CEPC Detector R&D Project

3.1.2 PFA Sci-ECAL Prototype

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| Document Responsible: | Jianbei Liu |
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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 **3.1.2** **PFA Sci-ECAL 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).

3.1.2 PFA Sci-ECAL Prototype: Project Objectives

1. To optimize the conceptual design of a highly-granular electromagnetic calorimeter CEPC using the Tungsten + scintillator (readout with SiPM) technology.
2. To optimize the way of the scintillator strip coupling to SiPM in an active cell of the calorimeter.
3. To develop SiPM readout electronics and then build a prototype for the Sci-W calorimeter that has the SiPM readout electronics embedded in the detector. Key parameters for the prototype are 22cm\*22cm for transverse area, 24X0 for thickness, and 5mm\*5mm for effective cell size.
4. To validate the Sci-W ECAL design by testing and characterizing the prototype with cosmic rays and high-energy particle beams.

3.1.2 PFA Sci-ECAL Prototype: Sub-projects Description

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| **Project ID** | **Title** | **Description** |
| 3.1.2.1 | Design optimization | Optimization of key parameters in the CEPC Sci-W ECAL conceptual design and in some technical and engineering aspects |
| 3.1.2.2 | Readout electronics | Development of SiPM readout electronics based on the SPIROC chip for a Sci-W ECAL prototype |
| 3.1.2.3 | ECAL prototype | Construction of a Sci-W ECAL prototype that has readout electronics embedded in the detector. |

3.1.2 PFA Sci-ECAL Prototype: CEPC Relationship

This project is part of the phase-1 CEPC R&D project funded by the Ministry of Science and Technology of China. The outcome from this project has already contributed to the CEPC CDR released last year. This project also constitutes a major detector R&D program for the CEPC Sci-W ECAL.

3.1.2 PFA Sci-ECAL Prototype: Project Schedule

This is a five-year R&D project which has entered its fourth year. The first two objectives have been met and the work related to the third objective has also been largely done. We are now in the middle stage of constructing and assembling the ECAL prototype. The full ECAL prototype is expected to be ready for initial commissioning with cosmic rays by the end of Feb. in 2020. It will be then fully integrated with readout electronics and DAQ and undergo thorough cosmic-ray testing at USTC from March to May in 2020. After that, the prototype will be moved from USTC to IHEP for further cosmic-ray testing from June to July in 2020 and hopefully a beam test if there will be single-particle beams available during that period at IHEP. The prototype will be eventually packaged and shipped to DESY for a two-week beam test there in August 2020. The remaining part of the project will be dedicated to data analysis, documenting, publication and summarizing/concluding the project.

3.1.2 PFA Sci-ECAL Prototype: Funding Availability

This project is mainly funded by the Ministry of Science and Technology of China. It has also received funds from two projects funded by the National Science Foundation of China. The total budget available for this project is about 3 M Chinese Yuan.

3.1.2 PFA Sci-ECAL Prototype: Leadership Arrangement

This is a joint project between University of Science and Technology of China and Institute of High Energy Physics, Chinese Academy of Sciences. The leadership of this project is also shared between the two institutes:

Yunlong Zhang, University of Science and Technology of China (USTC)

Yong Liu, Institute of High Energy Physics, Chinese Academy of Sciences (IHEP)

3.1.2 PFA Sci-ECAL Prototype: 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

Yazhou Niu, USTC, Student, 1.0

Shensen Zhao, USTC, Student, 1.0

Yong Liu, IHEP, Faculty, 0.3

Zhigang Wang, IHEP, Faculty, 0.3

Mingyi Dong, IHEP, Faculty, 0.3

Bing Zhao, IHEP, Student, 0.5