

Paragraph for document

US-China collaboration on the STAR TOF has successfully completed its construction and three years of operation. We have focused on the beginning of scientific analysis utilizing the capability of this new state of the art detector to search for a critical point in the QCD phase diagram and to study the properties of the new form of matter discovered at RHIC. Built on the success of TOF project and the expertise on the MRPC technology, the collaboration has proposed muon detector surrounding the outside of the STAR magnet. The production of modules and installation have started since 2011. Project is scheduled to be completed in 2013. The Chinese STAR group has been expanding its activities and leadership to other directions including the Heavy Flavor Track (HFT) upgrade and future forward upgrade projects.

Scientific Contributions to RHIC/STAR

(1) Physics Analysis Highlights:

“Observation of the Antimatter Helium-4 Nucleus”, *Nature*, 473, 353(2011). The China made MRPC barrel Time-of-flight detector (TOF) used for the anti-alpha identification. Anti-alpha is the heaviest known anti-matter. Several Ph.D students from China did the full data analysis including calibration, simulation and publication.

“Higher Moments of Net-proton Multiplicity Distributions at RHIC”, *Phys. Rev. Lett.* **105**, 22302(2010). Although TOF was not used in this analysis, the MRPC barrel TOF is crucial for the proton and anti-proton identification in future analysis. Higher moments for conserved quantities, net-baryon for example, is sensitive to the correlation length. The net-proton analysis was the first attempt for the QCD critical point search at RHIC. This data analysis was done by a joint trained Chinese Ph.D student.

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(2) R&D Efforts:

i) **“Long MRPC”**: After the STAR Barrel TOF production completed successfully, colleagues from both Tsinghua University and University of Science and Technology of China (USTC) lunched the R&D efforts on a long MRPC, envisioning its application for future RHIC upgrade. The STAR Muon Telescope Detector (MTD) is designed to enhance trigger for high p_T particles and study excited states of Upsilon. Both are important for RHIC-II physics program. The project is supported in part by NNFSC and US DOE. Module production has started in 2011, project completion in the summer of 2013.

Institute	leader	# of modules	Contributions	
University of Science and Technology of China	Dr. Yongjie Sun	50	\$1.5M	USA
Tsinghua University	Dr. Yi Wang	65	\$0.8(in kind)	China

ii) **“High-rate MRPC”**: The STAR group at Tsinghua University also worked on a high-rate MRPC. They have made significant progress in that direction. It could be used for future eRHIC low costs PIDs and CBM experiment at FAIR.

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(2) R&D Efforts (Cont.):

iii) **Heavy Flavor Tracker (HFT)**: Based on the state of art MAPS technology, STAR is constructing a new tracking device HFT. It will allow a vertex resolution in the order of 10-20 micrometer in the heavy ion collision environment. Chinese STAR group from Central China Normal University (CCNU) is actively participating the HFT R&D and construction. The leading person is Dr. Xiangming Sun from CCNU. The scope is in the order of \$1.5M and is partly support by NNSFC and CCNU. HFT will be commissioned early 2014 at STAR Experiment.

iv) inner TPC upgrade (iTPC): In order to extend its rapidity coverage, STAR has lunched it forward upgrade programs. Dr. Ming Shao (USTC) is leading the effort in the simulations for iTPC upgrade. Involved scientists are seeking for funds from US DOE, NSF and NNSFC.

Chinese Scientific Contributions to RHIC/STAR (2010 - 2012):

(I) **Scientific Publications:**

PRL: 3; PRC: 7; PRD: 1; Nature: 1

(II) **Quark Matter Conference**, August 13-18, 2012, Washington DC, USA.

Oral presentations: 6 out of STAR total of 20

- Shusu Shi (CCNU)
- Xiaofeng Luo (CCNU)
- Xiaoping Zhang (Tsinghua University)
- Lizhu Chen (CCNU)
- Xuan Li (Shandong University)
- Yihui Zhu (Shanghai Institute of Applied Physics, CAS)

(III) **Co-conveners for Physics Working Groups:**

- Shusu Shi (CCNU): Bulk Correlation PWG
- Xianglei Zhu (Tsinghua University): Spectra PWG
- Yifei Zhang (USTC): Heavy flavor PWG

(IV) **PhD Students:**

- CCNU: 3
- SINAP: 3
- Tsinghua University: 1
- Institute of Modern Physics: 2
- Shandong University: 2
- USTC: 4

MTD Status



1) MRPCs built at **USTC, Tsinghua University**, and VECC, trays assembled at UT-Austin.

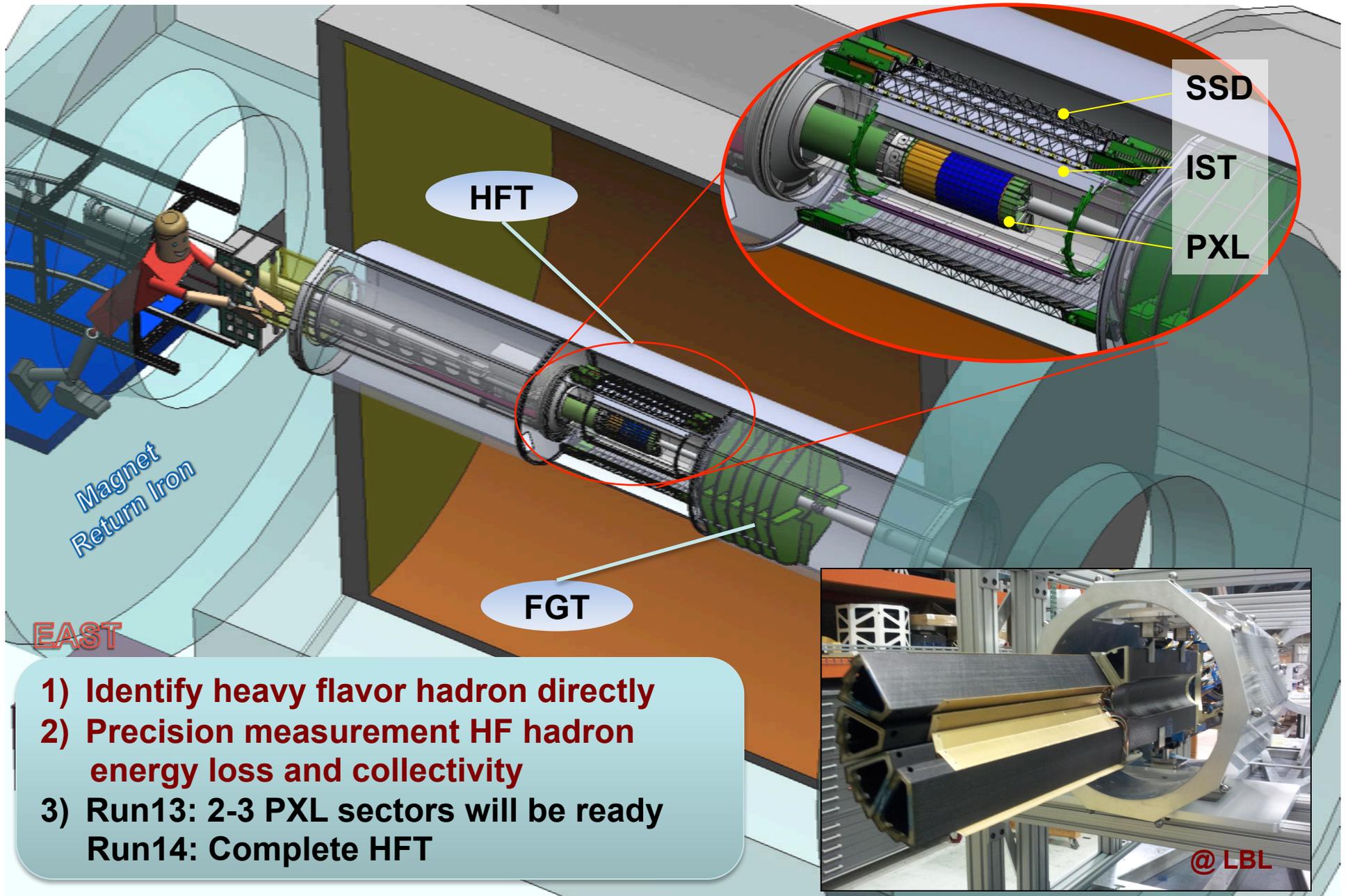
2) **Run12 (Dec. 2011-Jun 2012):**
10% of the full system installed. Fully integrated into STAR DAQ and Trigger systems.

3) **Run 13 (Jan. – May 2013):**
43-60% of the full system in total expected to be installed.

4) **Run 14 (p* Jan. – June 2014):**
100% MTD will be ready.

* proposed

Heavy Flavor Tracker



- 1) Identify heavy flavor hadron directly
- 2) Precision measurement HF hadron energy loss and collectivity
- 3) Run13: 2-3 PXL sectors will be ready
Run14: Complete HFT

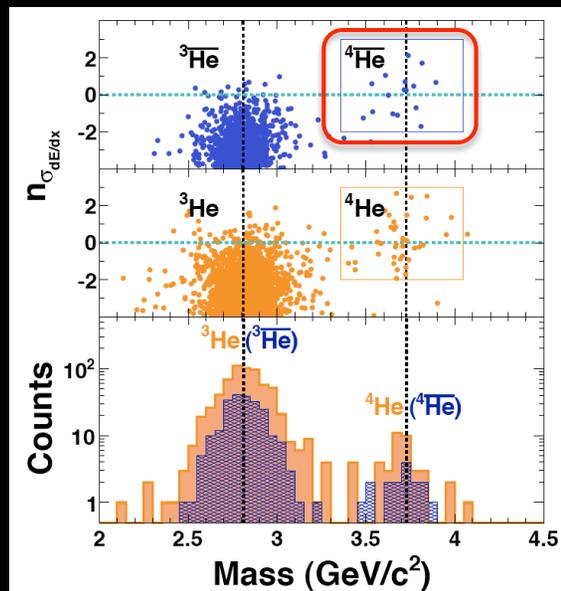
Antimatter Discoveries at RHIC

nature

April, 2011

“Observation of the Antimatter Helium-4 Nucleus”

by STAR Collaboration
Nature, 473, 353(2011).



Science

March, 2010

“Observation of an Antimatter Hypernucleus”

by STAR Collaboration
Science, 328, 58(2010).

