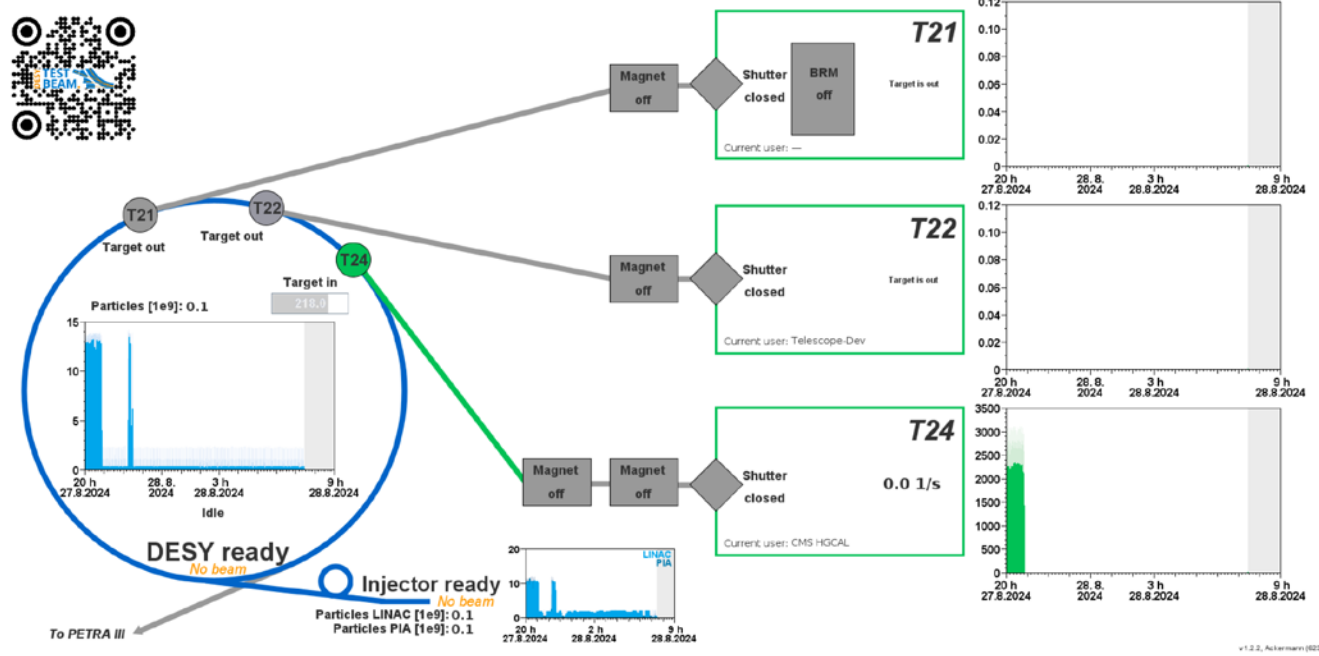


DESY beam plan

- Some time slots available for the test beam
- Test bam hall
 - TB241

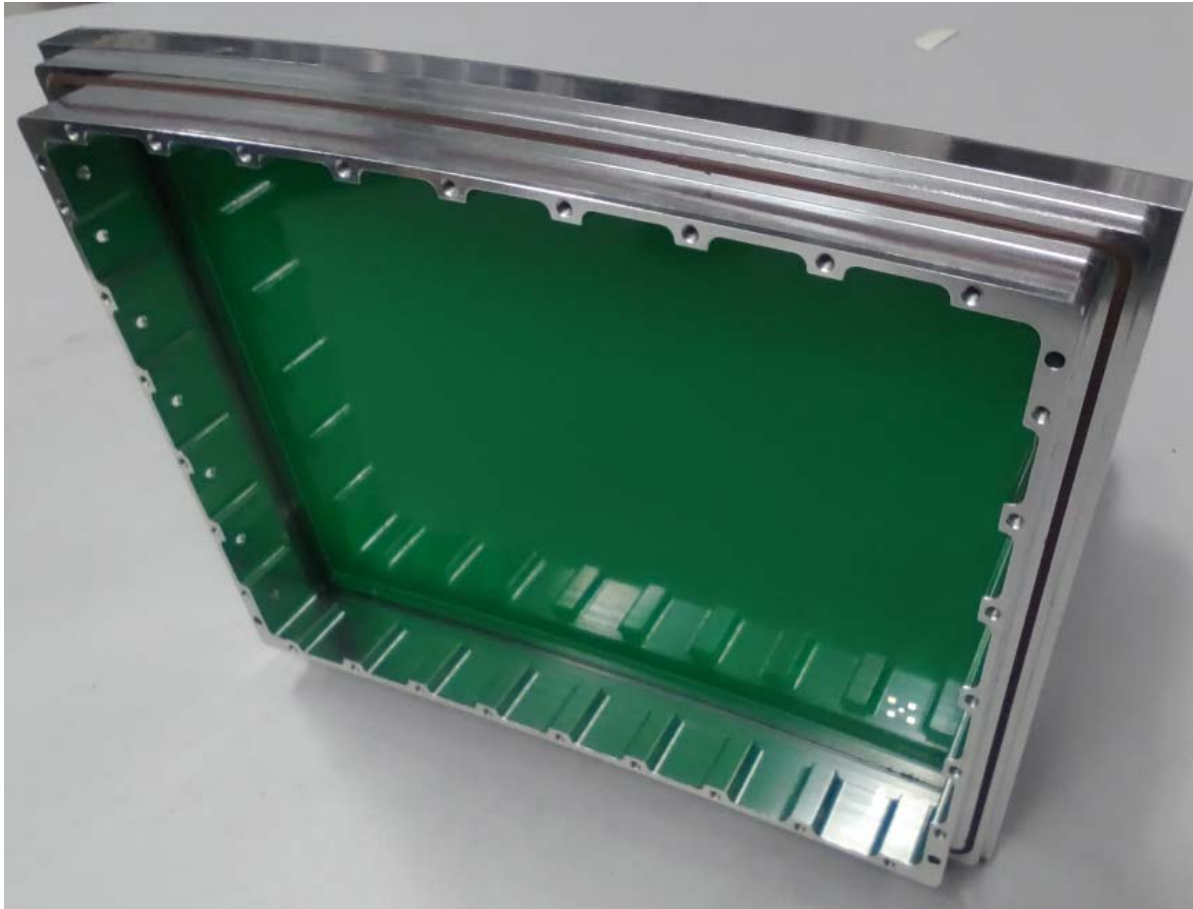
Startdate	Week.	TB21	T	TB22	T	TB241	T	TB24	T
01.01.2024	1	Shutdown		Shutdown		Shutdown		Shutdown	
08.01.2024	2	Shutdown		Shutdown		Shutdown		Shutdown	
15.01.2024	3	Shutdown		Shutdown		Shutdown		Shutdown	
22.01.2024	4	Shutdown		Shutdown		Shutdown		Shutdown	
29.01.2024	5	Startup		Startup		Startup		Startup	
05.02.2024	6	CMS Outer Tracker	X	dSIPM	X			CMS-HGCAL	X
12.02.2024	7	CMS Outer Tracker	X	Mu3e	X			Aldannova-WP6	X
19.02.2024	8	CMS ETL ETROC	X	Mu3e	X			Aldannova-WP6	X
26.02.2024	9	CMS ETL ETROC	X	TelePix	X			ATLAS HGTD	
04.03.2024	10	ITk Pixel Dortmund	X	ATLAS-ITk-Strips	X			ATLAS HGTD	
11.03.2024	11	CMS Inner Tracker	X	LHCb-MightyPix	X			CMS ETL	X
18.03.2024	12	CMS Inner Tracker	X	LHCb-MightyPix	X			SHIP-SHADOWS-ECAL	X
25.03.2024	13	Maintenance		Maintenance		Maintenance		Maintenance	
01.04.2024	14	Maintenance		Maintenance		Maintenance		Maintenance	
08.04.2024	15	DESY Heidelberg TB School	X	Tangerine	X			DESY Heidelberg TB School	
15.04.2024	16	Schwartz-Reisman School		Tangerine	X			ALICE-ITS3	
22.04.2024	17	MDI-2		RD50-MPW4	X			CalVision	X
29.04.2024	18	CMS ETL ETROC	X	CMOS Strips Detectors	X			Telescope-Dev	X
06.05.2024	19	CMS ETL ETROC	X	HD HV-MAPS	X			IPHC-CE65_v2	
13.05.2024	20	Maintenance		Maintenance		Maintenance		Maintenance	
20.05.2024	21	MDI-2		dSIPM	X			CMS HGAL	
27.05.2024	22	ATORCH		Tangerine	X			CMS HGAL	
03.06.2024	23	CMS ETL ETROC	X	Tangerine	X				
10.06.2024	24	CMS ETL ETROC	X						
17.06.2024	25	CMS ETL ETROC	X	DCRSD	X				
24.06.2024	26	CMS Inner Tracker	X	ATLAS-ITk-Strips	X				
01.07.2024	27	Maintenance		Maintenance		Maintenance		Maintenance	
08.07.2024	28	MONOPIX2	X	Telescope-Dev	X				
15.07.2024	29	Belle-II CMOS	X	CMS-HGCAL	X			MIMOSIS	
22.07.2024	30			TelePix	X				
29.07.2024	31	BL4S preparation		TelePix	X				
05.08.2024	32	Shutdown		Shutdown		Shutdown		Shutdown	
12.08.2024	33	Shutdown		Shutdown		Shutdown		Shutdown	
19.08.2024	34	Shutdown		Shutdown		Shutdown		Shutdown	
26.08.2024	35			Telescope-Dev				CMS HGAL	X
02.09.2024	36								
09.09.2024	37	BL4S	X						
16.09.2024	38	BL4S	X						
23.09.2024	39	BL4S	X	Tangerine	X			UHH-LGAD	X
30.09.2024	40			RD50-MPW4					
07.10.2024	41	Maintenance		Maintenance		Maintenance		Maintenance	
14.10.2024	42	ATORCH		ATLAS-ITk-Strips	X			DDR6-CALICE SIW-ECAL	X
21.10.2024	43			Tangerine	X			CalVision	
28.10.2024	44	MONOPIX2	X	Tangerine	X			EEEMCAL	
04.11.2024	45	MONOPIX2	X	UHH-LGAD	X			EEEMCAL	
11.11.2024	46	Maintenance		Maintenance		Maintenance		Maintenance	
18.11.2024	47	CMS HGAL	X	ATLAS HGTD	X			LHCb-ECAL	
25.11.2024	48	CMS Inner Tracker	X	ATLAS HGTD	X			LHCb-ECAL	
02.12.2024	49	CMS Inner Tracker	X	ATLAS-ITk-Strips	X			CMS ETL ETROC	X
09.12.2024	50	LHCb-MightyPix	X	DCRSD	X			CMS ETL ETROC	X
16.12.2024	51	LHCb-MightyPix	X	Telescope-Dev	X			EXFLU	
23.12.2024	52	Shutdown		Shutdown		Shutdown		Shutdown	

DESY II Test Beam Facility. State: User Operation 2024-08-28 07:28:27



Assembled module of the beam test

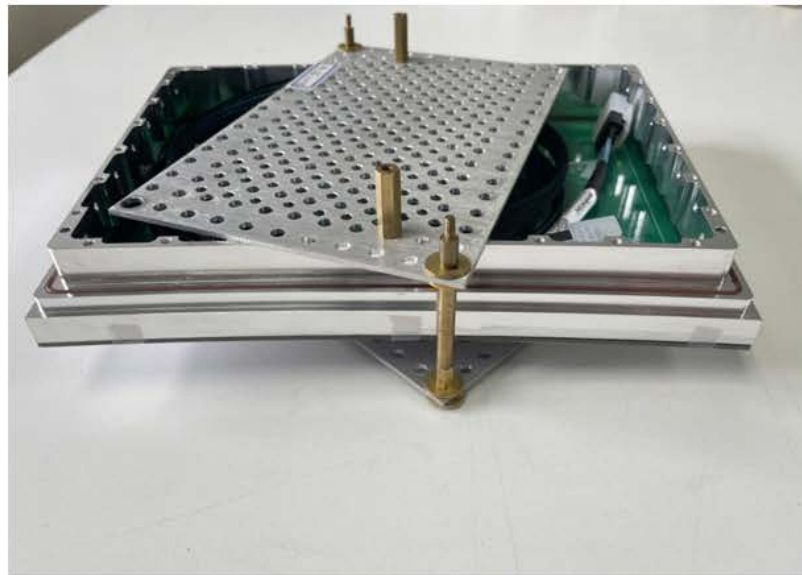
- Two Aluminum backframes have been done.
 - One assembled module delivered to Tsinghua.
 - **O ring has been selected using 2.3mm**



Magnetic field validation

■ 像素型TPC读出模块的磁场下实验确认

- 主要目标：采购的连接线与连接器件需要在磁场下进行确认。
- 在高能所超导磁铁组宁飞鹏老师的帮助下，完成了5小时的0.5T/1.0T/1.2T下实验测量。
- 结论：研制模块测试，可以满足1.2T磁场下探测器实验需求。

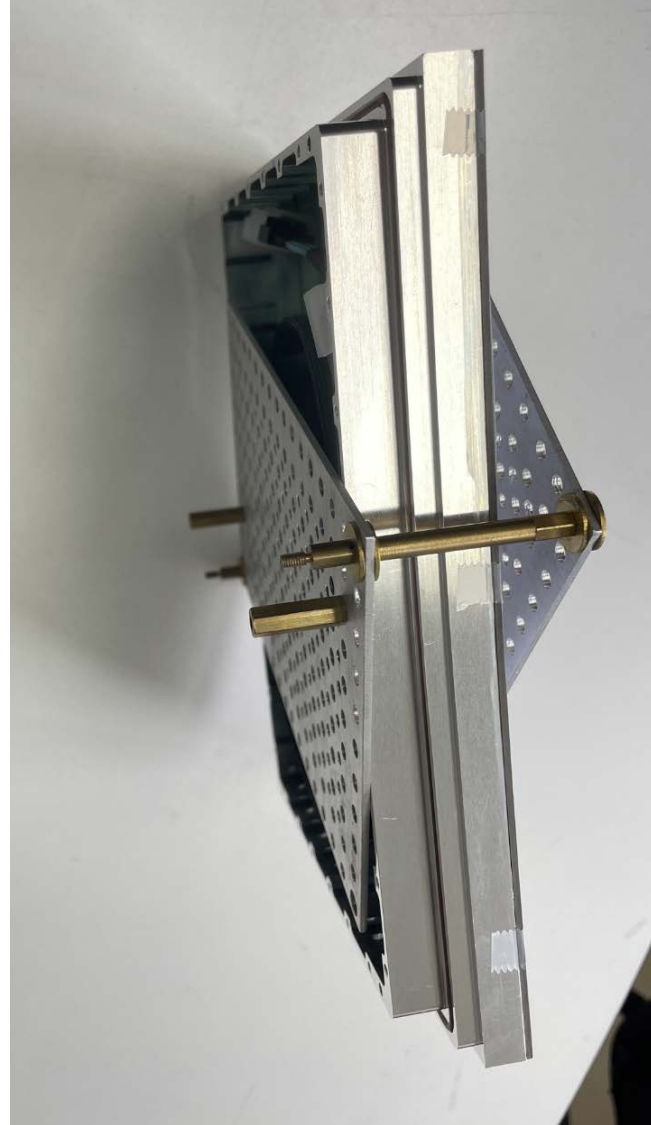


1.2T磁场内连接线缆的模块测试



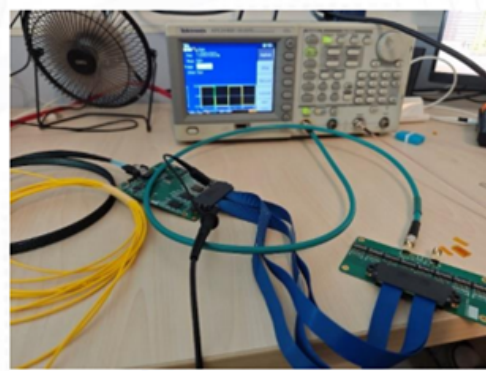
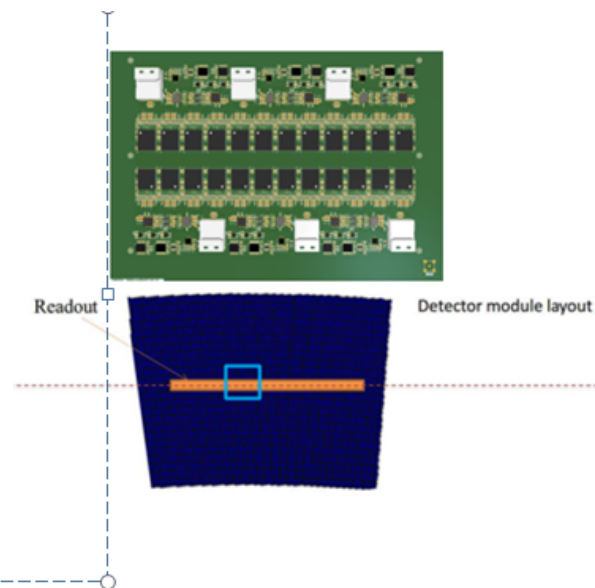
Magnetic field validation

- Would any other materials be studied surround the magnetic field of 1.2T?

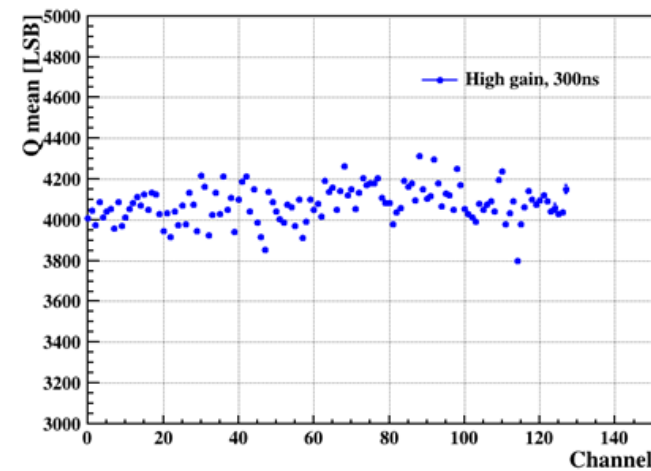
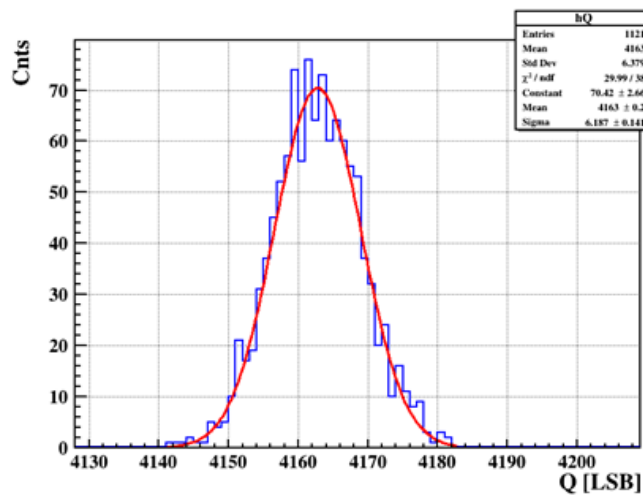


Progress of TEPIX chips measurement

- 像素型读出芯片TEPIX的测试，确定芯片可正常工作
 - 注入方波信号，外触发模式，芯片正常输出数据至上位机保存
- 基于TEPIX芯片和DAQ数据格式，完成离线数据处理程序的初步开发
 - 实现芯片数据的解包和各通道读取分析
 - 芯片幅度分布方差小于10LSB，各个通道一致性好于5%



芯片测试系统



输出通道幅度分布（左）以及各通道一致性测试结果(右)

Abstracts submitting to CEPC2024

	Presenter	Title	Region	Status
1	Huirong Qi	Progress of CEPC TPC Towards the TDR	China	Submitted
2	Mingyi Dong	Status of CEPC DC	China	Confirmed
3	Guang Zhao	Machine Learning for Gaseous Tracker dN/dx Reconstruction	China	Submitted
4	Zhi Deng	Low power readout ASIC R&D	China	Confirmed
5	Xin She	Studies of TPC detector prototype for the future collide	China	Submitted
6	Yue Chang	Pixelated readout gas detector for PID	China	Submitted
7	Canwen Liu	Status of FEE ASIC for TPC	China	Confirmed
8	Jinxian Zhang	Analysis of BK for TPC at the high luminosity Z pole on CEPC	China	Submitted
9	USTC	MPGD R&D	China	Confirmed
10	SDU	IBF R&D	China	Confirmed
11	CIEA	Micromegas R&D	China	Confirmed
12	PKU	GEM R&D	China	Confirmed
13	SJTU	TPC R&D	China	Confirmed
14	NIKHEF	GridPix TPC	Netherlands	Confirmed
15	CEA-Saclay	T2K TPC	French	Confirmed
16	INFN	DC R&D	Italy	Confirmed
17	INFN	DC electronics R&D	Italy	Confirmed
18	KEK	MPGD TPC R&D	Japan	Confirmed
19	CERN	MPGD R&D	CERN	Inviting

<https://indico.ihep.ac.cn/event/22089/>

Chapter 5 Gaseous trackers

- 5.1 Physics requirements and detection technology
 - 5.1.1 Physics requirements of Higgs and Tera-Z
 - 5.1.2 Technology choice and the baseline track detector
- 5.2 Pixelated readout TPC detection
 - 5.2.1 Challenges and critical R&D
 - 5.2.2 Mechanical and cooling design
 - 5.2.3 TPC detector and readout electronics
 - 5.2.4 Detector modules toward the validation prototype
- 5.3 Performance of TPC tracker
 - 5.3.1 Overall of the simulation framework
 - 5.3.2 Spatial resolution and PID performance
 - 5.3.3 Improvement using the machine learning algorithm
- 5.4 Alternative track detector of Drift Chamber in Tera-Z
 - 5.4.1 PID for high luminosity Z pole at 2T
 - 5.4.2 Performance and critical R&D
- 5.5 Cost estimation

Many thanks!