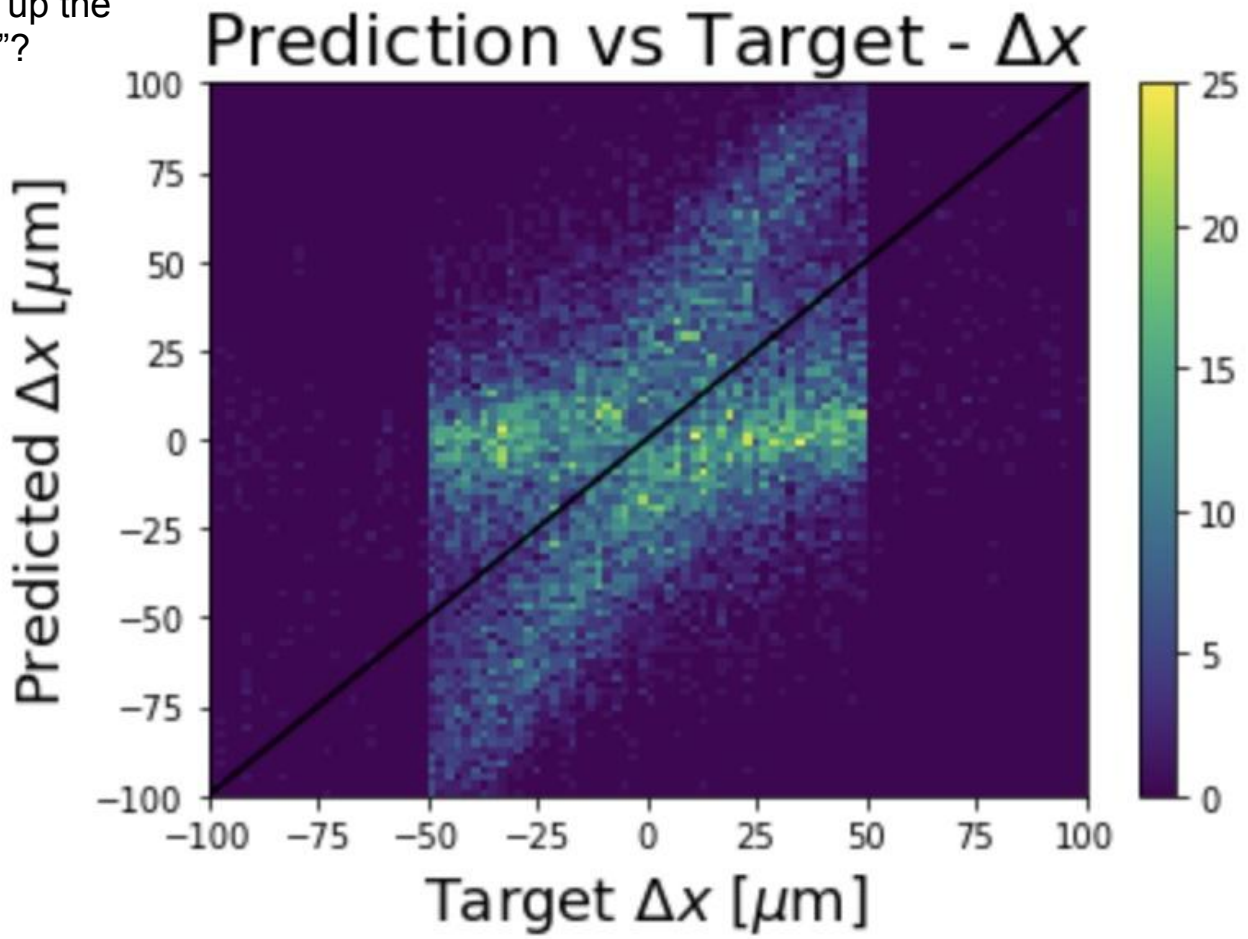
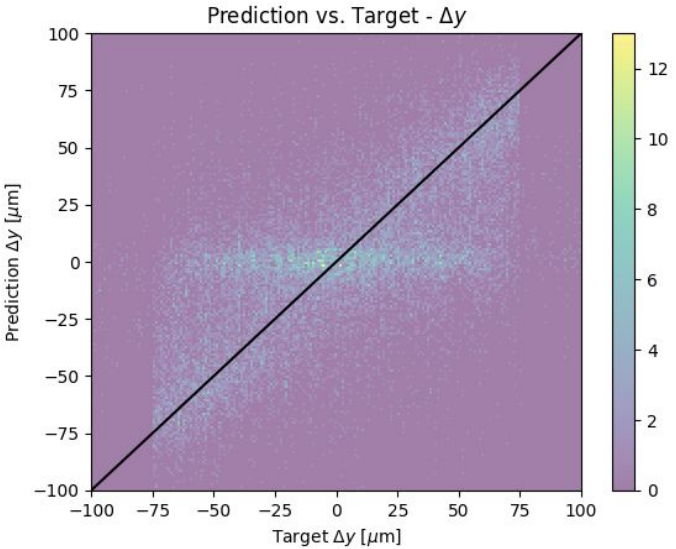
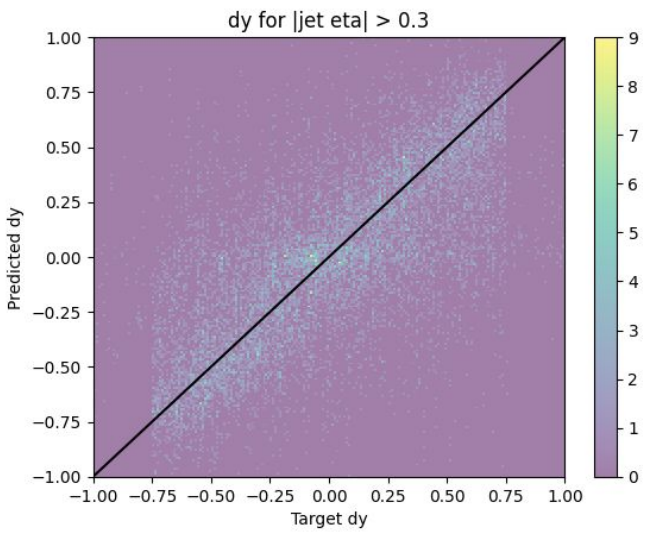
Results of dx Decomposition Attempt

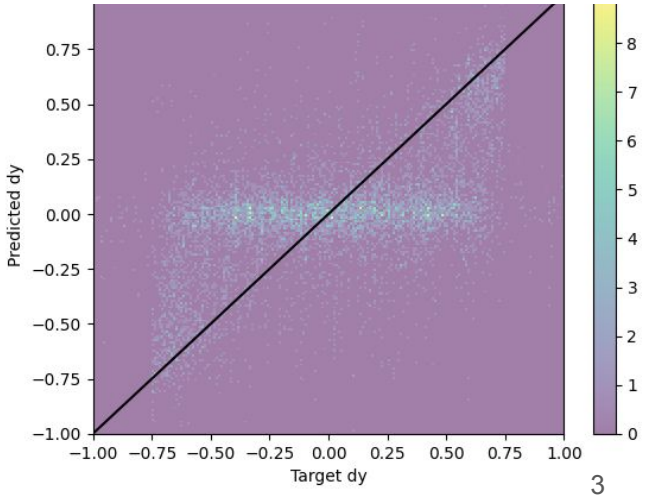
Liam O’Shaughnessy - 21/07/23 - DeepCore Studies

How to break up the “boomerangs”?









Conditioning on an underlying parameter worked here

$\Delta x_{pred} = f(\theta_1, \theta_2, ..., \theta_n)$ from neural network

If θ_i is causing boomerangs, then for $A = \{\Delta x_{pred_i} \mid \theta_i > c\}$ and $B = \{\Delta x_{pred_i} \mid \theta_i < c\}$,

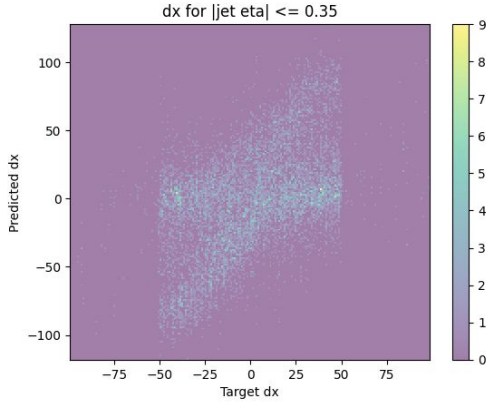
$\{(\Delta x_{target_{corr.\,A}}, A)\}$ and $\{(\Delta x_{target_{corr.\,B}}, B)\}$, where each A and B value is paired with its target,

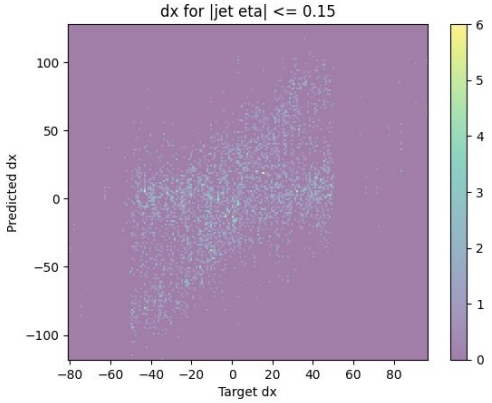
should yield the boomerangs $\Rightarrow$ problem is to find θ_i, c

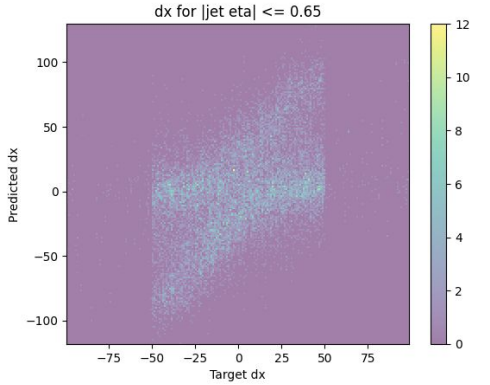
For reference, the threshold used throughout is
(pixel_pred_prob > 0.7 && pixel_true_prob == 1)

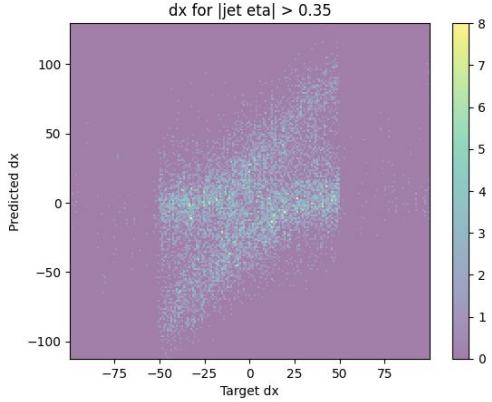
Naive approach: |jet eta| < 0.3 could separate dy, can it here?

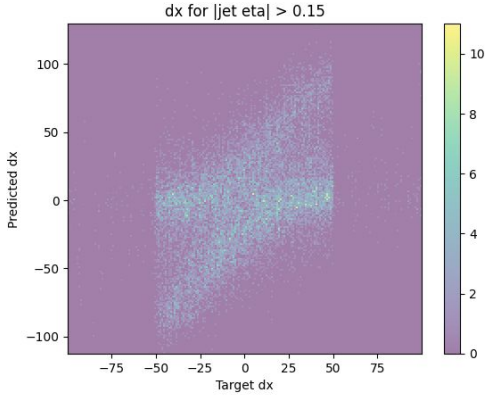
It appears not, neither can other values

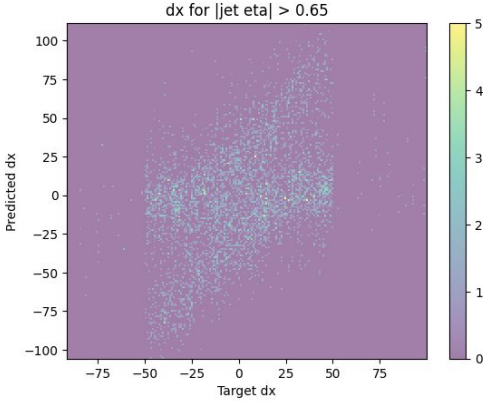








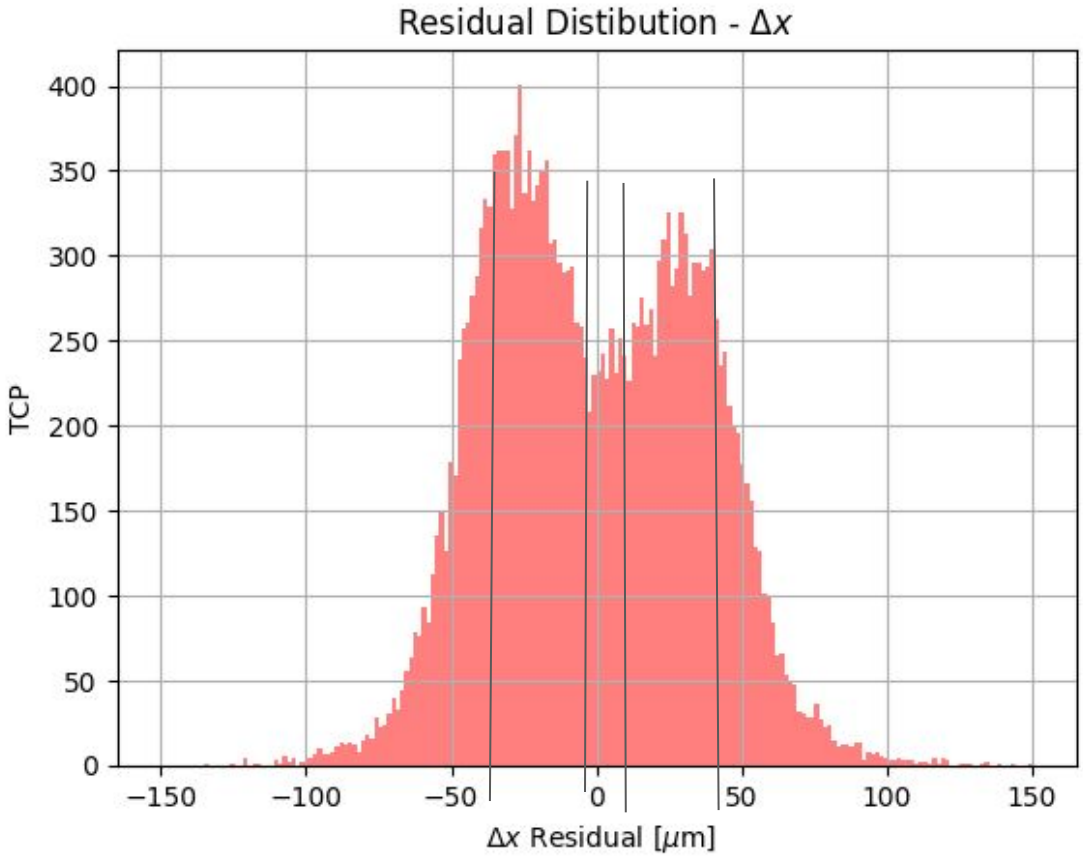


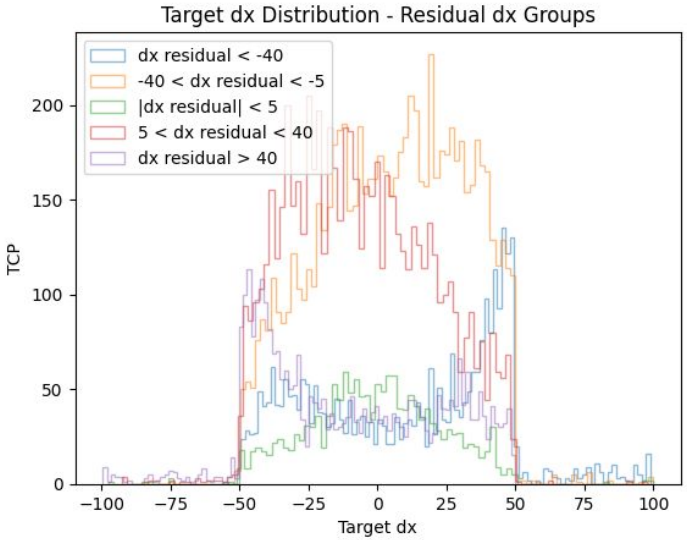


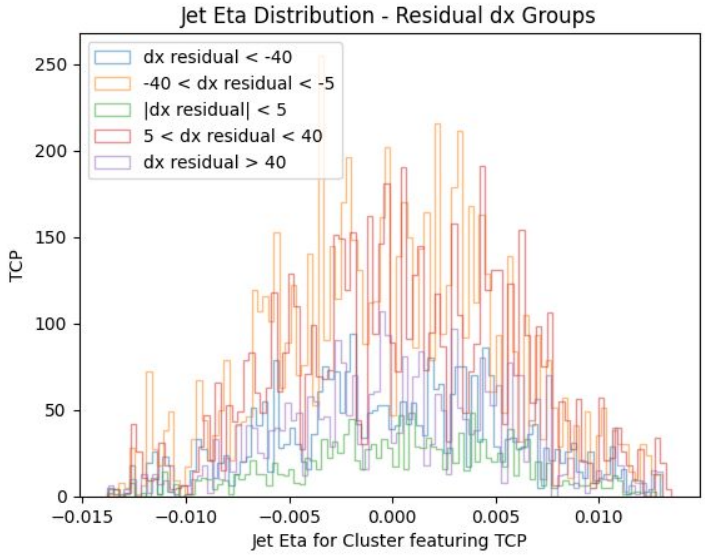
Attempt one: since residual distribution is bimodal, look at these groups, and accurate residuals?

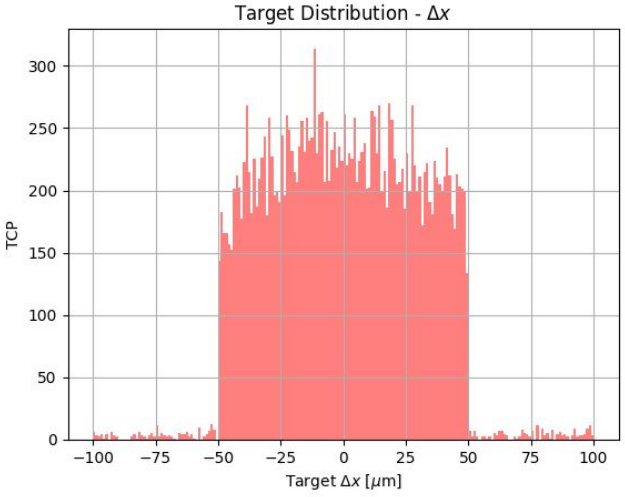
Groups are:

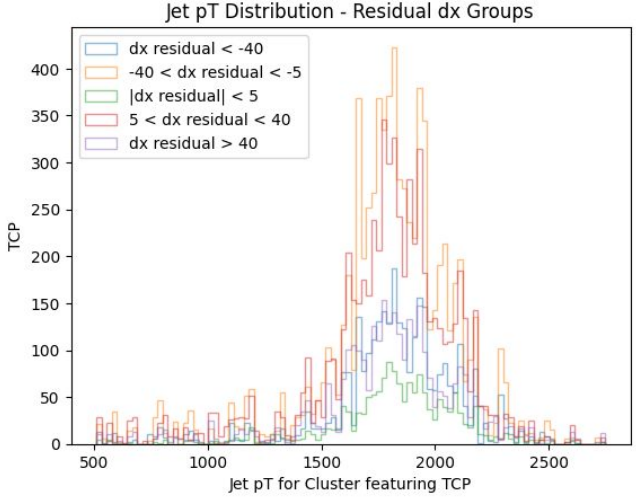
Resid < -40
-40 <resid < -5
-5 < resid < 5
5 < resid < 40
40 < resid

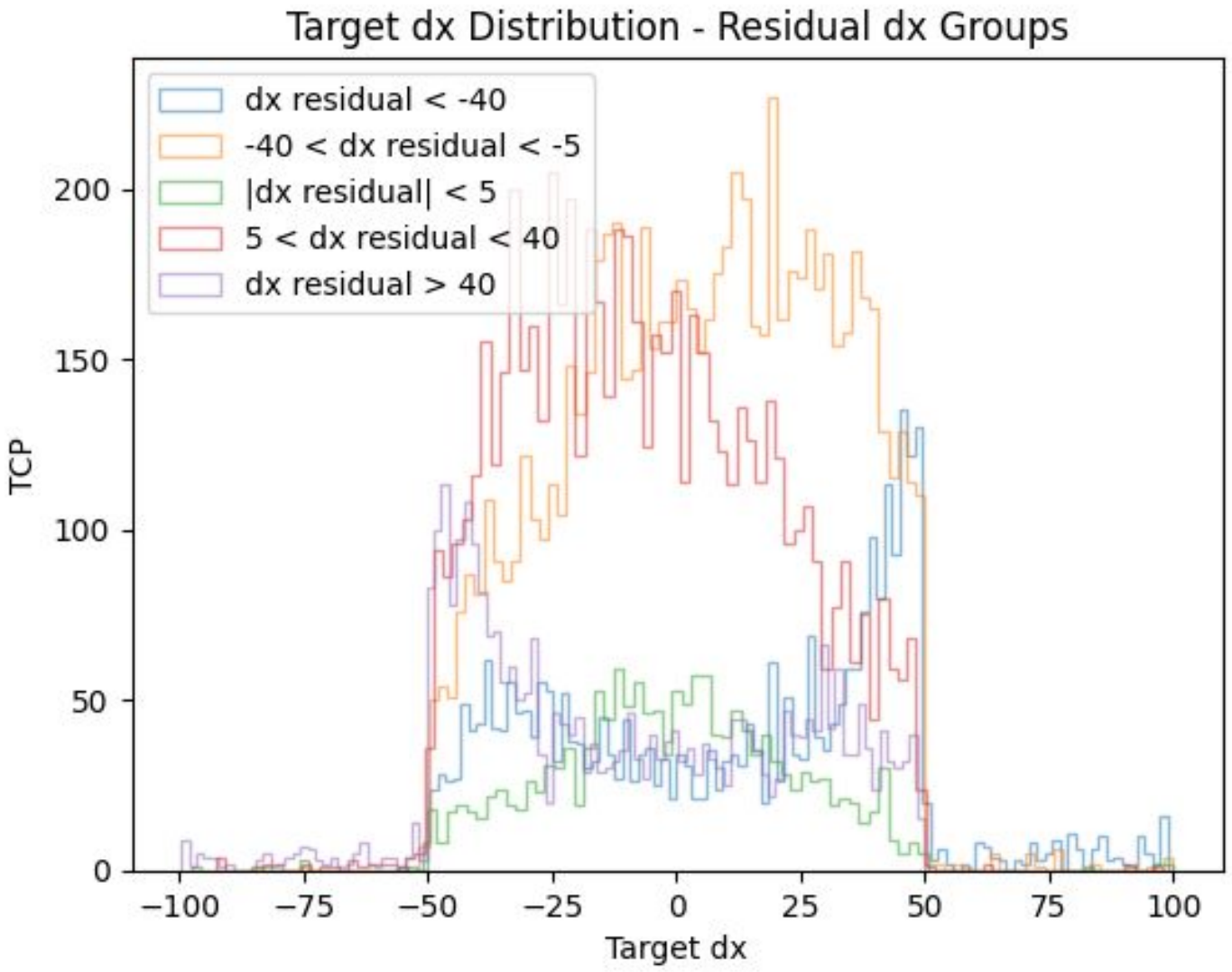


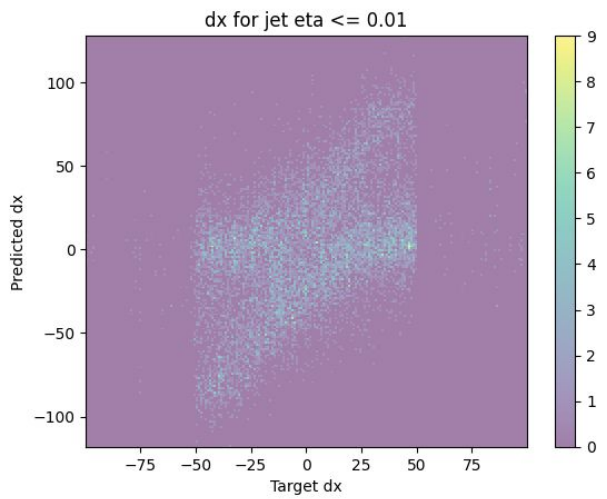

Target dx Distribution - Residual dx Groups
dx residual < -40
-40 < dx residual < -5
|dx residual| < 5
5 < dx residual < 40
dx residual > 40
TCP
Target dx

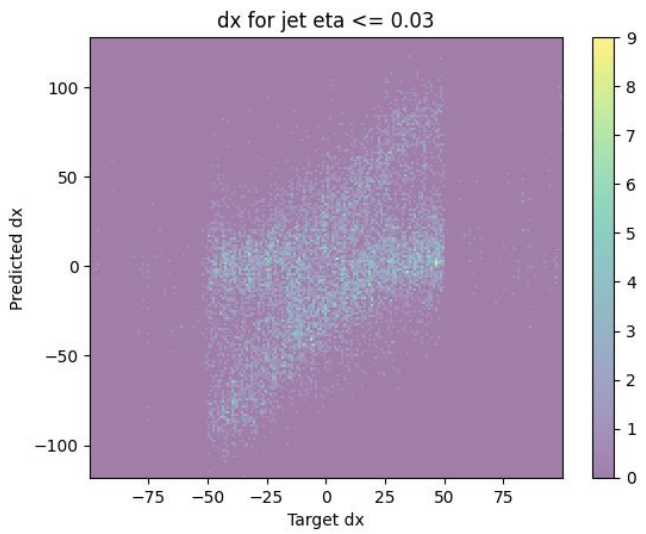

Jet Eta Distribution - Residual dx Groups
dx residual < -40
-40 < dx residual < -5
|dx residual| < 5
5 < dx residual < 40
dx residual > 40
TCP
Jet Eta for Cluster featuring TCP


Target Distribution - Δx
TCP
Target Δx [μm]

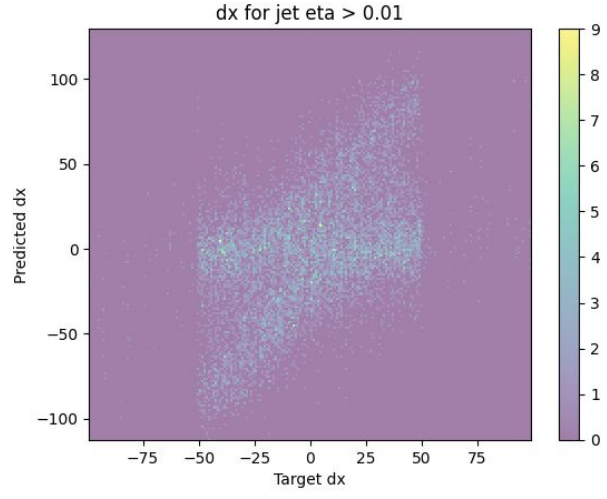

Jet pT Distribution - Residual dx Groups
dx residual < -40
-40 < dx residual < -5
|dx residual| < 5
5 < dx residual < 40
dx residual > 40
TCP
Jet pT for Cluster featuring TCP

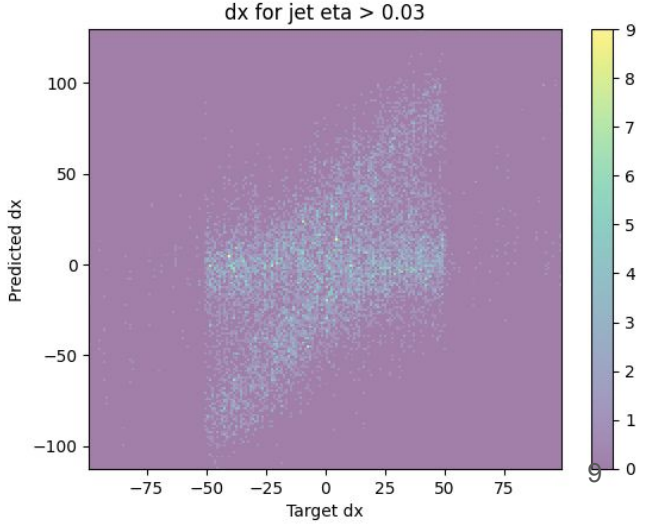

Target dx Distribution - Residual dx Groups
dx residual < -40
-40 < dx residual < -5
|dx residual| < 5
5 < dx residual < 40
dx residual > 40
TCP
0
50
100
150
200
−100
−75
−50
−25
0
25
50
75
100
Target dx

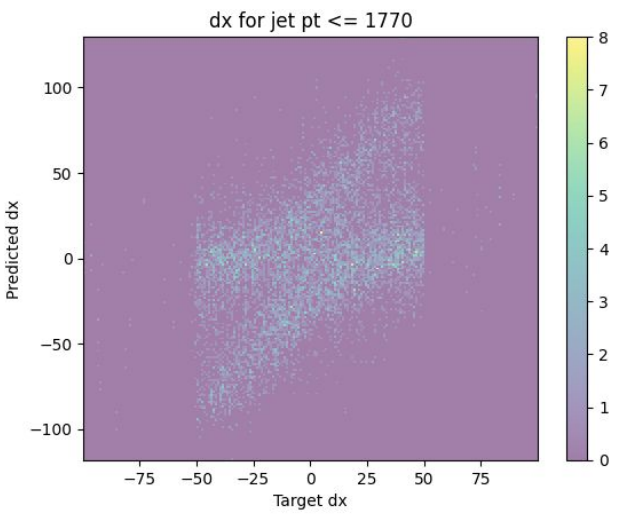


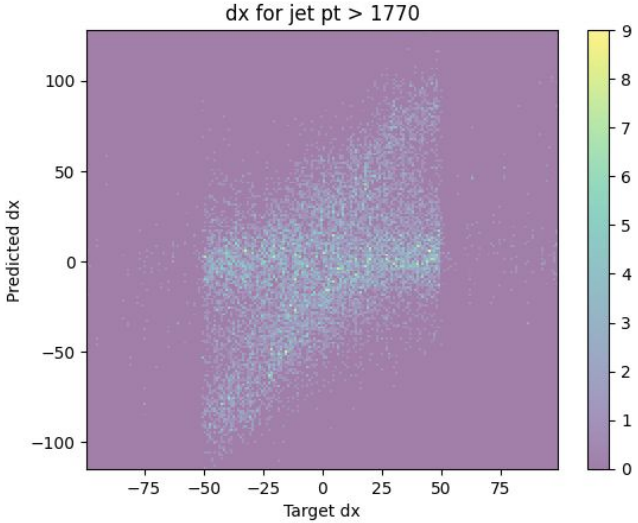


Appears that trying to split these distributions for eta has no impact



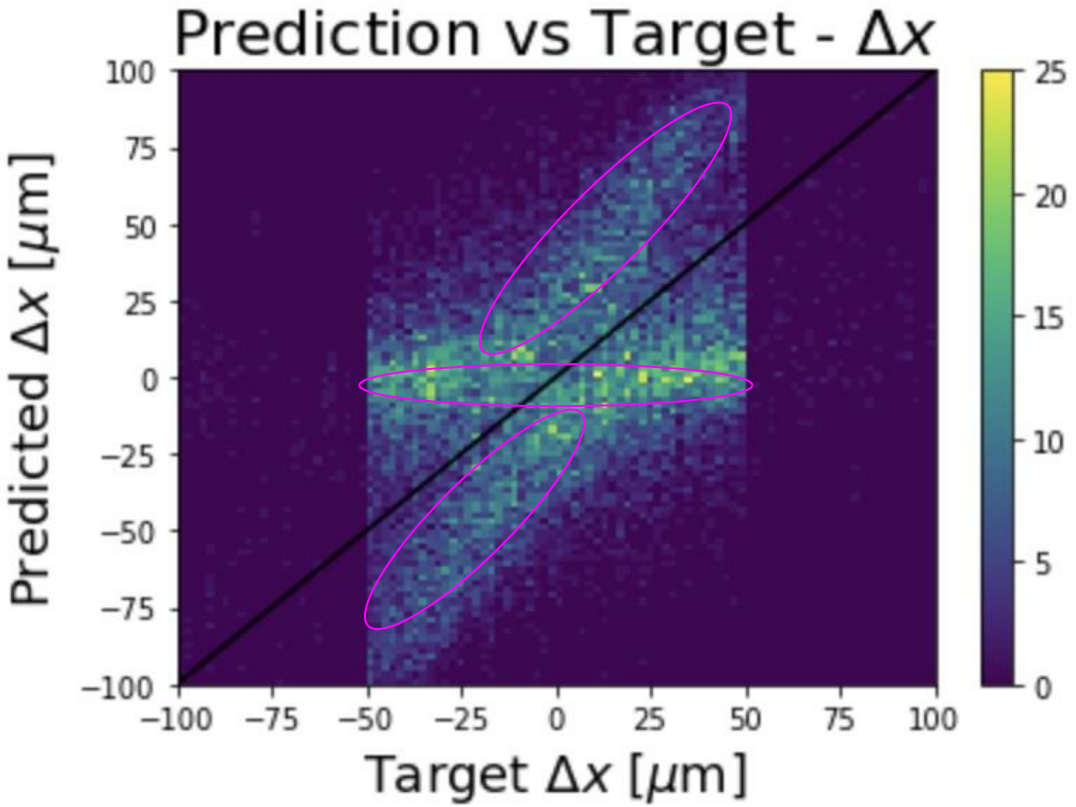


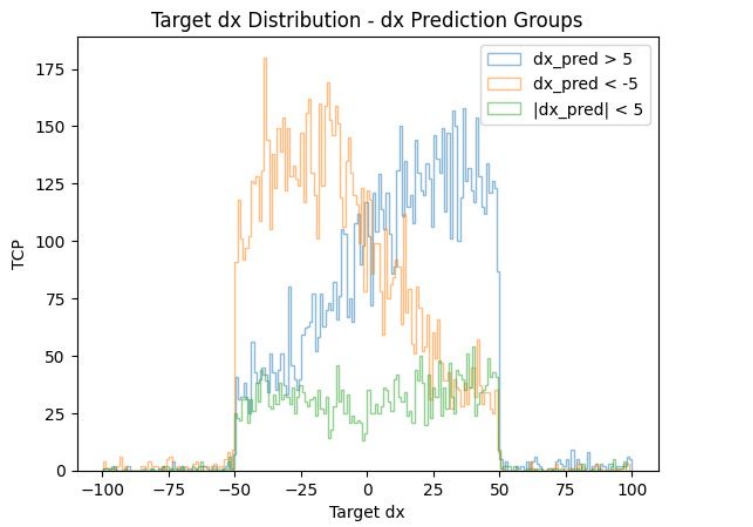


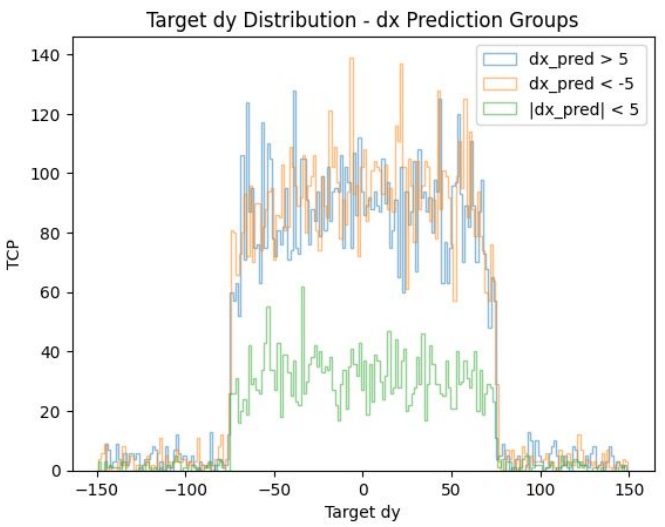


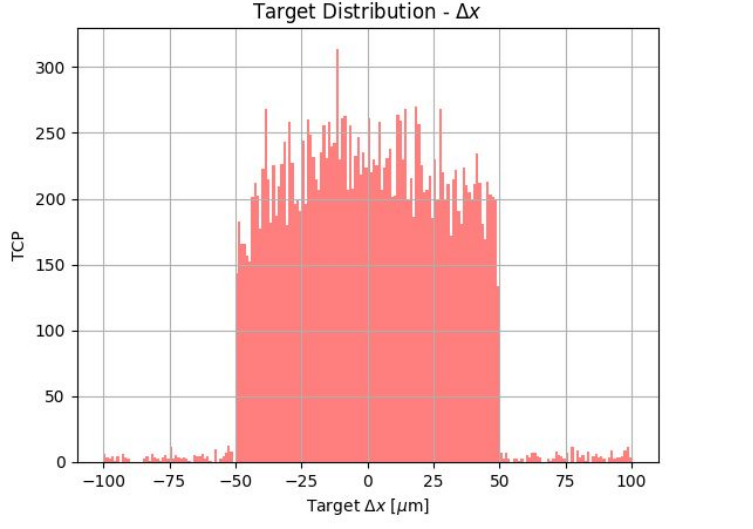
Using those splits for pt do not appear to be successful either

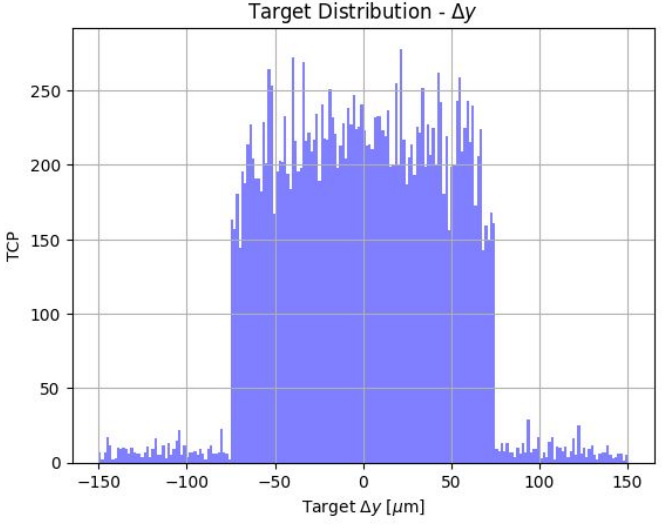
Attempt two: look at what gets predicted to a positive, negative, and near 0 value -> try to separate these means

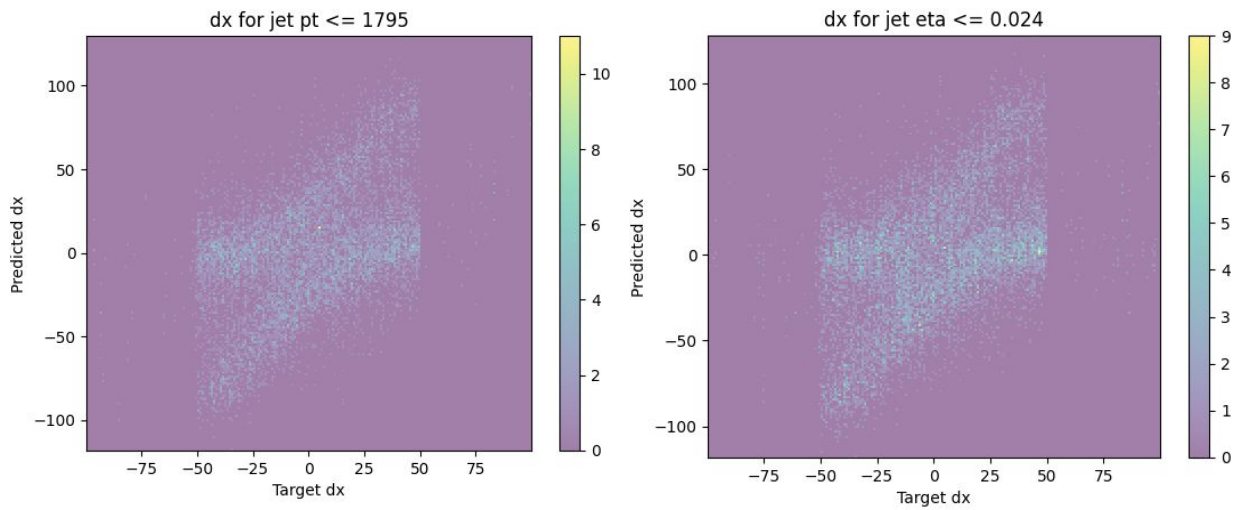


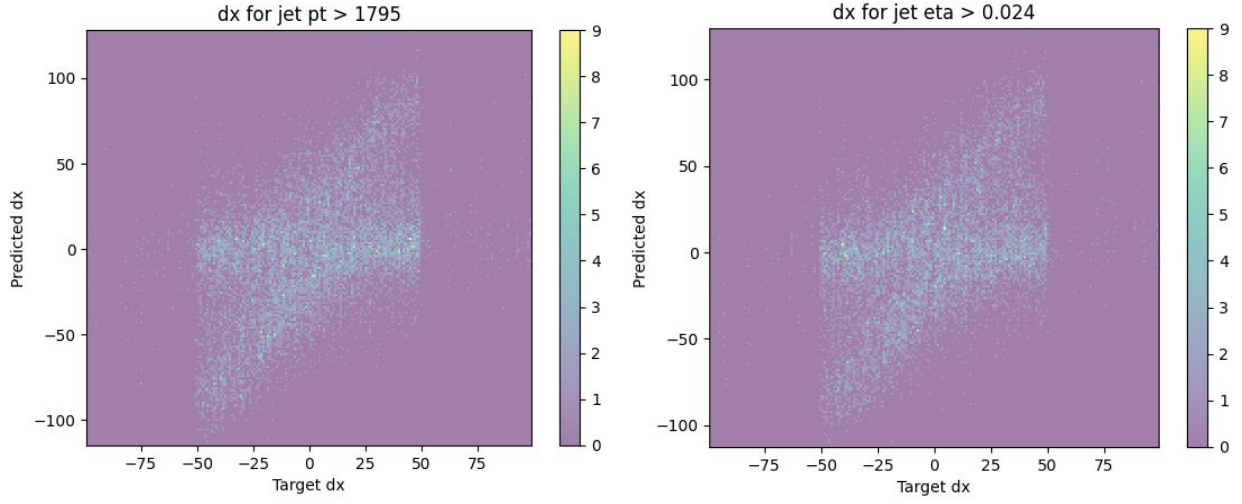

Target dx Distribution - dx Prediction Groups
dx_pred > 5
dx_pred < -5
|dx_pred| < 5
TCP
Target dx


Target dy Distribution - dx Prediction Groups
dx_pred > 5
dx_pred < -5
|dx_pred| < 5
TCP
Target dy

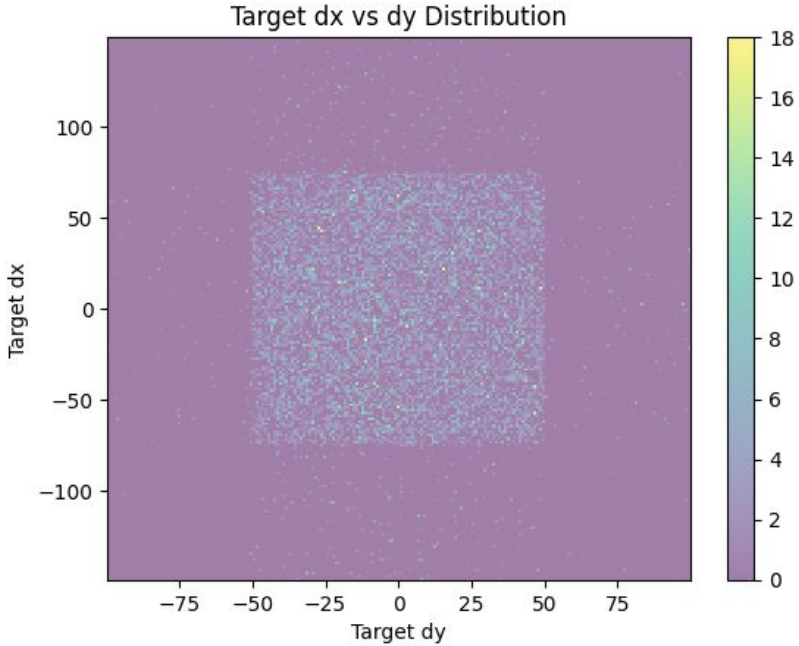

Target Distribution - Δx
TCP
Target Δx [μm]

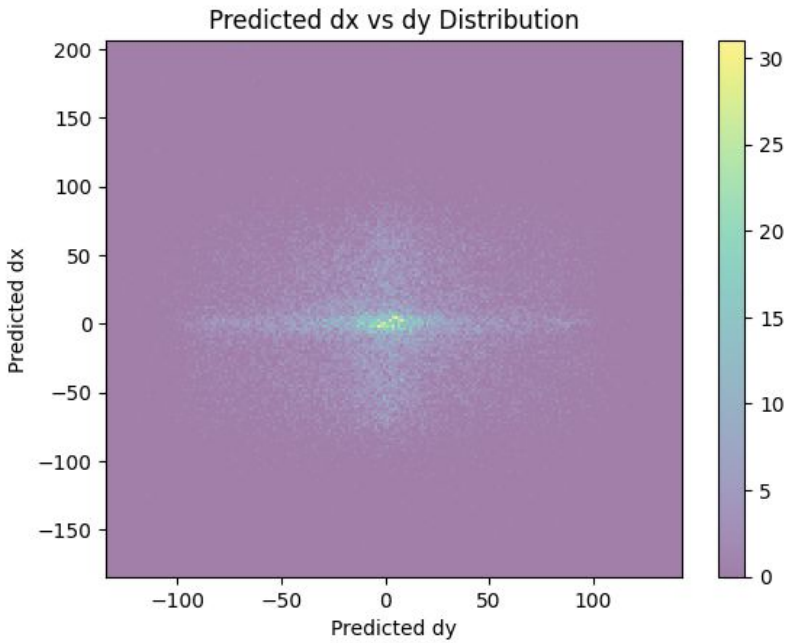

Target Distribution - Δy
TCP
Target Δy [μm]





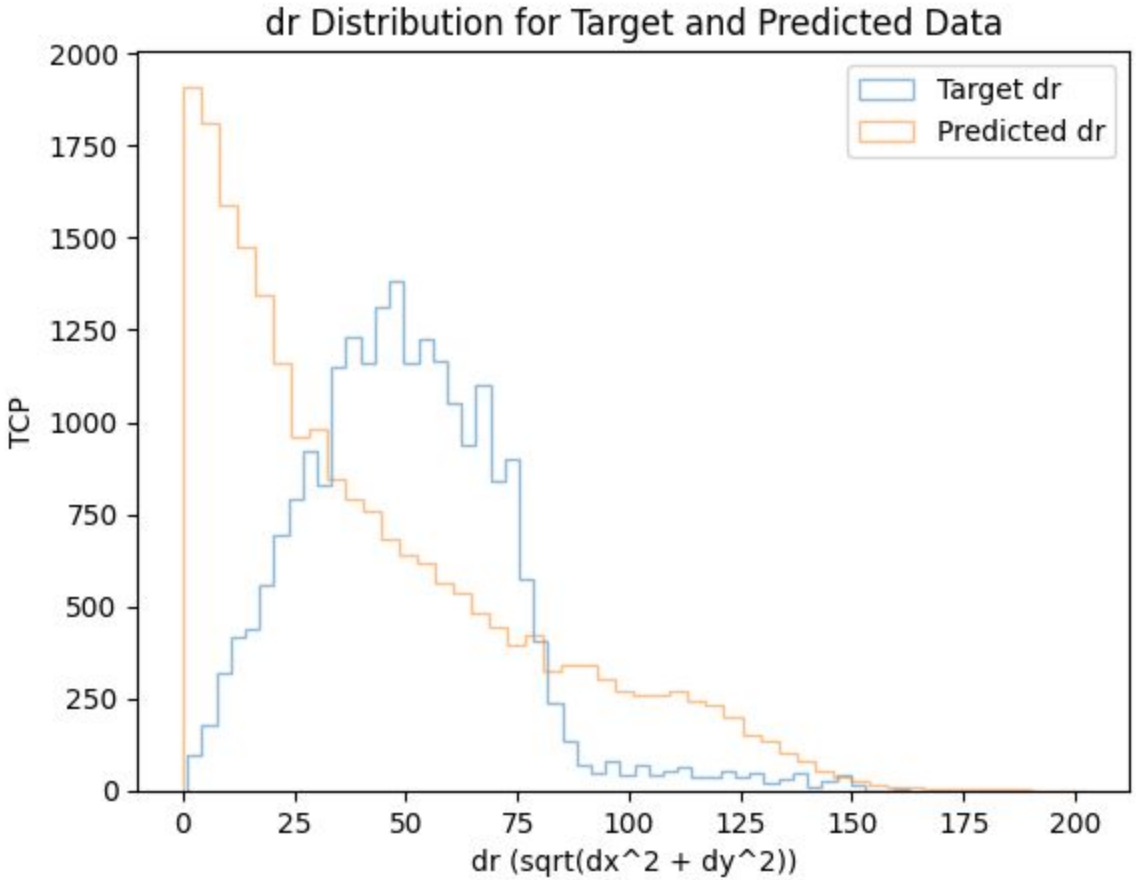
When computed the distribution of these eta and p_T's, not really much





Makes sense that target is uniform, predicted has two “sent to zero” lines
- dx is stronger

This leads to the most common dr being 0



In general, the compared 1-D histogram distributions do not appear significantly different (with mean/sd and appearance), and the attempts at splitting the plots do not appear to be successful. This leads me to think one or more of the following:

1. There is some “magic value” to split some of the groups by that I haven’t caught
2. The split groups need to be conditioned on two or more parameters i.e. jet eta > a and jet pt < b
3. The groups can be split by another parameter, but it isn’t one that I have in my notebook (maybe something in the ROOT files)
4. The trends are not separable by underlying parameters, and this is instead an issue with how the neural network is generating the predicted dx distribution - adding dr?