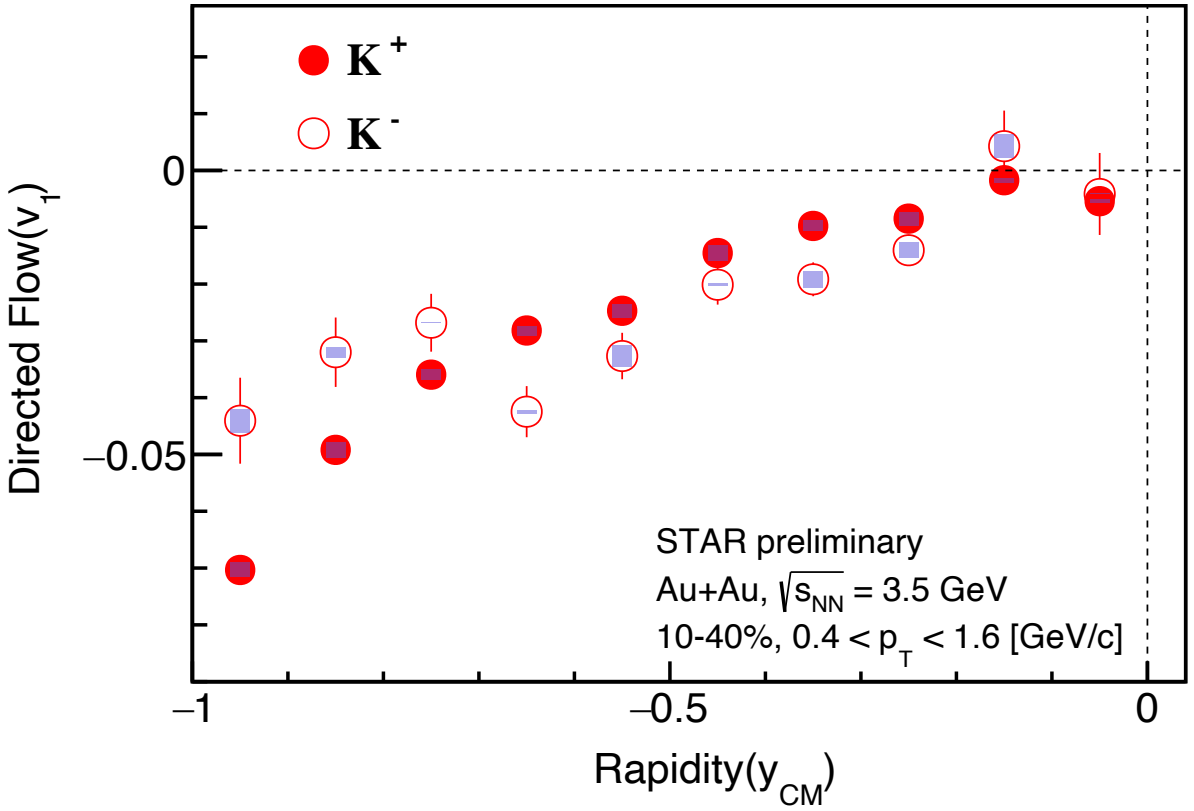
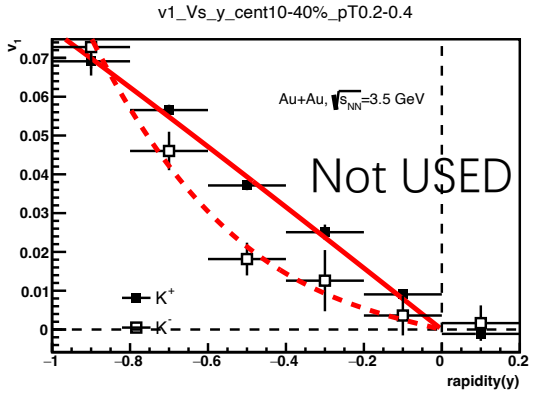
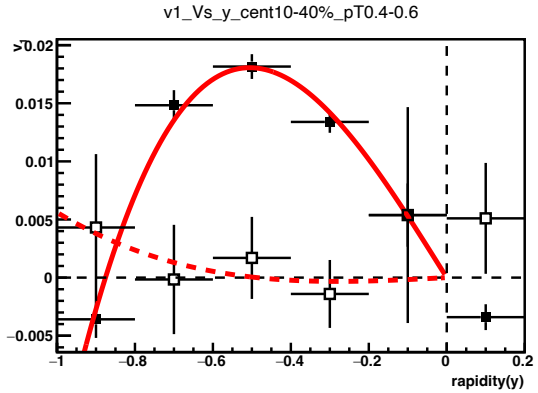
PWG review:
Measurements of Kaon Anti-flow in the High Baryon Density Region from Au + Au Collisions at √sNN = 3 - 3.9 GeV

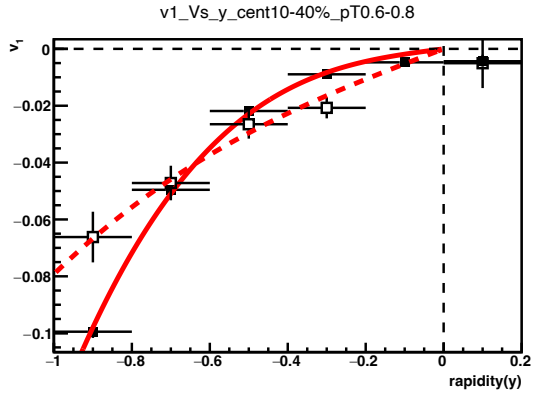
Zuowen Liu

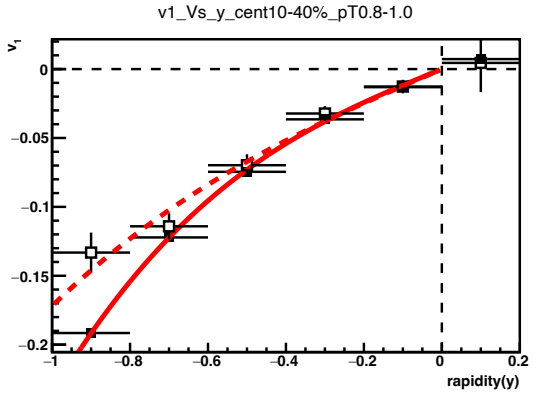
2024/4/18

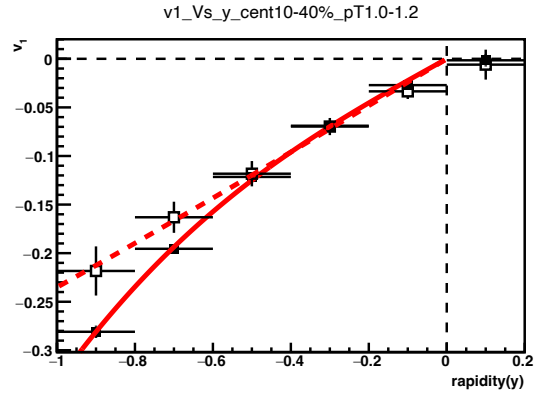

K+
K-
0
−0.05
−1
−0.5
0
Directed Flow(v1)
Rapidity(yCM)
STAR preliminary
Au+Au, √sNN = 3.5 GeV
10-40%, 0.4 < pT < 1.6 [GeV/c]

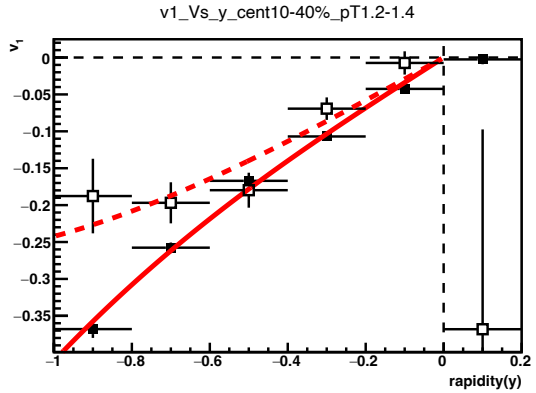

v1_Vs_y_cent10-40%_pT0.2-0.4
Au+Au, √sNN=3.5 GeV
Not USED
K+
K-
v1
rapidity(y)

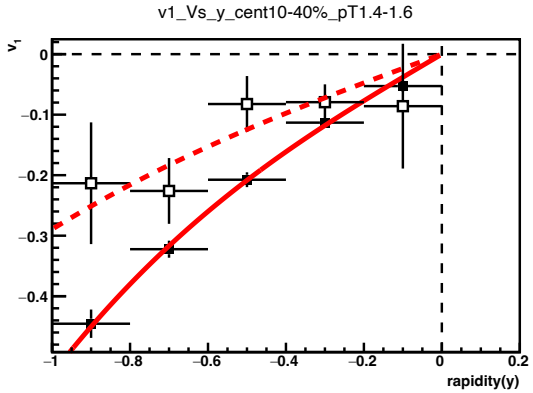

v1_Vs_y_cent10-40%_pT0.4-0.6
v1
rapidity(y)

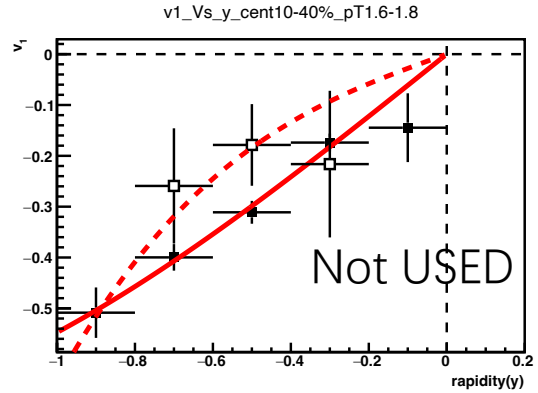

v1_Vs_y_cent10-40%_pT0.6-0.8
v1
rapidity(y)

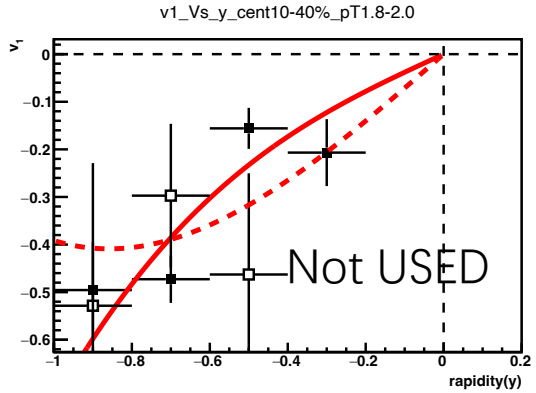

v1_Vs_y_cent10-40%_pT0.8-1.0
v1
rapidity(y)


v1_Vs_y_cent10-40%_pT1.0-1.2
v1
rapidity(y)


v1_Vs_y_cent10-40%_pT1.2-1.4
v1
rapidity(y)


v1_Vs_y_cent10-40%_pT1.4-1.6
v1
rapidity(y)


v1_Vs_y_cent10-40%_pT1.6-1.8
Not USED
v1
rapidity(y)

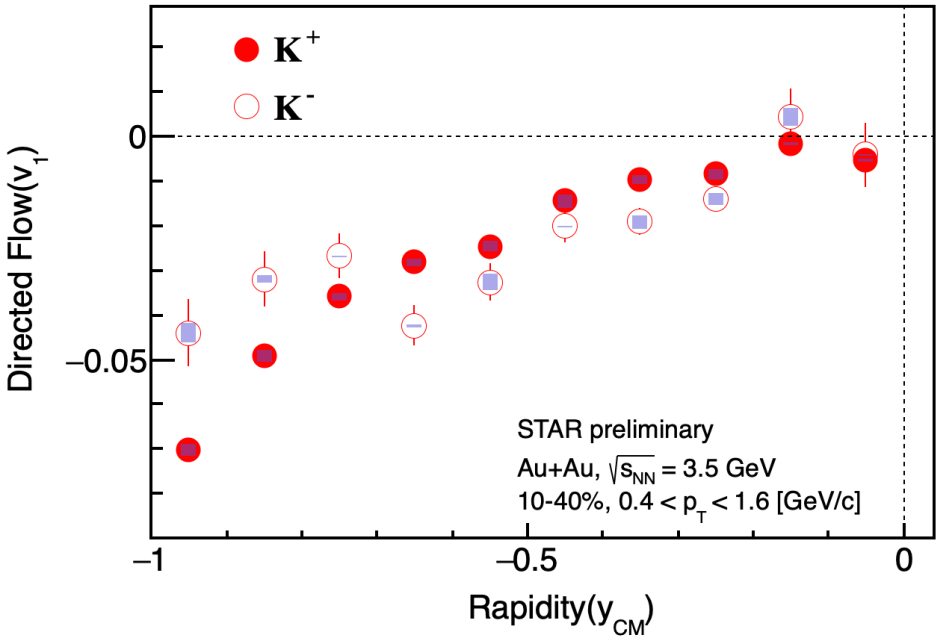

v1_Vs_y_cent10-40%_pT1.8-2.0
Not USED
v1
rapidity(y)

Suggestions

1) Kaon v1: your negative kaon points especially at 3.5 GeV are kind of fluctuating bin by bin, they look a lot smoother in 3 GeV data. The systematic is also changing bin-by-bin. Since this paper is focussed on kaons, I wanted to understand more on this behavior of K+ and K-. How do you understand the current behavior.
2) Proton v1: I am fine with it, please update all the latest version of figures.
3) v1 versus invariant mass for kshort: I would suggest to check the variation with background shape eg first/second order polynomial.
4) incompressibility: do you use K=210 (soft EOS) for all the energies? If I remember in our prior 3 GeV paper, we used K=380 (I believe hard EOS).
I would suggest to mention K values used in JAM in the main manuscript.
5) Since you are aiming for a letter, you don't have space. So I suggested to include event plane resolution and v1 versus pt figures as a supplemental materials to PRL.
6) around 196-197 of the draft, you should clarify that W/O spectator is the case where spectator interactions are turned off in JAM.

1) Kaon v1: your negative kaon points especially at 3.5 GeV are kind of fluctuating bin by bin, they look a lot smoother in 3 GeV data. The systematic is also changing bin-by-bin. Since this paper is focussed on kaons, I wanted to understand more on this behavior of K+ and K-. How do you understand the current behavior.

The K- v1 goes up in the for-rapidity, which is different with K+ and K0.
It might be related with EM field, but the K0 is not in the middle…
The following study focus on dv1/dy in the mid-rapidity, the K- behavior in the for-rapidity may not impact on the v1 slope extraction.
Anyway, it's a interesting behavior, we will follow it.



For the discontinuous you mentioned, I have re-calculated v1 and its sys. error with the most new dataset(P23ie), StRefMultCorr etc. The discontinuous still exists. I checked two possible reasons.

1) Purity. We got K- purity which is separate from K+, the nSigma shift I applied is unique for K-. The purity might be OK…
2) Efficiency correction. There is discontinuous the efficiency correction is not applied though. Note: the embedding data is from 3.2 GeV, I am not sure if we use the specific embedding data for 3.5 GeV, the discontinuous would gone or not.

The v1 statistic error is large at pT > 0.7 GeV. the discontinuous might be explained by the statistic fluctuation. Sorry, I can't this questions for now.

2) Proton v1: I am fine with it, please update all the latest version of figures.

Sure, thank you.

3) v1 versus invariant mass for kshort: I would suggest to check the variation with background shape eg first/second order polynomial.

Poly2nd					Poly2nd		
y	K0s v1	v1 err			y	lam v1	v1 err
-0.9	-0.0660992	0.00587223			-0.9	-0.245313	0.00207474
-0.7	-0.0430644	0.00366149			-0.7	-0.160383	0.00150039
-0.5	-0.0251633	0.00298053			-0.5	-0.0979796	0.00126827
-0.3	-0.0102379	0.00297726			-0.3	-0.0568806	0.00135654
-0.1	-0.00605152	0.00332894			-0.1	-0.0253145	0.0017294
Poly3rd					Poly3rd		
y	K0s v1	v1 err			y	lam v1	v1 err
-0.9	-0.066087	0.00587677			-0.9	-0.245251	0.00207484
-0.7	-0.0430798	0.00366529			-0.7	-0.160359	0.00150049
-0.5	-0.0251502	0.00298332			-0.5	-0.0979525	0.00126834
-0.3	-0.0102496	0.00297976			-0.3	-0.0568453	0.00135663
-0.1	-0.00602678	0.00333784			-0.1	-0.0241242	0.00172953

I tested the different v1^BG function, as you can see in the table. The v1 difference is about 0.0001. It would be covered by other sys. sources.

4) incompressibility: do you use K=210 (soft EOS) for all the energies?
If I remember in our prior 3 GeV paper, we used K=380 (I believe hard EOS).
I would suggest to mention K values used in JAM in the main manuscript.

Yes, for all energies.
You are right, K=380 in 3 GeV paper, and the JAM mode is named as RQMD/RMF.
In this work, the momentum dependence potential is taken into account, the JAM mode is RQMDv/MS2.
which can describe v1 better than the one used in 3 GeV paper.

Modified the draft as:
For protons, cascade mode (blue dash line) underestimates v_1 of protons, and mean-field mode (blue solid line) involved repulsive baryon interactions where the nucleon incompressibility κ is 210 MeV,
have a good agreement with the experimental data.

5) Since you are aiming for a letter, you don't have space. So I suggested to include event plane resolution and v1 versus pt figures as a supplemental materials to PRL.

Will do that, thank you.

6) around 196-197 of the draft, you should clarify that W/O spectator is the case where spectator interactions are turned off in JAM.

Updated it as follows:
Additionally, the JAM cascade without spectator (red dash band) where the spectator interactions are turned off, exhibits a larger v1 slope compared to the one with spectators.

Backup