

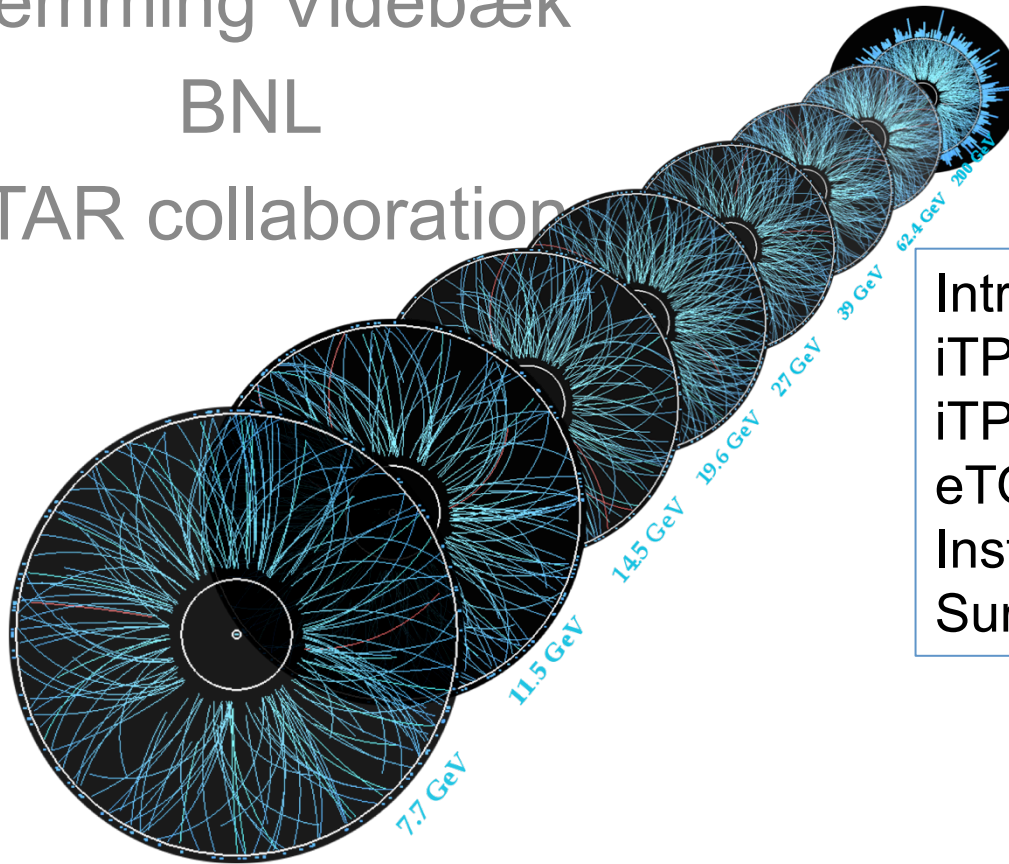


iTPC and eTOF status

Flemming Videbæk

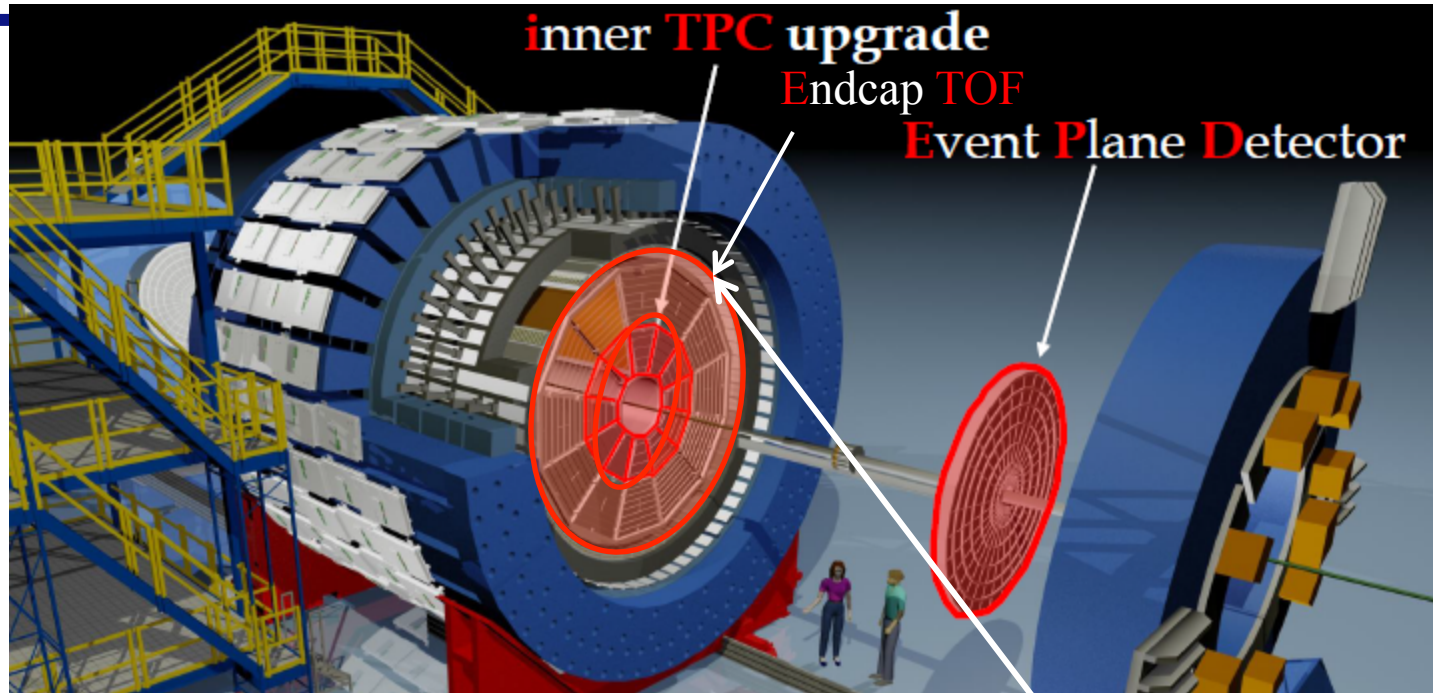
BNL

STAR collaboration



- Introduction
- iTPC
- iTPC Run 18 performance
- eTOF
- Installation & Schedule
- Summary

Upgrades and BES-II



iTPC Upgrade:

- Rebuilds the inner sectors of the TPC
- Continuous Pad Coverage
- Improves dE/dx (15-30%)
- Extends η coverage from 1.0 to 1.5
- Lowers p_T cut-in from 125 MeV/c to 60 MeV/c

eTOF Upgrade:

- Add CBM TOF modules and electronics (FAIR phase 0)
- $-1.5 < \eta < -1.1$
- Extend forward PID capabilities



Scope of iTPC Project

- 24 Inner sector modules
 - Al Strongbacks
 - Pad planes
 - Padplane joining
 - Multi Wire Proportional Chamber (MWPC) assembly
 - QA & Testing
- Readout Electronics
 - iFEE
 - iRDO
- Insertion Tooling and Installation



Mechanical

- Project started in March 2016
 - Fabrication of pad planes, strongback complete
 - The padplane precision bonding to strongback, sideboards mounting, trimming, CMM, and cleaning done at LBNL completed May 11 2018. Produced 27 good + 3 spares+two prototypes out of 36.
 - Initial production problems required us to fabricate strong backs, padplanes, etc. for an additional 6 sectors





MWPC assembly at SDU

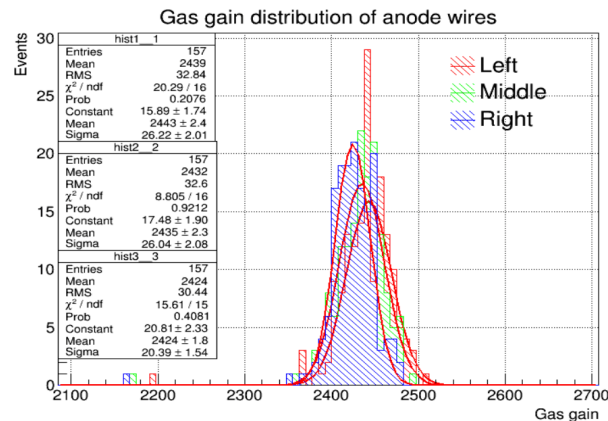
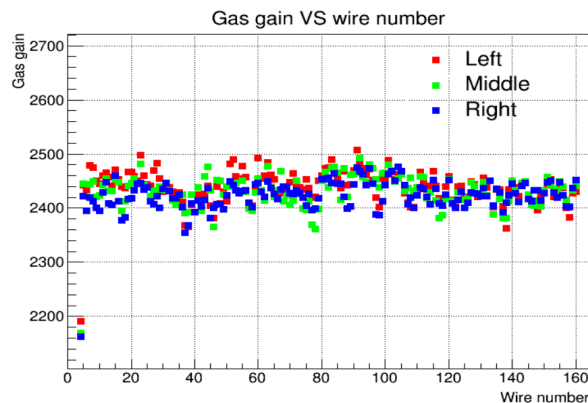
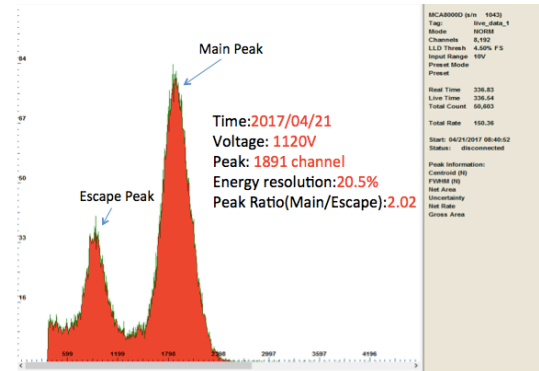
- Work in China – Shandong, USTC, SINAP
 - Two Prototypes of iTPC in 2016
 - Wire plane and assembly production 24+spares and assembly– Started May 2017
 - Sector test (uniformity, efficiency and linearity)
 - Shipping sector to BNL (last shipment July 2018)
- Supported by NSFC & MoST





QA at SDU

- The tests include **HV burn-in**, **gain uniformity**, and **high intensity X-ray stability**. The anode wire gain uniformity under G10 is $<1.5\%$ (better than 2% required), energy resolution is $\sim 8.5\%$ (in RMS, better than 10%) and the leakage current remains $<500\text{nA}$ under strong X-ray test without trip or spark for hours each channel. Leak test.



Production Status



- SDU has produced 2 prototypes
- SDU has assembled 20 production sectors, and 2 with small issues
- Production of last 8 has started
- 8 production sectors at BNL, 4 more in shipping preparation
- Expect all sectors at BNL by August

Electronics

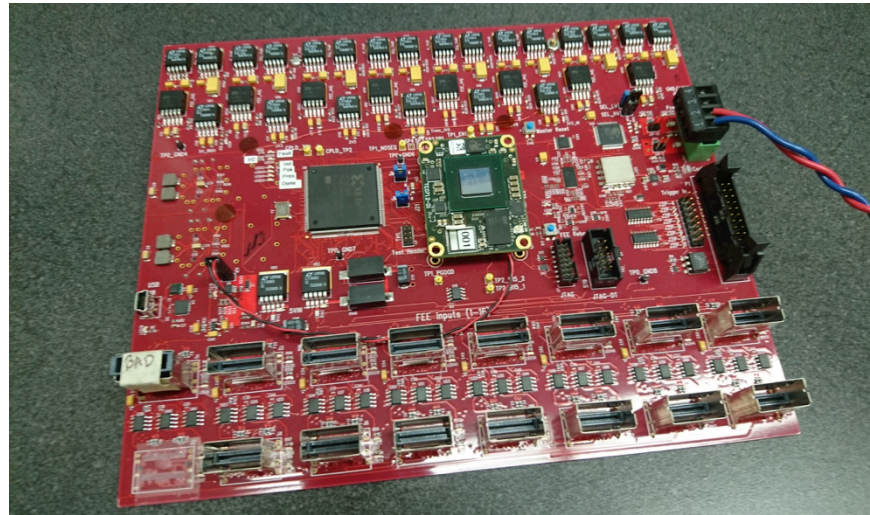
- Doubling # of channels per FEE card. 2 SAMPA per FEE. Have secured 4,000 SAMPA V3
- 55 FEEs per inner sector
- 16 FEEs per RD0
- 4 RDOs per inner sector



iFFE

Pre-production RDO-- installed

Readout Board



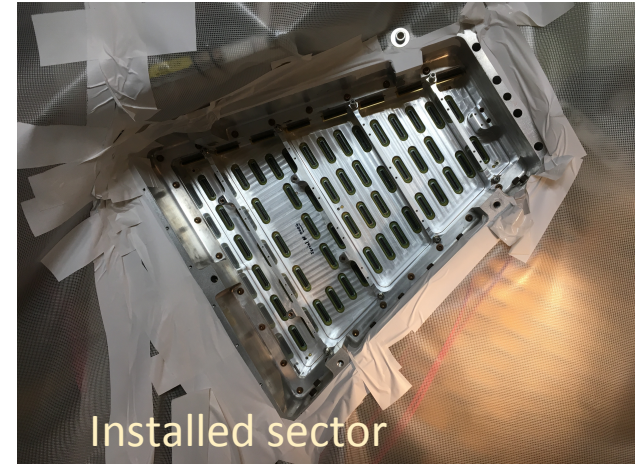
Actual 2017 installation



Unpacking and cover



Lowering sector



Installed sector



Peeking into STAR



Installation platform



Commissioning Status

- One sector was installed in October 2017
- The Run-18 physics program has been running since mid March.
- iTPC is routinely included in most of the runs
 - All firmware goals for Run 18 have been met;

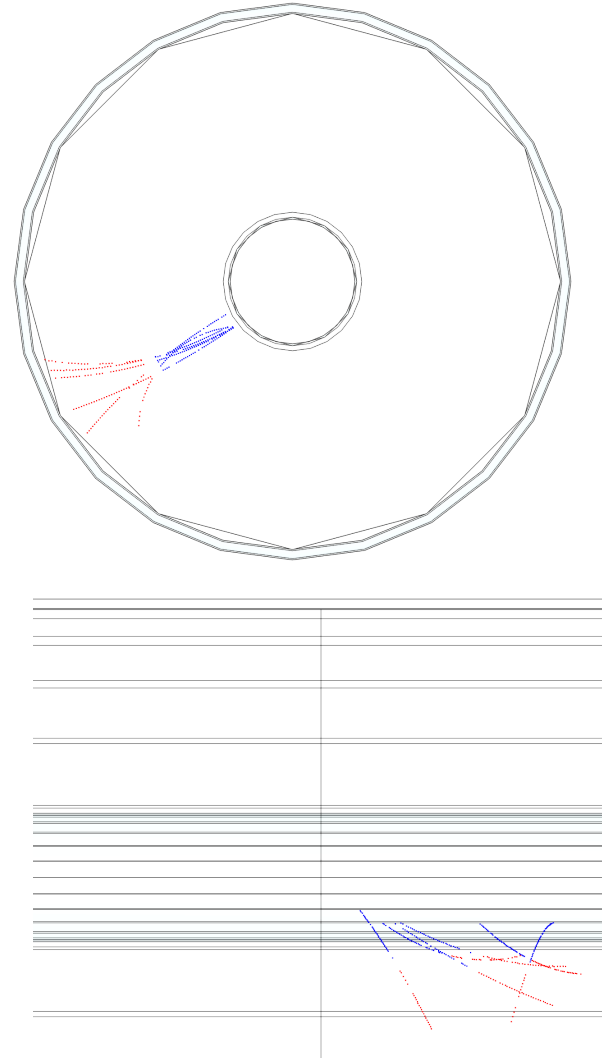
Including the following recent achievements:

- 1) iTPC calibration runs: pedestal, gains
- 2) 2D cluster finder: done, speed optimized, including tail suppression and gain/T0 corrections
- 3) DAQ stability: running very stably after many firmware/software tweaks. We also have auto-recovery in place to get us out of possible SEUs and other error conditions.



Software Progress

- Integration of hit and tracking software getting well along. We have a group of experts and students working on this
- Event display has been prepared (the example shows just sector 20 tracks alone)
- First results of tracking of isobar collisions

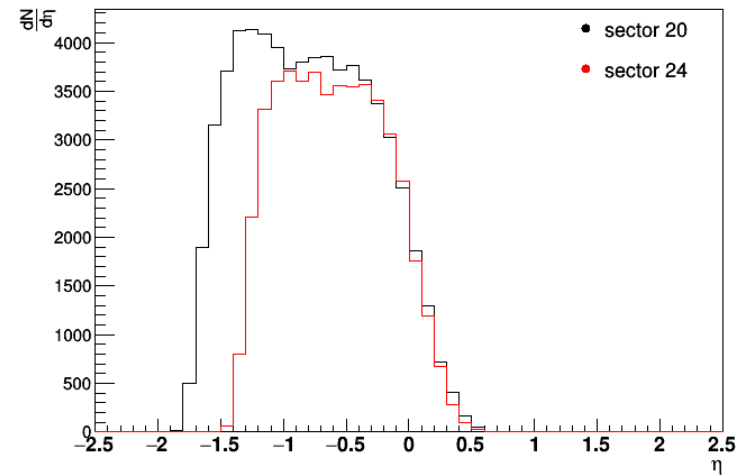




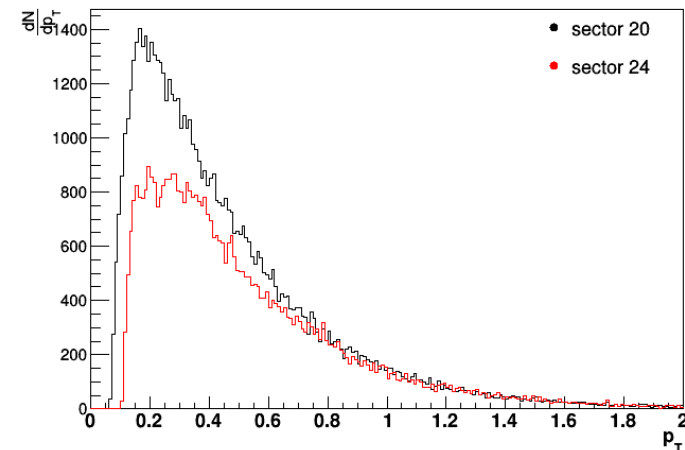
Tracking results

- Comparing tracking of iTPC sector (20) vs. standard sector (24). (Sector identified by first hit position)
- We see the expected improvement in coverage in both η and p_T

η distributions - negative particles



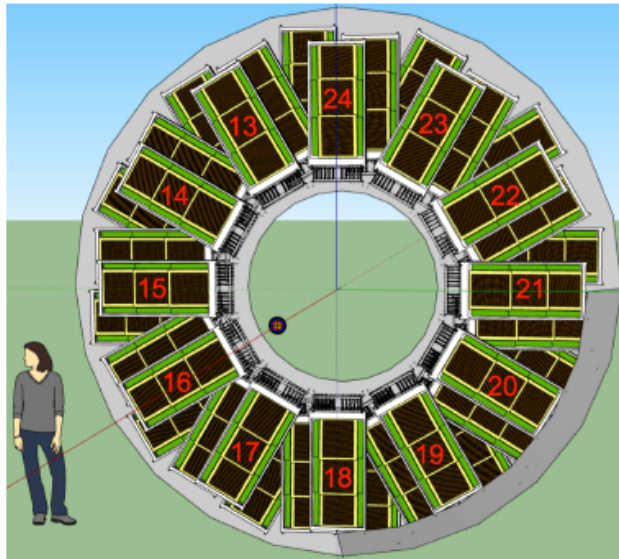
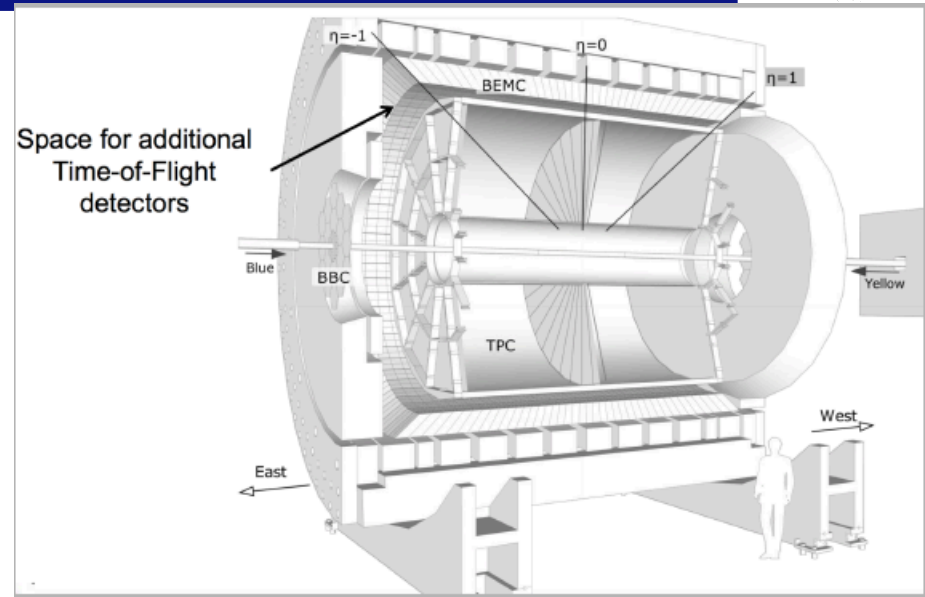
p_T distributions - negative particles



End Cap Time-Of-Flight

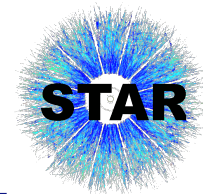


- STAR and CBM-TOF group will install TOF in one side of STAR; part of FAIR Phase-0
- Provide TOF PID in $1.1 < \eta < 1.6$
- Operation experience for CBM effort

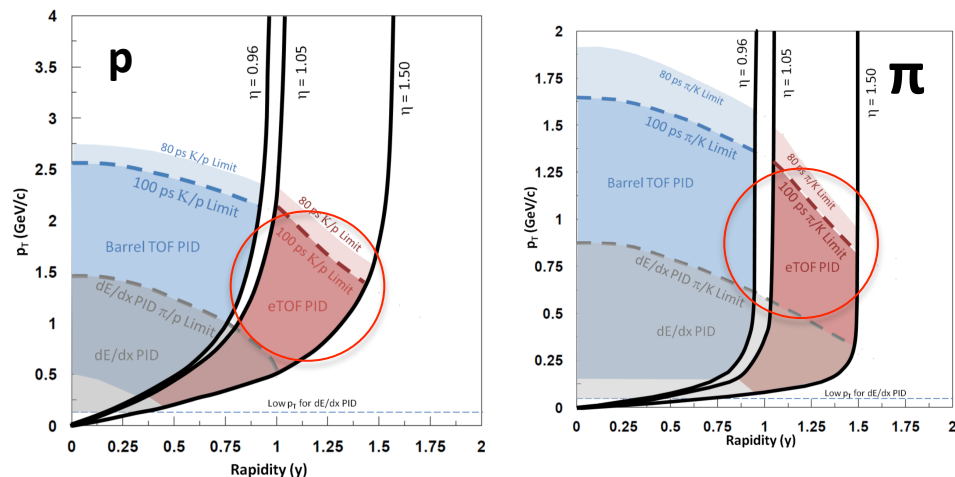


- 36 modules in 3 layers, Matched to 12 TPC sectors
- Long-strip MRPC readout
- Multiple hit probability $< 7.4\%$

End Cap Time-Of-Flight

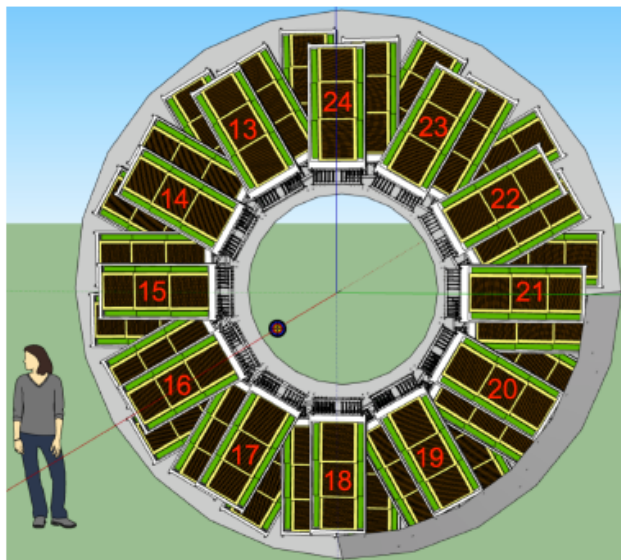


- STAR and CBM-TOF group plans to install TOF in one side of STAR; part of FAIR Phase-0
- Provide TOF PID in $1.1 < \eta < 1.6$
- Operation experience for CBM effort



Significant extension of PID beyond $y = 1$

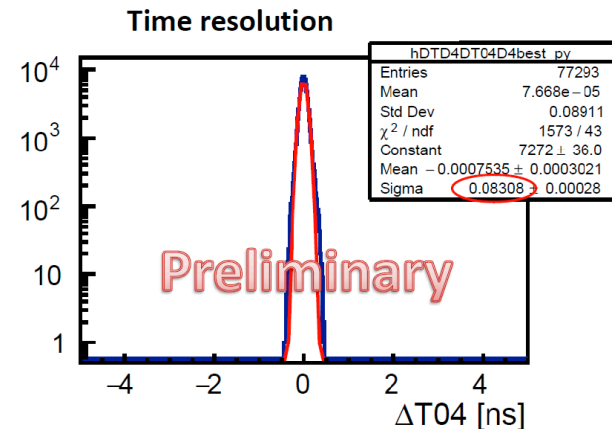
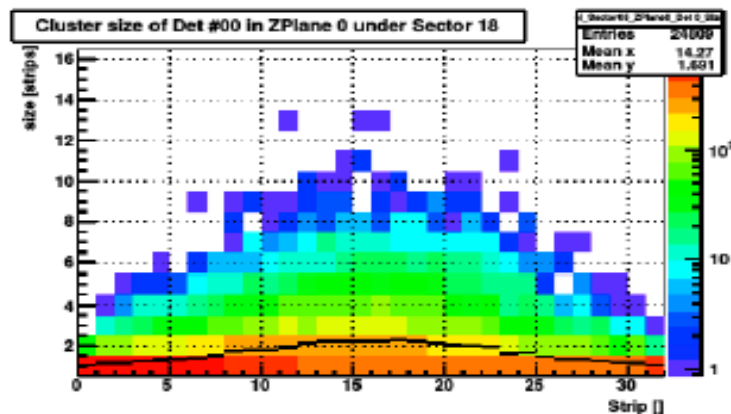
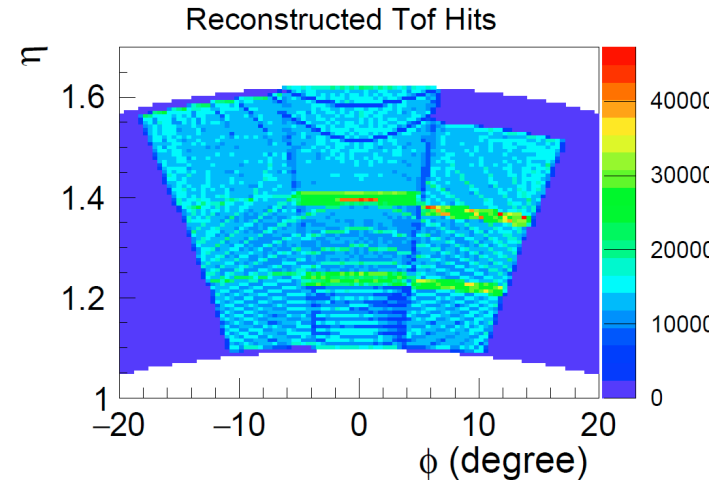
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Endcap TOF Status

- One sector with 3 modules was installed for Run 18
 - Integrated with STAR DAQ
 - Routinely read out in physics runs
 - Counter resolution of ~ 60 ps obtained
- Production of modules ongoing
- Complete installation in November 2018



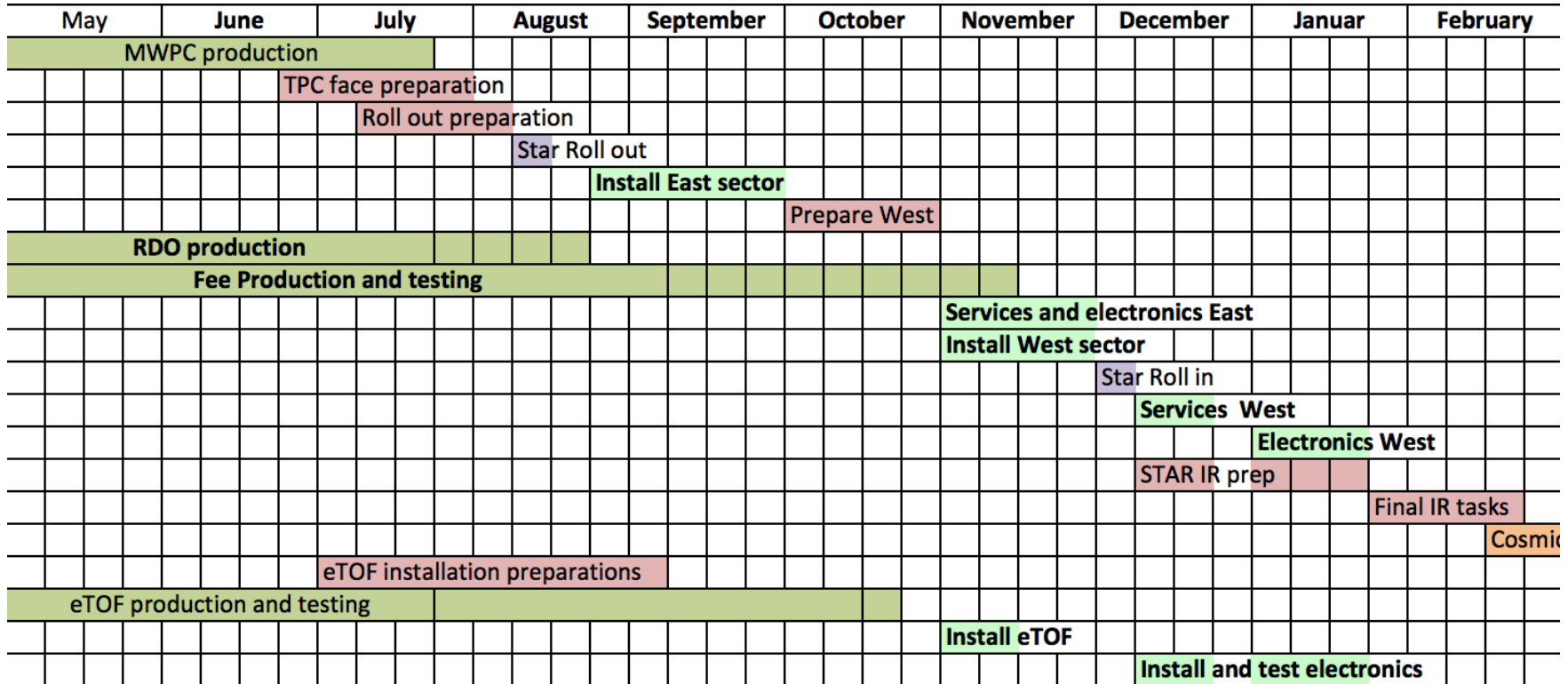


Installation Planning

- iTPC activities
 - Need to remove RDO water manifolds from all sectors; FEEs can stay on outer sectors
 - Remove all electronic from inner sectors
 - Install 11 sectors East and 12 West, respectively
 - Installation platform has to be moved from east to west
 - Install water manifolds, FEE's, RDO cabling
 - Check all connections, leakage, HV..
- This in addition to eTOF installation and all other shutdown activities, roll out/in, partial roll in/out
- STAR Technical Support Group, iTPC project have worked out detailed resource loaded shut down schedule including C-AD contributions



Key Installation Periods



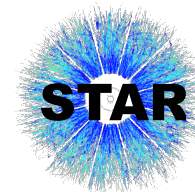
- STAR can be ready by end February for beam in the tight technically driven schedule

iTPC Risk assessment



- In 2016 the 3 highest risk identified for the iTPC project was
 - Wire mounting /construction of MWPC planes overall low to medium (technical, schedule)
 - Sector Insertion ,(technical) overall Medium
 - Electronics (Schedule risk) overall Medium
- Through the extensive prototyping of sectors at SDU, installation of one sector for Run 18 using installation tooling and operating with close to production ready electronics these risk have been greatly reduced

Summary



- Production of inner sectors will complete in August and will be of good quality
- iTPC Electronics in production mode
- The one sector installed and its associated electronics was fully integrated into STAR DAQ, and requirements are met
- Installation Schedule between Run 18 and Run 19 is tight. It has been carefully planned with STSG and C-AD
- iTPC and eTOF will be ready by February 2019



BACKUP



U.S. DEPARTMENT OF
ENERGY

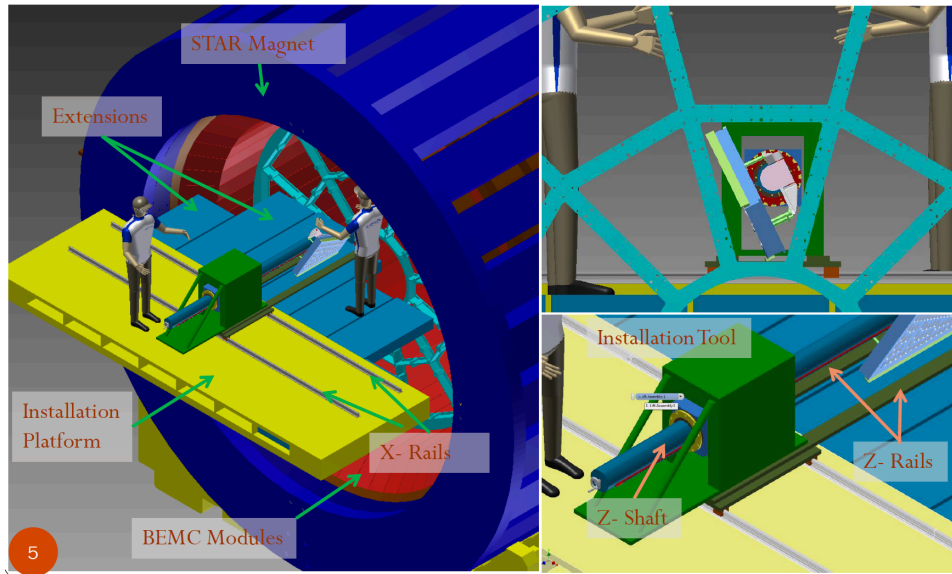
Office of
Science





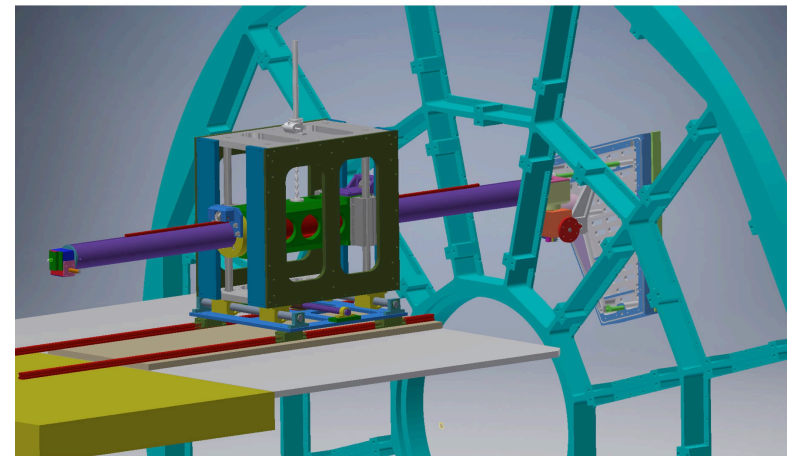
Insertion Tooling

Cartesian Installation Tool Design



Insertion tooling needed for installation and for replacement of two outer bad sectors

Designed by Rahul Sharma, Ralph Brown and much input from LBNL, CERN





Towards KPP for electronics

- 1) UPP: Compatible with the DAQ-1000 Achieved
5% deadtime at 1 kHz -- Met (we have 5%)
20% deadtime at 2 kHz -- Met (we have 20% at
2.15 kHz for ZrZr-200)
- 2) UPP: Operational electronics fraction
<3% dead channels -- Met (we have 1.1 %)
- 3) KPP: Electronics noise
<2 ADC channels -- Met (we have ~1 ADC)
- 4) KPP: electronics gain uniformity
<10% uniformity -- Met (we have <2.5%)



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- 1) 80 of required 120 MRPC counters have been produced in China.
 - 2) 36 (of 36) completed 3-counter modules will arrive at BNL by November 1 for November installation.
 - 3) electronics are completed or in production except for the GBTx board which is under test.
 - 4) The support infrastructure being provided by BNL will be complete and installed by November 1.
 - 5) The readout electronics will be installed and tested in December and January before cosmic ray testing in February.