

Questions about q-vectors

FCV PWG Weekly Meeting

Isaac Mooney (Yale University / BNL)

3/15/2023

Analysis

Looking at isobar 200 GeV dataset

Using q_2 to characterize event shape to study path length dependence of jet quenching in medium

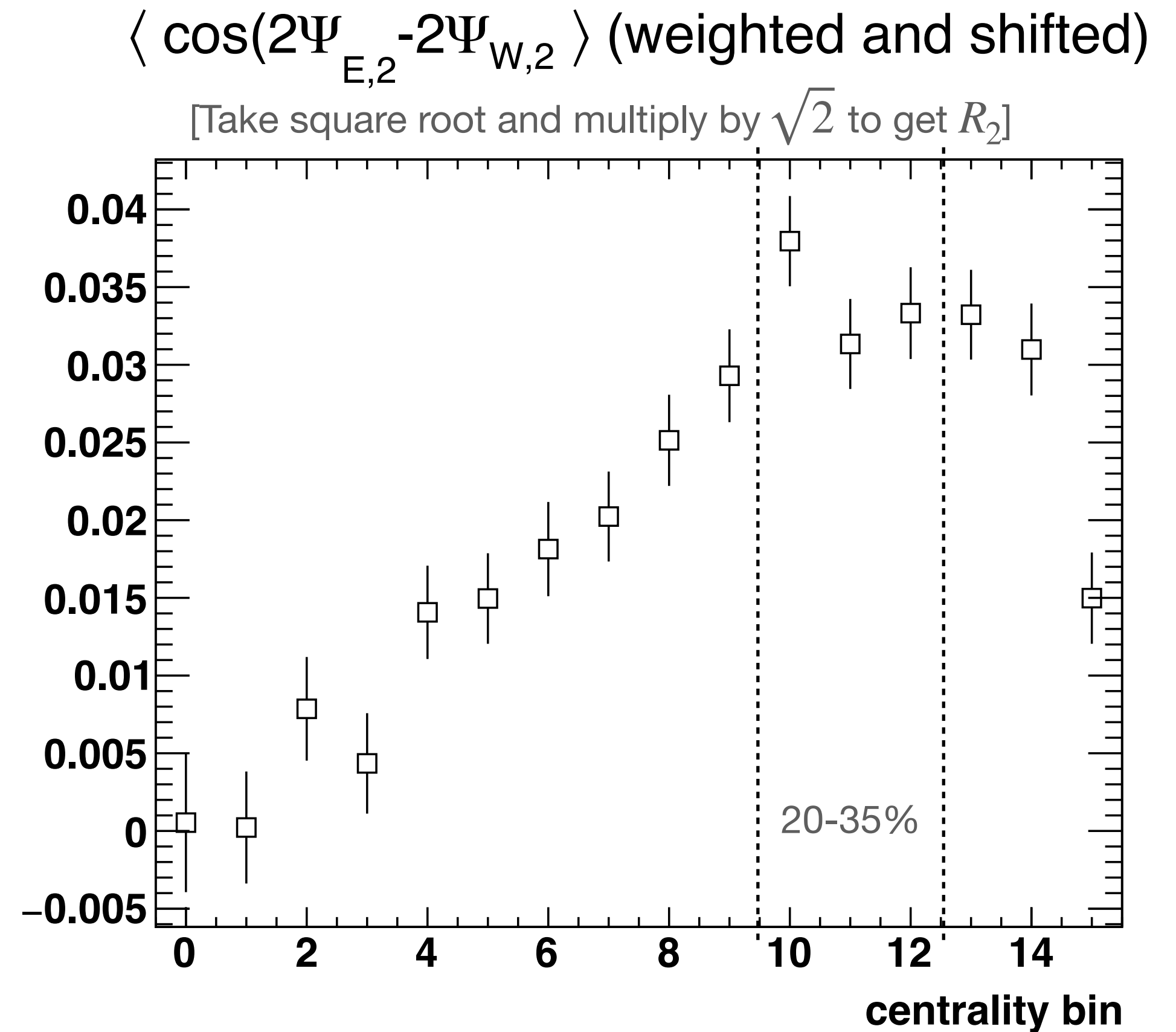
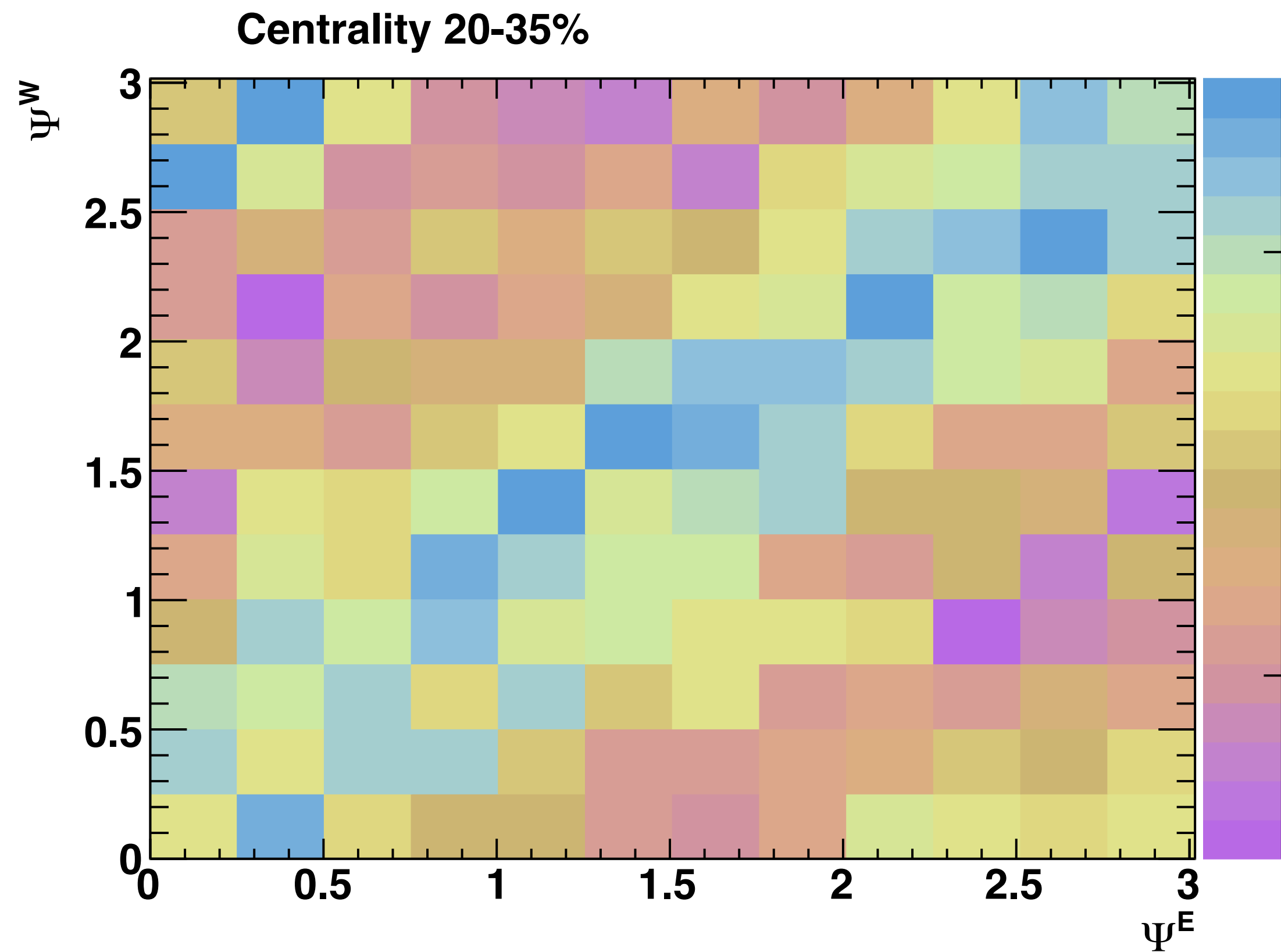
Reminder: $q_2 = |Q_2|/\sqrt{M}$ where $Q_2 = \left(\sum_{i=1}^M w_i \cos 2\phi_i, \sum_{i=1}^M w_i \sin 2\phi_i \right)$

Obtaining q_2 from EPD-**W** (and event plane angle from EPD-**E**)*, using a truncated nMIPs signal as ' M '

Question: we have an EPD resolution, but how does the q_2 resolution look?

N.B.: for all these tests, looking at ~1M total events, or about 1/10 that in this centrality range

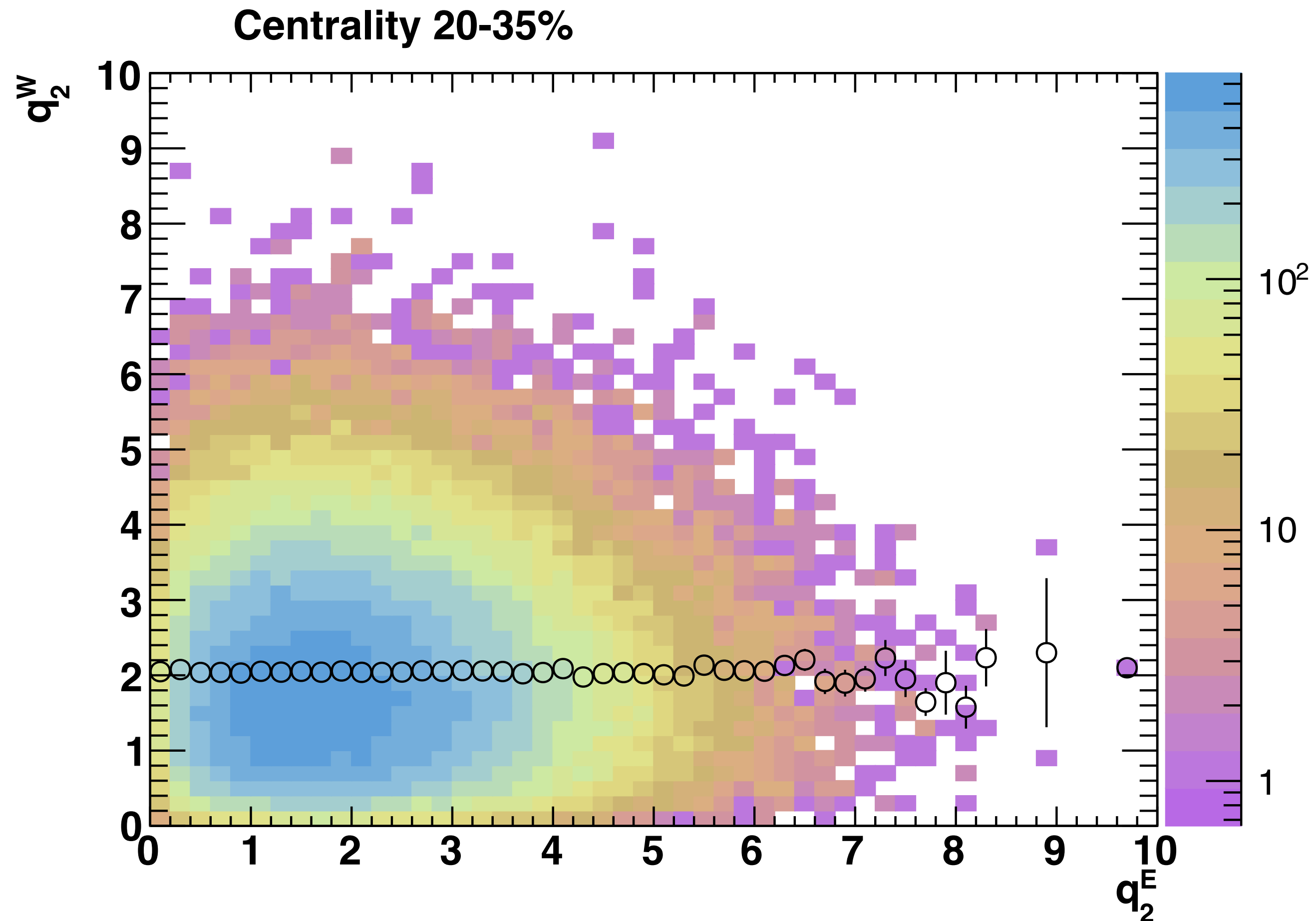
Event plane resolution



Some correlation (left) visible albeit with low statistics — easier to see on a linear scale
Resolution extracted from this (right) does roughly agree with Mike Lisa's here (with more statistics, I've seen better agreement):
<https://drupal.star.bnl.gov/STAR/blog/lisa/ep-resolution-epd-and-bbc> [last plot in Fig. 2]

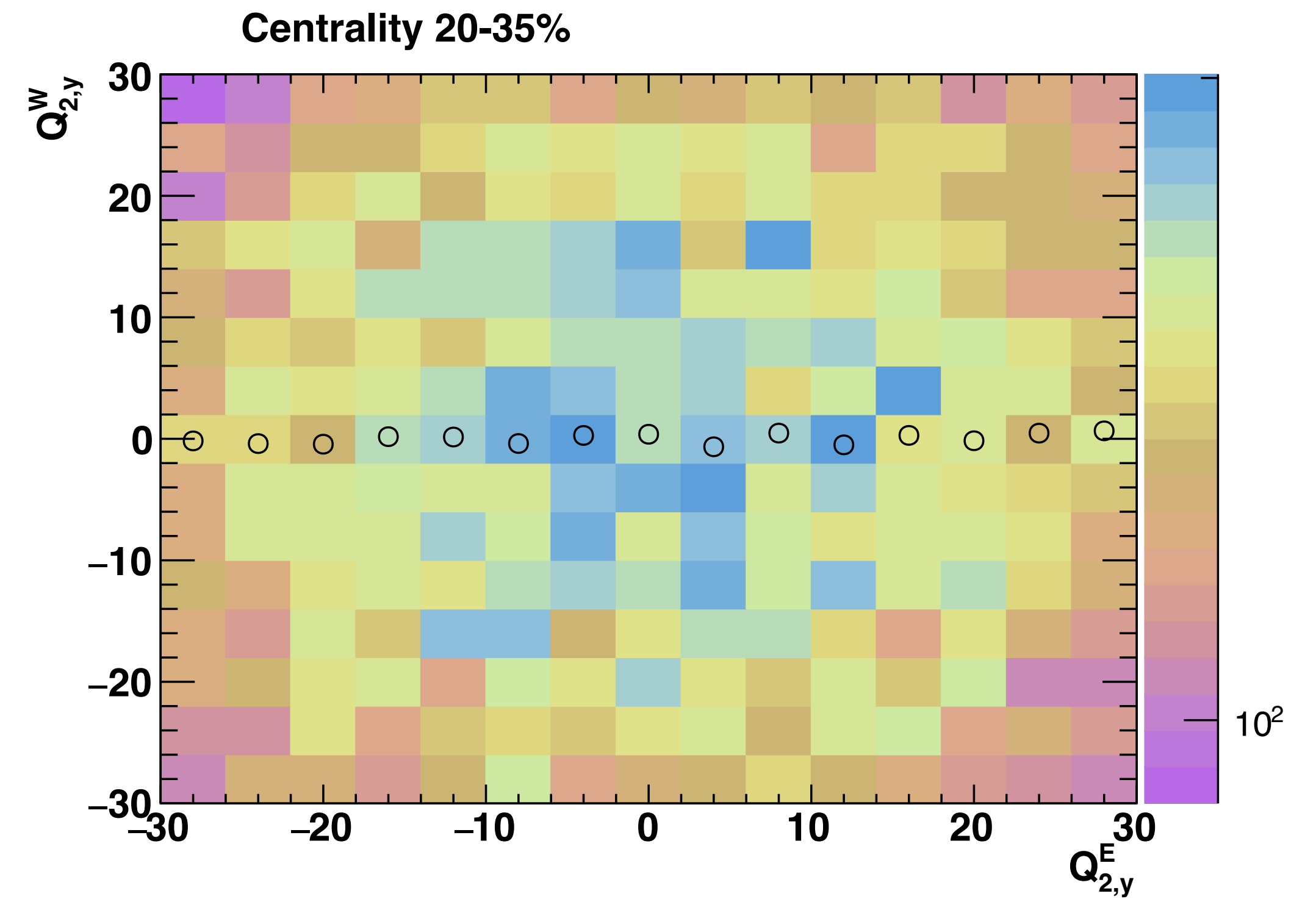
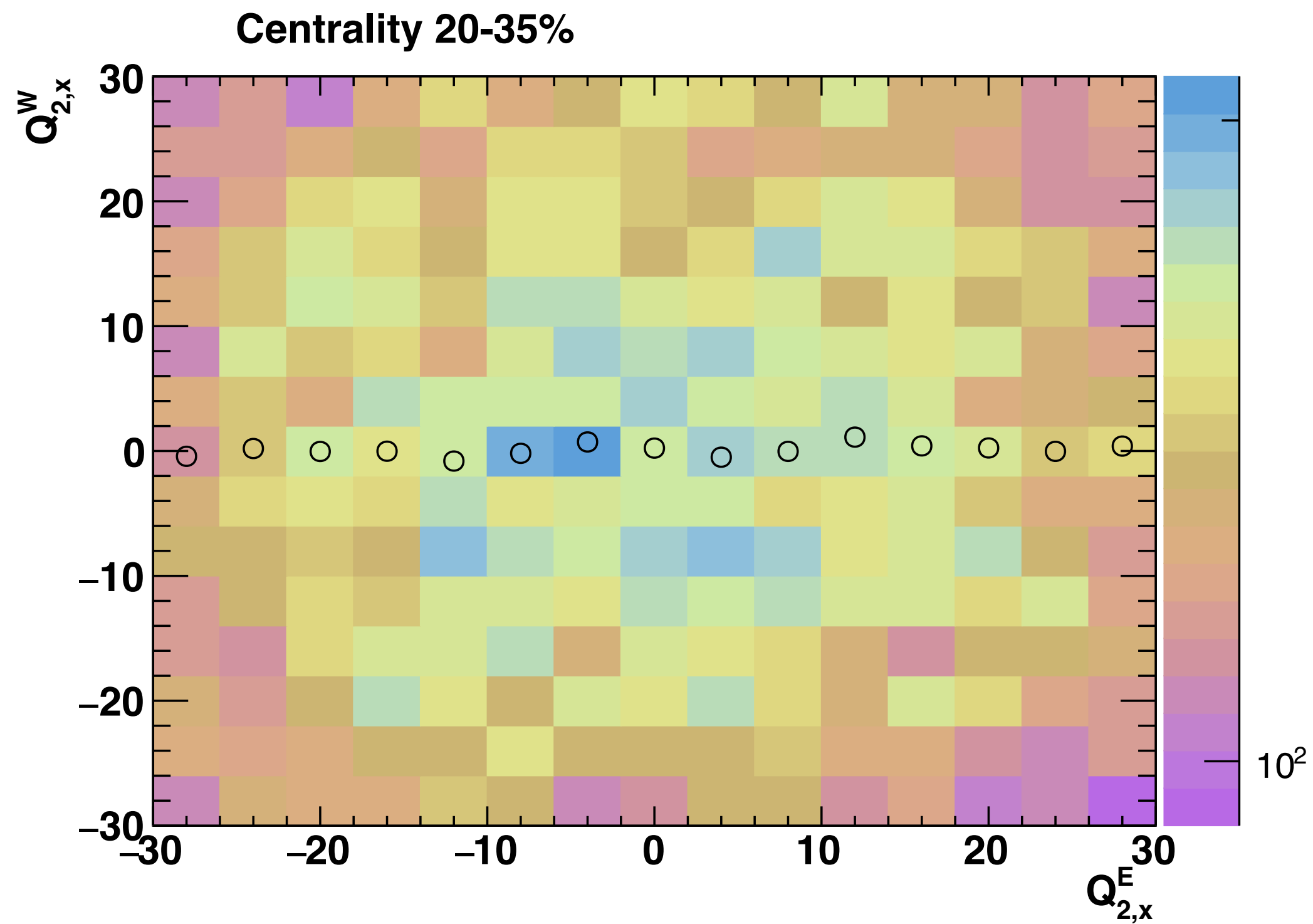
q_2 resolution

Comparing east and west EPD q_2



Shockingly uncorrelated! Since EP Ψ is built from Q_2 , and we have a correlation there, let's go back to the beginning and build up the EP Ψ from scratch

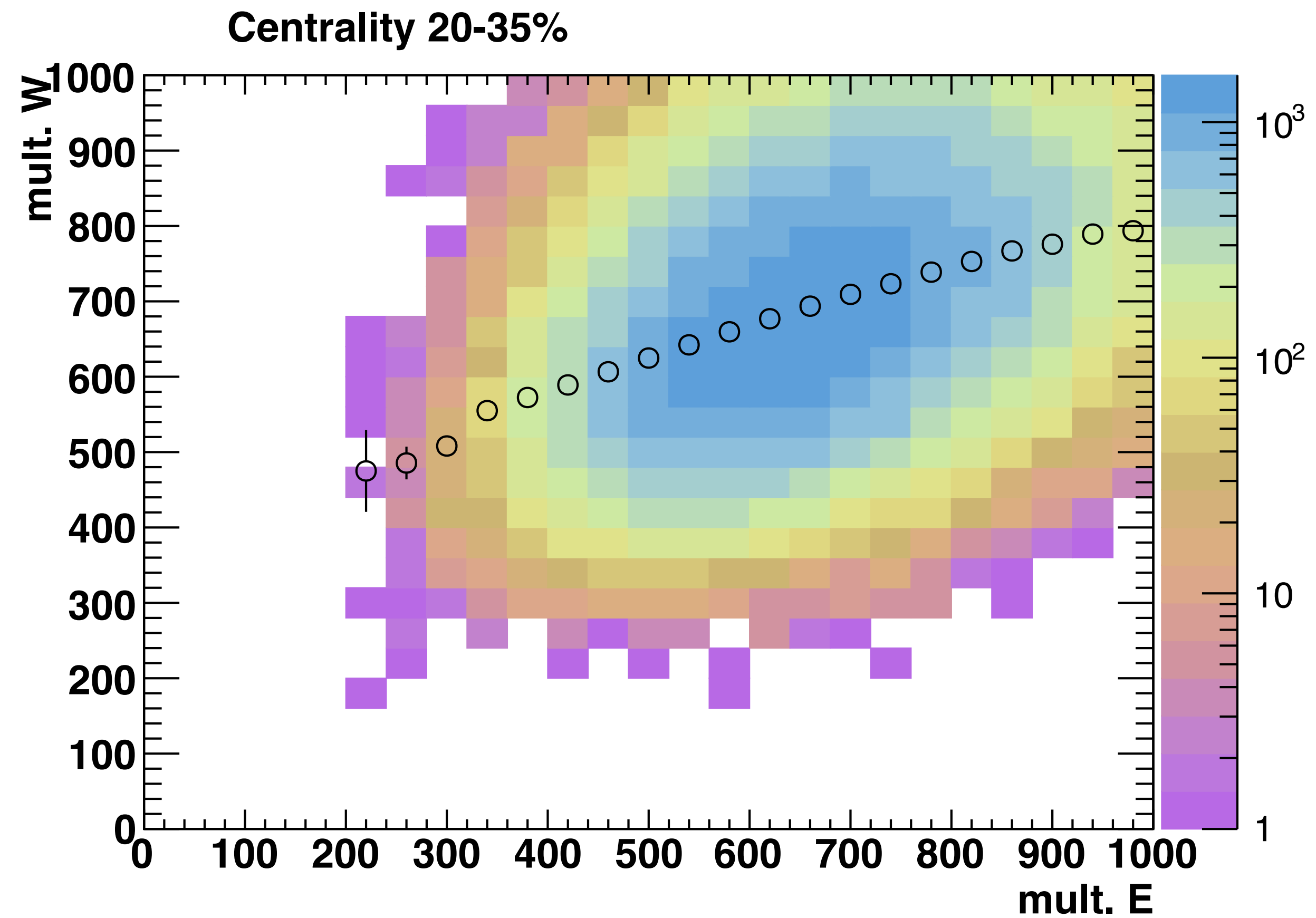
$Q_{2,x,y}$ (lack of) correlation*



Q_s (no multiplicity scaling) are also uncorrelated between EPD-E and EPD-W — how do we get from here to EP correlation?

Multiplicity

Truncated nMIP summed signal

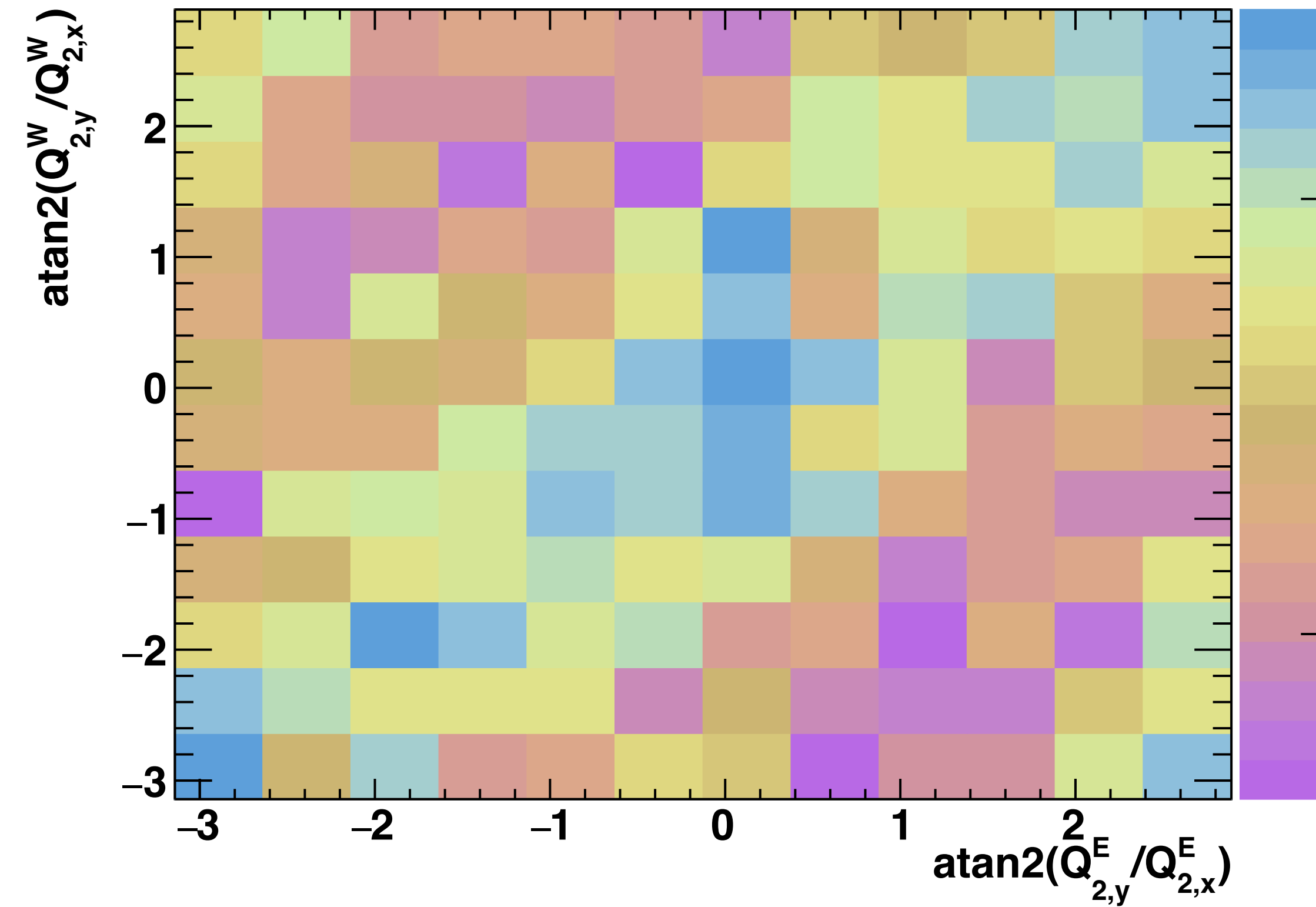


There is a correlation here, at least. But this doesn't propagate to Ψ , right?

EP from scratch

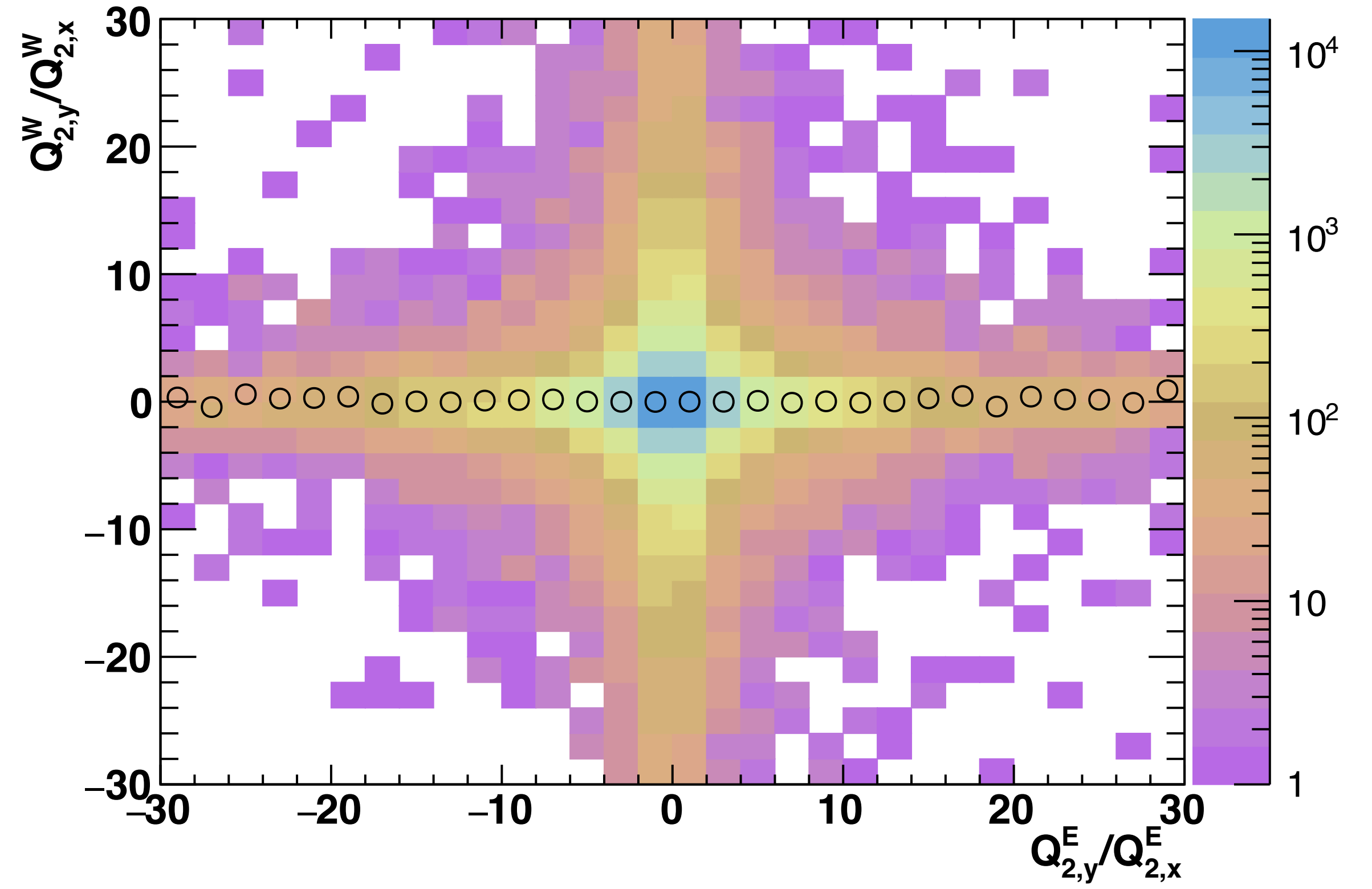
$$\Psi \sim \arctan(Q_{2,y}/Q_{2,x})$$

Centrality 20-35%



Similar level of correlation to EP angles in east and west

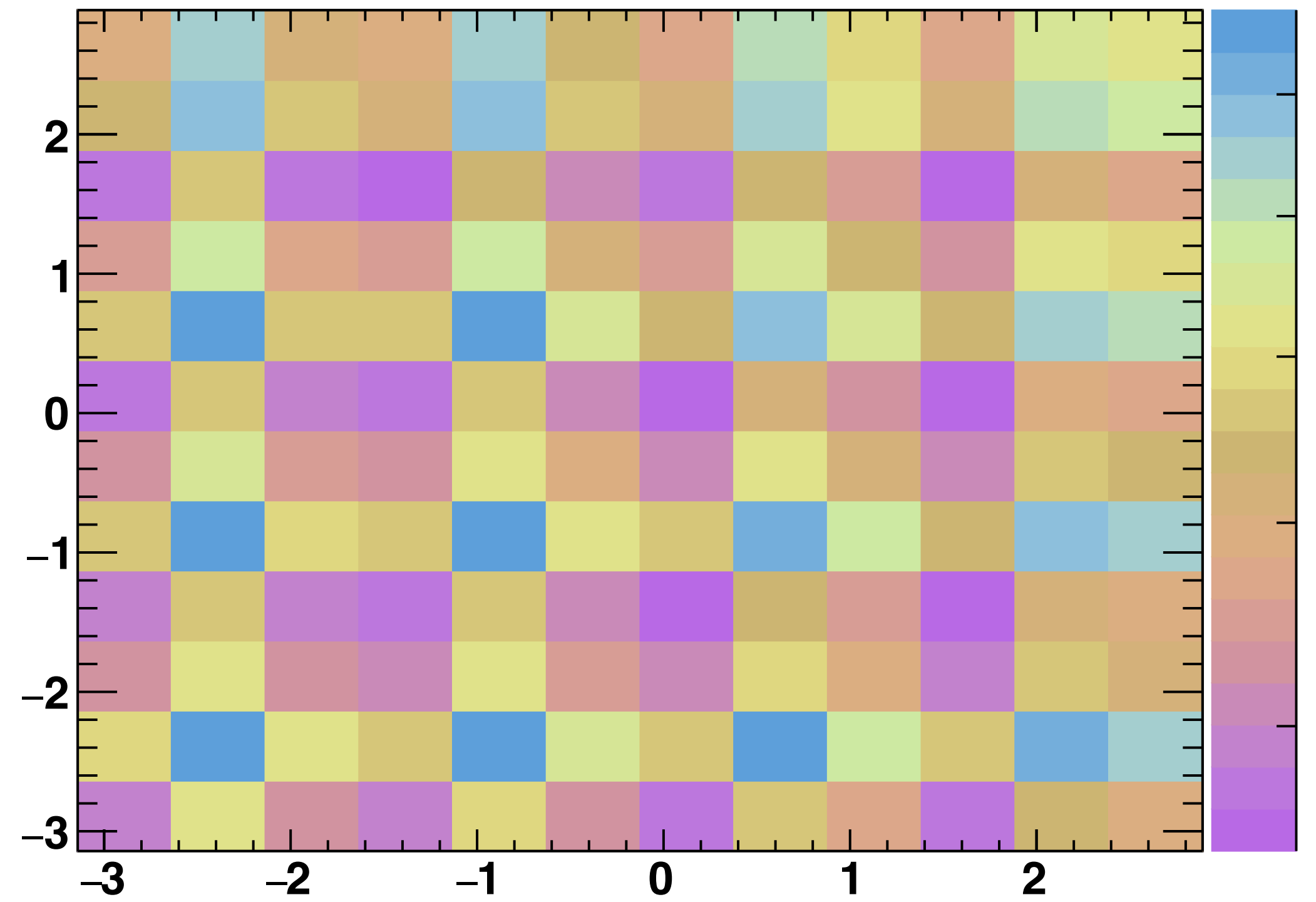
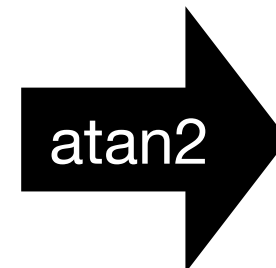
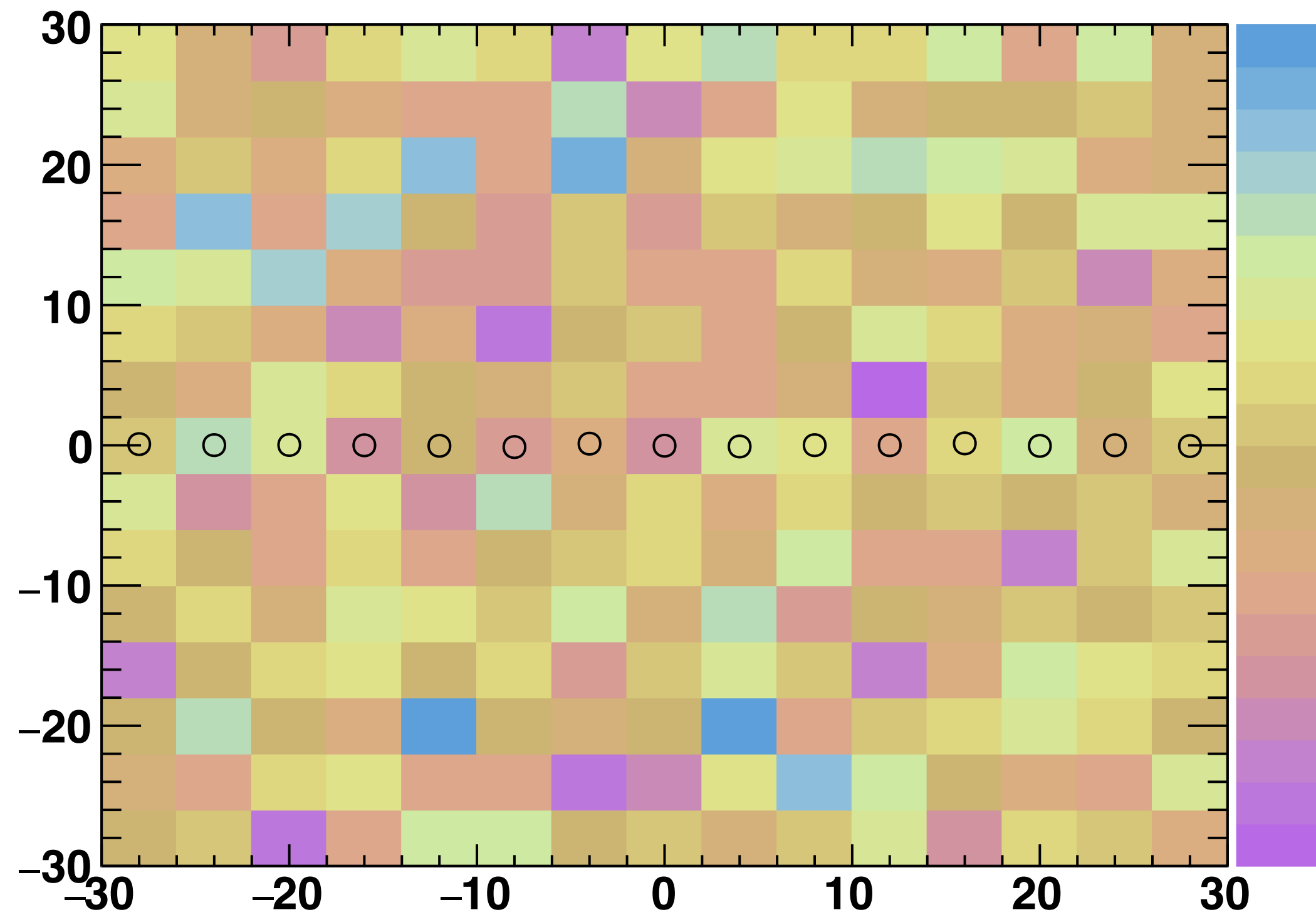
Centrality 20-35%



...despite arguments being un(anti?)correlated

Sanity check

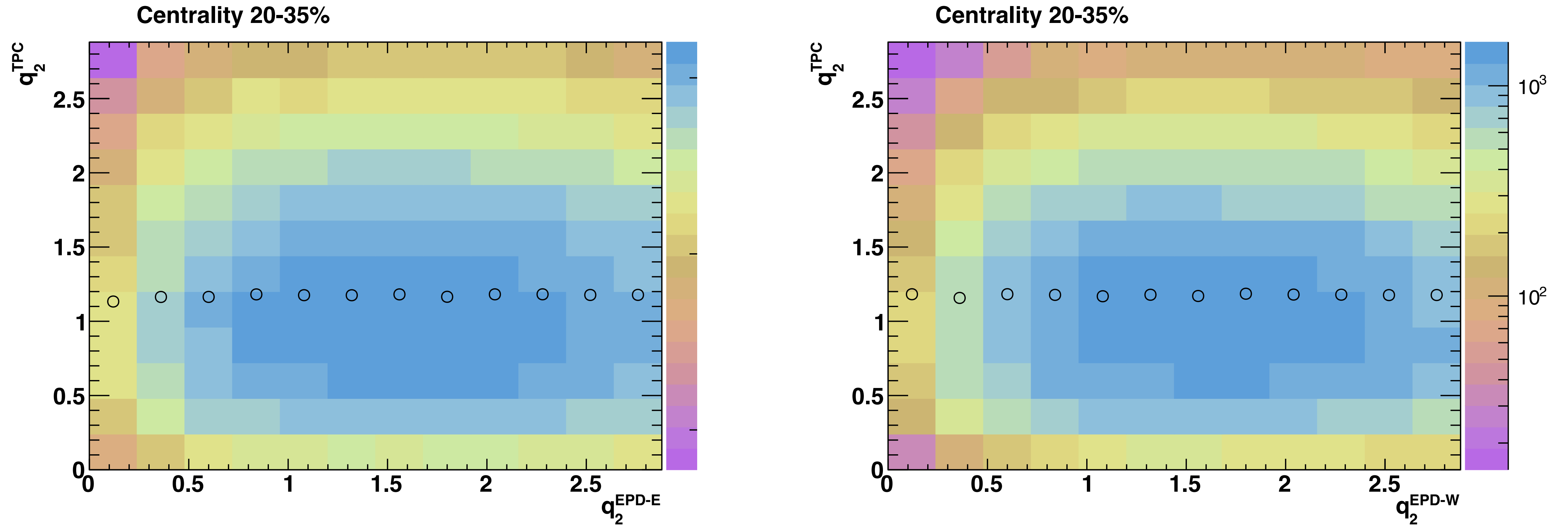
Using fake uncorrelated data



Doesn't seem to be what's happening with the $\text{atan2}()$ of the real data [or is it?], suggesting some real correlation there

Additional checks

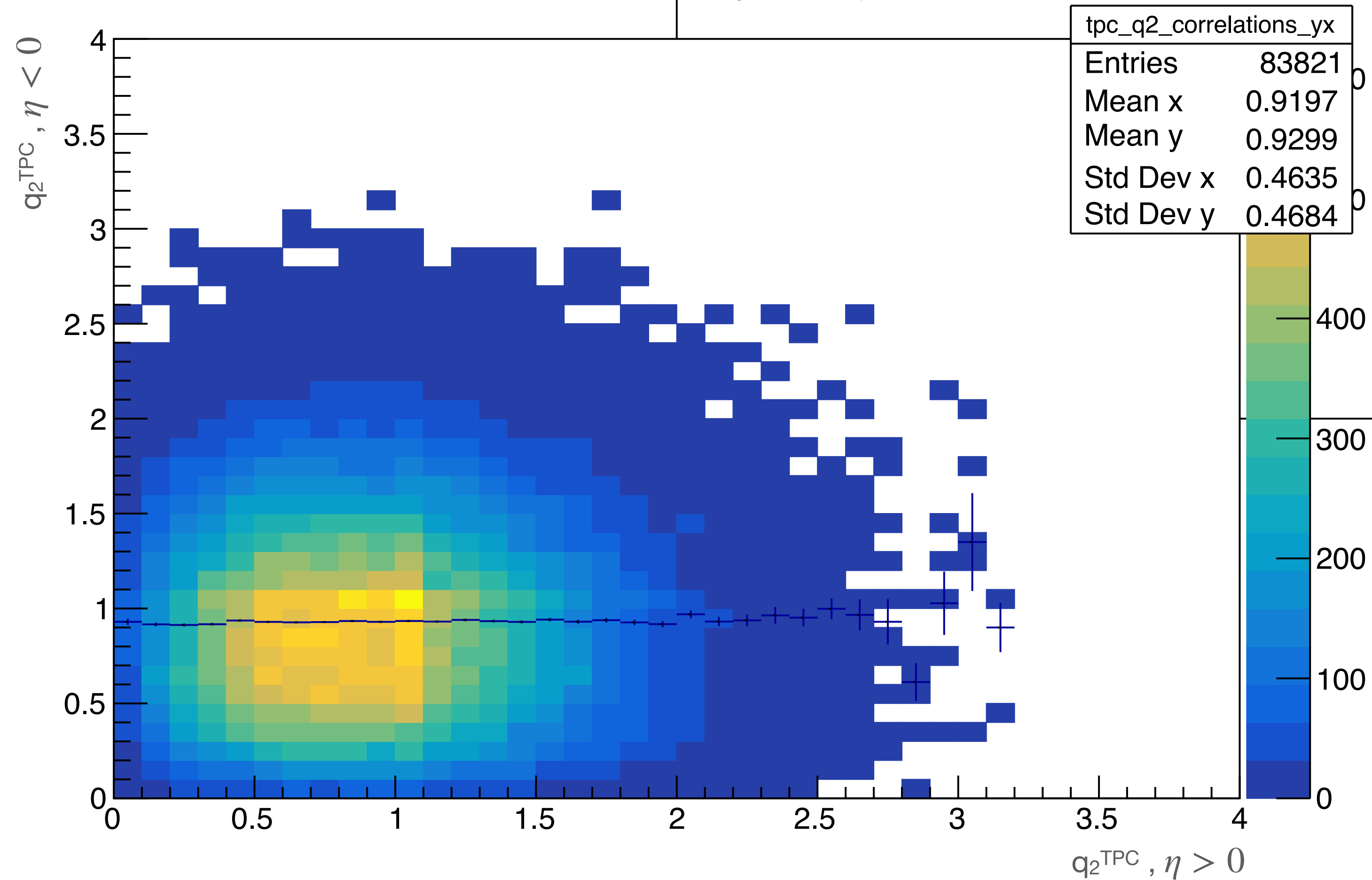
Is q_2 from EPD-E or W correlated with TPC?



No. So it's not that one half of the EPD is just wrong somehow.

TPC self-correlation?

TPC q2, $\text{letal} < 0.4$ yx projection

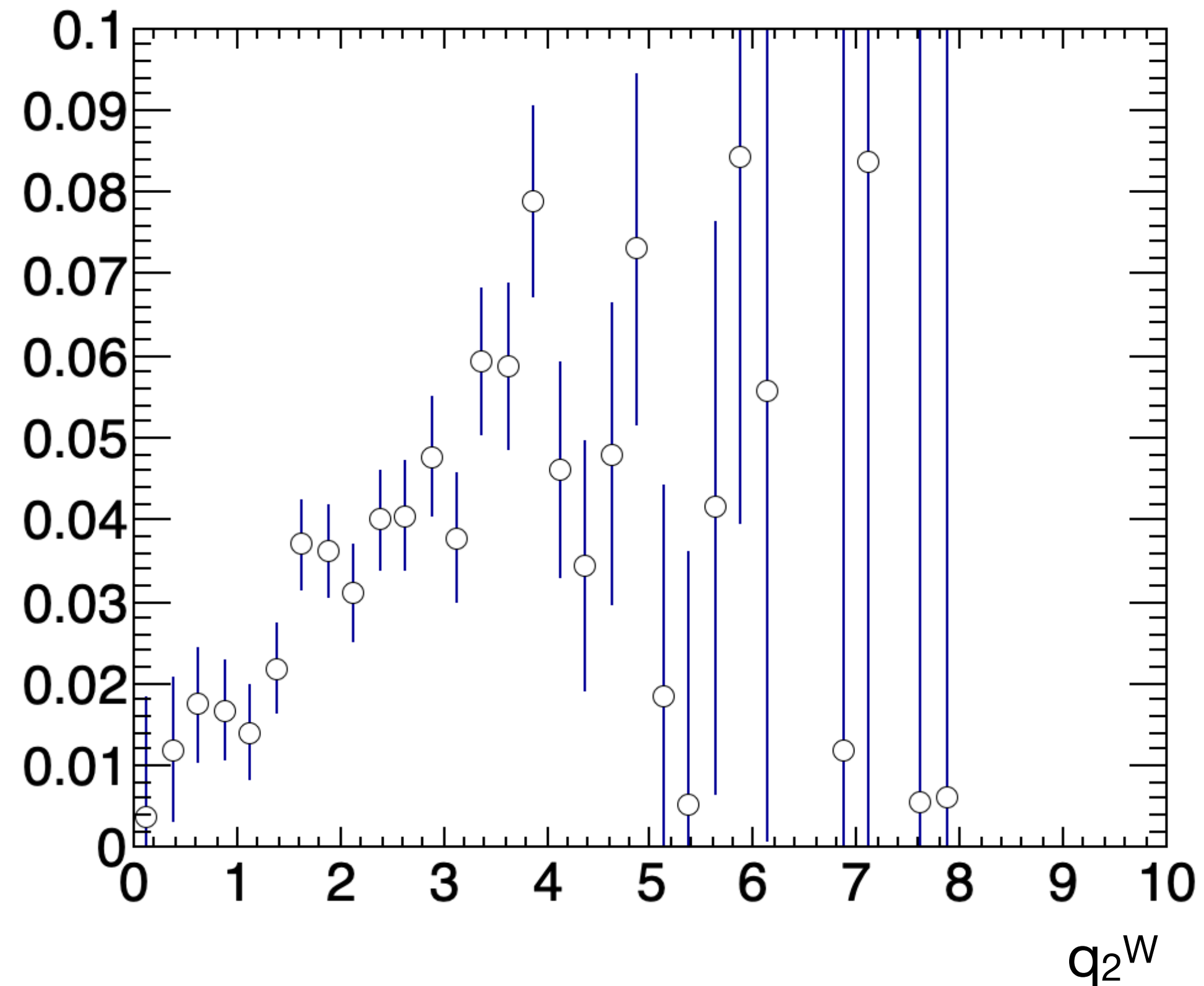


Additionally, Tristan Protzman from HP-PWG saw no correlation even between the two halves of the TPC, with independent code.
Must not be understanding something!

Additional checks

EP resolution as a function of q_2

$\langle \cos(2\Psi_{E,2} - 2\Psi_{W,2}) \rangle$ (weighted and shifted)



Do seem to improve EP resolution with increasing q_2 where not statistics-limited ($q_2 < 5$ here) as expected...not sure how this is possible

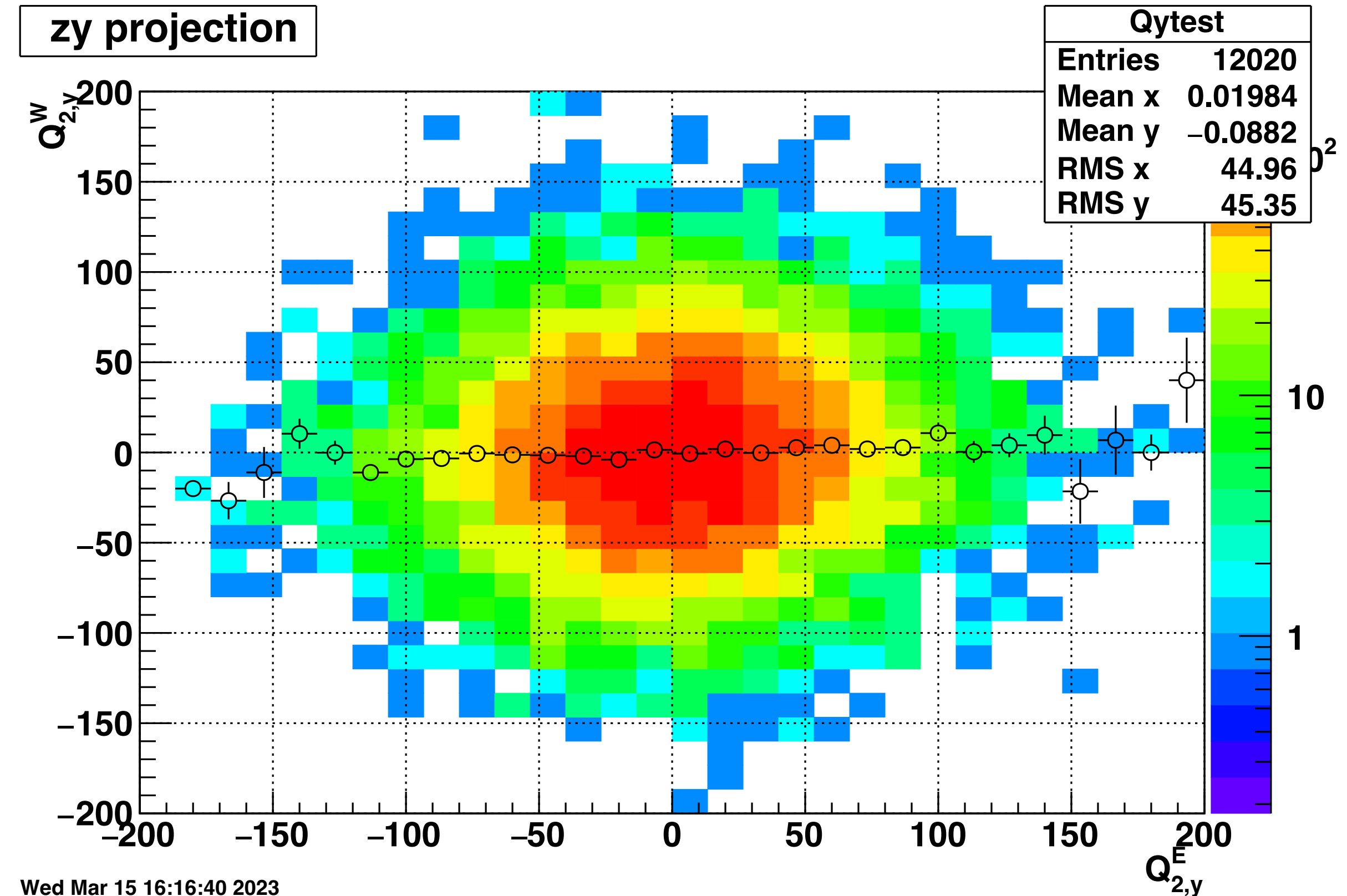
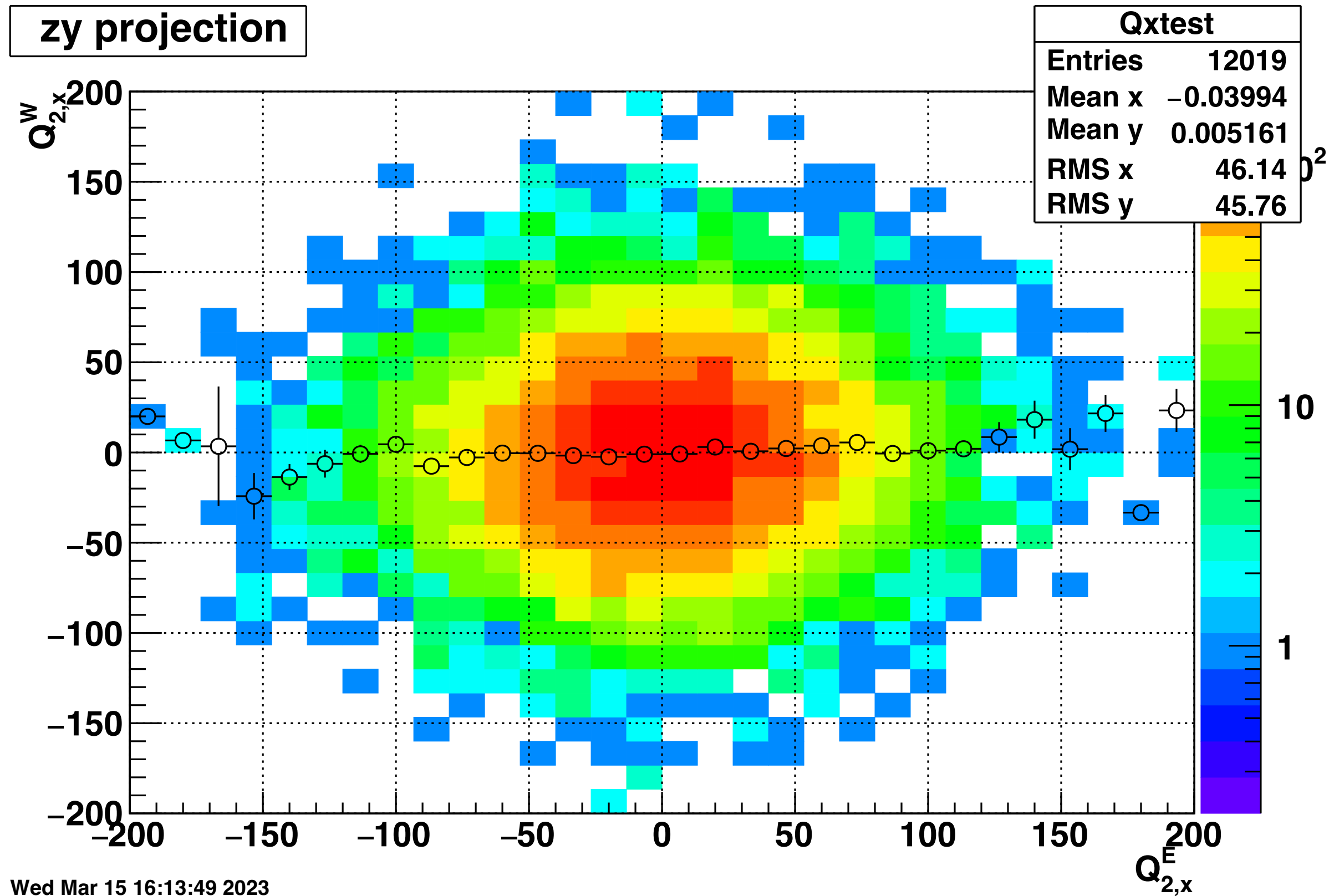
Technicalities for experts

- Running the code 3 times to get ϕ weighting and Ψ shifting and then look at the data
- Using StEpInfo functionality to obtain these quantities. E.g. `StEpInfo result = mEpFinder->Results(mEpHits,PV,cent16)`, where mEpFinder is an instance of `StEpFinder`
 - EP: `result.EastPhiWeightedAndShiftedPsi(2)`
 - $Q_{2,x}$: `result.WestPhiWeightedQ(2).X()* result.WestSumWeightsPhiWeighted(2)` [because the code seems to normalize by $1/M$ [l. 269 [here](#)], which we don't want at this stage.]
 - q_2 : `sqrt(pow(result.WestPhiWeightedQ(2).X(), 2) + pow(result.WestPhiWeightedQ(2).Y(),2))*sqrt(result.WestSumWeightsPhiWeighted(2))` [to end with overall $1/\sqrt{M}$ normalization]

All comments are appreciated!

Update:

Wrong axes on s. 5



I think I wanted -300 to 300 but typo'd to -30 to 30. When zooming out (after running for about 100k events total just to get an idea) if there's a correlation it's miniscule.