Time based simulation
&
CBM Event Building

Shreya Roy

Task : 1) Time based simulation for AuAu system
2) Revisit the existing “Real” event builder based on digis.

Digitisation output (event based)

No. of events processed = 1000
SIS100_electron setup, AuAu 10 AGeV

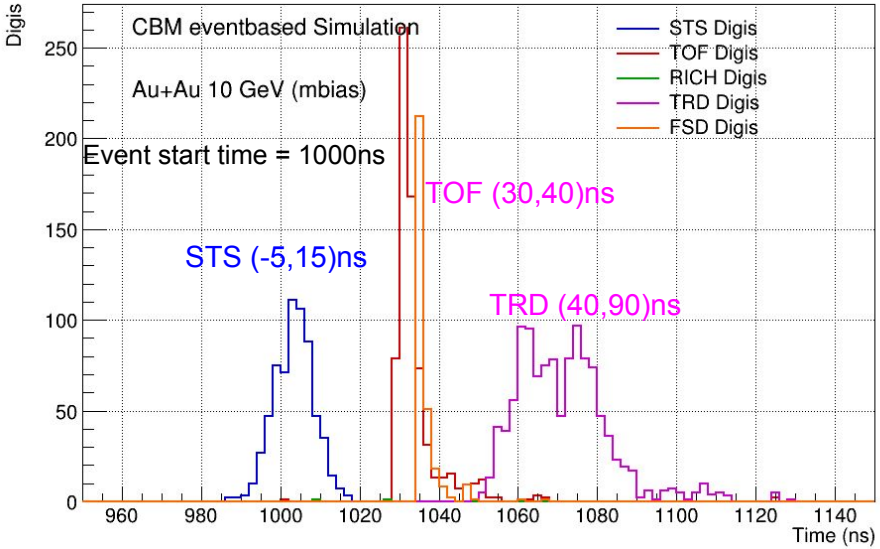
Subsystem	Minimum bias	
	MC points/event	Digis/event
STS	800	4000
RICH	1200	250
TRD	400	1200
TOF	3000	1000
FSD	300	287

Two things are important when it comes to digi based event building :

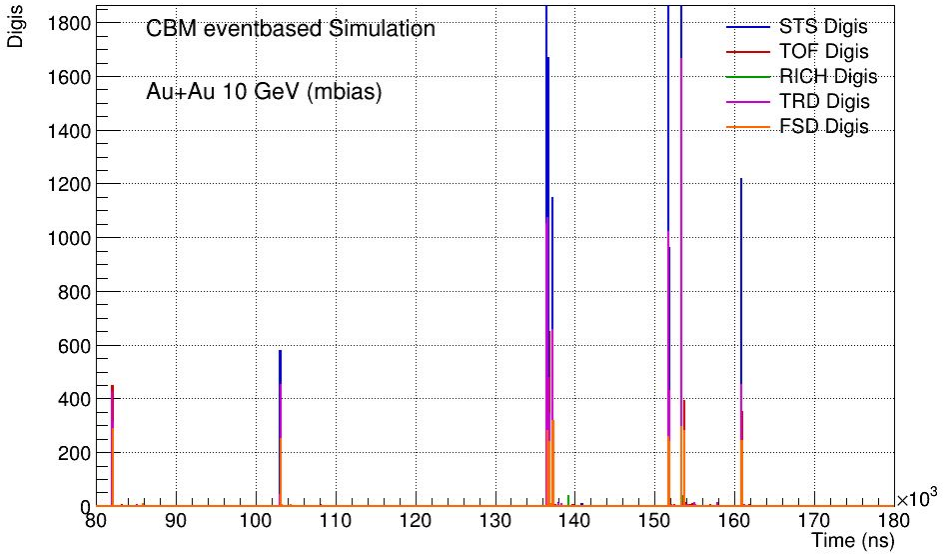
1) No. of digis expected in an event for a given collision system
2) Digi time distribution for all subsytems

>> Next we check the digi time distribution for all the subsystems

Digi time distribution : Event based vs Time based simulation

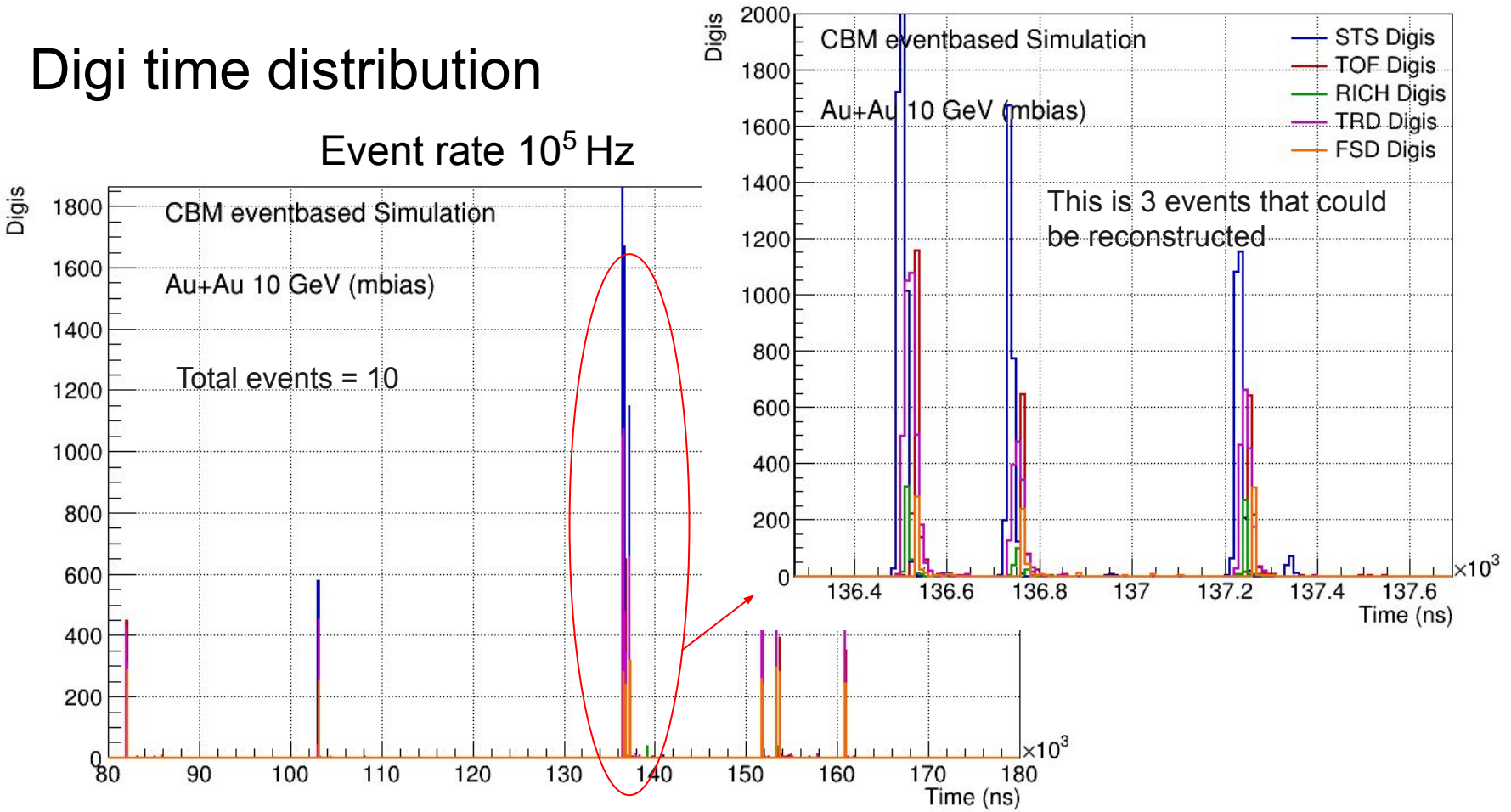


Event rate 10^5 Hz



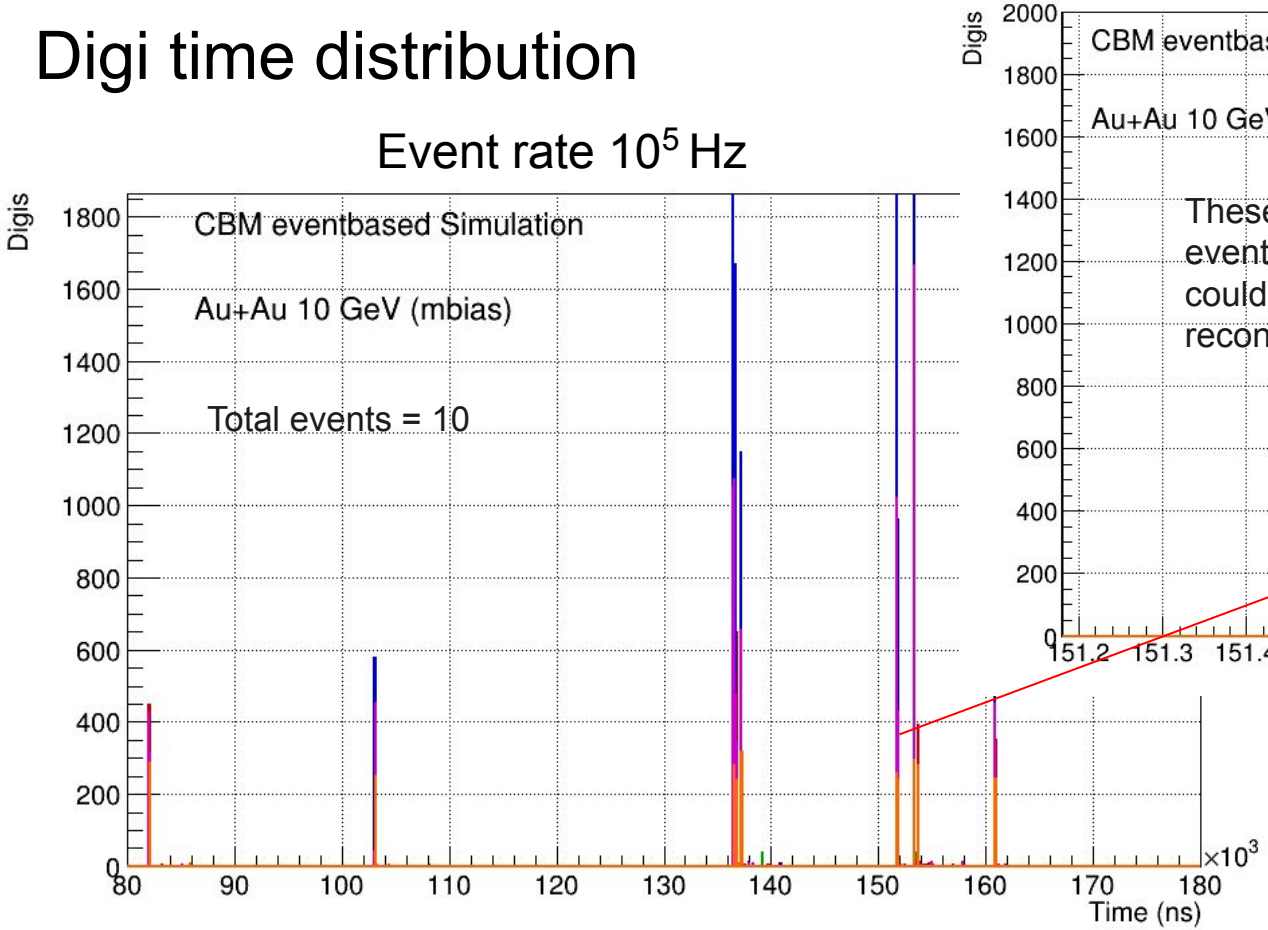
Digi time distribution

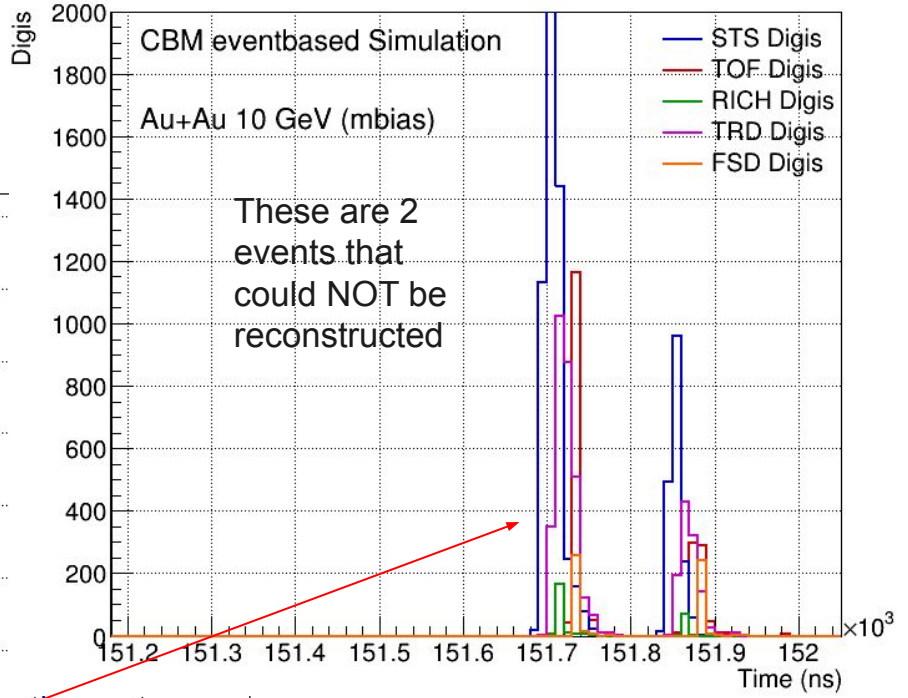
Event rate 10^5 Hz



Digi time distribution

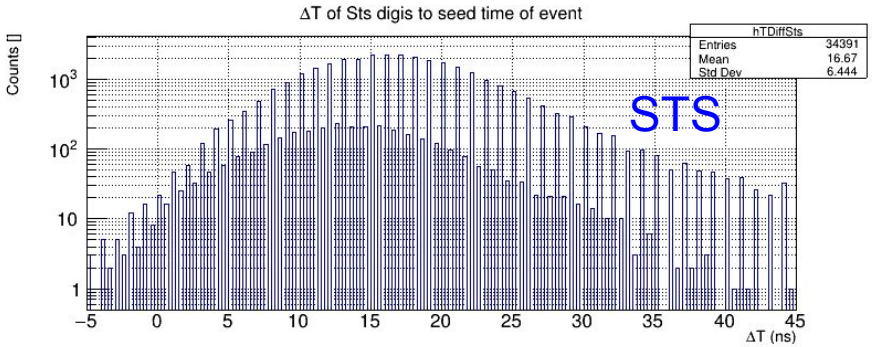
Event rate 10^5 Hz

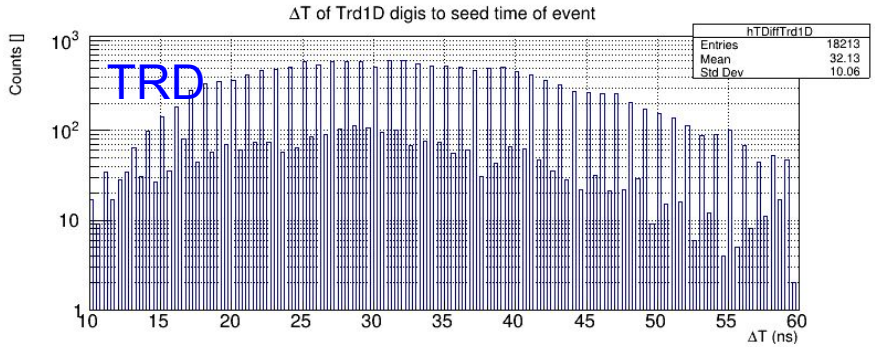




Parameters used for event trigger and building

```
Code : macro/run/run_reco.C    These parameters work for 10 AGeV AuAu minimbias events digitised with event rate 10^5 Hz
evBuildRaw->SetReferenceDetector(kRawEventBuilderDetUndef);
     evBuildRaw->AddSeedTimeFillerToList(kRawEventBuilderDetTof);
   //  evBuildRaw->SetSlidingWindowSeedFinder(50, 10, 50);//sts
     evBuildRaw->SetSlidingWindowSeedFinder(100, 10, 50);//tof

     evBuildRaw->SetSeedFinderQa(true);  // optional QA information for seed finder
     evBuildRaw->SetTsParameters(0.0, 1.e7, 0.0);

     // Use CbmMuchDigi instead of CbmMuchBeamtimeDigi
     evBuildRaw->ChangeMuchBeamtimeDigiFlag(kFALSE);
     evBuildRaw->SetEventOverlapMode(EOverlapModeRaw::AllowOverlap);

     evBuildRaw->SetTriggerMinNumber(ECbmModuleId::kSts, 30);
     evBuildRaw->SetTriggerMaxNumber(ECbmModuleId::kSts, -1);
     //evBuildRaw->SetTriggerWindow(ECbmModuleId::kSts, -5, 45);//when sts is the seed time filler
     evBuildRaw->SetTriggerWindow(ECbmModuleId::kSts, -45, 15);//when tof is the seed time filler

     evBuildRaw->SetTriggerMinNumber(ECbmModuleId::kTof, 1);
     //evBuildRaw->SetTriggerWindow(ECbmModuleId::kTof, 30, 80);//when sts is the seed time filler
     evBuildRaw->SetTriggerWindow(ECbmModuleId::kTof, -5, 30);//when tof is the seed time filler

   evBuildRaw->SetTriggerMinNumber(ECbmModuleId::kRich, 0);
 //  evBuildRaw->SetTriggerWindow(ECbmModuleId::kRich, 20, 40);//when sts is the seed time filler
   evBuildRaw->SetTriggerWindow(ECbmModuleId::kRich, -20, 20);//when tof is the seed time filler
```



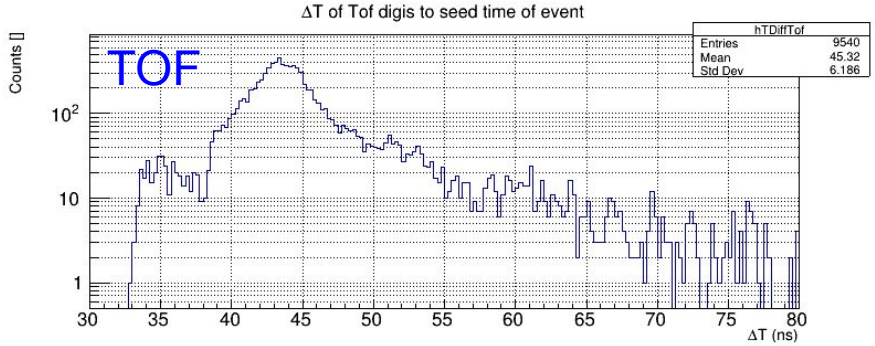


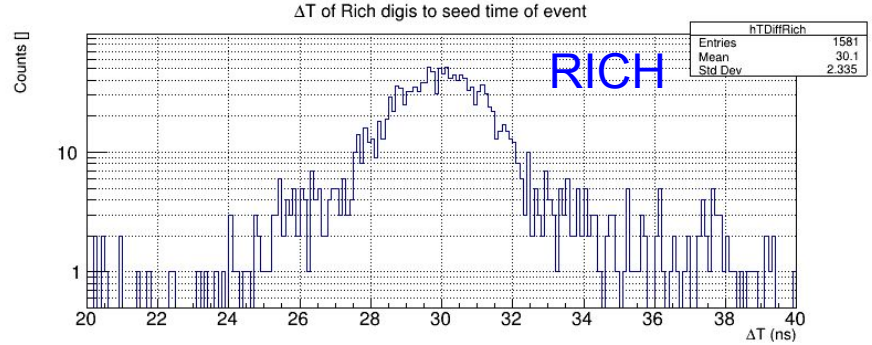
Digi time distribution w.r.t. the seed time (trigger time) of event after event building.

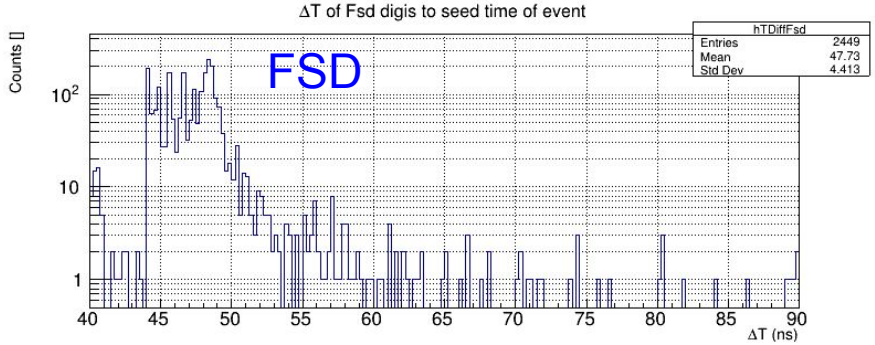
Event rate = 10^5 Hz (works fine)

Purity = 99%

Efficiency = 94%



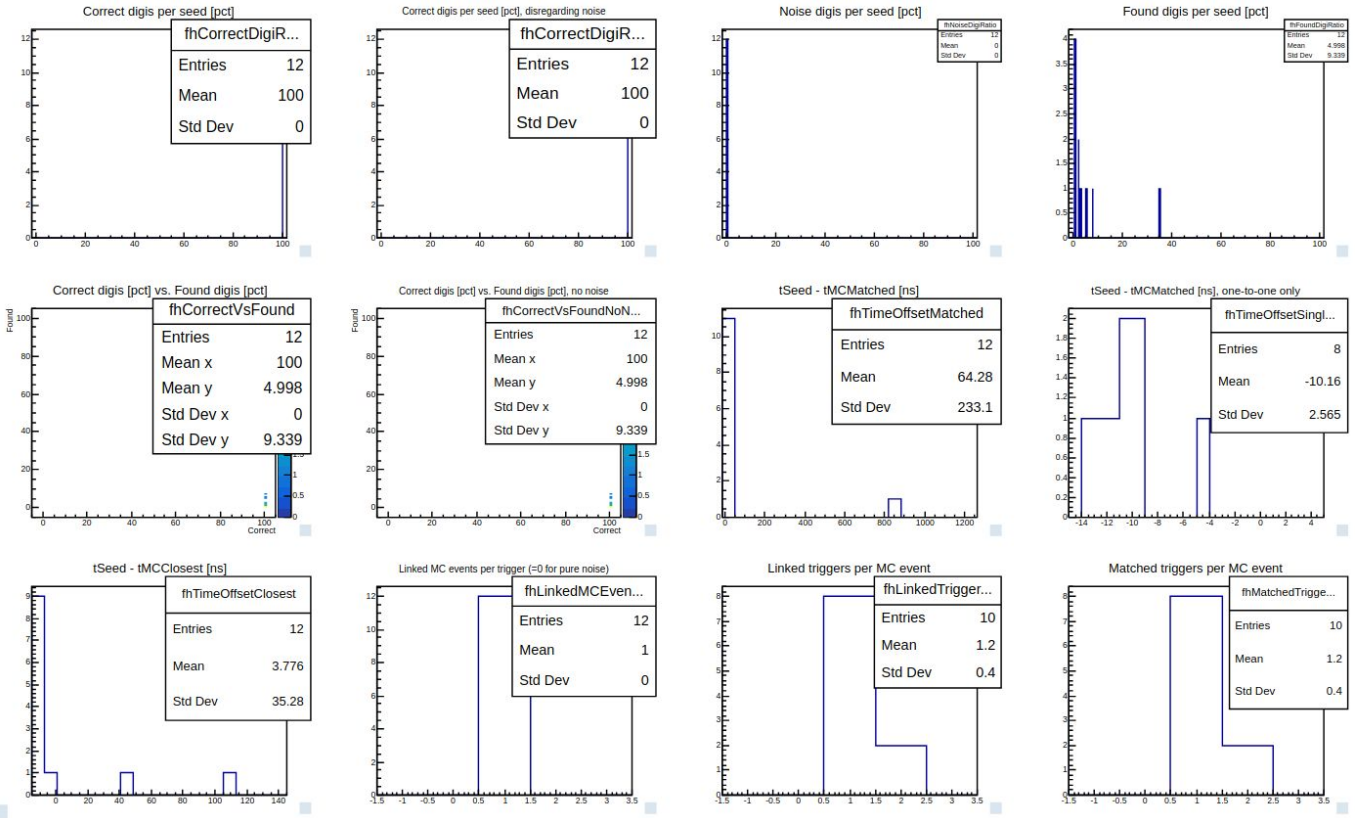




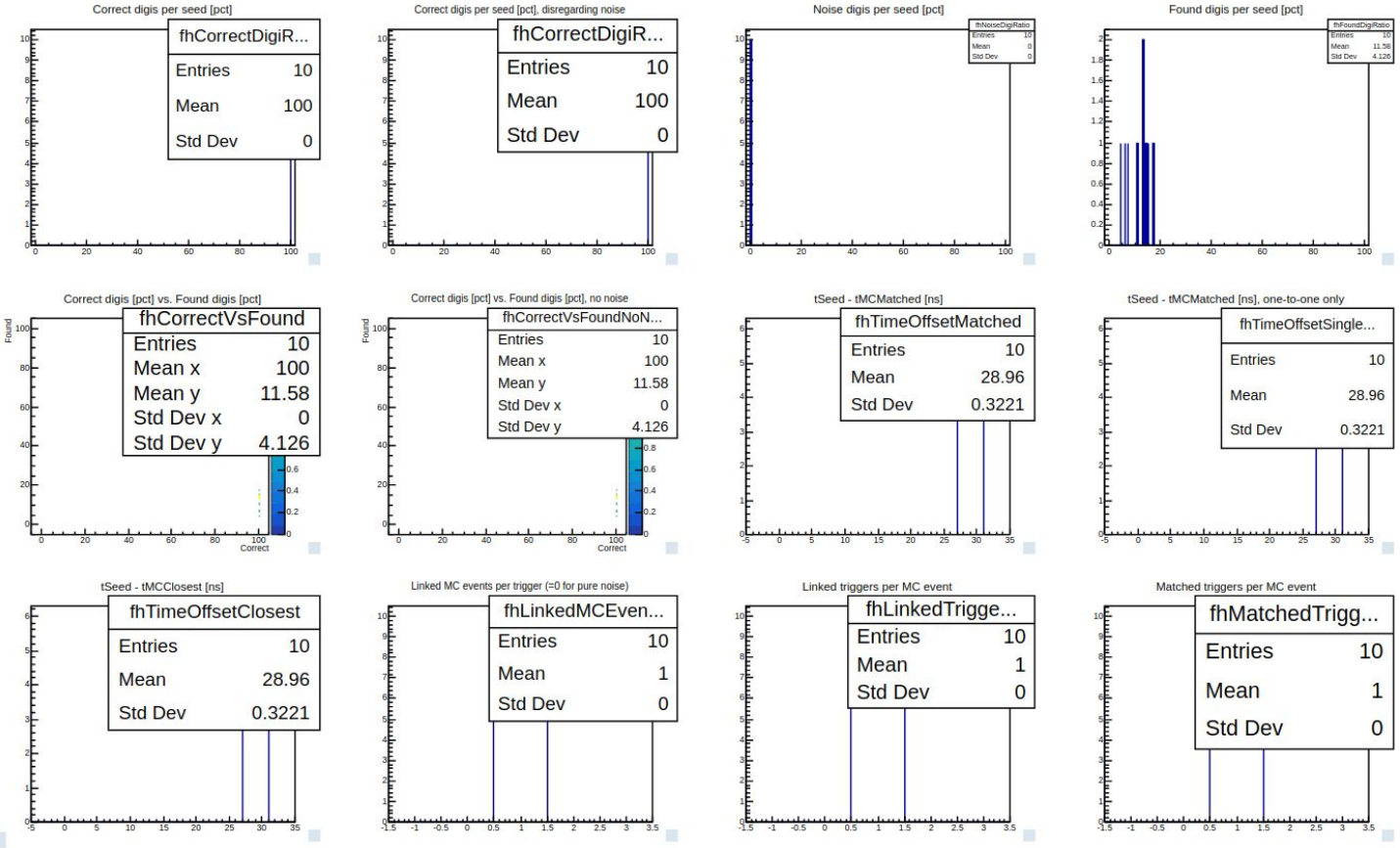
Ongoing tasks

- Optimising the parameters of the seed finder (trigger) such as the search window, minimum digis, deadime.
- Optimising the event building parameters such as event time window, minimum digis.
- QA : Checking the event purity and efficiency

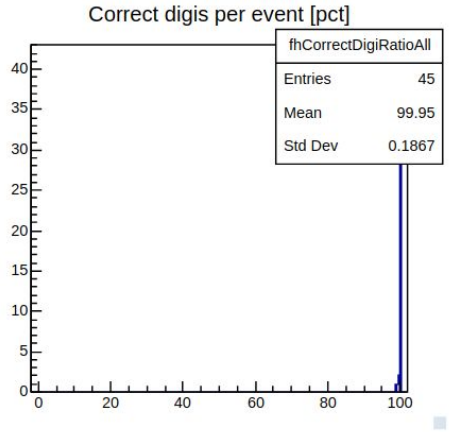
Seed finder QA (at 10^5 Hz) with STS

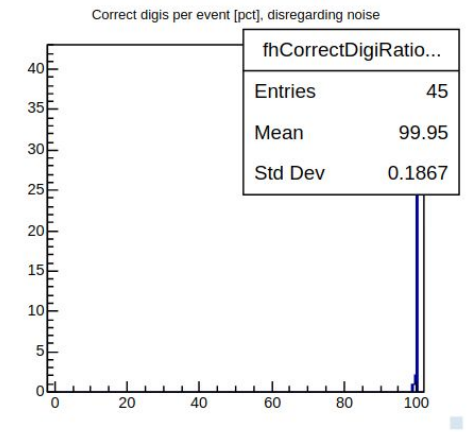


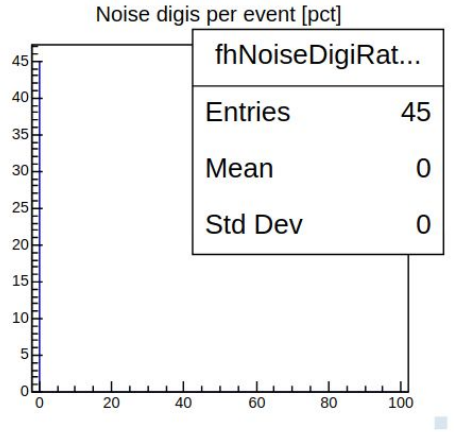
Seed finder QA (at 10^5 Hz) with TOF

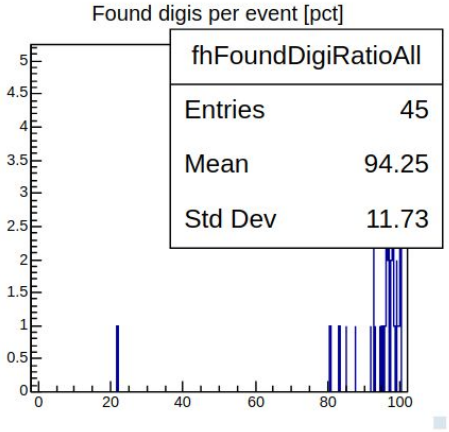


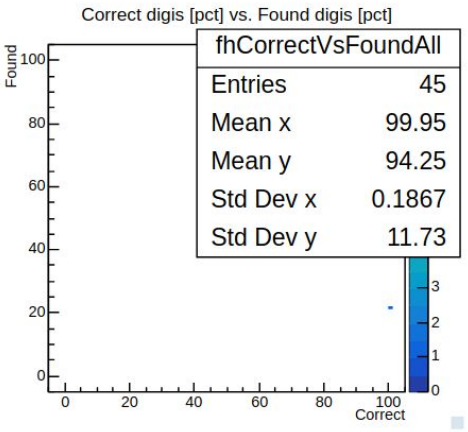
Event building QA (at 10^5 Hz)

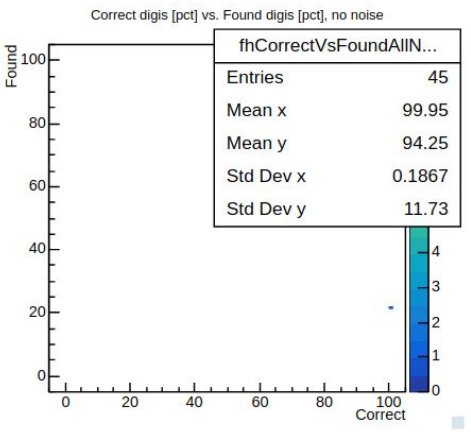




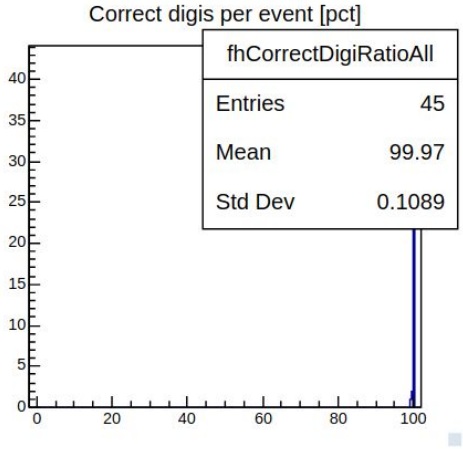


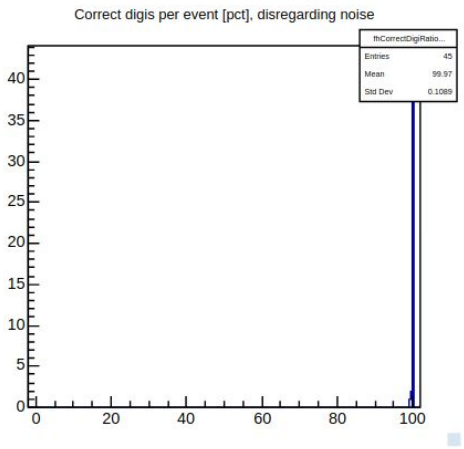


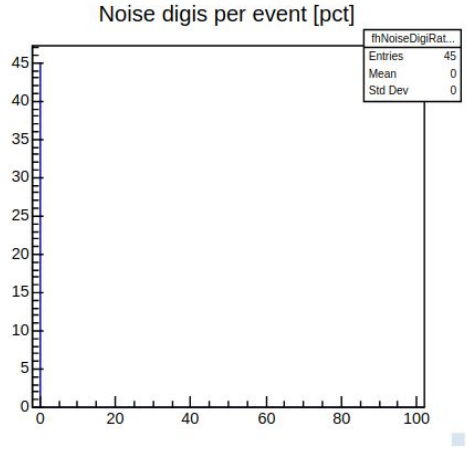


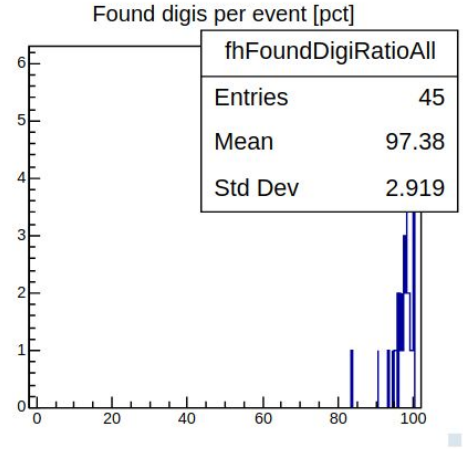


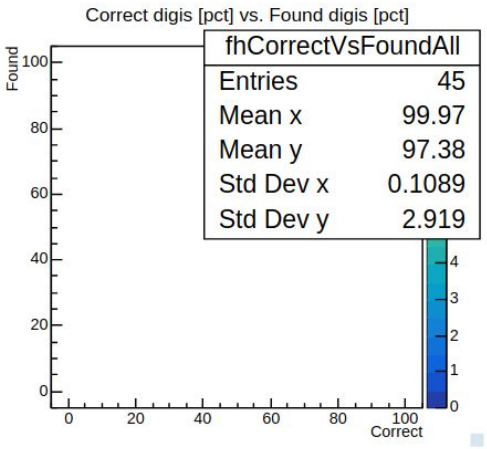
Event building QA (at 10^5 Hz)

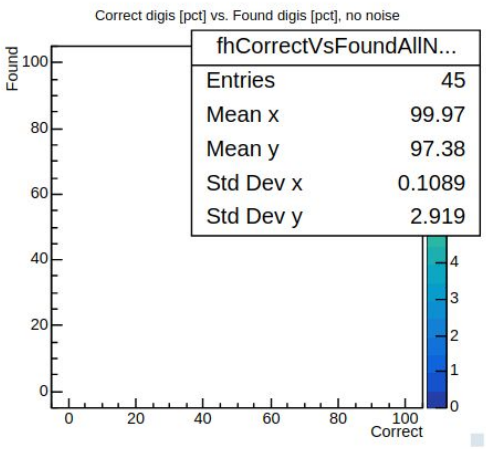








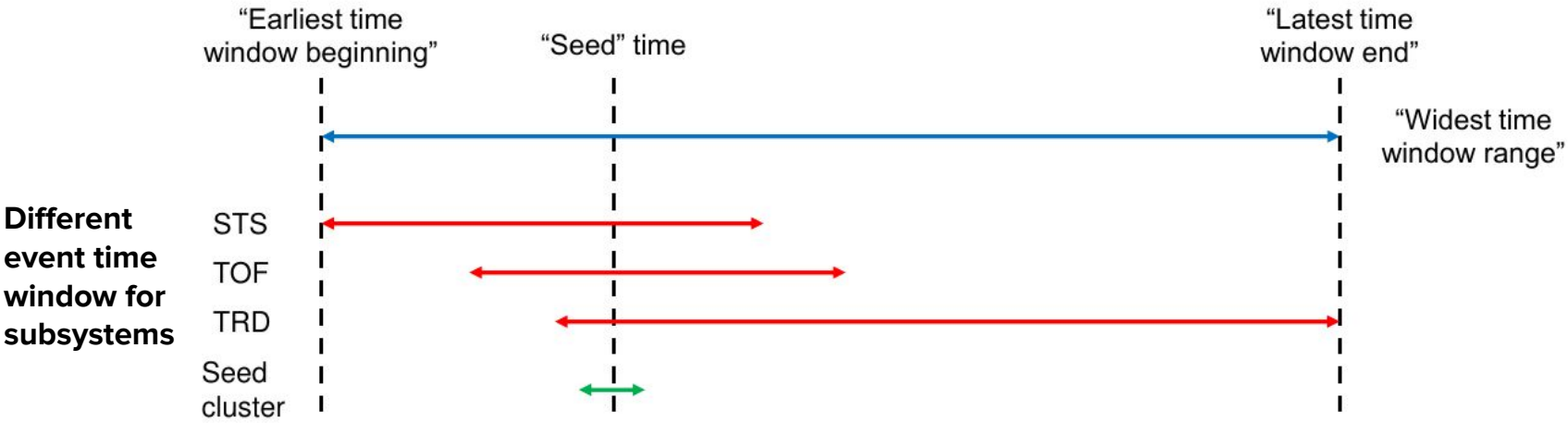




Backup slides

Real Event Builder (REB) : Algorithm

1. Pre-requisites for event building : time sorted digis of all subsystems
2. Select a reference detector (for e.g STS)
3. Seed time is set as the time of the first encountered digi in the reference detector
4. Collect all digis from all subsystems within a pre-set time window around the seed time
5. Select mode : No overlap, merge overlap, allow overlap
6. Form events with the collected digis if they fulfill the pre-defined event selection criteria



D. Smith *et al.*, "Event building in CBM", CBM Progress Report 2021

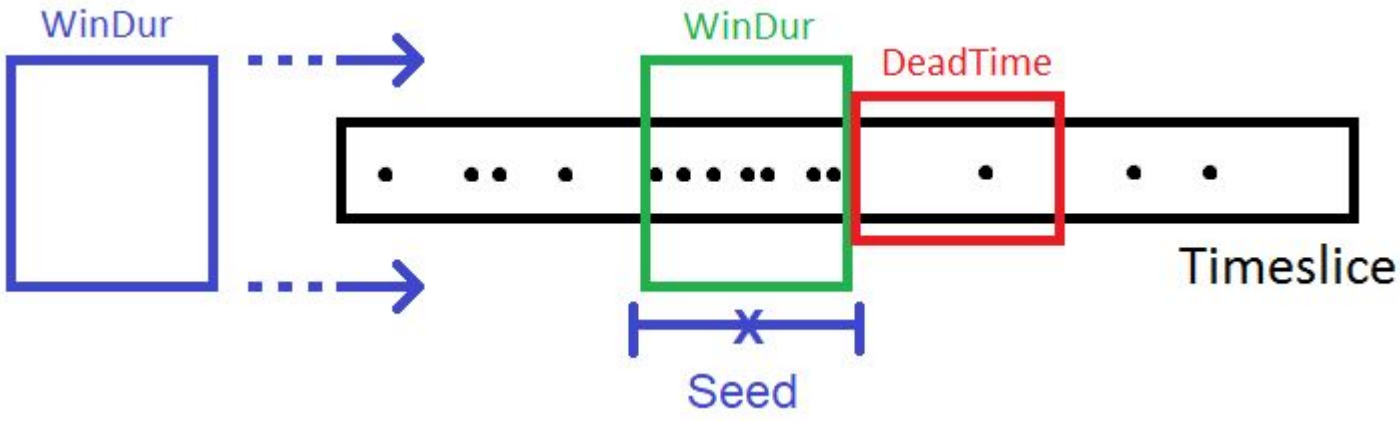
Real Event Builder (REB) : Algorithm

Problem : Seed time is fetched from a reference detector, which could give false seeds if there is noise in the detector.

Solution : Develop a seed finder algorithm in addition to REB

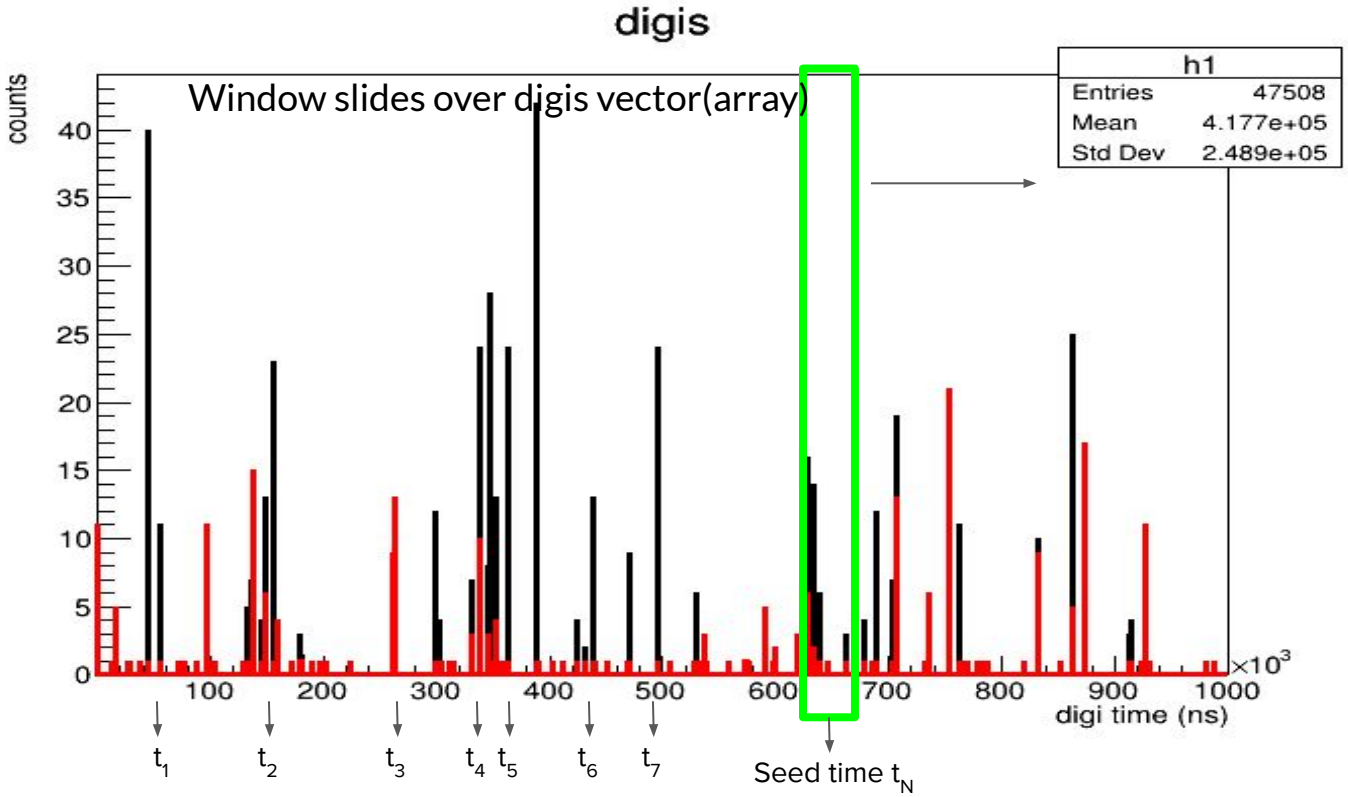
. . . The sliding window seed finder or trigger finder . . .

Window slides over digis vector(array)



D. Smith *et al.*, “A minimum-bias trigger algorithm based on the digi time distribution”, CBM Progress Report 2021

Sliding window seed finder algorithm

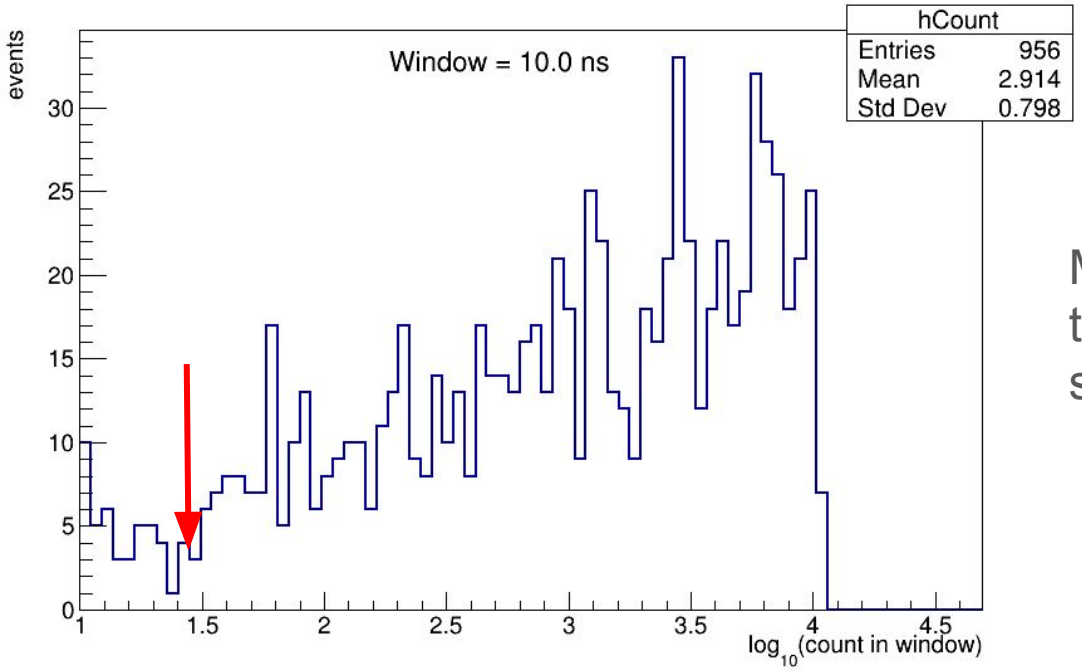


3 parameters to be set by the user :

1) Trigger window

2) Minimum no. of digis in the trigger window

3) Deadtime (minimum gap between two trigger windows)



Minimum digis = 30, that is equal to one track though all STS stations

Event building QA

Correct digis (Purity) = $\frac{\text{Digis whose MC link matched MC event}}{\text{digis assigned to this reconstructed event}}$

Found digis (Efficiency) = $\frac{\text{digis whose MC link matched MC event}}{\text{total number of digis from this MC event}}$

/lustre/cbm/users/friese/vt25/digi/data/evt_beam_noise.digi.root