

USTC and Plans in ALICE-FCPPL

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USTC

University of Science and Technology of China



- Founded in 1958 at Beijing
- Moved to Hefei, Anhui Province in 1970
- ~1600 faculty members
- $\sim 1900 \times 4$ undergraduate students
- Established the first graduate school in China
- Operates two National Laboratories and two State key laboratories (MoST)

School of Physical Sciences of USTC

- Top 3 (with Peking and Nanjing Univ.) among China universities
- 240 faculty members including ~100 full Profs and ~70 Assoc. Profs
- ~1200 undergraduate students
- ~400 Master students and 560 Ph.D students

Particle and Nuclear Physics at USTC

Experimental high-energy physics



Theory and phenomenology



Electronics



Involvements in large collaborations

- L3@LEP: 1983-1995
- BES@BEPC: 1991-present
- Belle@KEK: 1995-present
- ATLAS@LHC: 1999-present
- D0@Tevatron: 2004-present
- STAR@RHIC: 2001-present
- ALICE@LHC: 2016-present
- CBM@FAIR: 2008-present
- Dayabay: 2006-present
- LHAASO: 2009-present
- ...

$e^+ + e^-$ collision

$p + p$ (\bar{p}) collision

Heavy-ion collision

Non-accelerator

USTC Experiences on Detector system

Project completed

**State Key Laboratory of
Particle Detection
and Electronics**

- Detector:
 - STAR TOF: 2000-2010
 - STAR MTD: 2005-2014
- Detector + Electronics:
 - BESIII Scin. ETOF: 2001-2006
 - BESIII MRPC ETOF: 2011-2016
 - DAMPE BGO Calorimeter: 2011-2015

R&D → Proposal → Mass production → Commission

Physics analysis ← Calibration / Software ←

USTC Experiences on Detector system

Ongoing detector R&D

**State Key Laboratory of
Particle Detection
and Electronics**

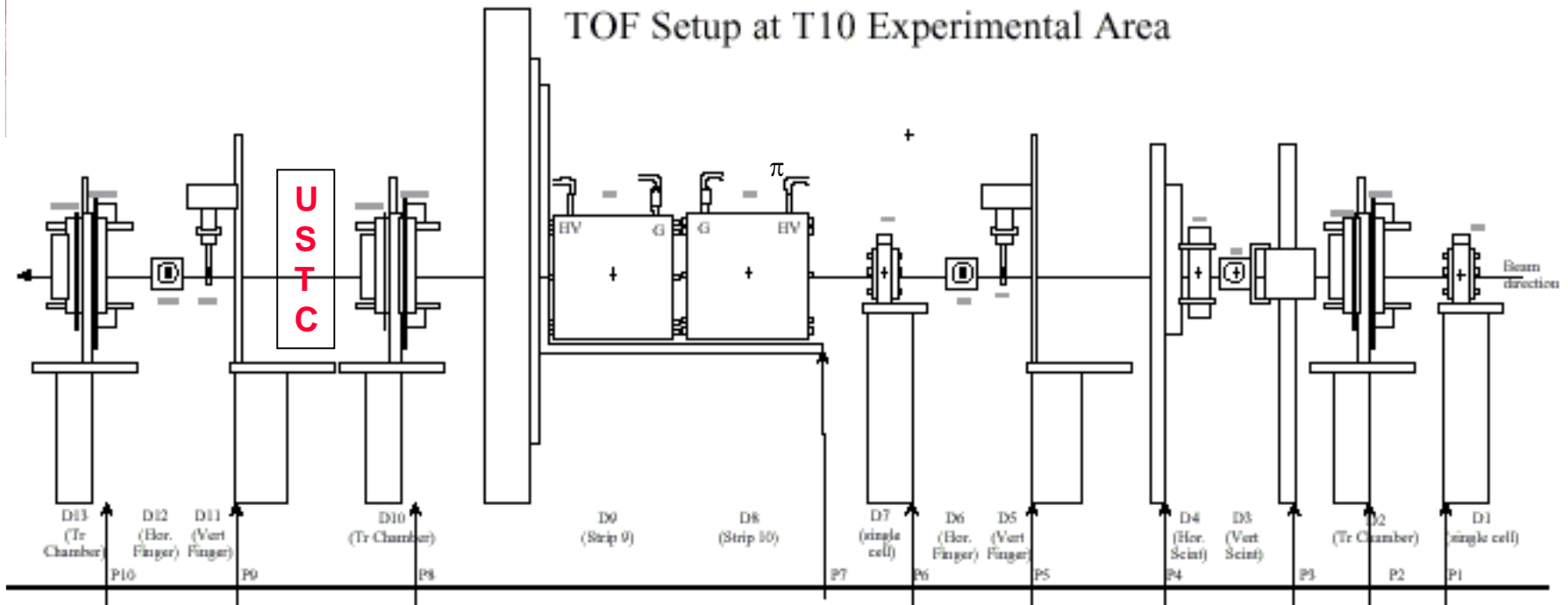
- CBM TOF, STAR Endcap TOF
- STAR iTPC upgrade
- Large size GEM, Micromegas (RD-51 Collaboration member)
- ATLAS TGC electronics, ATLAS RPC
- STAR Event Plane Detector (Scin.+WLS+SiPM)
- LHAASO WCDA and MD
- Imaging Calorimeter
- Crystal Calorimeter compatible with high luminosity

Multi-gap Resistive Plate Chamber



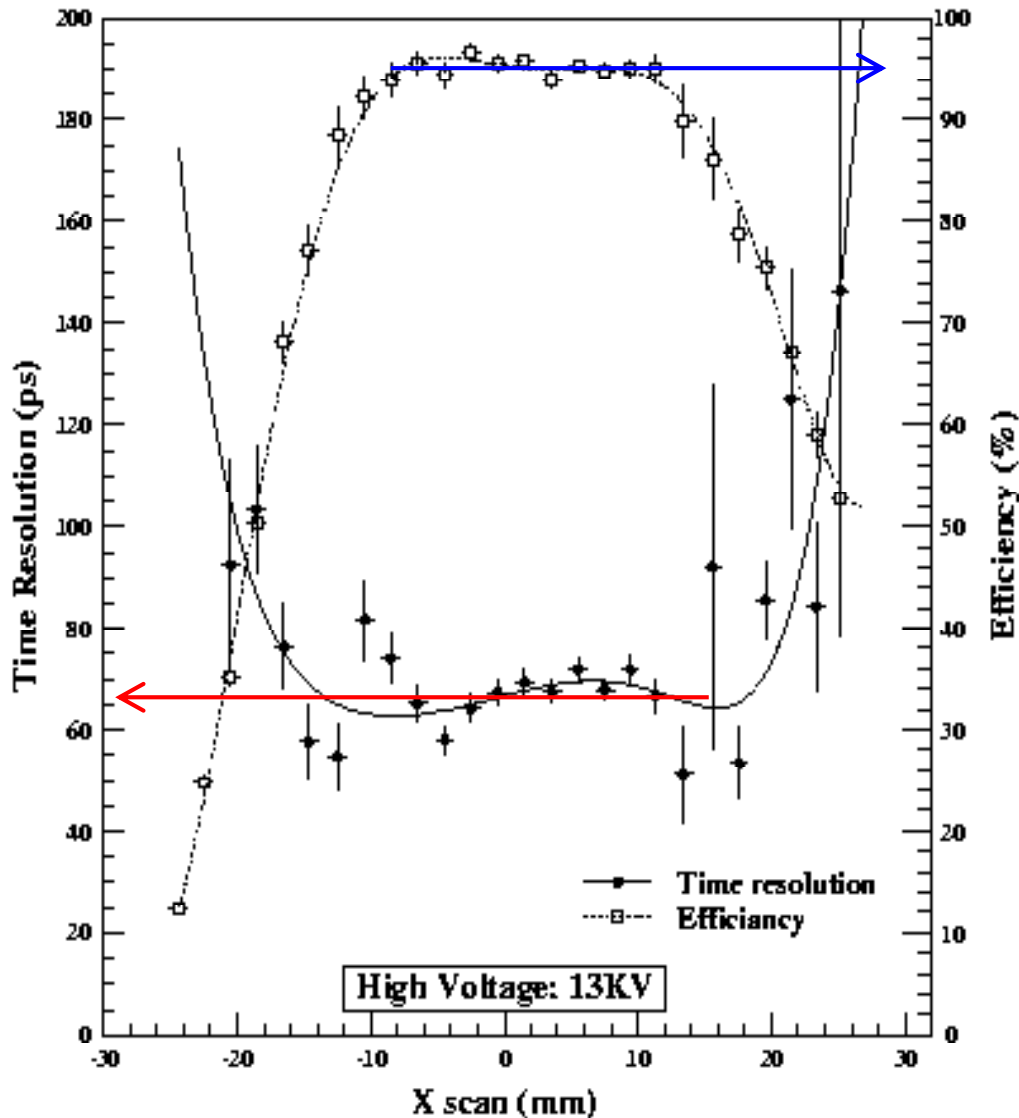
- Involved in detector R&D for heavy-ion collision experiment in 2000
- A single cell MRPC built at USTC in Sep. 2000
- Beam test at CERN T10 in Nov. 2000

TOF Setup at T10 Experimental Area



EACZ; 02.05.2001

Performance of USTC first MRPC



$3 \times 3 \text{ cm}^2$ electrode
 $5 \times 0.22 \text{ mm}$ gas gaps

- Efficiency $> \sim 95\%$
- Timing resolution $\sim 70 \text{ ps}$
- Good uniformity

Prototypes in 2001

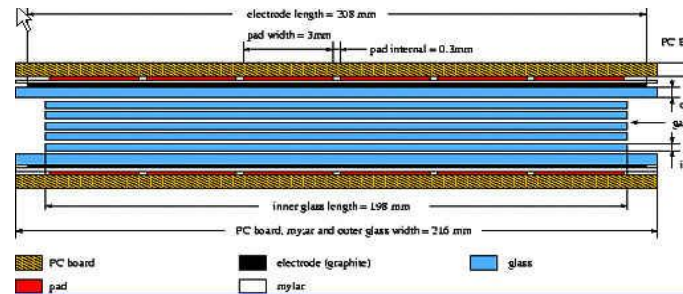
Two types of MRPC built and tested at CERN in 2001

12-pads MRPC

$7 \times 20 \text{ cm}^2$

$6 \times 0.25 \text{ mm}$ gas gaps

pad size: $3.1 \times 3 \text{ cm}^2$

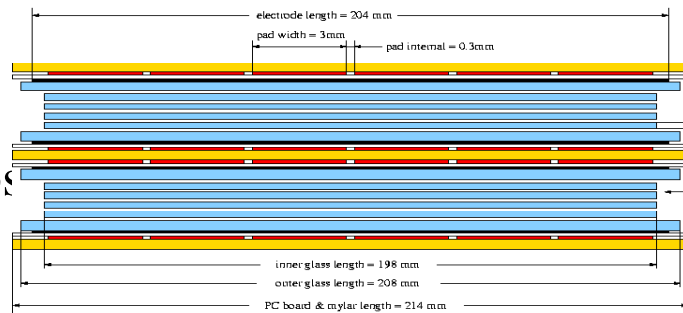


6-pads

$7 \times 21 \text{ cm}^2$

$2 \times 5 \times 0.25 \text{ mm}$ gas gaps

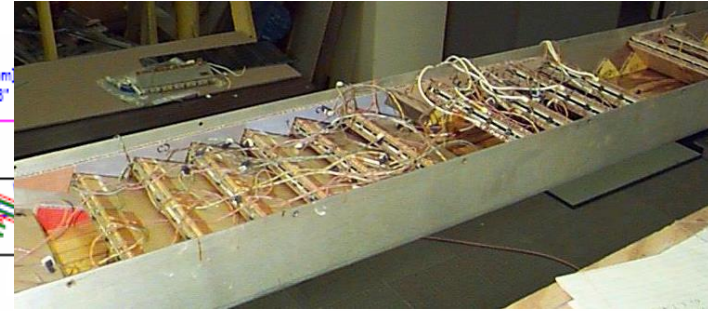
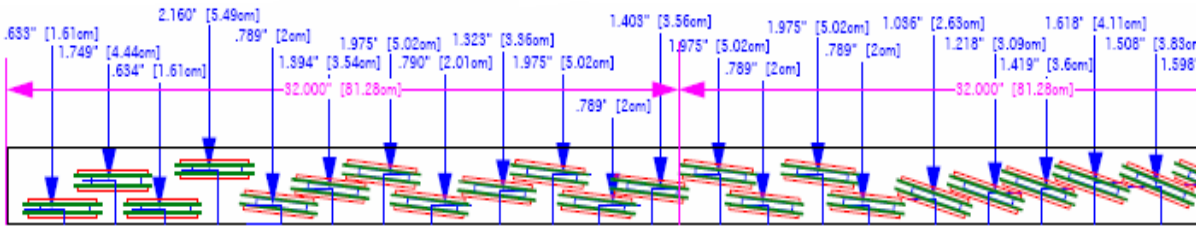
pad size: $6 \times 3.1 \text{ cm}^2$



Gas Gaps	Efficiency	Timing resolution (ps)
5	>95%	~70
6	>97%	~60
2×5	>99%	~50

Counting rates :
Up to 500 Hz/cm^2 (with normal float glass)

TOF prototype at STAR (2002-2004)



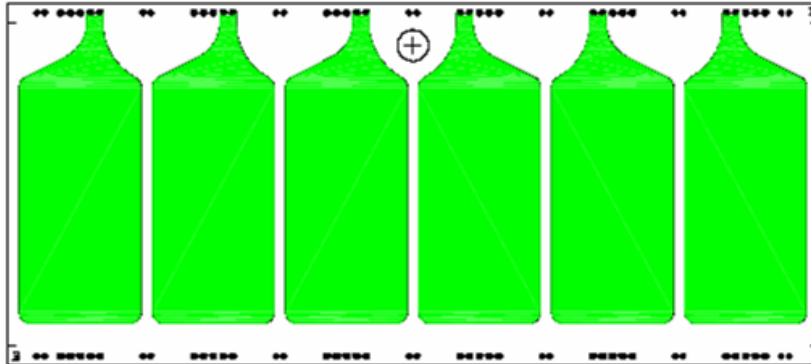
24 out of 28 modules made in USTC

Module: 20×6 cm

Gap: 6×0.22 mm

Pad: $3.15\text{cm} \times 6.1\text{cm}$

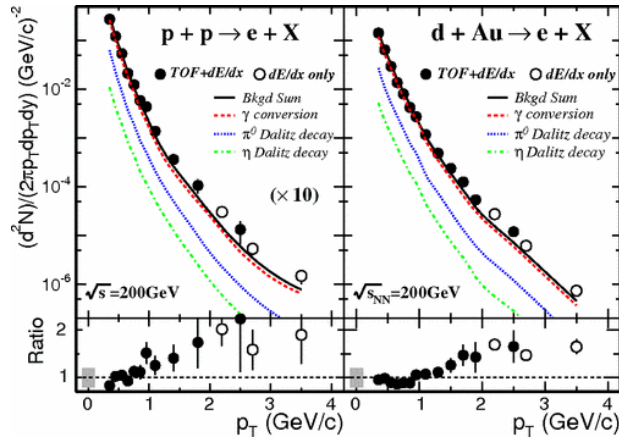
Gas: 95% $\text{C}_2\text{H}_2\text{F}_4$
+5% Iso- C_4H_{10}



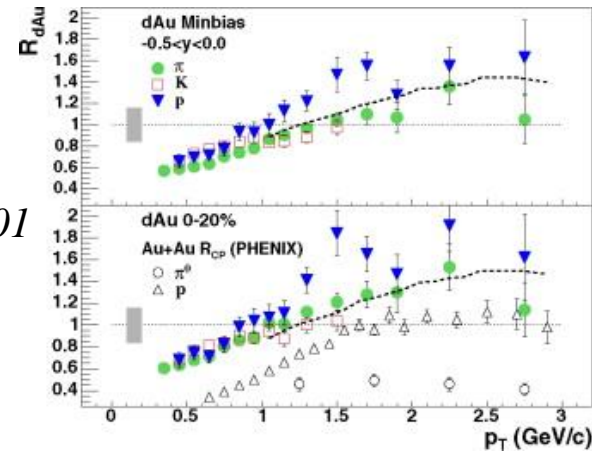
Operation condition		Time Resolution (ps)		
		VPD (start time)	TOFr (overall)	TOFr (stop time)
Run III	200GeV d+Au	~85	~120	~85
	200GeV p+p	~140	~160	~80
Run IV	62GeV (Au+Au)	~55	~105	~89
	200GeV (Au+Au)	FF/RFF	~74	~70
		HF	~74	~71

Physics results from the first TOFr tray

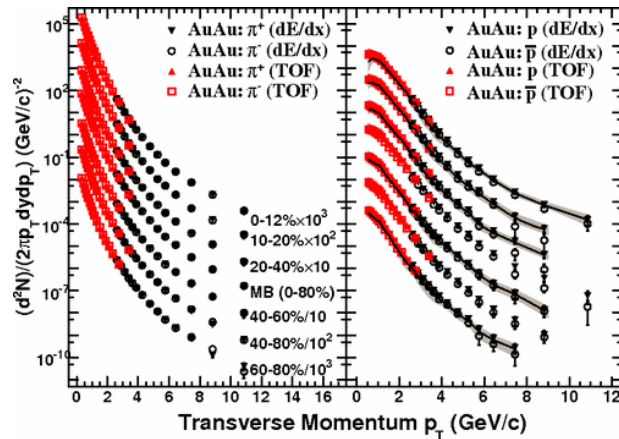
TOF prototype (1/120 of full coverage) collected data in 2002-2004



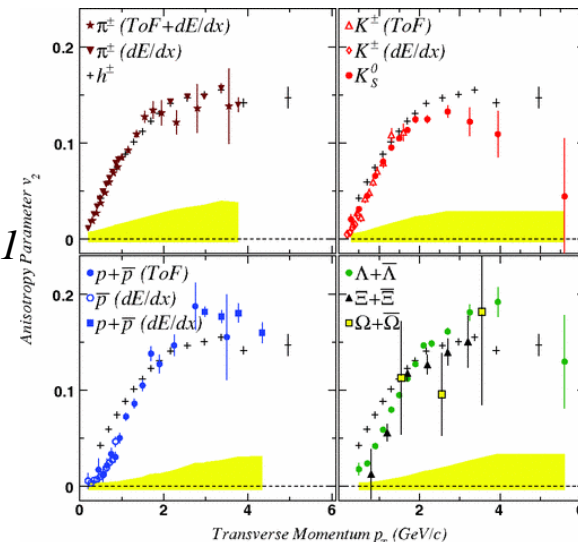
Phys. Rev. Lett.
 94 (2005) 062301



Phys. Lett. B
 616 (2005) 8



Phys. Rev. Lett.
 97 (2006) 152301



Phys. Rev. C 75
 (2007) 054906

USTC-STAR

- Joined STAR Collaboration in 2001
- Played key role in two large-area detectors
 - Time-of-Flight (2000-2010) — significantly extend PID capability
 - Muon Telescope Detector (2005-2014) — Enable muon measurement
- Physics analysis
 - Identified particle production in heavy-ion collisions
 - Open heavy-flavor production in heavy-ion collisions
 - Quarkonium production in heavy-ion collisions
 - Dilepton production in heavy-ion collisions
 - Principal Authors of **20+** STAR papers
 - Trained **14** Ph.D. All are doing research, **11** still in this field.
- Ongoing detector R&D
 - Event Plane Detector, Inner Time Projection Chamber ...

Current research interest in HIC

Physics analysis:

- Open heavy flavor production
- Quarkonium production
- Dilepton production

State-of-the-art detector technologies:

- Silicon tracking device
- Micro-pattern Gaseous Detector (GEM, Micromegas)
- Particle Identification detector
- Calorimeter

DE LA RECHERCHE À L'INDUSTRIE

cea

CERN



HELLENIC REPUBLIC



ARISTOTLE
UNIVERSITY OF
THESSALONIKI



RD51 Mini Week - Precise timing workshop
21 February 2017
CERN

Fast timing with Micromegas: Status and Plans

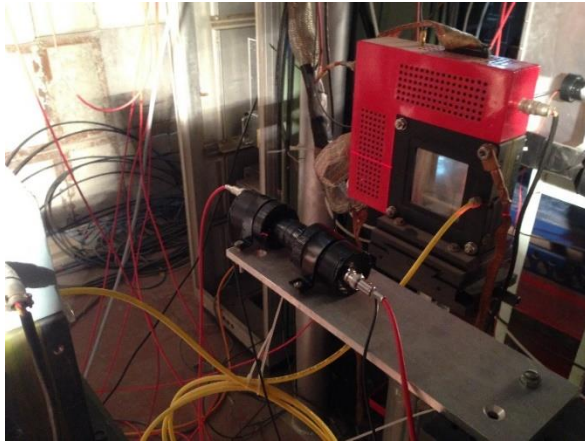
Thomas Papaevangelou, IRFU-CEA/Saclay

Representing:

CEA (Saclay), CERN (GDD), NSRC "Demokritos",
Princeton University, Thessaloniki University, USTC (Hefei)

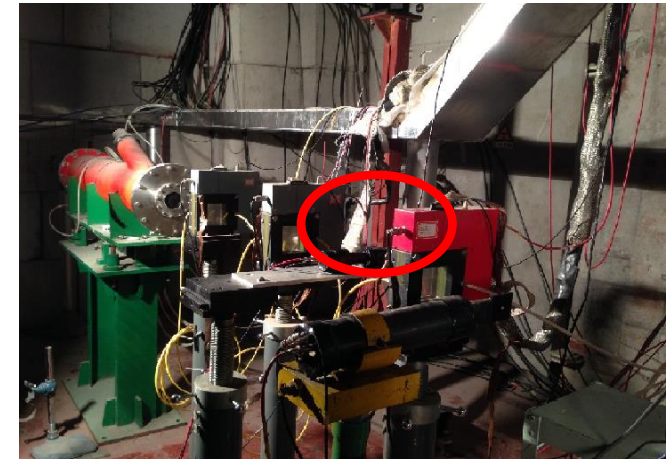
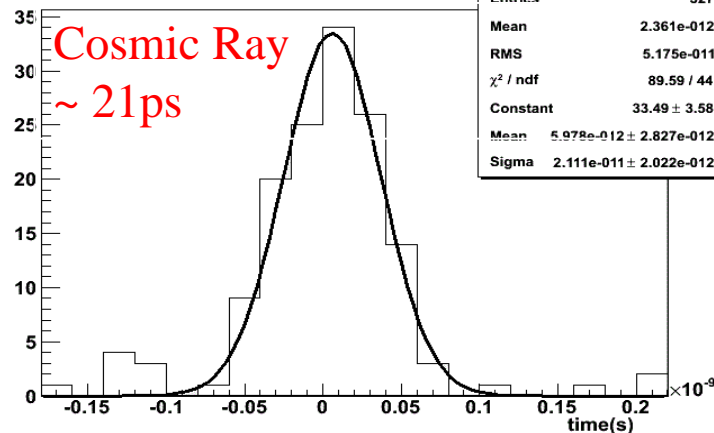
High resolution Time-of-Flight

In collaboration with Sergey Barsuk, Research Director, Laboratoire de l'Accelérateur Lineaire (LAL), IN2P3-CNRS

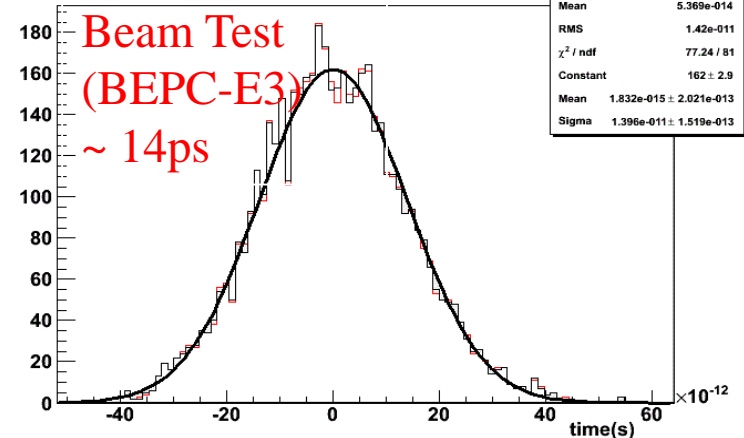


quartz radiator + MCP-PMT

cosmic ray time distribution



time distribution after T-A correction



Plan for ALICE

- Nov. 13, 2016, ALICE accepted USTC as full member

Motivation:

- Studying QGP with higher temp. and longer lifetime than at RHIC
- State-of-the-art detector technologies

Foreseen activities:

- Physics analysis
 - Heavy flavor physics
- Detector upgrade
 - ITS upgrade
 - Assembly and module test
 - Commission and calibration?
 - Micro-pattern gaseous detector
 - Potential participation in future

Thanks!

Looking forward for close collaboration within FCPPL