

Study the potential of cell timing to improve cluster/jet calibration

2023, September 7

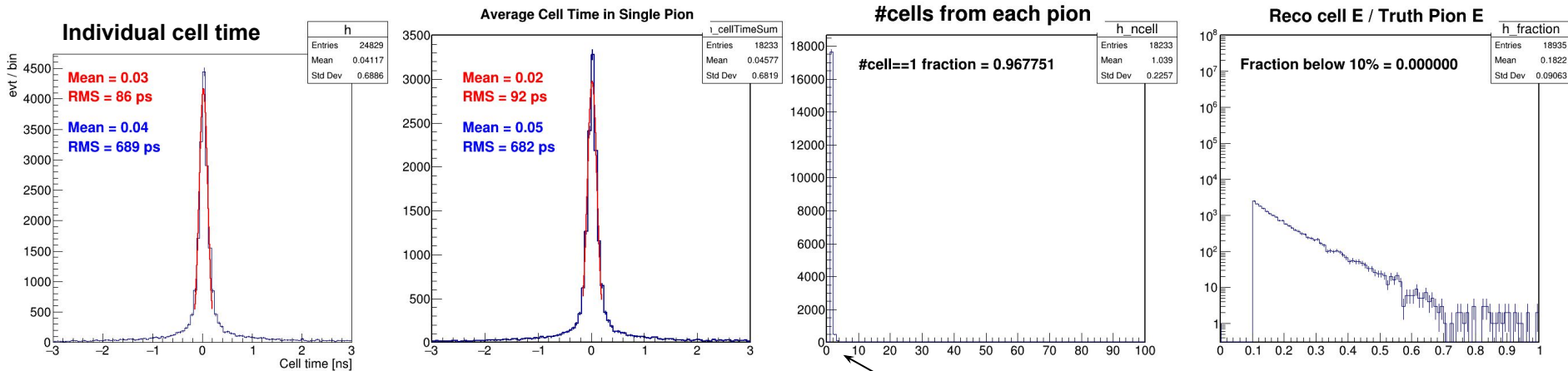


Kim Doyeong 김도영
Zahra Farazpay



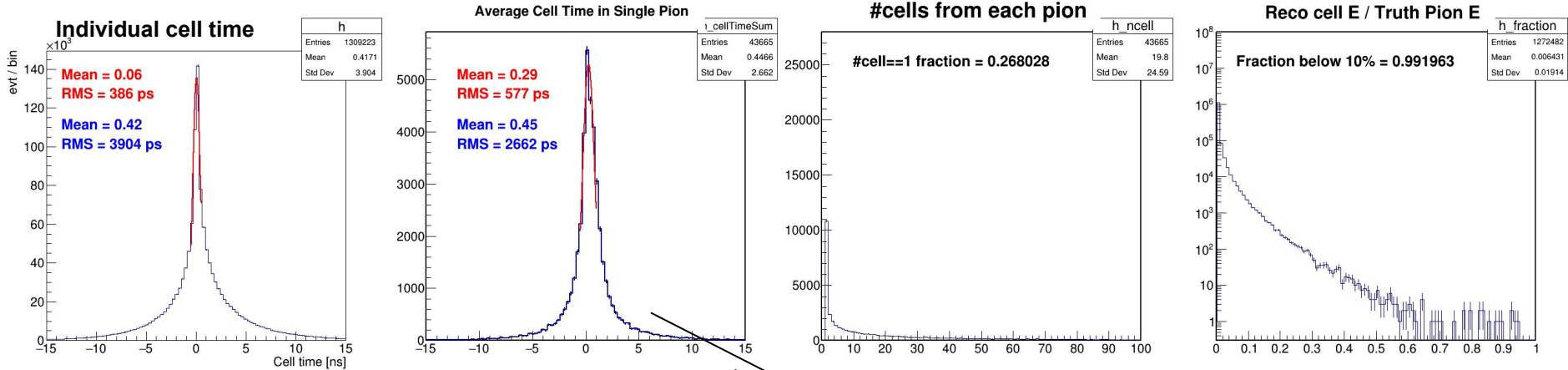
Tool validations using π^- sample (we've been using since HFSF2023)

The first two plots from the left implied that there was something wrong in my code as we expect smaller RMS from the averaged cell time plot by definition



● Selection:

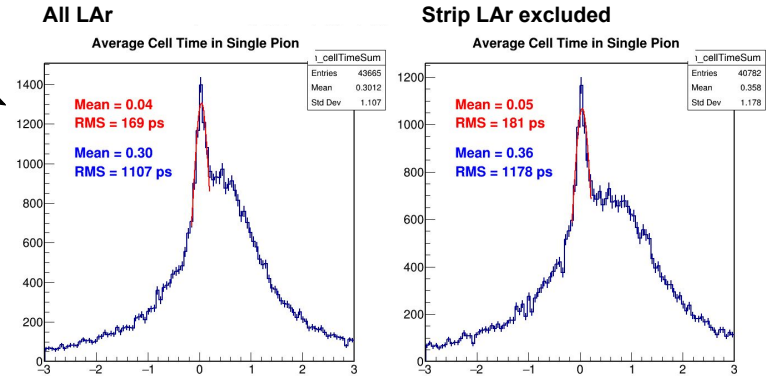
- truth cell E > 0.001 GeV ([cellEdep>0.001GeV motivation](#)) **!! temporary cut, will be removed !!**
- cellTime != 0
- LAr Berrel (cell center R < 2.1 m && |cell eta| < 0.8)
- reco cell E > 0.1 GeV
- **reco cell E / truth pion E > 0.1** → practically truth pion E < 1 GeV
this cut is not ideal as it include truth pion E, and indeed 96.8% of pions got contribution from only one cell



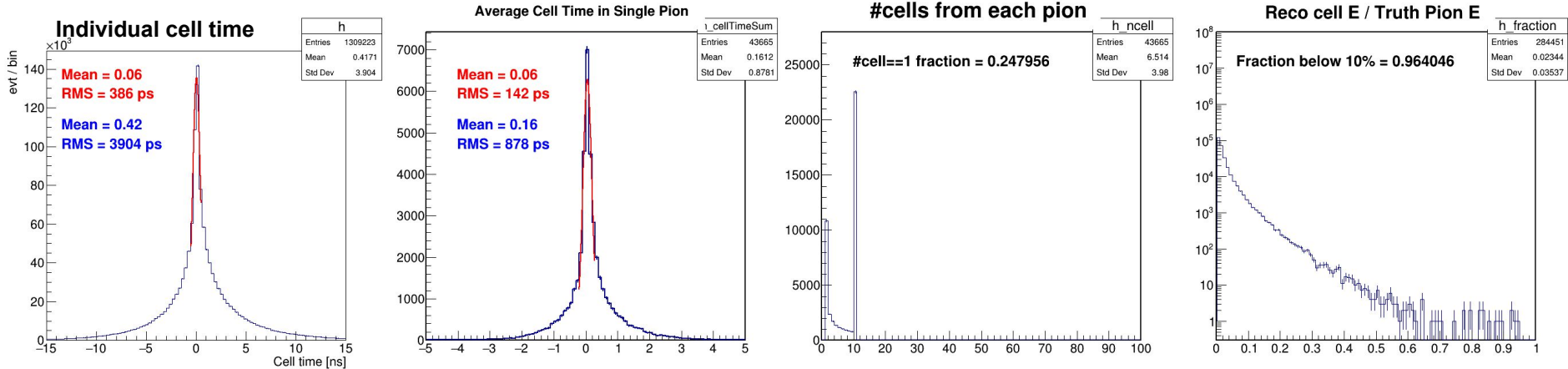
● Selection:

- truth cell E > 0.001 GeV ([cellEdep>0.001GeV motivation](#))
- cellTime != 0
- LAr Berrel (cell center R < 2.1 m && |cell eta| < 0.8)
- reco cell E > 0.1 GeV
- reco cell E / truth pion E > 0.1
this cut removed wrt previous slide

Zoomed in



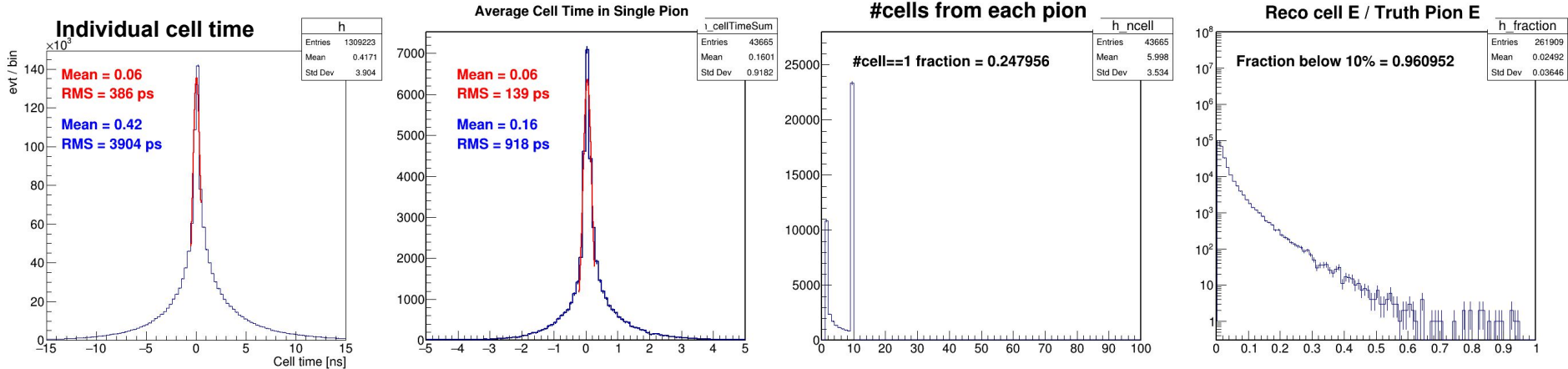
There are two peaks



- Selection:

- truth cell E > 0.001 GeV ([cellEdep>0.001GeV motivation](#)) !! temporary cut, will be removed !!
- cellTime != 0
- LAr Berrel (cell center R < 2.1 m && |cell eta| < 0.8)
- reco cell E > 0.1 GeV

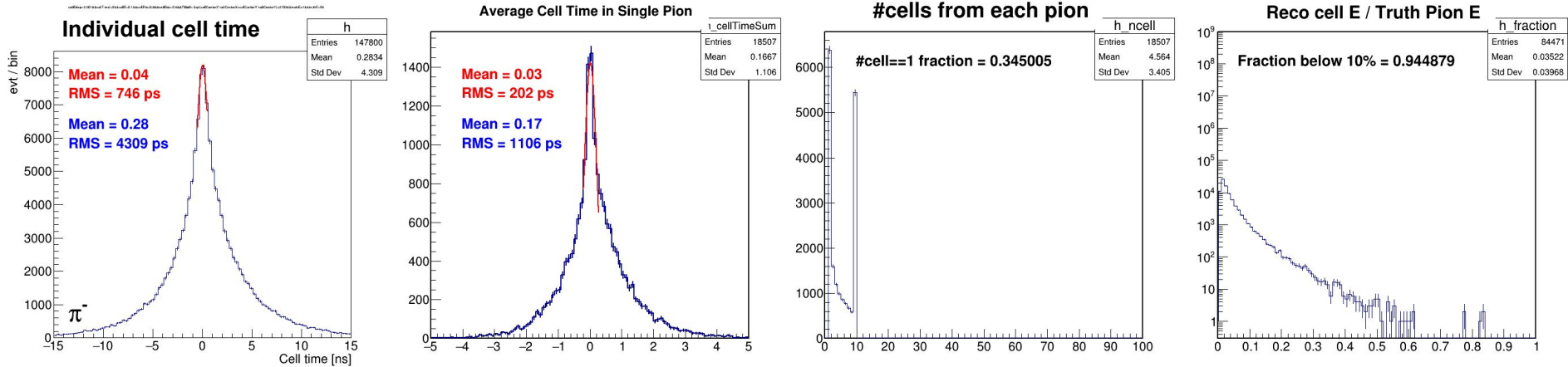
Only up to 10 energetic cells in each pion used for average (2nd plot), and one clean peak centered at near 0 remained



- Selection:

- truth cell E > 0.001 GeV ([cellEdep>0.001GeV motivation](#)) !! temporary cut, will be removed !!
- cellTime != 0
- LAr Berrel (cell center R < 2.1 m && |cell eta| < 0.8)
- reco cell E > 0.1 GeV

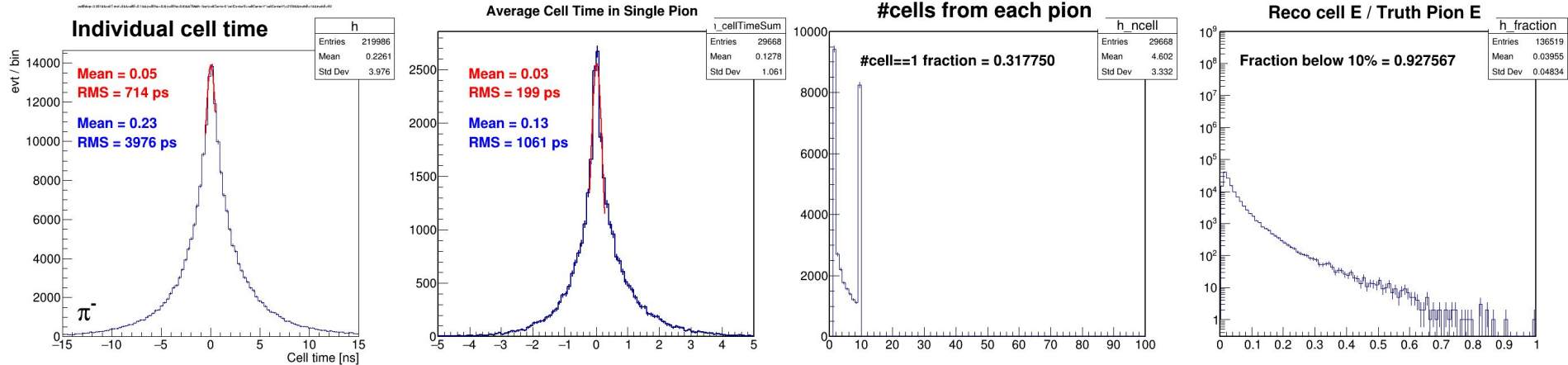
Only up to 9 energetic cells in each pion used for average (2nd plot), and one clean peak centered at near 0 remained



● Selection:

- truth cell E > 0.001 GeV ([cellEdep>0.001GeV motivation](#)) !! temporary cut, will be removed !!
- cellTime != 0
- LAr Barrel (cell center R < 2.1 m && |cell eta| < 0.8)
- reco cell E > 0.1 GeV
- 1 GeV < truth pion E < 50 GeV

Only up to 9 energetic cells in each pion used for average (2nd plot), and one clean peak centered at near 0 remained



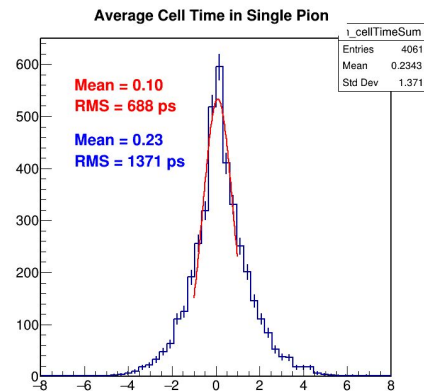
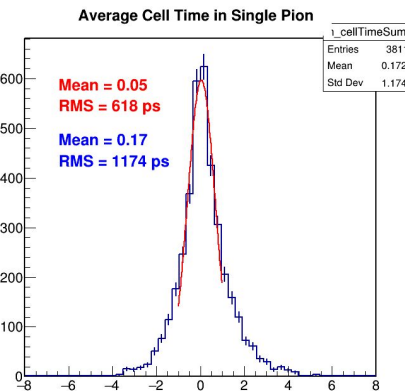
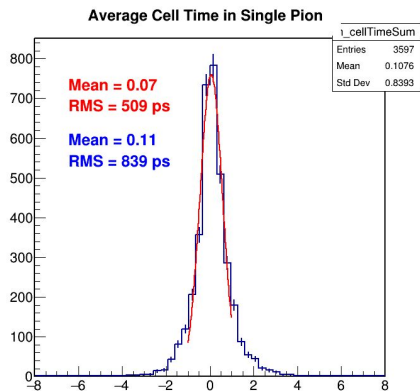
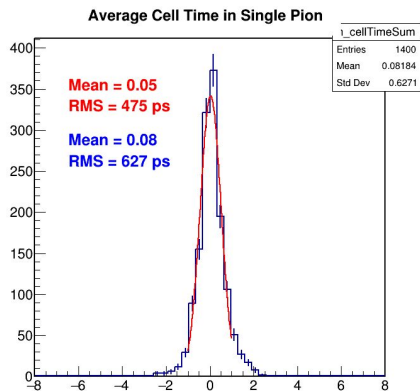
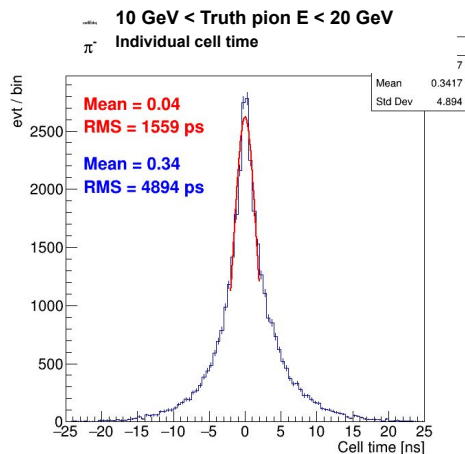
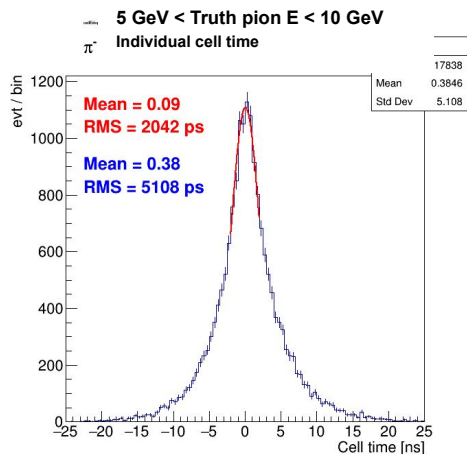
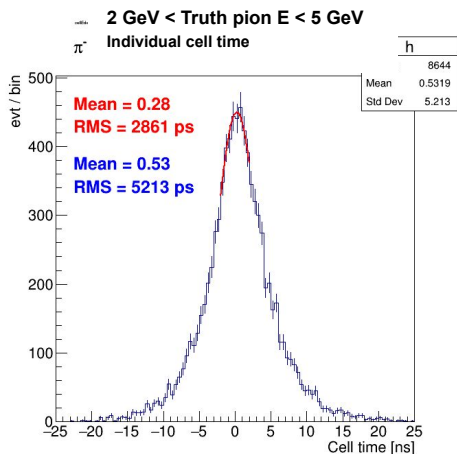
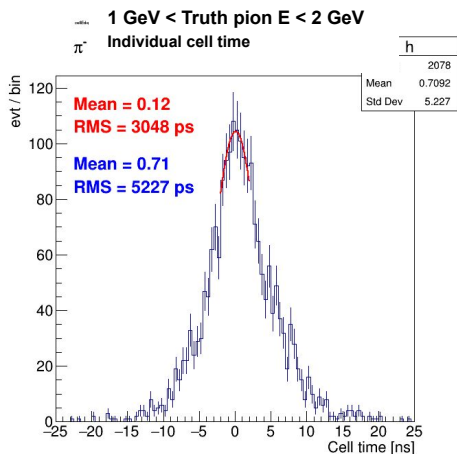
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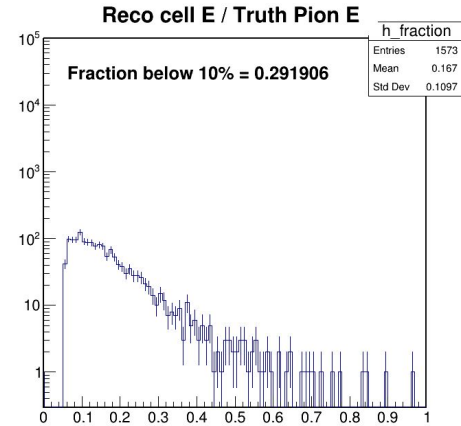
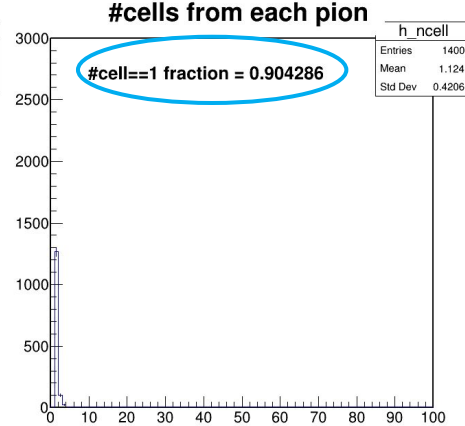
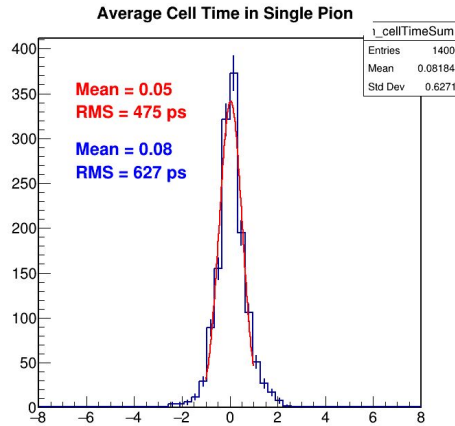
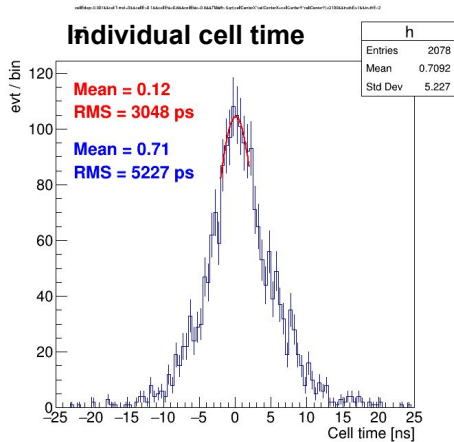
- truth cell E > 0.001 GeV ([cellEdep>0.001GeV motivation](#)) !! temporary cut, will be removed !!
- cellTime != 0
- LAr Endcap (cell center R < 2.1 m && |cell eta| > 0.8)
- reco cell E > 0.1 GeV
- 1 GeV < truth pion E < 50 GeV

Only up to 9 energetic cells in each pion used for average (2nd plot), and one clean peak centered at near 0 remained

Cell time in bins of pion energy using π^- sample

(we've been using since HFSF2023)

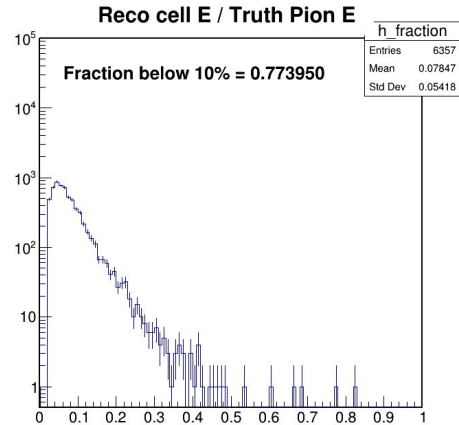
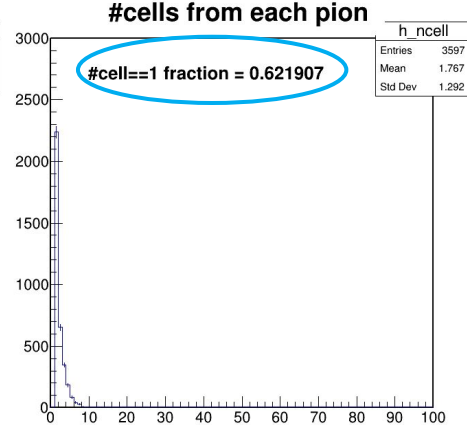
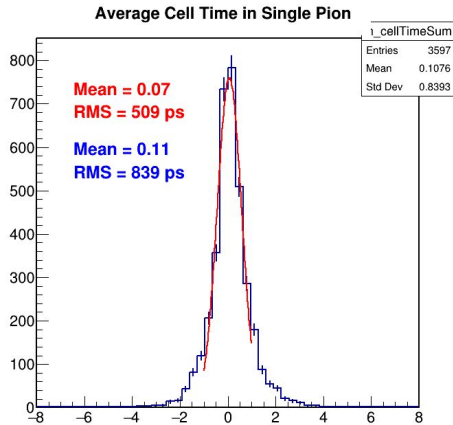
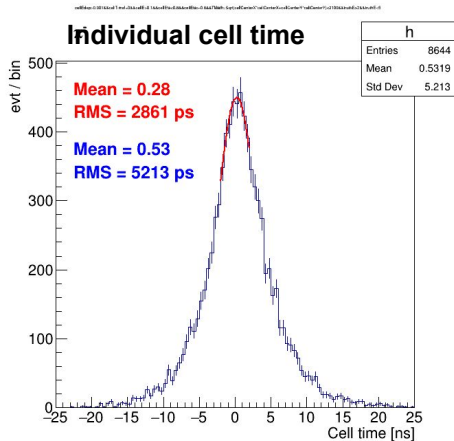




● Selection:

- truth cell E > 0.001 GeV ([cellEdep>0.001GeV motivation](#)) !! temporary cut, will be removed !!
- cellTime != 0
- LAr Barrel (cell center R < 2.1 m && |cell eta| < 0.8)
- reco cell E > 0.1 GeV
- 1 GeV < truth pion E < 2 GeV

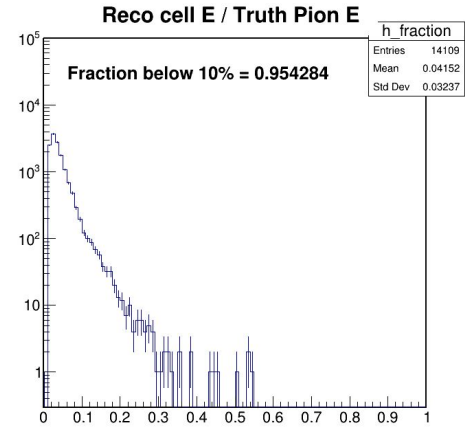
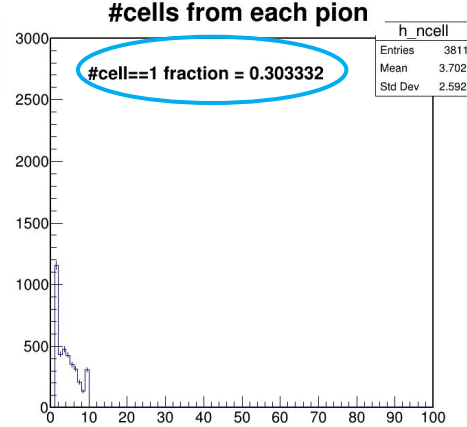
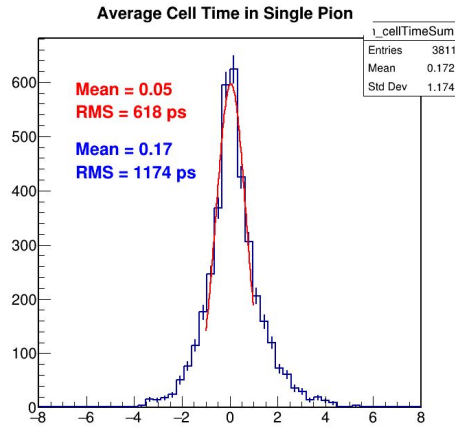
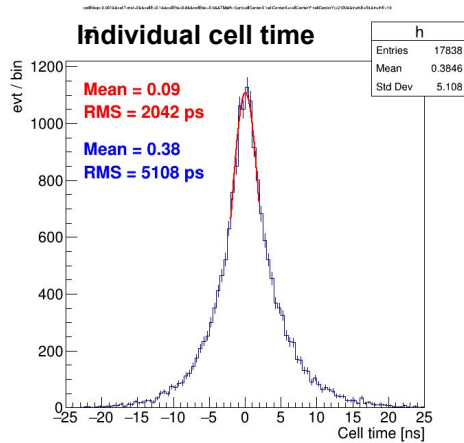
Only up to 9 energetic cells in each pion used for average (2nd plot), and one clean peak centered at near 0 remained



● Selection:

- truth cell E > 0.001 GeV ([cellEdep>0.001GeV motivation](#)) !! temporary cut, will be removed !!
- cellTime != 0
- LAr Barrel (cell center R < 2.1 m && |cell eta| < 0.8)
- reco cell E > 0.1 GeV
- 2 GeV < truth pion E < 5 GeV

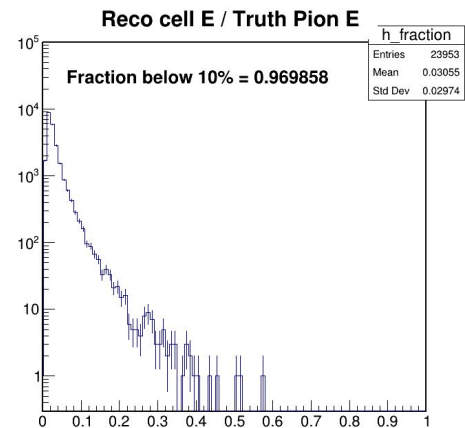
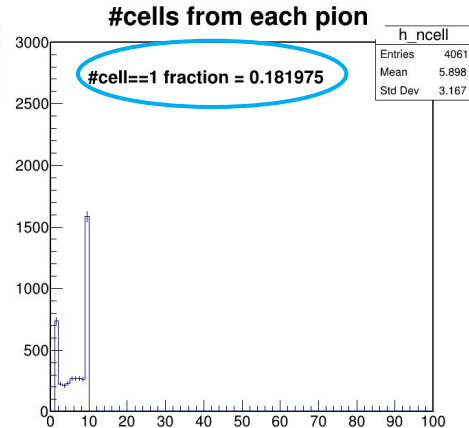
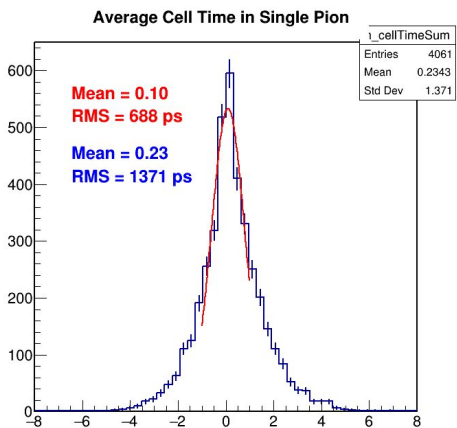
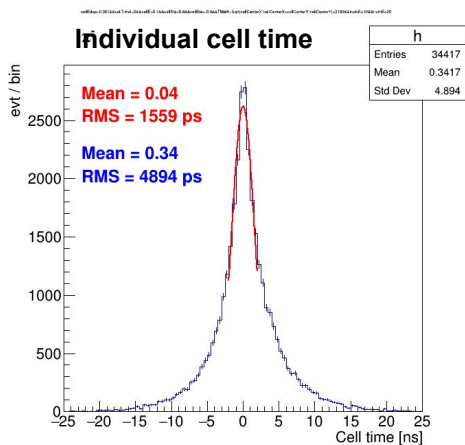
Only up to 9 energetic cells in each pion used for average (2nd plot), and one clean peak centered at near 0 remained



● Selection:

- truth cell E > 0.001 GeV ([cellEdep>0.001GeV motivation](#)) !! temporary cut, will be removed !!
- cellTime != 0
- LAr Barrel (cell center R < 2.1 m && |cell eta| < 0.8)
- reco cell E > 0.1 GeV
- 5 GeV < truth pion E < 10 GeV

Only up to 9 energetic cells in each pion used for average (2nd plot), and one clean peak centered at near 0 remained

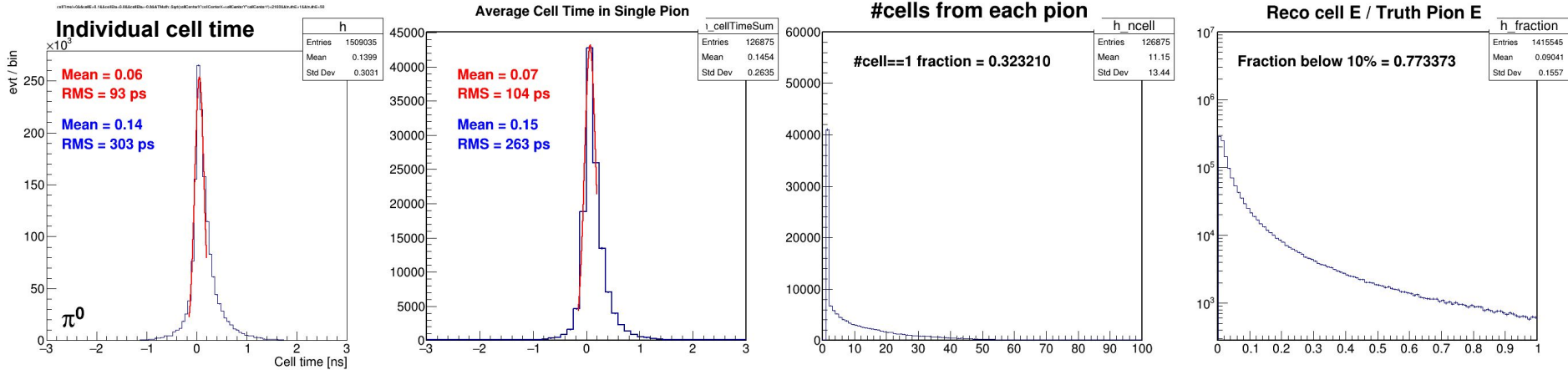


● Selection:

- truth cell E > 0.001 GeV ([cellEdep>0.001GeV motivation](#)) !! temporary cut, will be removed !!
- cellTime != 0
- LAr Barrel (cell center R < 2.1 m && |cell eta| < 0.8)
- reco cell E > 0.1 GeV
- 10 GeV < truth pion E < 20 GeV

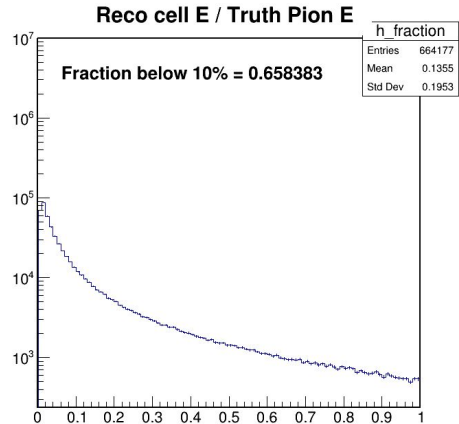
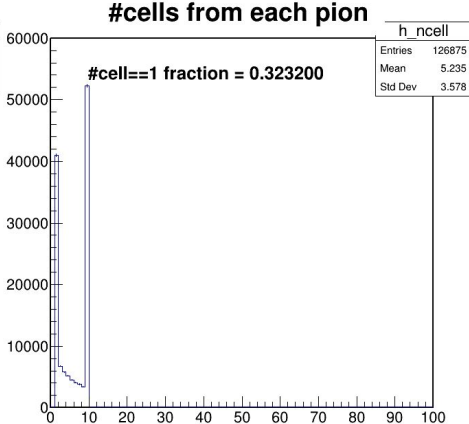
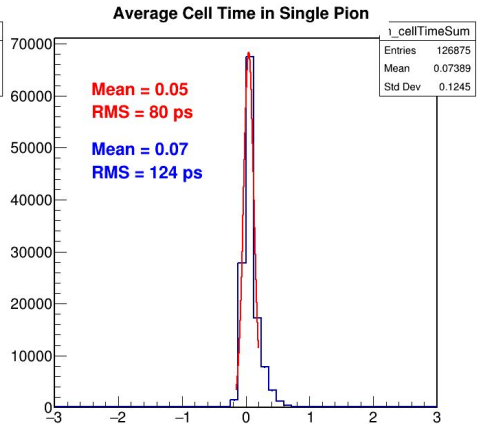
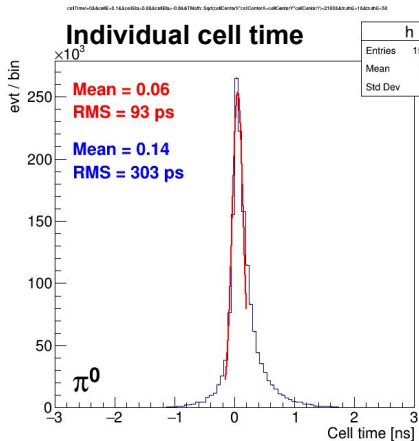
Only up to 9 energetic cells in each pion used for average (2nd plot), and one clean peak centered at near 0 remained

Cell time in bins of pion energy using π^0 w/o PU sample



- Selection:

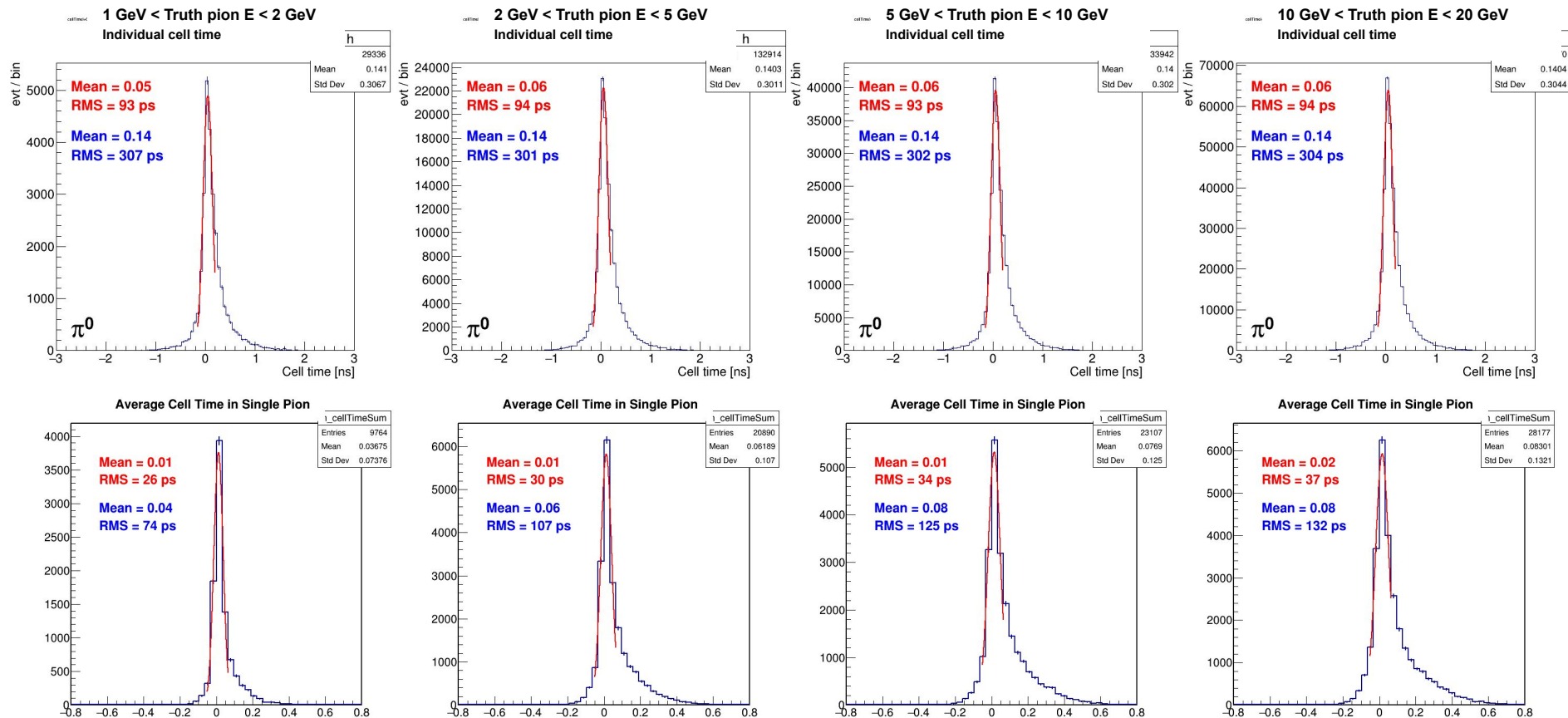
- cellTime != 0
- LAr Barrel (cell center R < 2.1 m && |cell eta| < 0.8)
- reco cell E > 0.1 GeV
- 1 GeV < truth pion E < 50 GeV

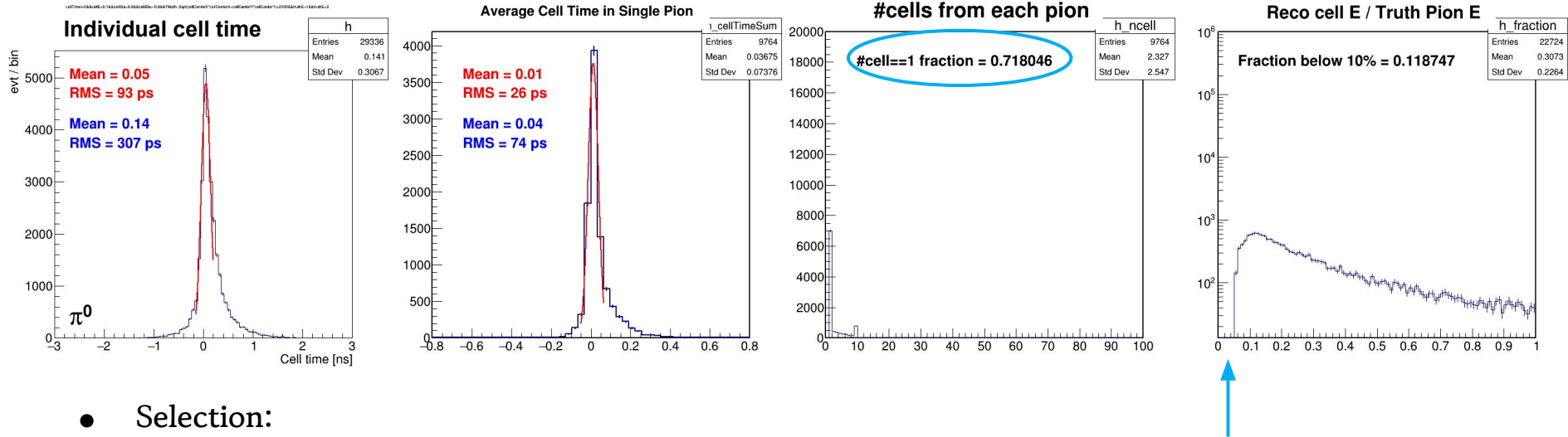


● Selection:

- cellTime != 0
- LAr Barrel (cell center $R < 2.1 \text{ m}$ && $|\text{cell eta}| < 0.8$)
- reco cell E > 0.1 GeV
- 1 GeV < truth pion E < 50 GeV

Only up to 9 energetic cells in each pion used for average (2nd plot), and one clean peak centered at near 0 remained

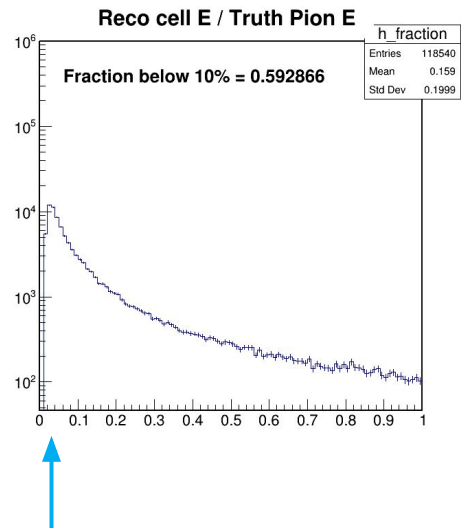
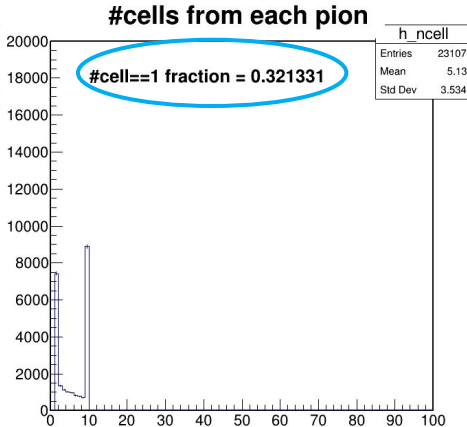
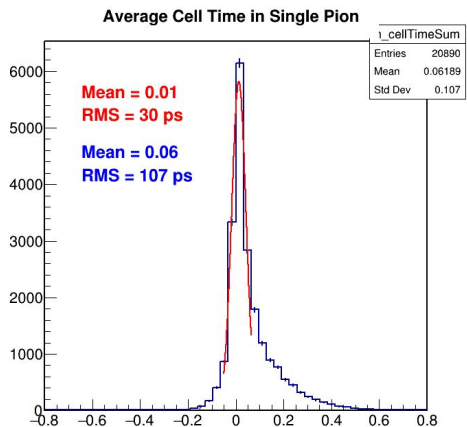
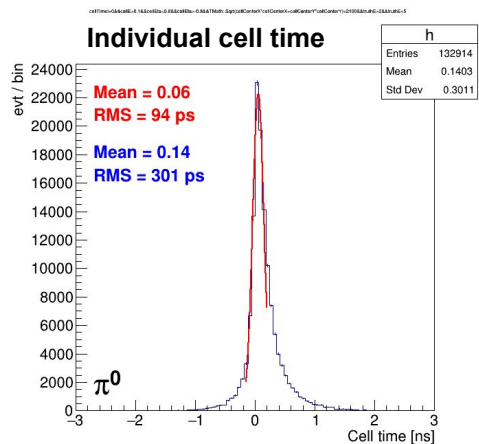




- Selection:

- cellTime != 0
- LAr Barrel (cell center $R < 2.1 \text{ m}$ && $|\text{cell eta}| < 0.8$)
- reco cell E $> 0.1 \text{ GeV}$
- $1 \text{ GeV} < \text{truth pion E} < 2 \text{ GeV}$

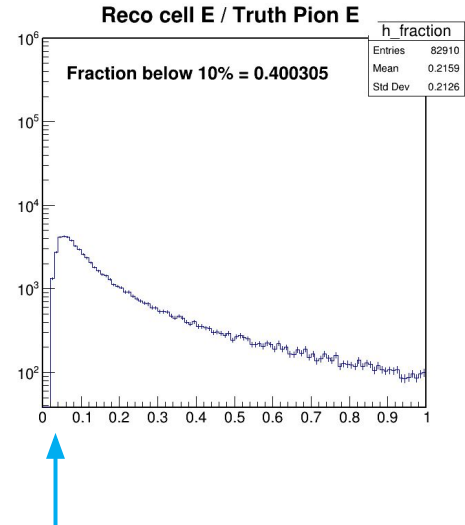
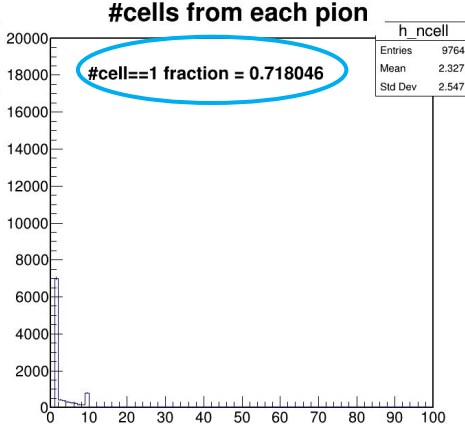
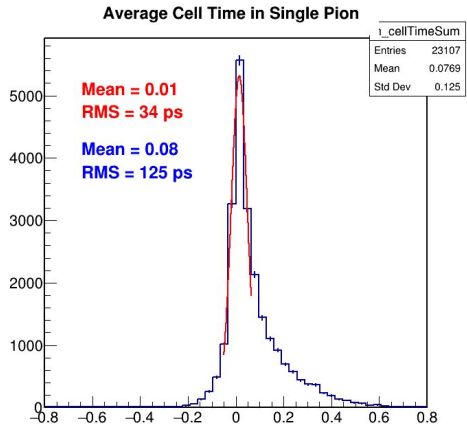
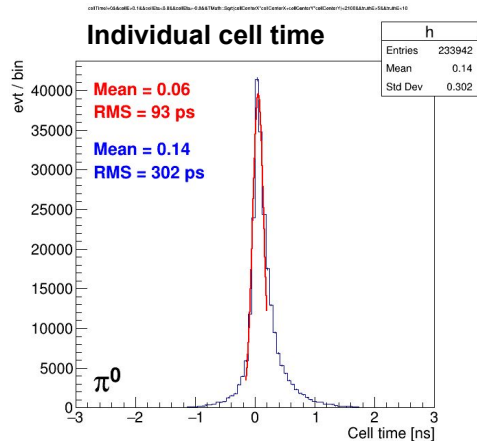
Only up to 9 energetic cells in each pion used for average (2nd plot), and one clean peak centered at near 0 remained



- **Selection:**

- cellTime != 0
- LAr Barrel (cell center $R < 2.1 \text{ m}$ && $|\text{cell eta}| < 0.8$)
- reco cell E > 0.1 GeV
- $2 \text{ GeV} < \text{truth pion E} < 5 \text{ GeV}$

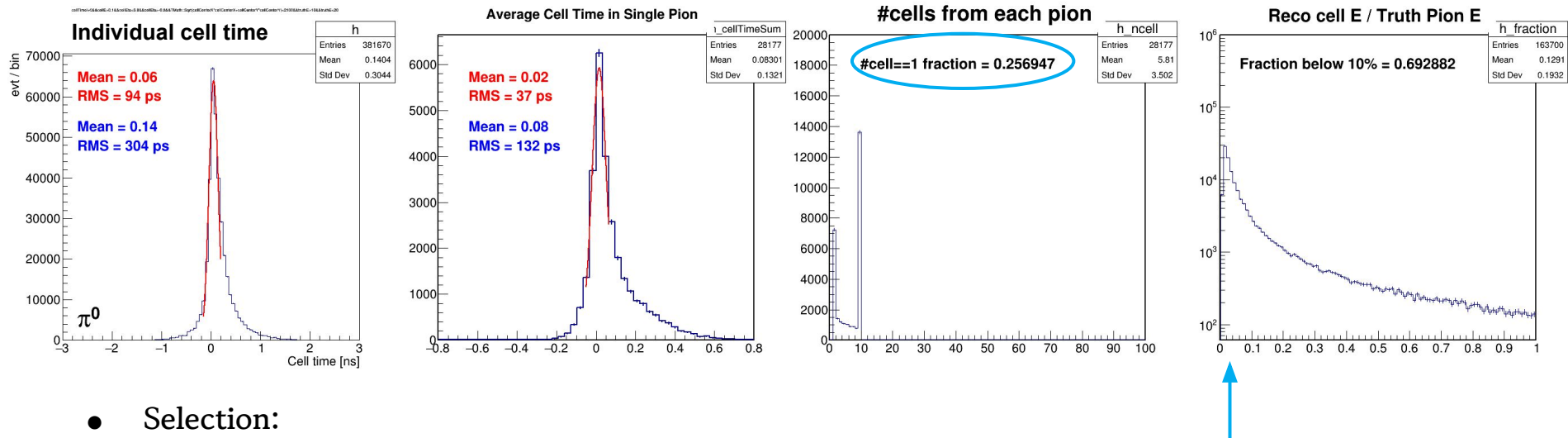
Only up to 9 energetic cells in each pion used for average (2nd plot), and one clean peak centered at near 0 remained



- **Selection:**

- cellTime != 0
- LAr Barrel (cell center $R < 2.1 \text{ m}$ && $|\text{cell } \eta| < 0.8$)
- reco cell E $> 0.1 \text{ GeV}$
- $5 \text{ GeV} < \text{truth pion } E < 10 \text{ GeV}$

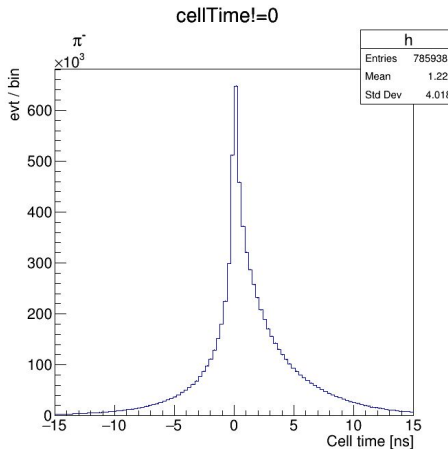
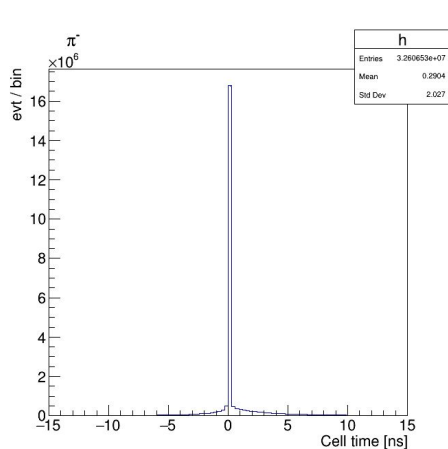
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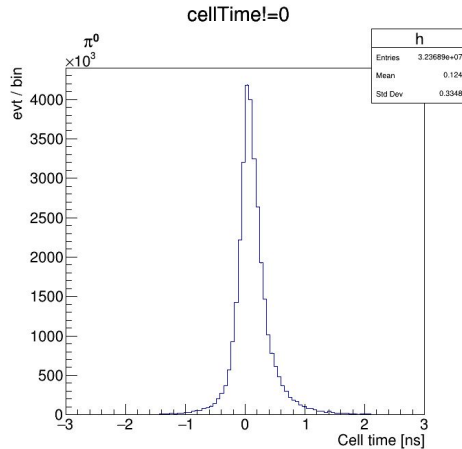
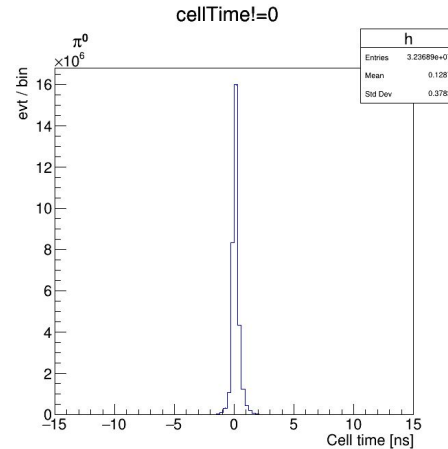
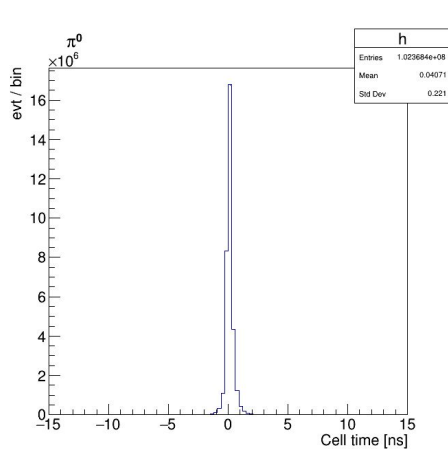
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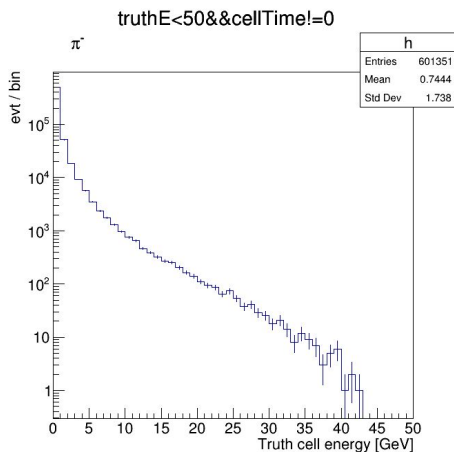
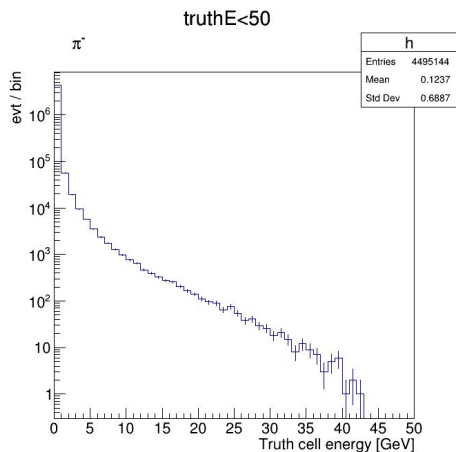
- cellTime != 0
- LAr Barrel (cell center $R < 2.1 \text{ m}$ && $|\text{cell eta}| < 0.8$)
- reco cell E $> 0.1 \text{ GeV}$
- $10 \text{ GeV} < \text{truth pion E} < 20 \text{ GeV}$

Only up to 9 energetic cells in each pion used for average (2nd plot), and one clean peak centered at near 0 remained

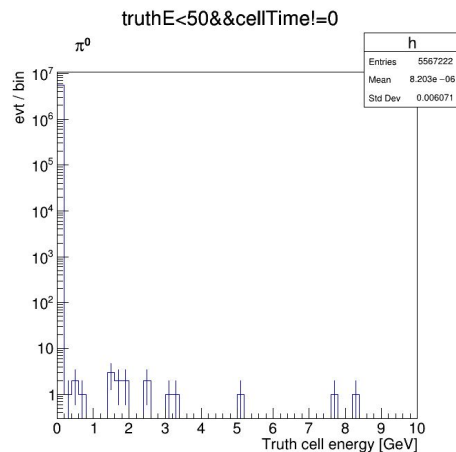
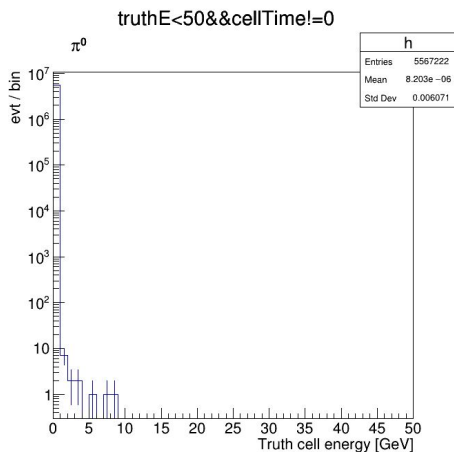
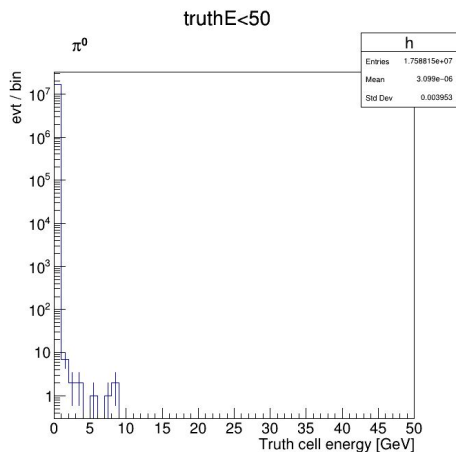


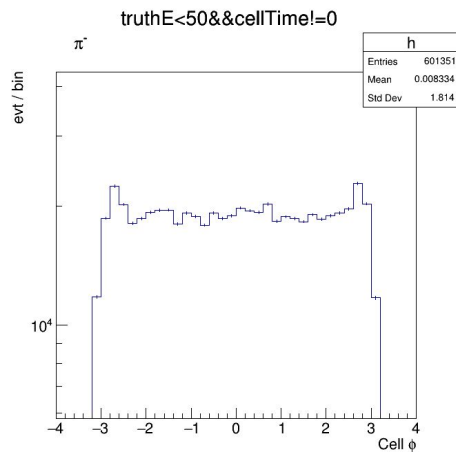
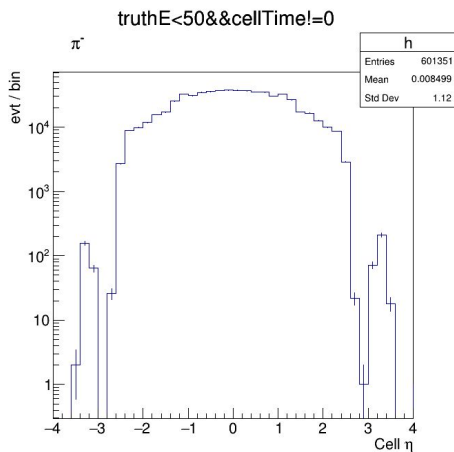
More validation study was done by Zahra



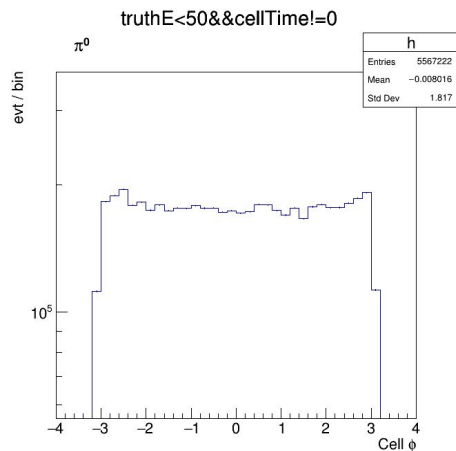
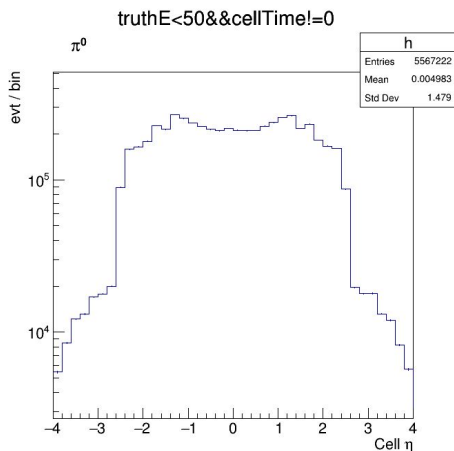


More validation study was done by Zahra



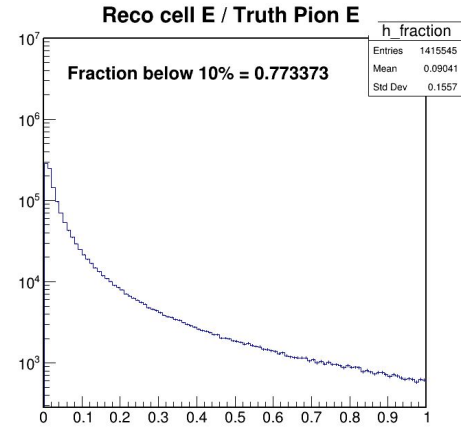
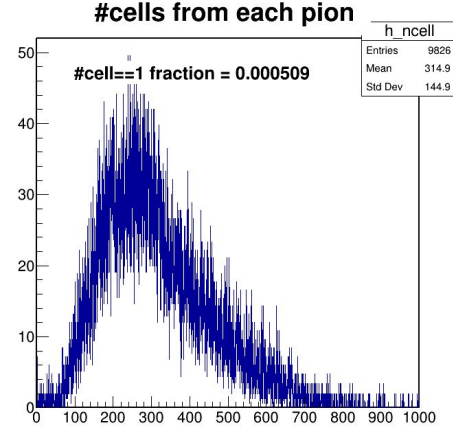
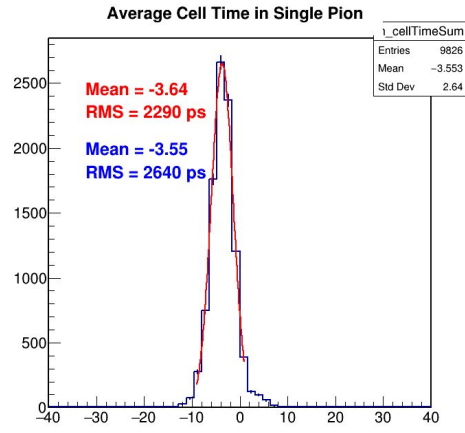
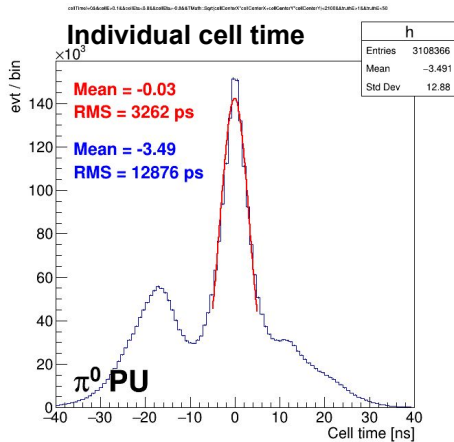


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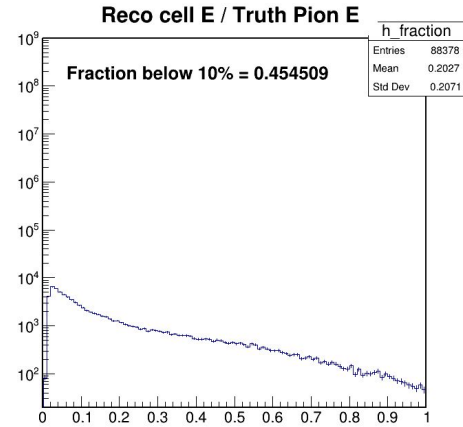
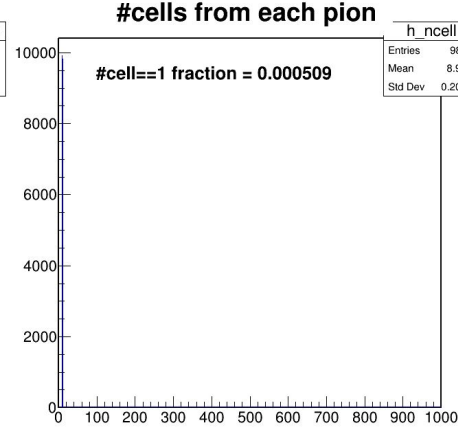
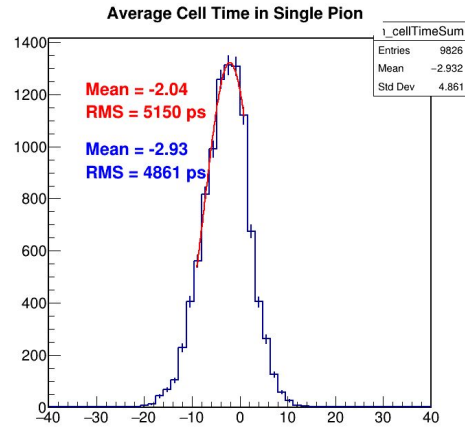
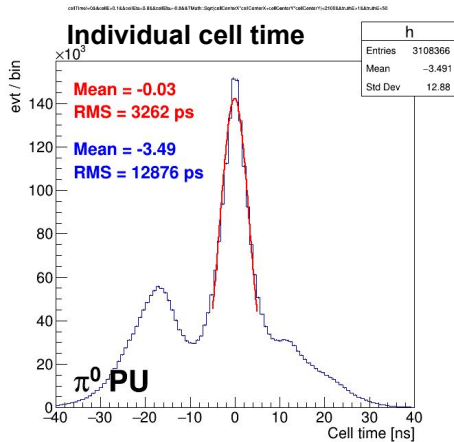


Cell time in bins of pion energy using π^0_{PU} sample



- Selection:

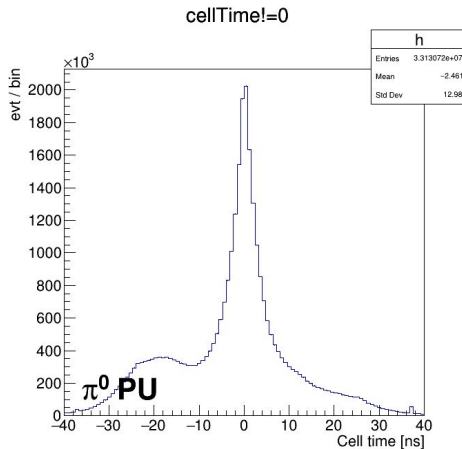
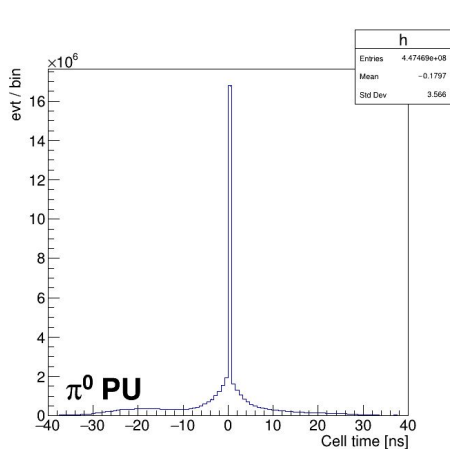
- cellTime != 0
- LAr Barrel (cell center R < 2.1 m && |cell eta| < 0.8)
- reco cell E > 0.1 GeV
- 1 GeV < truth pion pT < 50 GeV



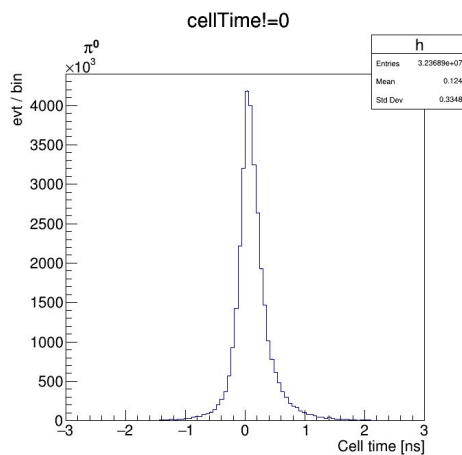
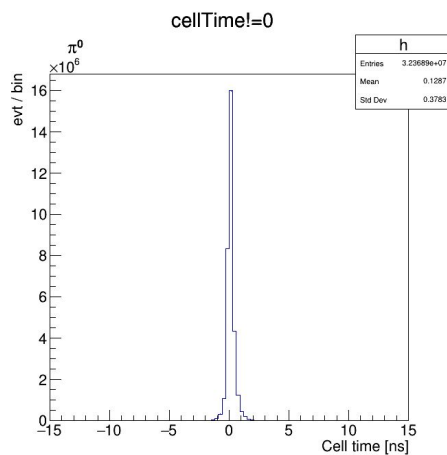
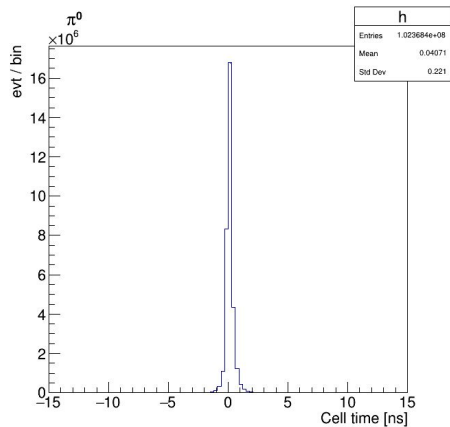
- Selection:

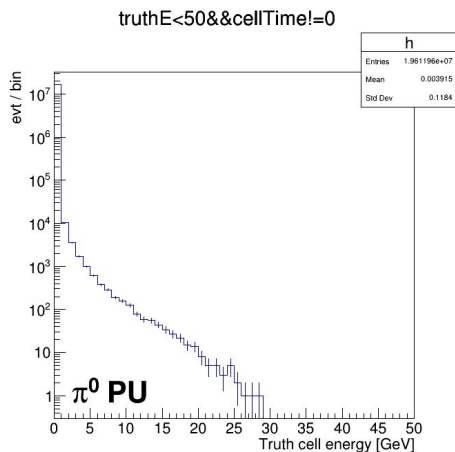
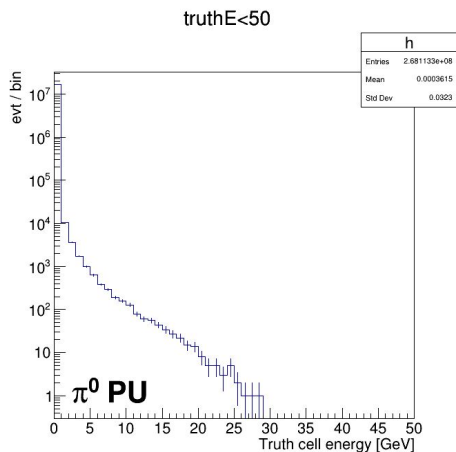
- cellTime != 0
- LAr Barrel (cell center $R < 2.1 \text{ m}$ && $|\text{cell } \eta| < 0.8$)
- reco cell E > 0.1 GeV
- $1 \text{ GeV} < \text{truth pion } p_T < 50 \text{ GeV}$

Only up to 9 energetic cells in each pion used for average (2nd plot), and one clean peak centered at near 0 remained

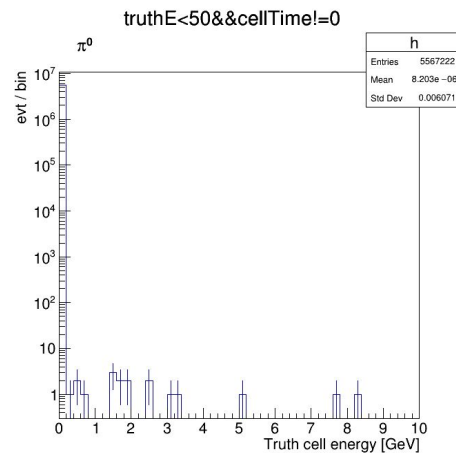
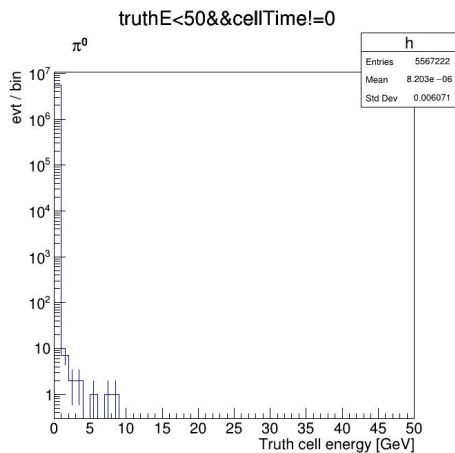
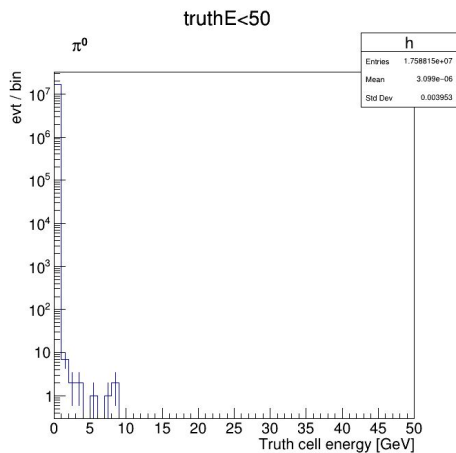


More validation study was done by Zahra





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