Update on correcting timing information in MC and data for selecting anode piercing tracks

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DRA Meeting

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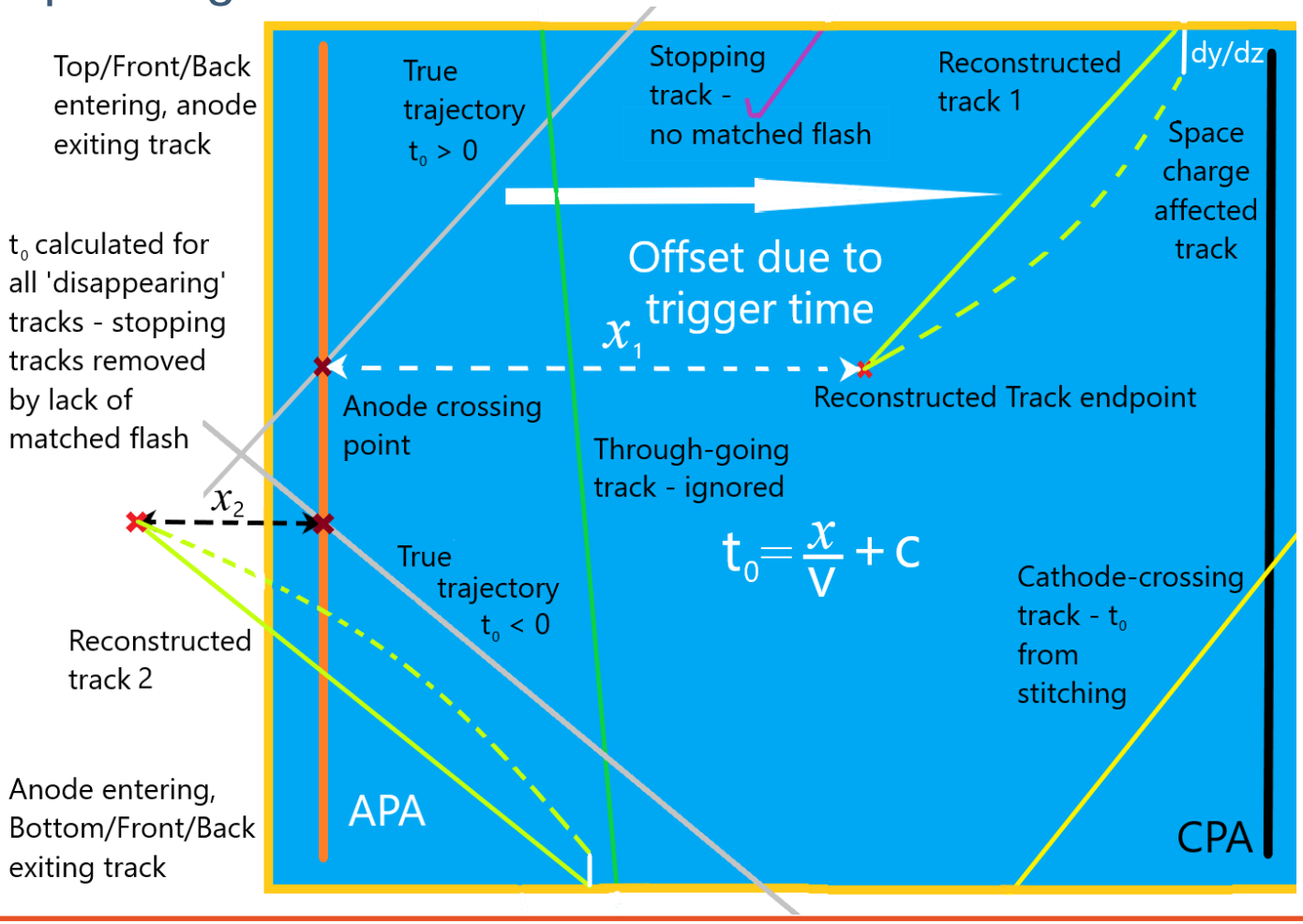
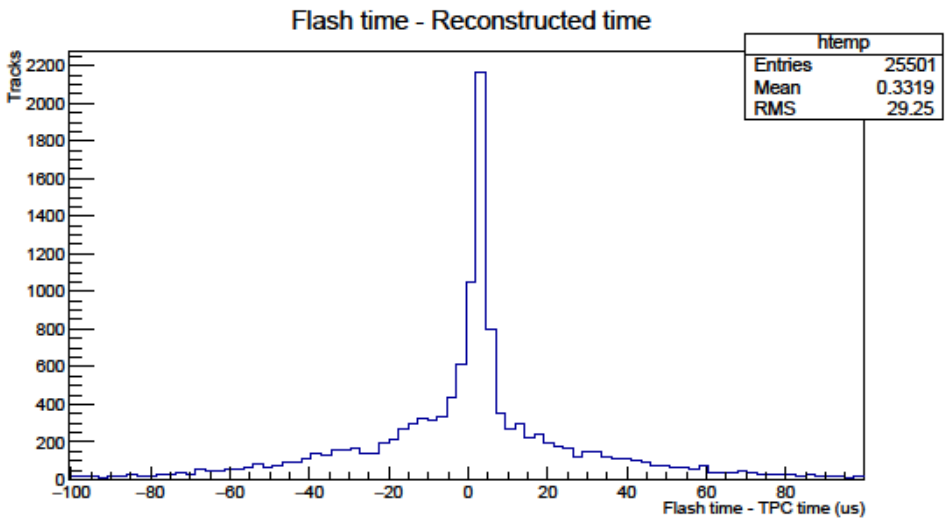
Anode piercing tracks diagram

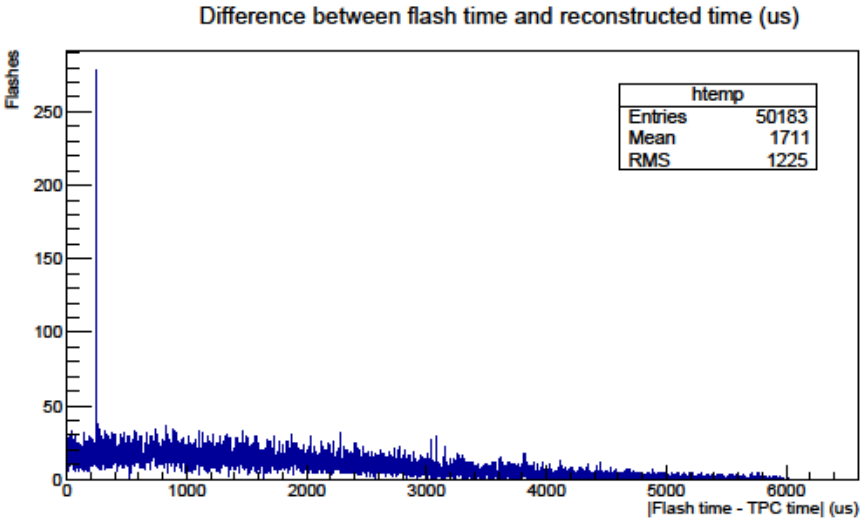
- Stephen requested a diagram showing the process of selecting anode piercing tracks:



Resolving MC timing issue

- The wide spread of time differences in MCC11 (l) strongly suggested that the flashes were not being correctly matched to tracks and the matches were through random coincidence.

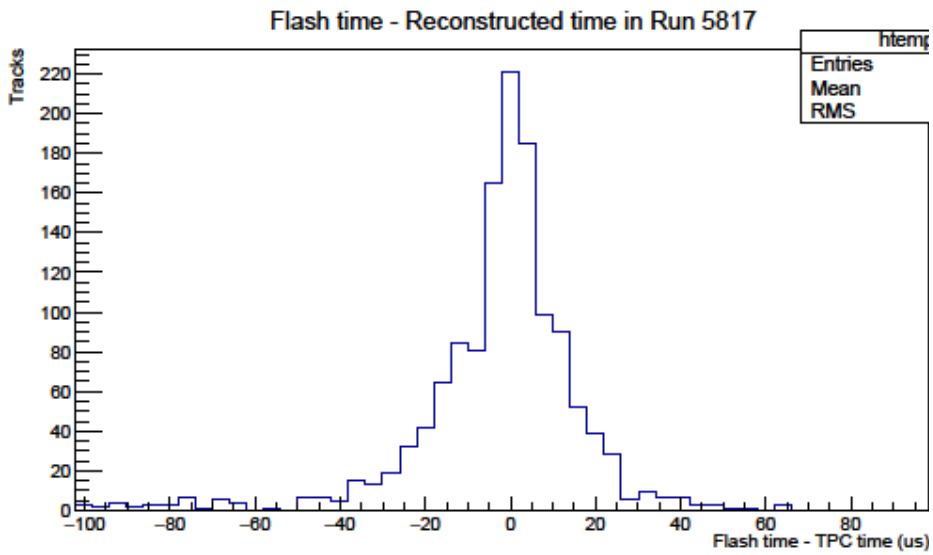


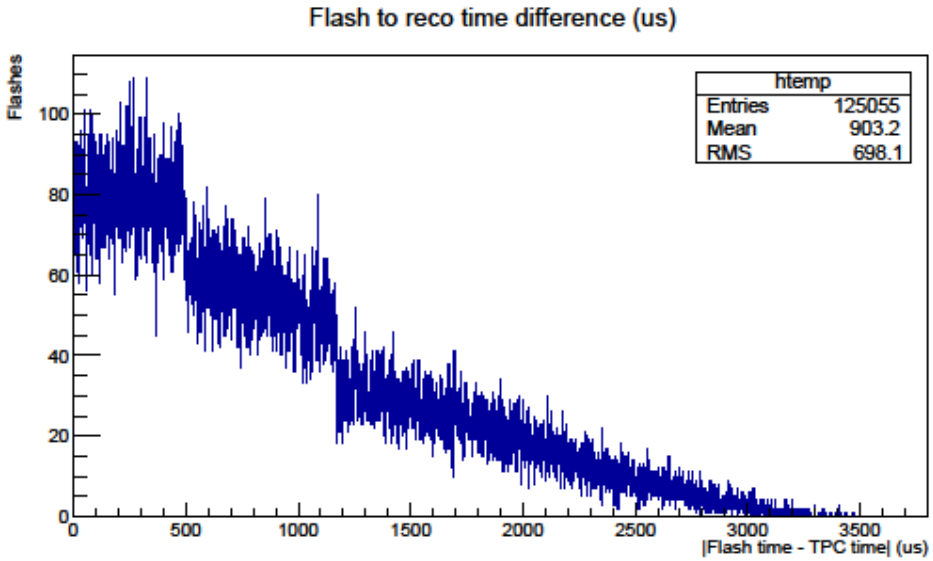


- To establish whether this was due to an offset between the timing systems, I have plotted the time difference between anode piercing track candidates and all flashes in each event (r). A clear peak is visible at 250 µs, which corresponds to an offset in MCC11 which I had not been accounting for previously.

Resolving data timing issue

- The spread in the data (l) looked similarly wide and incorrect. Using the same technique, I looked at the time differences in data (r).

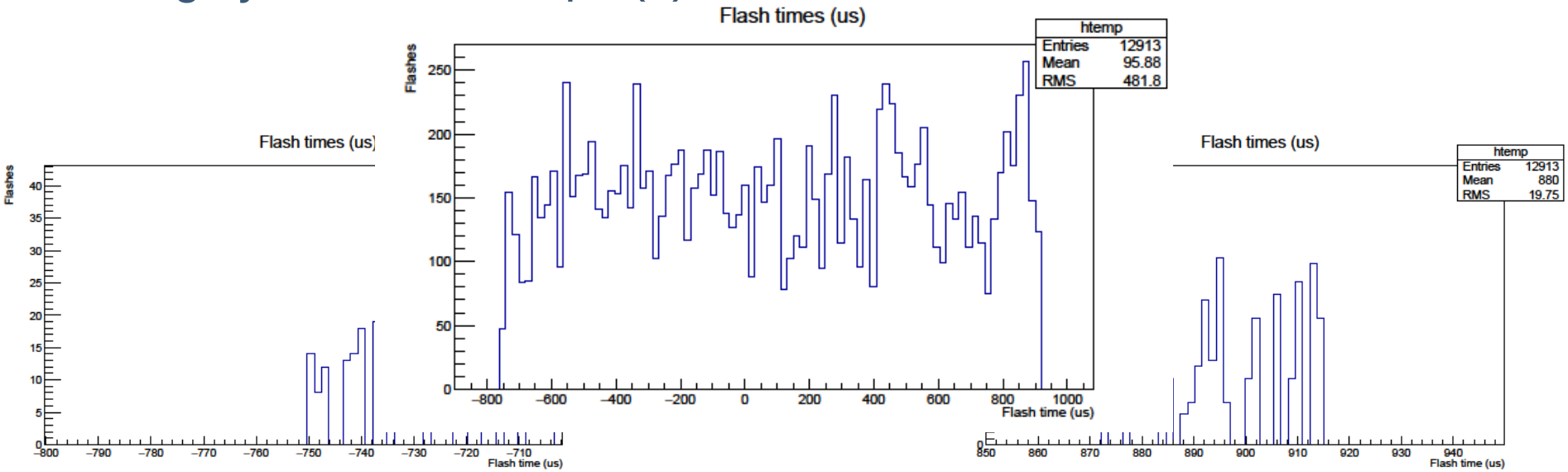




- Using the flash time as stored, no peak can be seen but there is an unusual pattern in the number of flashes matched against the time difference.

Examining flash times closely

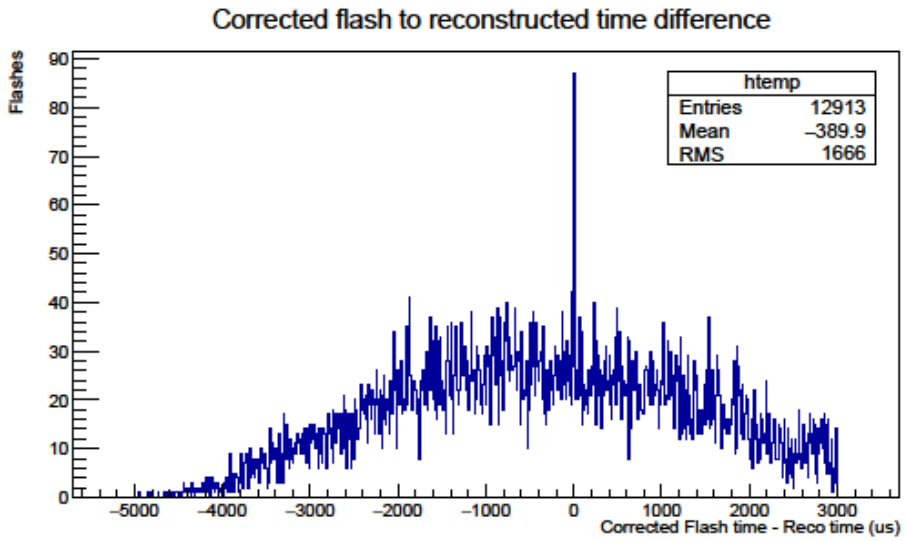
- I have previously shown the shortened flash time window, from roughly -800 to +900 µs (c).

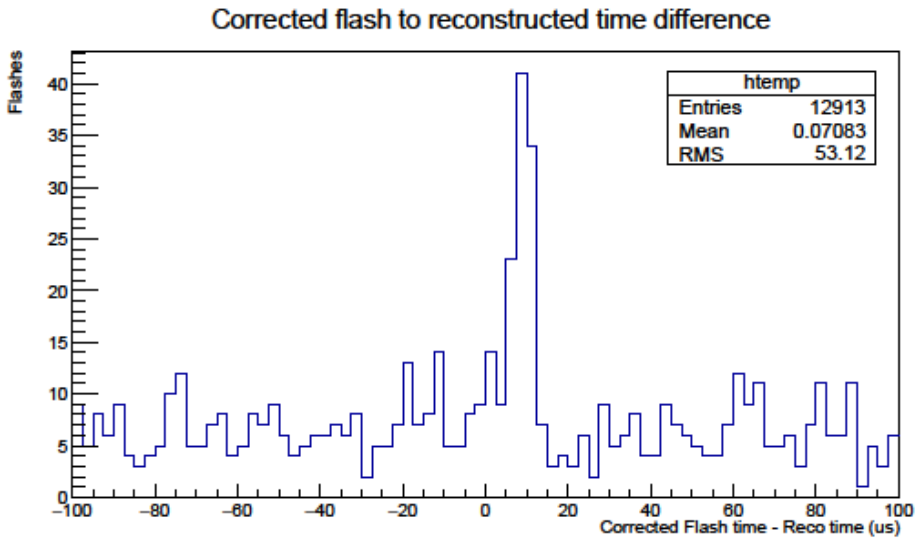


- When zooming in to the end points, these values are more precisely -750 (l) and 915 µs (r). These are exactly 1/3 of the photon detector readout window, which runs from -2.25 to 2.75 ms.

Correcting flash times

- I have taken these stored values and multiplied by 3 to give a corrected flash time.

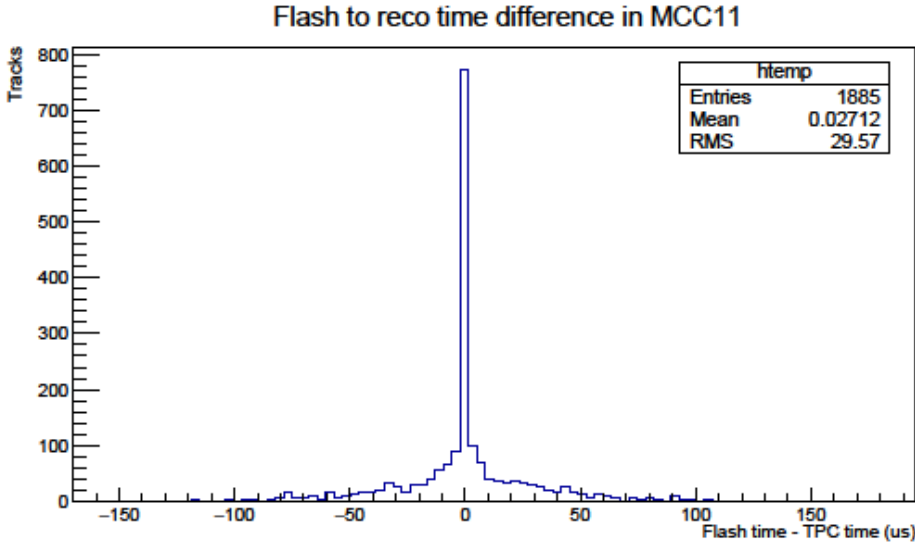


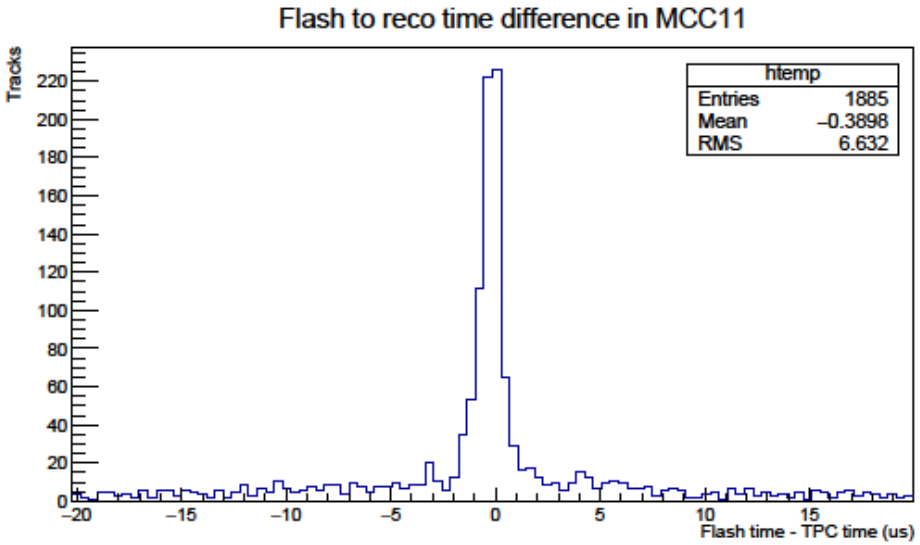


- Comparing this corrected flash time to reconstructed t_0 shows a clear peak, close to zero, which strongly suggests that this corresponds to correctly matched particles.

MC Matched flash time difference

- Correcting for these issues, I have produced plots of the matched flash time to reco time difference for MCC11 and data.

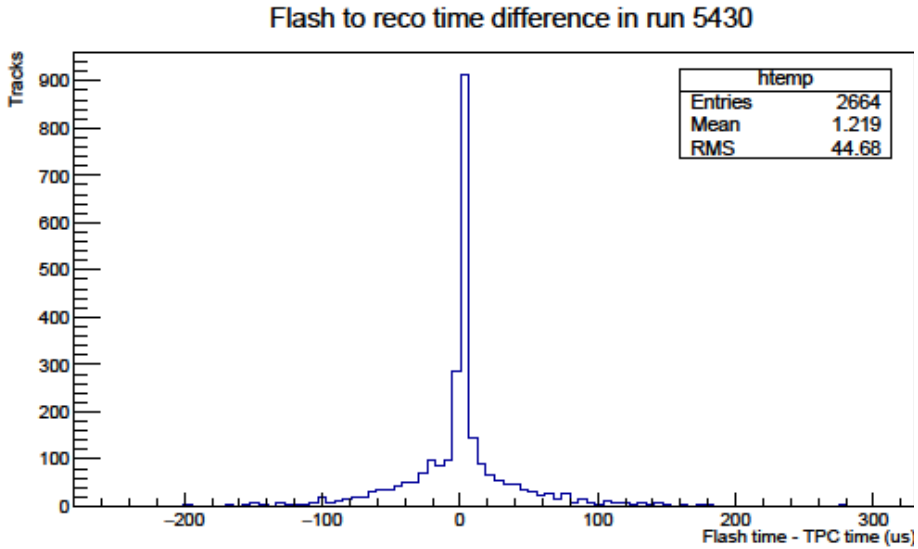


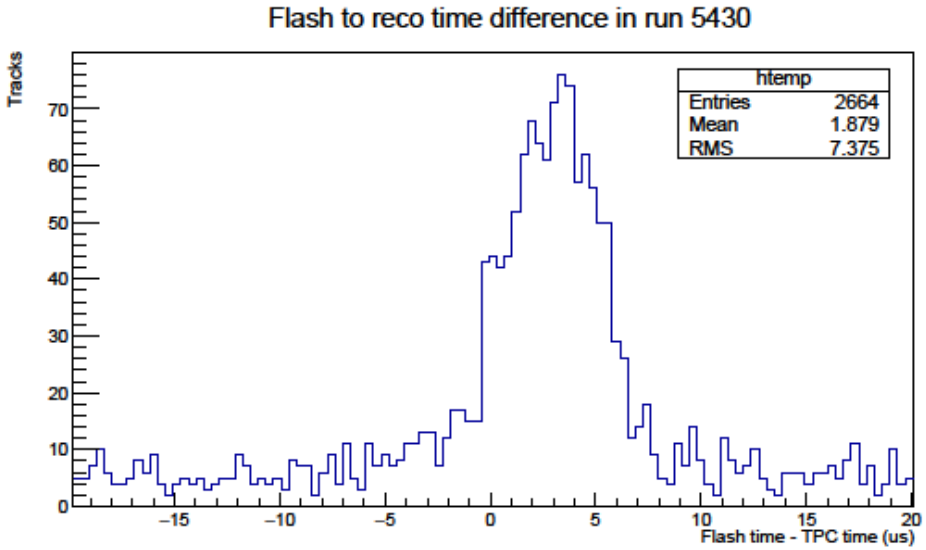


- In MCC11 (l, zoomed in r), the matching now produces a narrow peak which looks to correspond to correctly matched anode piercing tracks and flashes.

Time difference in data

- The peak is not as narrow in the data, but it does appear to be centred fairly well, with a small offset that is not otherwise accounted for yet.

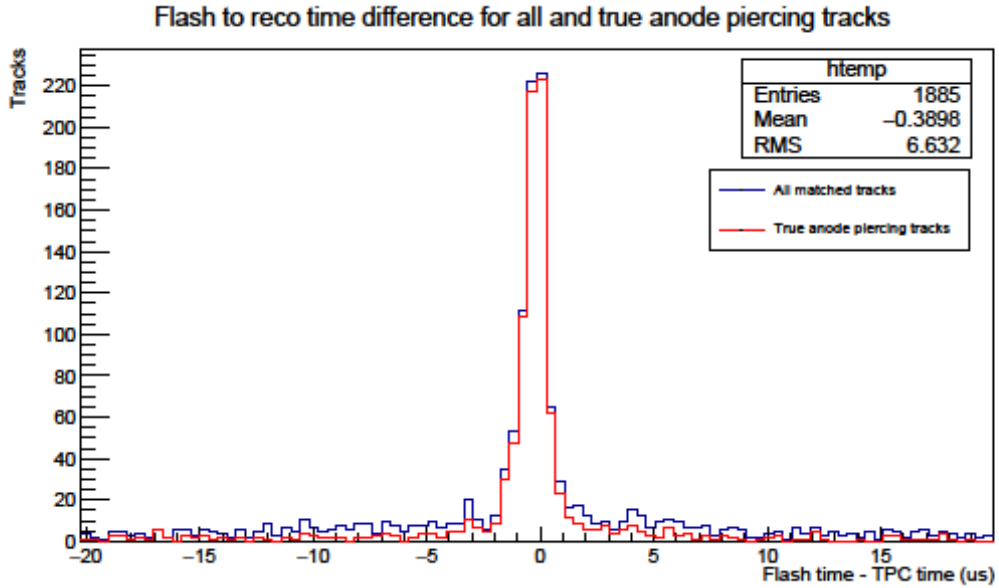




- However, no cuts have been applied yet beyond a nominal minimum 20 PE and 5 cm track length, so applying cuts of this nature will likely narrow the peak region.

Initial purity in MC

- For the MC, I have taken tracks matched to MC particles which start/end at the anode plane and treated these as true anode piercing tracks.



- In the peak region, there is little difference between the two distributions, with a -2 to +1 μs cut giving 95.4% purity of ‘true’ anode piercing particles selected in this way, for MCC11, with no other cuts applied, and 64.0% efficiency.

Next Steps

- I will implement the T0Offset parameter for the MC, in case this changes in future productions.
- Further studies on the purity using the MC, including studying the method of determining true anode piercing particles and determining which cuts to apply to select tracks.
- Further ahead, using cryostat side hits to corroborate data selection and determine purity.
- Then we can start using anode piercing tracks to actually study space charge!