EMCal Development

Progress @ Fudan

sPHENIX Fudan Group

Weihu Ma

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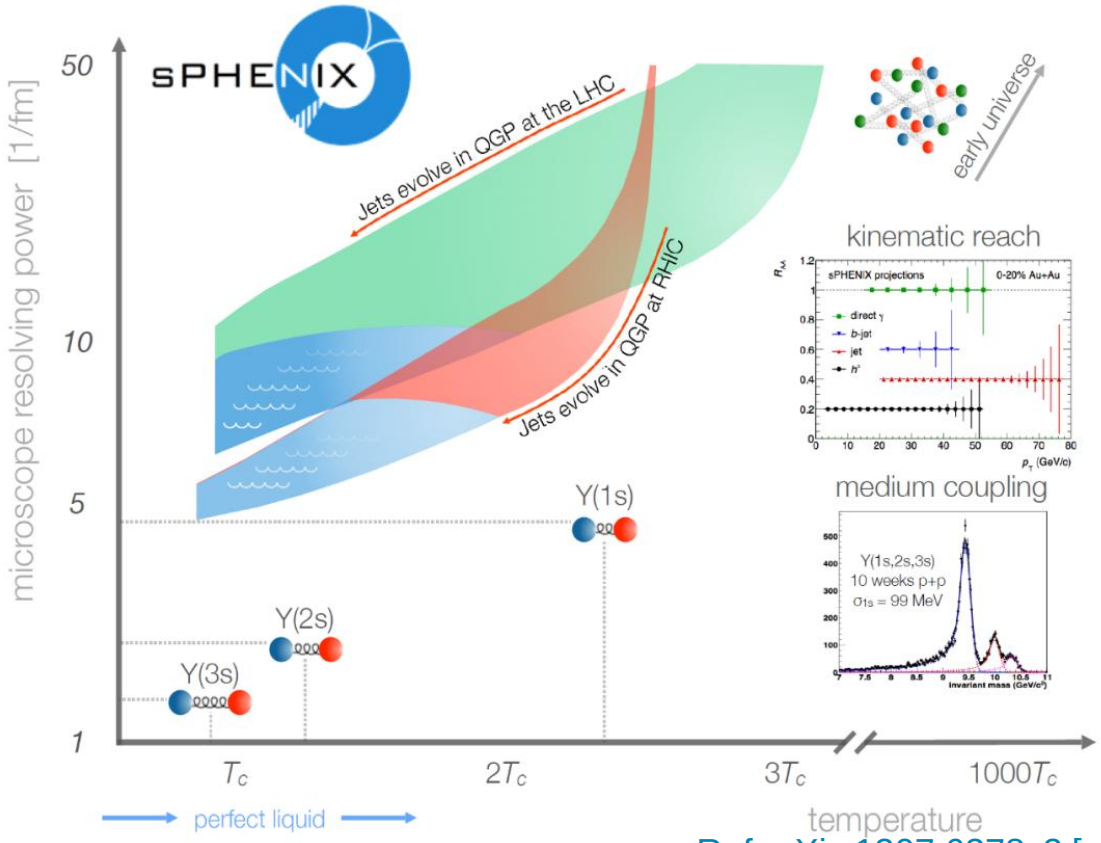
OUTLINE

1. Objectives of sPHENIX
2. EMCal Performance
3. EMCal Design
4. Progress at Fudan Uni.
5. Summary

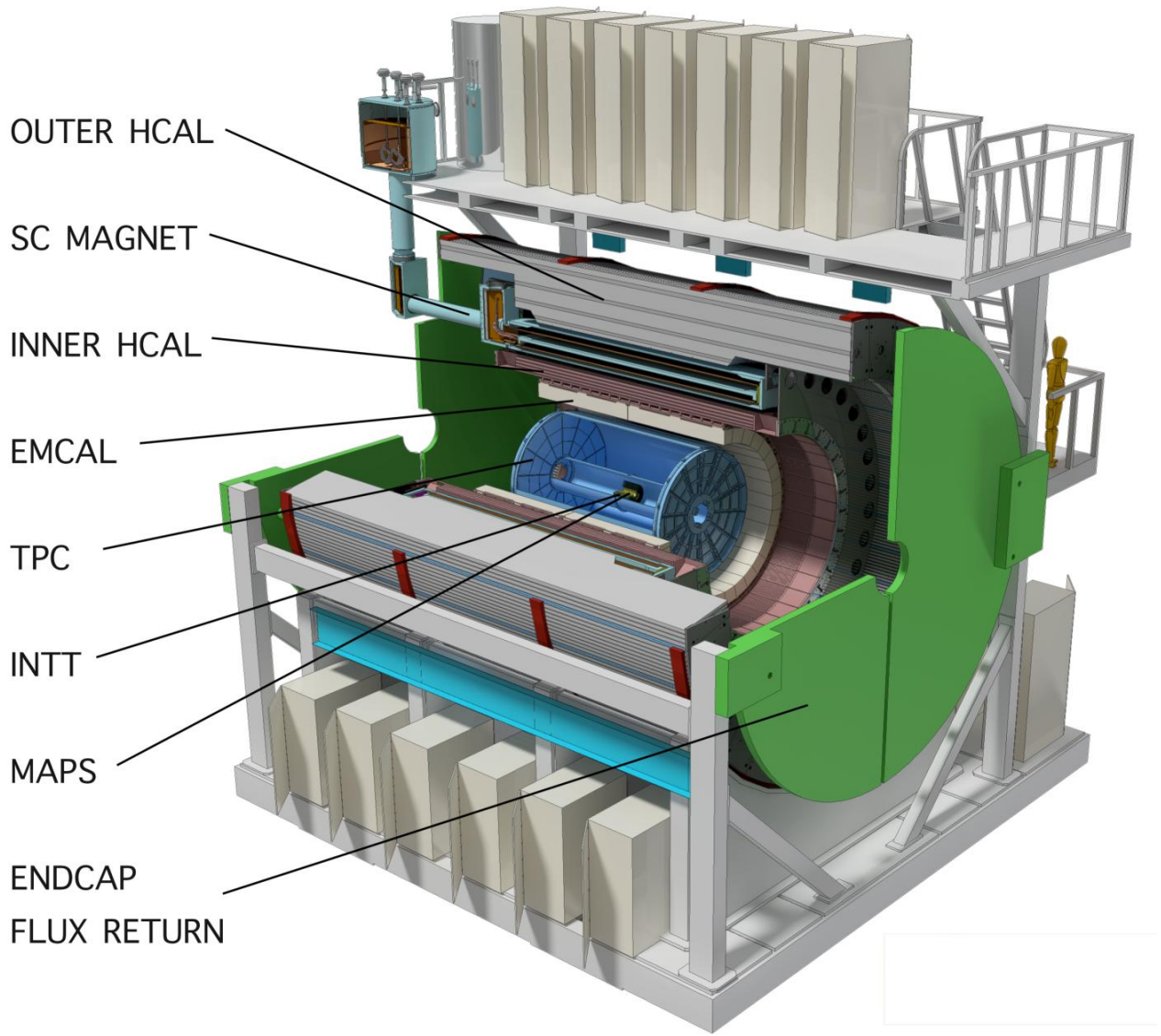
Objectives of sPHENIX

The scientific objective of the sPHENIX experiment is to gain an understanding of the evolution of the system and its coupling strength at RHIC from the initial high temperatures. It will address fundamental questions about the nature of the strongly coupled 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.



Ref:arXiv:1207.6378v2 [nucl-ex] 27 Jul 2012

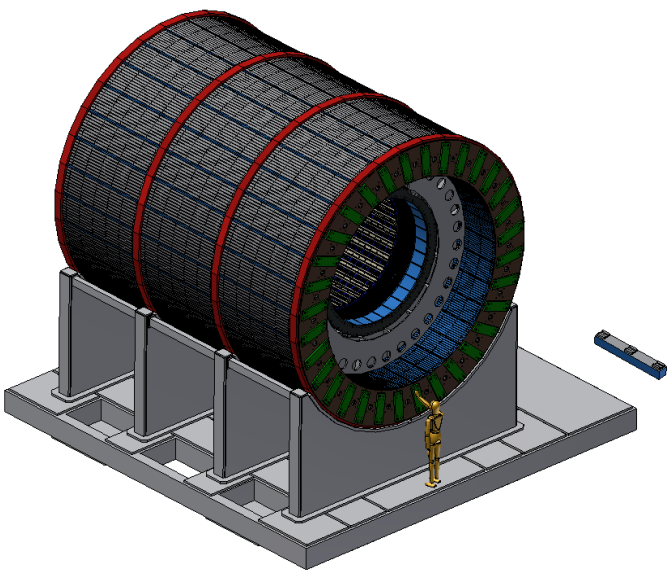
The Overview of sPHENIX

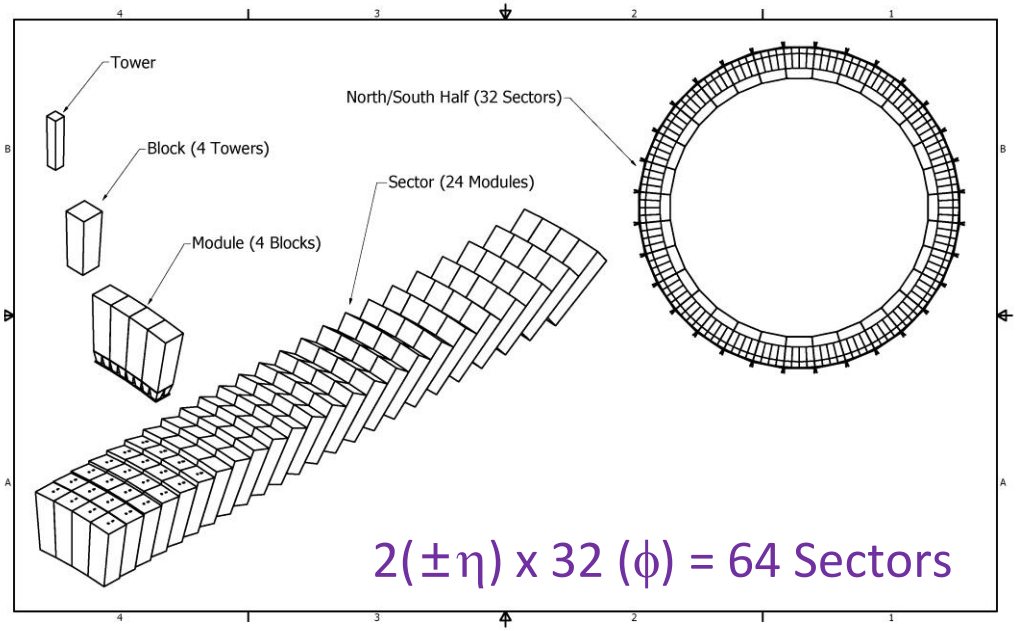


EMCal Design Performance

The EMCal (Electromagnetic Calorimeter) is an essential sub-detector for sPHENIX to measure the QGP near the critical temperature.

EMCal covering ± 1.1 in η and 2π in ϕ. $\Delta\phi$ x $\Delta\eta$ ~ 0.025x 0.025

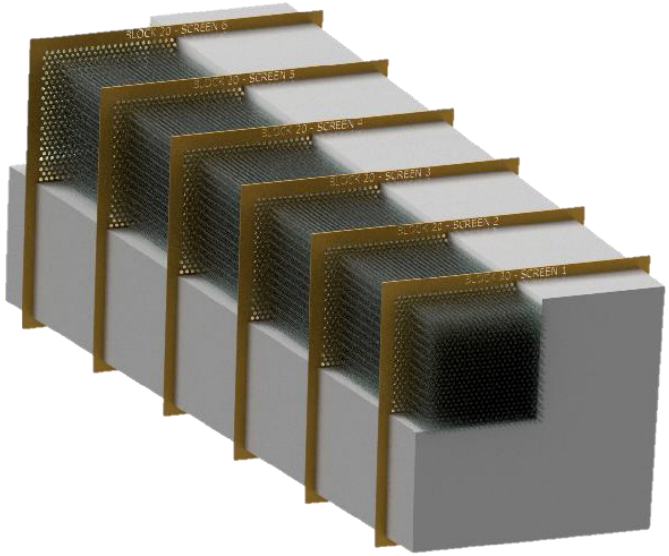


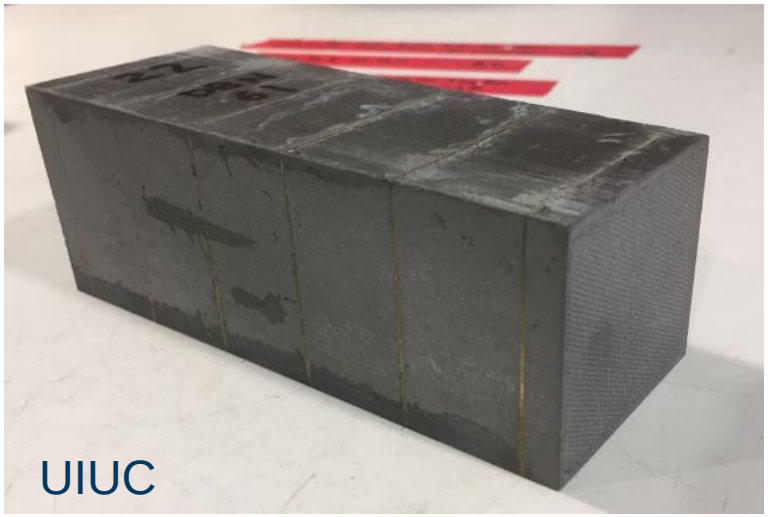


The EMCal performance is central to the direct photon and Upsilon measurements and it is also a key component, along with the HCal, of the jet reconstruction.

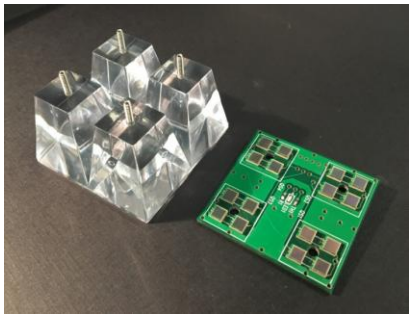
EMCal Design

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).



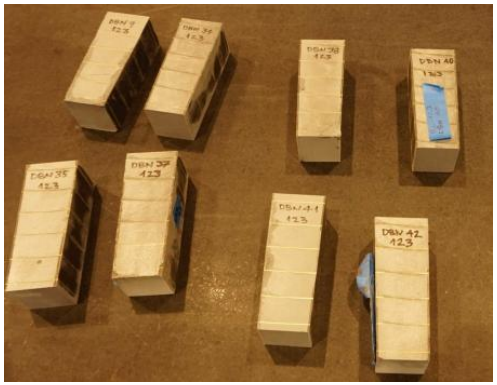


- High density (9-10 g/cm^3), low radiation length (~ 7 mm), small Molière radius (~ 2 cm), compact structure and low cost.
- The readout system adopts light guide combined with SiPM.



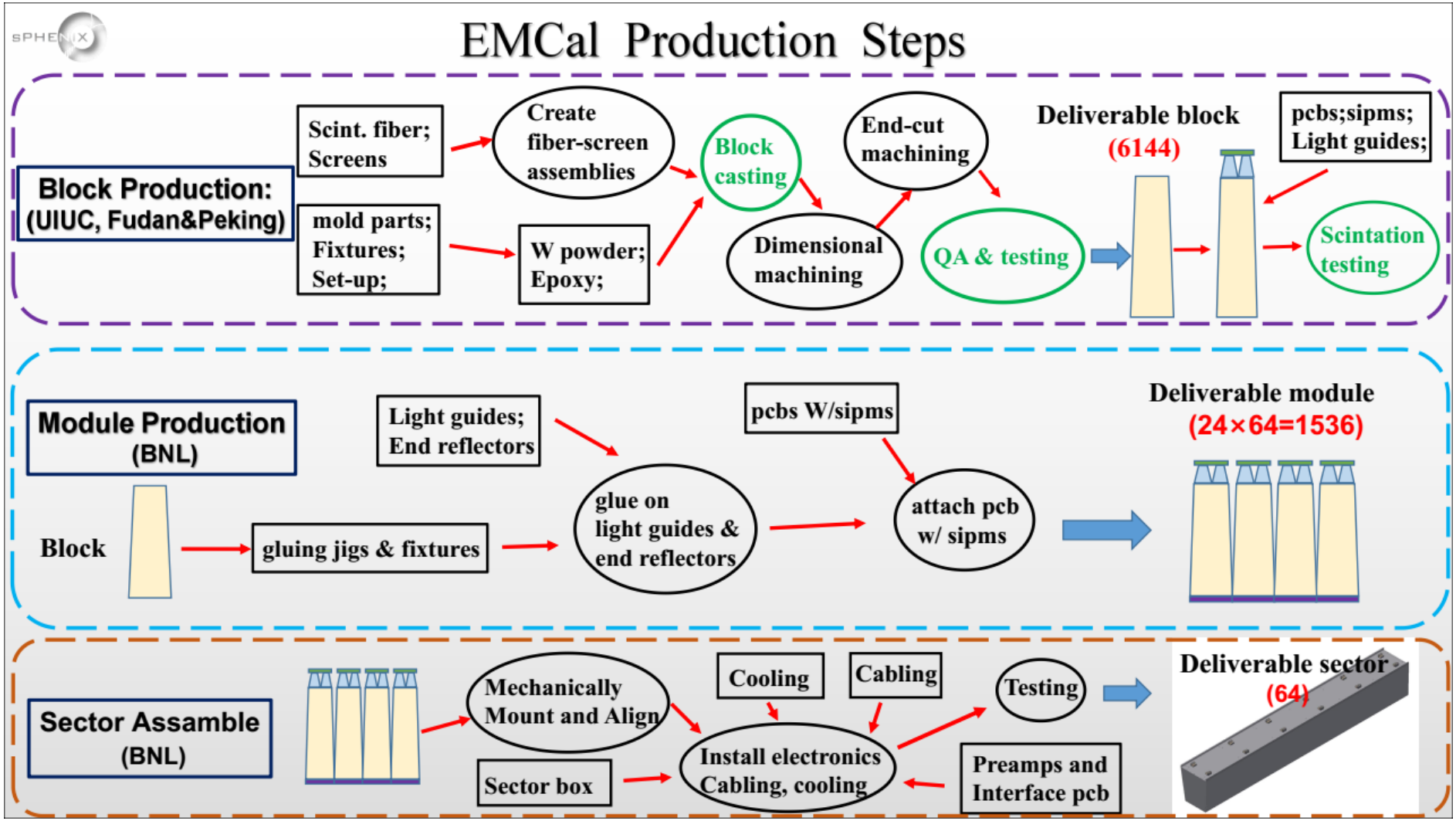
EMCal Sector-0

EMCal blocks made in UIUC:

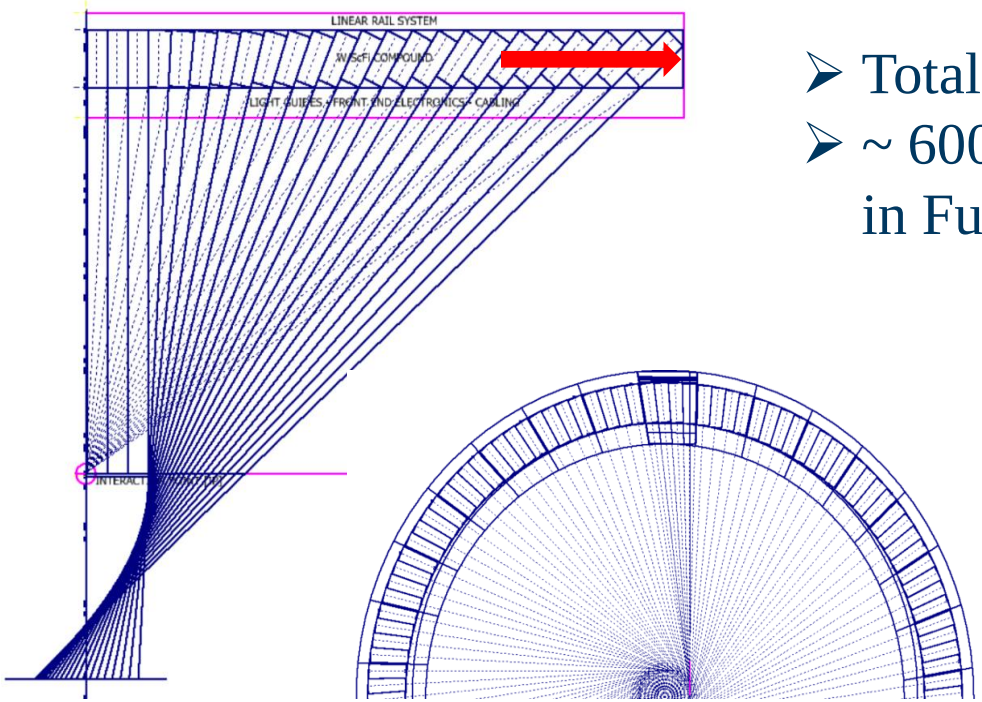


EMcal Sector-0 assembled at BNL:

How to Build the EMCal



Progress at Fudan



- Total 6144 blocks for EMCal
- ~ 600 blocks ($0.8<|\eta|<1.1$) will be made in Fudan.

The pseudo-rapidity coverage of $0.8<|\eta|<1.1$ can greatly enhance the physics capability for jets and Upsilon measurements.

- Assembly of various sub-detectors for sPHENIX are underway.
- sPHENIX-EMCal has completed the design, prototype testing and started producing modules.
- Fudan is one of the main cooperative sites in EMCal construction and will make an important contribution to the sPHENIX experiment.

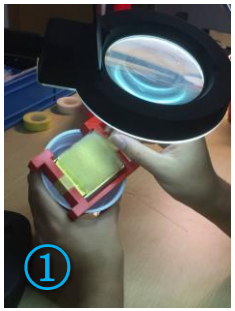
Progress at Fudan

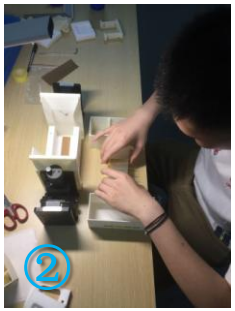
1. Production Flow
2. Lab. Construction
3. Material Readiness
4. Collab. Consortium
5. QA & Testing
6. Schedule

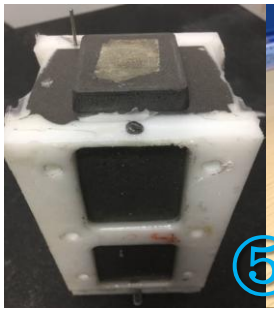
Progress at Fudan

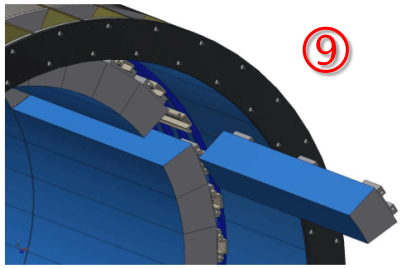
Production flow for making blocks:

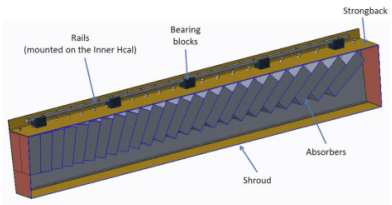
- Fudan has fully mastered the EMCal module construction technology and QA.
- At present, five blocks have been manufactured and related tests (dimension, density, light transmission test, etc.) have been completed, which meet the design requirements.







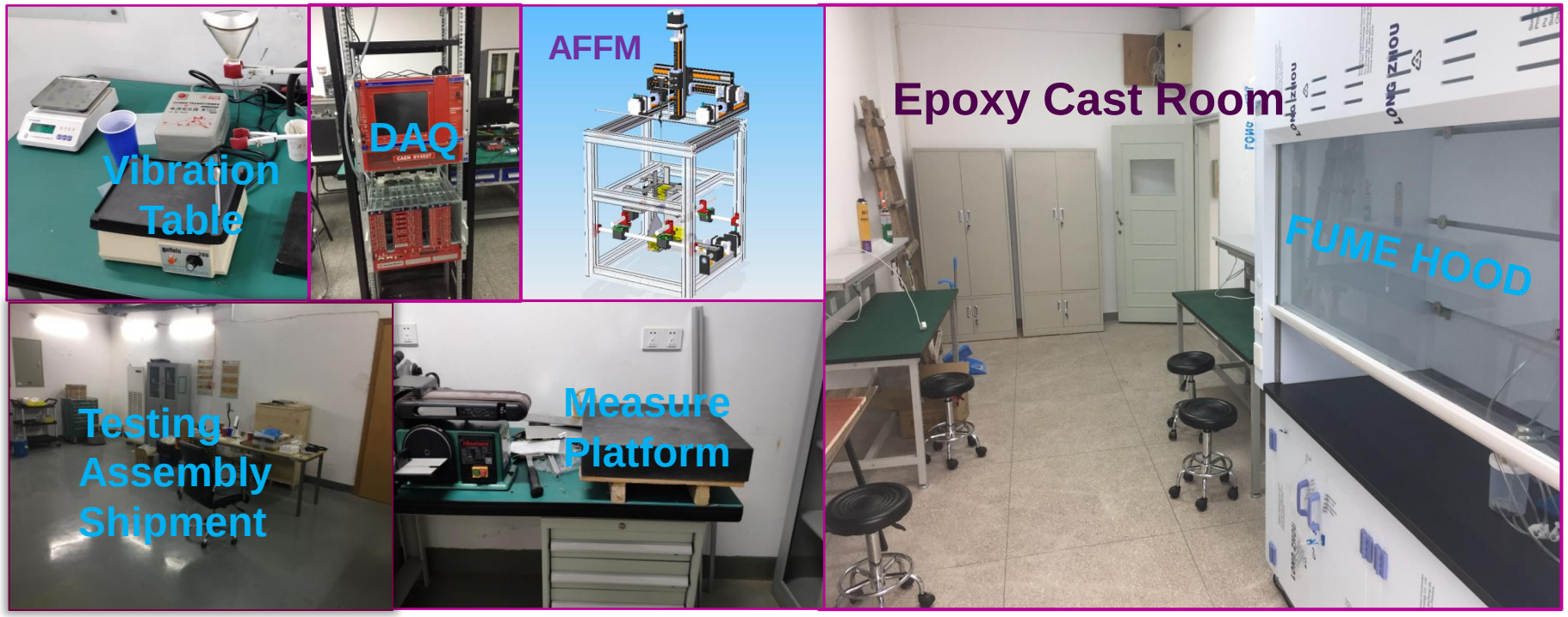




Progress at Fudan

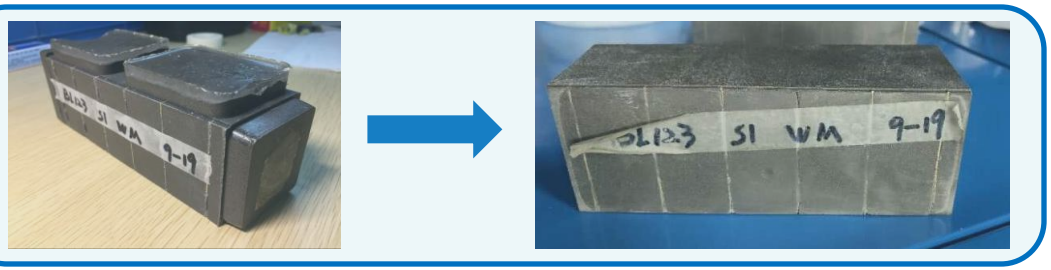
Laboratory construction:

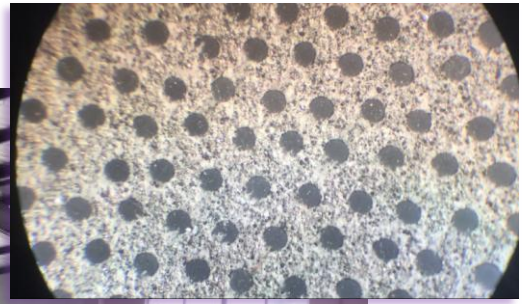
Fudan has built a laboratory for making EMCal modules.

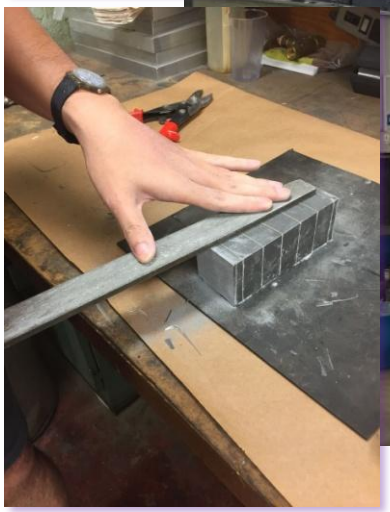


Progress at Fudan

Laboratory construction:



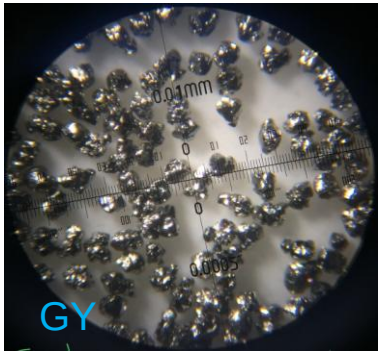


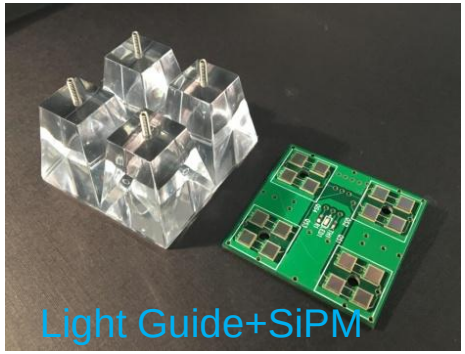


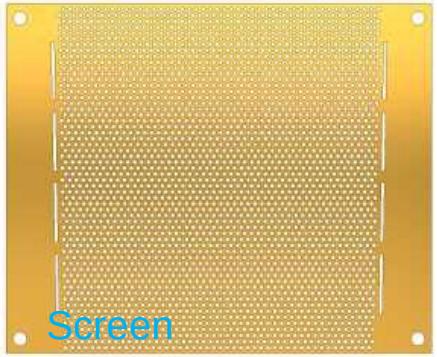
Progress at Fudan

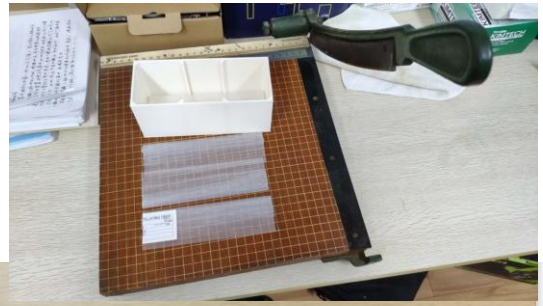
Material readiness:

The key raw materials for EMCal (tungsten powder, scintillating fibers, molds, Epoxy, etc.) are ready.





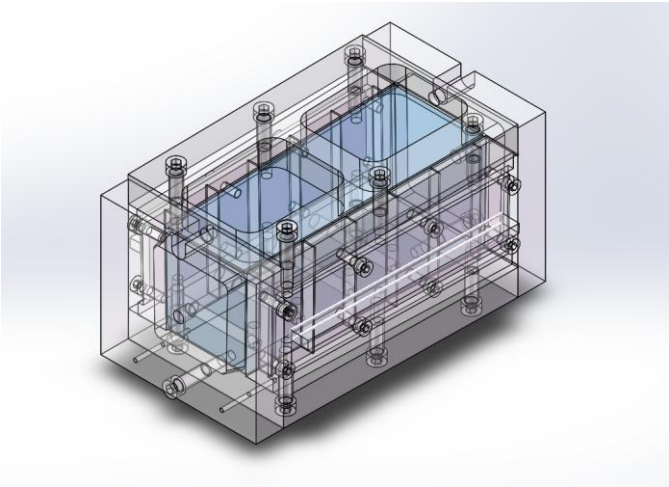


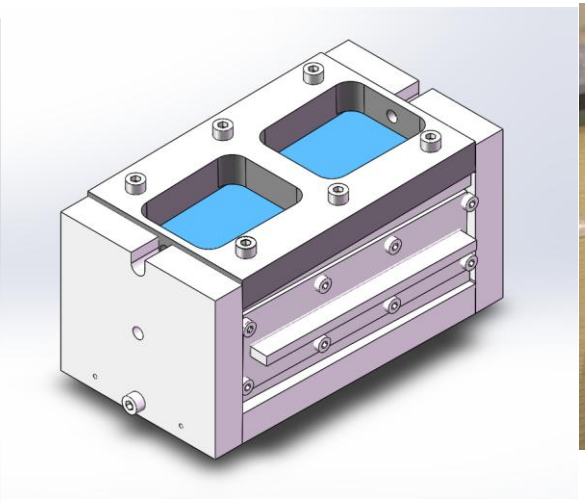


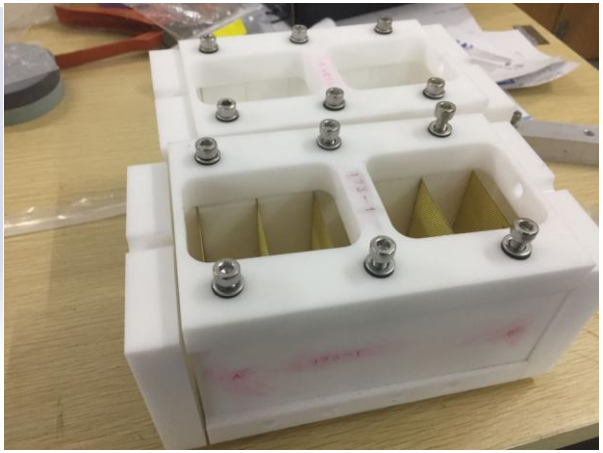
Progress at Fudan

Material readiness:

Molds



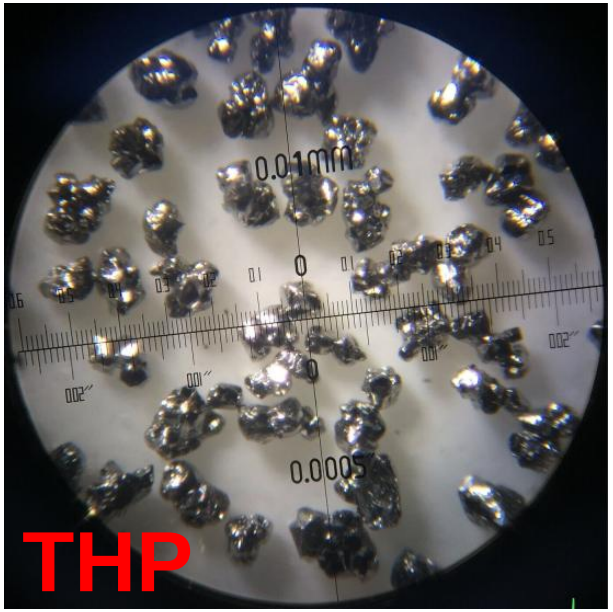


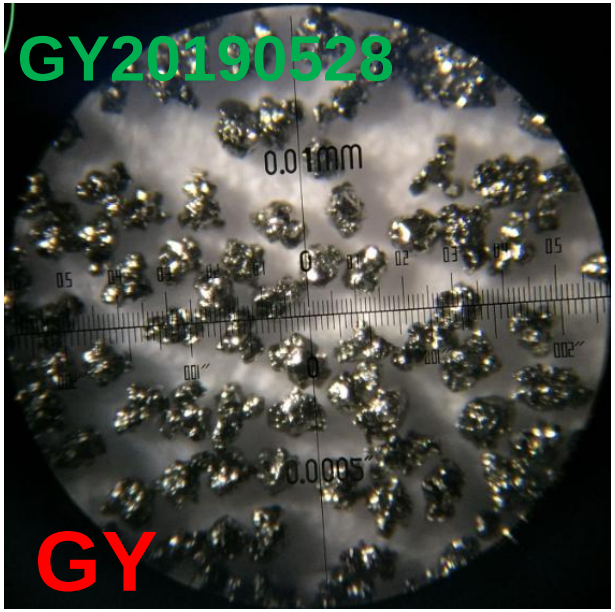


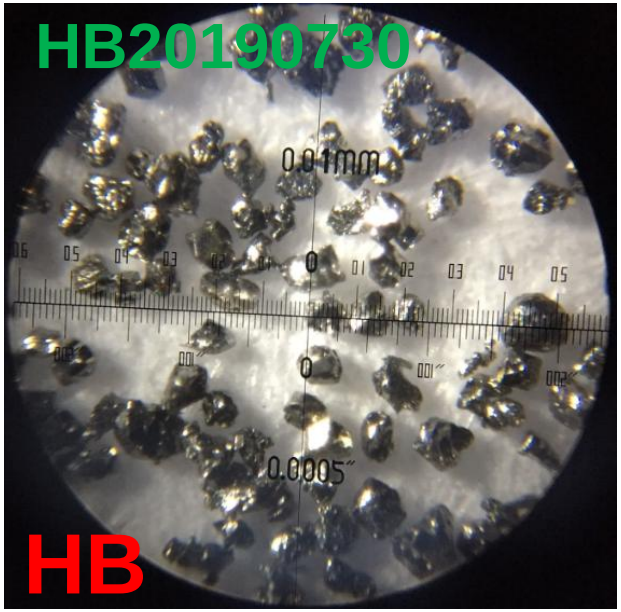
Progress at Fudan

Material readiness:

Tungsten Powder







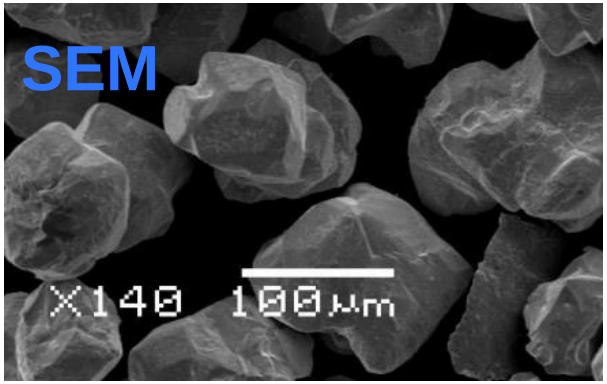
Tap density:
10.8-11.4 g/cm^3 (UIUC);
HC Starck:10.5g/cm^3 (UIUC)

11.2-11.7 g/cm^3

11.5 g/cm^3

Purity ~99.9%, Fe, Co, Ni <100 ppm

EMCal block desity: 9.0-10.0 g/cm^3

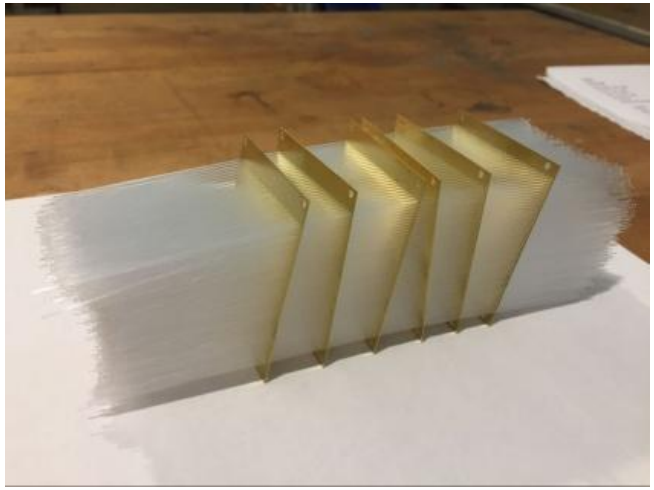


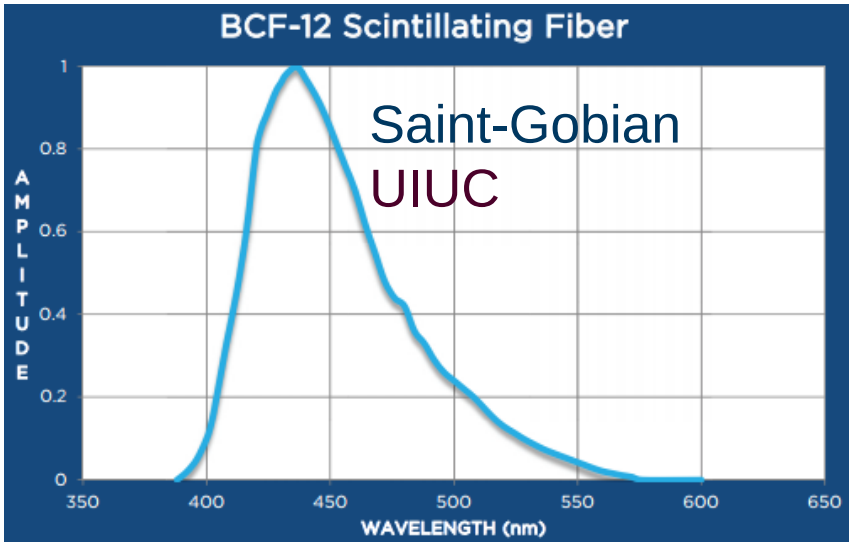
Progress at Fudan

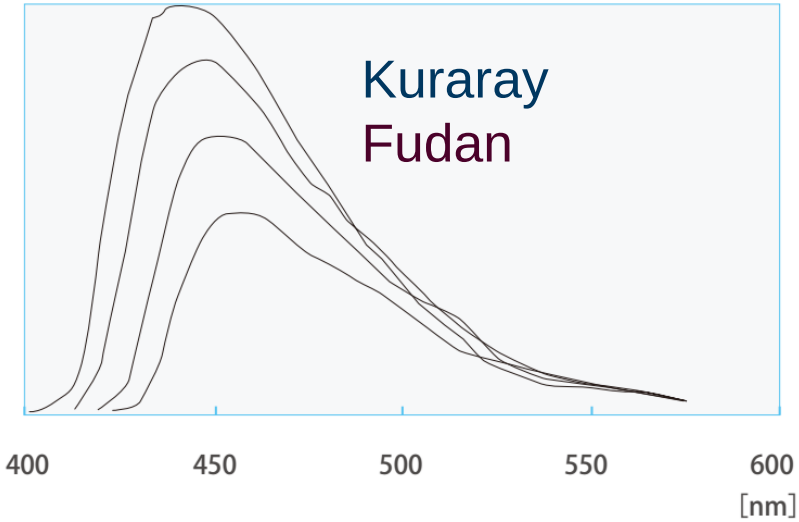
Material readiness:

Scintillation fibers

- Diameter: 0.47 mm
- Emission peak: ~ 450 nm



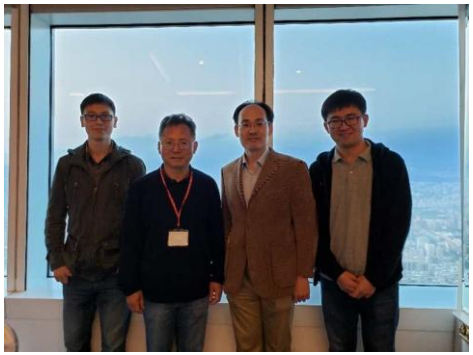


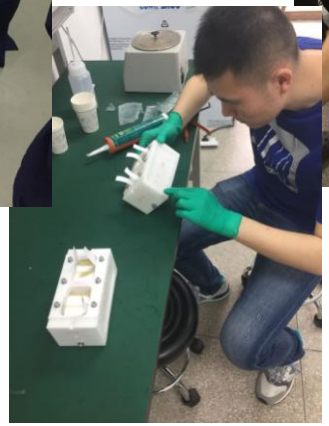


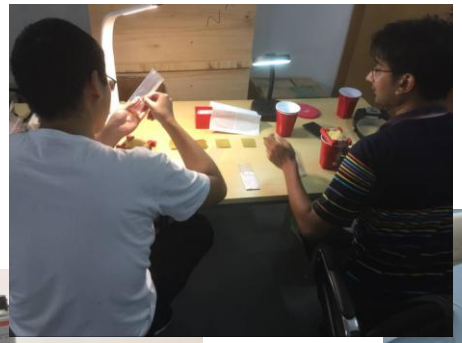
Progress at Fudan

Collaboration Consortium :

- Four professors, two post-doctors, and students are involved in sPHENIX project.







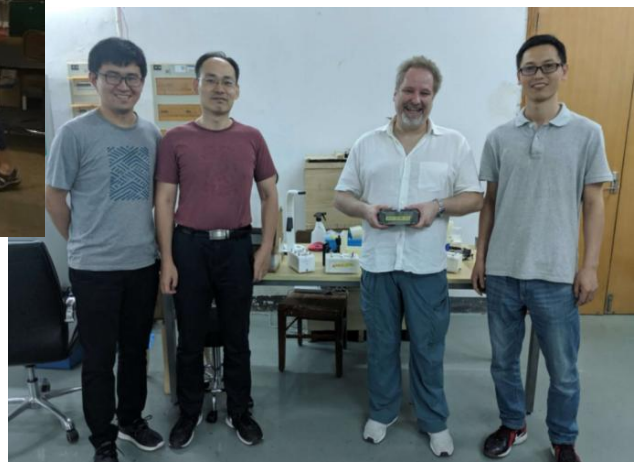
Progress at Fudan

Collaboration Consortium :

- Cooperation with BNL, MIT, and UIUC: participating in the design and development of EMCal, dispatching team members to visit UCLA, UIUC, and BNL.
- Cooperation with Peking University, CIAE and other Institutes.

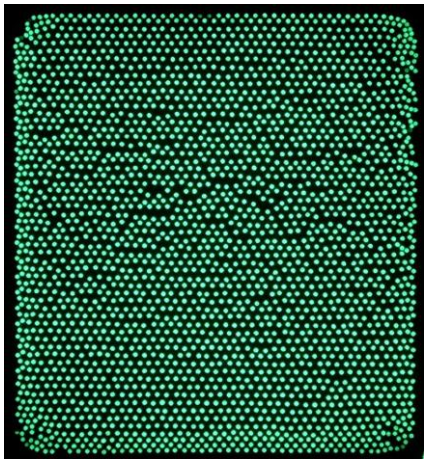
at UIUC

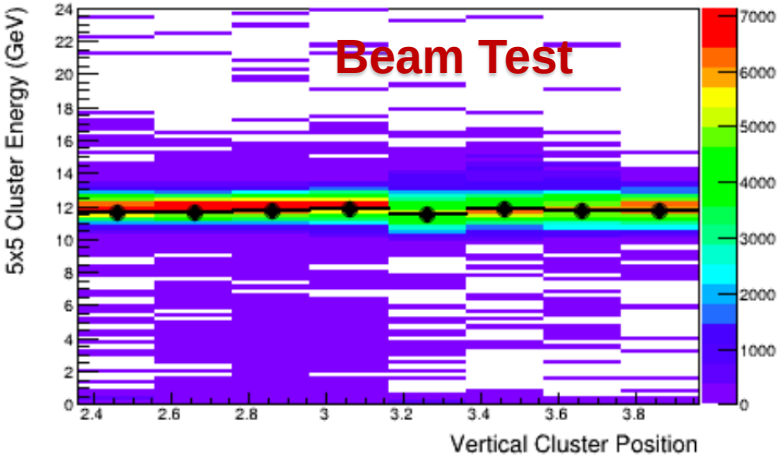
at Fudan

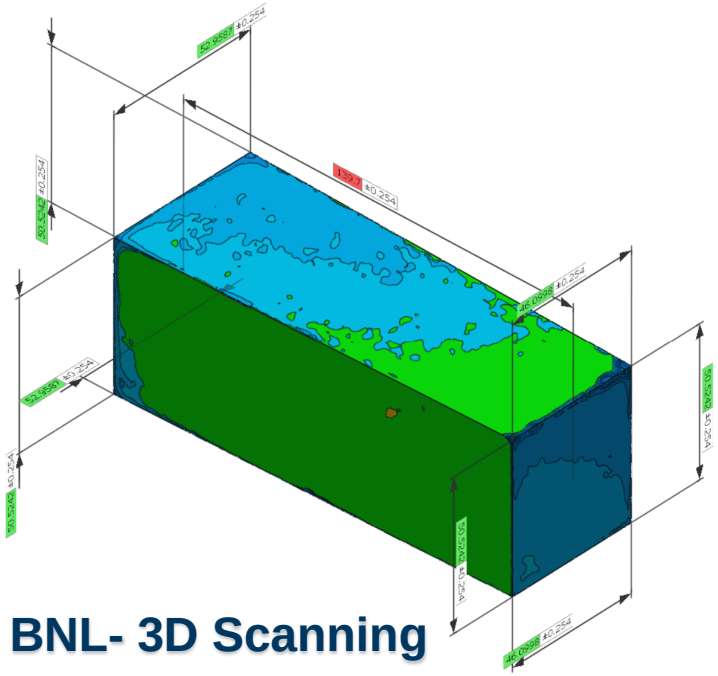

at Fudan

Progress at Fudan

QA & Testing :



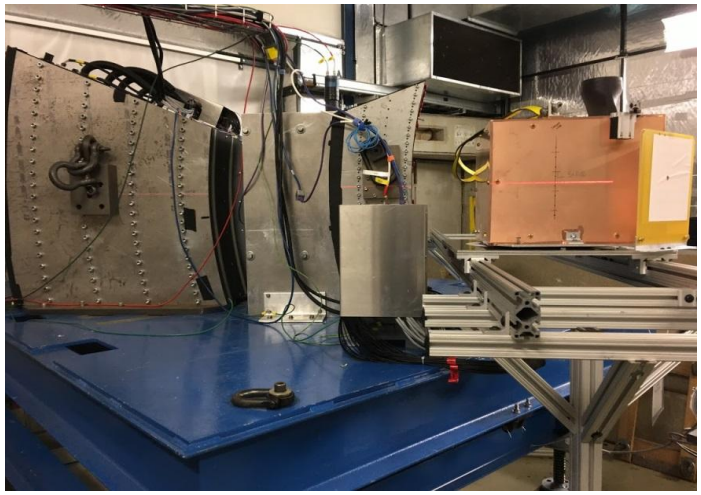


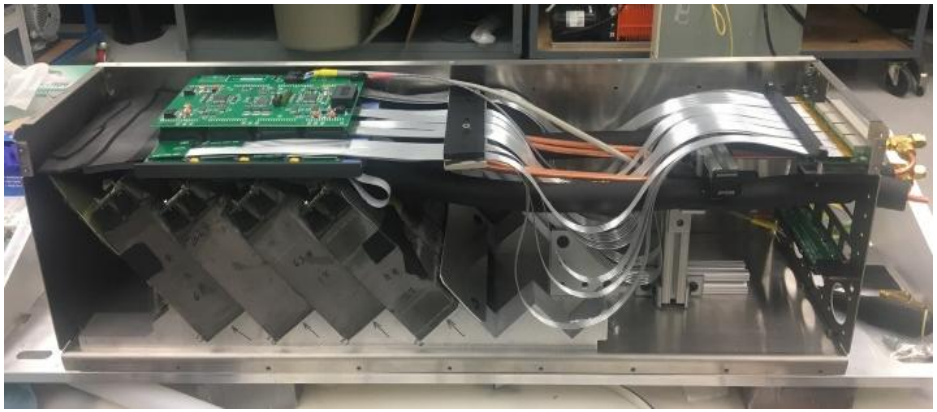


BNL- 3D Scanning

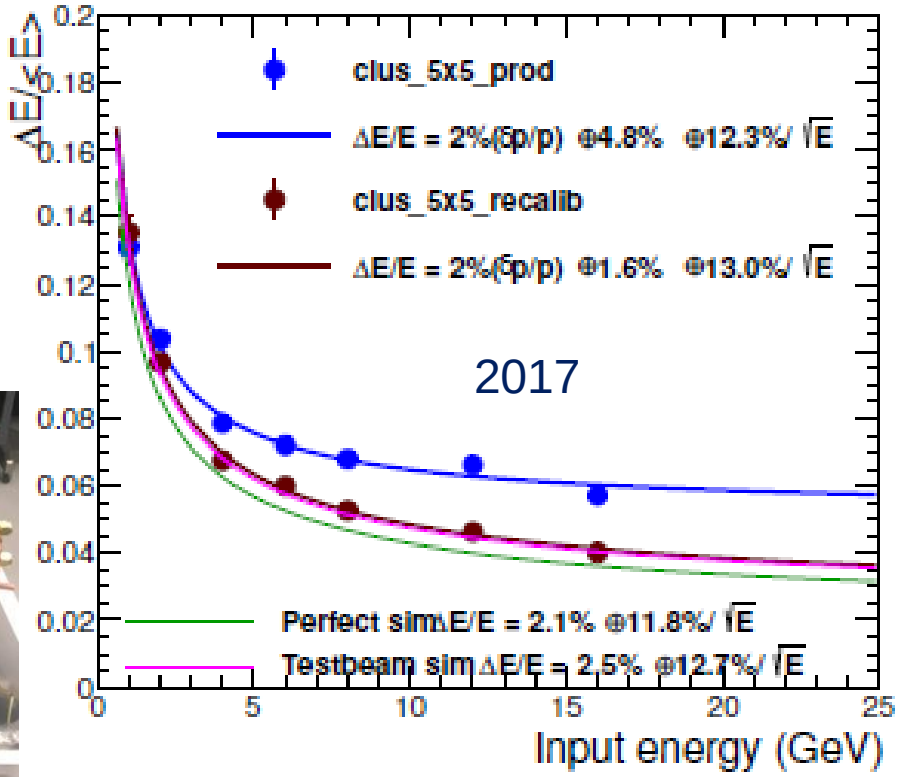
Prototyping and Testing

The design has undergone several stages of prototyping and testing in the test beam at Fermilab



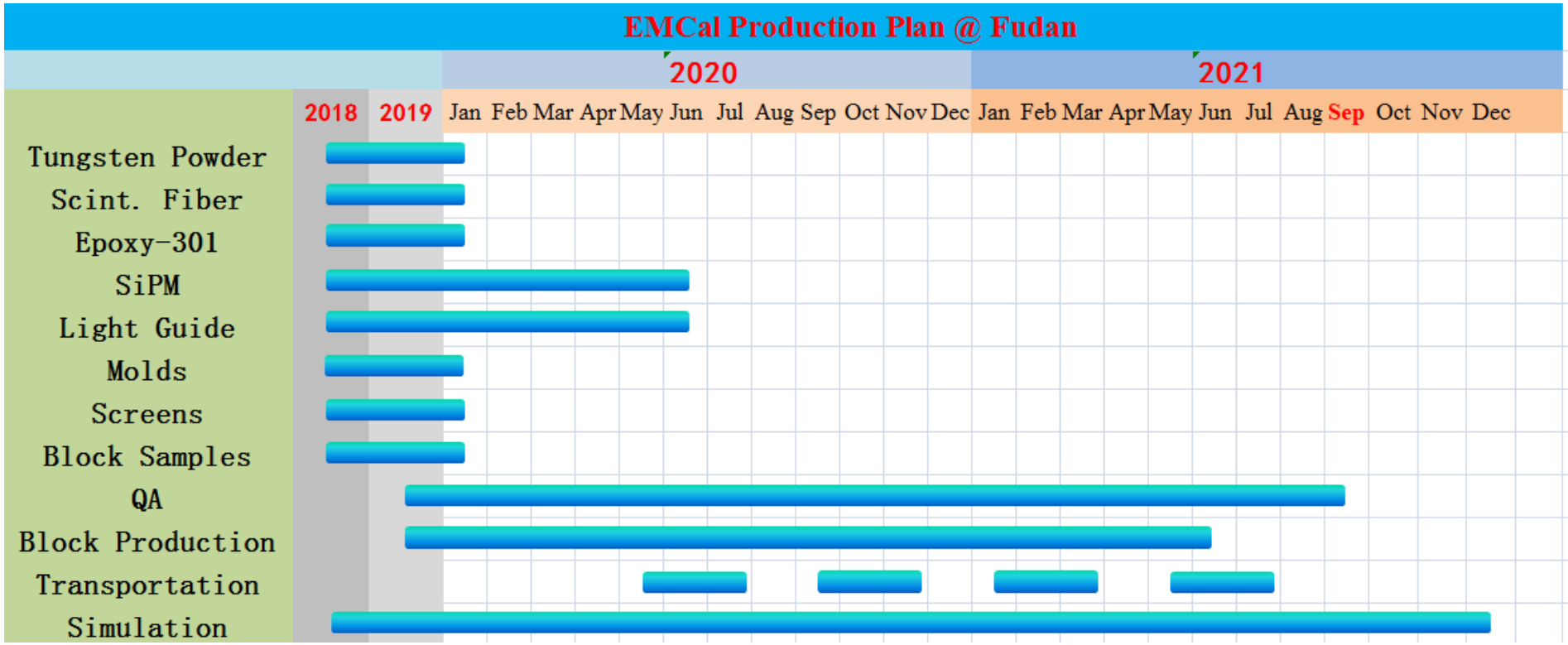


sPHENIX design requirement
$\sigma/E < 16\%/\sqrt{E} \oplus 5\%$



Progress at Fudan

Production schedule at Fudan:

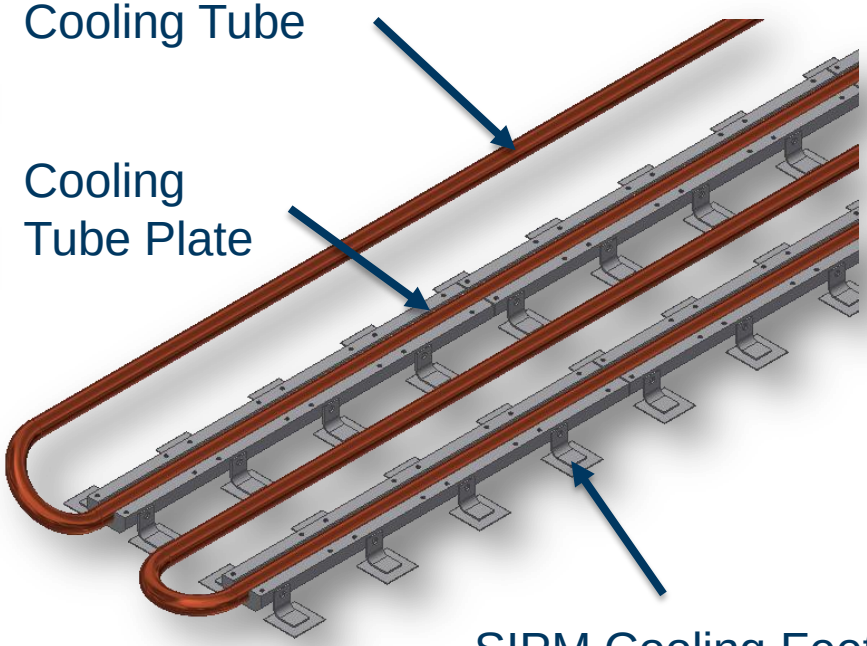
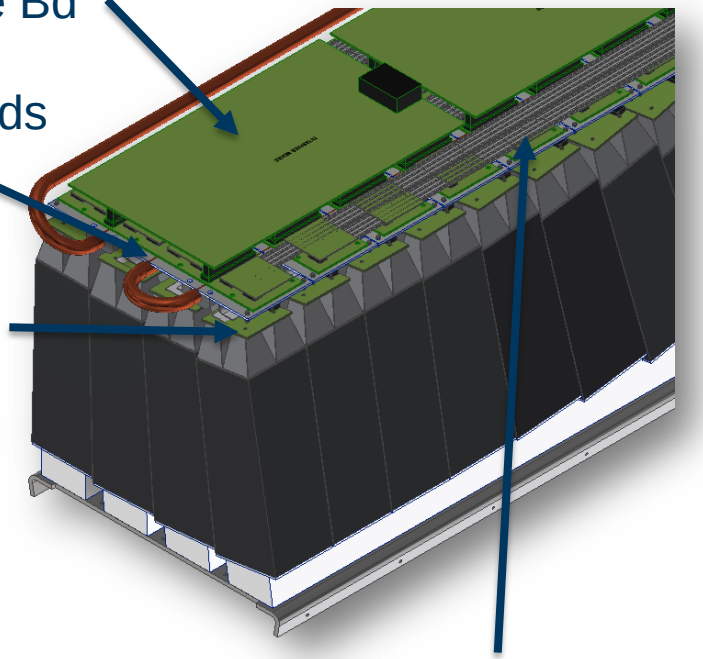
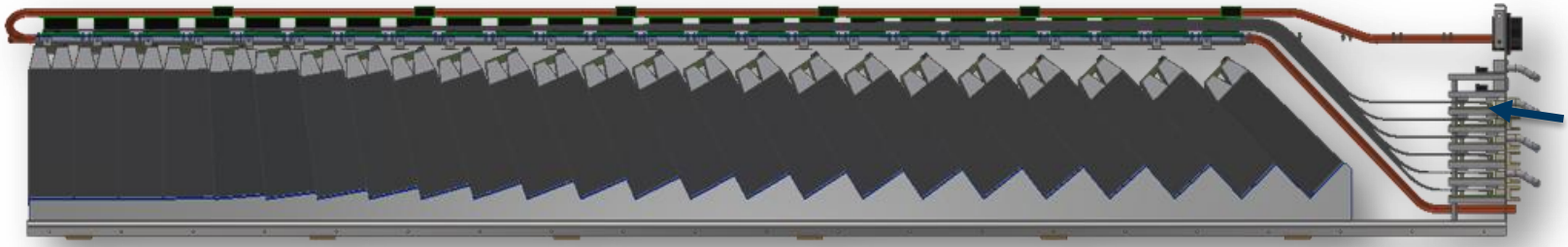


Summary

- The sPHENIX experiment is mainly to gain an understanding of the evolution of QGP.
- The Jets and the Upsilon states will be the major probes to investigate the QGP medium.
- The EMCal performance is central to the direct photon and Upsilon measurements.
- EMCal block production progress at Fudan.

sPHENIX

Thanks

sPHENIX Fudan Group

Design of EMCal Electronics and Cooling