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PID Considerations for Jet Substructure

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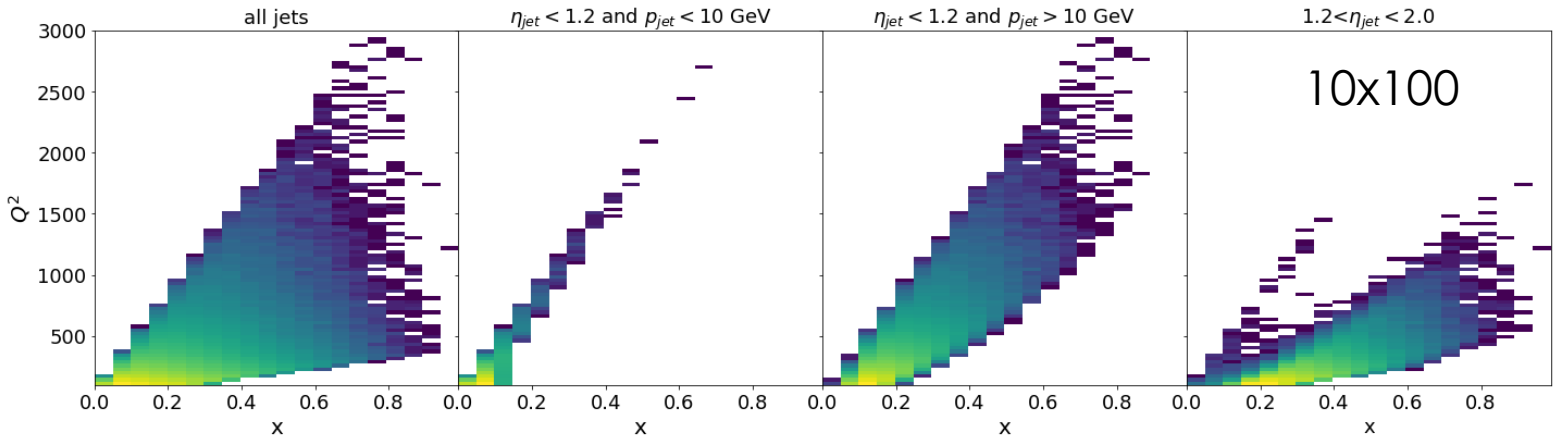
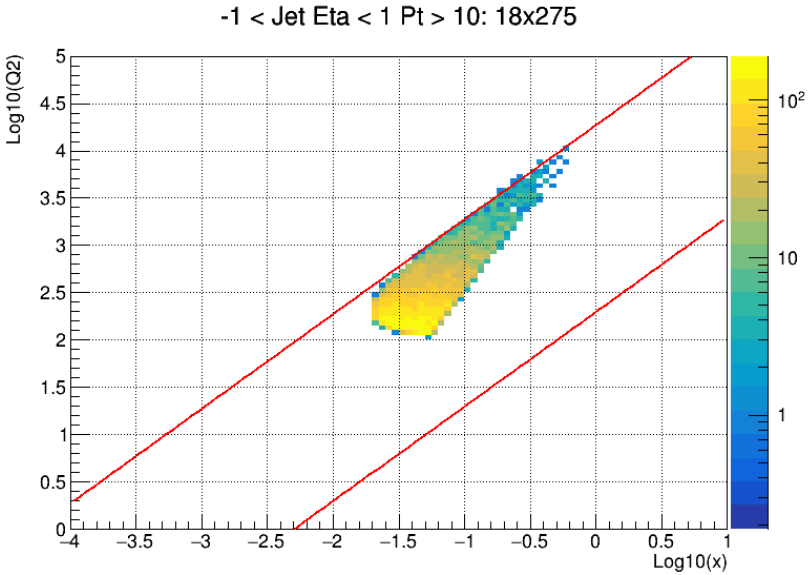
Overview

- Current detector matrix PID requirements limit PIDed high z reach
- Many questions by others in EICUG about whether changing COM energy, Q^2, etc. would allow us to access high z
- Studied (z, j_T) loss of statistics as function of x, Q^2, COM energy

Jet x-Q^2 Phase Space





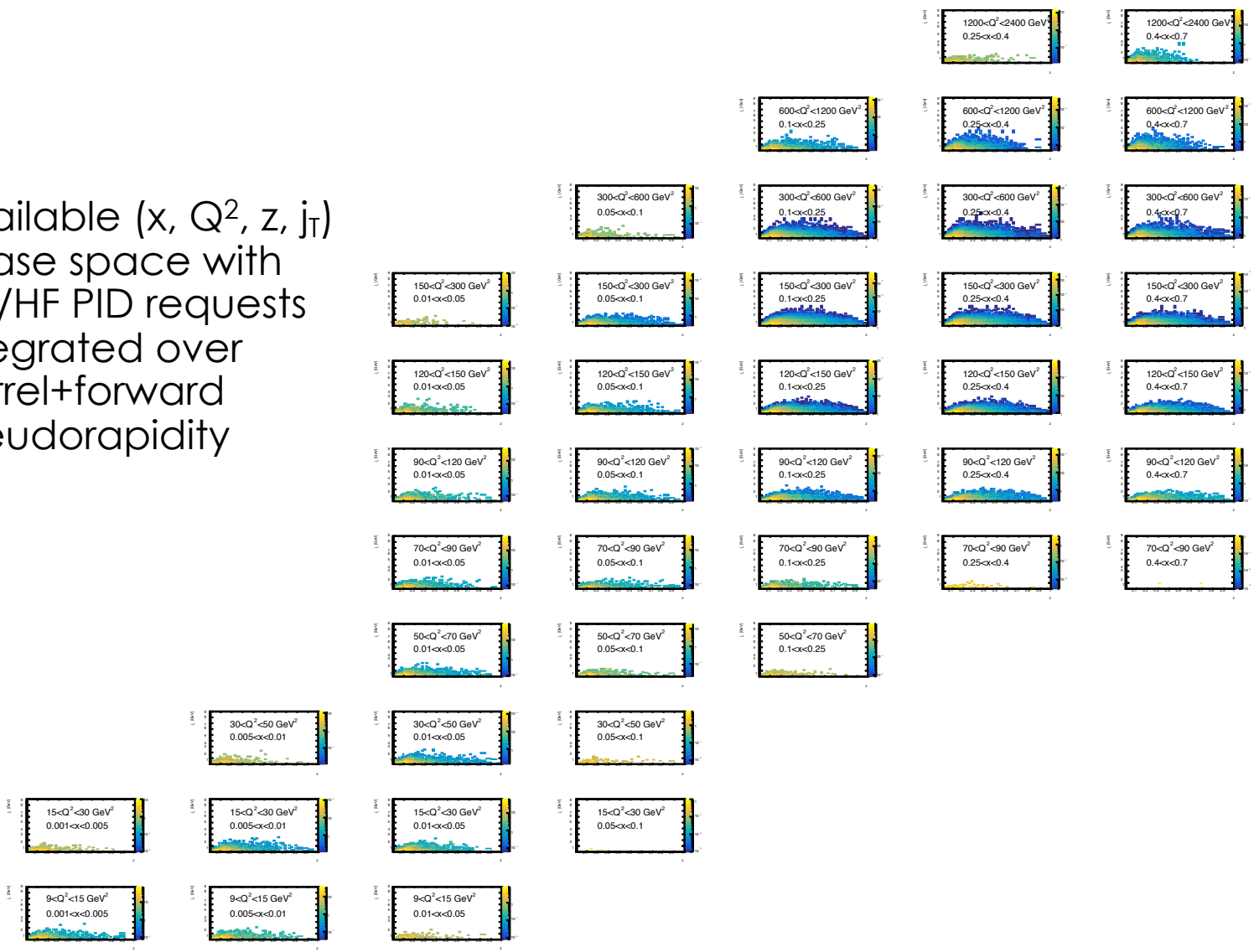
- Brian and Miguel made these nice plots showing where in x-Q^2 jets actually are produced
- Provide some context of event kinematic phase space probed

10x100

p_T^{jet}>10 GeV

$\pi^{\pm}$-in-jet

- Available (x, Q^2, z, j_T) phase space with Jet/HF PID requests
- Integrated over barrel+forward pseudorapidity

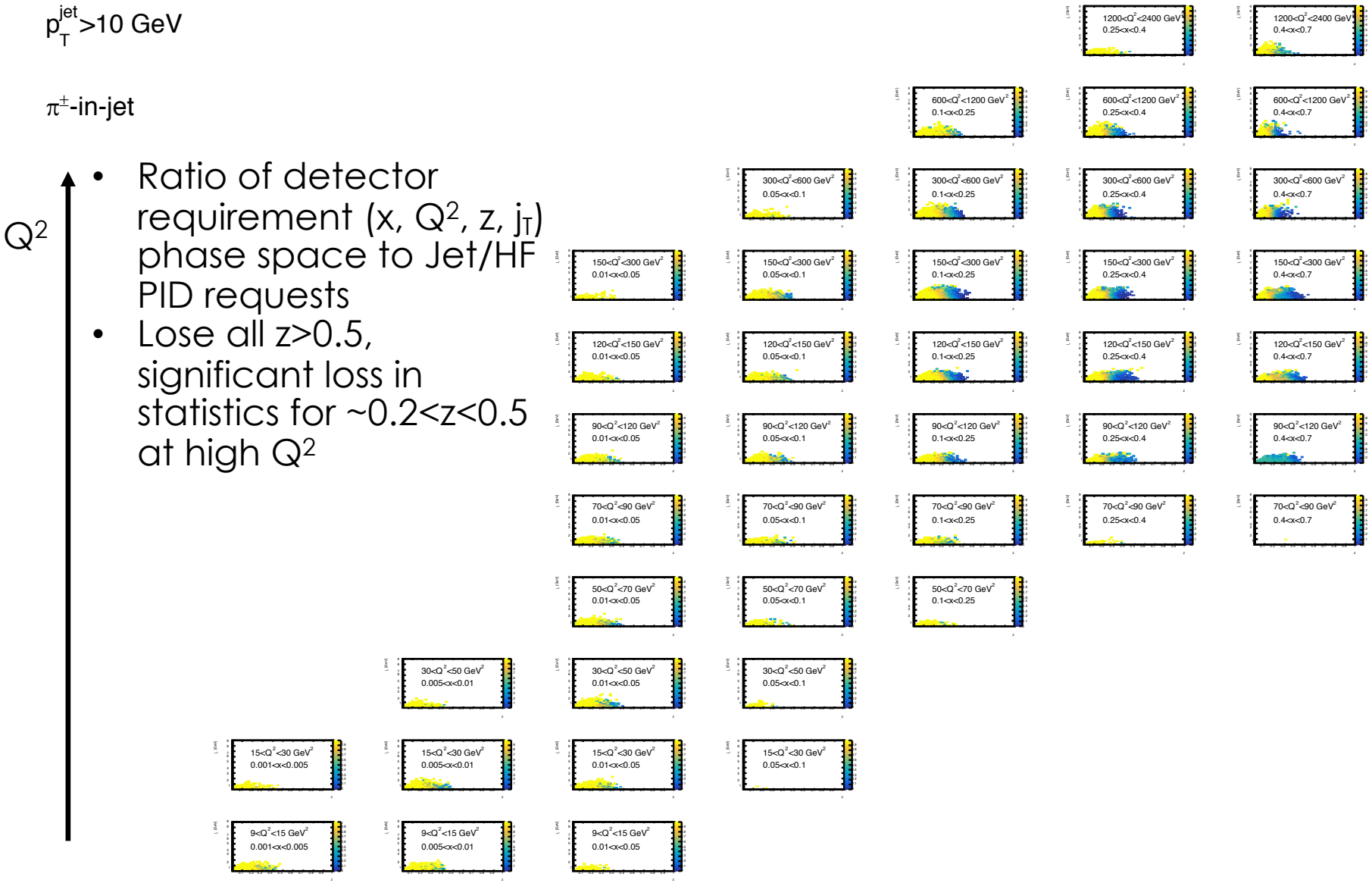


10x100

p_T^{jet}>10 GeV

$\pi^{\pm}$-in-jet

- Ratio of detector requirement (x, Q^2, z, j_T) phase space to Jet/HF PID requests
- Lose all z>0.5, significant loss in statistics for ~0.2<z<0.5 at high Q^2



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10x100

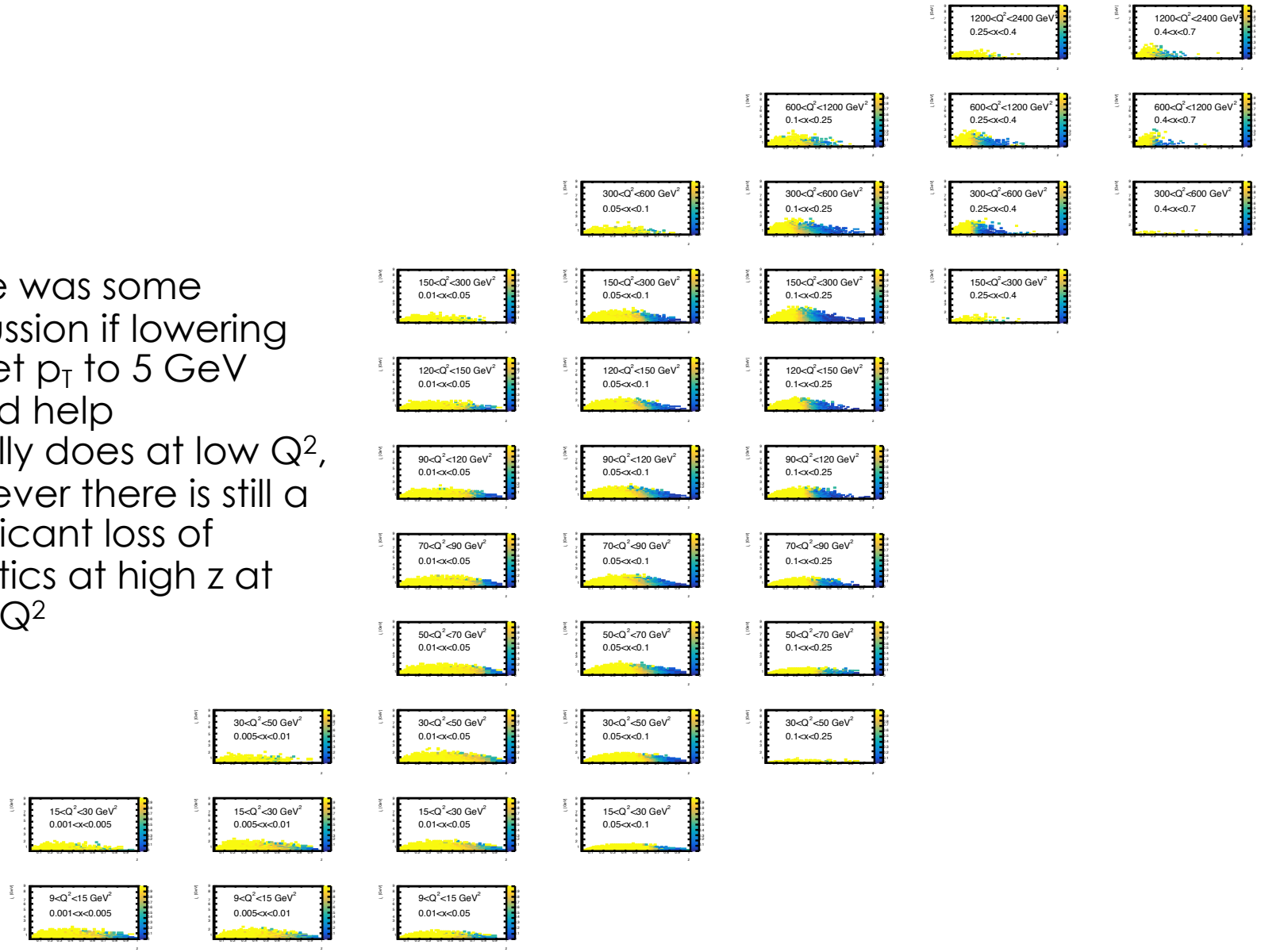
Limited to Barrel

p_T^{jet}>5 GeV

$\pi^{\pm}$-in-jet

$|\eta^{jet}|$<1

- There was some discussion if lowering the jet p_T to 5 GeV would help
- Trivially does at low Q^2, however there is still a significant loss of statistics at high z at high Q^2



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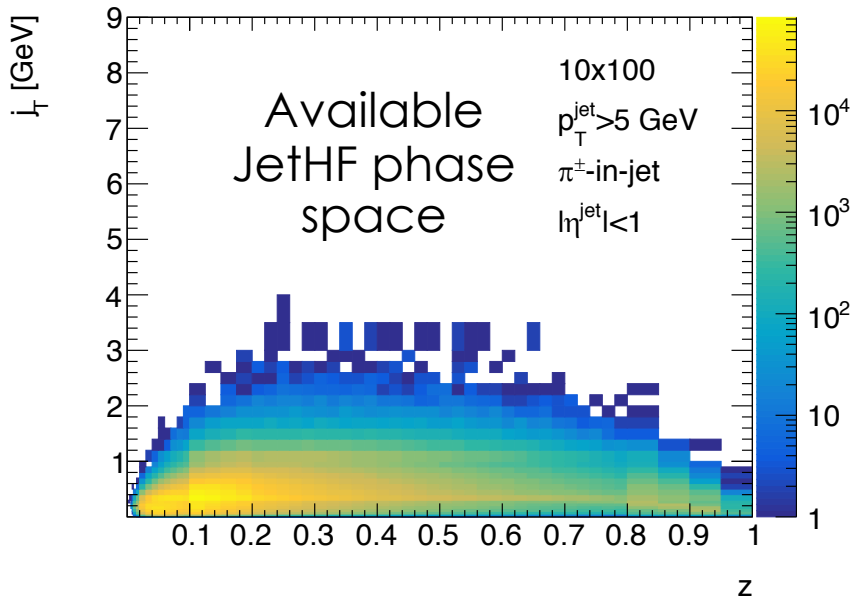
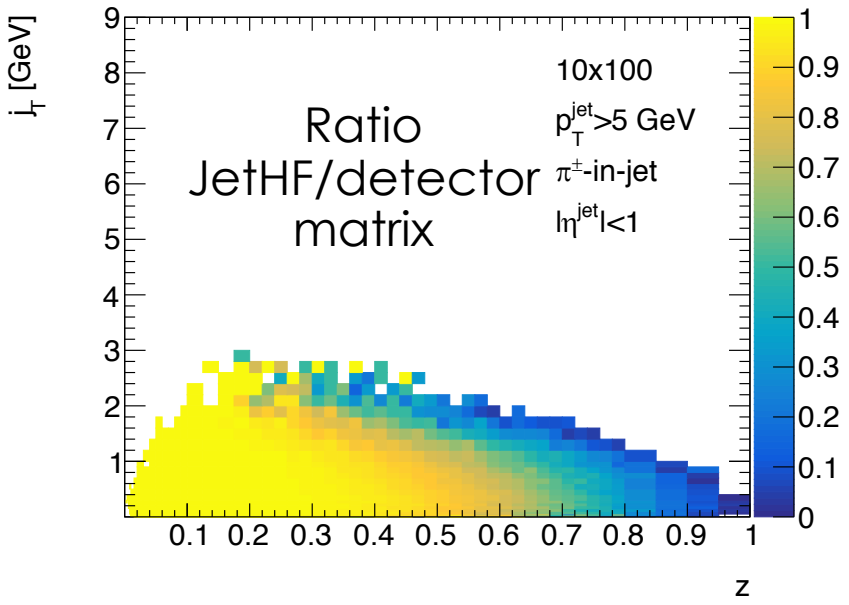
Integrated Barrel Reach/Ratio





- This shows the (x, Q^2) integrated values for Q^2>9 GeV^2, which make it easier to see and draw conclusions from
- Even after reducing minimum jet p_T to 5 GeV, there is still a nontrivial loss in high z statistics in the barrel
- With current detector matrix PID, the only way we would be able to access high z is in 5-10 GeV jets at low Q^2

Conclusions

- There is not an area in $(\sqrt{s}, x, Q^2)$ phase space that will allow us to access high z PIDed hadrons-in-jets with the current detector matrix PID requirements
  - Can access some high z at small Q^2 and jet p_T, but as soon as the requirement of p_T^{jet}>10 GeV or Q^2>100 GeV^2, lose statistics
- Note - I only showed plots for the 10x100 beam energies. 18x275 are in backups, but tell the same story
- If we want to measure high z PIDed TMD FFs in jets at the EIC, the PID coverage has to be improved
  - We would still be able to do non-PIDed FFs; however, it is my personal opinion that this would be a major limitation of the hadronization program at the EIC

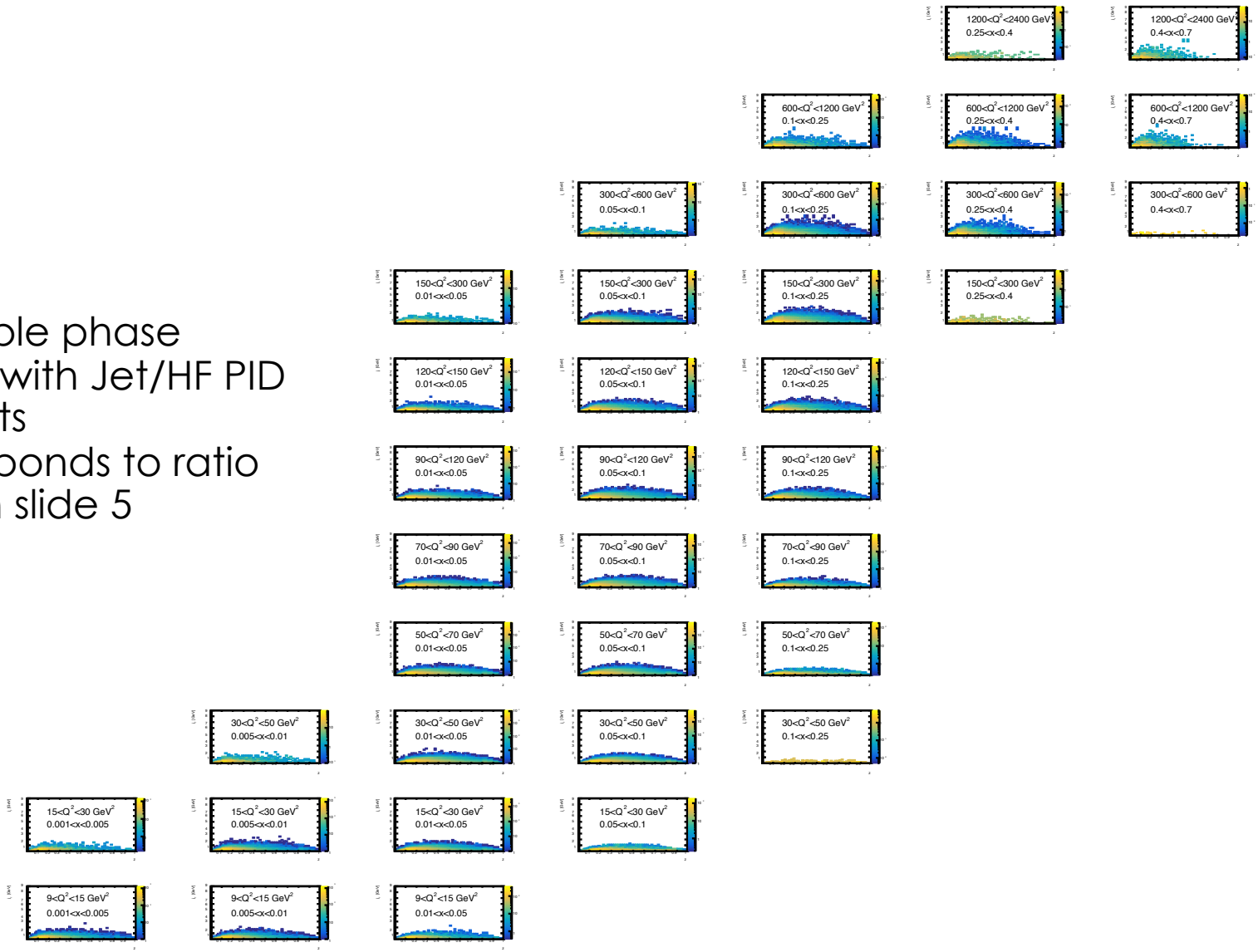
10x100

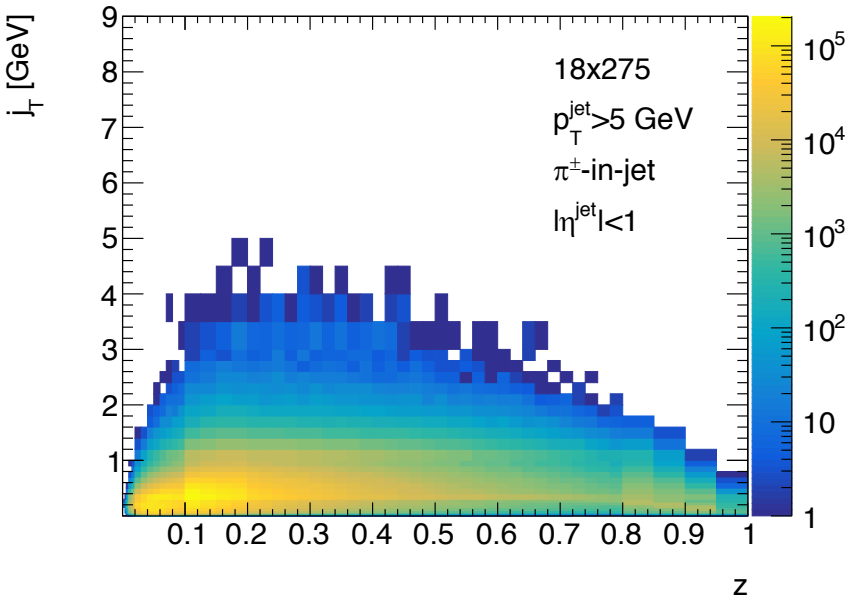
p_T^{jet}>5 GeV

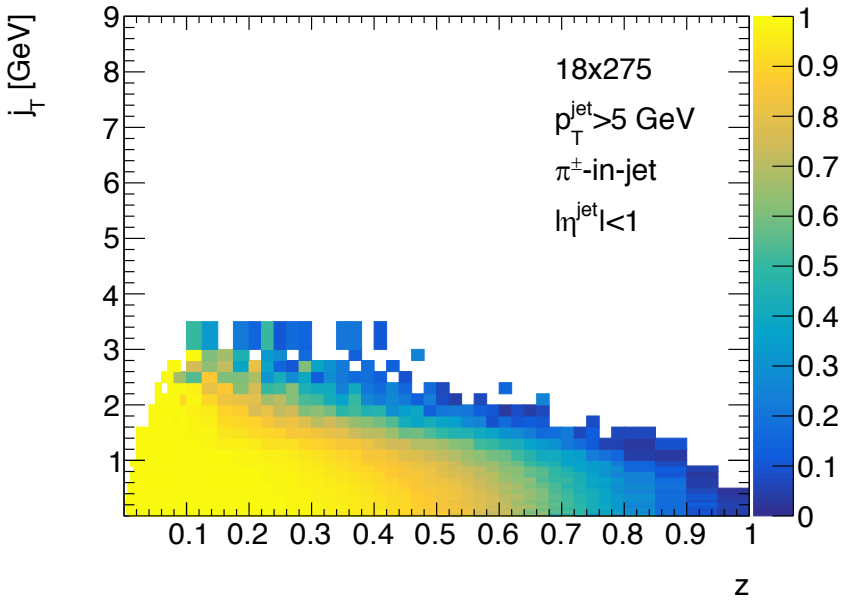
$\pi^{\pm}$-in-jet

$|\eta^{jet}|$<1

- Available phase space with Jet/HF PID requests
- Corresponds to ratio plot on slide 5





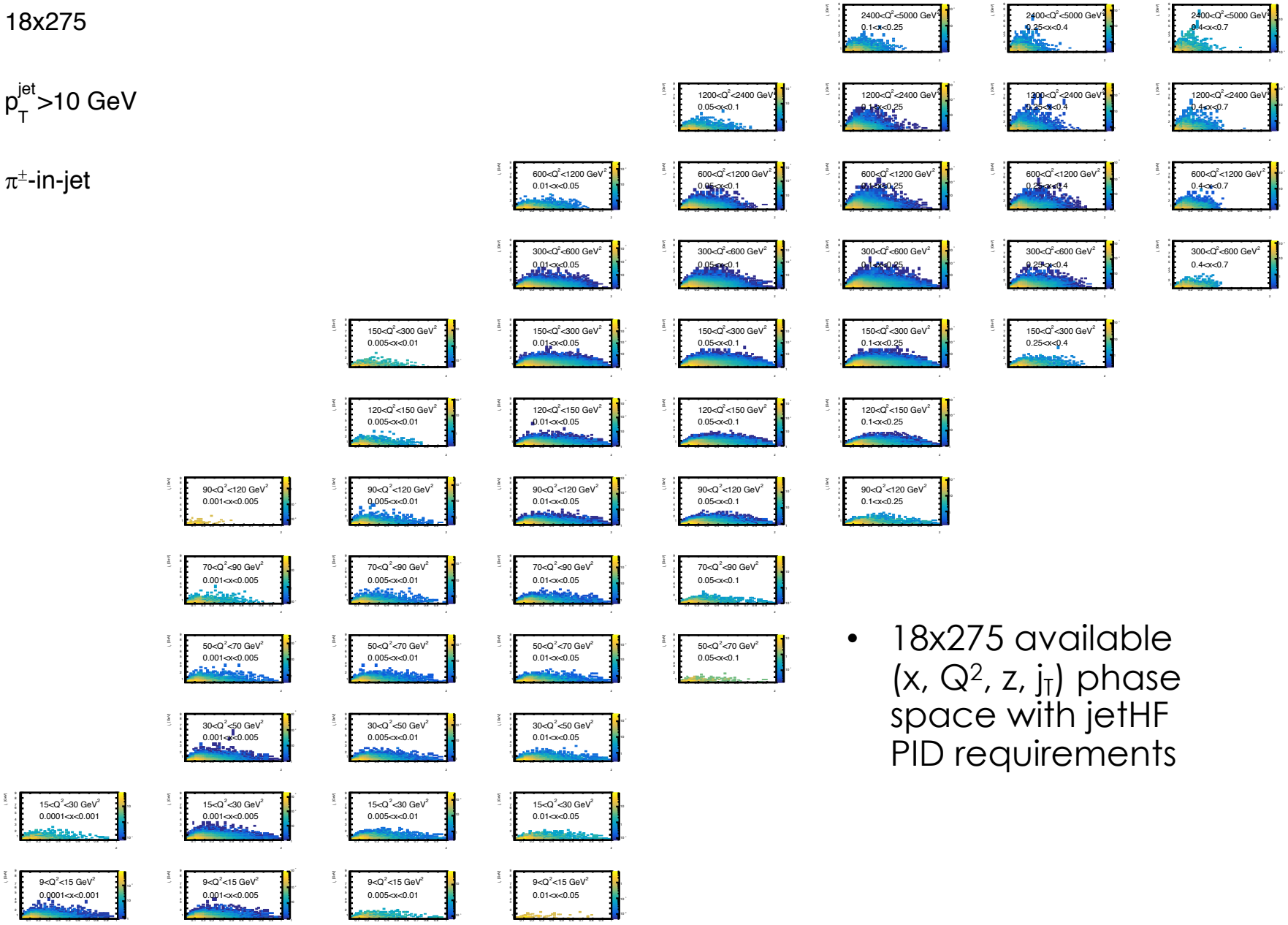


- Barrel x, Q^2 integrated jetHF PID requirements available phase space (left) and ratio of detector matrix to jetHF PID requirements (right) for 18x275 beam configuration

18x275

p_T^{jet}>10 GeV

$\pi^{\pm}$-in-jet



- 18x275 available (x, Q^2, z, j_T) phase space with jetHF PID requirements

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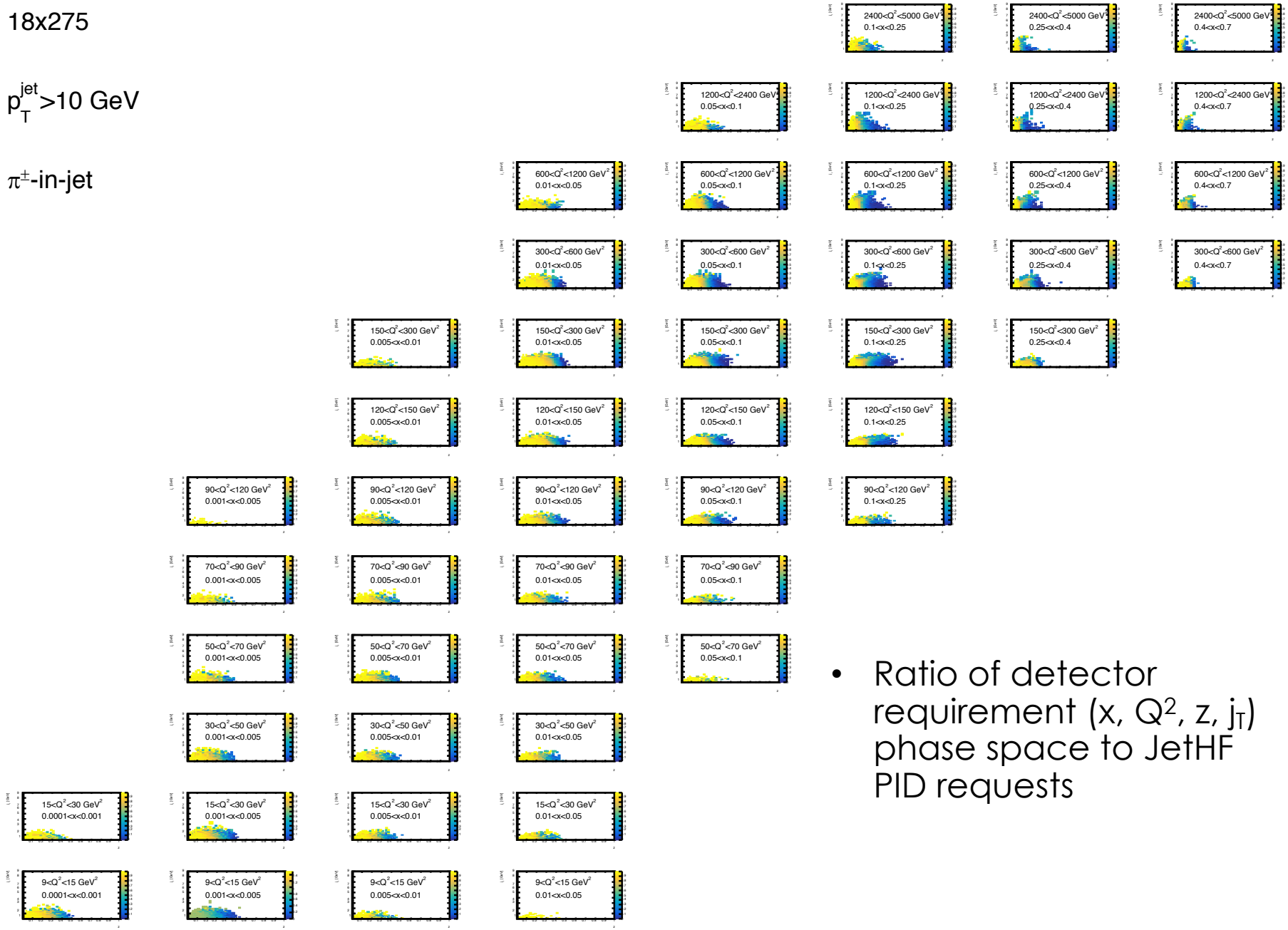
18x275

p_T^{jet}>10 GeV

$\pi^{\pm}$-in-jet



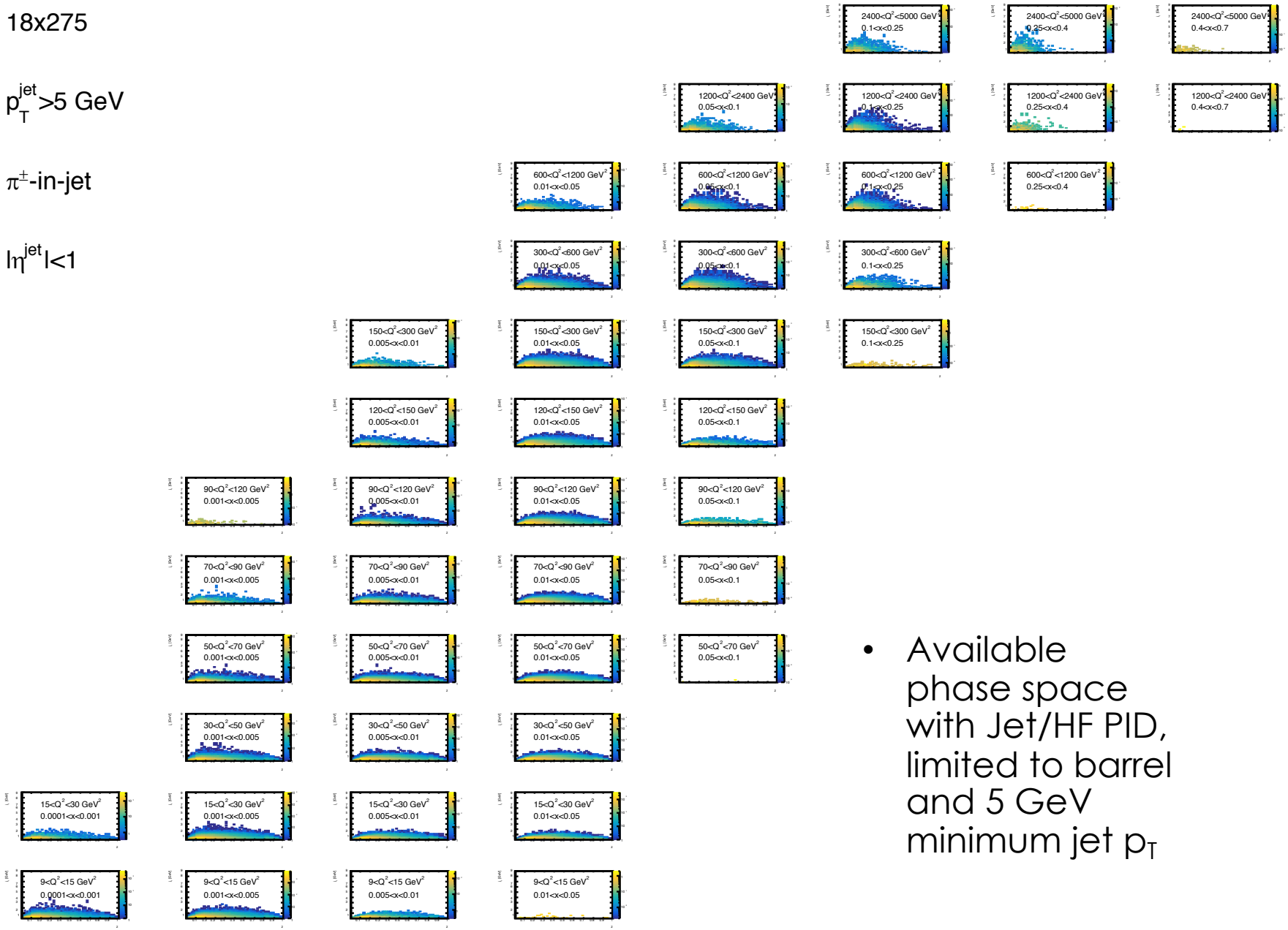
- Ratio of detector requirement (x, Q^2, z, j_T) phase space to JetHF PID requests

18x275

p_T^{jet}>5 GeV

$\pi^{\pm}$-in-jet

$|\eta^{jet}|$<1



- Available phase space with Jet/HF PID, limited to barrel and 5 GeV minimum jet p_T

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18x275

p_T^{jet}>5 GeV

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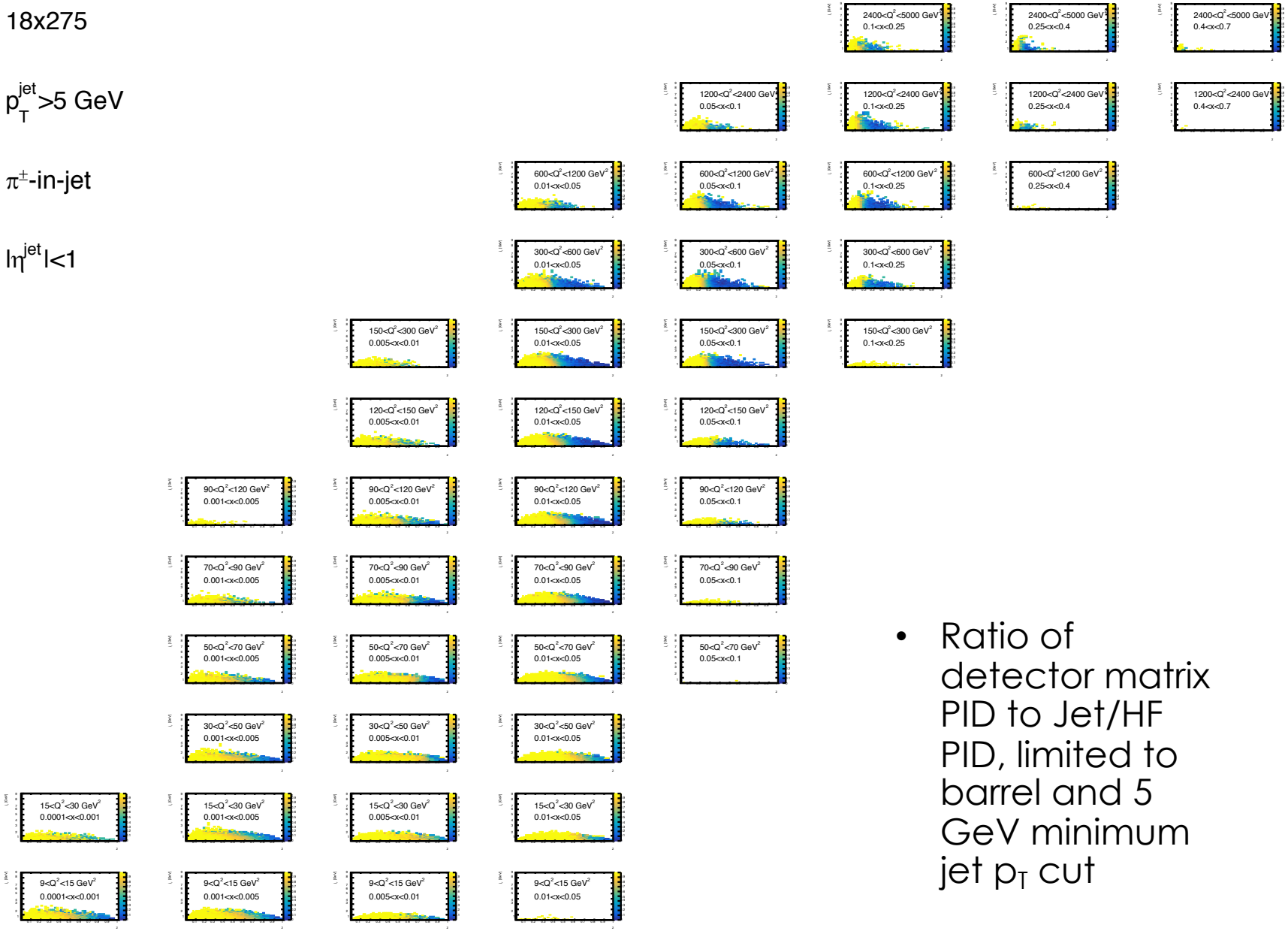

- Ratio of detector matrix PID to Jet/HF PID, limited to barrel and 5 GeV minimum jet p_T cut

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