CEPC Detector R&D Project

3.2.2 PFA Sci-AHCAL Prototype

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| Document Responsible: | Jianbei Liu |
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| Revision number: | 1 |
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Change history

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| --- | --- | --- |
| **Revision** | **When** | **What changed and why** |
| 1 | 12/12/2019 | First draft |
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Readme first

1. Please do not delete or modify this section or its structure.
2. Only change text enclosed by (and including) angled brackets “< … >”.
3. Don’t change field directly, instead modify the document options, under File🡪 Properties (or similar)
   * Enter name of person that wrote the document in Document:Summary: Author
   * The project ID number, should follow the rules provided to you earlier. The number should be changed in Document:Custom: PBS.
   * The project name should be changed in Document:Summary: Subject.
4. In Section [*Project Objectives*](#ProjectObjectives) provide a brief description of the project goals, i.e. why and what is being produced, for PBS item **3.2.2** **PFA Sci-AHCAL Prototype**. If this project includes identifiable sub-projects you can indicate them in the [*Sub-projects Description*](#SubprojectsDescription) Section, otherwise submit a separate document for each of them. The sub-project IDs are free for you to define.
5. Finally, remember to update the [*Change History*](#ChangeHistory).

: Project Objectives

1. To optimize the conceptual design of a highly-granular hadronic calorimeter for CEPC using the iron + scintillator (readout with SiPM) technology. Important design parameters to be optimized include cell size, number of sampling layers, total thickness of absorber, thickness of scintillator tile serving as the active medium of the calorimeter.
2. To develop techniques and devices for production, wrapping and quality-control of scintillator titles on a large scale, and for assembling of active layers of the calorimeter.
3. To develop a SiPM calibration circuit and readout electronics embedded in the calorimeter.
4. To build a large-size prototype for the CEPC hadronic calorimeter that could fully contain hadronic showers with energy up to 100 GeV.
5. To validate the Sci-Fe HCAL design by testing and characterizing the prototype with cosmic rays and high-energy particle beams.

: Sub-projects Description

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| **Project ID** | **Title** | **Description** |
| 3.2.2.1 | Design optimization | Optimization of key parameters in the CEPC Sci-Fe HCAL conceptual design |
| 3.2.2.2 | Production and assembling techniques and devices | Development of techniques and devices for massive production of scintillator tiles and assembling of scintillator tile layers. |
| 3.2.2.3 | SiPM calibration circuit and readout electronics | Development of a SiPM calibration circuit based on LED and SiPM readout electronics that works in a continuous mode. |
| 3.2.2.4 | HCAL prototype | Construction of a Sci-Fe HCAL prototype with readout electronics embedded. Characterization of the prototype with high-energy particle beams. |

: CEPC Relationship

This project is one of the three tasks of the phase-2 CEPC R&D project funded by the Ministry of Science and Technology of China. The central goal of this project is to validate the Sci-Fe calorimeter technology option for its application to CEPC. So it lies along with a few other detector R&D projects at the heart of the ongoing CEPC detector R&D activities.

: Project Schedule

This is a five-year R&D project which was launched in July 2018. The yearly milestones set for the project are as follows:

1st year: complete the design of the detection cell of the CEPC Sci-Fe HCAL

2nd year: complete the detector design of the HCAL prototype, finish mass production and wrapping of scintillator tiles .

3rd year: finish assembling all active layers for the HCAL prototype and the mechanical design of the prototype.

4th year: complete the construction of the HCAL prototype and its integration with readout electronics and DAQ.

5th year: complete the commissioning and beam test of the prototype

: Funding Availability

This project is fully funded by the Ministry of Science and Technology of China. It will also receive resource from an international project jointly funded by the National Science Foundation of China and Israel Science Foundation. The total budget available for this project is about 10 M Chinese Yuan.

: Leadership Arrangement

The institutes being involved in this project include University of Science and Technology of China (USTC), Institute of High Energy Physics, Chinese Academy of Sciences (IHEP), and Shanghai JiaoTong University (SJTU), while USTC is the leading institute with Jianbei Liu being the PI of the project. The representatives of the other two institutes are Yong Liu for IHEP and Haijun Yang for SJTU. They work together closely with the PI to coordinate the whole project.

: Manpower Resources

Yunlong Zhang, USTC, Faculty, 0.3

Zhongtao Shen, USTC, Faculty, 0.3

Shubin Liu, USTC, Factulty, 0.1

Jianbei Liu, USTC, Faculty, 0.3

Yukun Shi, USTC, Student, 1.0

Anshun Zhou, USTC, Student, 1.0

Hao Liu, USTC, Student, 1.0

Yong Liu, IHEP, Faculty, 0.3

Boxiang Yu, IHEP, Faculty, 0.3

Jiecheng Jiang, IHEP, Student, 1.0

Haijun Yang, SJTU, Faculty, 0.3

Shu Li, SJTU, Faculty, 0.2

Weihao Wu, Faculty, 0.2

Yanyun Duan, Postdoc, 0.8