


p pbar M^2 splitting in 19 GeV 2019 data

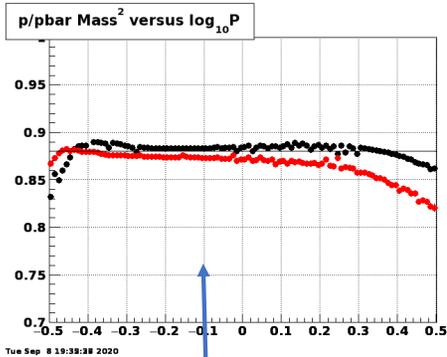
Yuri Fisyak

TPC alignment procedure:

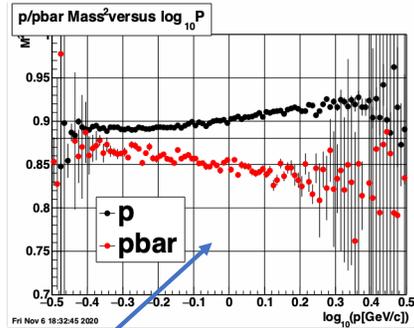
1. Adjust sector time offsets using prompt hits.
2. Using cosmic align inner sector with respect to outer ones.
 - It is assumed that all dynamical distortions (Space Charge, Grid Leak,...) are negligible.
 - Hits from reconstructed tracks are refitted in inner and outer sectors separately as track segments, and
 - Alignment parameters fit provides the best match of these track segments at plane $Y = 123$ cm in TPC sector coordinate system.
 - The conversion has considered as achieved when alignment parameters are stable within ~ 100 μm and ~ 0.1 mrad.
3. Attempt to do sector alignment with respect to each other based of cosmics also made. But the results of this alignment is unstable.
4. To do sector alignment I reconstruct primary vertices with KFParticle using low luminosity data for all tracks (\mathbf{V}), only tracks from West half of TPC (\mathbf{V}_W), and only tracks from East half of TPC (\mathbf{V}_E).
 - The difference between \mathbf{V}_W and \mathbf{V}_E allows us to measure overall trigger time offset.
 - DCA ($d\mathbf{X}$, $d\mathbf{Y}$, $d\mathbf{Z}$) distribution of tracks with respect to \mathbf{V} in local sector coordinate system allows to measure sector alignment parameters.
 - In Run XIV and Run XVI the sector alignment has been verified with HFT and some extra corrections has been applied (Mustafa Mustafa).
5. The next step is to calibrate dynamical distortions for all available data (Space Charge Distortion calibration).
6. In Run XIX alignment using cosmic and the first part of 19 GeV data (including dE/dx) has been completed on April 16, 2019.
7. This calibration and alignment has been used for the express production (TFG19e) on HLT and the results of the production were used for iTPC review in September 2019.
8. The first (nonzero) Space Charge Calibration has been added 2019-04-15 for 14p5GeV sample and other multiple changes were done during period since October 2, 2019 till August 5, 2020. I have a few questions to these corrections. I would expect that we have almost the same (close to zero) correction for all BES 2 collider runs, significant and non symmetric corrections for fixed target runs, and significant correction for AuAu200. In Data Base I see kind of messy corrections in sense of trigger (see backup slides) which are not matched with my expectation.
9. Fall of 2019 Irakli has started with revisiting 2019 TPC alignment:
 - He started with fixed target where has been observed extra offset between trigger and TPC start time. He has introduced new correction from EPD timing measurement.
 - He has changed the calibration cosmic sample by removing runs with problematic Gating Grid. With this sample he has redone inner to outer sector alignment.
 - Using 19 GeV sample he has redone sector alignment. The alignment parameter was put in DB on April 27, 2020.
10. The calibration production for 19GeV sample with these parameters has demonstrated rather big difference between BToF M^2 measurement for proton and antiprotons.
11. The last four month we have tried to understand the reason for the problem.

Problem: ToF M^2 measurement with 19 GeV sample for different reconstructions/calibrations.

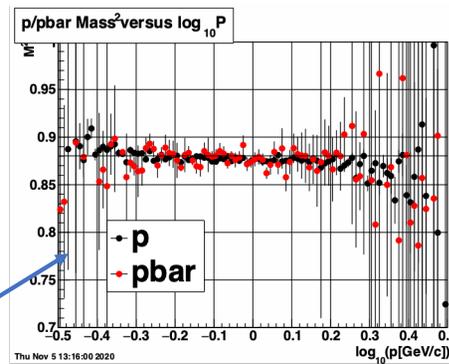
TFG19e,
xproduction



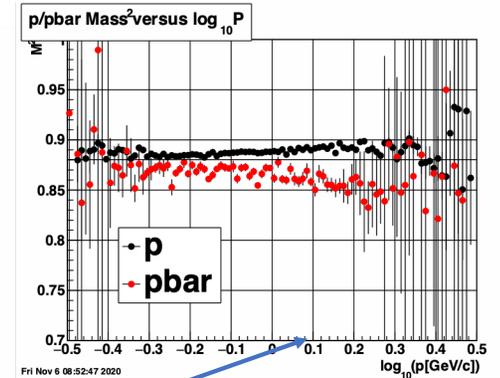
TFG20g, default



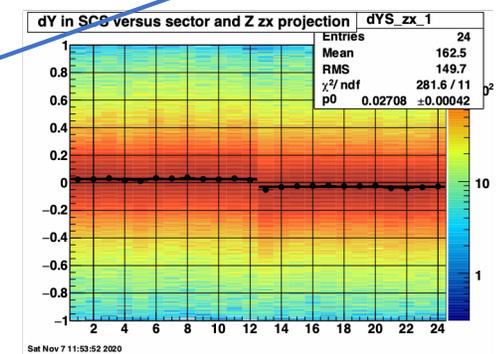
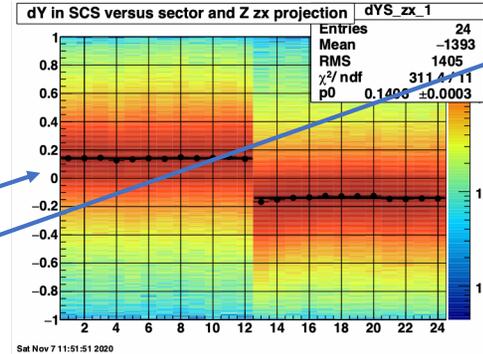
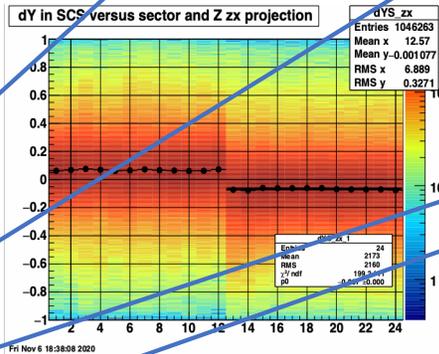
TFG20j, removed Irakli's
alignment



Removed Space Charge correction after
10/01/2019, Dbv20191001

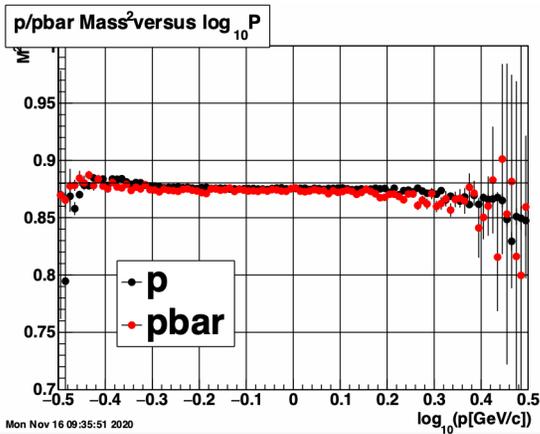


1. Express production with alignment from 04/16/2019 using Cosmic data, no Space Charge Correction (SCC), shows some difference in M^2 versus momentum between p and pbar in BToF.
2. TFG20g, default with the latest (Irakli) alignment and SSC shows significant difference.
3. The difference in M^2 is done with old alignment but there is significant difference in dY (~ 0.2 cm, local radial sector shift).
4. Removing the latest SC and Irakli's alignment reproduces xProduction.

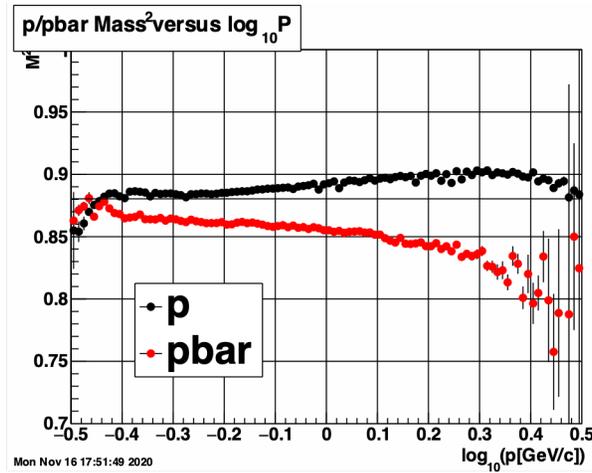


Run XIX 14p5GeV and 19 GeV samples with SCC and redone TPC alignment.

- 19GeV



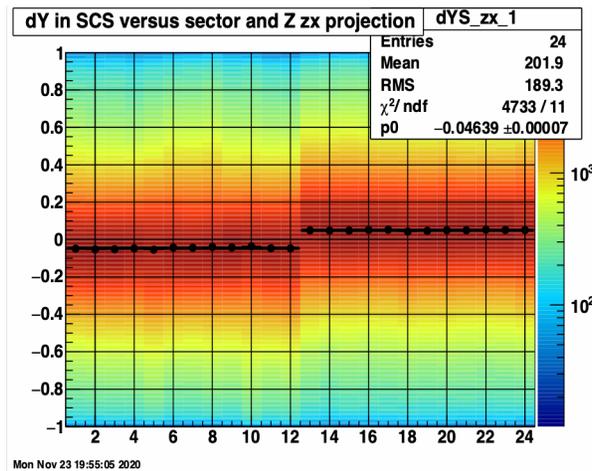
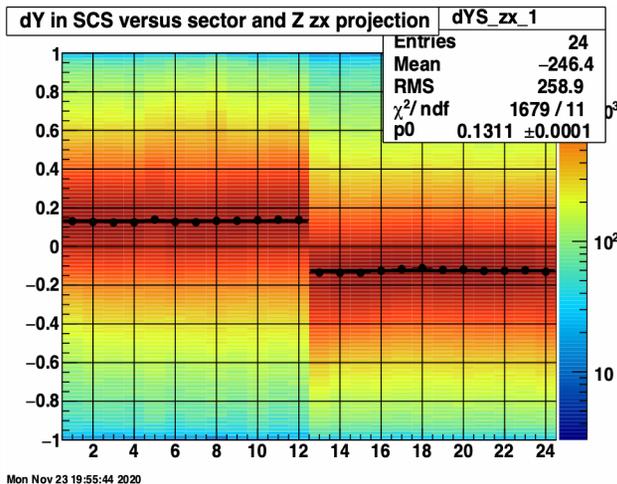
- 14p5 GeV



Two sample with the same alignment but different Space Charge correction give different results.

I believe that this observation has pointed to problem with Space Charge Correction (not only with dynamical ones).

I have asked Irakli to check this observation with the standard STAR release.

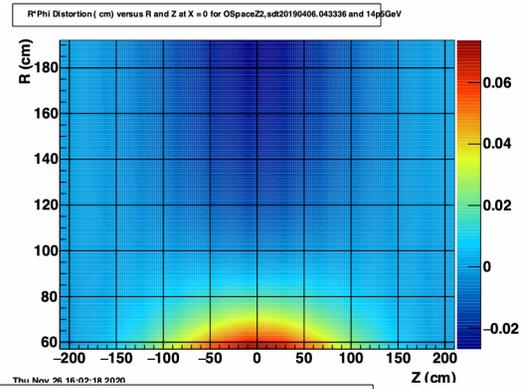
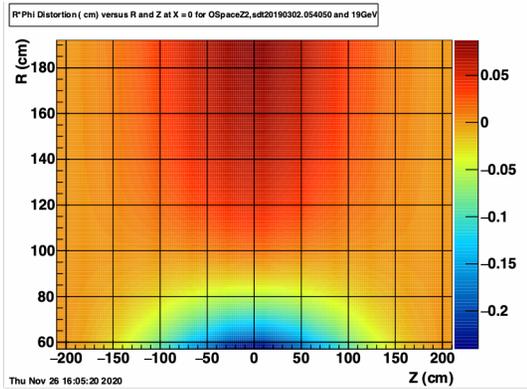


Questions to OSpaceZ2 (<https://www.star.bnl.gov/~fisyak/star/Tpc/Distortions/>)

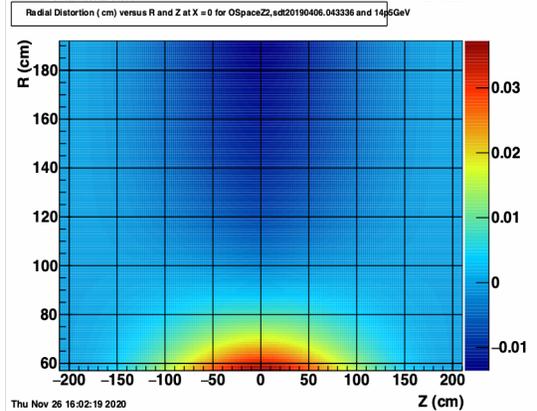
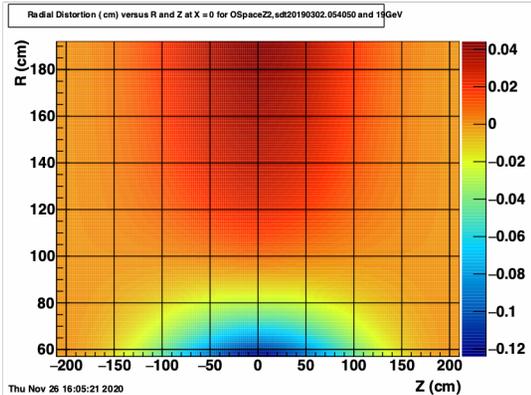
19 GeV

14p5GeV

dX



dY



Space Charge Distortions versus Z and R at X = 0 for 2019 AuAu19GeV and 2019 AuAu14p5GeV.

Two questions:

1. Why the distortions flip sign for 19GeV => 14p5GeV ?
2. Why the distortions have the same sign for West and East halves of TPC ?

To do list

1. Reset dynamical Space Charge corrections for Run XIX and XX.
2. Check static Space Charge corrections.
3. Check/Redo TPC alignment with cosmic data.
4. Redo dynamic Space Charge corrections for low energy collider data, fixed target data and AuAu200 data.
5. Recover GMT and test TPC sector alignment with GMT.
6. Check results: p/pbar Mass splitting, momentum reconstruction, ...

Backups

MySQL [Calibrations_tpc]> select entryTime,beginTime,elementID,fullFieldB,detector,offset from Calibrations_rich.spaceChargeCorR2 where beginTime > "2019" and beginTime < "2019-11-10" and entryTime > "2019" and elementID=1 order by beginTime;

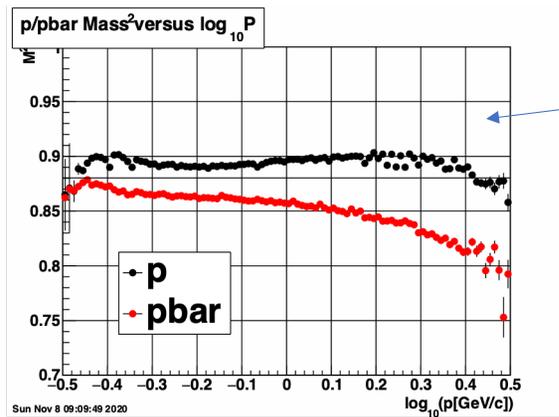
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2019-10-03 19:16:21	2019-02-21 00:00:01	1	-0.00000000114	8.00000000	-1124000.00000000
...					
2020-08-05 17:18:09	2019-02-21 00:00:05	1	-0.0000000008131	8.00000000	1173000.00000000
20190225.202320	20190404.094405	19GeV begin time of run : end time of run trigger			
2019-04-15 20:54:43	2019-04-04 00:00:00	1	0.00000001229	4.00000000	209200.00000000
2019-10-31 19:21:40	2019-04-04 00:00:01	1	-0.00000001552	10.00000000	-12510.00000000
20190404.094405	20190417.133401	14p5GeV			
20190417.133401	20190417.141246	7.3GeV_fixedTarget			
20190417.141246	20190423.155418	14p5GeV			
20190423.155418	20190423.181158	7.3GeV_fixedTarget			
20190423.181158	20190519.160048	14p5GeV			
20190519.172346	20190603.223655	14p5GeV till 2019-06-03 20:00:00			
2019-10-02 20:41:27	2019-06-03 20:00:00	1	-0.00000001402	1.00000000	-15690.00000000
20190519.172346	20190603.223655	14p5GeV after 2019-06-03 20:00:00			
20190603.223655	20190607.174702	7p7GeV			
2019-07-12 20:03:56	2019-06-07 17:41:00	1	0	-1.00000000	0.00000000
20190607.174702	20190607.202244	3p85GeV_fixedTarget till 2019-06-07 17:56:30			
2019-07-12 18:23:01	2019-06-07 17:56:30	1	0.00000001229	4.00000000	209200.00000000
2019-10-03 00:41:27	2019-06-07 17:56:31	1	-0.00000001402	1.00000000	-15690.00000000
20190607.174702	20190607.202244	3p85GeV_fixedTarget after 2019-06-07 17:56:31			
20190607.202244	20190609.124528	7p7GeV till 2019-06-09 12:45:00			
2019-07-12 20:03:56	2019-06-09 12:45:00	1	0	-1.00000000	0.00000000
20190609.124528	20190610.024109	3p85GeV_fixedTarget till 2019-06-09 14:00:00			
2019-07-12 18:25:07	2019-06-09 14:00:00	1	0.00000001229	4.00000000	209200.00000000
2019-10-03 00:41:27	2019-06-09 14:00:01	1	-0.00000001402	1.00000000	-15690.00000000
20190609.124528	20190610.024109	3p85GeV_fixedTarget after 2019-06-09 14:00:01			
20190610.024109	20190618.143658	7p7GeV till 2019-06-18 09:16:33			
2019-07-12 20:03:56	2019-06-18 09:16:33	1	0	-1.00000000	0.00000000
20190610.024109	20190618.143658	7p7GeV after 2019-06-18 09:16:33			
20190618.143658	20190619.025126	7.3GeV_fixedTarget till 2019-06-19 02:10:00			
2019-07-12 18:26:29	2019-06-19 02:10:00	1	0.00000001229	4.00000000	209200.00000000
20190618.143658	20190619.025126	7.3GeV_fixedTarget after 2019-06-19 02:10:00			
2019-10-03 00:41:27	2019-06-19 02:10:01	1	-0.00000001402	1.00000000	-15690.00000000
20190619.025126	20190628.081931	7p7GeV			
20190628.081931	20190629.032834	9p2GeV			
2019-07-12 18:29:51	2019-06-28 23:22:02	1	0	-1.00000000	0.00000000
20190629.032834	20190702.144151	4p59GeV_fixedTarget till 2019-06-29 15:40:00			
2019-07-12 20:03:56	2019-06-29 15:40:00	1	0.00000001229	4.00000000	209200.00000000
20190629.032834	20190702.144151	4p59GeV_fixedTarget after 2019-06-29 15:40:00			
2019-07-12 18:22:15	2019-06-30 02:00:00	1	0	-1.00000000	0.00000000
2019-07-05 18:31:07	2019-07-02 14:30:00	1	0.00000001229	4.00000000	209200.00000000
20190702.144151	20190709.032312	9p2GeV till 2019-07-08 21:29:01			
2019-07-12 20:03:56	2019-07-08 21:29:01	1	0	-1.00000000	0.00000000
20190709.032312	20190710.110157	31GeV_fixedTarget till 2019-07-09 16:00:00			
2019-07-12 20:03:56	2019-07-09 16:00:00	1	0.00000001229	4.00000000	209200.00000000
20190709.032312	20190710.110157	31GeV_fixedTarget after 2019-07-09 16:00:00			
2020-02-07 22:54:38	2019-07-10 00:00:00	1	-0.000004586	1.00000000	-322.20001221
20190710.110157	20190715.085141	AuAu200			
20190715.085141	20190715.103049	9p2GeV			

12/2/20

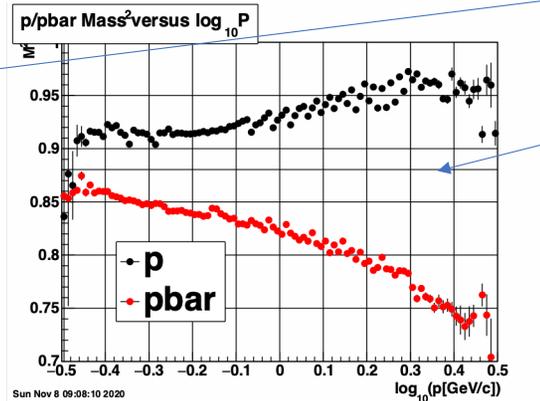
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ToF M^2 200 GeV 2019

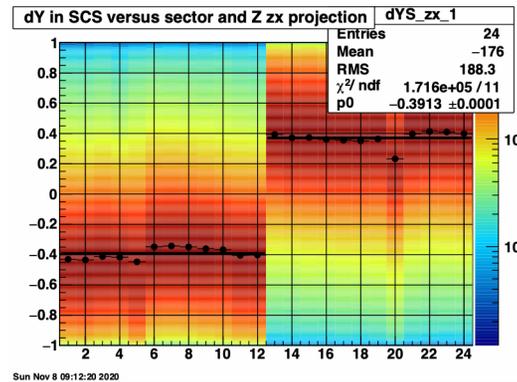
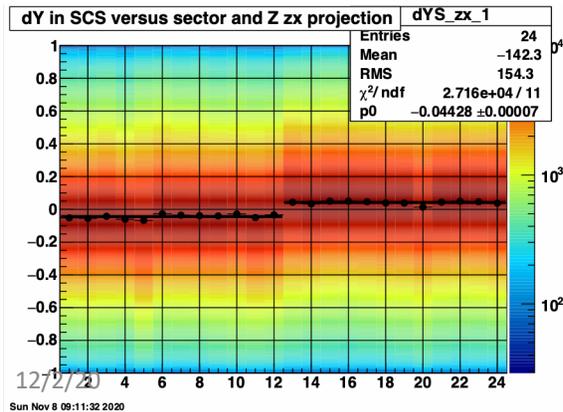
TFG20jb



TFG20j, DbV20190715

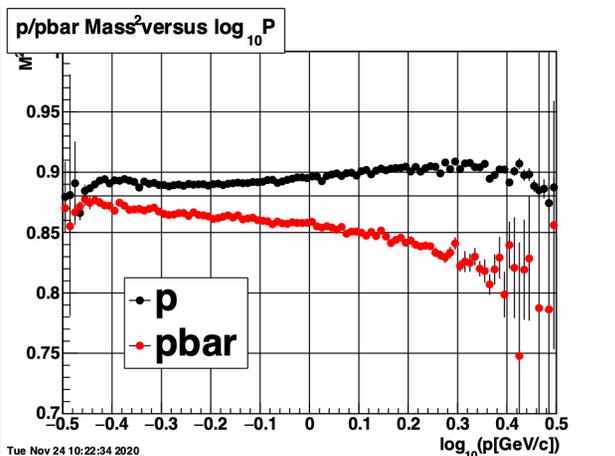


200 GeV AuAu 2019 sample shows the same difference which has increased without the latest SC corrections.

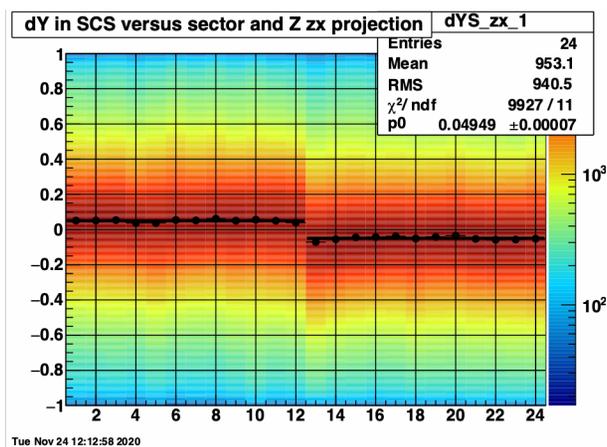
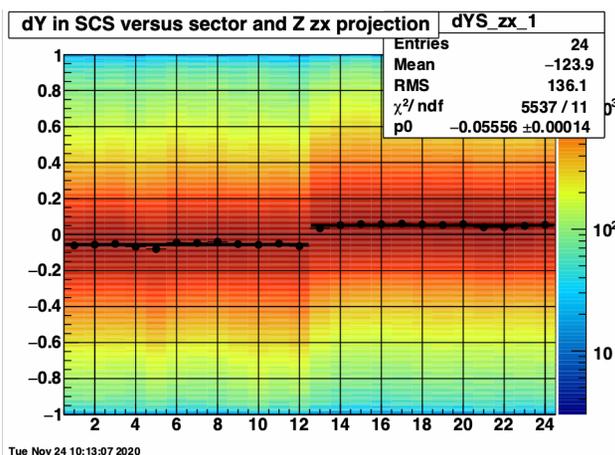
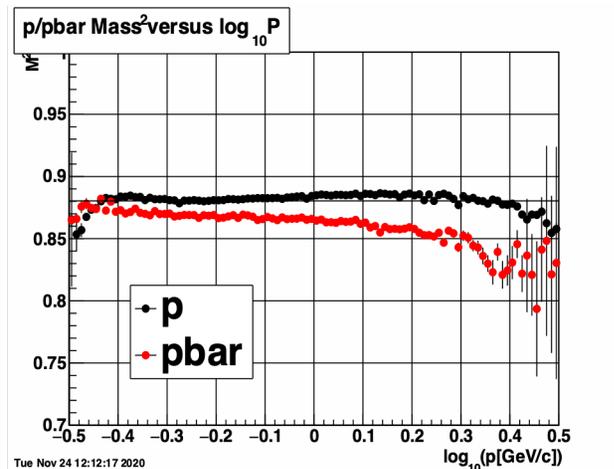


Run XIX 14p5GeV and 19 GeV samples with redone TPC alignment and after that switched off OSpaceZ2

• 19GeV



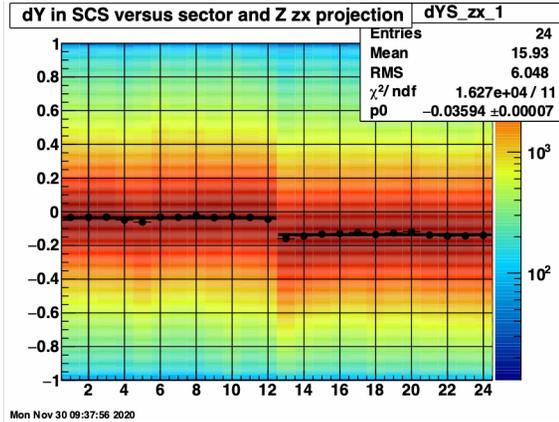
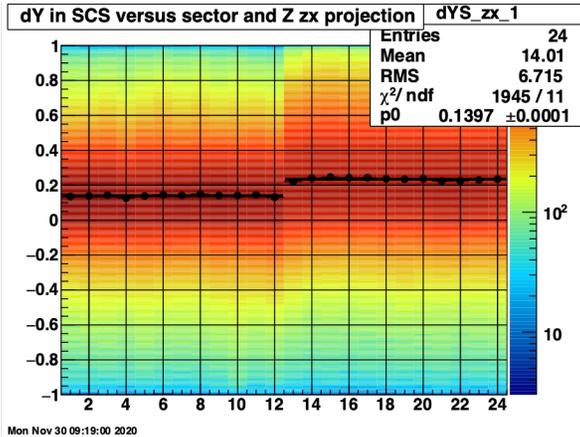
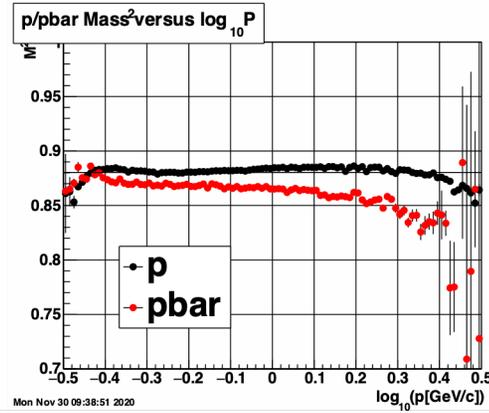
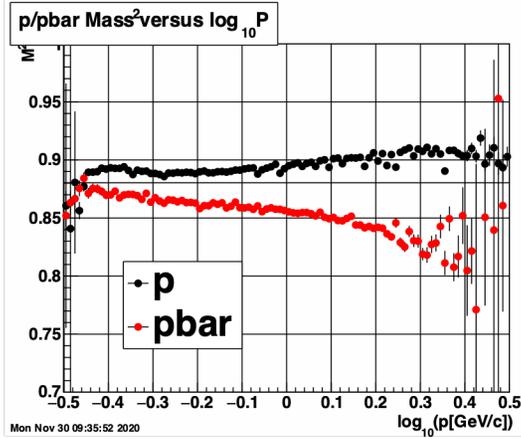
• 14p5 GeV



Run XIX 14p5GeV and 19 GeV samples with redone TPC alignment and after that change sign of OSpaceZ2 for east TPC

• 19GeV

• 14p5 GeV



12/2/20