Determination of z in back-to-back hadron production in e^+e^- annihilation

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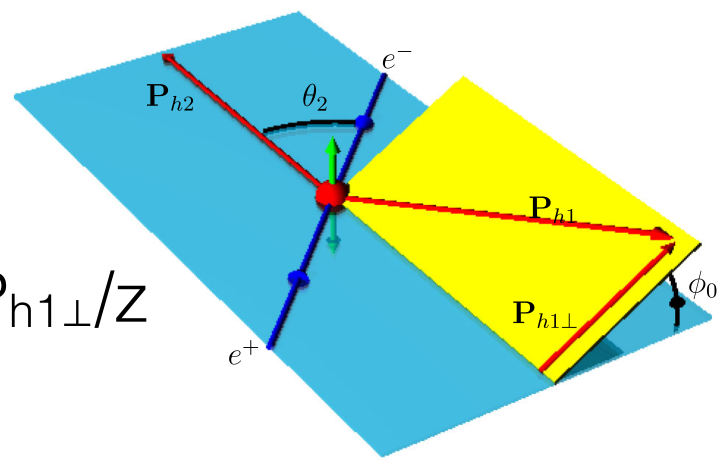
21 February 2018

Transverse momenta

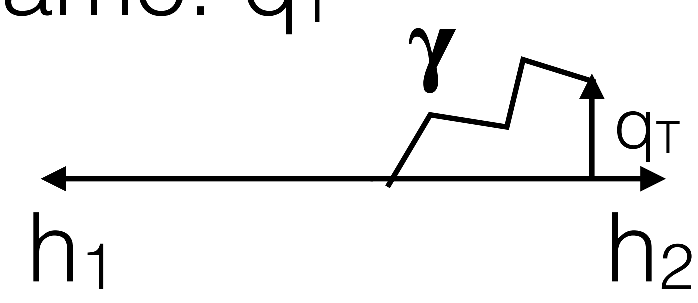
e^+e^- CM frame:

$P_{h1\perp}/z$



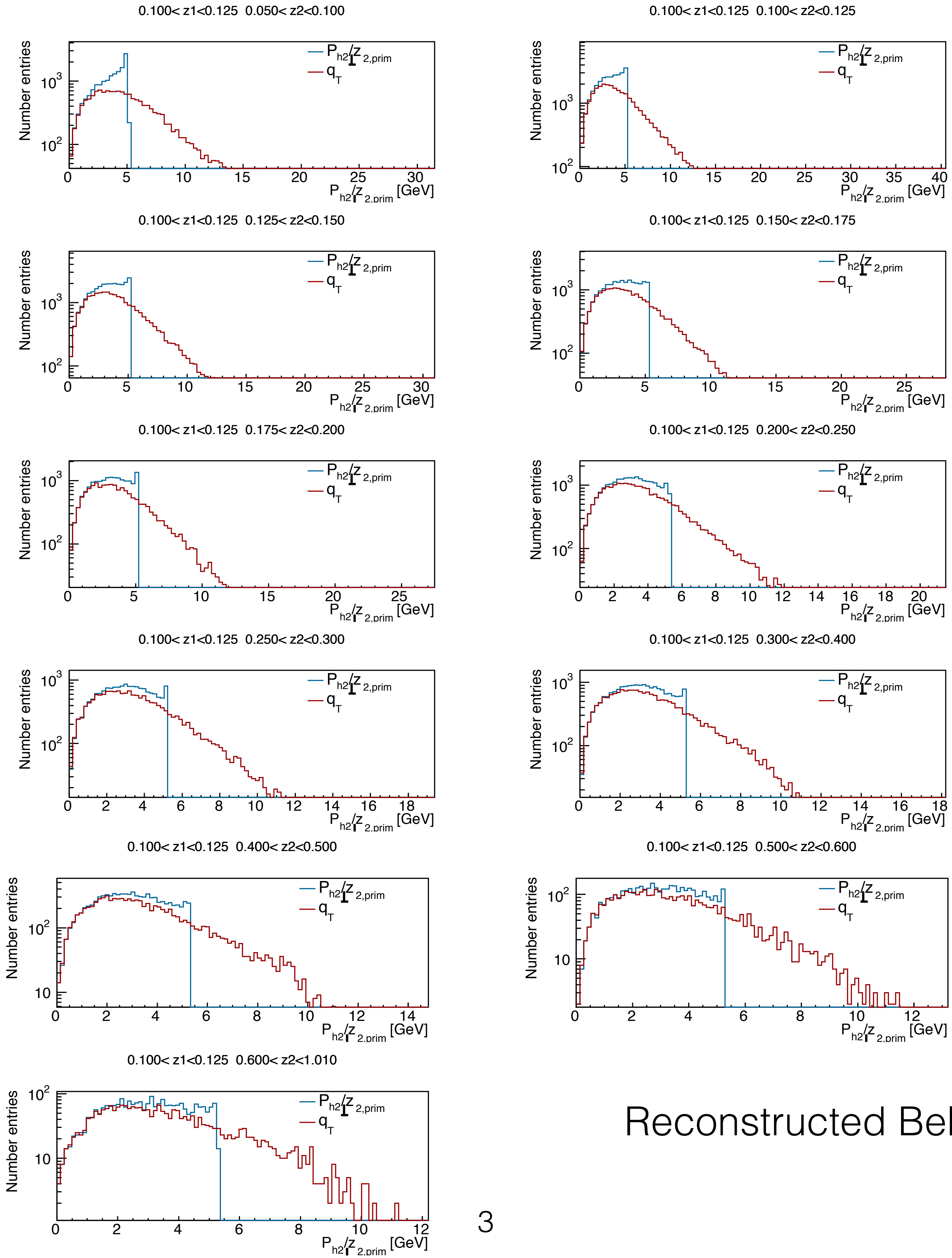
$$z_i = \frac{E_{h,i}}{\sqrt{s}/2}$$

h_1-h_2 CM frame: q_T



$\pi^+\pi^+$

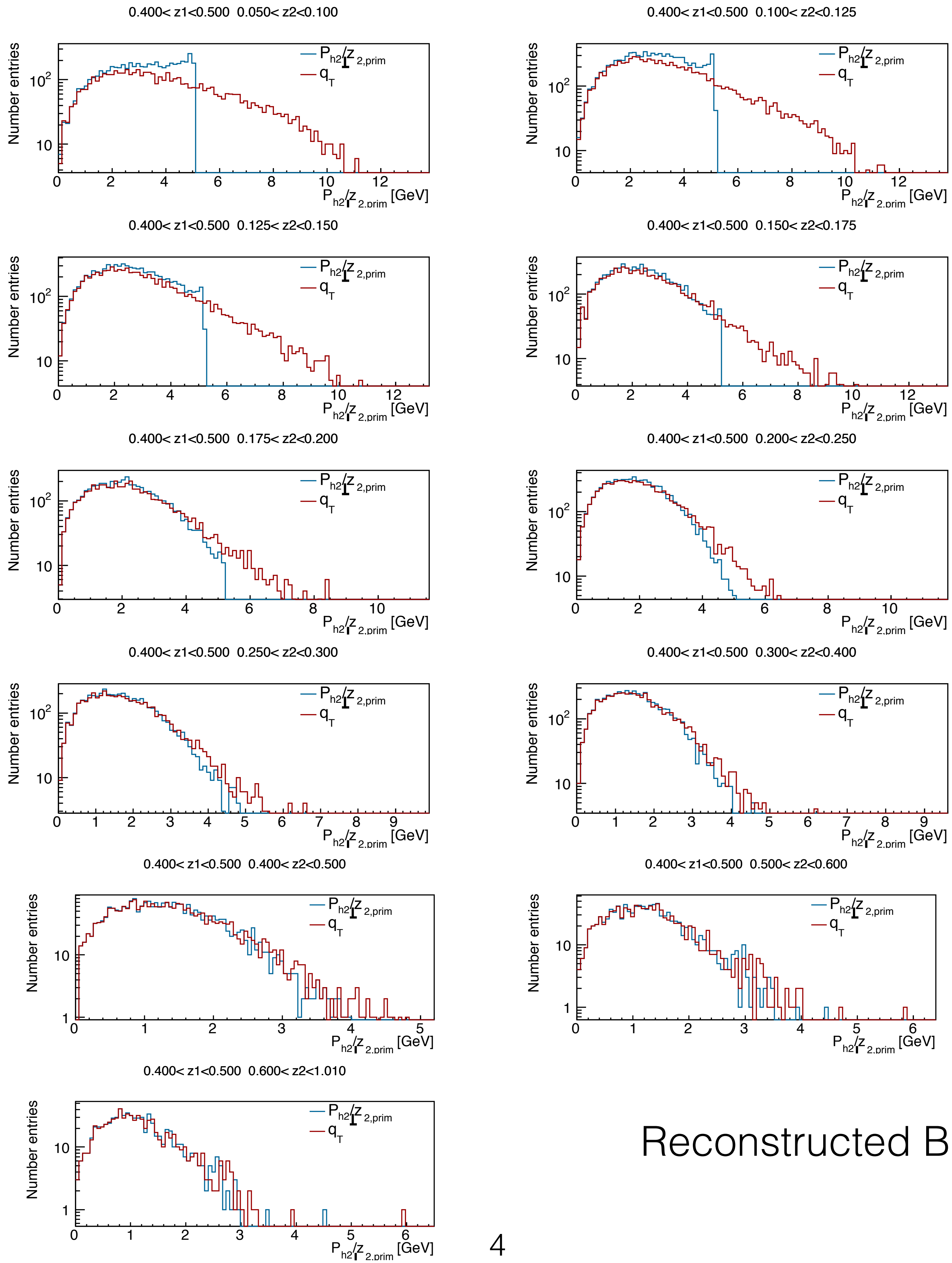
lowest z



Reconstructed Belle Monte Carlo

$\pi^+\pi^+$

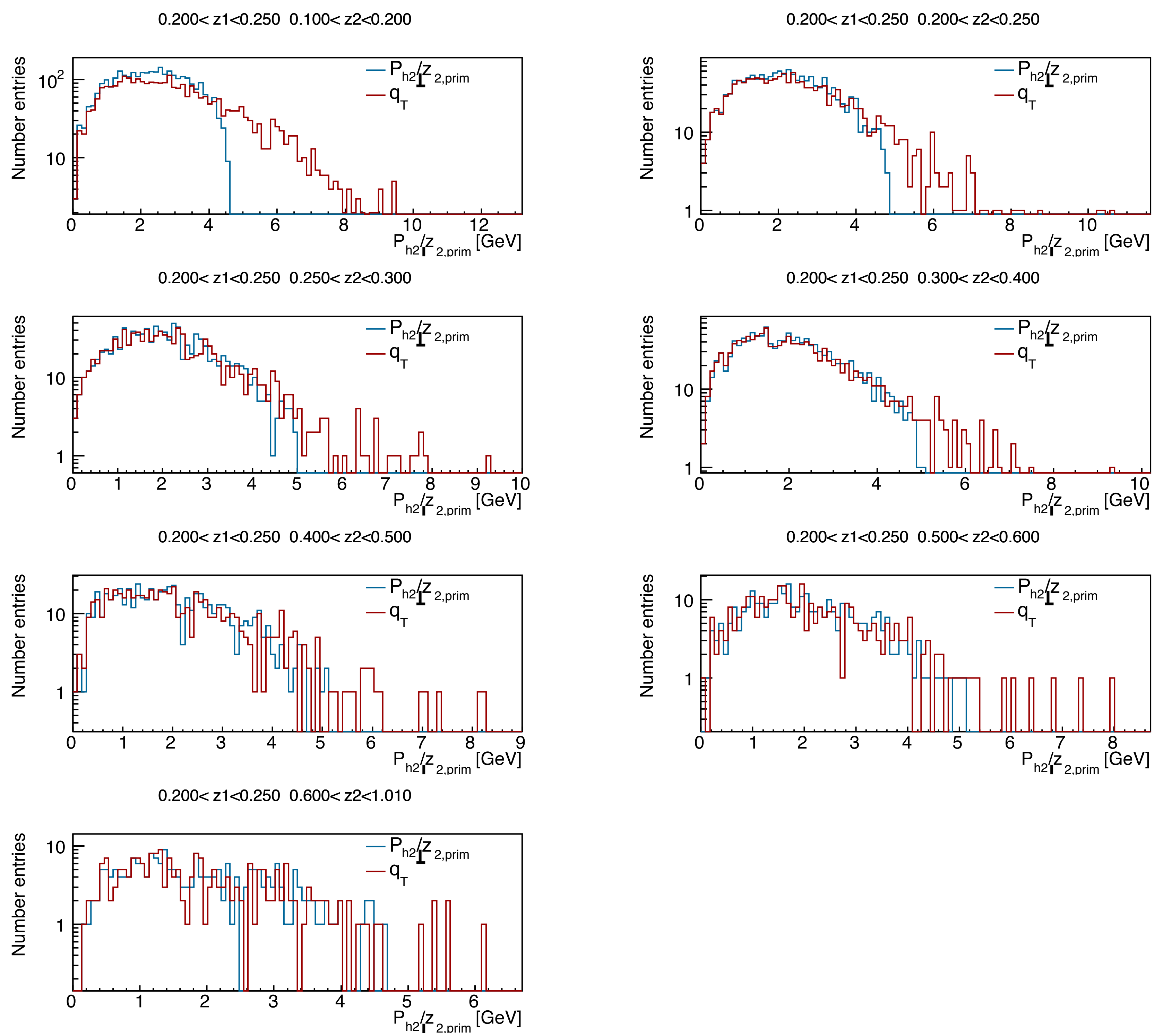
middle z



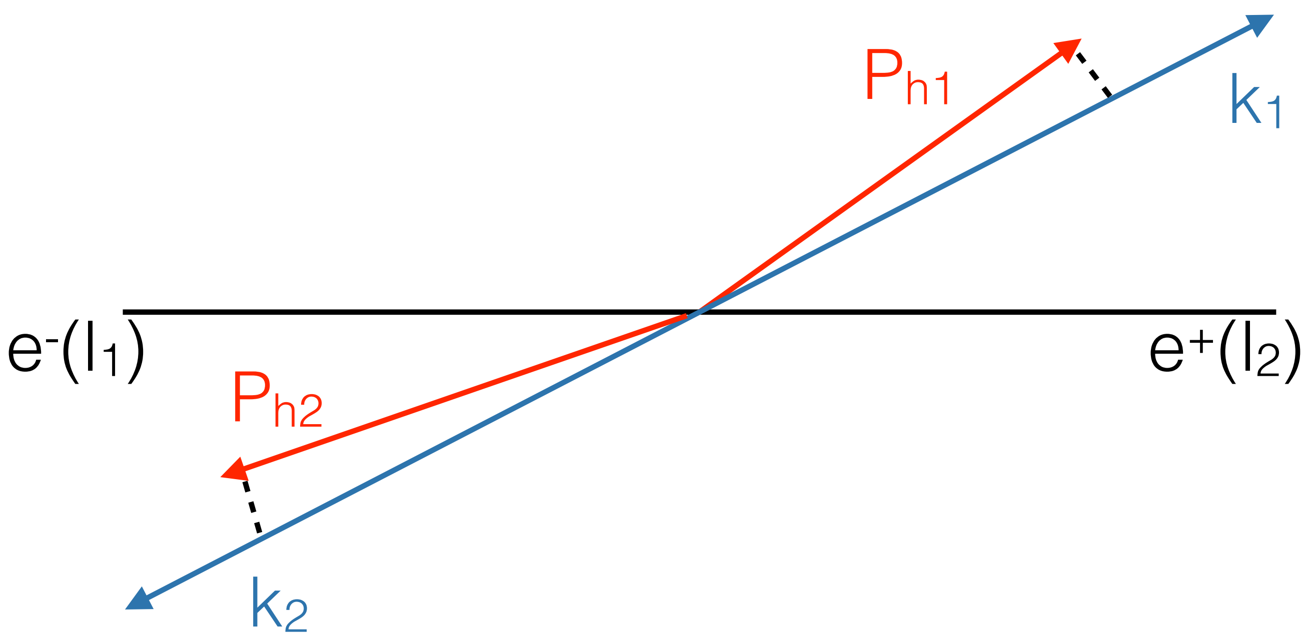
Reconstructed Belle Monte Carlo

K^+K^+

lowest z



Reconstructed Belle Monte Carlo



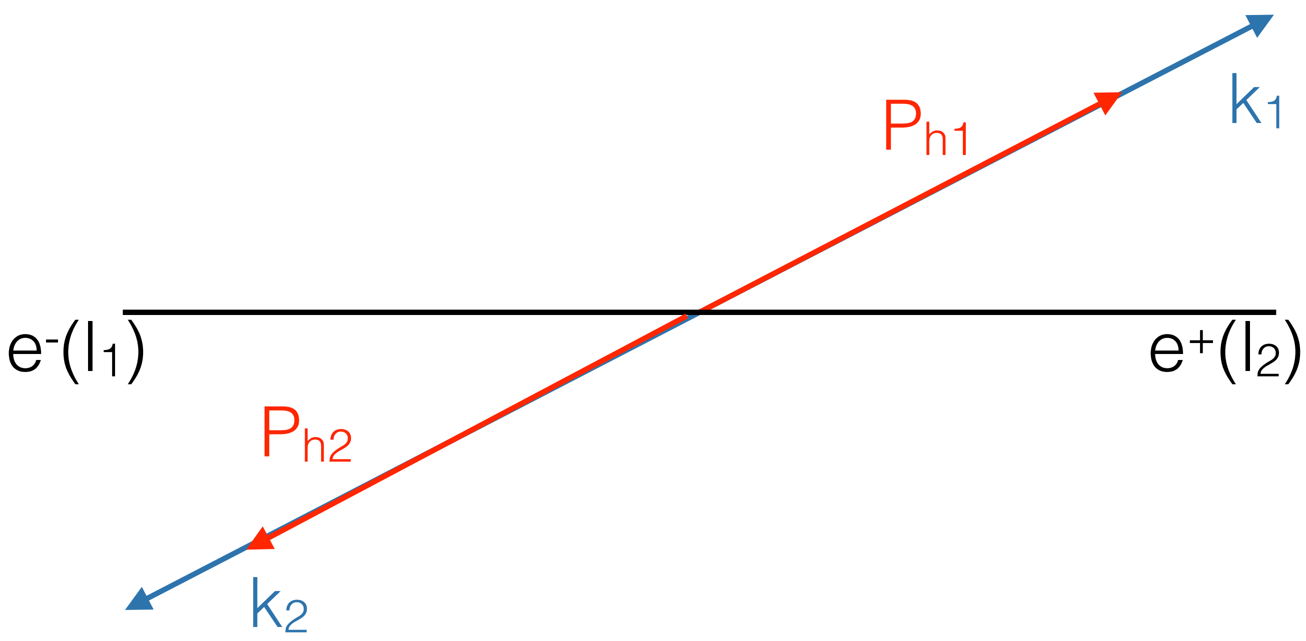
$$q_T = (k_1 - \frac{P_{h1}}{z_1}) + (k_2 - \frac{P_{h2}}{z_2})$$
$$= q - \frac{P_{h1}}{z_1} - \frac{P_{h2}}{z_2}$$

$$P_{h1}.q_T = P_{h2}.q_T = 0$$

$P_{h1}.q$ and $P_{h2}.q$ $\longrightarrow$

$$z_1 = \left(P_{h1}.P_{h2} - \frac{M_{h1}^2.M_{h2}^2}{P_{h1}.P_{h2}}\right) \cdot \frac{1}{P_{h2}.q - M_{h2}^2 \frac{P_{h1}.q}{P_{h1}.P_{h2}}}$$

$$z_2 = \left(P_{h1}.P_{h2} - \frac{M_{h1}^2.M_{h2}^2}{P_{h1}.P_{h2}}\right) \cdot \frac{1}{P_{h1}.q - M_{h1}^2 \frac{P_{h2}.q}{P_{h1}.P_{h2}}}$$



$$q_T = (k_1 - \frac{P_{h1}}{z_1}) + (k_2 - \frac{P_{h2}}{z_2})$$
$$= q - \frac{P_{h1}}{z_1} - \frac{P_{h2}}{z_2}$$

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$$z_1 = \left(P_{h1}.P_{h2} - \cancel{\frac{M_{h1}^2.M_{h2}^2}{P_{h1}.P_{h2}}}\right) \cdot \frac{1}{P_{h2}.q - \cancel{M_{h2}^2 \frac{P_{h1}.q}{P_{h1}.P_{h2}}}}$$

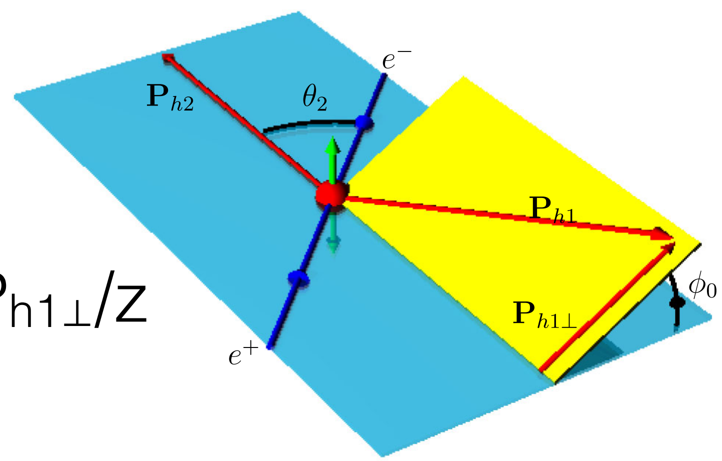
$$z_2 = \left(P_{h1}.P_{h2} - \cancel{\frac{M_{h1}^2.M_{h2}^2}{P_{h1}.P_{h2}}}\right) \cdot \frac{1}{P_{h1}.q - \cancel{M_{h1}^2 \frac{P_{h2}.q}{P_{h1}.P_{h2}}}}$$

collinear

Transverse momenta

e^+e^- CM frame:

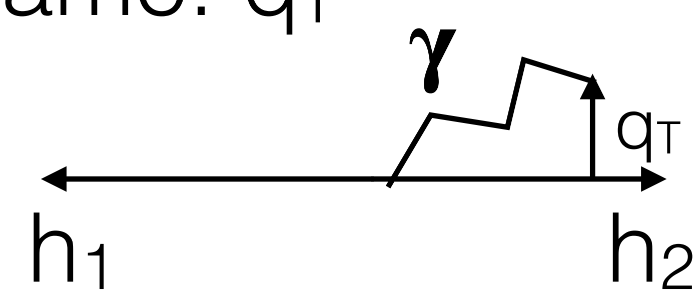
$P_{h1\perp}/z$



$$z_1 = \left(P_{h1}.P_{h2} - \frac{M_{h1}^2.M_{h2}^2}{P_{h1}.P_{h2}} \right) \cdot \frac{1}{P_{h2}.q - M_{h2}^2 \frac{P_{h1}.q}{P_{h1}.P_{h2}}}$$

$$z_2 = \left(P_{h1}.P_{h2} - \frac{M_{h1}^2.M_{h2}^2}{P_{h1}.P_{h2}} \right) \cdot \frac{1}{P_{h1}.q - M_{h1}^2 \frac{P_{h2}.q}{P_{h1}.P_{h2}}}$$

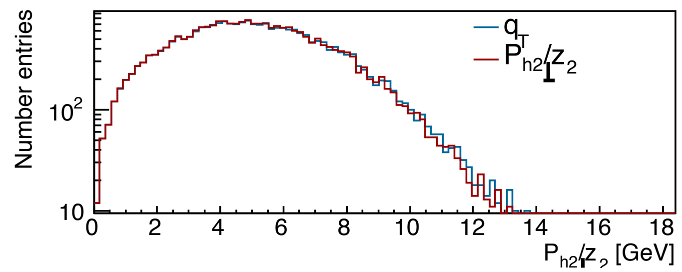
h_1-h_2 CM frame: q_T



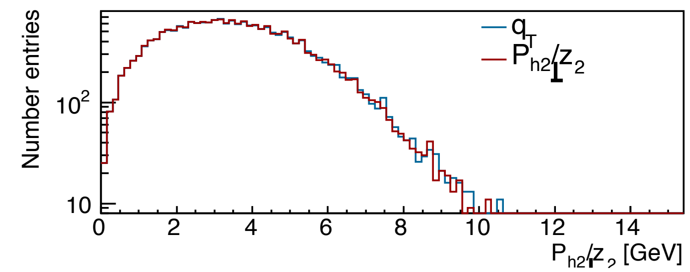
$\pi^+\pi^+$

lowest z

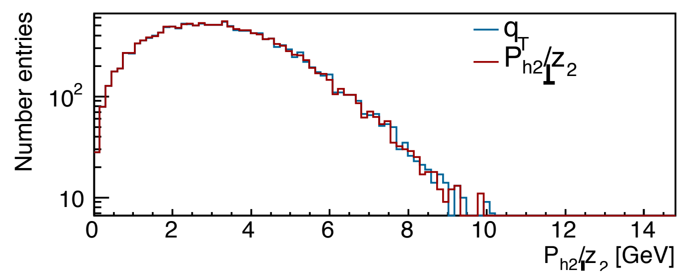
0.100< z1<0.125 0.050< z2<0.100



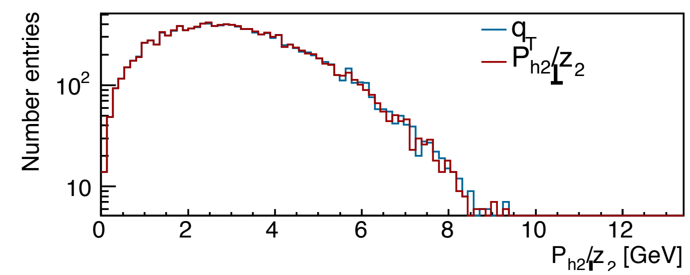
0.100< z1<0.125 0.100< z2<0.125



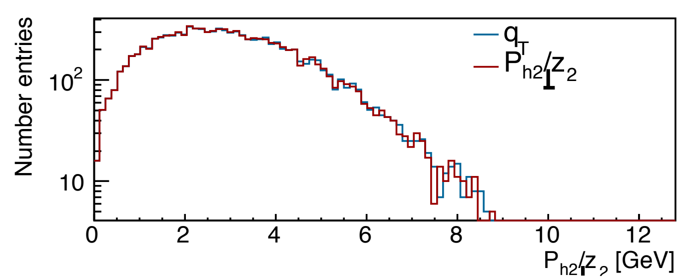
0.100< z1<0.125 0.125< z2<0.150



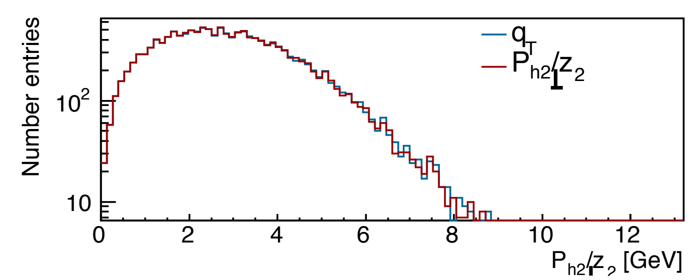
0.100< z1<0.125 0.150< z2<0.175



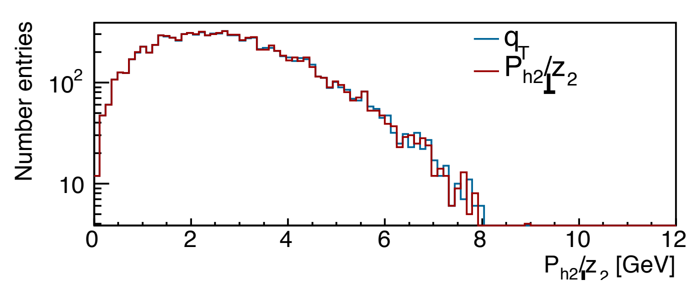
0.100< z1<0.125 0.175< z2<0.200



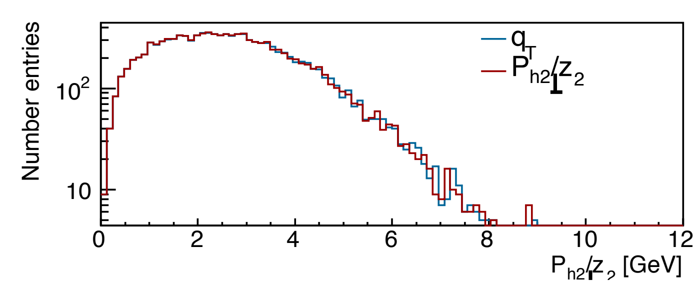
0.100< z1<0.125 0.200< z2<0.250



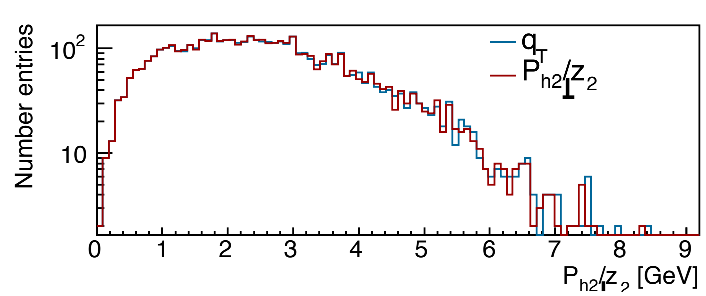
0.100< z1<0.125 0.250< z2<0.300



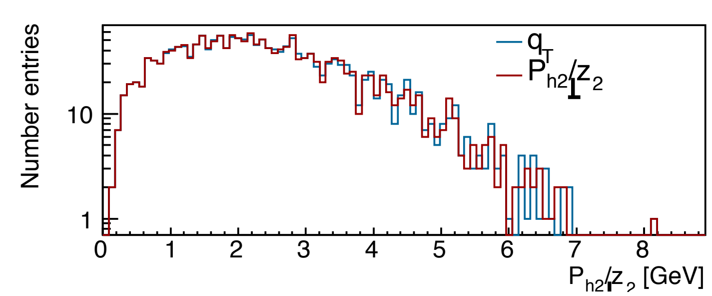
0.100< z1<0.125 0.300< z2<0.400



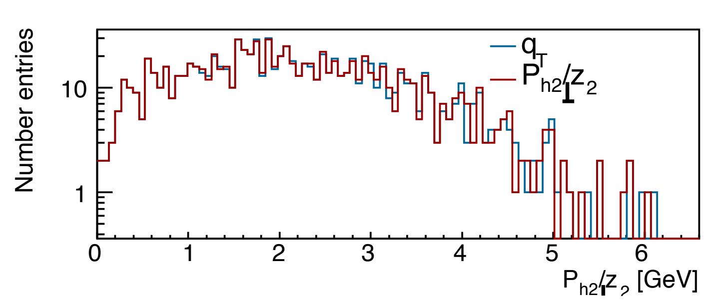
0.100< z1<0.125 0.400< z2<0.500



0.100< z1<0.125 0.500< z2<0.600



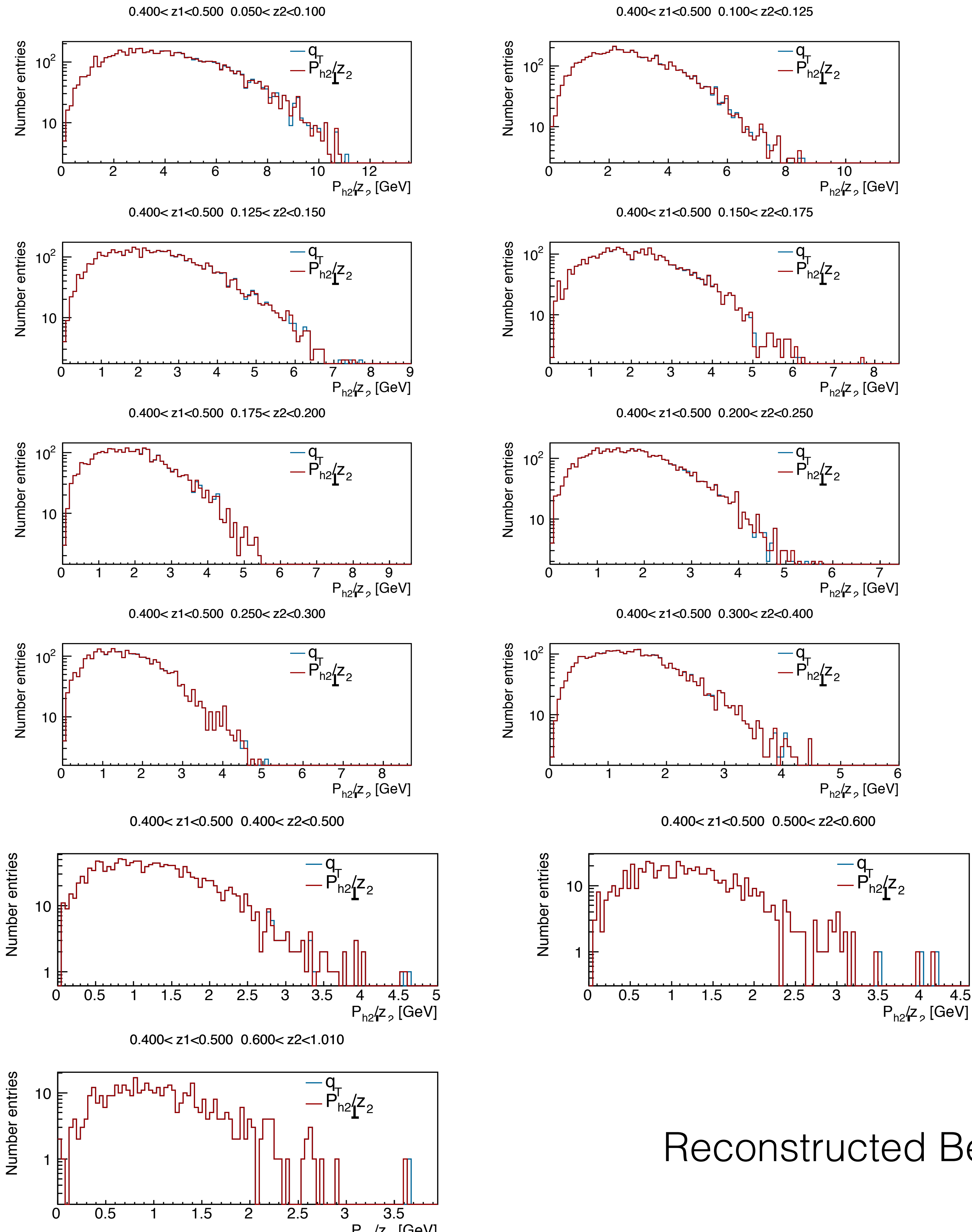
0.100< z1<0.125 0.600< z2<1.010



Reconstructed Belle Monte Carlo

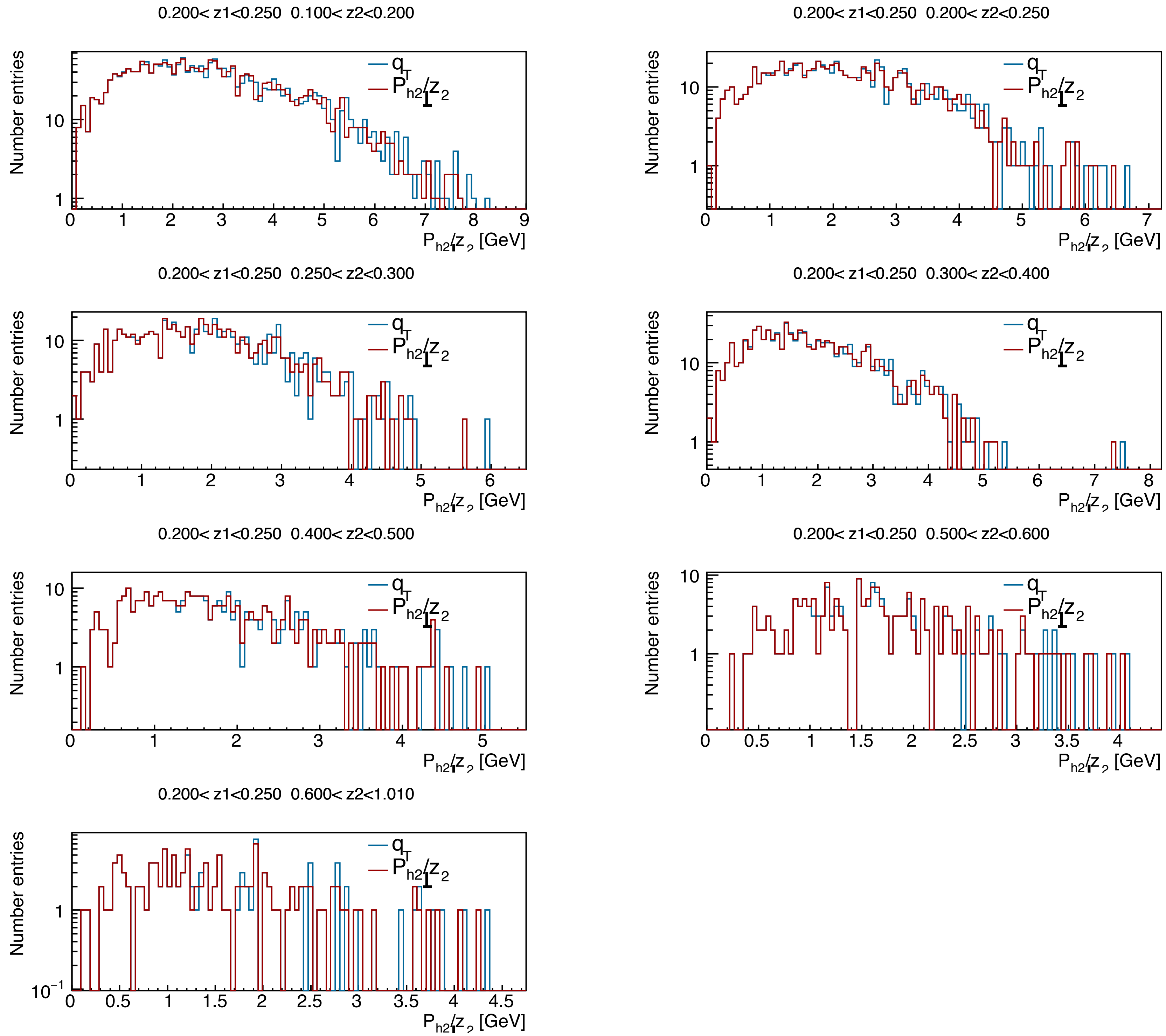
$\pi^+\pi^+$

middle z

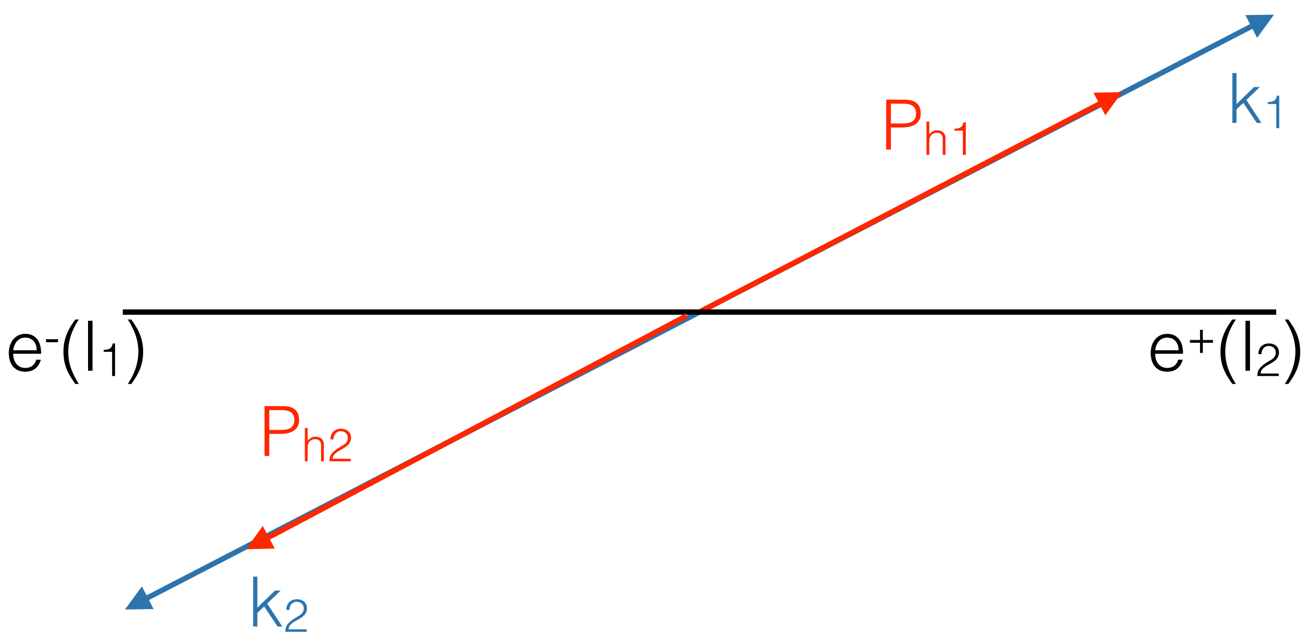


Reconstructed Belle Monte Carlo

K^+K^+
lowest z



Reconstructed Belle Monte Carlo



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$$P_{h1}.q_T = P_{h2}.q_T = 0$$

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$$z_1 = \left(P_{h1}.P_{h2} - \cancel{\frac{M_{h1}^2.M_{h2}^2}{P_{h1}.P_{h2}}}\right) \cdot \frac{1}{P_{h2}.q - \cancel{M_{h2}^2 \frac{P_{h1}.q}{P_{h1}.P_{h2}}}}$$

$$z_2 = \left(P_{h1}.P_{h2} - \cancel{\frac{M_{h1}^2.M_{h2}^2}{P_{h1}.P_{h2}}}\right) \cdot \frac{1}{P_{h1}.q - \cancel{M_{h1}^2 \frac{P_{h2}.q}{P_{h1}.P_{h2}}}}$$

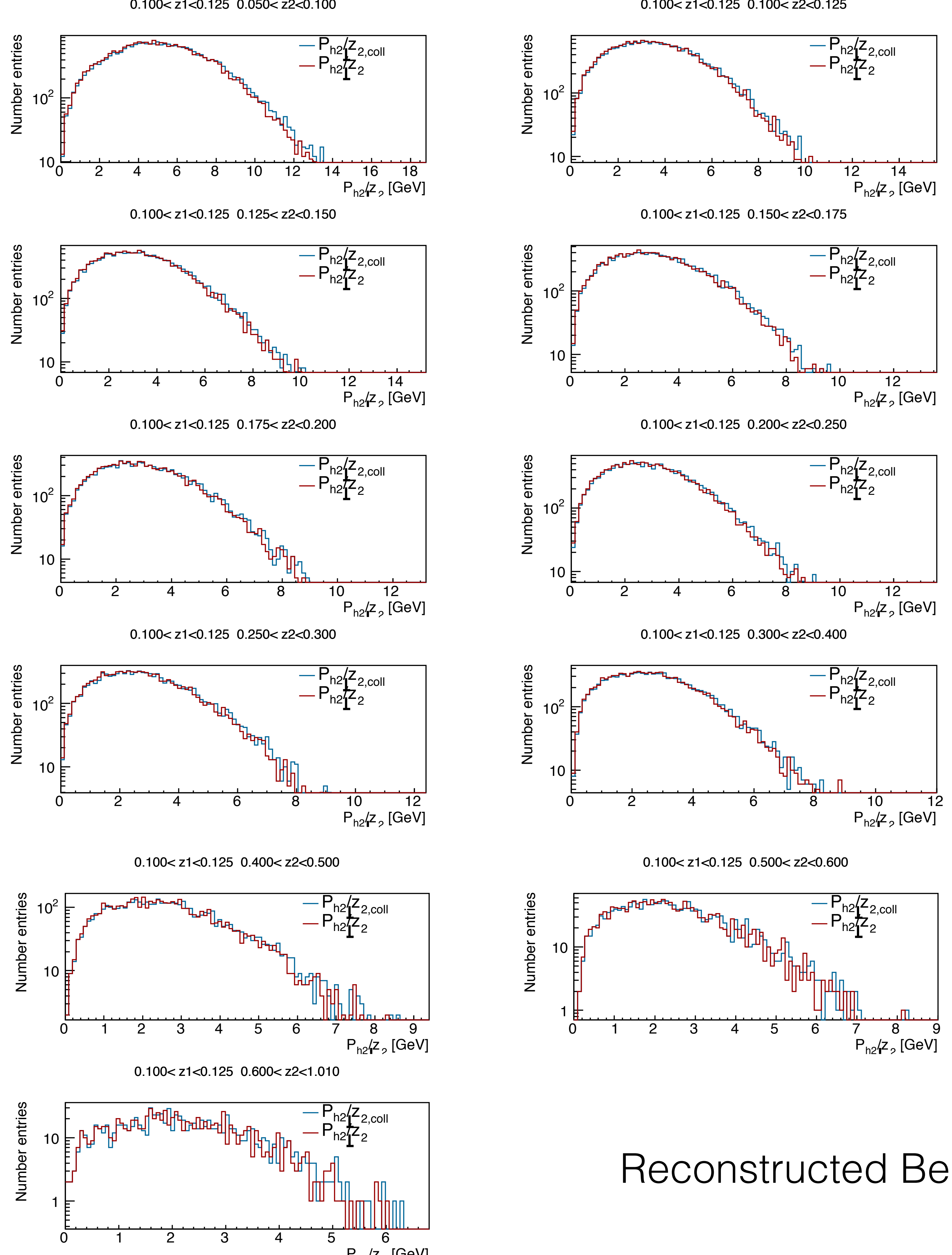
collinear

$\pi^+\pi^+$

lowest z

collinear

non-collinear



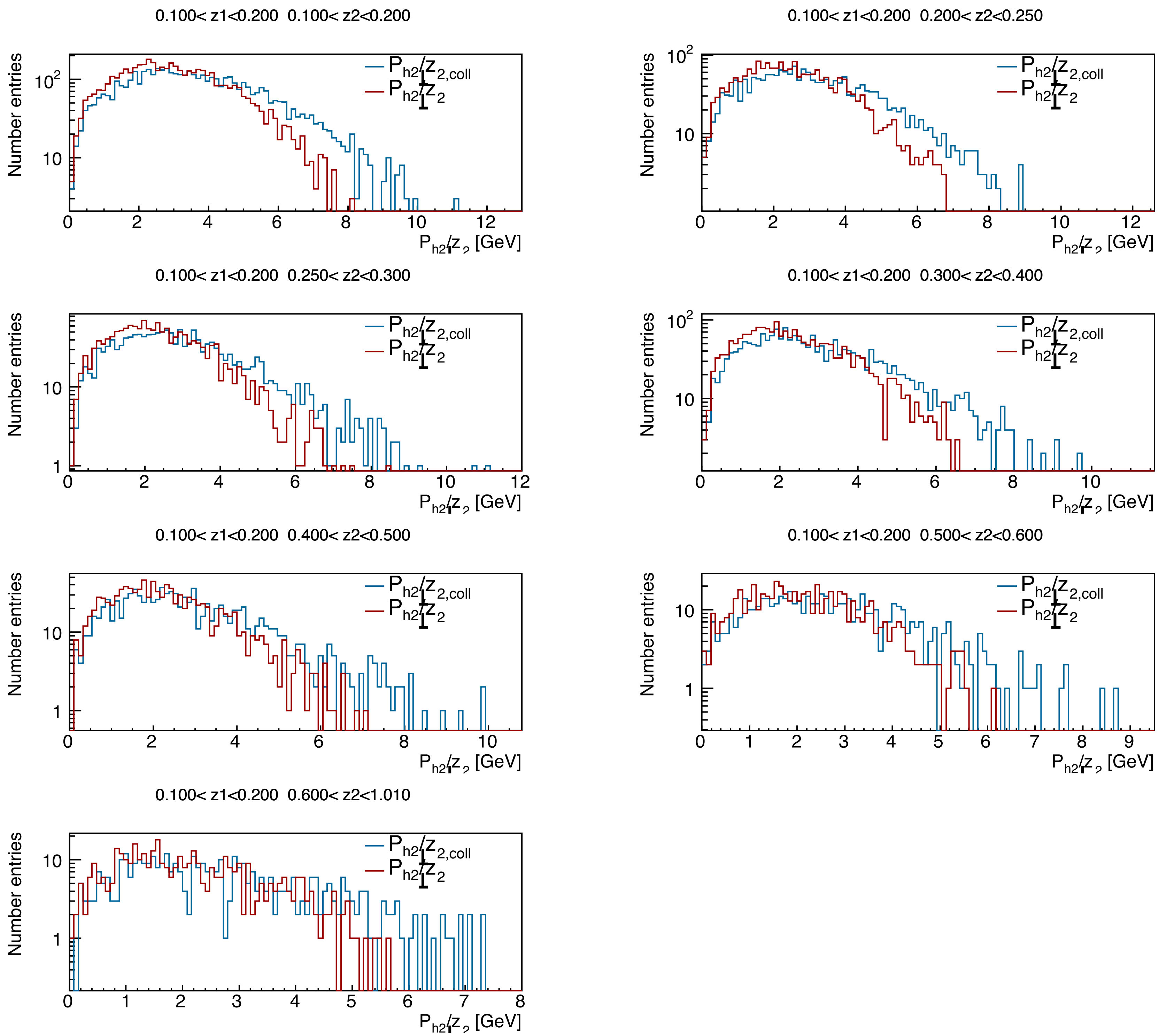
Reconstructed Belle Monte Carlo

K^+K^+

padding z

collinear

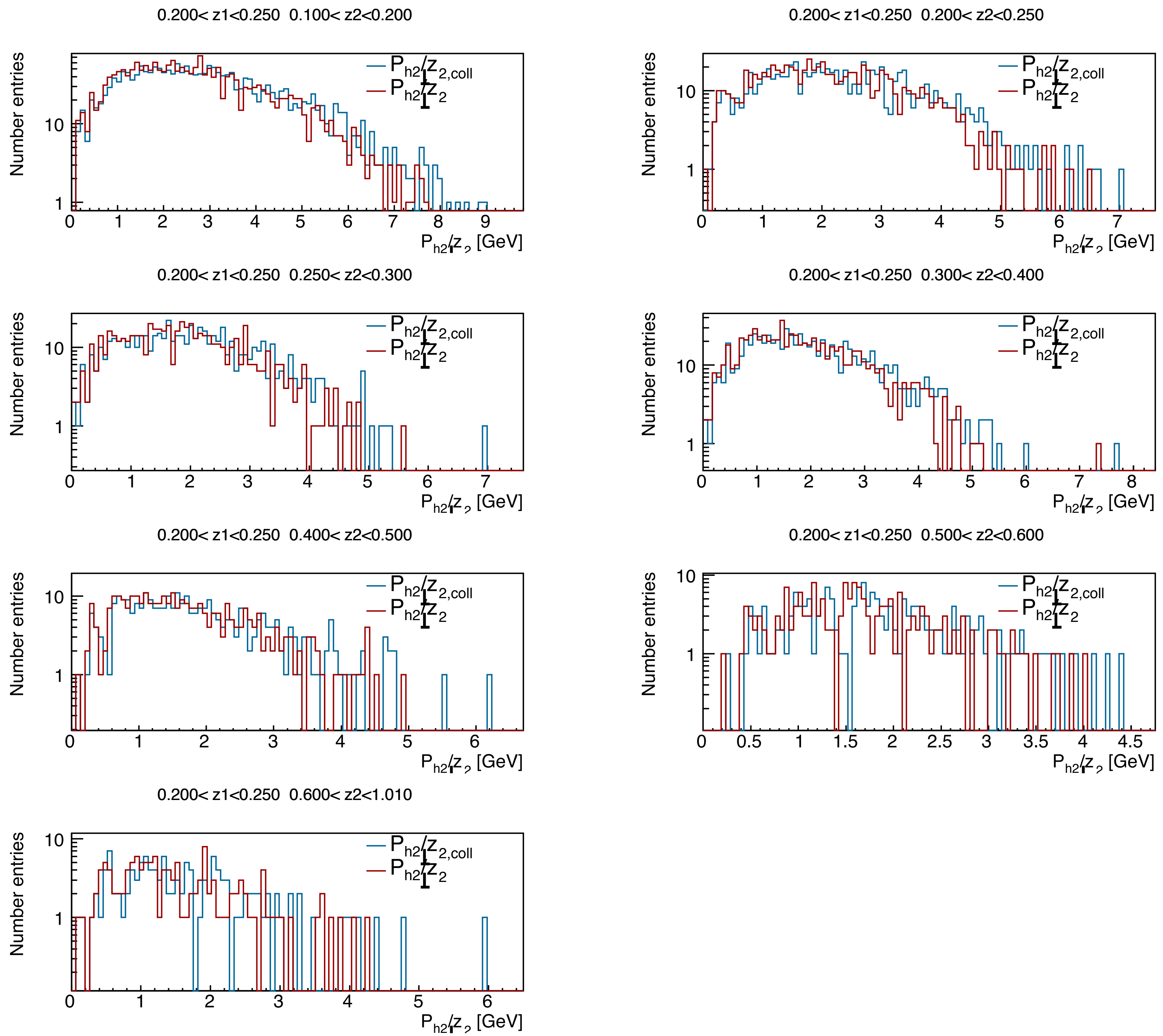
non-collinear



Reconstructed Belle Monte Carlo

K^+K^+

lowest z



Reconstructed Belle Monte Carlo

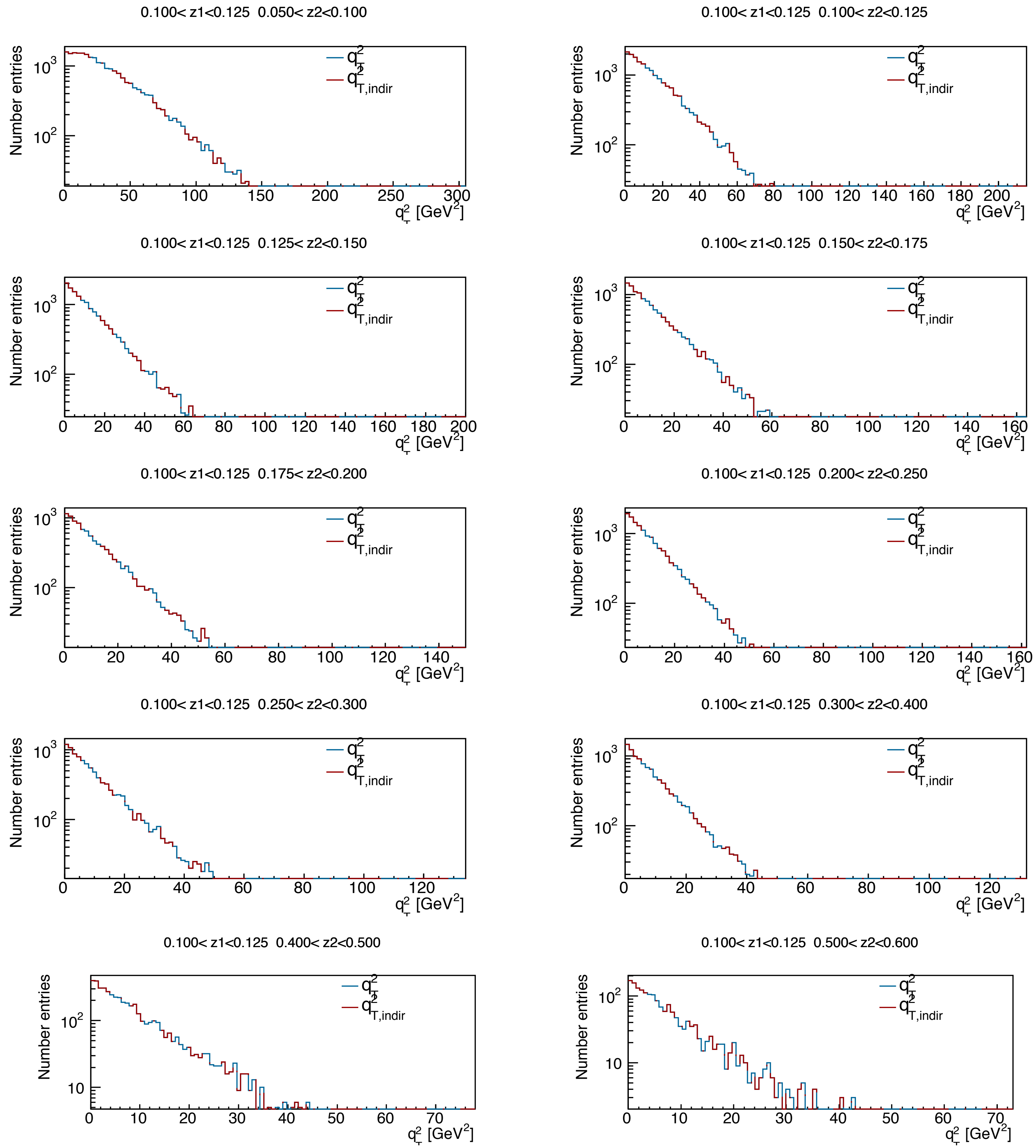
q_T and q

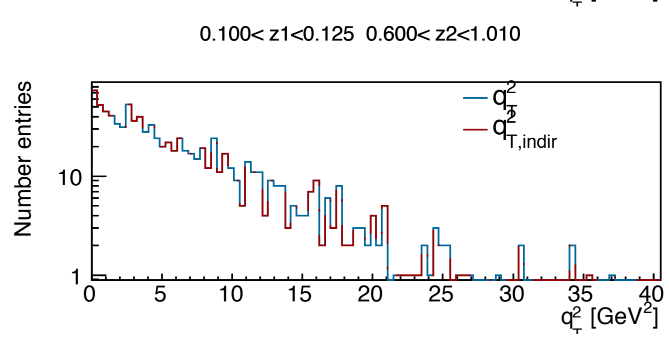
$$q_T^2 = \frac{1}{2} q^2 (2 - \frac{z_1'}{z_1} - \frac{z_2'}{z_2})$$

$$z_1 = \left(P_{h1}.P_{h2} - \frac{M_{h1}^2.M_{h2}^2}{P_{h1}.P_{h2}} \right) \cdot \frac{1}{P_{h2}.q - M_{h2}^2 \frac{P_{h1}.q}{P_{h1}.P_{h2}}}$$

$$z_2 = \left(P_{h1}.P_{h2} - \frac{M_{h1}^2.M_{h2}^2}{P_{h1}.P_{h2}} \right) \cdot \frac{1}{P_{h1}.q - M_{h1}^2 \frac{P_{h2}.q}{P_{h1}.P_{h2}}}$$

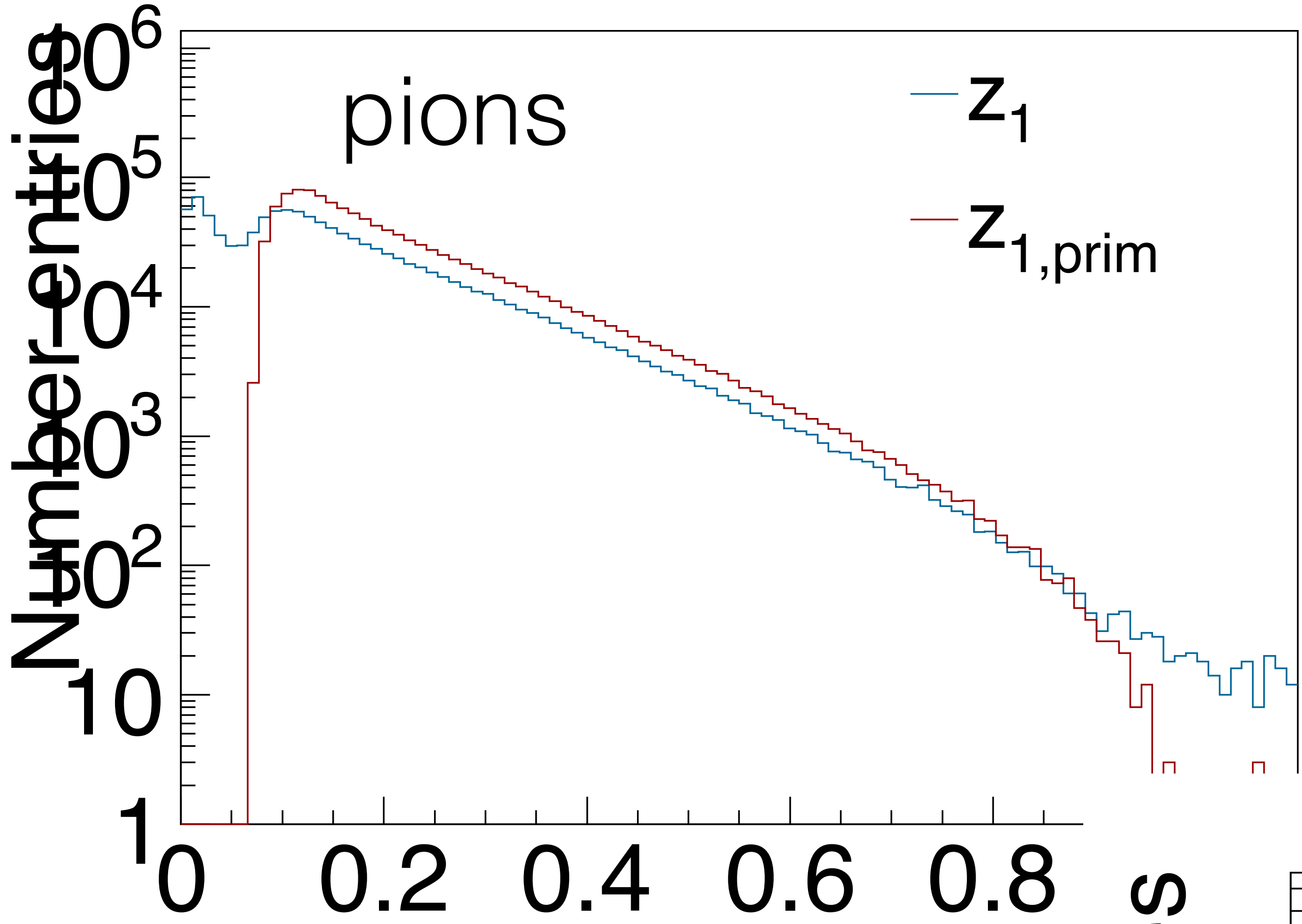
$$z_i' = \frac{E_{h,i}}{\sqrt{s}/2}$$

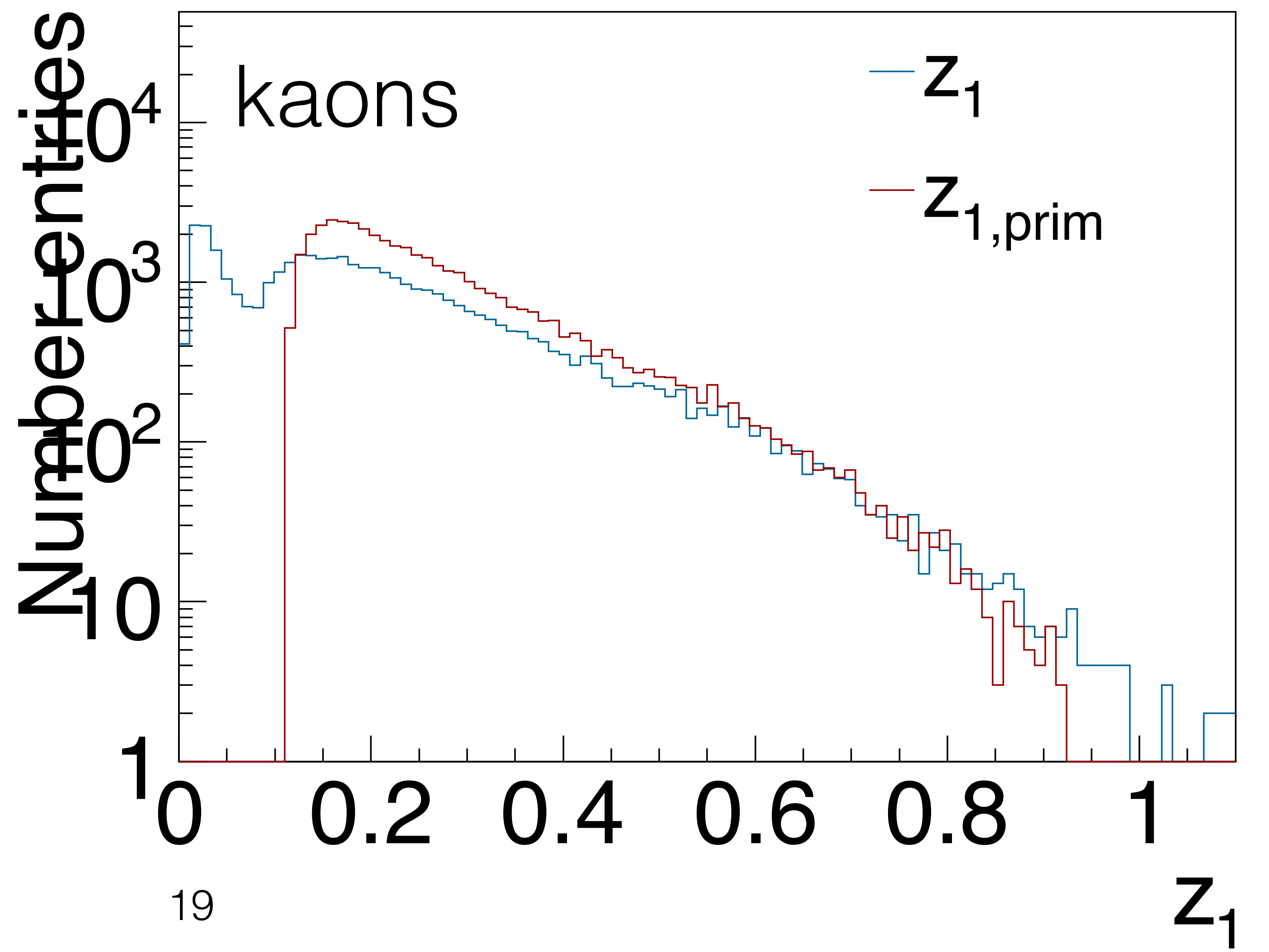




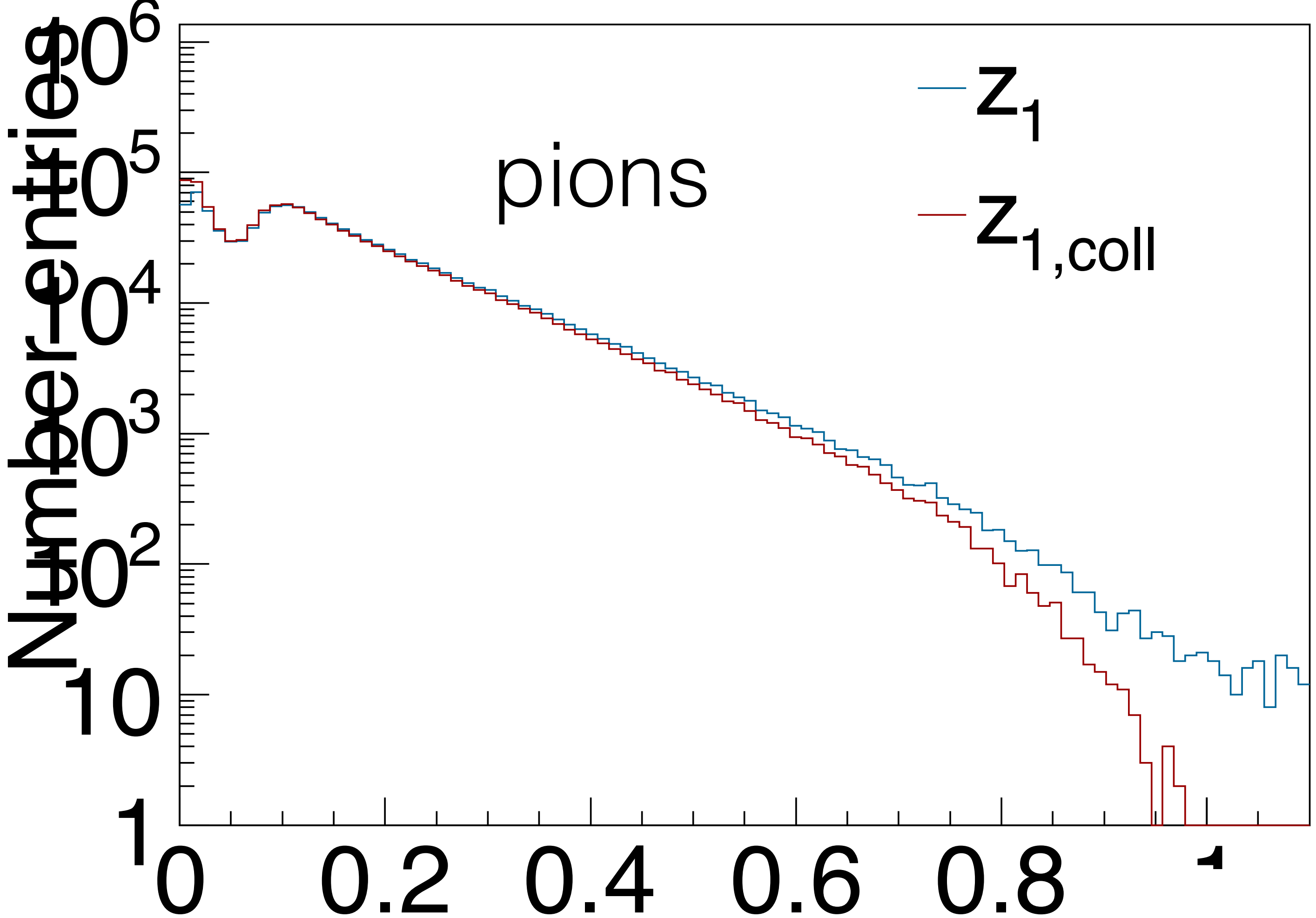
Reconstructed Belle Monte Carlo

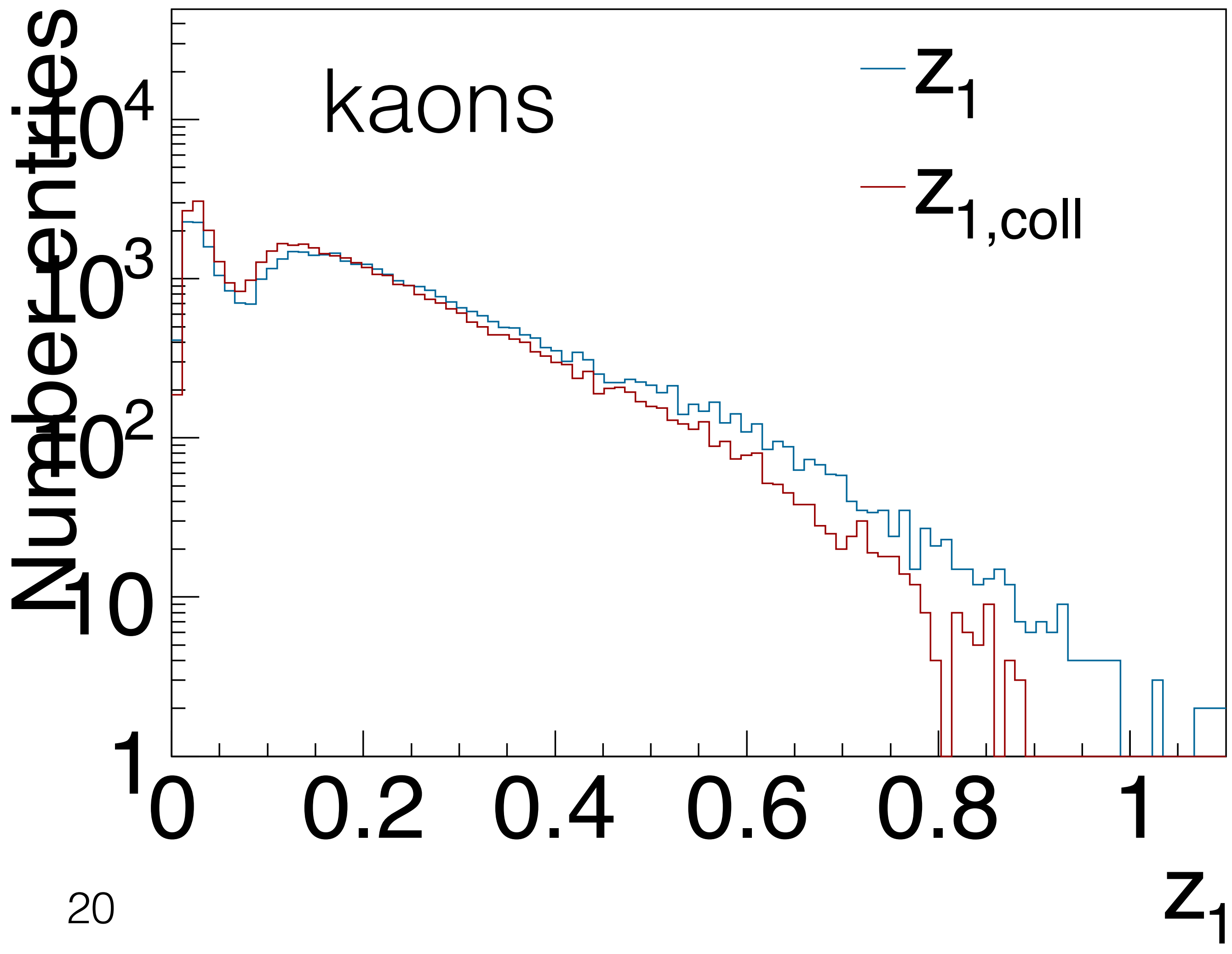
z spectra





Reconstructed Belle Monte Carlo





Reconstructed Belle Monte Carlo