国家重点研发计划 · 项目实施方案汇报

R&D and Verification of Key Technologies for a High Energy Circular Electron-Positron Collider

2021 Annual Meeting

所属专项： 大科学装置前沿研究

项目负责人： João Guimarães da Costa

项目承担单位： 中国科学院 高能物理研究所

April 23, 2021

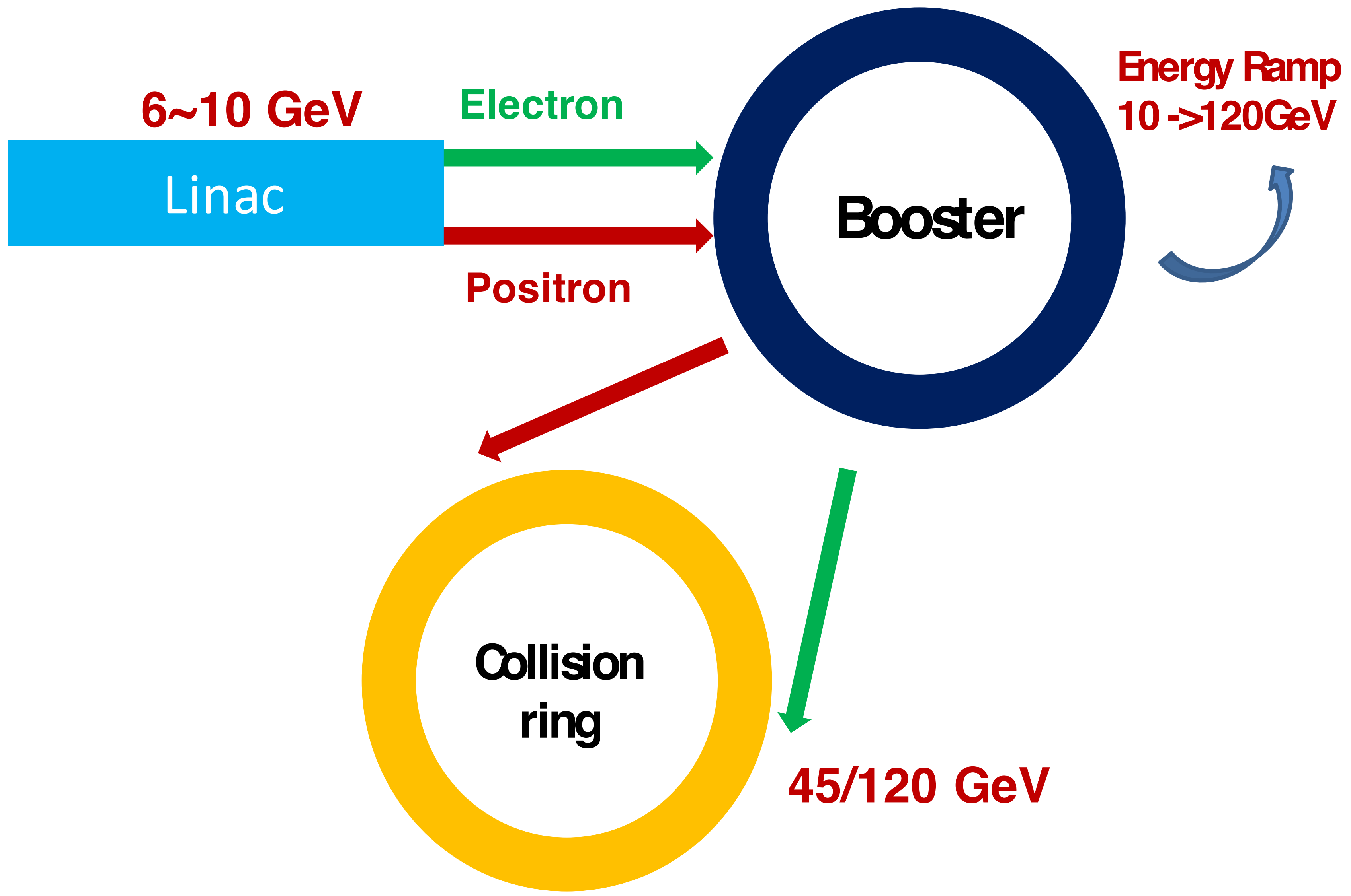
中国科学院高能物理研究所
Institute of High Energy Physics
Chinese Academy of Sciences

Main contents and objectives of the project

Advance research and validation on key technologies of accelerator and detector

Accelerator

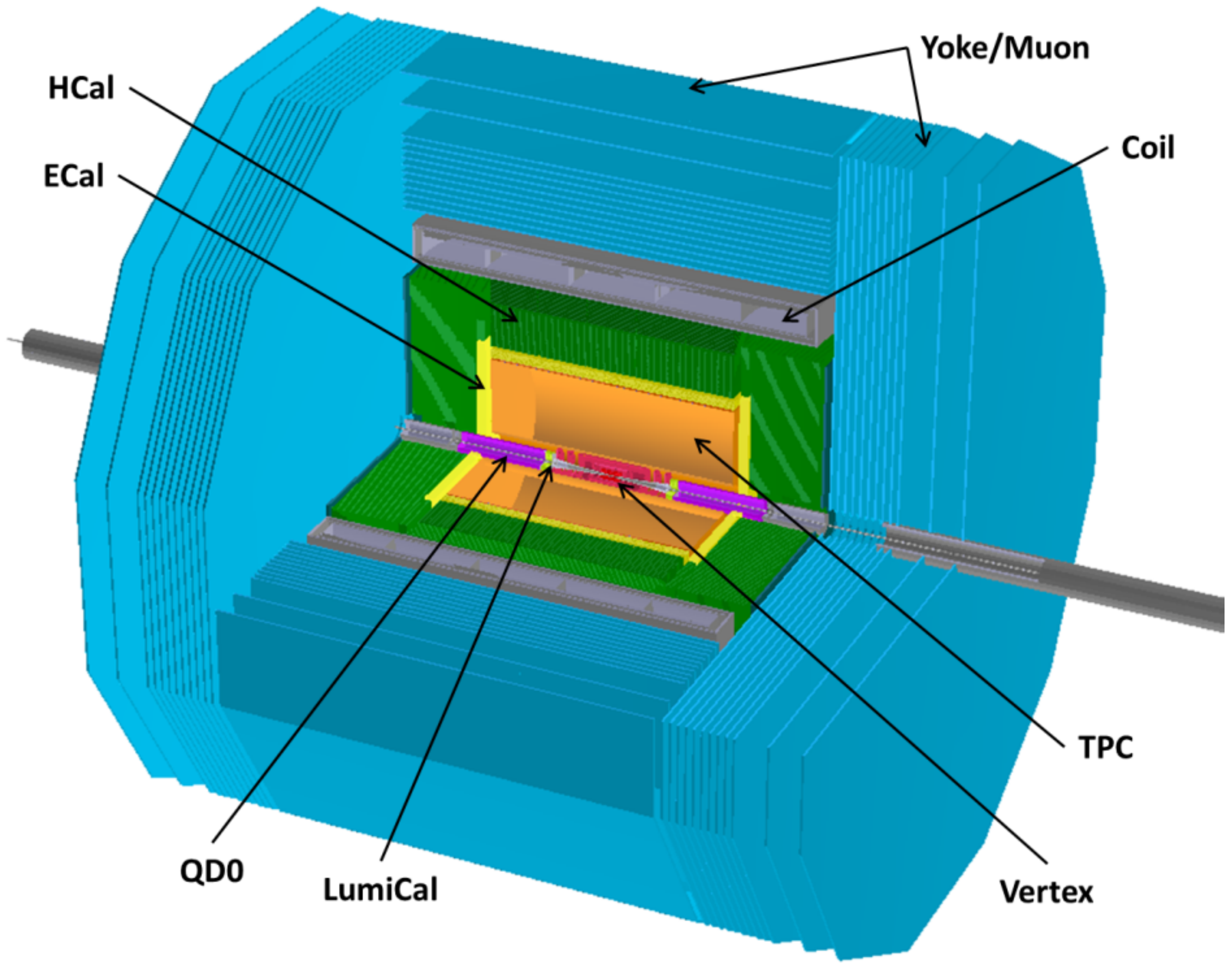
Aim for high-luminosity, low cost



课题1: Key accelerator technologies

Detector

High-precision, high-resolution to insure physics goals



课题2: Silicon pixel detector

课题3: Hadronic calorimeter

Build prototypes: Demonstrate technologies
Meet possible technical limitations

任务分解和主要研究: Task Arrangement and Main Research

Task	Task Leader Institute	Research Content	Funds
Task 1: Accelerator	Yunlong Chi IHEP	Prototypes: low-field dipole magnet, main ring vacuum system, electrostatic separator; Beam polarization design	974万
Task 2: Silicon Detector	João Guimarães da Costa IHEP	Prototype: silicon vertex with low-material budget, radiation resistant	1200万
Task 3: Hadronic Calorimeter	Jianbei Liu USTC	Prototype: imaging hadron calorimeter with scintillator + silicon photomultiplier tube (SiPM)	971万

Total funding: 3145 万

Major Project Milestones:

- Official starting date: May 1, 2018
- Official kick-off meeting: November 28, 2018
- First Annual Meeting: April 2019
- Midterm review: August 2020
- Final report: April 2023

Agenda for meeting

General Overview: Today

Friday, April 23, 2021		
08:00 - 18:00	Review Meeting	
	09:00	**Project Overview (30'+10') 项目进展汇报** *40'* Speaker: Joao Guimaraes Costa
	09:40	**Task 1 Progress report 课题一进展汇报：高能环形正负电子对撞机加速器关键技术验证** *50'* Speaker: Prof. 云龙 池 (高能所)
	10:30	**Group photo and Coffee break** *30'*
	11:00	**Task 3 Progress Report 课题三进展汇报：成像型强子量能器技术验证** *50'* Speaker: Dr. Jianbei Liu (University of Science and Technology of China)
	12:00	**Lunch** *1h30'*
	13:30	**Task 2 Progress Report 课题二进展汇报：硅径迹探测器关键技术验证** *50'* Speakers: Joao Guimaraes Costa, Prof. LIANG Zhijun
	14:20	**Coffee Break** *20'*
	14:40	**Discussion (Project Team Only)** *1h0'* (229)
	14:40	**Discussion (Referees only) 评委内部讨论与撰写评审意见** *1h0'*
	15:40	**Close out session 总结** *2h20'*
18:00 - 20:00	Dinner	

Zoom room will be provided for referees discussion at 2:40 pm

Agenda for meeting

Detailed internal discussions happened in the last two days

Wednesday, April 21, 2021

09:30 - 12:00 Internal Meeting: HCAL
Location: Multi-subject Building (229)

09:30 **Overview** *20'*
Speaker: Dr. Jianbei Liu (University of Science and Technology of China)
Material: Slides

10:05 **AHCAL design and optimization** *20'*
Speaker: 禹坤 石 (中国科学技术大学)
Material: Slides

10:25 **Status of production and quality control of scintillator tiles** *20'*
Speaker: Dr. Yanyun Duan (TDLI/SJTU)
Material: Slides

10:45 **Status of readout electronics and HBU development** *20'*
Speaker: 仲弢 沈 (University of Science and Technology of China)
Material: Slides

11:05 **Discussion** *55'*

Thursday, April 22, 2021

09:00 - 12:00 Internal Meeting: Accelerator

09:15 **Progress of Prototype Dipole Magnet for CEPC Booster (20'+5')** *25'*
Speaker: Dr. Wen 康文 (Accelerator Centor, IHEP)
Material: Slides

09:40 **R&D progress of CEPC vacuum system (20'+5')** *25'*
Speaker: MA Yongsheng (高能所)
Material: Slides

10:05 **Coffee break** *20'*

10:25 **CEPC MOST Project Midterm Review Meeting-separator (20'+5')** *25'*
Speaker: Mr. bin 陈斌 (高能所)
Material: Slides

10:50 **Polarization (20'+5')** *25'*
Speaker: Dr. Zhe DUAN (高能所)
Material: Slides

11:15 **Discussion** *45'*

12:00 - 14:00 Lunch Box

14:00 - 17:30 Internal Meeting: Silicon

14:00 **Overview of Silicon Task** *20'*
Speaker: Prof. LIANG Zhijun
Material: Paper, Slides

14:35 **Status of the TaichuPix chip for the high-rate CEPC Vertex Detector** *25'*
Speaker: Mr. Wei WEI (高能所)
Material: Slides

15:00 **Detector optimization and software** *15'*
Speaker: Hao Zeng (IHEP)
Material: Slides

15:15 **Mechanical Design of Silicon Vertex Detector Prototype** *25'*
Speaker: Jinyu (高能所)
Material: Slides

15:40 **Coffee break** *20'*

16:00 **Vertex detector geometry implementation** *15'*
Speaker: Kewei Wu
Material: Slides

16:15 **Plan for flex PCB design** *25'*
Speaker: Mr. 俊 胡 (高能所)
Material: Slides

16:40 **Plan for DAQ system development** *25'*
Speaker: Hongyu ZHANG (EPC, IHEP, CAS, China)
Material: Slides

17:05 **Discussion** *25'*

17:30 - 19:00 Dinner

Lively discussions!

Dinner 2.5 hours later

第二年（2019.5-2020.4）— Up to midterm

Main Milestones

- Task 1: Accelerator
  - ✓ Manufacture the high-precision low-field dipole magnet small experimental prototype
  - ✓ Finish engineering design of vacuum tube and bellows, and electrostatic separator
  - ✓ Simulation program for storage ring polarization is developed
- Task 2: Vertex Detector
  - ✓ Engineering designs of mechanics structure
  - ✓ Second ASIC MPW submitted
- Task 3: Calorimeter
  - ✓ Simulate whole HCAL prototype and develop software framework
  - ✓ Carry out production of scintillator units
  - ✓ Prototype absorber and supporting structure are designed

Delays in the implementation of the “tile production” due to re-optimization of the tile size, and COVID-19

Outcome

- Mid-term report

Midterm indicators achieved for all tasks

第三年（2020.5-2021.4）

Main Milestones

- Task 1: Accelerator IHEP
  - Small prototype of magnet fully tested
  - Design of magnet complete
  - Processing of the vacuum tube, the coating experiment device and the shielding bellows are completed
- Task 2: Vertex Detector
  - Mechanical structure completed
  - Second ASIC MPW tested
  - ASIC design optimized and completed
- Task 3: Calorimeter
  - Batch production of readout electronics, development of data acquisition system
  - Development of beam test platform and cosmic ray test platform

Outcome

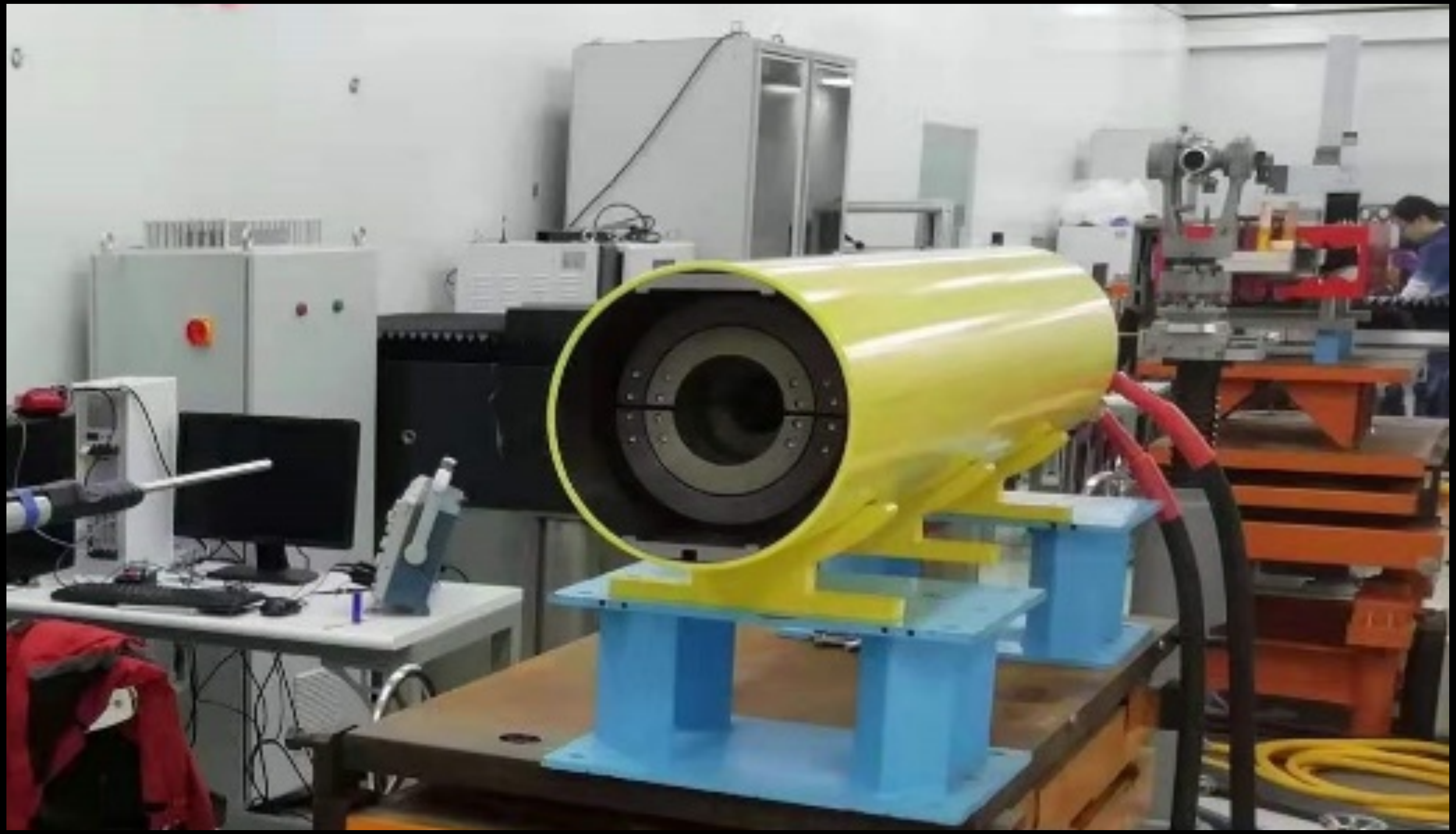
- Annual report

Task 1 - Mission 1: High precision low-field dipole magnet

Two small low-field dipole magnet prototypes built and tested

Iron core

CT Coil — no iron core



Better performance in testing

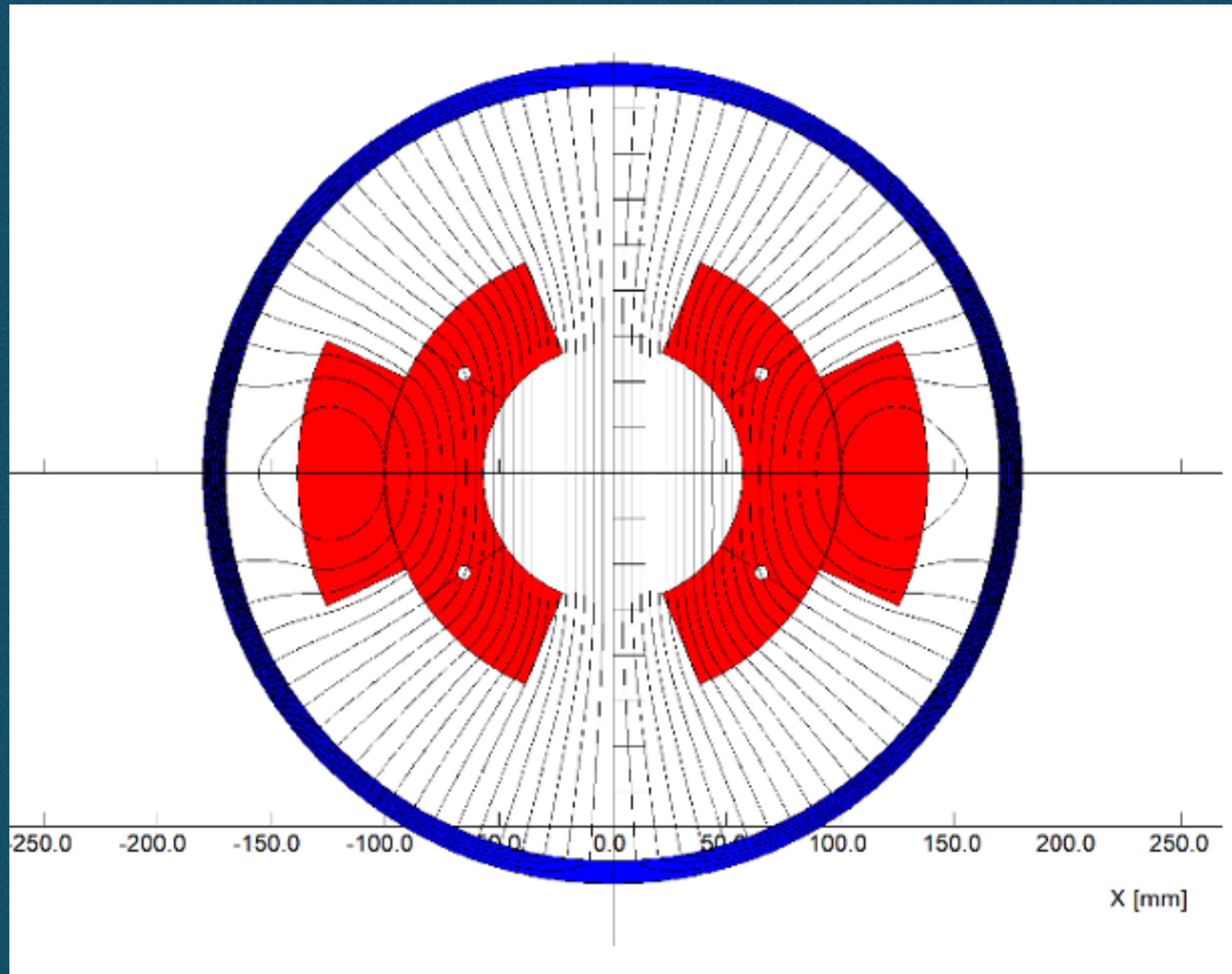
↓

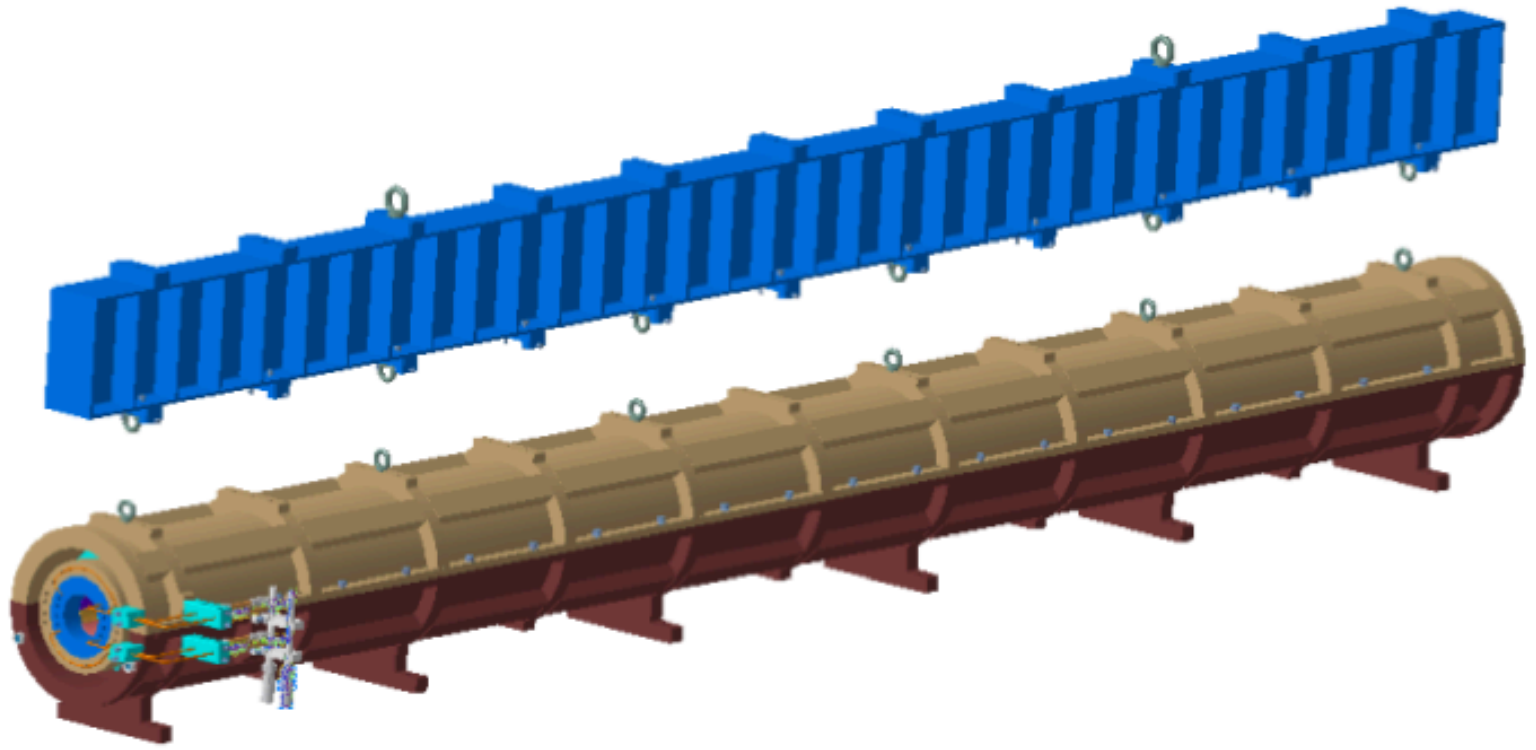
Design full size prototype

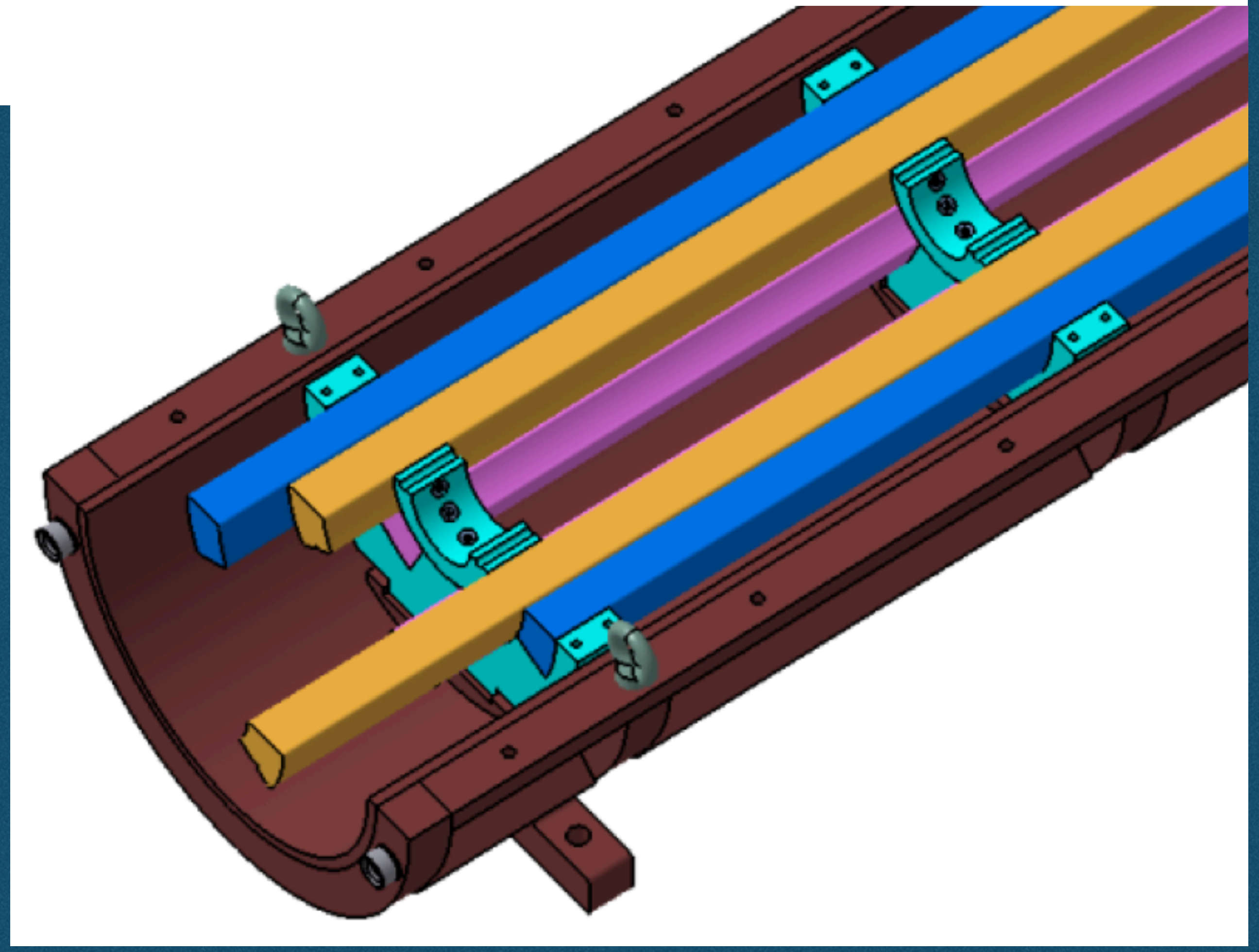
Task 1 - Mission 1: High precision low-field dipole magnet

Full-scale prototype CT coil dipole magnet

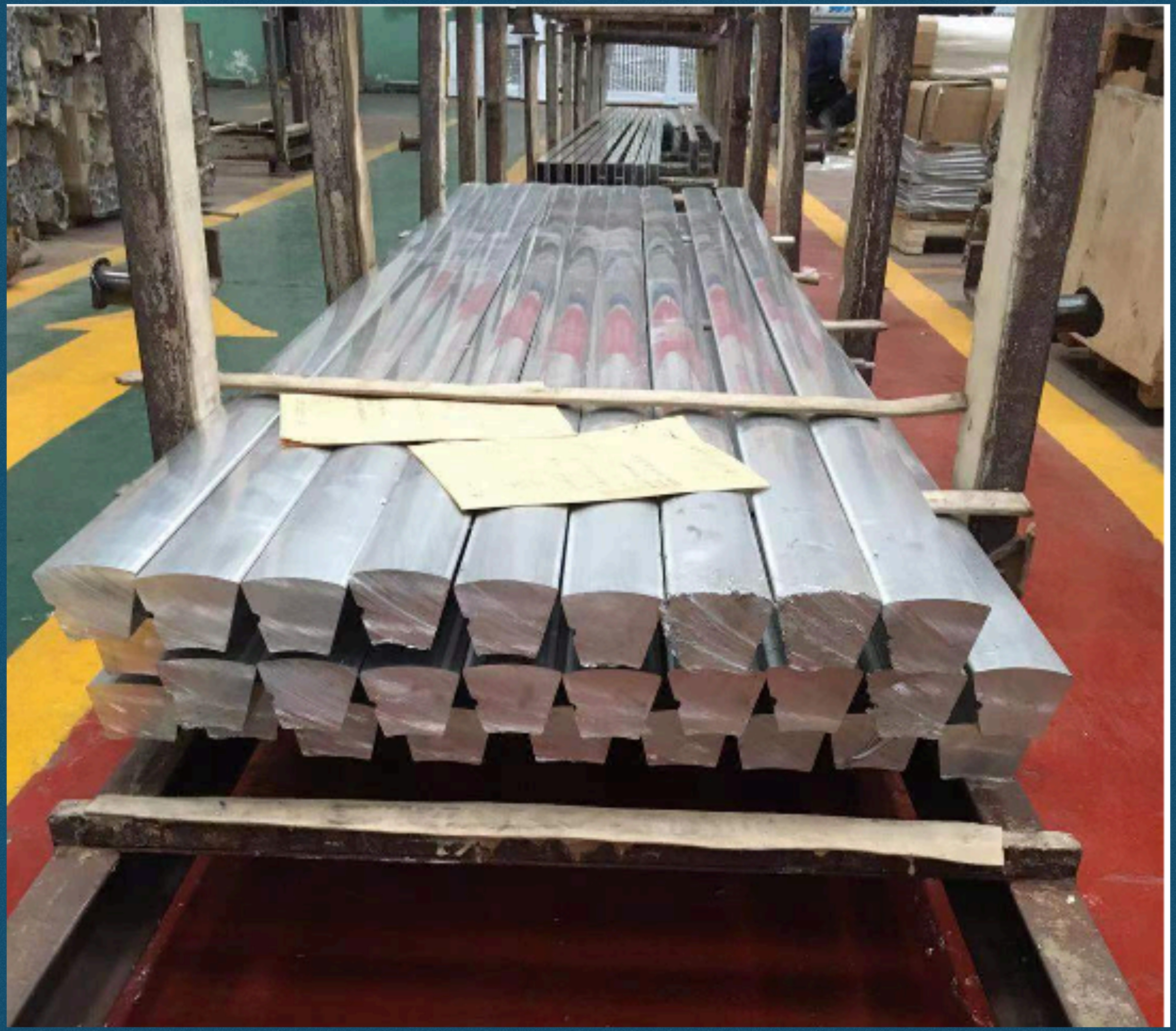
Design complete







Production already underway



2.5 m conductor bars

(ahead of schedule)

Task 1 - Mission 2: Main ring vacuum system

6-m long vacuum tubes

(meets engineering requirements)

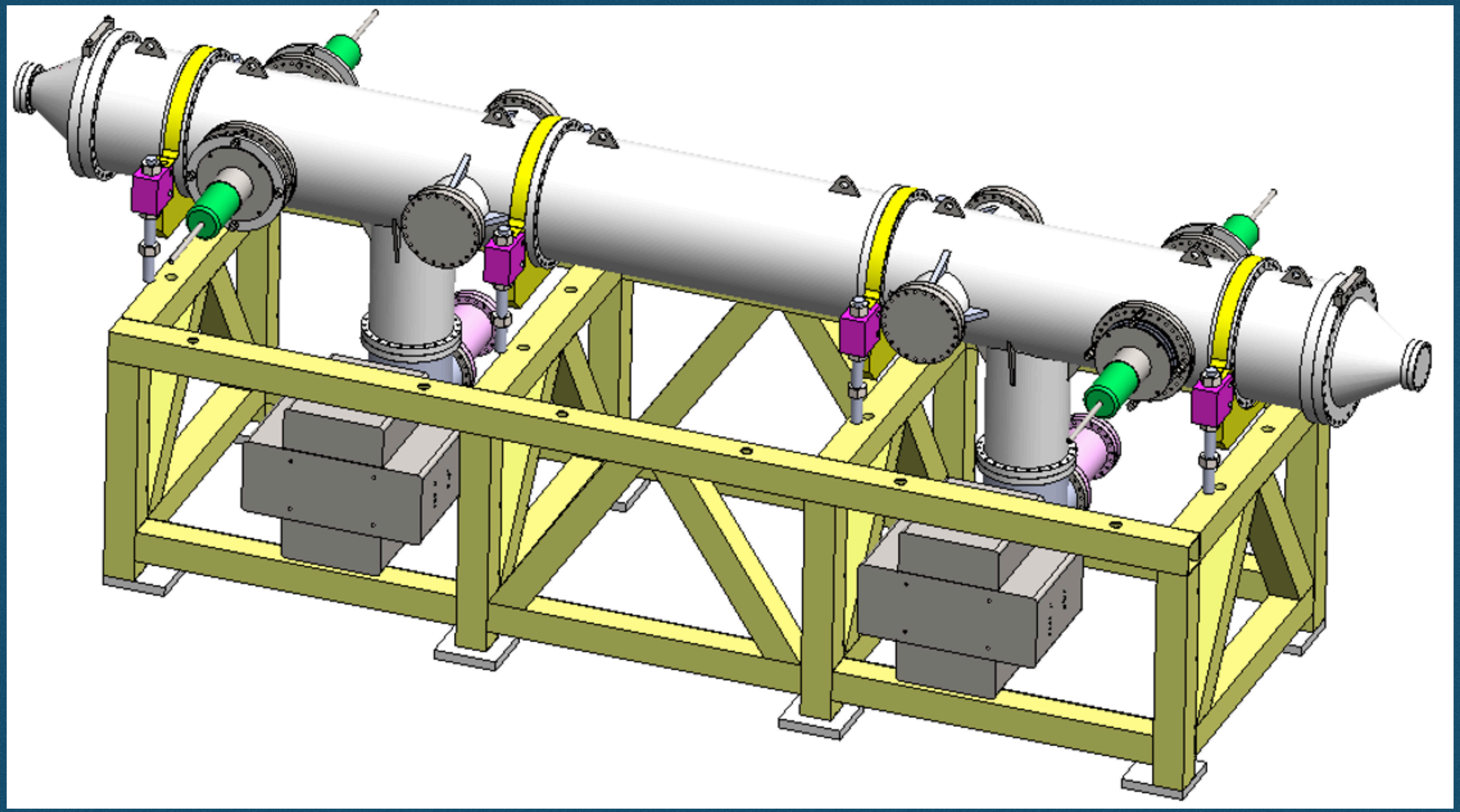
RF shielding bellows

(finished - meets target

NEG Coating setup (6 m tubes)

Task 1 - Mission 3: Electrostatic separator

Design was finished last year and prototype construction started ahead of schedule



Design improvements implemented this year

Testing platform built

Separator to be shipped to IHEP soon

第三年（2020.5-2021.4）

Main Milestones

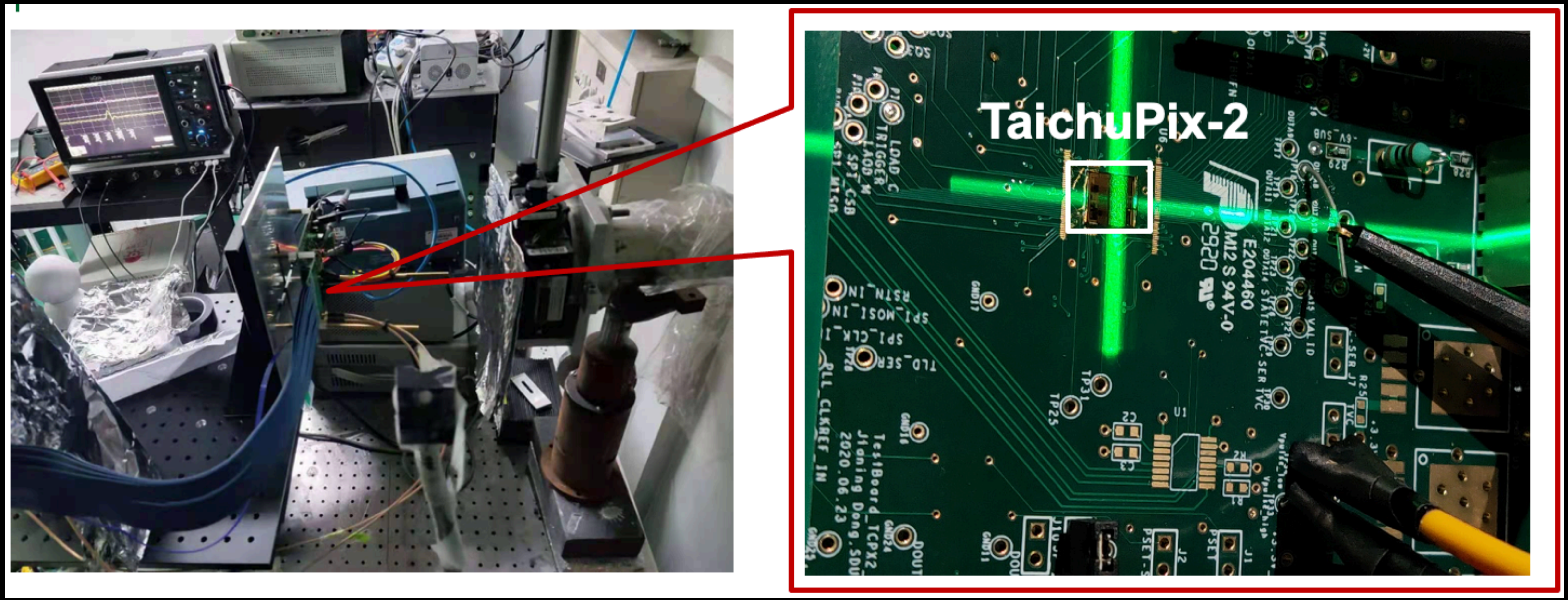
- Task 1: Accelerator
  - ✓ Small prototype of magnet fully tested
  - ✓ Design of magnet complete
  - ✓ Processing of the vacuum tube, the coating experiment device and the shielding bellows are completed
- Task 2: Vertex Detector
  - Mechanical structure completed
  - Second ASIC MPW tested
  - ASIC design optimized and completed
- Task 3: Calorimeter
  - Batch production of readout electronics, development of data acquisition system
  - Development of beam test platform and cosmic ray test platform

IHEP, SDU, NJU, NWPU, (IFAE & CCNU)

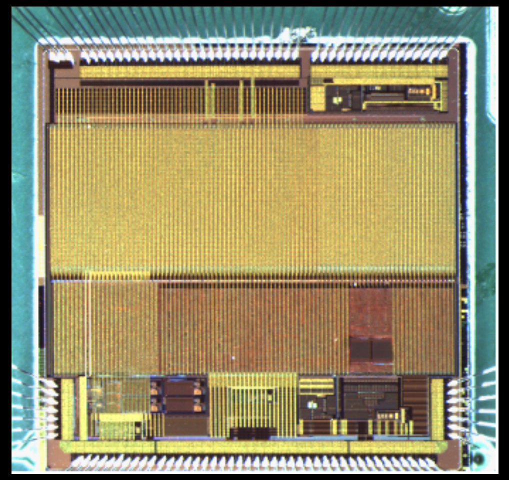
Outcome

- Annual report

Task 2: Vertex Detector Highlights



TaichuPix-2 irradiated at IHEP (6 keV X-ray)



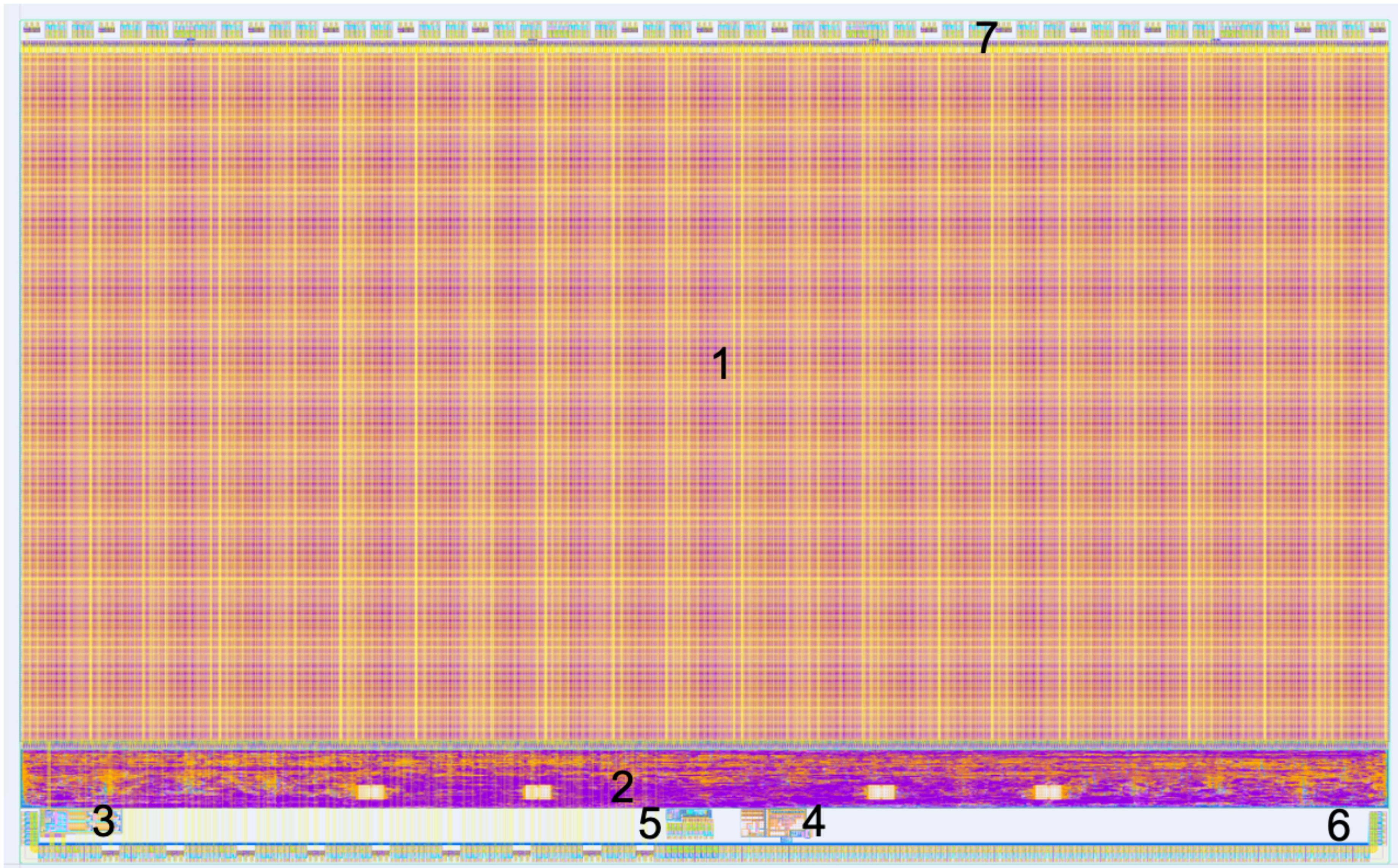
Pitch: 25/24 × 25 μm^2

Power: 100-150 mW/cm^2

Size: 5 × 5 mm^2

Good chip function and noise performance up to 30 Mrad TID

MOST project goals achieved



1. Pixel array 1024*512
2. Periphery
3. DAC & Bias generation
4. Data interface
5. LDO (test blocks)
6. Chip inter-connection features
7. Scribe-able top power connection features

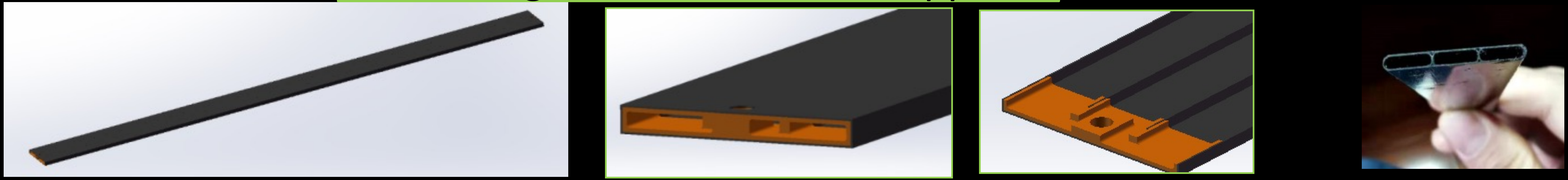
Full size chip ready to submit next month

Engineering run for Pixel Vertex detector prototype

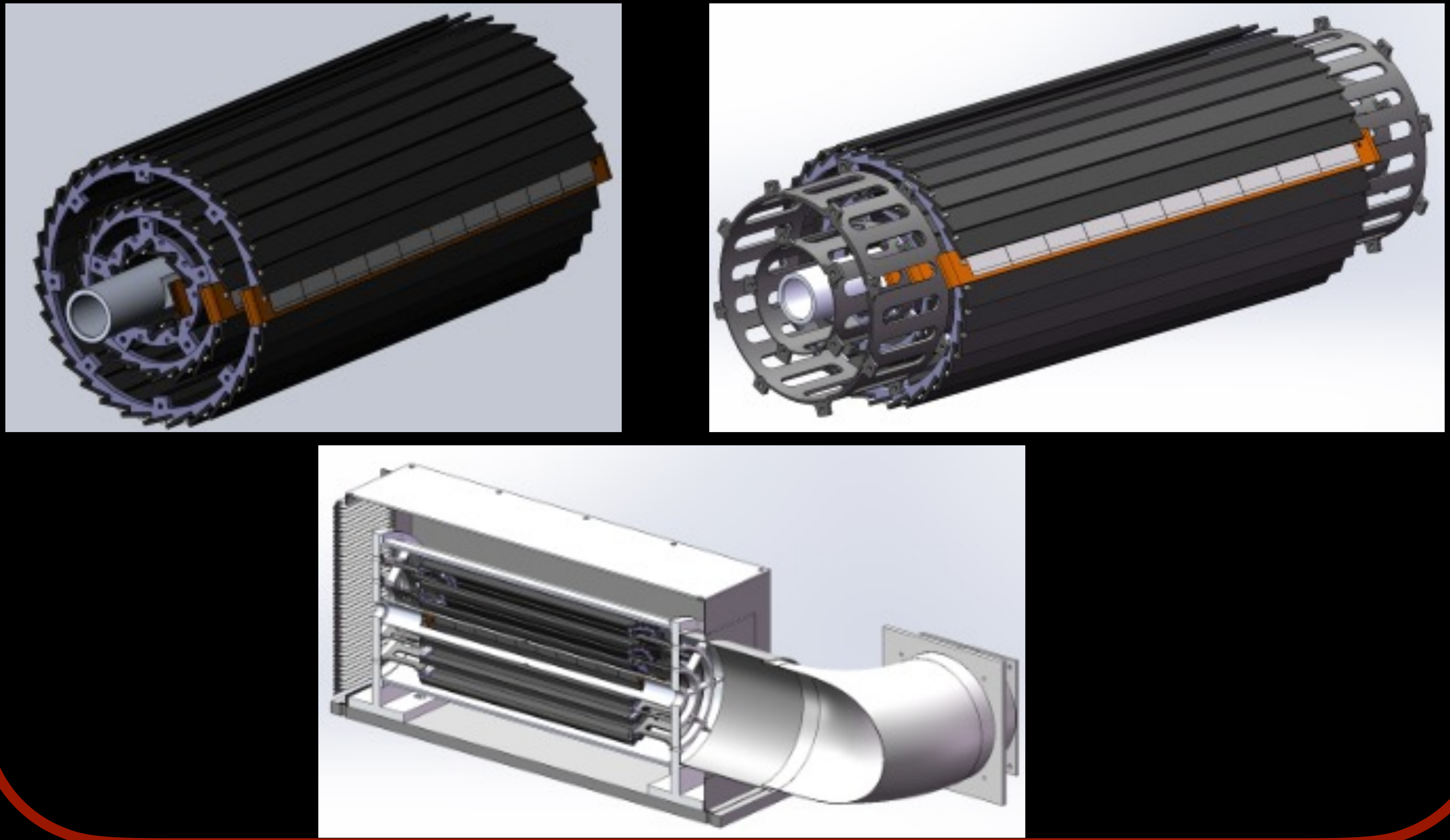
(ahead of schedule)

Task 2: Vertex Detector Highlights

The design model of ladder support

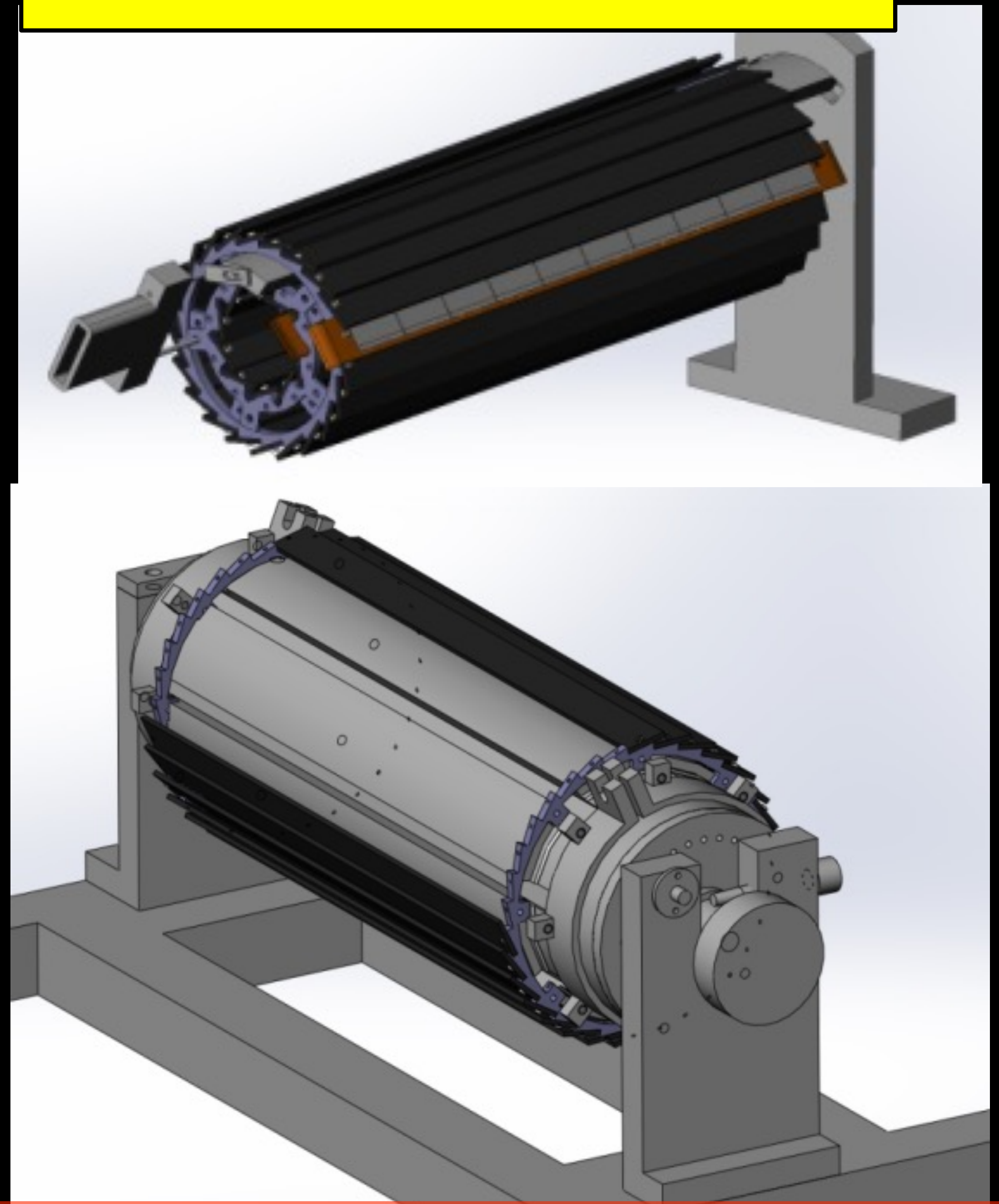


Vertex Detector Structure



Assembling Tooling

Inner and middle barrels combination and customized tool



第三年（2020.5-2021.4）

Main Milestones

- Task 1:
  - Small prototype of magnet fully tested
  - Design of magnet complete
  - Processing of the vacuum tube, the coating experiment device and the shielding bellows are completed
- Task 2:
  - ✓ Mechanical structure completed
  - ✓ Second ASIC MPW tested
  - ✓ ASIC design optimized and completed
- Task 3: USTC, IHEP, SJTU
  - Batch production of readout electronics, development of data acquisition system
  - Development of beam test platform and cosmic ray test platform

Outcome

- Annual report

Task 3: Calorimeter Highlights

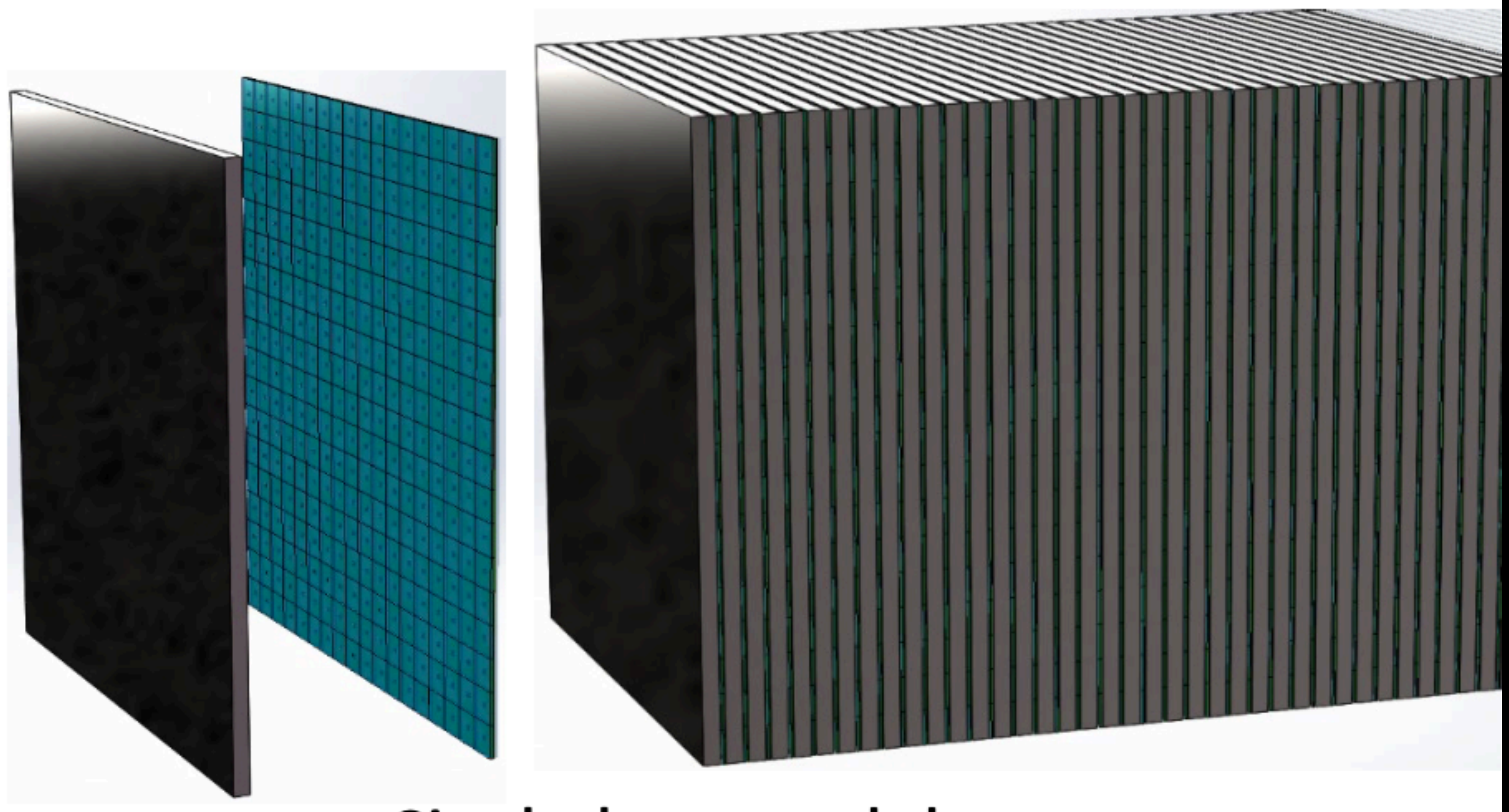
Resolution: $\dfrac{60\,\%}{\sqrt{E(GeV)}} \oplus 3\,\%$

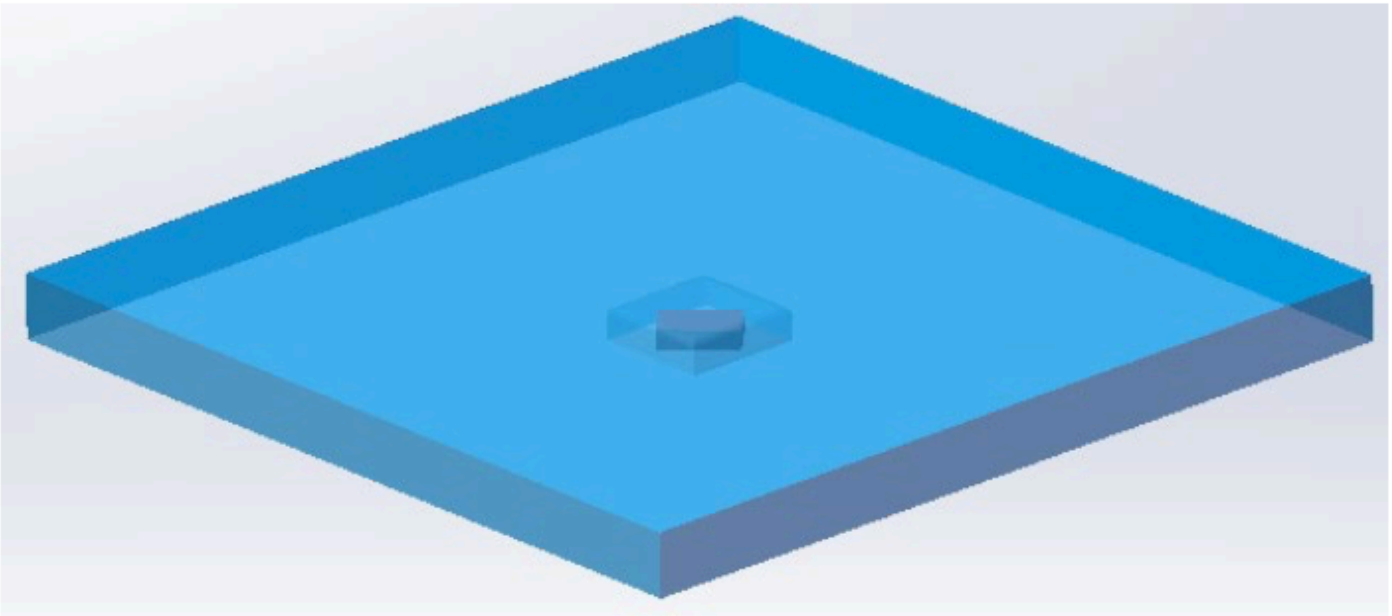
AHCAL
Scintillator and SiPM

40 layers of 20 mm stainless steel
+ 3 mm scintillator
+ 2 mm PCB

Transverse size: $72 \times 72\ cm^2$

Length: 1.3 m


Single layer and detector part



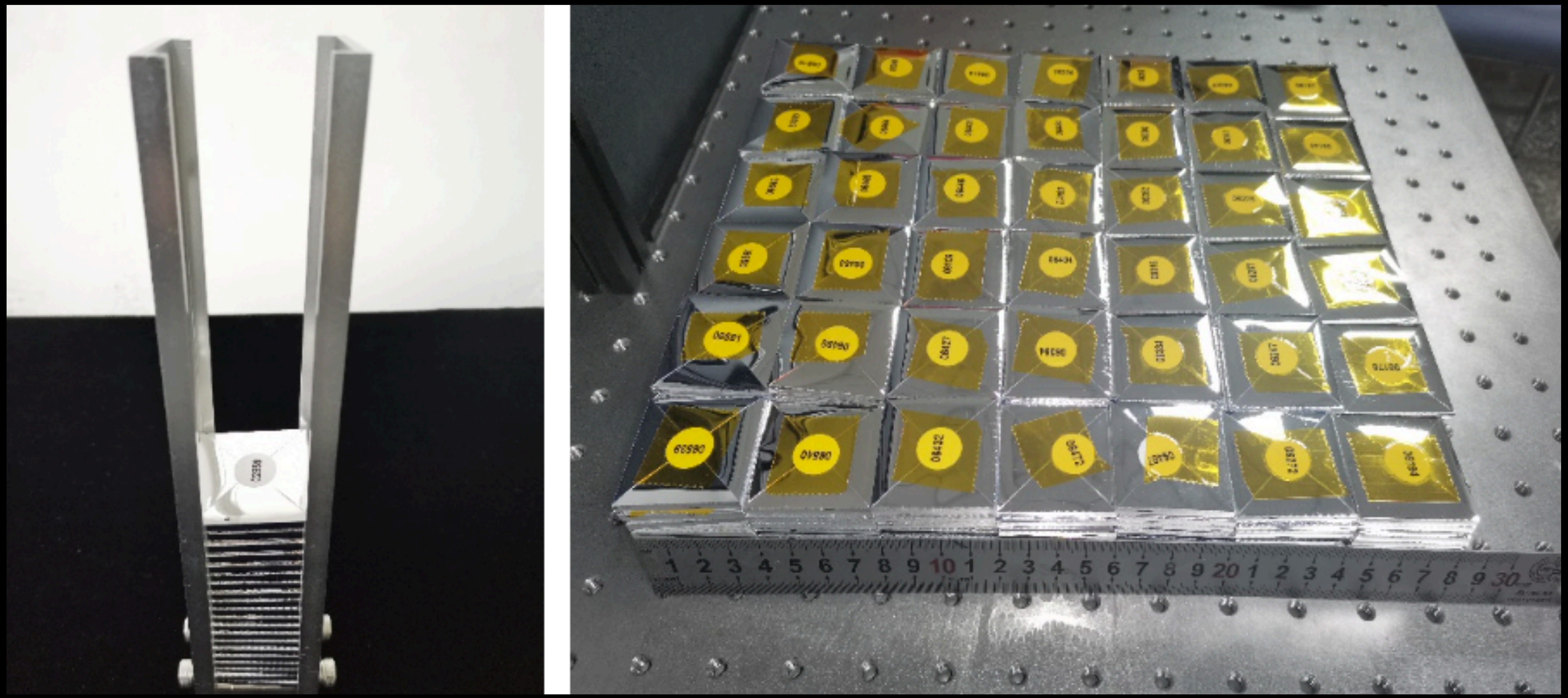
Cell size: $4 \times 4\ cm^2$

Task 3: Calorimeter Highlights

10000 scintillators have been produced using the injection molding technique

Light yield of each scintillator is about 40 p.e., tested with NDL-22-1313-15S

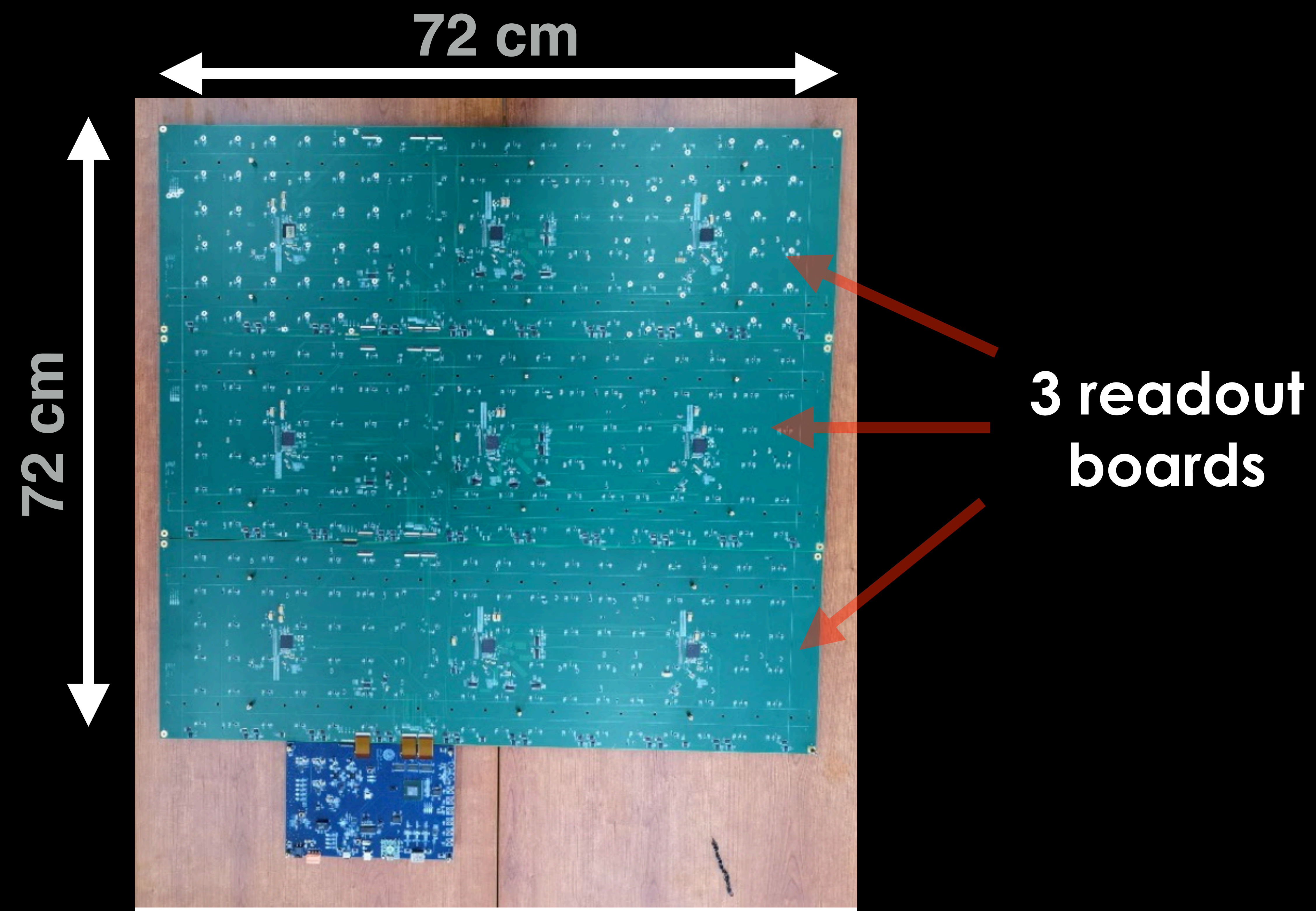
Automatic wrapping and labelling



3 batch testing platforms built (USTC, SJTU, IHEP)

SPIROC chip packaged and available

Front-end readout board prototype built



HBU:HCAL Basic Unit

Mass production to start soon

Funding Allocation and Implementation

Project Funds Allocation

Implementation:

Direct fee	Task 1	Task 2	Task 3
by today	66%	60%	35%
Total	50%	34%	25%

Bulk of expenses to build and test prototypes still in the future

Task 1: Funds allocation and implementation

序号	预算科目名称	Expense until 2021/4/14	Total budget	Rate of expense/total budget	Budget until 2021/4/30	Rate of expense/budget till 2021/4/14
2	**direct fee**	**438.86**	**878.19**	**49.97%**	**659.29**	**66.56%**
3	1、device fee	377.00	456	82.68%	359.00	105.01%
4	(1) purchase device	122.35	140	87.39%	113.00	108.27%
5	(2) Trial device	256.10	296	86.52%	226.00	113.32%
6	(3) modifed device	0.00	20	0.00%	20.00	0.00%
7	2、material fee	7.98	116	6.88%	93.00	8.59%
8	3、testing fee	2.10	76.2	2.76%	63.20	3.32%
9	4、power fee	0.00	18	0.00%	10.00	0.00%
10	5、travel/conference/international communication	26.71	131.1	20.37%	84.40	31.64%
11	6、publication	2.60	20.29	12.81%	16.49	15.76%
12	7、labor	22.47	51	44.05%	27.20	82.60%
13	8、consult	0.00	9.6	0.00%	6.00	0.00%

Task 2: Funds allocation and implementation

序号	预算科目名称	Expense until 2021/4/14	Total budget	Rate of expense/ total budget	Budget until 2021/4/30	Rate of expense/ budget till 2021/4/14
2	**direct fee**	**355.35**	**1047.71**	**33.92%**	**594.03**	**59.82%**
3	1、device fee	76.99	196.30	39.22%	196.30	39.22%
4	（1）purchase device	76.99	196.30	39.22%	196.30	39.22%
5	（2）Trial device					
6	（3）modifed device					
7	2、material fee	109.33	235.66	46.39%	188.24	58.08%
8	3、testing fee	2.25	299.80	0.75%	27.60	8.15%
9	4、power fee	0.12	20.64	0.59%	12.39	0.98%
10	5、travel/conference/ international communication	52.99	123.81	42.80%	74.82	70.83%
11	6、publication	2.08	8.50	24.46%	5.10	40.77%
12	7、labor	109.54	157.00	69.77%	86.00	127.38%
13	8、consult	2.04	6.00	33.92%	3.60	56.53%

Task 3: Funds allocation and implementation

序号	预算科目名称	Expense until 2021/4/14	Total budget	Rate of expense/total budget	Budget until 2021/4/30	Rate of expense/budget till 2021/4/14
2	**direct fee**	**210.06**	**840.50**	**24.99%**	**592.56**	**35.45%**
3	1、device fee	51.53	135.60	38.01%	135.60	38.01%
4	(1) purchase device	51.53	135.60	38.01%	135.60	38.01%
5	(2) Trial device					
6	(3) modifed device					
7	2、material fee	72.95	379.46	19.22%	279.46	26.10%
8	3、testing fee	15.51	45.00	34.46%	27.00	57.44%
9	4、power fee	0.00	4.60		3.00	
10	5、travel/conference/international communication	24.42	128.34	19.03%	65.00	37.57%
11	6、publication	0.09	6.00	1.49%	3.00	2.98%
12	7、labor	45.35	137.50	32.98%	77.50	58.52%
13	8、consult	0.21	4.00	5.25%	2.00	10.50%

Planning

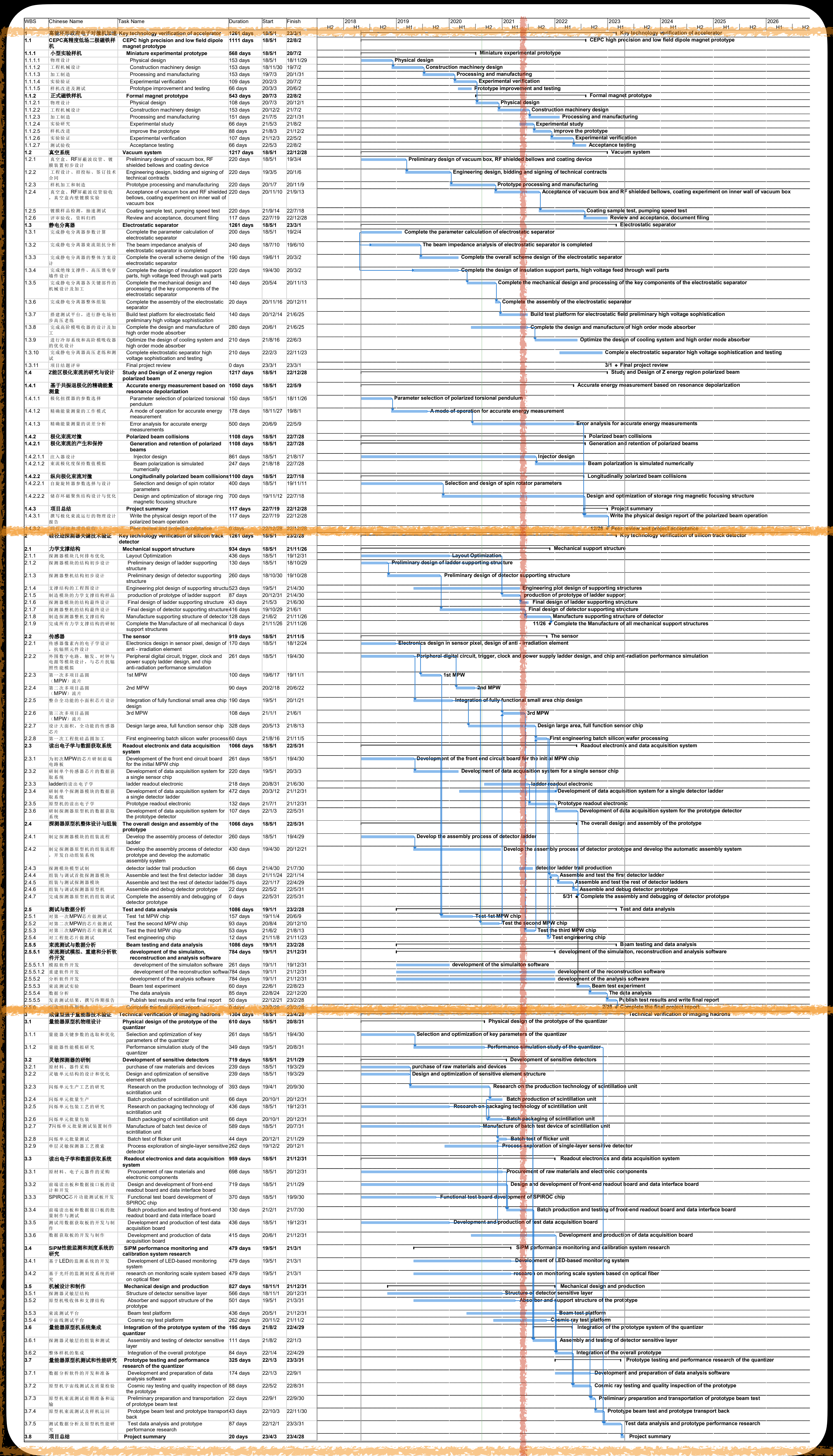
Impact due to Covid-19 pandemic

- International collaboration diminished
  - Travel to/from international partner institutions
    - Collaboration with BINP of Russia on Beam Polarization most affected
  - Work at partner international institutions was reduced but has no critical impact
    - Collaboration with Barcelona continued without interruption

- Work in laboratories at universities and IHEP reduced —> delay still being recovered
  - Main driver of delays in the calorimeter task
    - e.g. production of scintillator tiles, wrapping and testing

- Other main tasks proceeded without major delays
  - Personnel worked from home on most design activities
    - 2nd version of vertex detector chip finalized at home and submitted to vendor in Israel with no impact on schedule

Future Integrated Plan (Microsoft Project)



Task 1: Accelerator

by end 2021, complete:
- dipole magnet prototype
- vacuum tubes and RF bellows

by end 2022, complete:
- electrostatic separator
- polarization studies

Task 2: Vertex

by end 2021, complete:
- first chip engineering run produced
- manufacturing of detector support structure finished
- single ladder DAQ ready

early 2022, complete:
- prototype

by end 2022, complete:
- prototype test beam

Task 3: Calorimeter

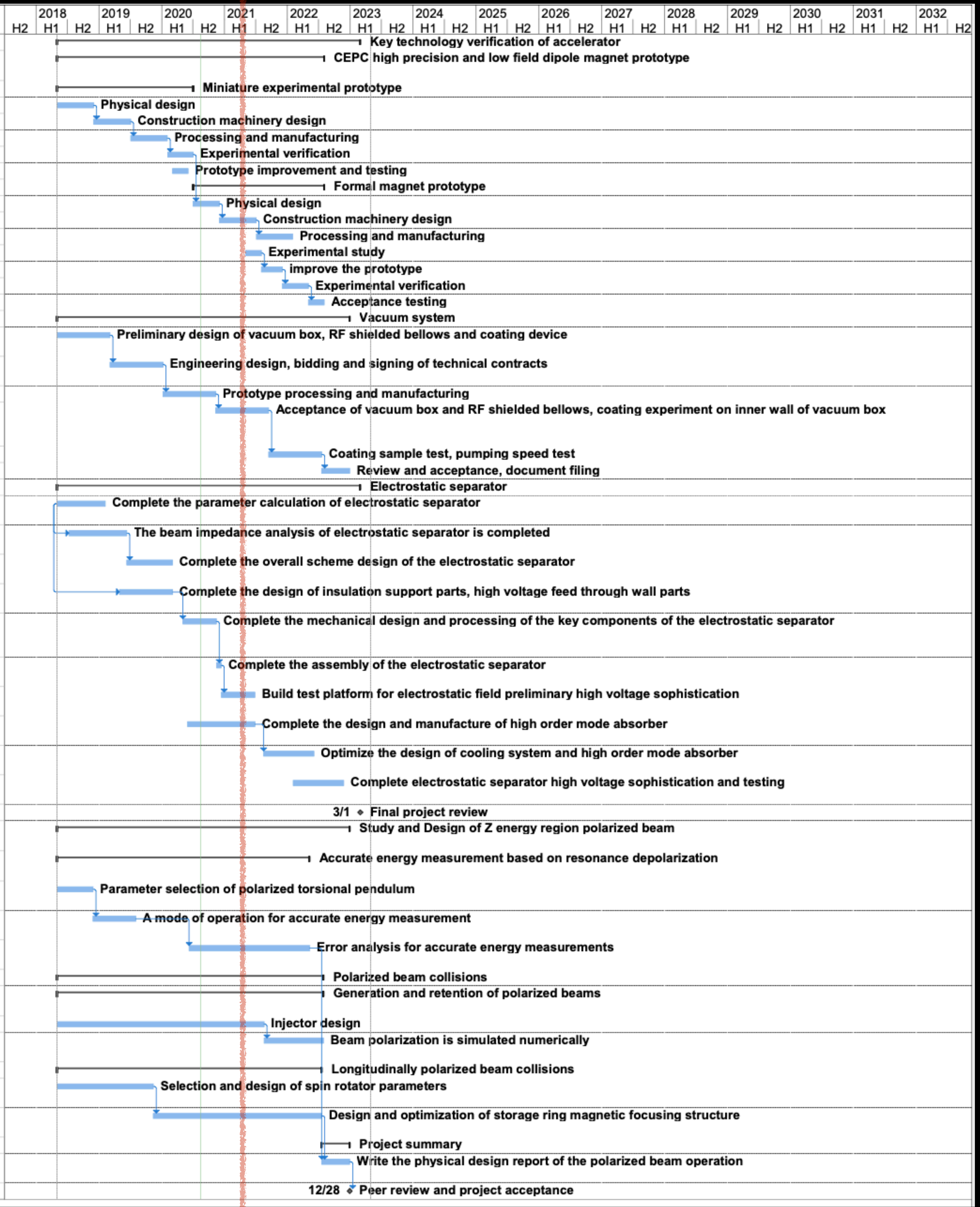
by end 2021, complete:
- batch production and wrapping of scintillator tiles
- batch production of front end electronics

early 2022, complete:
- prototype

by end 2022, complete:
- prototype test beam

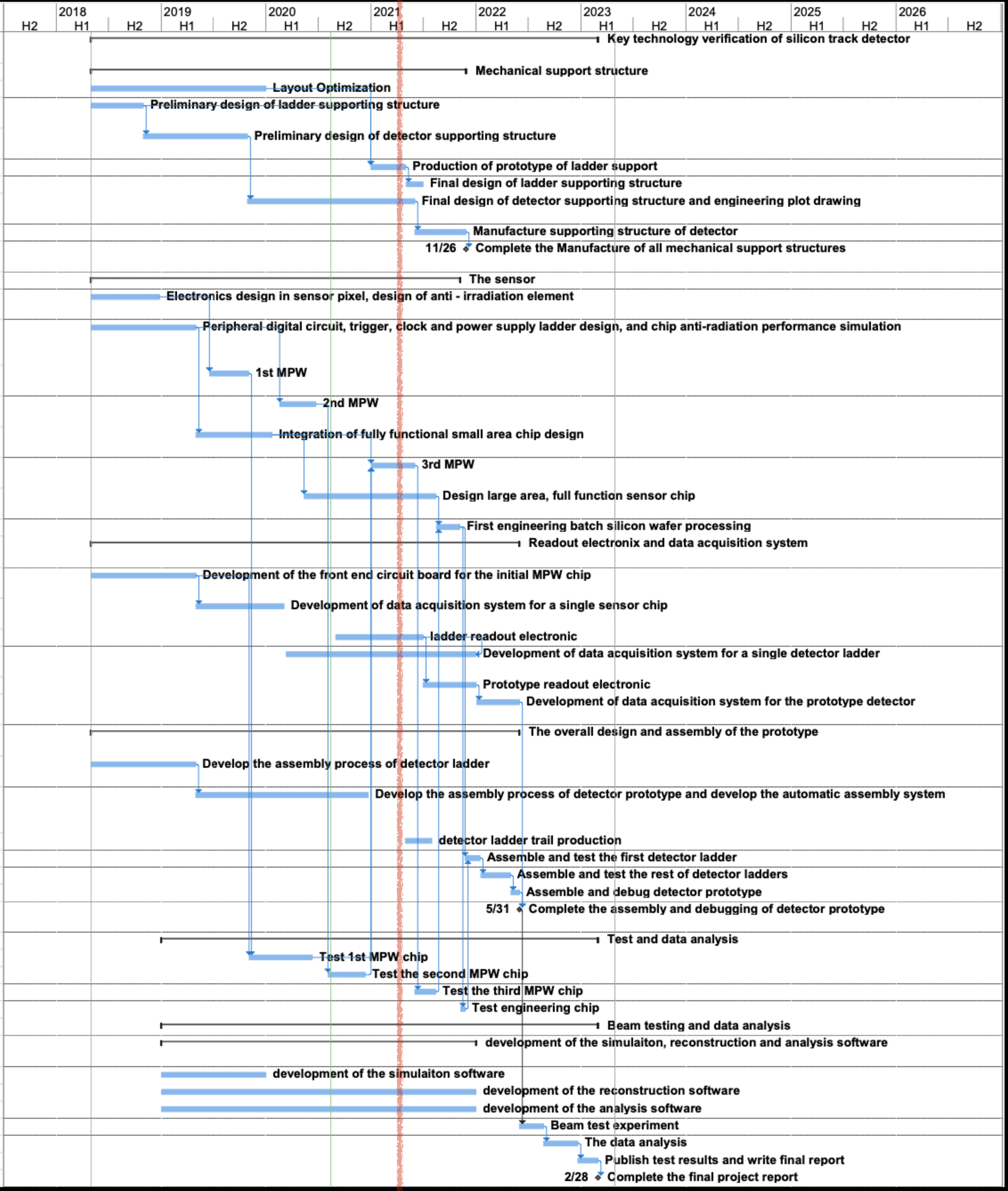
Task 1: Accelerator Plan

WBS	Chinese Name	Task Name	Duration	Start	Finish
1	**高能环形政府电子对撞机加**	**Key technology verification of accelerator**	**1261 days**	**18/5/1**	**23/3/1**
1.1	**CEPC高精度低场二极磁铁样机**	**CEPC high precision and low field dipole magnet prototype**	**1111 days**	**18/5/1**	**22/8/2**
1.1.1	**小型实验样机**	**Miniature experimental prototype**	**568 days**	**18/5/1**	**20/7/2**
1.1.1.1	物理设计	Physical design	153 days	18/5/1	18/11/29
1.1.1.2	工程机械设计	Construction machinery design	153 days	18/11/30	19/7/2
1.1.1.3	加工制造	Processing and manufacturing	153 days	19/7/3	20/1/31
1.1.1.4	实验验证	Experimental verification	109 days	20/2/3	20/7/2
1.1.1.5	样机改进及测试	Prototype improvement and testing	66 days	20/3/3	20/6/2
1.1.2	**正式磁铁样机**	**Formal magnet prototype**	**543 days**	**20/7/3**	**22/8/2**
1.1.2.1	物理设计	Physical design	108 days	20/7/3	20/12/1
1.1.2.2	工程机械设计	Construction machinery design	153 days	20/12/2	21/7/2
1.1.2.3	加工制造	Processing and manufacturing	151 days	21/7/5	22/1/31
1.1.2.4	实验研究	Experimental study	66 days	21/5/3	21/8/2
1.1.2.5	样机改进	improve the prototype	88 days	21/8/3	21/12/2
1.1.2.6	实验验证	Experimental verification	107 days	21/12/3	22/5/2
1.1.2.7	测试验收	Acceptance testing	66 days	22/5/3	22/8/2
1.2	**真空系统**	**Vacuum system**	**1217 days**	**18/5/1**	**22/12/28**
1.2.1	真空盒、RF屏蔽波纹管、镀膜装置初步设计	Preliminary design of vacuum box, RF shielded bellows and coating device	220 days	18/5/1	19/3/4
1.2.2	工程设计、招投标、签订技术合同	Engineering design, bidding and signing of technical contracts	220 days	19/3/5	20/1/6
1.2.3	样机加工和制造	Prototype processing and manufacturing	220 days	20/1/7	20/11/9
1.2.4	真空盒、RF屏蔽波纹管验收，真空盒内壁镀膜实验	Acceptance of vacuum box and RF shielded bellows, coating experiment on inner wall of vacuum box	220 days	20/11/10	21/9/13
1.2.5	镀膜样品检测，抽速测试	Coating sample test, pumping speed test	220 days	21/9/14	22/7/18
1.2.6	评审验收，资料归档	Review and acceptance, document filing	117 days	22/7/19	22/12/28
1.3	**静电分离器**	**Electrostatic separator**	**1261 days**	**18/5/1**	**23/3/1**
1.3.1	完成静电分离器参数计算	Complete the parameter calculation of electrostatic separator	200 days	18/5/1	19/2/4
1.3.2	完成静电分离器束流阻抗分析	The beam impedance analysis of electrostatic separator is completed	240 days	18/7/10	19/6/10
1.3.3	完成静电分离器的整体方案设计	Complete the overall scheme design of the electrostatic separator	190 days	19/6/11	20/3/2
1.3.4	完成绝缘支撑件、高压馈电穿墙件设计	Complete the design of insulation support parts, high voltage feed through wall parts	220 days	19/4/30	20/3/2
1.3.5	完成静电分离器各关键部件的机械设计及加工	Complete the mechanical design and processing of the key components of the electrostatic separator	140 days	20/5/4	20/11/13
1.3.6	完成静电分离器整体组装	Complete the assembly of the electrostatic separator	20 days	20/11/16	20/12/11
1.3.7	搭建测试平台，进行静电场初步高压老练	Build test platform for electrostatic field preliminary high voltage sophistication	140 days	20/12/14	21/6/25
1.3.8	完成高阶模吸收器的设计及加工	Complete the design and manufacture of high order mode absorber	280 days	20/6/1	21/6/25
1.3.9	进行冷却系统和高阶模吸收器的优化设计	Optimize the design of cooling system and high order mode absorber	210 days	21/8/16	22/6/3
1.3.10	完成静电分离器高压老练和测试	Complete electrostatic separator high voltage sophistication and testing	210 days	22/2/3	22/11/23
1.3.11	项目结题评审	Final project review	0 days	23/3/1	23/3/1
1.4	**Z能区极化束流的研究与设计**	**Study and Design of Z energy region polarized beam**	**1217 days**	**18/5/1**	**22/12/28**
1.4.1	**基于共振退极化的精确能量测量**	**Accurate energy measurement based on resonance depolarization**	**1050 days**	**18/5/1**	**22/5/9**
1.4.1.1	极化扭摆器的参数选择	Parameter selection of polarized torsional pendulum	150 days	18/5/1	18/11/26
1.4.1.2	精确能量测量的工作模式	A mode of operation for accurate energy measurement	178 days	18/11/27	19/8/1
1.4.1.3	精确能量测量的误差分析	Error analysis for accurate energy measurements	500 days	20/6/9	22/5/9
1.4.2	**极化束流对撞**	**Polarized beam collisions**	**1108 days**	**18/5/1**	**22/7/28**
1.4.2.1	**极化束流的产生和保持**	**Generation and retention of polarized beams**	**1108 days**	**18/5/1**	**22/7/28**
1.4.2.1.1	注入器设计	Injector design	861 days	18/5/1	21/8/17
1.4.2.1.2	束流极化度保持数值模拟	Beam polarization is simulated numerically	247 days	21/8/18	22/7/28
1.4.2.2	**纵向极化束流对撞**	**Longitudinally polarized beam collisions**	**1100 days**	**18/5/1**	**22/7/18**
1.4.2.2.1	自旋旋转器参数选择与设计	Selection and design of spin rotator parameters	400 days	18/5/1	19/11/11
1.4.2.2.2	储存环磁聚焦结构设计与优化	Design and optimization of storage ring magnetic focusing structure	700 days	19/11/12	22/7/18
1.4.3	**项目总结**	**Project summary**	**117 days**	**22/7/19**	**22/12/28**
1.4.3.1	撰写极化束流运行的物理设计报告	Write the physical design report of the polarized beam operation	117 days	22/7/19	22/12/28
1.4.3.2	同行评议和项目验收	Peer review and project acceptance	0 days	22/12/28	22/12/28



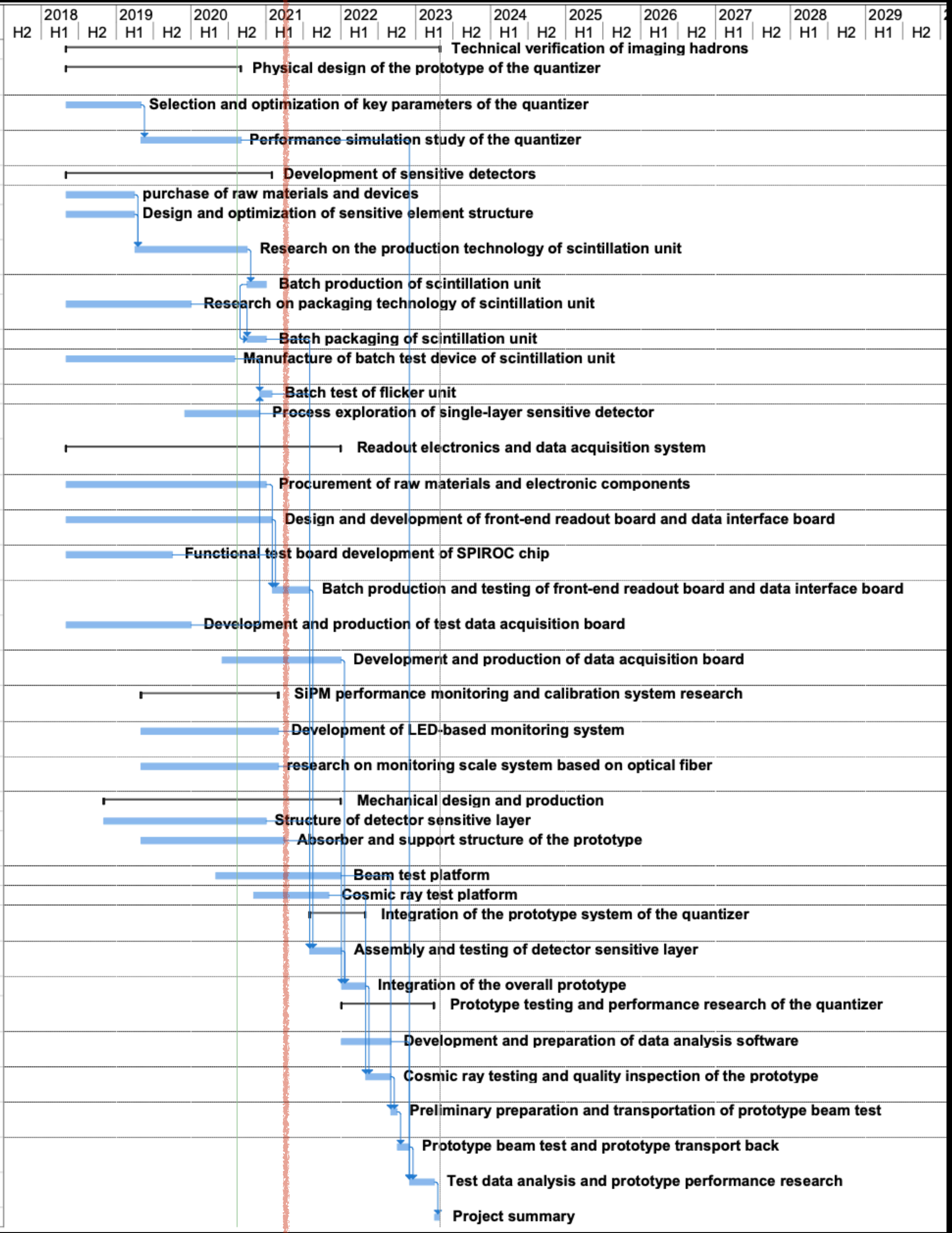
Task 2: Vertex Detector Prototype Plan

WBS	Chinese Name	Task Name	Duration	Start	Finish
2	**硅径迹探测器关键技术验证**	**Key technology verification of silicon track detector**	**1261 days**	**18/5/1**	**23/2/28**
2.1	**力学支撑结构**	**Mechanical support structure**	**934 days**	**18/5/1**	**21/11/26**
2.1.1	探测器模块几何排布优化	Layout Optimization	436 days	18/5/1	19/12/31
2.1.2	探测器模块支撑结构初步设计	Preliminary design of ladder supporting structure	130 days	18/5/1	18/10/29
2.1.3	探测器整机支撑结构初步设计	Preliminary design of detector supporting structure	260 days	18/10/30	19/10/28
2.1.4	制造模块支撑结构样品	Production of prototype of ladder support	87 days	20/12/31	21/4/30
2.1.5	探测器模块支撑结构最终设计	Final design of ladder supporting structure	43 days	21/5/3	21/6/30
2.1.6	探测器整机支撑结构最终设计和工程图	Final design of detector supporting structure and engineering plot drawing	416 days	19/10/29	21/6/1
2.1.7	制造探测器整机支撑结构	Manufacture supporting structure of detector	128 days	21/6/2	21/11/26
2.1.8	完成所有力学支撑结构的研制	Complete the Manufacture of all mechanical support structures	0 days	21/11/26	21/11/26
2.2	**传感器**	**The sensor**	**919 days**	**18/5/1**	**21/11/5**
2.2.1	传感器像素内的电子学设计，抗辐照元件设计	Electronics design in sensor pixel, design of anti - irradiation element	170 days	18/5/1	18/12/24
2.2.2	外围数字电路、触发、时钟与电源等模块设计，与芯片抗辐照性能模拟	Peripheral digital circuit, trigger, clock and power supply ladder design, and chip anti-radiation performance simulation	261 days	18/5/1	19/4/30
2.2.3	第一次多项目晶圆（MPW）流片	1st MPW	100 days	19/6/17	19/11/1
2.2.4	第二次多项目晶圆（MPW）流片	2nd MPW	90 days	20/2/18	20/6/22
2.2.5	整合全功能的小面积芯片设计	Integration of fully functional small area chip design	190 days	19/5/1	20/1/21
2.2.6	第三次多项目晶圆（MPW）流片	3rd MPW	108 days	21/1/1	21/6/1
2.2.7	设计大面积，全功能的传感器芯片	Design large area, full function sensor chip	328 days	20/5/13	21/8/13
2.2.8	第一次工程批硅晶圆加工	First engineering batch silicon wafer process	60 days	21/8/16	21/11/5
2.3	**读出电子学与数据获取系统**	**Readout electronix and data acquisition system**	**1066 days**	**18/5/1**	**22/5/31**
2.3.1	为初次MPW的芯片研制前端电路板	Development of the front end circuit board for the initial MPW chip	261 days	18/5/1	19/4/30
2.3.2	研制单个传感器芯片的数据获取系统	Development of data acquisition system for a single sensor chip	220 days	19/5/1	20/3/3
2.3.3	ladder的读出电子学	ladder readout electronic	218 days	20/8/31	21/6/30
2.3.4	研制单个探测器模块的数据获取系统	Development of data acquisition system for a single detector ladder	472 days	20/3/12	21/12/31
2.3.5	原型机的读出电子学	Prototype readout electronic	132 days	21/7/1	21/12/31
2.3.6	研制探测器原型机的数据获取系统	Development of data acquisition system for the prototype detector	107 days	22/1/3	22/5/31
2.4	**探测器原型机整体设计与组装**	**The overall design and assembly of the prototype**	**1066 days**	**18/5/1**	**22/5/31**
2.4.1	制定探测器模块的组装流程	Develop the assembly process of detector ladder	260 days	18/5/1	19/4/29
2.4.2	制定探测器原型机的组装流程，开发自动组装系统	Develop the assembly process of detector prototype and develop the automatic assembly system	430 days	19/4/30	20/12/21
2.4.3	探测模块模型试制	detector ladder trail production	66 days	21/4/30	21/7/30
2.4.4	组装与调试首批探测器模块	Assemble and test the first detector ladder	38 days	21/11/24	22/1/14
2.4.5	组装与测试探测器模块	Assemble and test the rest of detector ladder	75 days	22/1/17	22/4/29
2.4.6	组装与调试探测器原型机	Assemble and debug detector prototype	22 days	22/5/2	22/5/31
2.4.7	完成探测器原型机的组装调试	Complete the assembly and debugging of detector prototype	0 days	22/5/31	22/5/31
2.5	**测试与数据分析**	**Test and data analysis**	**1086 days**	**19/1/1**	**23/2/28**
2.5.1	对第一次MPW芯片做测试	Test 1st MPW chip	157 days	19/11/4	20/6/9
2.5.2	对第二次MPW的芯片做测试	Test the second MPW chip	93 days	20/8/4	20/12/10
2.5.3	对第三次MPW的芯片做测试	Test the third MPW chip	53 days	21/6/2	21/8/13
2.5.4	对工程批芯片做测试	Test engineering chip	12 days	21/11/8	21/11/23
2.5.5	**束流测试与数据分析**	**Beam testing and data analysis**	**1086 days**	**19/1/1**	**23/2/28**
2.5.5.1	**束流测试模拟、重建和分析软件开发**	**development of the simulaiton, reconstruction and analysis software**	**784 days**	**19/1/1**	**21/12/31**
2.5.5.1.1	模拟软件开发	development of the simulaiton software	261 days	19/1/1	19/12/31
2.5.5.1.2	重建软件开发	development of the reconstruction softwar	784 days	19/1/1	21/12/31
2.5.5.2	分析软件开发	development of the analysis software	784 days	19/1/1	21/12/31
2.5.5.3	束流测试实验	Beam test experiment	60 days	22/6/1	22/8/23
2.5.5.4	数据分析	The data analysis	85 days	22/8/24	22/12/20
2.5.5.5	发表测试结果，撰写终期报告	Publish test results and write final report	50 days	22/12/21	23/2/28
2.5.6	完成项目终期报告	Complete the final project report	0 days	23/2/28	23/2/28



Task 3: Calorimeter Prototype Plan

WBS	Chinese Name	Task Name	Duration	Start	Finish
3	**成像型强子量能器技术验证**	**Technical verification of imaging hadrons**	**1304 days**	**18/5/1**	**23/4/28**
3.1	**量能器原型机物理设计**	**Physical design of the prototype of the quantizer**	**610 days**	**18/5/1**	**20/8/31**
3.1.1	量能器关键参数的选取和优化	Selection and optimization of key parameters of the quantizer	261 days	18/5/1	19/4/30
3.1.2	量能器性能模拟研究	Performance simulation study of the quantizer	349 days	19/5/1	20/8/31
3.2	**灵敏探测器的研制**	**Development of sensitive detectors**	**719 days**	**18/5/1**	**21/1/29**
3.2.1	原材料、器件采购	purchase of raw materials and devices	239 days	18/5/1	19/3/29
3.2.2	灵敏单元结构的设计和优化	Design and optimization of sensitive element structure	239 days	18/5/1	19/3/29
3.2.3	闪烁单元生产工艺的研究	Research on the production technology of scintillation unit	393 days	19/4/1	20/9/30
3.2.4	闪烁单元批量生产	Batch production of scintillation unit	66 days	20/10/1	20/12/31
3.2.5	闪烁单元包装工艺的研究	Research on packaging technology of scintillation unit	436 days	18/5/1	19/12/31
3.2.6	闪烁单元批量包装	Batch packaging of scintillation unit	66 days	20/10/1	20/12/31
3.2.7	7闪烁单元批量测试装置制作	Manufacture of batch test device of scintillation unit	589 days	18/5/1	20/7/31
3.2.8	闪烁单元批量测试	Batch test of flicker unit	44 days	20/12/1	21/1/29
3.2.9	单层灵敏探测器工艺摸索	Process exploration of single-layer sensitive detector	262 days	19/12/2	20/12/1
3.3	**读出电子学和数据获取系统**	**Readout electronics and data acquisition system**	**959 days**	**18/5/1**	**21/12/31**
3.3.1	原材料、电子元器件的采购	Procurement of raw materials and electronic components	698 days	18/5/1	20/12/31
3.3.2	前端读出板和数据接口板的设计和开发	Design and development of front-end readout board and data interface board	719 days	18/5/1	21/1/29
3.3.3	SPIROC芯片功能测试板开发	Functional test board development of SPIROC chip	370 days	18/5/1	19/9/30
3.3.4	前端读出板和数据接口板的批量制作与测试	Batch production and testing of front-end readout board and data interface board	130 days	21/2/1	21/7/30
3.3.5	测试用数据获取板的开发与制作	Development and production of test data acquisition board	436 days	18/5/1	19/12/31
3.3.6	数据获取板的开发与制作	Development and production of data acquisition board	415 days	20/6/1	21/12/31
3.4	**SiPM性能监测和刻度系统的研究**	**SiPM performance monitoring and calibration system research**	**479 days**	**19/5/1**	**21/3/1**
3.4.1	基于LED的监测系统的开发	Development of LED-based monitoring system	479 days	19/5/1	21/3/1
3.4.2	基于光纤的监测刻度系统的研究	research on monitoring scale system based on optical fiber	479 days	19/5/1	21/3/1
3.5	**机械设计和制作**	**Mechanical design and production**	**827 days**	**18/11/1**	**21/12/31**
3.5.1	探测器灵敏层结构	Structure of detector sensitive layer	566 days	18/11/1	20/12/31
3.5.2	原型机吸收体和支撑结构	Absorber and support structure of the prototype	501 days	19/5/1	21/3/31
3.5.3	束流测试平台	Beam test platform	436 days	20/5/1	21/12/31
3.5.4	宇宙线测试平台	Cosmic ray test platform	262 days	20/11/2	21/11/2
3.6	**量能器原型机系统集成**	**Integration of the prototype system of the quantizer**	**195 days**	**21/8/2**	**22/4/29**
3.6.1	探测器灵敏层的组装和测试	Assembly and testing of detector sensitive layer	111 days	21/8/2	22/1/3
3.6.2	整体样机的集成	Integration of the overall prototype	84 days	22/1/4	22/4/29
3.7	**量能器原型机测试和性能研究**	**Prototype testing and performance research of the quantizer**	**325 days**	**22/1/3**	**23/3/31**
3.7.1	数据分析软件的开发和准备	Development and preparation of data analysis software	174 days	22/1/3	22/9/1
3.7.2	原型机宇宙线测试及质量检验	Cosmic ray testing and quality inspection of the prototype	88 days	22/5/2	22/8/31
3.7.3	原型机束流测试前期准备和运输	Preliminary preparation and transportation of prototype beam test	22 days	22/9/1	22/9/30
3.7.4	原型机束流测试及样机运回	Prototype beam test and prototype transport back	43 days	22/10/3	22/11/30
3.7.5	测试数据分析及原型机性能研究	Test data analysis and prototype performance research	87 days	22/12/1	23/3/31
3.8	**项目总结**	**Project summary**	**20 days**	**23/4/3**	**23/4/28**



Problems and Main Risks

- COVID-19 had significant impact on the calorimeter task schedule. Still trying to recover the lost time.

- Continuation of travel restrictions due to COVID-19 could impact tasks long term:
  - CEPC Beam Polarization design. Trying to implement video-based collaboration.
  - Longer timescale, beam testing of vertex and calorimeter prototypes

- Trade conflict with USA affected purchase of gantry for precision assembly of silicon vertex detector. Purchase of gantry from chinese vendor completed but cause delays in preparation for assembly.

- Funding for 2nd engineering run of vertex chip not available, and schedule very tight. Skipped 3rd MPW, hoping that 1st engineering run chip works

- Access to international test beam facility

Summary

- The project is progressing well towards completion
    - Accelerator and Vertex tasks meeting or exceeding expectations of work package
    - Calorimeter task still needs to accelerate production and design of prototype
- Impact due to COVID-19 partially recovered, but some delays persist.
    - Possible impact on the availability of beam test time
- Expenses are not uniform and are expected to ramp up when final prototypes are produced and paid for

More details next

Agenda for meeting

General Overview: Today

Friday, April 23, 2021

08:00 - 18:00	Review Meeting	
	09:00	**Project Overview (30'+10') 项目进展汇报** *40'* Speaker: Joao Guimaraes Costa
	09:40	**Task 1 Progress report 课题一进展汇报：高能环形正负电子对撞机加速器关键技术验证** *50'* Speaker: Prof. 云龙 池 (高能所)
	10:30	**Group photo and Coffee break** *30'*
	11:00	**Task 3 Progress Report 课题三进展汇报：成像型强子量能器技术验证** *50'* Speaker: Dr. Jianbei Liu (University of Science and Technology of China)
	12:00	**Lunch** *1h30'*
	13:30	**Task 2 Progress Report 课题二进展汇报：硅径迹探测器关键技术验证** *50'* Speakers: Joao Guimaraes Costa, Prof. LIANG Zhijun
	14:20	**Coffee Break** *20'*
	14:40	**Discussion (Project Team Only)** *1h0'* (229)
	14:40	**Discussion (Referees only) 评委内部讨论与撰写评审意见** *1h0'*
	15:40	**Close out session 总结** *2h20'*
18:00 - 20:00	Dinner	

Zoom room will be provided for referees discussion at 2:40 pm

Extra Slides

Task 1: Funds allocation and implementation by Midterm

预算科目名称	Total	Budget until Midterm	Implementation until 2020/6/30	Rate of expense/ total budget	Rate of expense/ midterm budget
（一） direct fee	878.19	430.49	379.5	43.21%	88.16%
1、device fee	456	261	333.2	73.07%	127.66%
（1） purchase device	140	75	105.9	75.64%	141.20%
（2） trial device	296	166	227.3	76.79%	136.93%
（3） modifed device	20	20	0.00	0.00%	0.00%
2、material fee	116	56	2.9	2.50%	5.18%
3、testing fee	76.2	24.7	2	2.62%	8.10%
4、power fee	18	4	0	0.00%	0.00%
5、travel/conference/ international communication	131.1	53.2	21.9	16.70%	41.17%
6、publication	20.29	15.19	1.6	7.89%	10.53%
7、labor	51	13.6	17.9	35.10%	131.62%
8、consult	9.6	2.8	0	0.00%	0.00%

Task 2: Funds allocation and implementation by Midterm

预算科目名称	Total	Budget until Midterm	Implementation until 2020/6/30	Rate of expense/total budget	Rate of expense/ midterm budget
（一） direct fee	1047.700	402.583	234.84	22.41%	58.33%
1、device fee	196.300	176.2	53.11	27.06%	30.14%
2、material fee	235.66	112.49	52.01	22.07%	46.24%
3、testing fee	299.8	9.45	2.20	0.73%	23.28%
4、power fee	20.64	8.26	0.00	0.00%	0.00%
5、travel/conference/ international communication	123.81	39.9	44.80	36.18%	112.28%
6、publication	8.5	3.4	1.90	22.35%	55.88%
7、labor	157	50.5	81.27	51.76%	160.93%
8、consult	6	2.4	1.56	26.00%	65.00%

Task 3: Funds allocation and implementation by Midterm

预算科目名称	Total	Budget until Midterm	Implementation until 2020/6/30	Rate of expense/total budget	Rate of expense/ midterm budget
（一） direct fee	840.5	385.56	111.01	13.21%	28.79%
1、device fee	135.6	105.6	39.88	29.41%	37.77%
2、material fee	379.46	179.46	28.05	7.39%	15.63%
3、testing fee	45	18	5	11.11%	27.78%
4、power fee	4.6	2	0	0.00%	0.00%
5、travel/conference/ international communication	128.34	30	16.67	12.99%	55.57%
6、publication	6	2	0.07	1.17%	3.50%
7、labor	137.5	47.5	20.13	14.64%	42.38%
8、consult	4	1	0.21	5.25%	21.00%

"大科学装置前沿研究"重点专项2018年度项目申报指南

3. 新一代粒子加速器和探测器关键技术预研

3.1 高能环形正负电子对撞机关键技术验证

Research content: Prototype Verification of Key Technologies and High Resolution Detection Technologies for Electron Positron Colliders

Assessment indicators:

Validation of key technologies for high energy circular electron positron accelerators.
Complete the prototype of the enhancer alternating two-pole low-field magnet. The magnetic field is from 31-620 Gs, the field uniformity is 5 x 10^{-4}; Complete the prototype of bending vacuum chamber and RF shielded bellows, the total leakage rate is less than 2 × 10^{-10} Torr • L/s; Complete the prototype of electron and positron beam electrostatic separator, the maximum working field strength is 2MV/m, field uniformity is (1‰) 10×10 mm^2; Complete the design of polarized beam collision in the Z energy region, beam polarization degree is larger than 50%, life time is larger than 60 minutes; Complete the prototype of polarization beam core device, spiral superconducting undulator.

Verification of High Resolution Detecting Technology on High Energy Accelerator. Complete the prototype of inner silicon track detector, verify the main design indicators through beam test, spatial resolution is 3-5 microns (um); Design a silicon detector with 1MRad Total ionization dose; Complete the original prototype of high granulated imaging type of HCAL, solving the key issues for process and test. Doing beam test to certify the main design conclusion.

3. 项目实施关键节点和具体实施计划:
Key Points and Project Implementation Plans

第三年（2020.5-2021.4）

Main Milestones

- Task 1:
  - Smal prototype of magnet fully tested
  - Design of magnet complete
  - Processing of the vacuum tube, the coating experiment device and the shielding bellows are completed
- Task 2:
  - Mechanical structure completed
  - Second ASIC MPW tested
  - ASIC design optimized and completed
- Task 3:
  - Batch production of readout electronics, development of data acquisition system
  - Development of beam test platform and cosmic ray test platform

Outcome

- Annual report

第四年（2021.5-2022.4）

Main Milestones

- Task 1:
  - Completed the formal prototype of the dipole magnet and measurement system
  - Prototypes of vacuum tube and RF bellows completed
  - High pressure experiment was carried out on the electrostatic separator
- Task 2:
  - Silicon wafer processing of large area sensor submitted
  - Assembling and installing the prototype
- Task 3:
  - Integrated calorimeter prototype.
  - Carry out the cosmic ray test of the prototype

Outcome

- Annual report

第五年（2022.5-2023.4）

Main Milestones

- Task 1:
  - Complete the performance test of dipole prototype
  - Complete tests of prototypes of vacuum tube, RF bellows and electrostatic separator
  - High pressure experiment was carried out on the electrostatic separator
- Task 2:
  - Test beam and data analysis
  - Finish assembling of prototype
- Task 3:
  - Test beam and data analysis
  - Finish assembling of prototype

Outcome

- Final report, paper and experimental equipment

4. 项目组织管理机制:
Project Management Organization

Project management organization

- MOST Project Responsibility Expert
  - Zhao Hongwei (Institute of Modern Physics, CAS)
  - Wang Qiuliang (Institute of Electrical Engineering, CAS)
  - Xu HongJie (Shanghai Institute of Application Physics, CAS)
- Expert Team (8 people)
  - Xu Nu (Institute of Modern Physics, CAS)
  - Tang Chuanxiang (Tsinghua University)
  - Lv Junguang (Institute of High Energy Physics, CAS)
  - Li Jin (Institute of High Energy Physics, CAS)
  - Gao Yuanning (Peking University)
  - Youjin Yuan (Institute of Modern Physics, CAS)
  - Hu Guo Chaoying (IN2P3-CNRS-University of Strasbourg, IPHC)
  - Zhentang Zhao (Shanghai Institute of Applied Physics, CAS)

Project leader — Management responsibilities

HTRDC 高技术研究发展中心

- Edit and sign project task book, review project task book;
- Establish a project management office and a project expert group based on the project leading institute;
- Formulate the project research plan, make sure the academic direction and research focus of the project;
- Carry out academic and technical communication and integration among tasks, and promote data sharing;
- Review the annual summary, technical report and other materials, compile and report project information, achievements and other progress reports;
- Develop project publicity plans and programs to enhance the impact of the project;
- Formulate the project (task) implementation management system, formulate the approval system of funding allocation process;
- Propose major adjustment suggestions for projects (tasks), including adjustment or change of research objectives, contents, personnel and funding;
- Compile the mid-term assessment and annual report of the project, and cooperate with the completion of the mid-term assessment and acceptance of the tasks;
- Cooperate with MOST to complete the project assessment and acceptance;
- Complete other tasks entrusted by MOST.

5. 成果呈现形式及测试方法:

Achievement Presentation and Assessment Methods

Achievement Presentation and Assessment Methods

项目目标[1]	成果名称	成果类型	对应的课题（任务）[2]	考核指标[3]				考核方式（方法）及评价手段[5]
				指标名称	立项时已有指标值/状态	中期指标值/状态[4]	完成时指标值/状态	
1. 开展CEPC增强器关键设备高精度低场二极磁铁、弯转真空盒、RF屏蔽波纹管和真空盒内表面镀吸气剂膜、高能正负电子束静电分离器的研制；开展CEPC在Z能区极化束流的加速	高精度低场二极磁铁 **Dipole Magnet**	□新理论 □新原理 □新产品 □新技术 □新方法 ■关键部件 □数据库 □软件 □应用解决方案 □实验装置/系统 ■工程工艺 □标准 □专利 ■论文 □其他	课题1：加速器关键技术的研发和验证	高精度低场二极磁铁场强和均匀性	最低工作磁场127Gs，磁场均匀度5×10-4	最低工作磁场60Gs，磁场均匀度5×10-4	最低工作磁场31Gs，磁场均匀度5×10-4	同行专家组现场测试，测试报告将写入高能环型正负电子对撞机加速器关键技术设计和测试报告
	研制弯转真空盒、RF屏蔽波纹管、真空盒内表面 **Vacuum pipe**	□新理论 □新原理 □新产品 □新技术 □新方法 ■关键部件 □数据库 □软件 □应用解决方案 □实验装置/系统 ■工程工艺 □标准	课题1：加速器关键技术的研发和验证	真空盒极限真空	5×10^{-10}Torr	3×10^{-10}Torr	2×10^{-10}Torr	同行专家组现场测试，测试报告将写入高能环型正负电子对撞机加速器关键技术设计和测试报告

Assessment method and means of evaluation:

Expert review in the visit to prototype

Test report will be included in "CEPC accelerator key technology design report and testing report”

Achievement Presentation and Assessment Methods

器物理研究与设计。 2. 研制出硅径迹探测器原型机，并验证其空间分辨率达到3-5微米；设计出抗电离辐射总剂量达到 1MRad的硅探测器。 3. 完成对采用闪烁体作为灵敏层的成像型强子量能器技术方案的验证	镀吸气剂膜 **Vacuum pipe**	☐专利 ■论文 ☐其他		真空盒总漏率	5×10^{-10} Torr•L/s	3×10^{-10} Torr•L/s	2×10^{-10} Torr•L/s	同行专家组现场测试，测试报告将写入高能环型正负电子对撞机加速器关键技术设计和测试报告
	Bellows			RF屏蔽波纹管接触力	125±50g	125±30g	125±25g	同行专家组现场测试，测试报告将写入高能环型正负电子对撞机加速器关键技术设计和测试报告
	高能正负电子静电分离器 **Electrostatic separator**	☐新理论 ☐新原理 ☐新产品 ☐新技术 ☐新方法 ☐关键部件 ☐数据库 ☐软件 ☐应用解决方案 ■实验装置/系统 ■工程工艺 ☐标准	课题 1：加速器关键技术的研发和验证	静电分离器电场强度	1.8MV/m@±60kV 工作电压	完成静电分离器的初步设计，以实现：2MV/m@±110kV 工作电压的电场强度要求	2MV/m@±110kV 工作电压	同行专家组现场测试，测试报告将写入高能环型正负电子对撞机加速器关键技术设计和测试报告

Assessment method and means of evaluation:

Expert review in the visit to prototype

Test report will be included in "CEPC accelerator key technology design and test report"

Achievement Presentation and Assessment Methods

Electrostatic separator	☐专利 ■论文 ☐其他		静电分离器电场均匀性	无	完成静电分离器初步设计，以实现(1‰)10×10 mm^{2}的场均匀性	(1‰)10×10 mm^2	同行专家评议，静电分离器设计报告将写入高能环型正负电子对撞机加速器关键技术设计和测试报告
			静电分离器腔体真空度	6×10^{-10}Torr	完成静电分离器初步设计，以实现2×10^{-10}Torr的腔体真空度要求	2×10^{-10}Torr	同行专家组现场测试，测试报告将写入高能环型正负电子对撞机加速器关键技术设计和测试报告
Polarization	☐新理论 ☐新原理 ☐新产品 ☐新技术 ■新方法 ☐关键部件 ☐数据库 ☐软件 ☐应用解决方案 ☐实验装置/系统 ☐工程工艺 ☐标准 ☐专利 ■论文 ☐其他	课题 1：加速器关键技术的研发和验证	在Z能区极化束流的加速器物理研究与设计	已有不含极化插入件的lattice 设计	明确极化插入件的基本参数选择和精确能量测量的工作模式；模拟研究束流极化度大于50%的实现条件	束流极化度大于 50%，束流 寿命大于 60 分钟	同行专家评审，束流极化物理设计报告报告将写入高能环型正负电子对撞机加速器关键技术设计和测试报告

Assessment method and means of evaluation:

- Expert review in the visit to prototype
- **Test** report will be included in final report (1)

- Peer expert review
- **Design** report will be included in final report (1)

(1) Final report: ”CEPC accelerator key technology design and test report”

Achievement Presentation and Assessment Methods

Silicon Detector 研制出硅径迹探测器原型机	□新理论 □新原理 □新产品 □新技术 □新方法 □关键部件 □数据库 □软件 □应用解决方案 ■实验装置/系统 □工程工艺 □标准 □专利 ■论文 □其他	课题 2：硅径迹探测器关键技术验证	硅径迹探测器原型机的空间分辨率	无	研制出小型传感器芯片，像素单元尺寸小于或等于 25 微米 ×25 微米。	3-5 微米	同行专家评审。(通过束流实验，离线分析数据获得空间分辨率。该测试结果写入原型机设计与测试报告，以供同行专家评审)
			所设计的抗辐照硅传感器能承受的总剂量	无	完成传感器的初步设计，通过仿真初步验证其抗辐照性能	1 MRad	同行专家评审(提供传感器的设计与测试报告供专家评审)

Assessment method and means of evaluation:

- Peer expert review
- **Beam test** and offline analysis; report to be included in final report (2)

- Peer expert review
- Provide sensor **design** and **test** report for expert evaluation

(2) Final report: ”CEPC Detectors Test Report”

Achievement Presentation and Assessment Methods

Calorimeter	□新理论 □新原理 □新产品 □新技术 □新方法 □关键部件 □数据库 □软件 □应用解决方案 ■实验装置/系统 □临床指南/规范 □工程工艺 □标准	课题 3：成像型强子量能器技术验证	量能器能量分辨	无	完成原型机物理设计，模拟得到原型机能量分辨达到 $60\%/\sqrt{E/GeV} \oplus 3\%$ (10 GeV<E<80 GeV)	$60\%/\sqrt{E/GeV} \oplus 3\%$ (10 GeV<E<80 GeV)	利用高能粒子束对原型机进行测试，离线分析测试数据获得性能指标。同行专家评审测试报告。
Calorimeter	■论文 □发明专利 □其他		量能器能量线性	无	完成原型机物理设计，模拟得到原型机能量线性达到 3%(10GeV<E<80GeV)	3%(10GeV<E<80GeV)	利用高能粒子束对原型机进行测试，离线分析测试数据获得性能指标。同行专家评审测试报告。

Assessment method and means of evaluation:

- Peer expert review
- **Beam test** and offline analysis; report to be included in final report (2)

- Peer expert review
- **Beam test** and offline analysis; report to be included in final report (2)

* Final report: "CEPC Detectors Test Report"

Project Organization Issues: Communication Issues

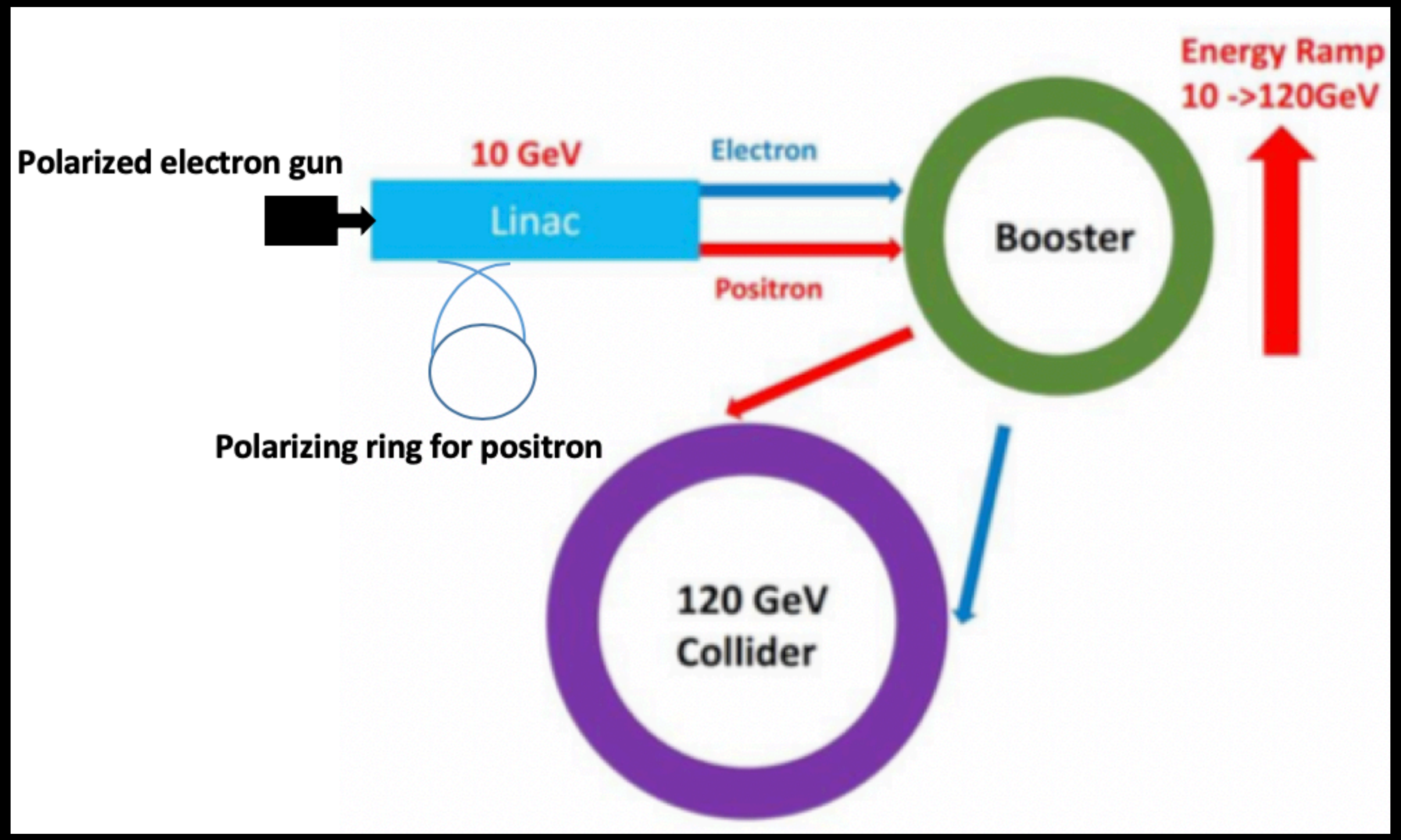
- Meetings:
  - Schedule monthly short videoconference meetings on the global project
  - Weekly or biweekly video conference meetings on various research topics
    - (e.g. international meeting on ASIC design every monday)
  - Satellite Meetings with CEPC International Workshops (e.g. Hong Kong, Oxford, ….)
  - Next Annual Meeting (with reviewers) in November — suggest immediately after CEPC workshop — Options: Nov 23-24 (weekend) or Nov 25-26 (M-T)

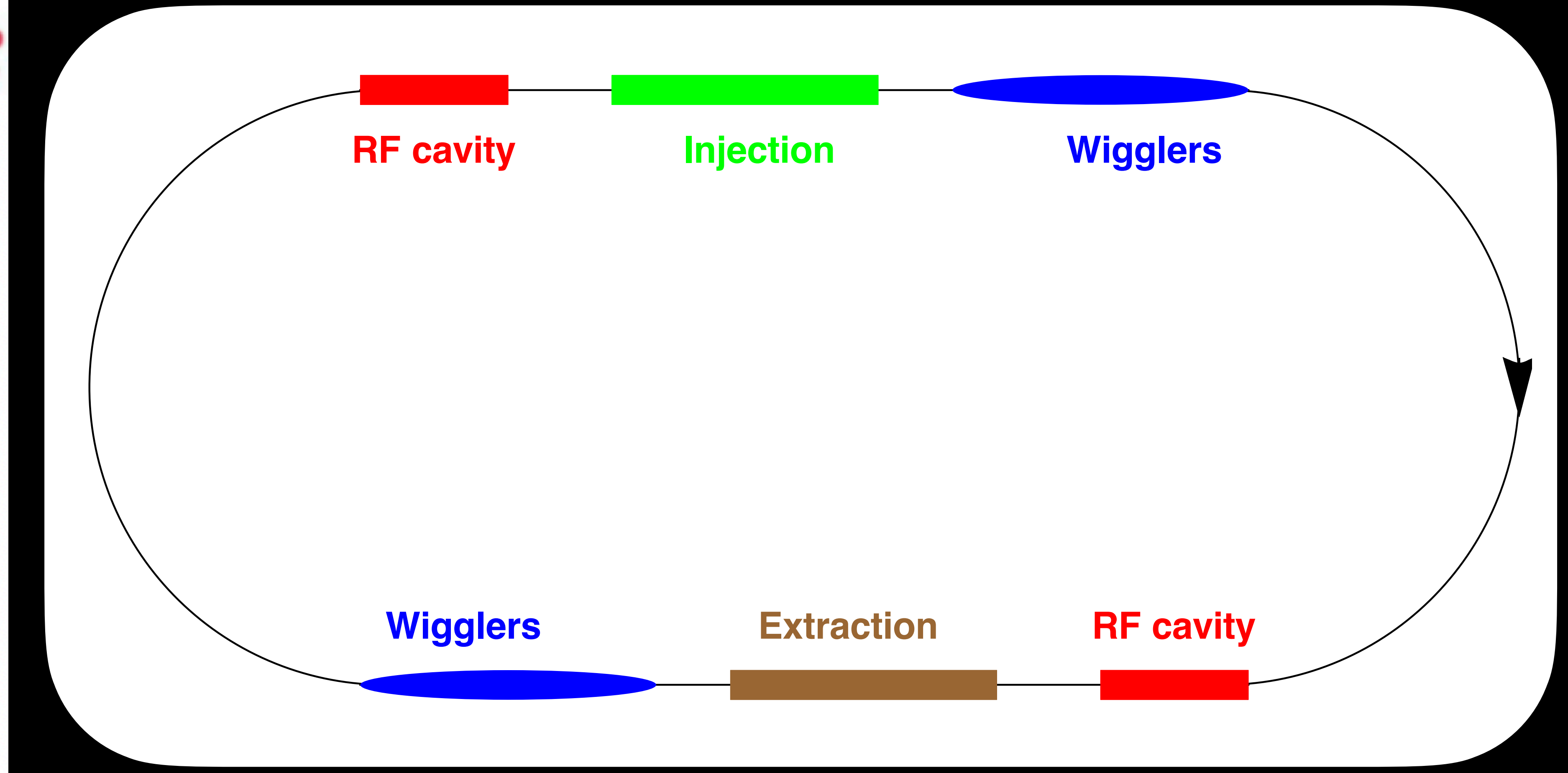
- Documentation archiving:
  - Indico: Meetings and minutes
  - DocDB: Internal reports and technical reports archiving
  - Need new project webpage

- Project management:
  - Common gantt software

Task 1: Beam Polarization at Z-pole

- To address the great challenges in polarized e^+ source, propose to **convert the e^+ damping ring into a e^+ polarizing ring**, by introducing asymmetric wigglers to boost self-polarization build-up down to ~20 second, this novel idea looks promising to facilitate polarized e^+/e^- colliding beams





A tentative parameter table of e+ polarizing ring

Parameter	value
Beam energy (GeV)	2.5
Circumference (m)	200
Wiggler total length (m)	22
B+/B- (Tesla)	15[3] / 1.5
U0 (MeV)	4
Polarization build-up time (s)	17
rms energy spread	~0.3%
Natural emittance (nm)	~10
Radiation damping time (ms)	~1

To maintain beam polarization during acceleration in the booster, we found that at least one Siberian snake is required, an idea of using fixed field solenoids as a partial snake is being investigated.