# Beam Charge:

Beam current I:  $I = m*f + b$

Where: f is frequency and (m, b) are two parameter from bcm calibration

Charge Qe:  $Qe = \int I\,dt = \int (m*f + b)$
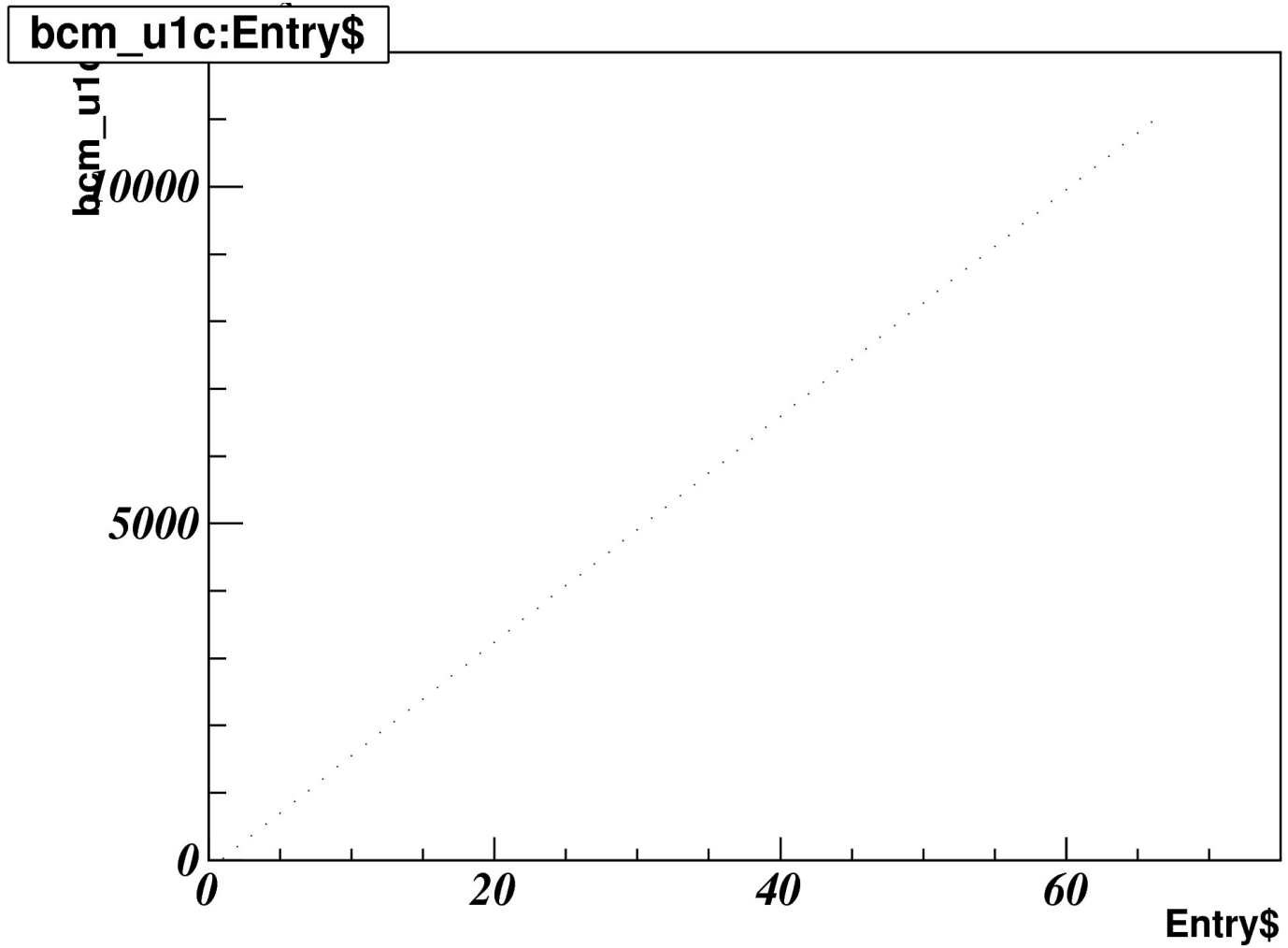
→ First term: m* BCM_count
→ Second term: b* time

So we have scalers to record those information:
- BCM scaler: Up, Down stream. U1, D1, U3,D3 → bcm_count
- Clock scaler: for timing information.  → time_count
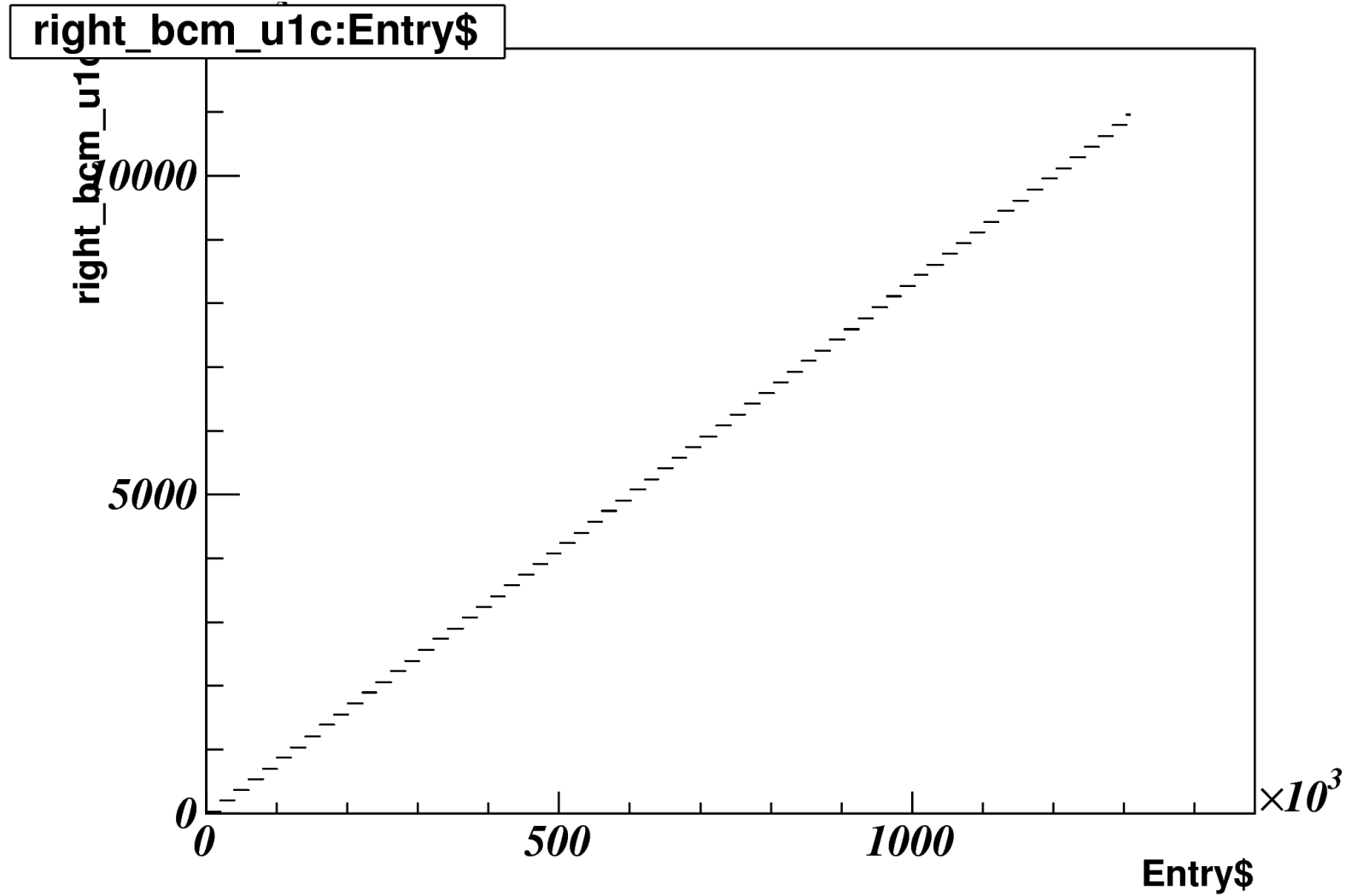
BCM and clk information in data.

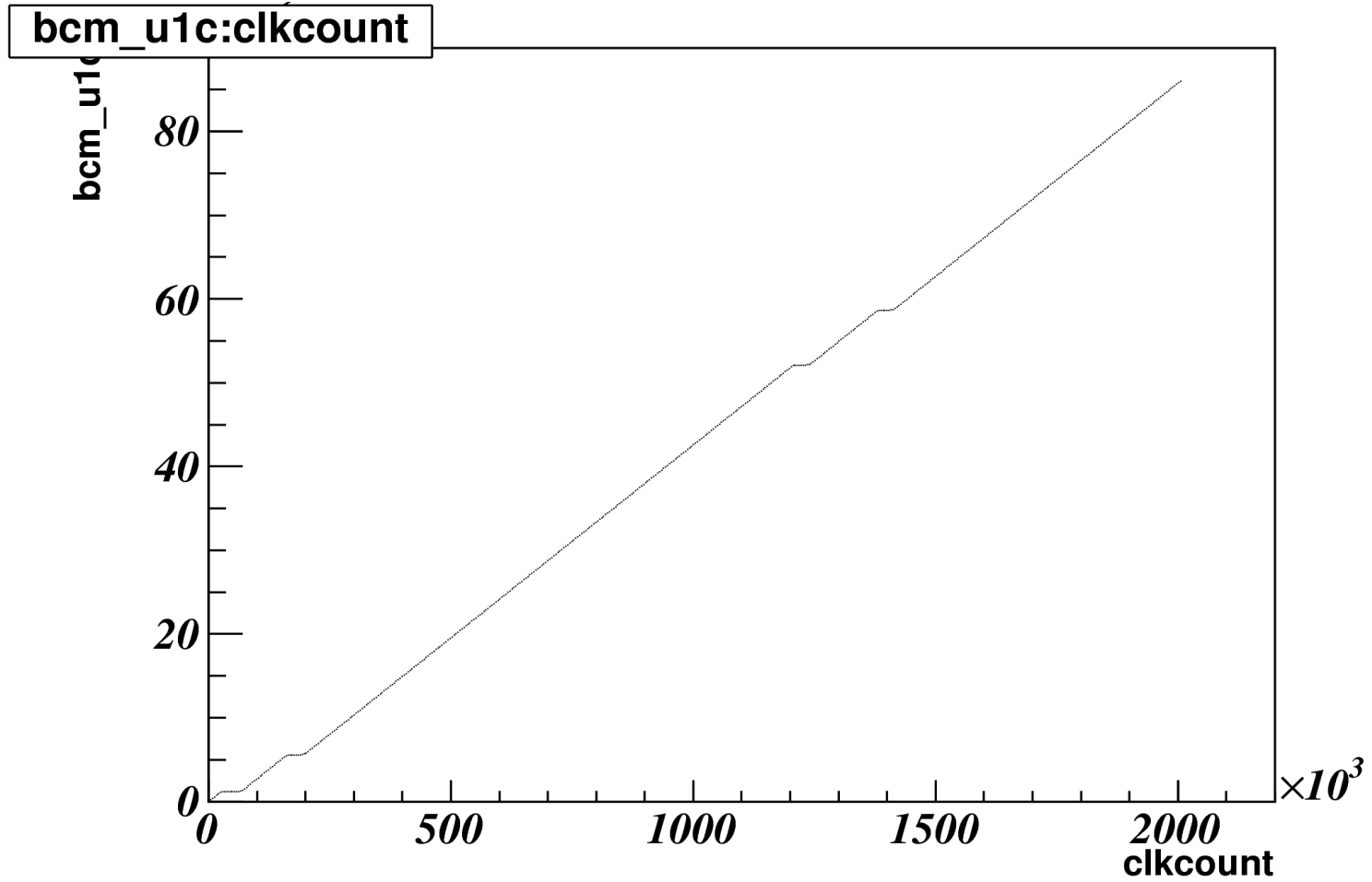**RIGHT tree:** (Scaler tree: Scaler event)

Bcm_u1:clkcount

**T tree**: event tree (Trigger event)

Right_bcm_u1:clkcount

Beam Trip problem :

bcm_count vs clk_count

Important Notices:

- Between two scalers events we can have many trigger events.

- When no beam BCM count not increasing but time still going
(this we need to take care by cutting event when there is no beam : beam trip cuts).

- Timing information and BCM support to be synchronized Together but not
  completely.
    + This data the bcm in scaler tree and the one on T tree not start
     at the same value.
    + Number of time BCM and clkcount update in two trees may
    different as well.

=> Need to be carefully when you try to syn them.
=>Consider the offset between two trees. And remember that this bcm are the same
in two tree so you should get very similar total charge when u use either of them.
If they are different we may need to recheck.

Perfect situation: no beam trip :

BCM count = Last – first

Clk_count = last – first

Time = clk_count/clk_rate

Qe = m*BCM_count + b*time

How about beam_trip ?

Using Scaler tree: RIGHT tree first:

- calculate the accumulating charge between two continuous scaler events.

- Calculate the current between two contimuous scaler events

How to get charge?

Idea: you will sum all of accumulating charge with the current is above beam trip cut.

I used both RIGHT and T tree to calculate the charge for D2 data

| run: | Qe_RIGHT | Qe_T |
|------|----------|----------|
| 3681 | 32389.3 | 32362.8 |
| 3682 | 33005.4 | 32978.2 |
| 3683 | 62693.5 | 62693.5 |
| 3642 | 16184.3 | 16184.3 |
| 3643 | 58508.4 | 58508.4 |
| 3644 | 162569 | 162570 |
| 3645 | 156734 | 156693 |
| 3646 | 148341 | 148304 |
| 3648 | 100993 | 100993 |

Compare to Zhihong results: use RIGHT tree.

| Run | Qe_RIGHT | Diff from mine in % |
|------|----------|---------------------|
| 3681 | 31896.6 | 1.5% |
| 3682 | 32658.9 | 1% |
| 3683 | 61646.4 | 1.7% |

We used the same idea but diff way. I calculate the charge and current dirrectly and add them. He filled them in new branchs add to the Tree. And there is offset between the entry. Other things is that the rootfiles slipted with big data file so when we Chain them together we loss in connection of different slipted.

## But

We need to fill the current branch in T tree to sign up current for each trigger event. We need to use them to set beam trip cuts again in the analysis.

→ But need to be careful when we fill them