sPHENIX EMCal Module Prototyping and Production Plan in China

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Abstract

The sPHENIX experiment is a next generation of large acceptance detector at RHIC whose scientific goals center on probing the strongly interacting Quark-Gluon Plasma (QGP) with jets, heavy flavor tagged jets and Upsilon production. The EMCal detector is an essential subsystem for these measurements. The Chinese sPHENIX EMCal Consortium includes groups from Fudan, PKU and CIAE. The Chinese Consortium plans to build the sPHENIX EMCal modules covering the pseudo-rapidity region of 0.8-1.1, approximately 20% of the EMCal modules. The extension of the pseudo-rapidity coverage can greatly enhance the physics capability for jets and Upsilon measurements. We will show the status of Chinese prototyping project including investigations on the quality of Tungsten powder from Chinese vendors and the quality assurance procedures under development. We will also report on the status of our development of an automatic fiber filing machine.

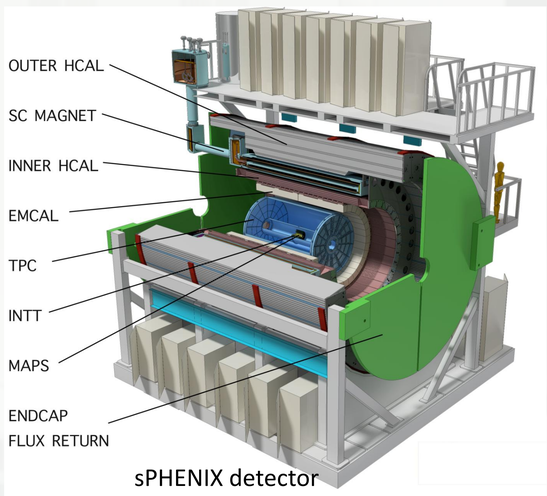
The Design of sPHENIX and EMCal

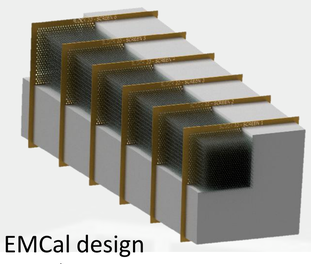
The main scientific objective of the sPHENIX experiment is to probe the QCD properties of the strongly interacting Quark-Gluon Plasma (QGP). This will be accomplished by using hard-scattered partons that traverse the medium and the Upsilon states to investigate the medium at the different length scales. The sPHENIX detector includes MAPS, INTT, TPC, EMCal, inner-HCal, and outer-HCal subsystems with a solenoidal magnet.

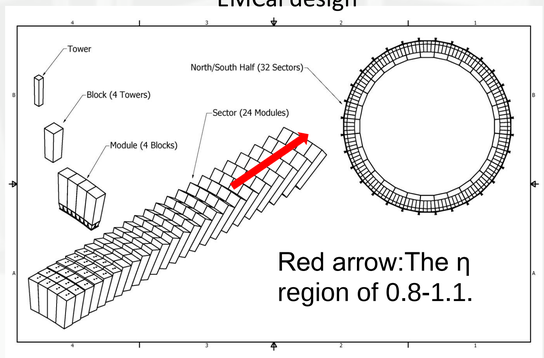
The EMCal (Electromagnetic Calorimeter) is an essential sub-detector for sPHENIX to measure the photons and electrons from nuclear collisions and it is also a key component, along with the HCal, of the jet reconstruction. The EMCal is designed as a cylinder and will consist of 6144 blocks, covering the pseudo-rapidity (η) region of 0.0-1.1 and the 2π azimuth angle. The EMCal block design consists of scintillating fibers embedded in the absorber material, which is a matrix of tungsten powder infused with epoxy (W/SciFi). The EMCal has features of high density (9-10 g/cm^3), low radiation length (~7 mm), small Molière radius (~2 cm), compact structure and low cost. The readout system adopts light guide combined with SiPM.

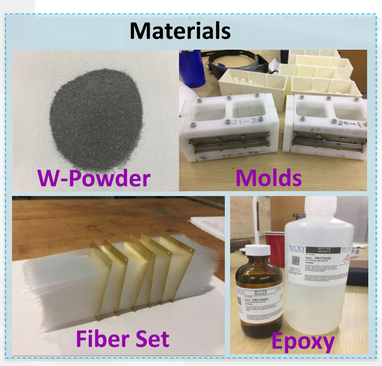
A Collection of Plots

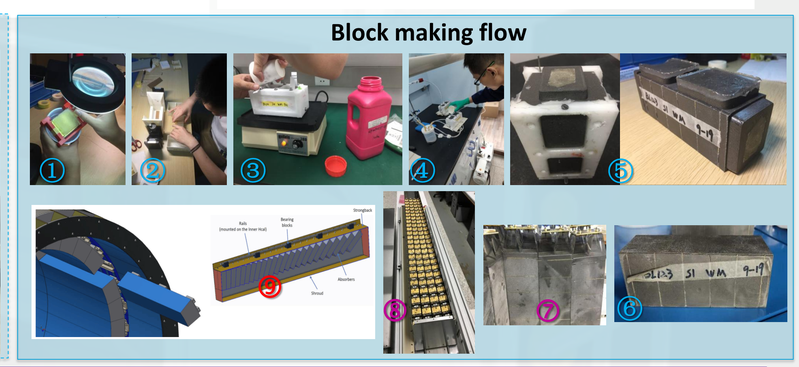
- Plots of sPHENIX design and EMCal design.
- Plots of Materials, Production flow, and Labrotary in China.

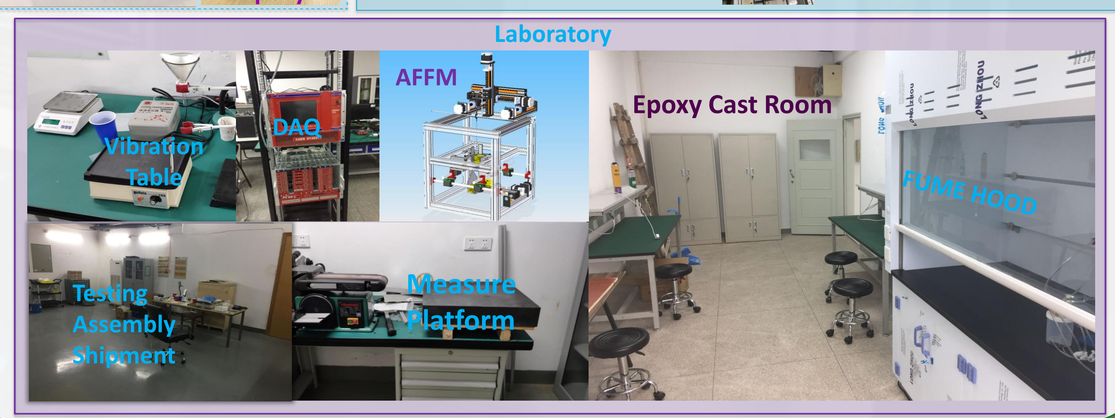



EMCal design







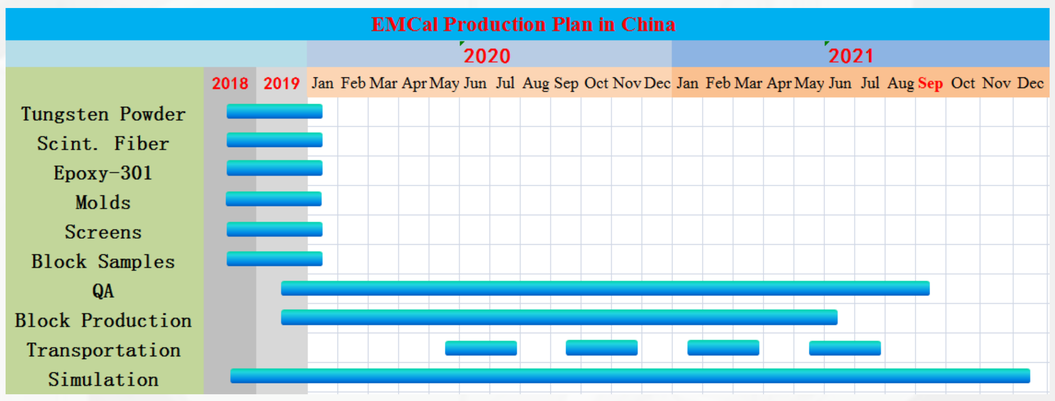


The Status of Materials and EMCal Prototypes in China

The EMCal is designed as a cylinder and will consist of 6144 blocks, covering the η region of 0.0-1.1 and the 2π azimuth angle. The EMCal block design consists of a matrix of scintillating fibers embedded in the absorber material of Tungsten powder infused with epoxy (W/SciFi). The Chinese consortium plans to build the sPHENIX EMCal modules covering the η region of 0.8-1.1, approximately 20% of the EMCal modules.

Material readiness: The key raw materials for EMCal (tungsten powder, scintillating fibers, molds, Epoxy, etc.) are ready. The tap density of the tungsten powder we found and used is greater than 10.5g/ml, meeting the criteria to make the block get a density of 9.0-10.0g/ml. The scintillating fibers can be supplied by Kuraray and Saint-Gobain. The molds are also ready for the high pseudo-rapidity blocks that we intend to build in China.
Laboratory construction: Fudan and Peking Universities have built laboratories for making EMCal blocks. As shown in the top right-hand area, the equipment is ready, such as the Fume hood, Vibration table, Measure platform, etc. For machining blocks, we will use commercial shops.
Collaboration consortium: At Fudan University, four professors, two post-doctors, and students are involved in sPHENIX project. We keep cooperating with BNL, MIT, and UIUC, participating in the design and development of EMCal, and dispatching team members to visit UCLA, UIUC, and BNL. In China, Fudan University, Peking University, CIAE and other Institutes are cooperating together to produce the blocks.
Production Flow: We follow the general procedure of EMCal construction developed at UIUC. The deliverable blocks are produced at local sites (UIUC, Fudan, Peking, etc.) and shipped to BNL for modules production and sectors assemble. The details of how to make a block can be found in the top right-hand area.
Testing and QA: dimension(tolerance 0.25mm), density (9~10g/ml), light transmission test, etc.
EMCal Prototypes: Fudan and Peking have mastered the EMCal module construction technology and QA. At present, five blocks have been manufactured and related tests (dimension, density, light transmission test, etc.) have been completed, which meet the design requirements. We will make several block samples for testing and we will start the production from next year.

EMCal Production Plan in China



Collaboration in China

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