Flow and non-flow in jet correlation

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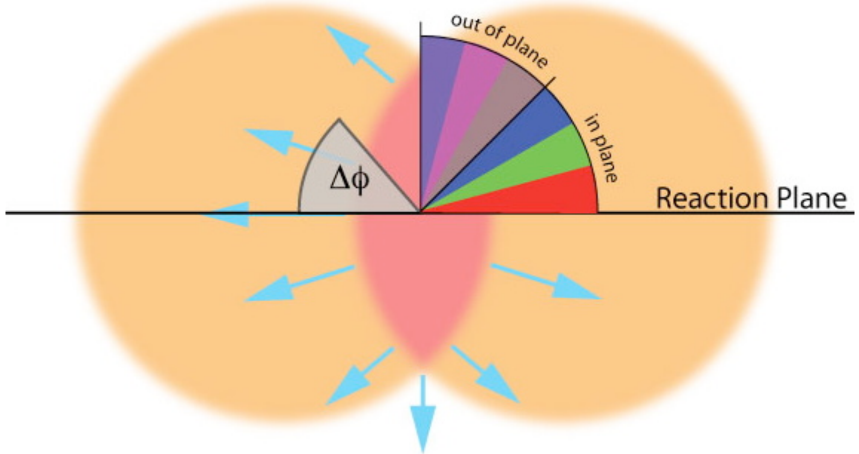
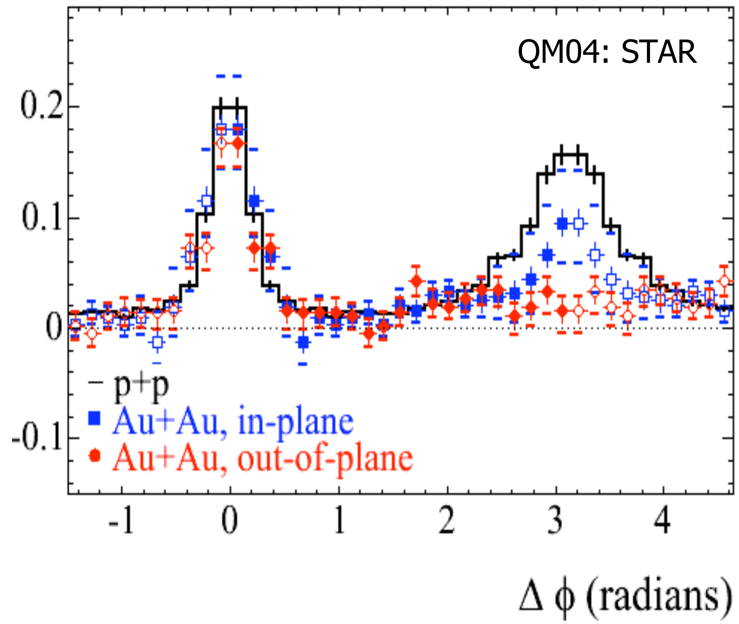
flow : any-correlation with R.P.
non-flow : random w.r.t. R.P.

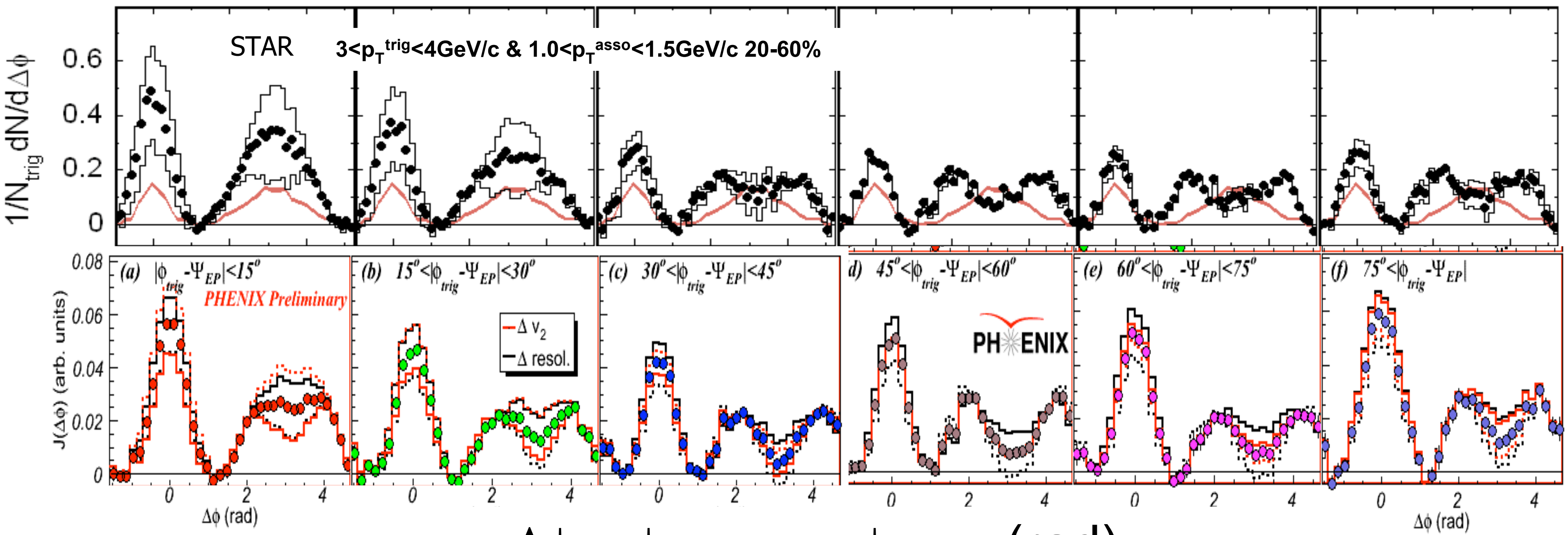
Jet : If it's correlated with R.P. ---> flow (high p_T v_2 > 0) and non-flow
If it's not correlated with R.P. ---> pure non-flow (B.G. for true v_2)

(1) "non-flow" effect modifies the measured v_2, when they give any correlations between R.P. detector and v_2 detector.
(2) If medium responses (mach-cone, ridge) are related with jet, they will also be a part of "flow" or "non-flow" according to jet.
(3) Inclusive v_2 should contain all of them (jet, mach-cone, ridge), "non-flow" should always reduce the inclusive (true) v_2, while "flow" of (jet, mach-cone, ridge) can enhance the (true) v_2.
(4) Recent results tell "medium responses" do change its shape and yield as a function of relative angle w.r.t. R.P.



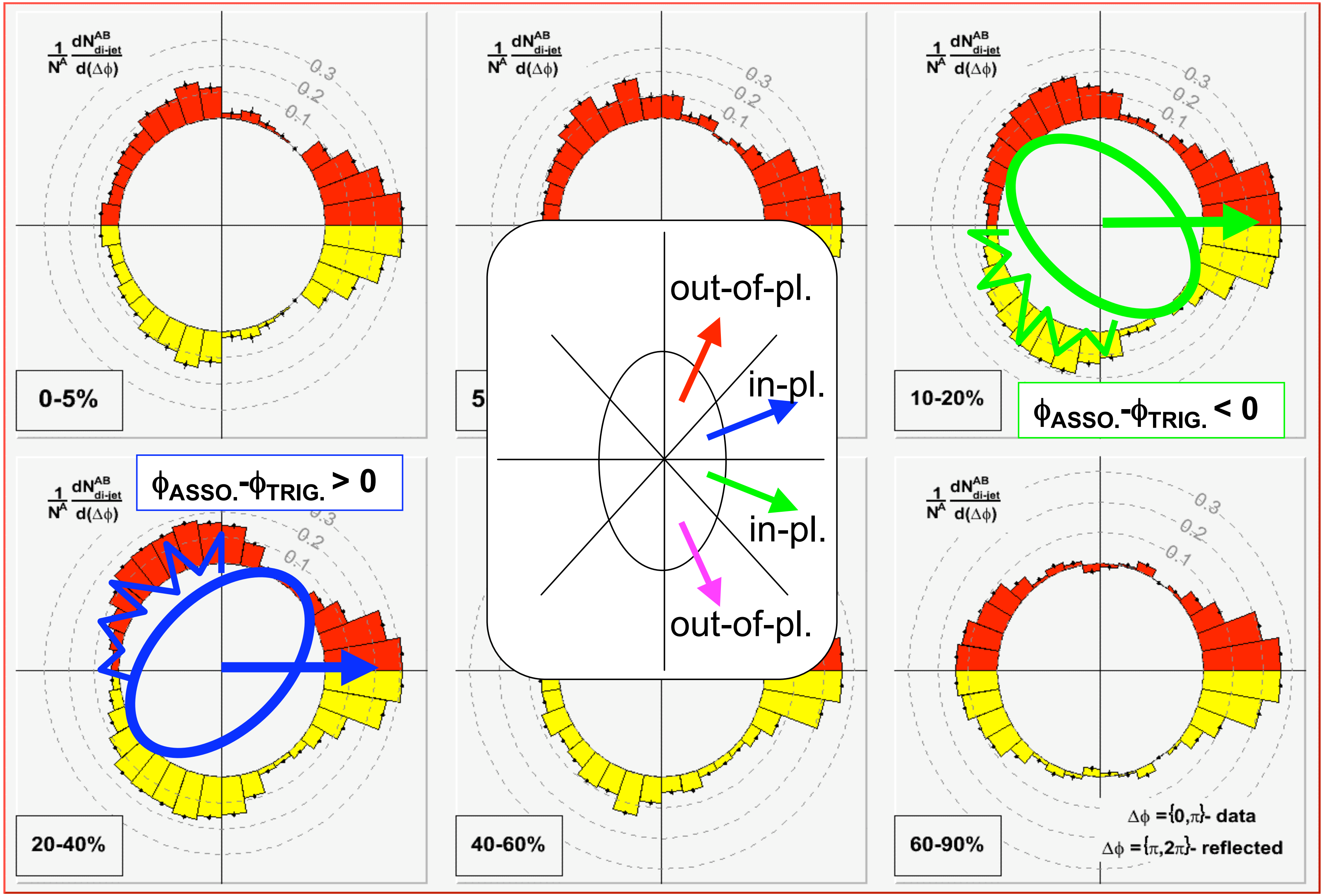


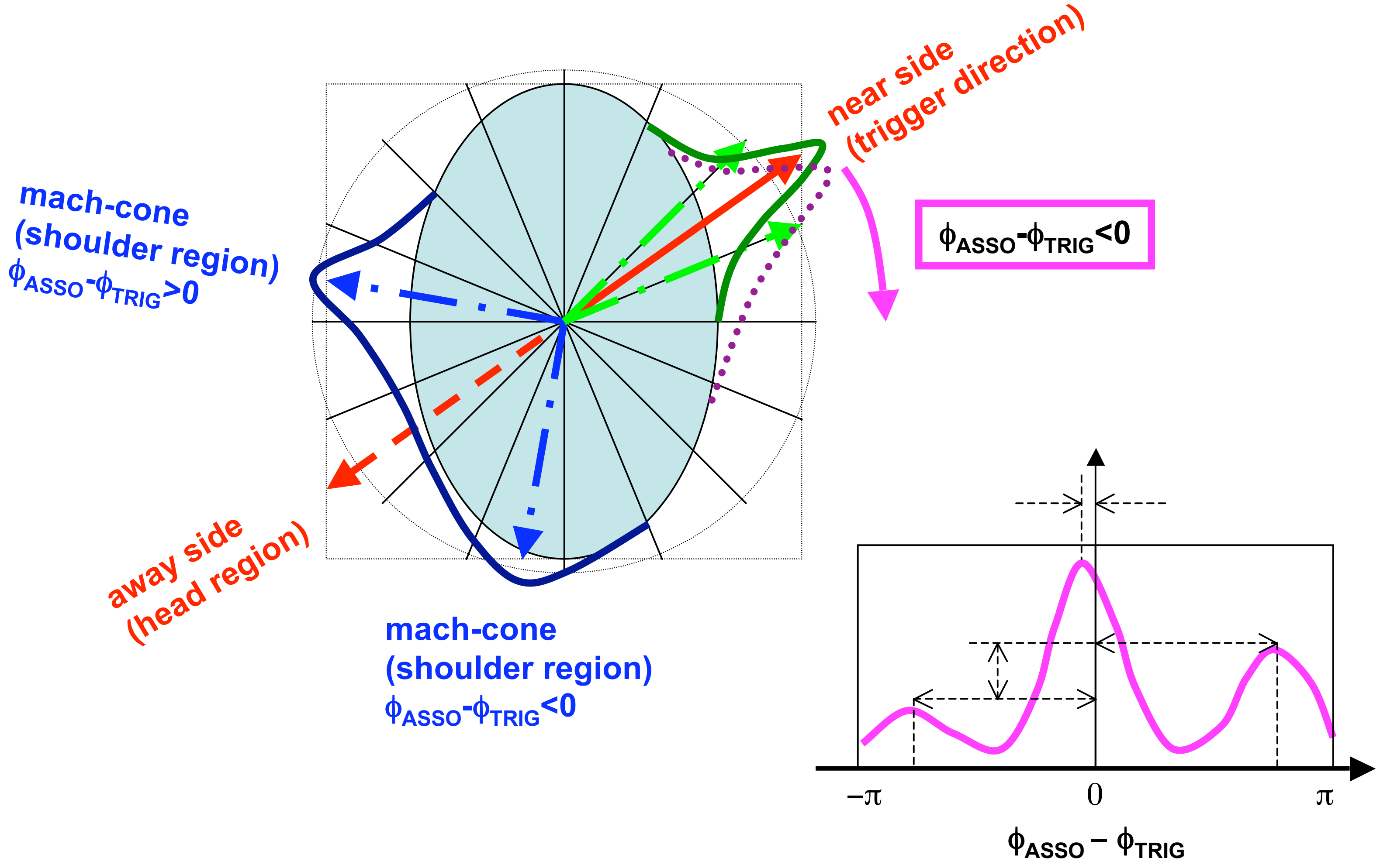
QM08: STAR, PHENIX



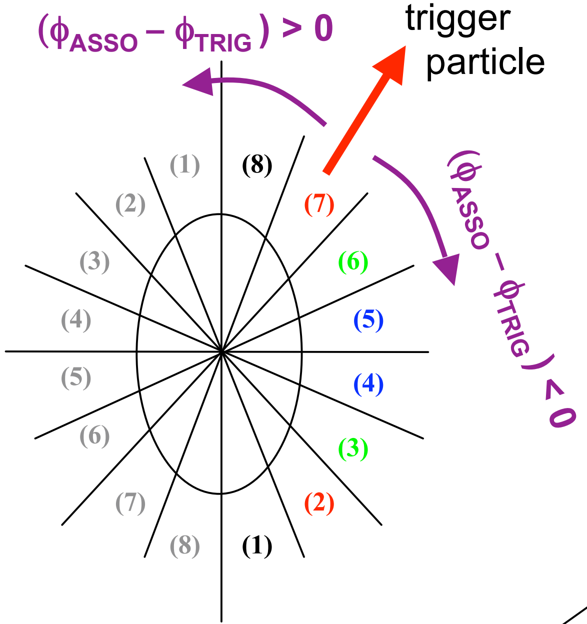
$$\Delta\phi = \phi_{associate} - \phi_{trigger} \text{ (rad)}$$

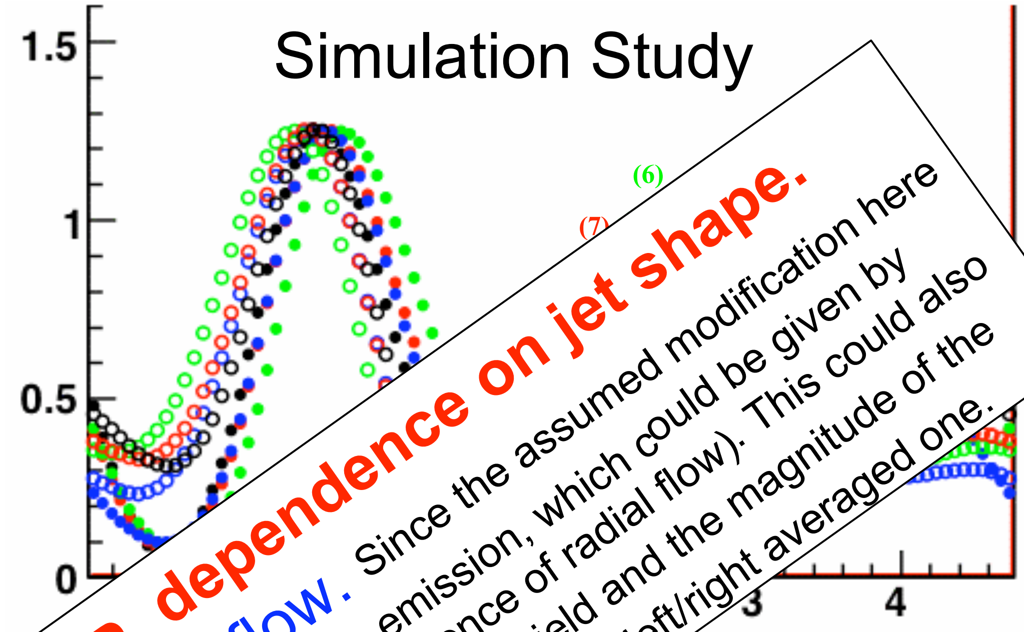
Understanding of Mach-cone shape of (p_T^{Asso}=1~2GeV/c)
with trigger angle selected 2-particle correlration (p_T^{Trig}=2~4GeV/c)

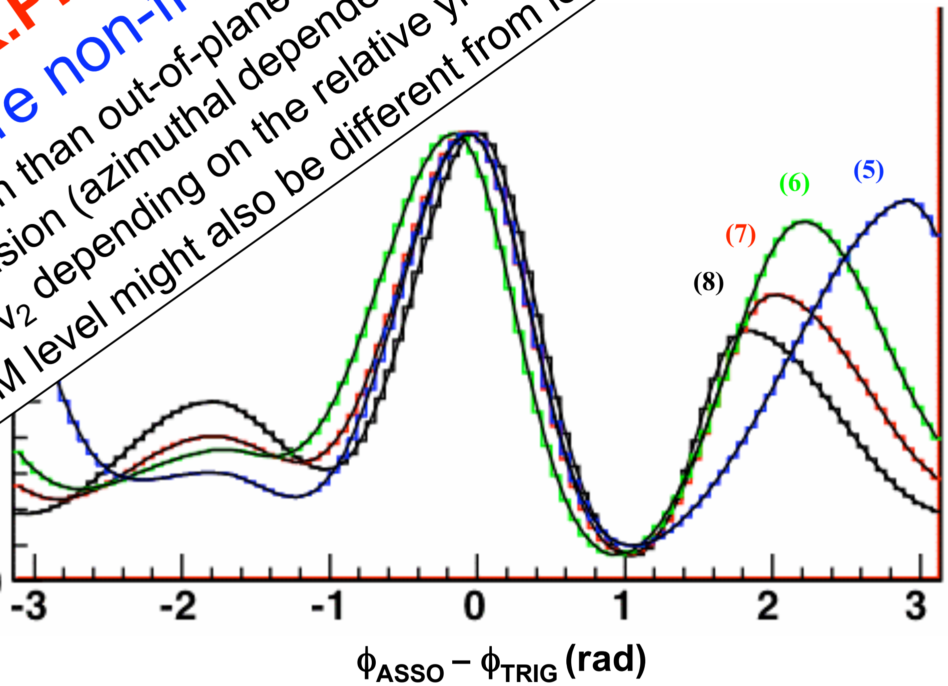




near side
(trigger direction)
ϕ_{ASSO}-ϕ_{TRIG}<0
mach-cone
(shoulder region)
ϕ_{ASSO}-ϕ_{TRIG}>0
away side
(head region)
mach-cone
(shoulder region)
ϕ_{ASSO}-ϕ_{TRIG}<0
$-\pi$
0
π
$\phi_{ASSO} - \phi_{TRIG}$







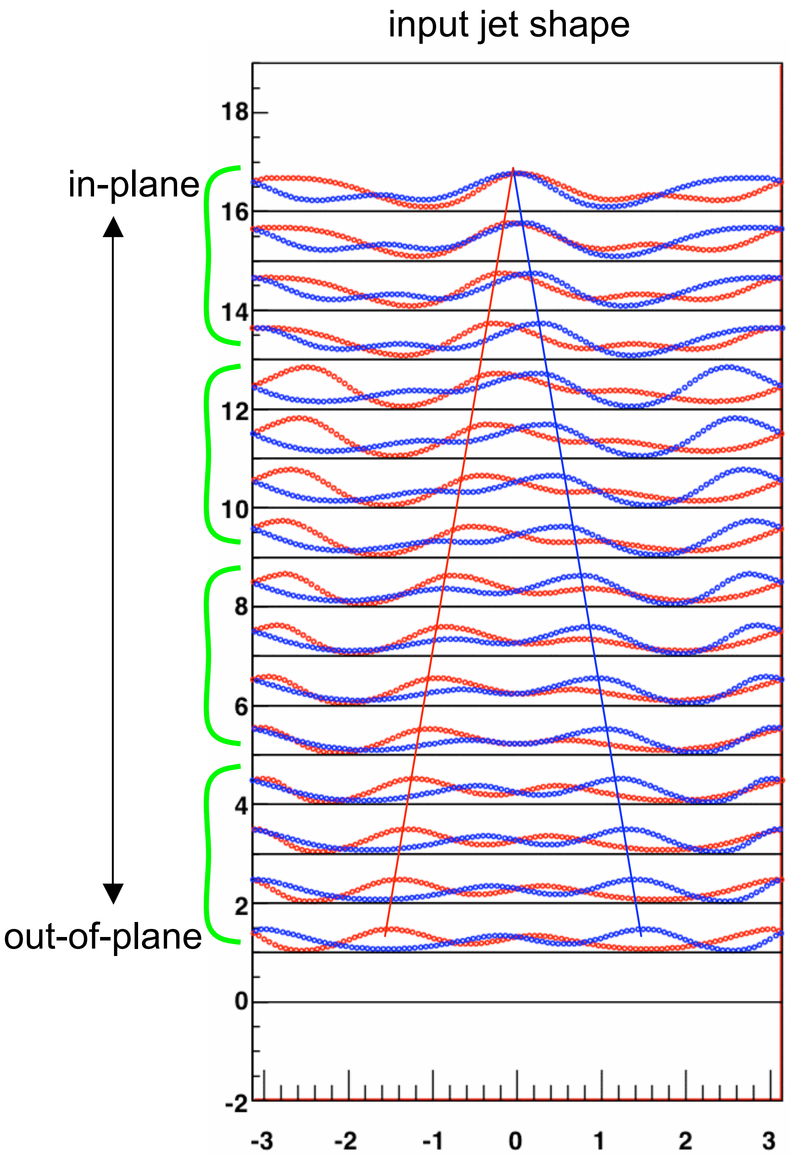
Assume very strong R.P. dependence on jet shape.

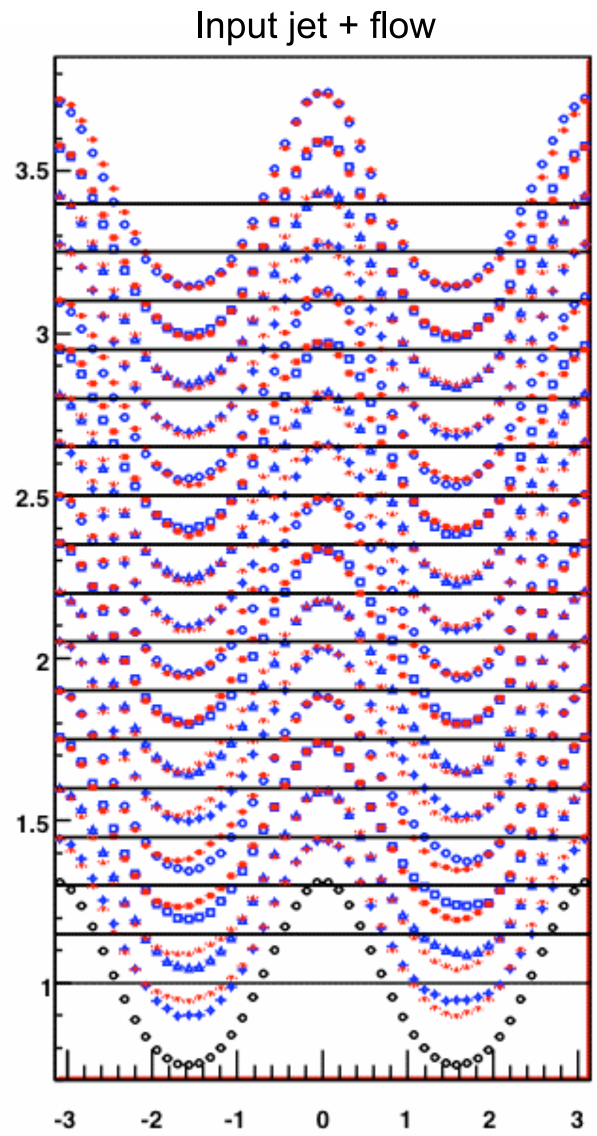
This will NOT be a pure non-flow. Since the assumed modification here always prefer in-plane emission than out-of-plane emission, which could be given by geometry or by elliptic expansion (azimuthal dependence of radial flow). This could also be a strong contribution to v_2 depending on the relative yield and the magnitude of the shape modification. ZYAM level might also be different from left/right averaged one.

shape(1) = $f_1(x)$
shape(2) = $f_2(x)$
shape(3) = f
shape(4)
shap
s
sh
shap

3 x (peak, ...)
+ 2 x relative ... par

Simulation





Input parameters

(1) Jet shape (11x4)
(2) $v_{2,4}^{Trig}$ (soft)
(3) $v_{2,4}^{Asso}$ (soft)
(4) $v_{2,4}^{Jet}$ (hard)
(5) $v_{2,4}^{PTY}$ (hard)
(6) n_{Trig} / eve (soft)
(7) n_{Asso} / eve (soft)
(8) n_{Jet} / eve (hard)
(9) n_{PTY} / jet (hard)

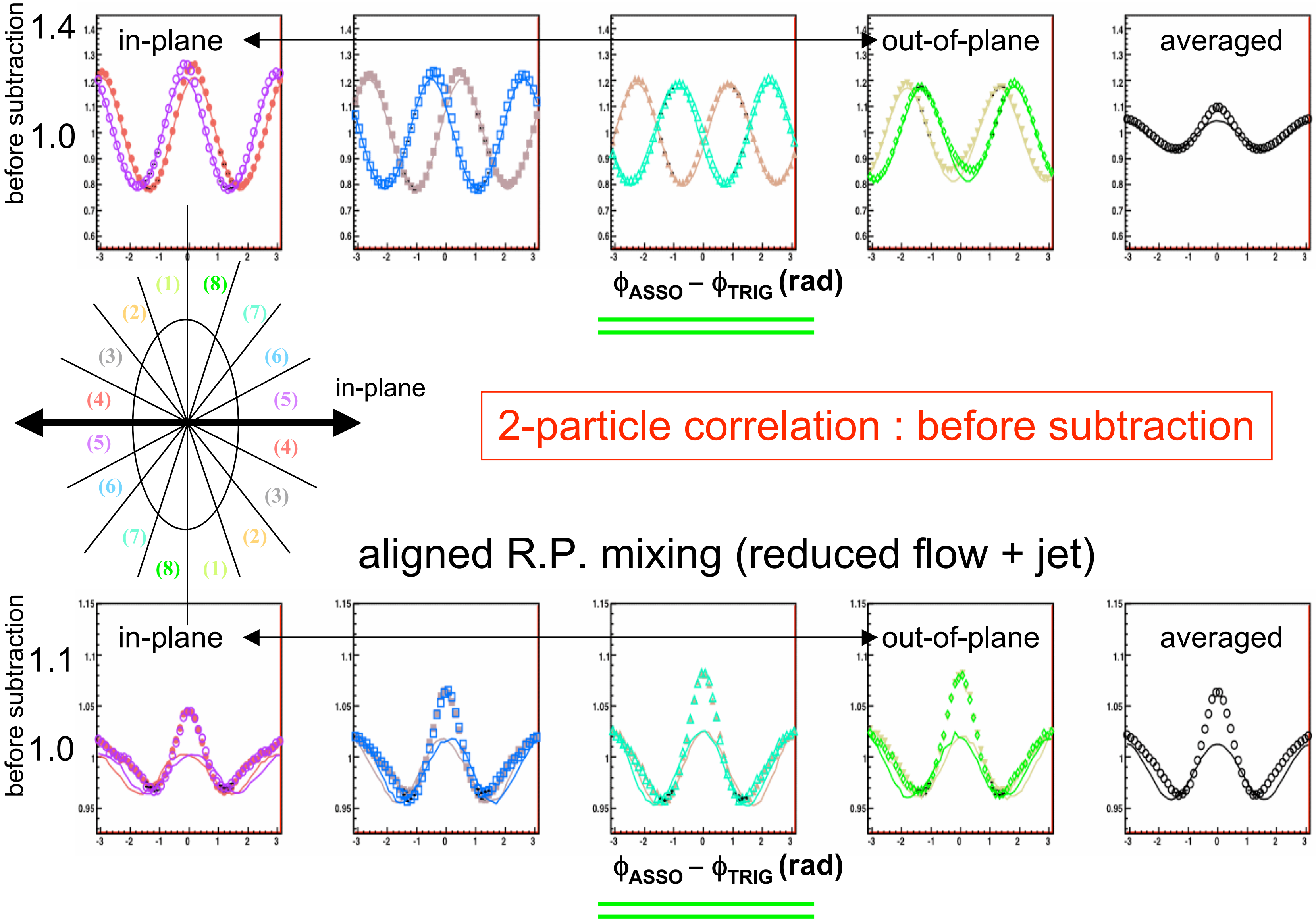
Output parameters

(a) $v_{2,4}^{Trig}$ (incl)
(b) $v_{2,4}^{Asso}$ (incl)
(c) n_{Trig} / eve (incl)
(d) n_{Asso} / eve (incl)
(e) hard/soft frac.
(true frac.)
(zyam frac.)

$\phi_{Asso} - \Phi_{R.P.}$ (trigger angle ϕ_{Trig} selection w.r.t. R.P.,
where, ϕ_{Trig} gives the sign of 2nd order $\Phi_{R.P.}$)

Simulation

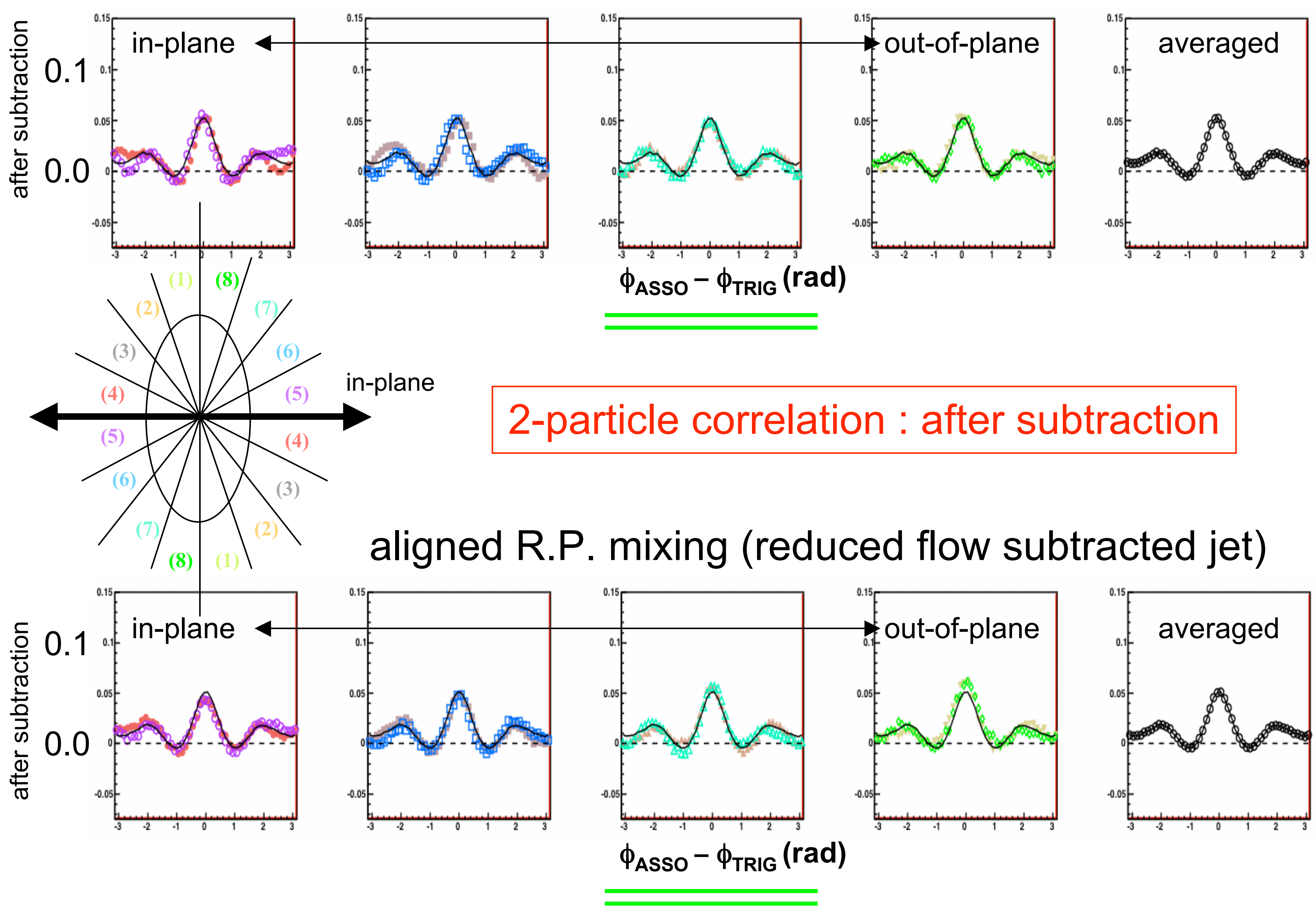
random R.P. mixing (total flow + jet)



2-particle correlation : before subtraction

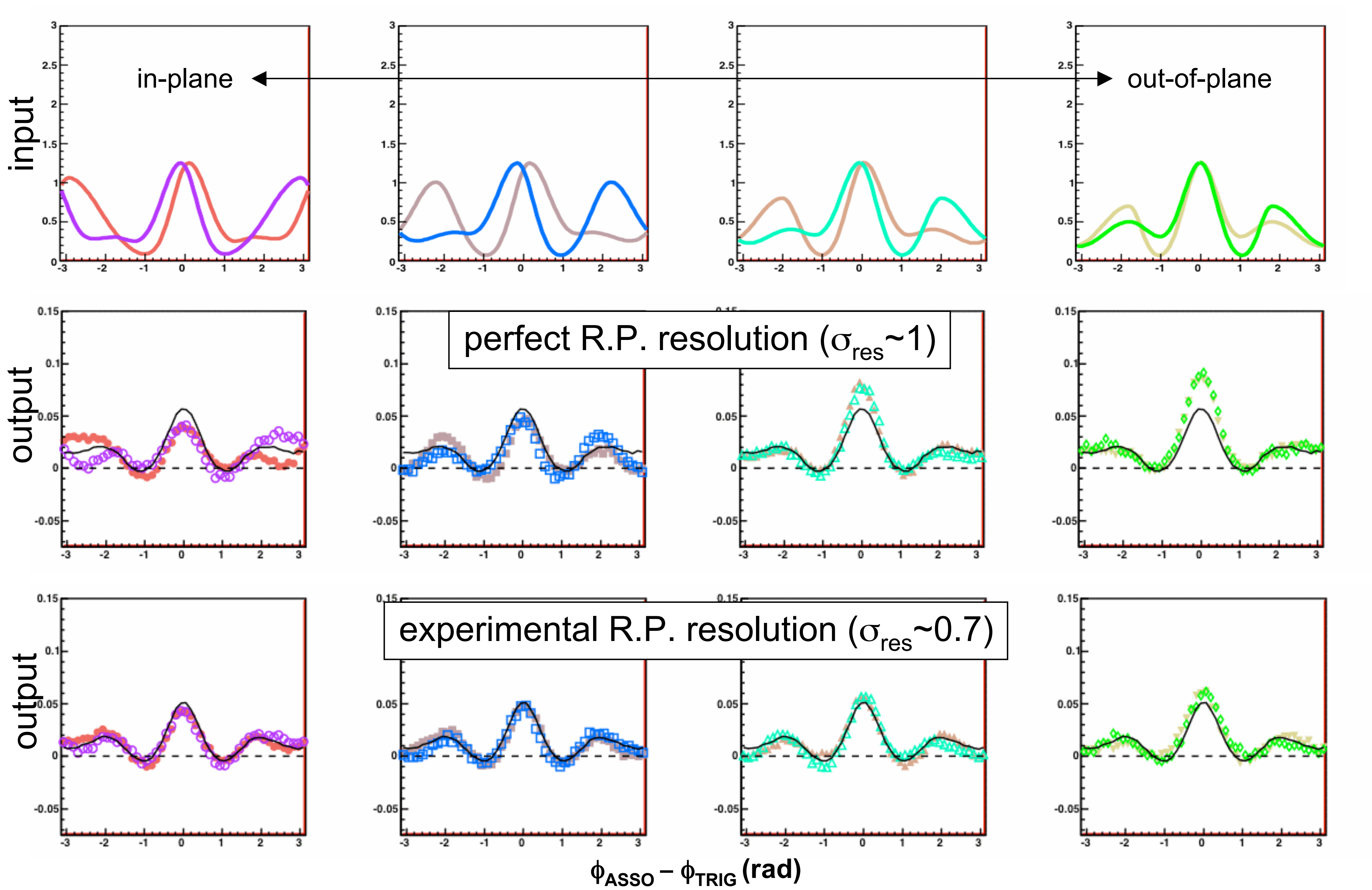
Simulation

random R.P. mixing (total flow subtracted jet)



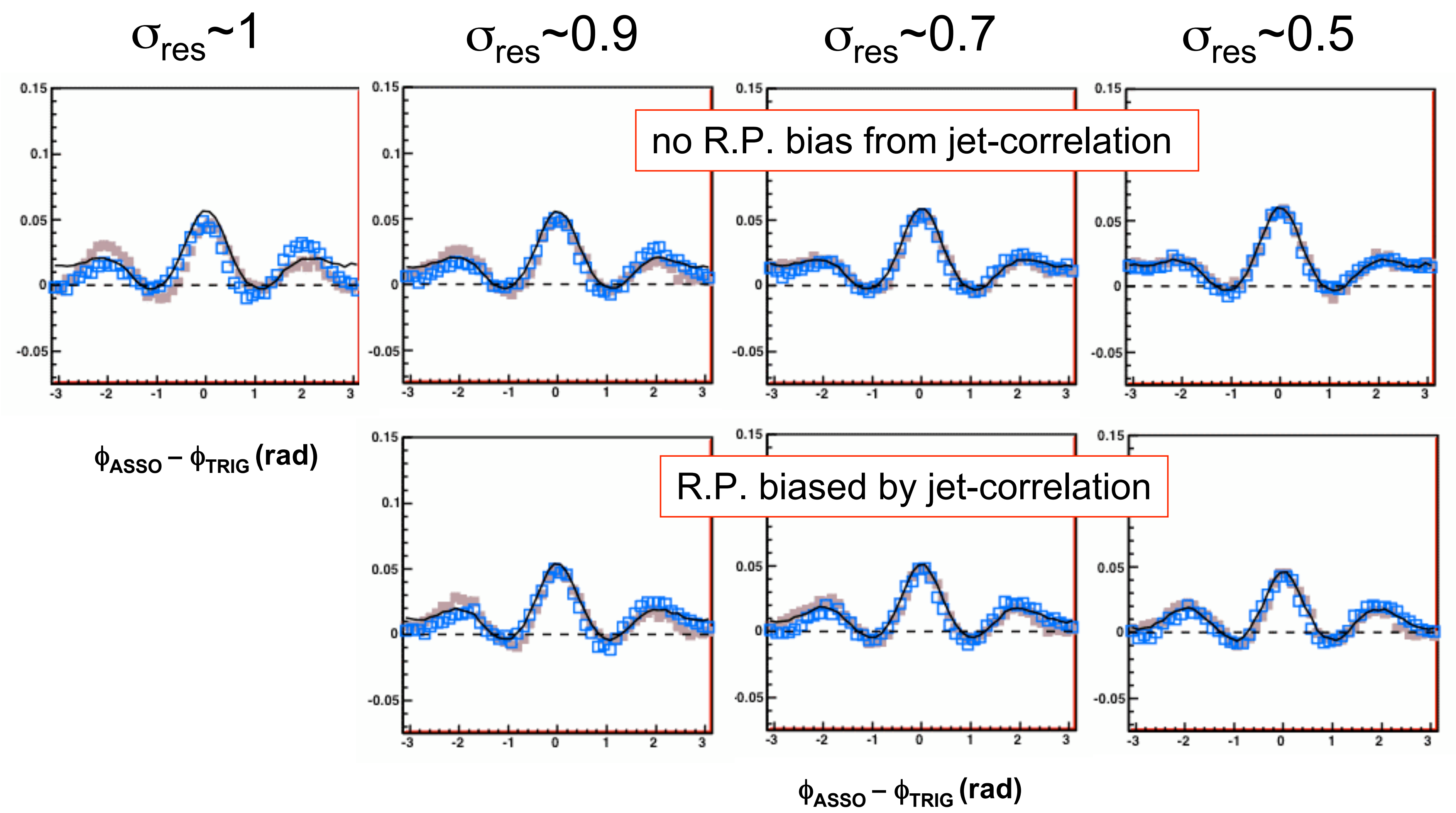
comparison between input and output

Simulation

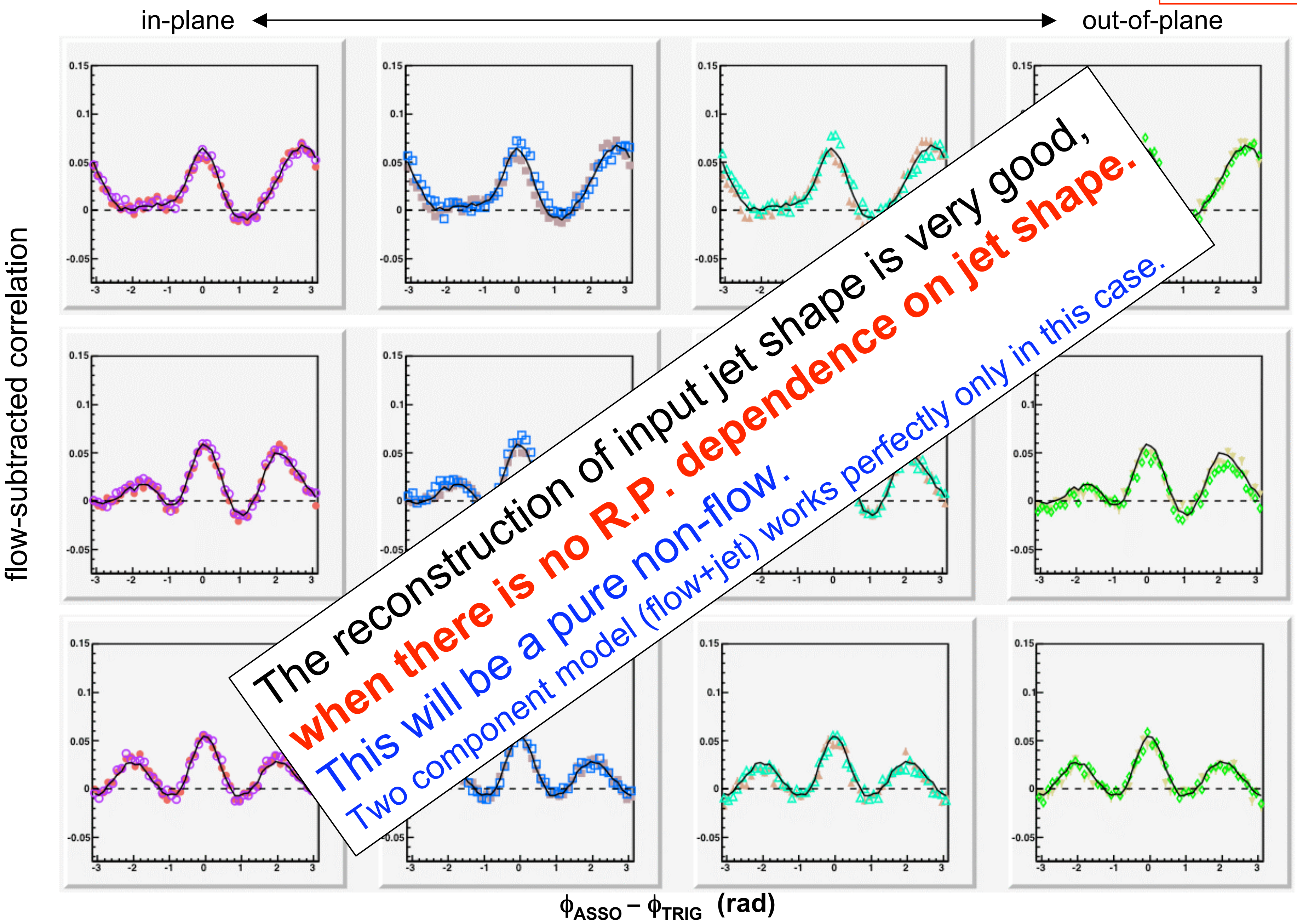


Simulation

effect of the experimental resolution



Simulation



The reconstruction of input jet shape is very good,

when there is no R.P. dependence on jet shape.

This will be a pure non-flow.

Two component model (flow+jet) works perfectly only in this case.

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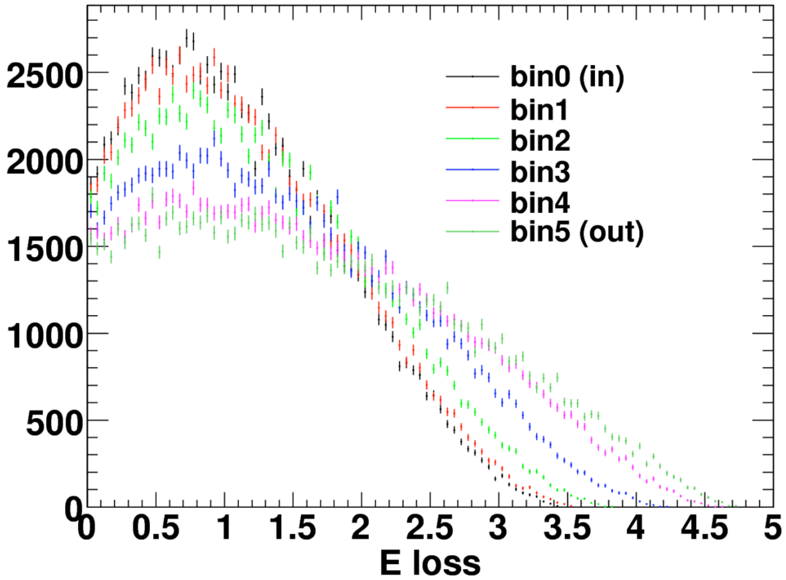
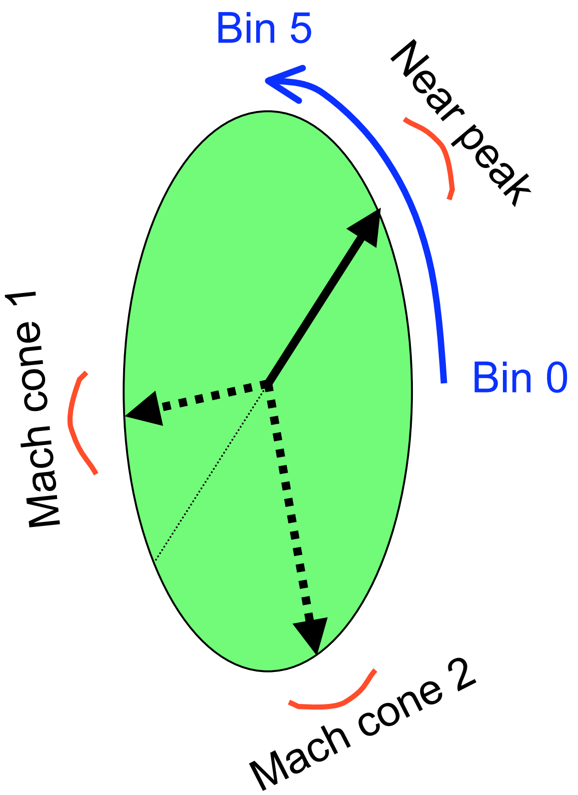
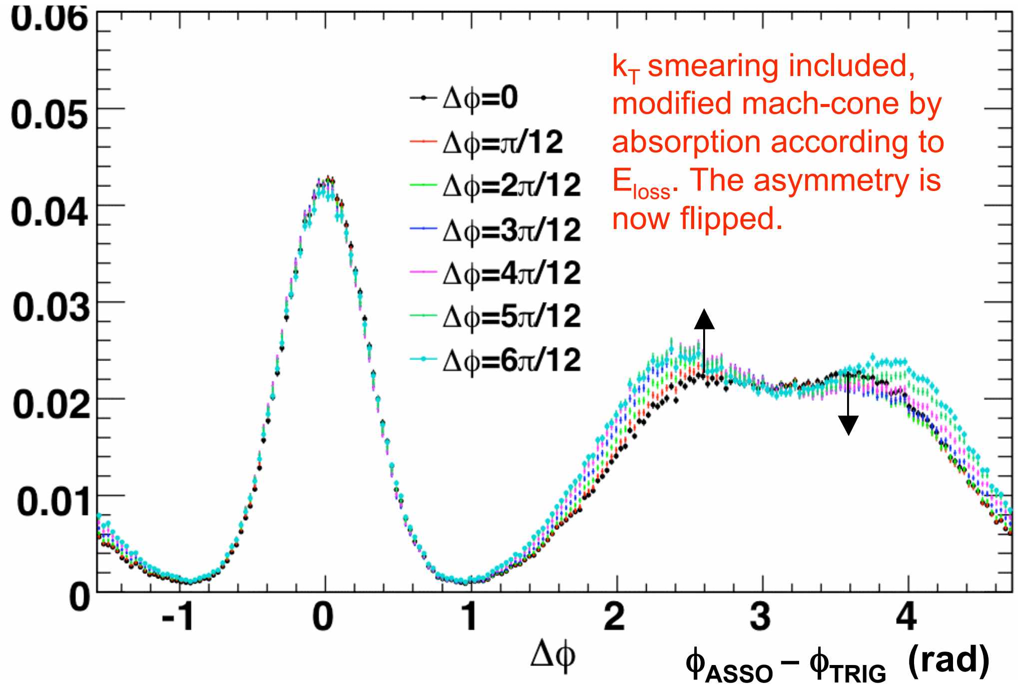


E_{loss} depending on angle w.r.t. R.P. for near peak and Mach cone 1/2

Simulation





The multiplicities in these regions are assumed to be proportional to the path length (a la energy loss).

Note: original jets are generated according to N_{coll} profile

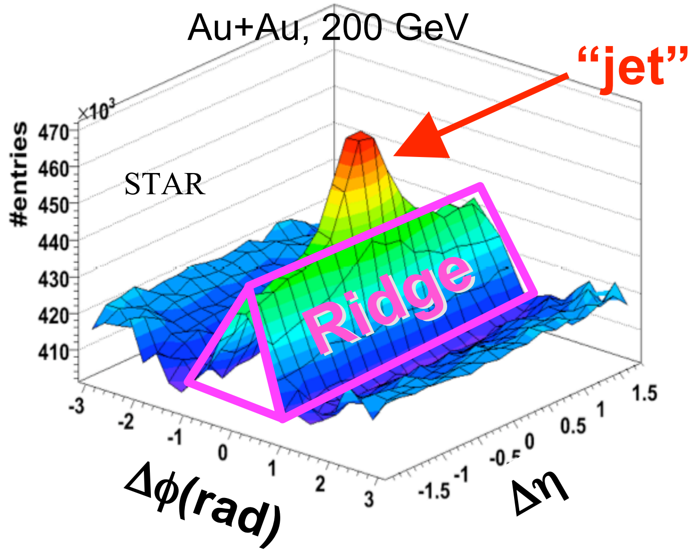
RHIC 200GeV Au+Au, mid-central collisions at mid-p_T region (1-4 GeV/c) with v_2 = 0.1 ~ 0.2

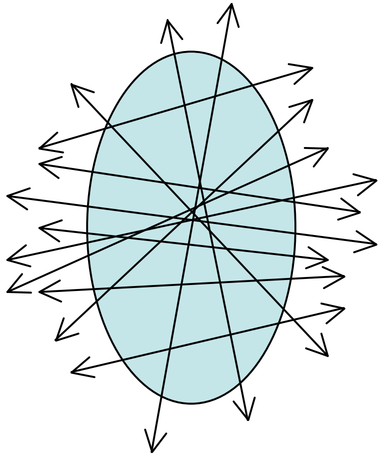
* Significant semi-hard (mini-jet) fraction
  relative to soft-thermal contribution ~ several*10%

* Significant v_2 effect from the semi-hard component
  relative to soft-thermal particle v_2 ~ several*10%

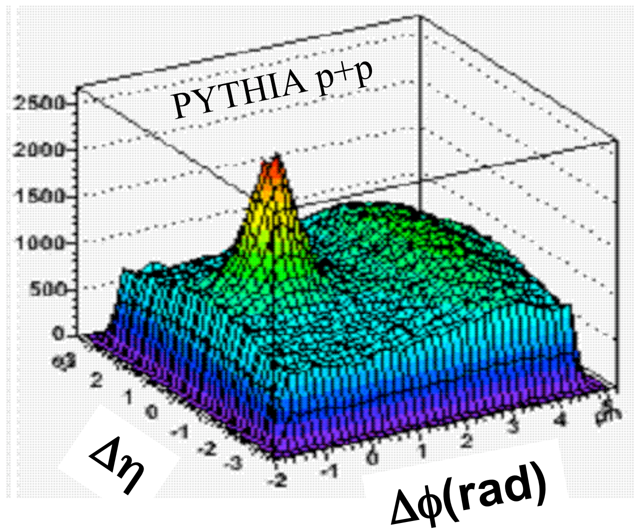
* Significant smearing on jet shape even with $\sigma_{R.P.}$ ~ 0.7
  But it's not really because of poor accuracy of E.P. angle,
  it's more because mini-jets push up the inclusive v_2
  which is subtracted.

* RHIC data analysis is in progress…
* E.P. can also be biased by correlated pair even with large η gap…

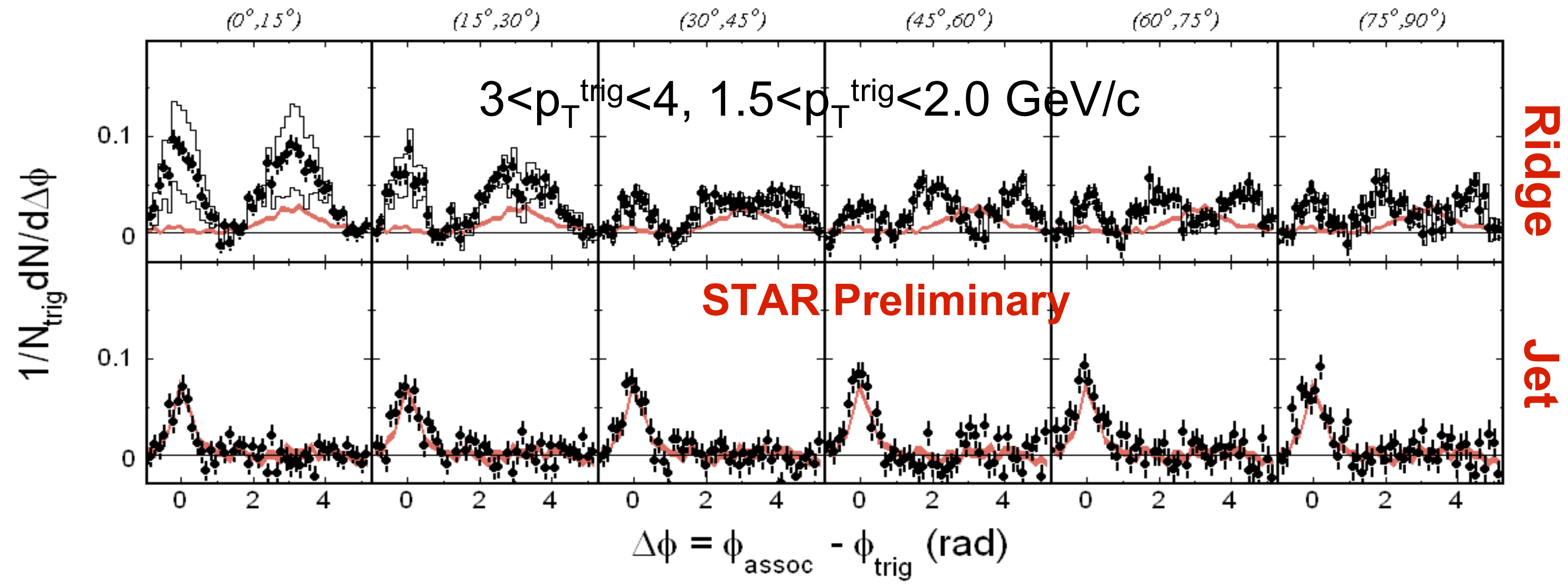


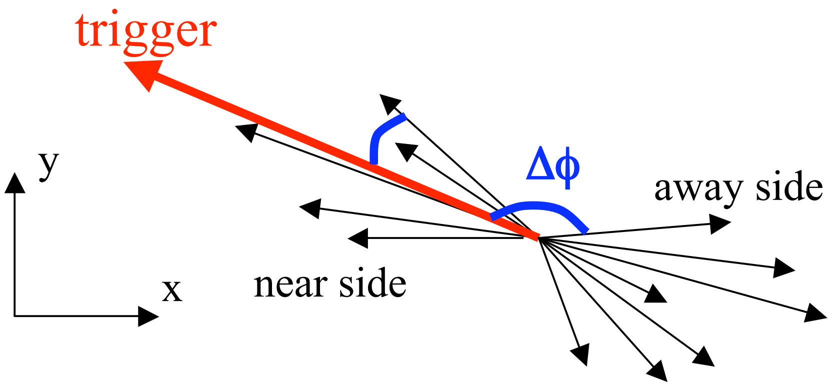


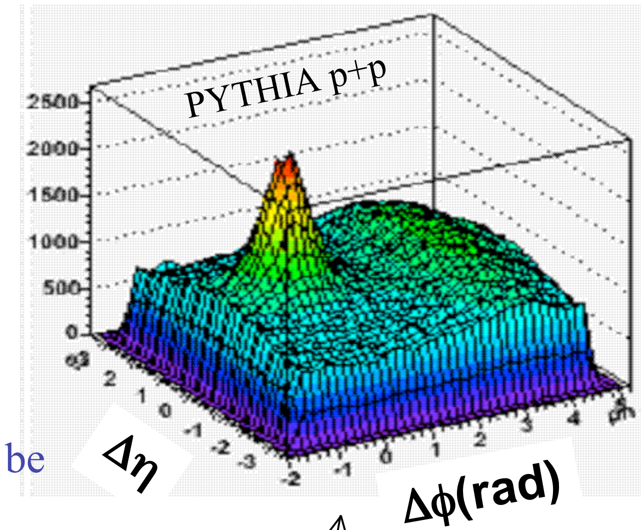
away side (in dφ) of one di-jet can be near side (in dφ) of another di-jet



QM08 STAR







(1) away side of a back-to-back(b-t-b) jet is wider in η than in ϕ

(2) If there are two parallel b-t-b jets, away side of one b-t-b jet can be near side of the another b-t-b jet.

(3) Suppression as well as modification of b-t-b jet would depend on relative angle w.r.t. almond geometry, we know this from v_2 measurement and believe this is the major source of v_2 at high p_T .

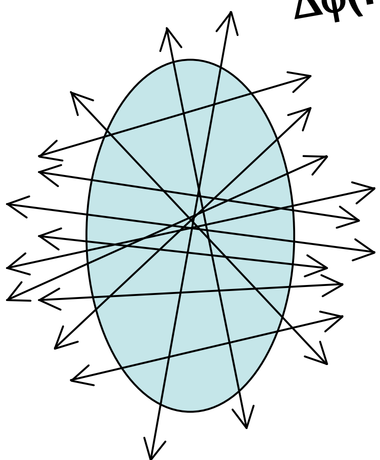
(4) Therefore, there should be inter b-t-b jets correlation give by the geometry from (3), this could make near side ridge like effect, especially if the effect (3) has shaper dependence than v_n(=cosNx).

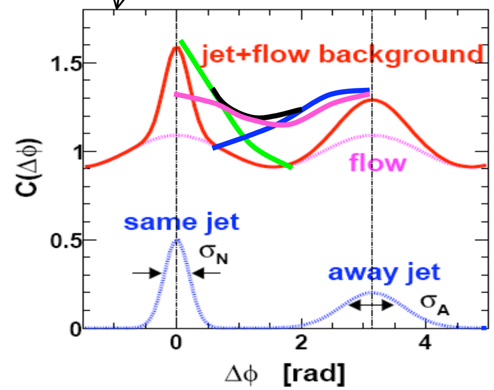
(5) We always measure inclusive $v_{2,4}$, which includes the effect (3). Therefore any modification which could generates the elliptic (or harmonic) anisotropy would be included in the measured $v_{2,4}$.

(6) We subtract BG contribution with this $v_{2,4}$ from (5) by maximizing BG contribution assuming zero jet yield at minimum at any dϕ.

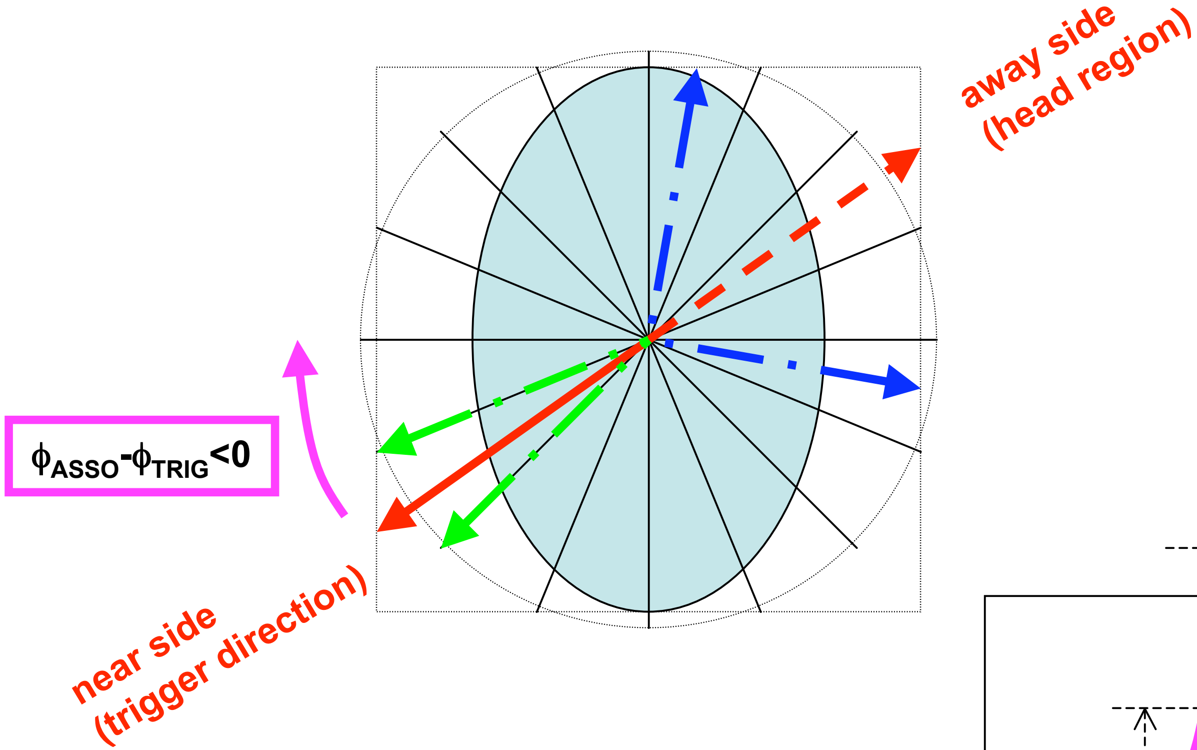
(7) If near and away side jets overlap each other, this subtraction underestimates the jet yield and can change the extracted jet shape.

(8) If you extract angular dependence of jet w.r.t. R.P., the results will easily be affected by the choice of $v_{2,4}$ from (5).

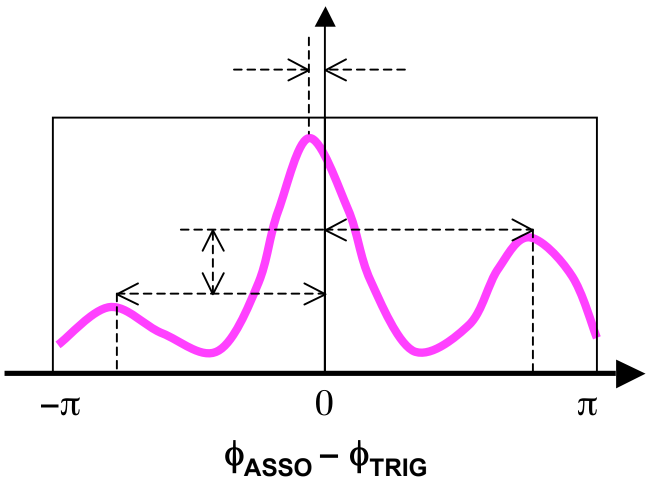




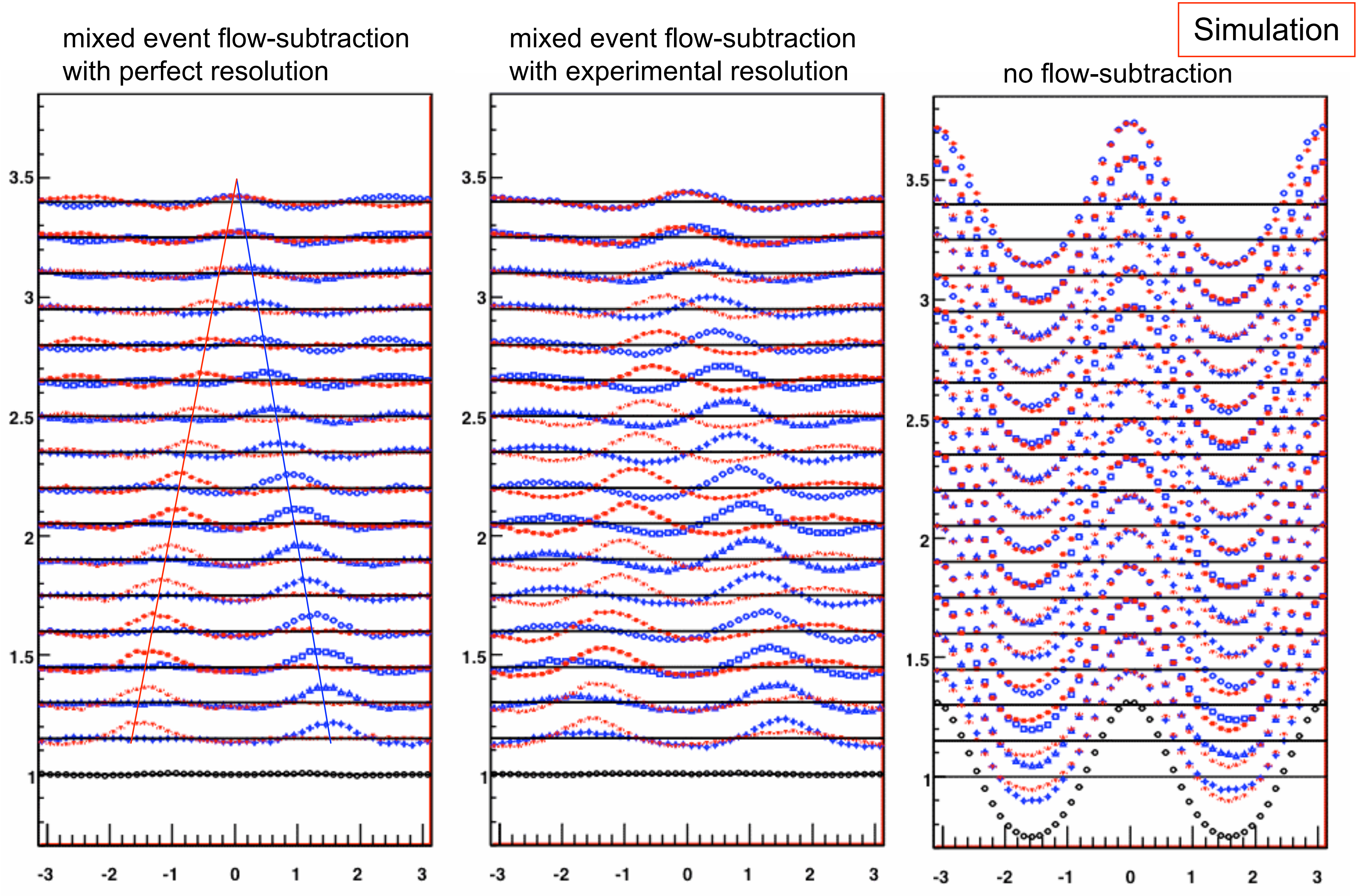
Back-up slides



away side
(head region)
ϕ_{ASSO}-ϕ_{TRIG}<0
near side
(trigger direction)



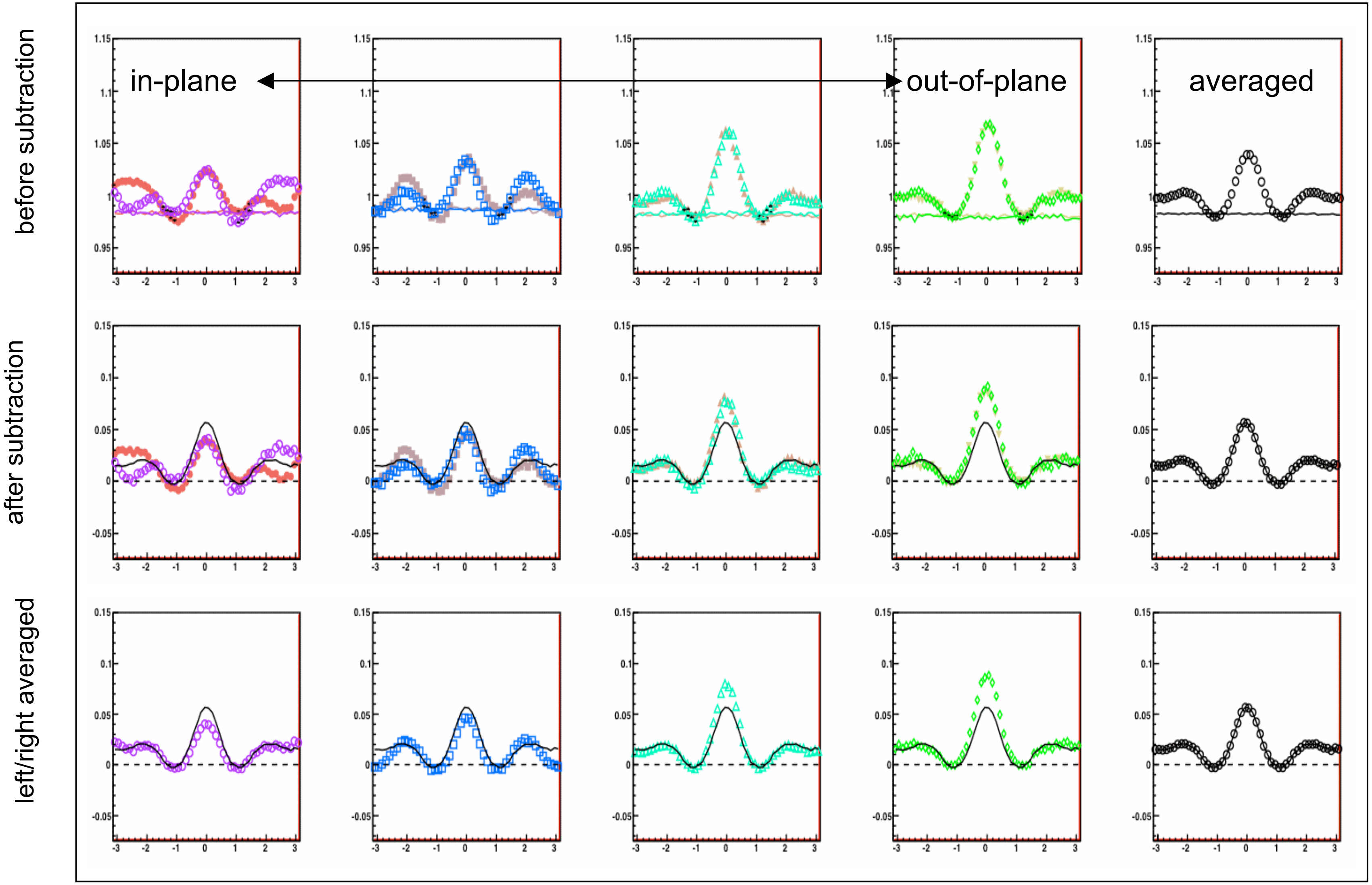
−π
0
π
$\phi_{ASSO} - \phi_{TRIG}$



$\phi_{Asso} - \Phi_{R.P.}$ (trigger angle ϕ_{Trig} selection w.r.t. R.P.,
where, ϕ_{Trig} gives the sign of 2nd order $\Phi_{R.P.}$)

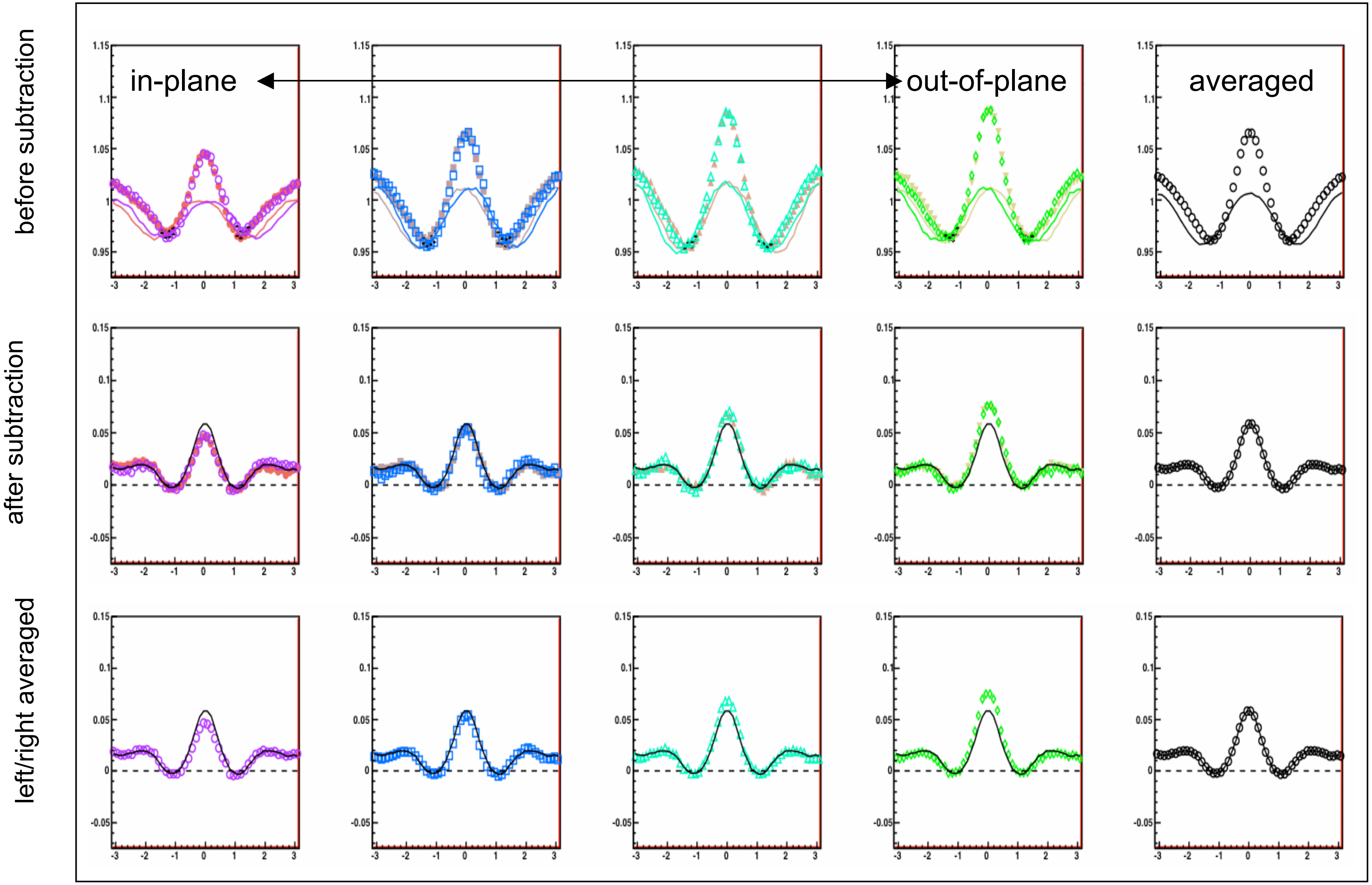
Simulation

R.P. resolution = 1



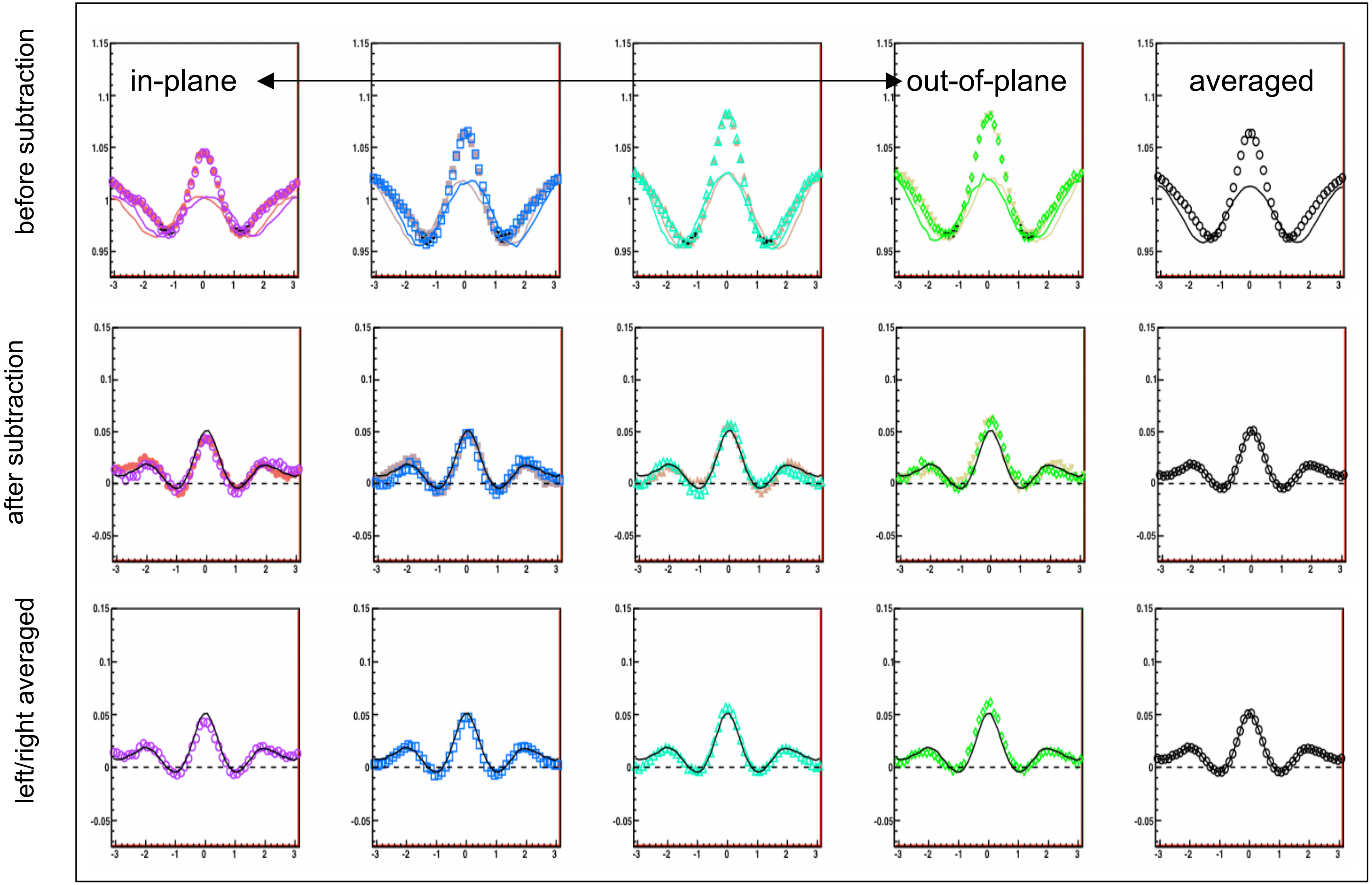
Simulation

R.P. resolution ~ 0.75



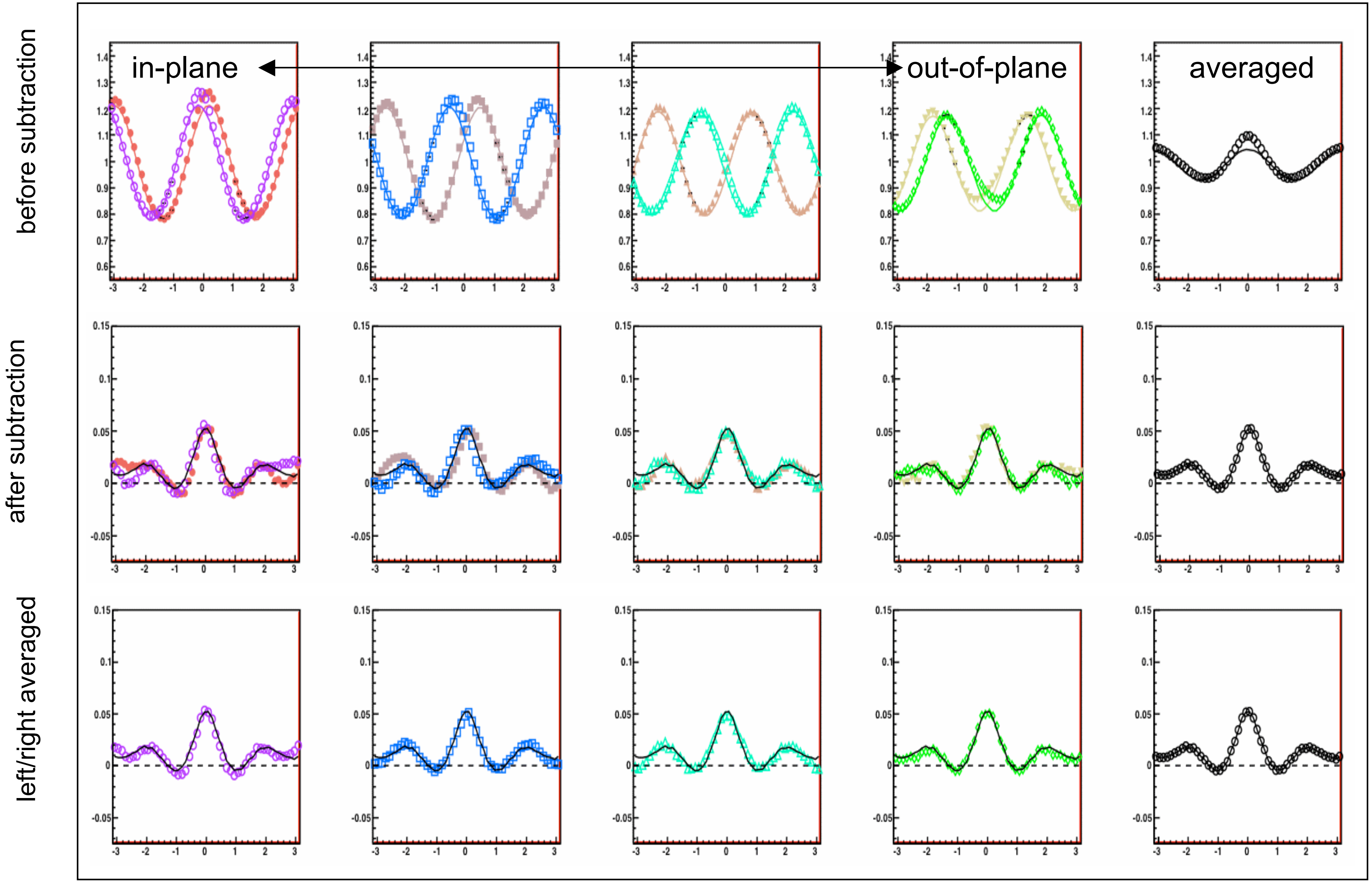
Simulation

R.P. biased by jet-correlation

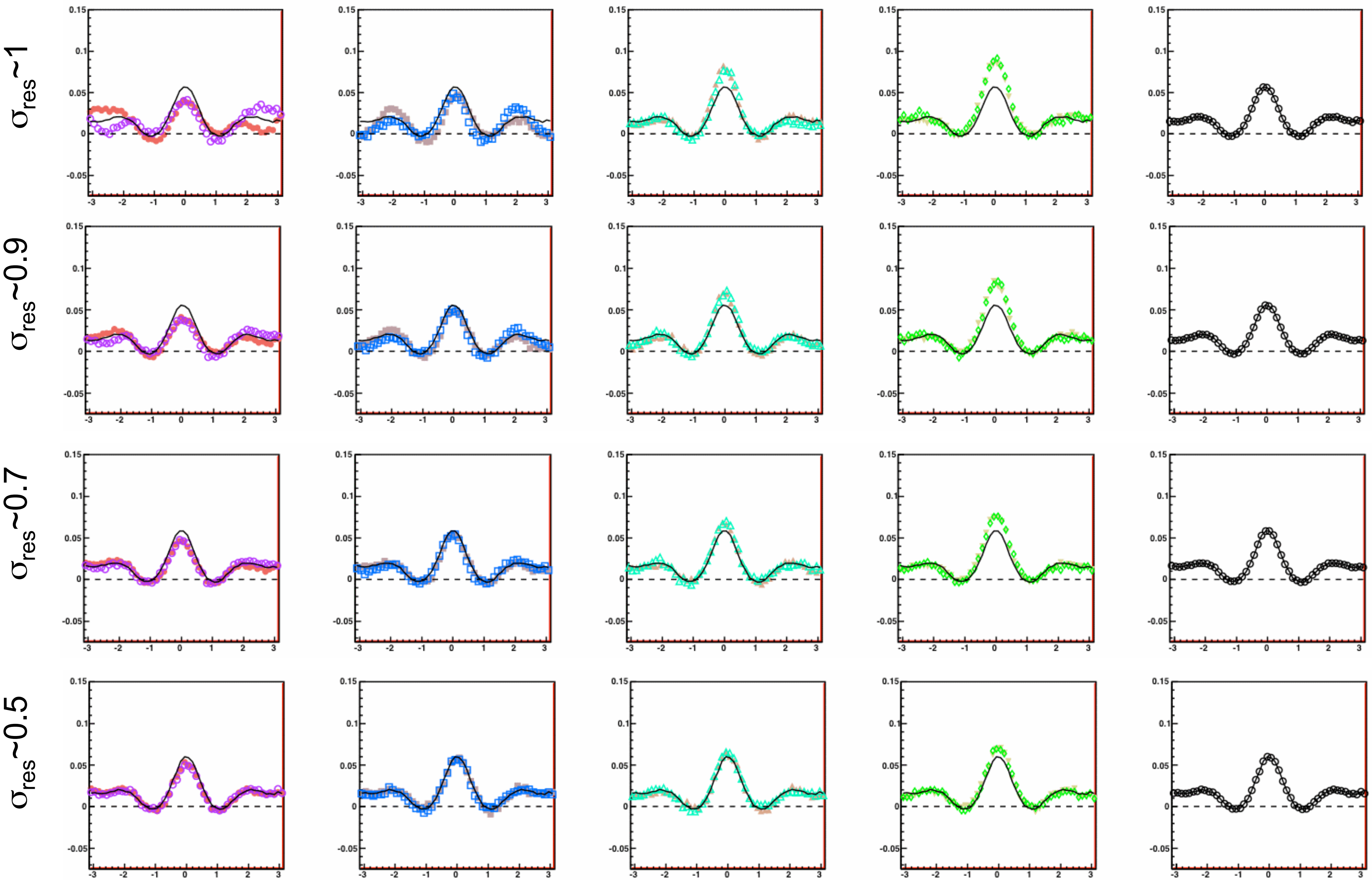


Simulation

R.P. biased by jet-correlation (random r.p. mixing)



Simulation without R.P. bias



Simulation with R.P. biased by jet-correlation