Evaluating the triggers efficiency in an Xenon run

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SCIENCE BRINGING NATIONS TOGETHER

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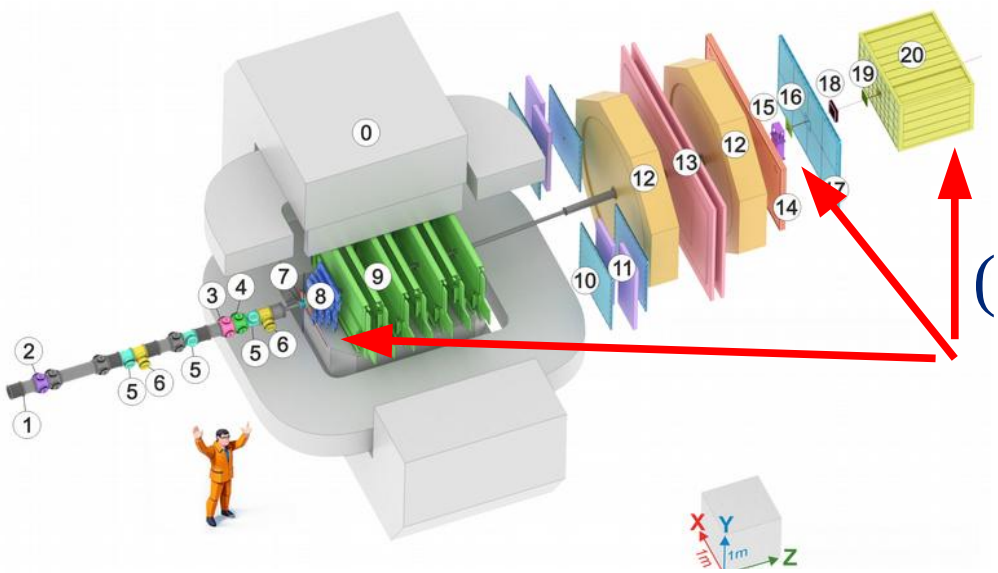
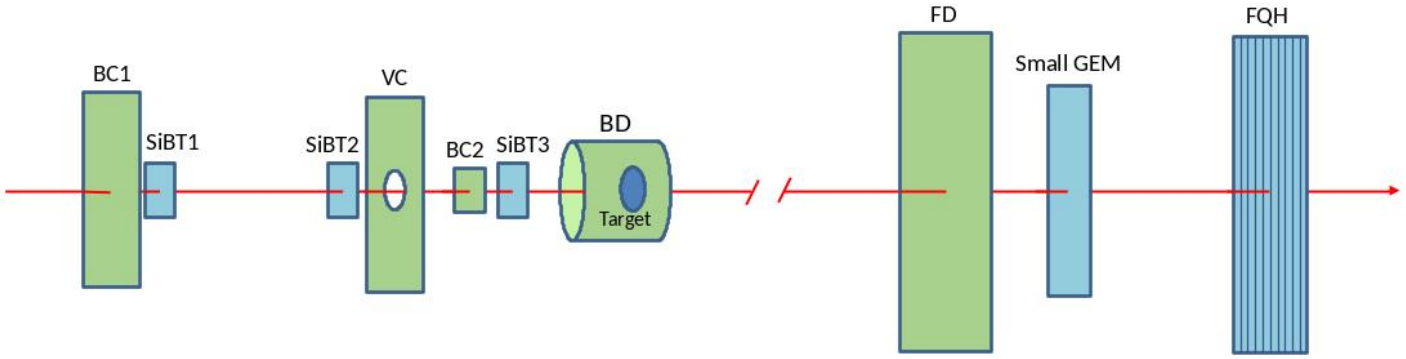
Outline

1. Trigger system
2. BD efficiency
3. FD efficiency
4. Pile up suppression using BC2
5. Dependence of trigger system parameters on run id
6. Efficiency of BD and FD and its systematics
7. Using FHCal as a trigger instead of FD
8. Plans

Trigger system



(**2**) BC1, (**3**) VC, (**4**) BC2,
(**7**) BD, (**15**) FD,
(**20**) FHCal



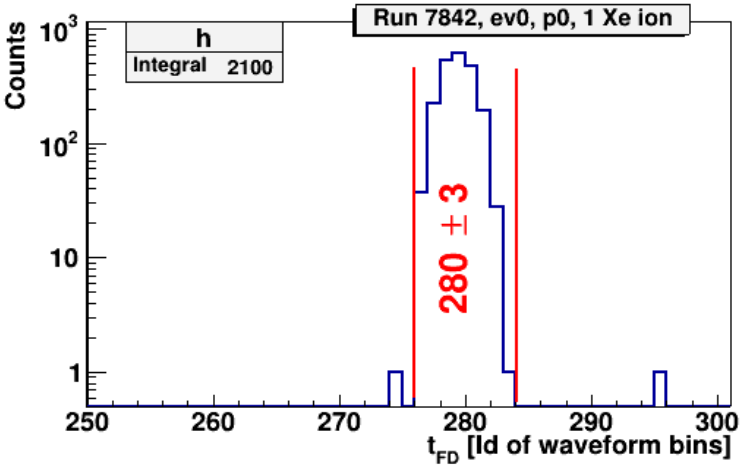
BD efficiency

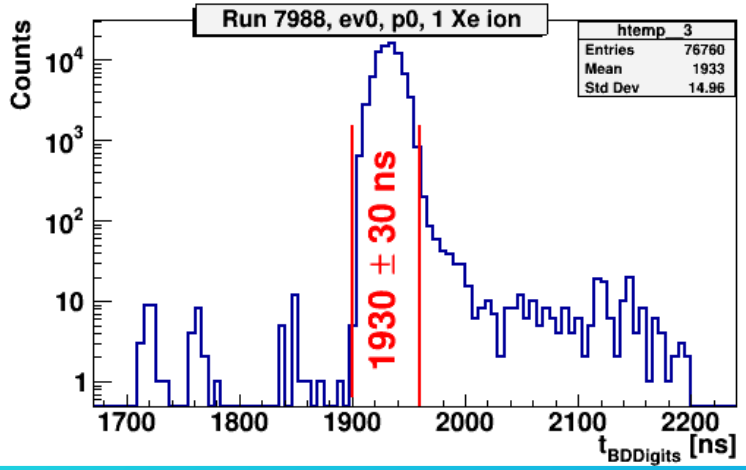
Base procedure

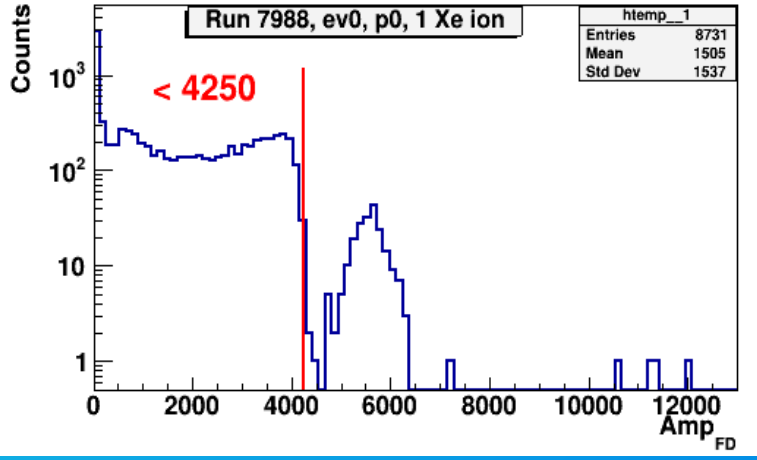
- ✓ Denominator: events with MBT flag (after reduction) && FD signals in TW
- ✓ Numerator : as denominator && BD signals in TW (NBD≥4)
- ✓ ε_{BD}: numerator divided by denominator

FD parameters

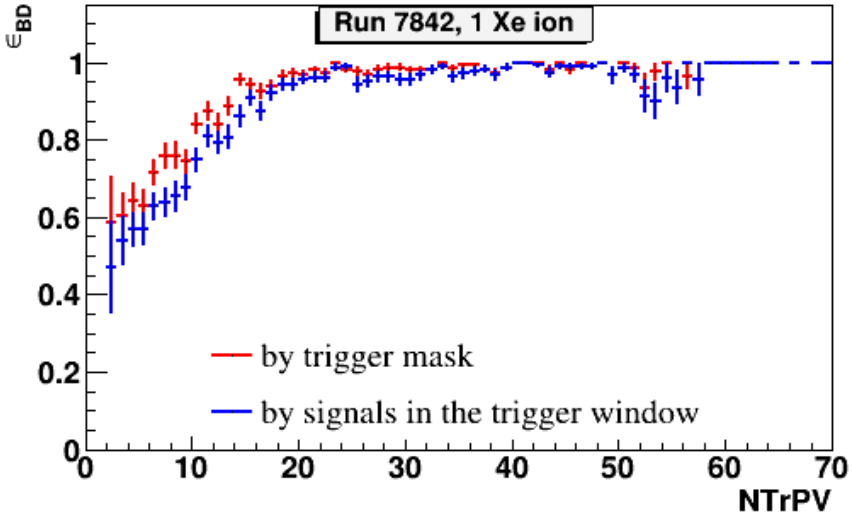
- ✓ Trigger window
- ✓ Signal amplitude

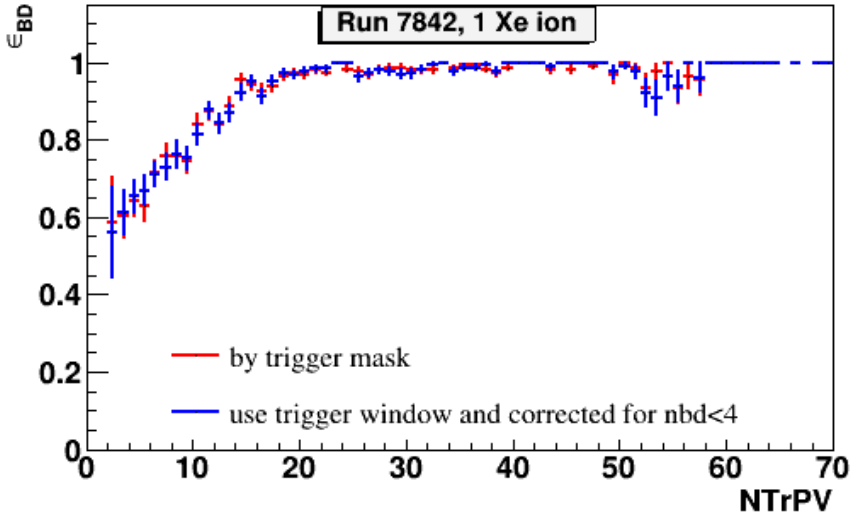




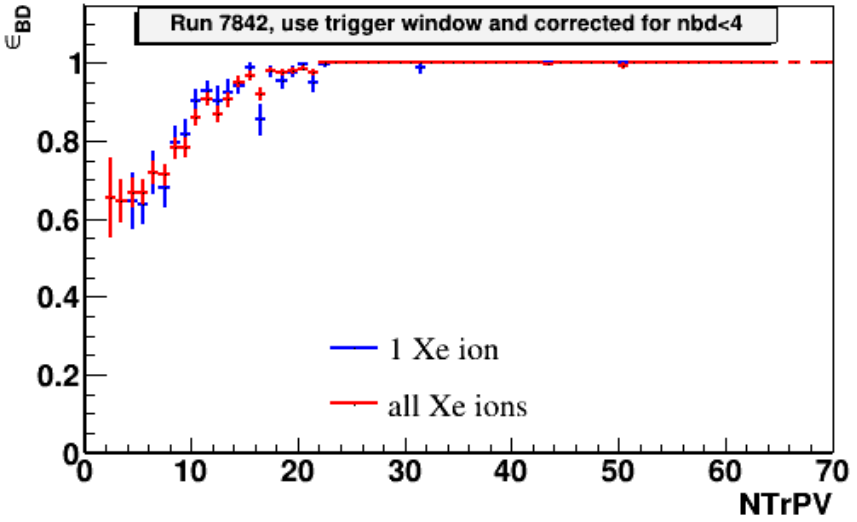


BD efficiency





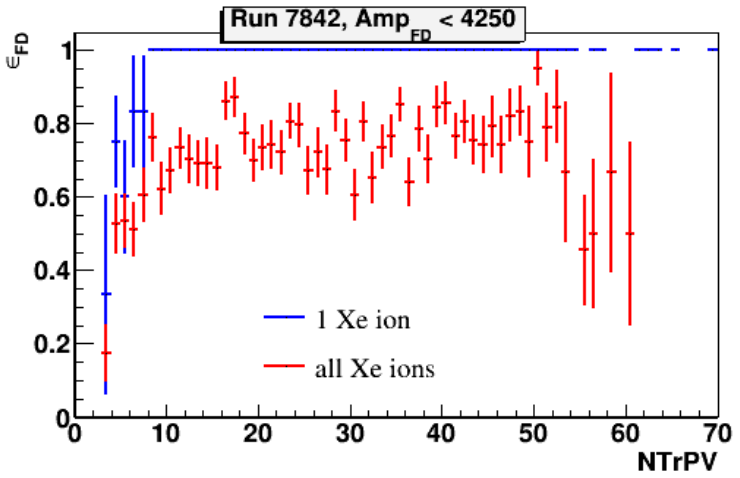
- ✓ Runs with **Mixed Trigger**
- ✓ Correction for events with NBD<4
- ✓ 1 Xe ion by **BC1** in 3 μs



FD efficiency

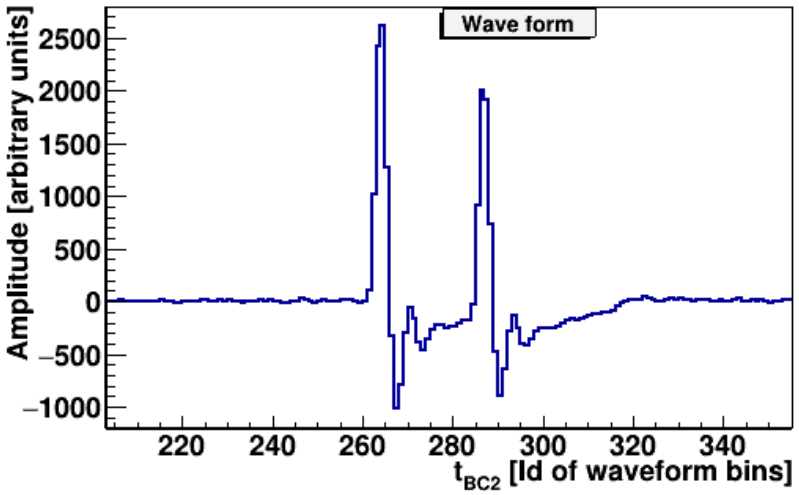
Base procedure

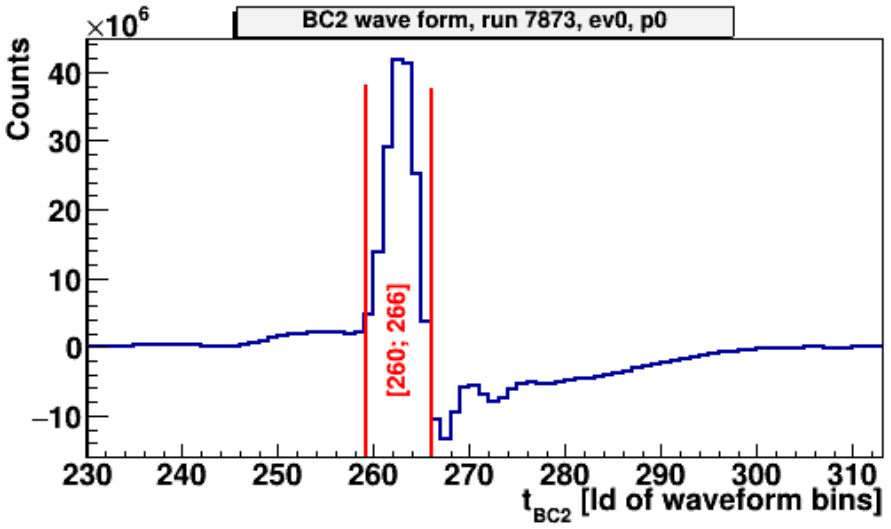
- ✓ Denominator: events with CCT1 flag (after reduction) && BD signals in TW
- ✓ Numerator: as denominator && FD signals in TW (Amp_{FD}<4250)
- ✓ ε_{FD}: numerator divided by denominator

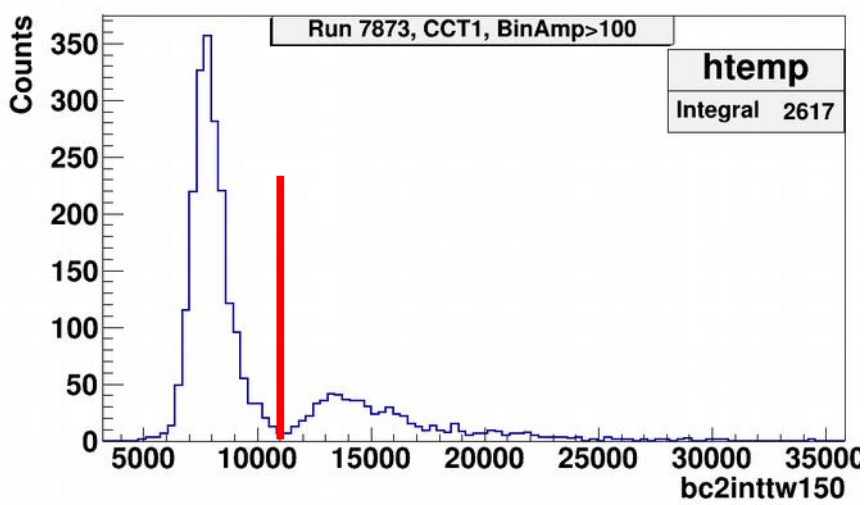


- ✓ Runs with **Mixed Trigger**
- ✓ 1 Xe ion by **BC1** in 3 μs (suppresses the number of events by ~4 times)

Pile up suppression using BC2

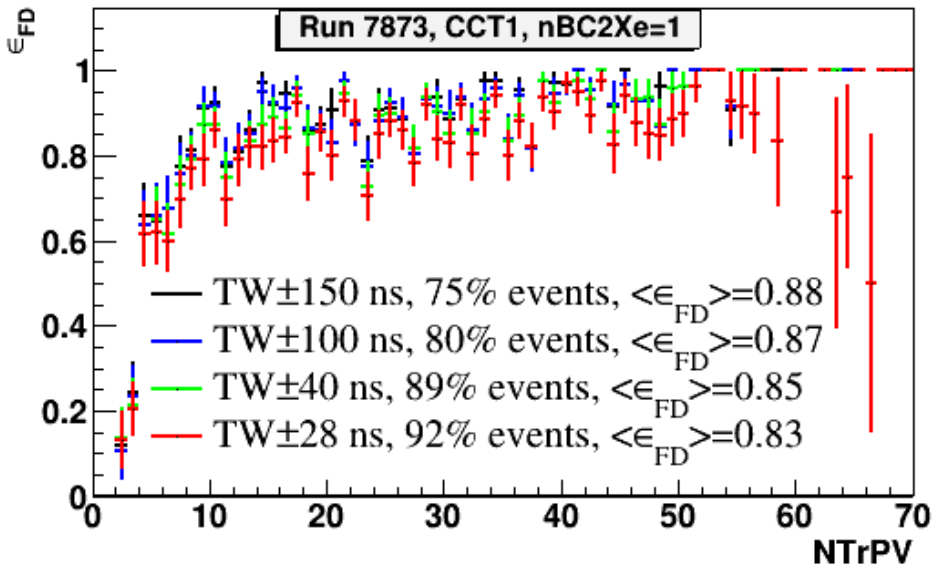






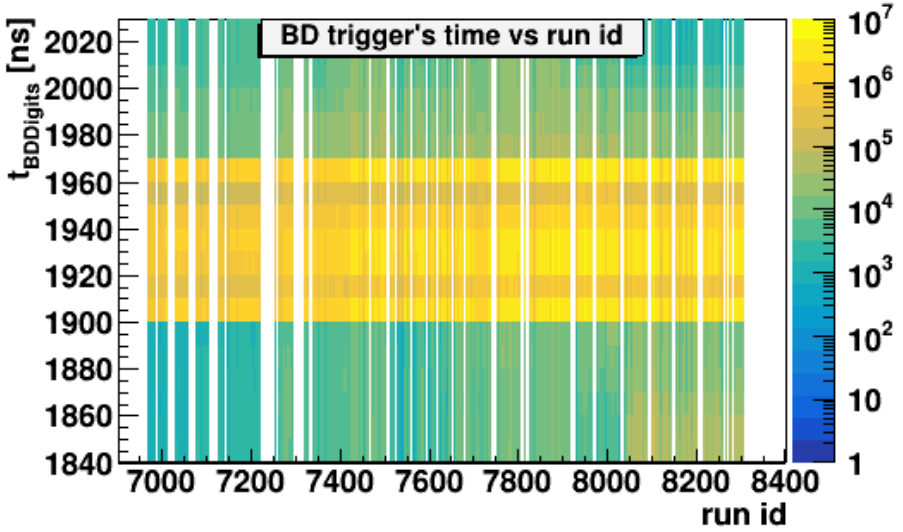
- ✓ Long and deep negative tail after the signal in BC2
- ✓ Only positive amplitudes are included in the integral
- ✓ The integral is calculated in a window of ±150 ns relative to the middle of trigger window (TW)
- ✓ The peak with 1 Xe ion is clearly distinguished by the integral

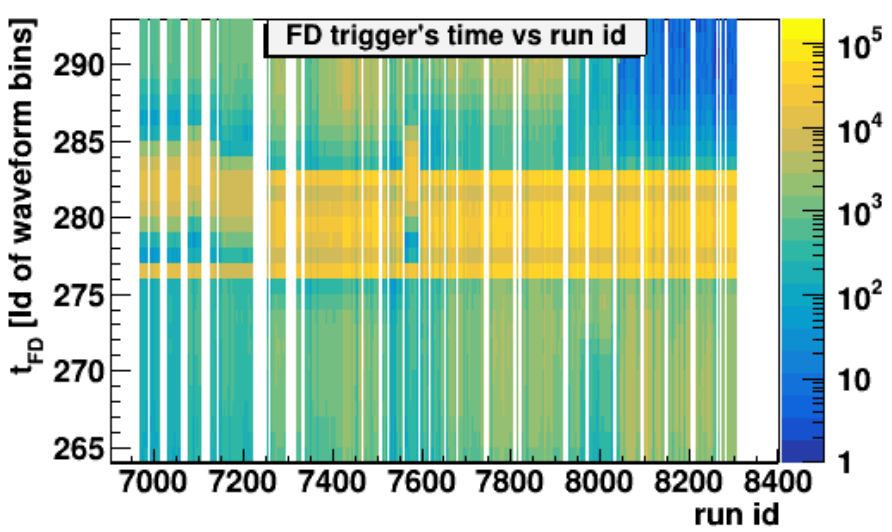
Pile up suppression using BC2



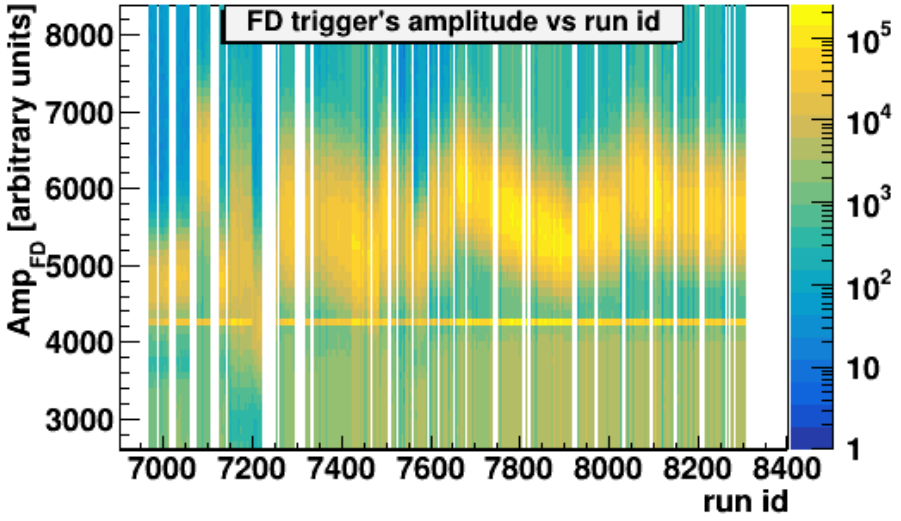
- ✓ Different BC2 trigger windows
- ✓ Part of events after nBC2Xe==1 cut
- ✓ Total FD efficiency
- ✓ The window TW±40 ns is chosen as optimal

Dependence of trigger system parameters on run id

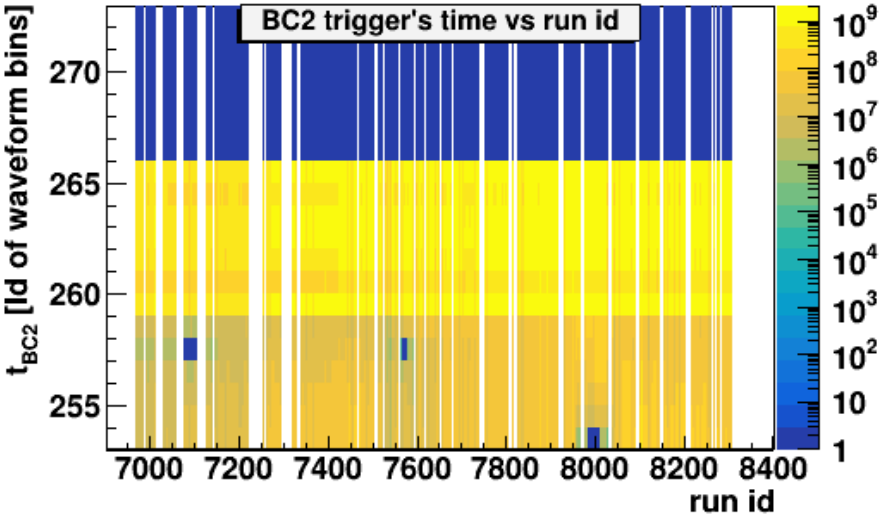


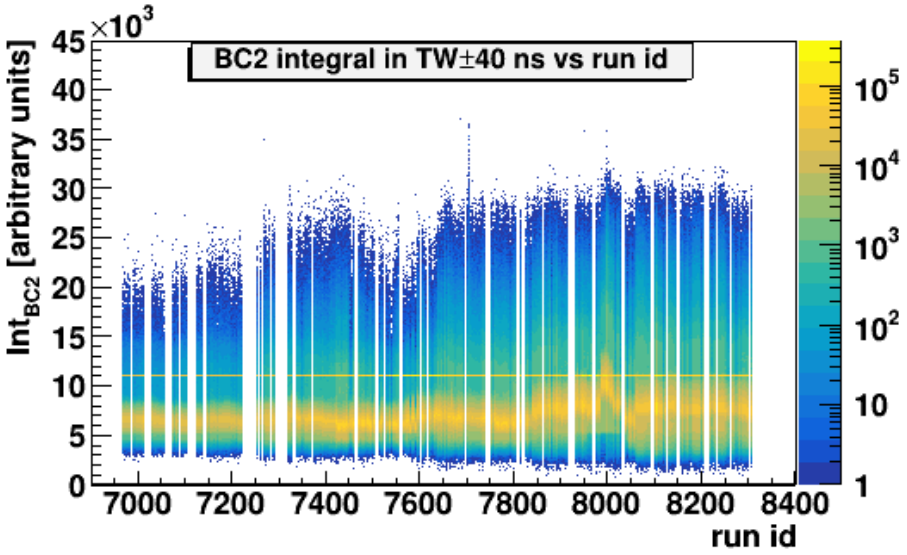


- ✓ BD time by TDC
- ✓ FD time by TQDC
- ✓ BD is stable during Xe run
- ✓ FD parameters changed



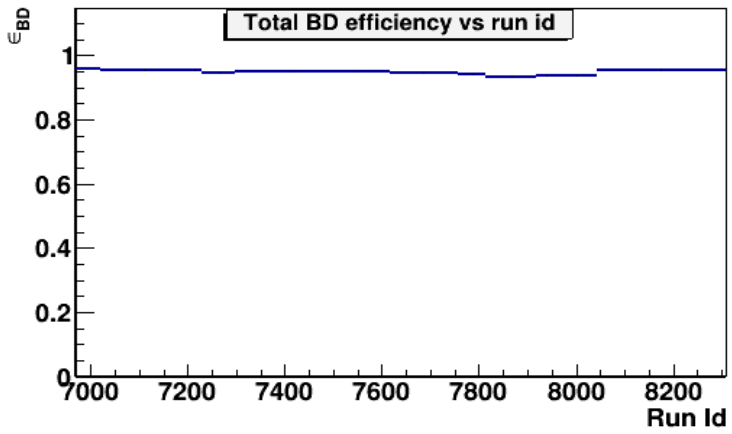
Dependence of trigger system parameters on run id

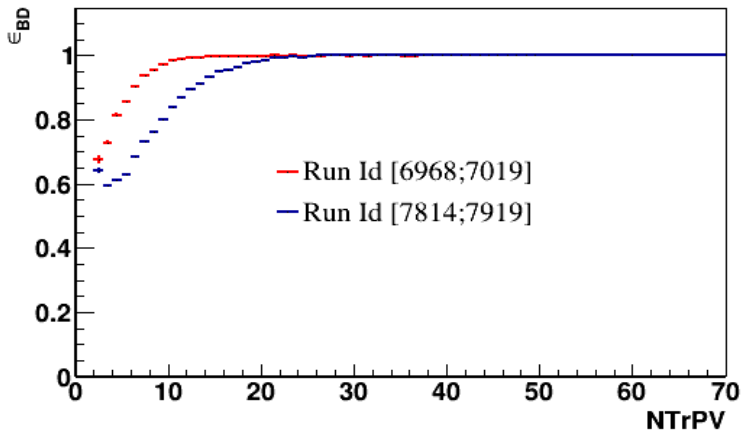


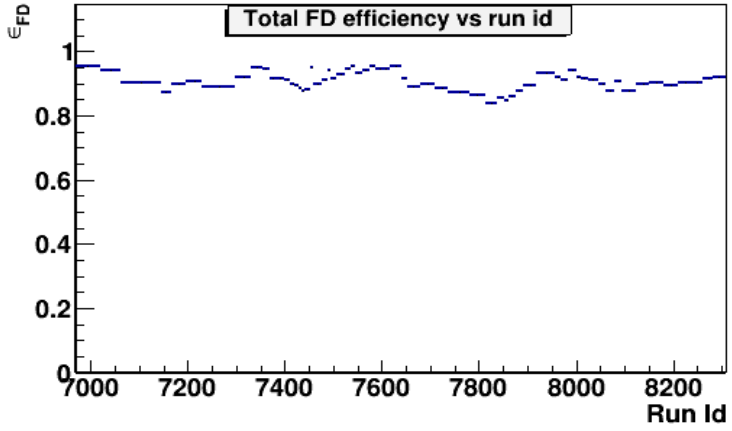


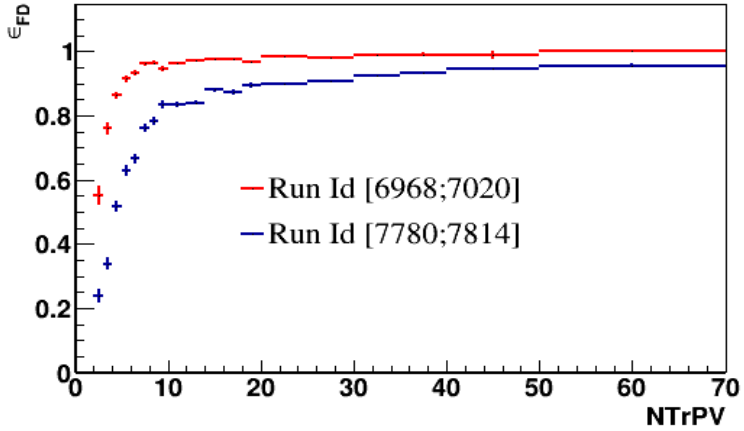
- ✓ BC2 time by TQDC
- ✓ BC2 time is stable during Xe run
- ✓ BC2 integral changed

BD and FD efficiency by runs



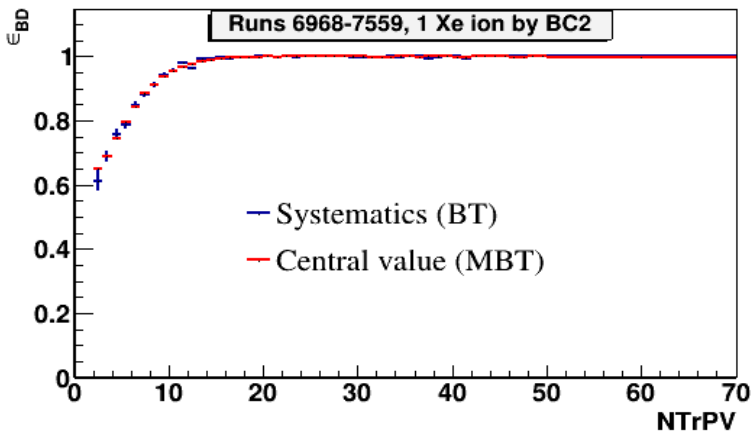


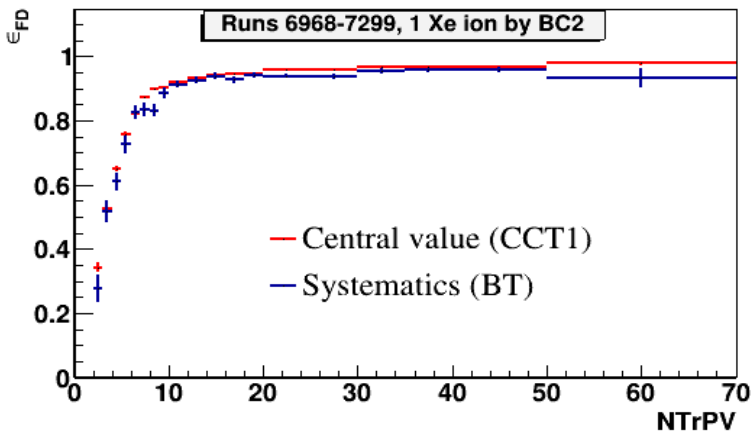




- ✓ **BD** efficiency is quite stable during Xe run
- ✓ **FD** efficiency varies significantly

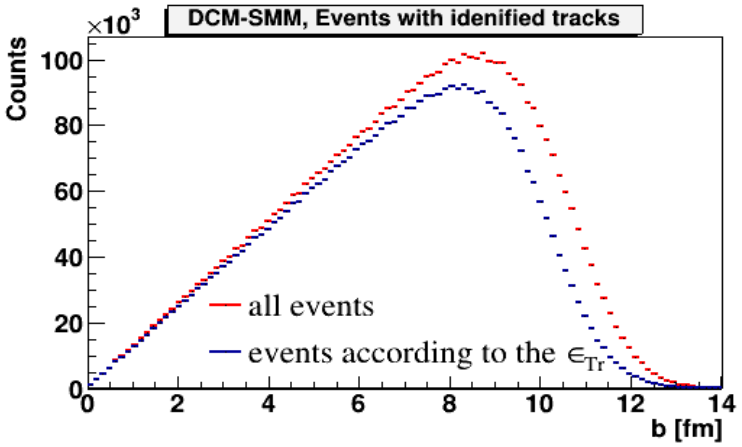
BD and FD efficiency systematics

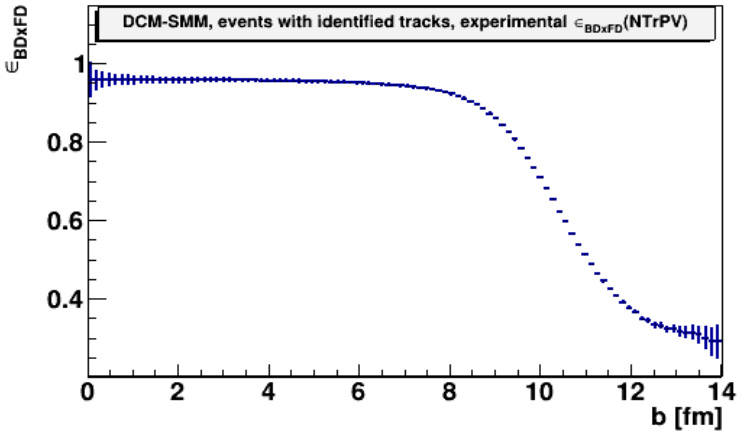




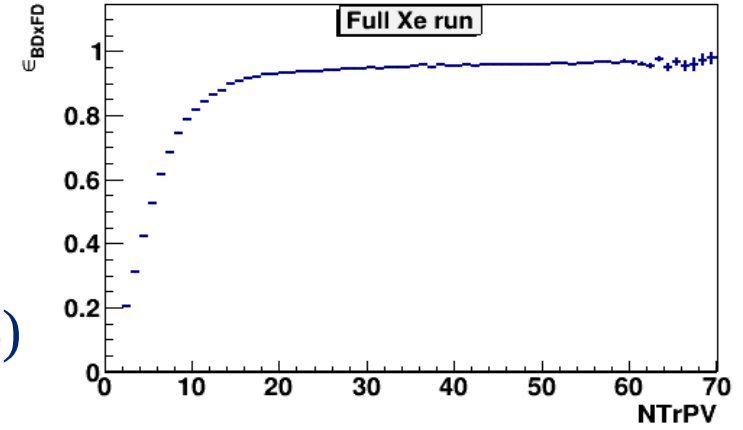
- ✓ The statistical uncertainty in each NTrPV bin does not exceed 5%
- ✓ 4 run ranges for systematics of **BD**, 5 run ranges – for **FD**
- ✓ When calculating the ε_{BD}, the BC2 cat rejects 0.5% of events, for ε_{FD} – 8%

Combined efficiency of BD and FD

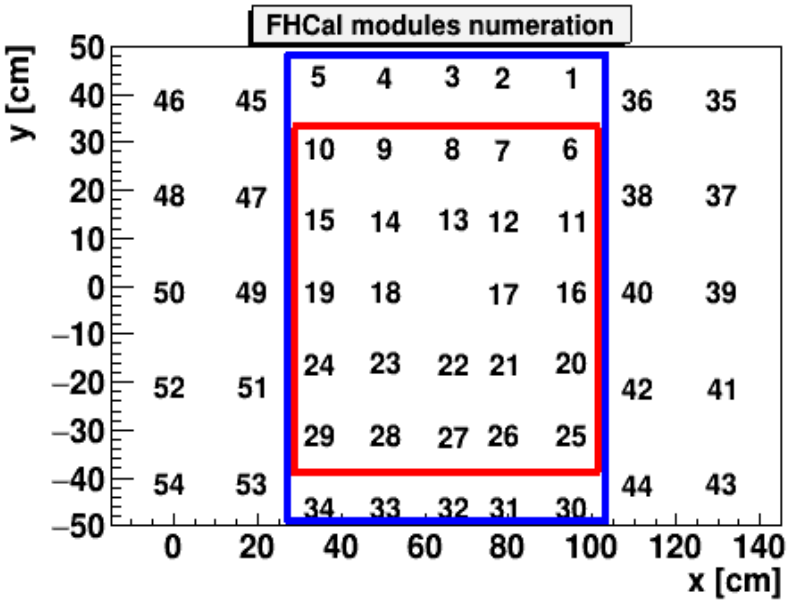


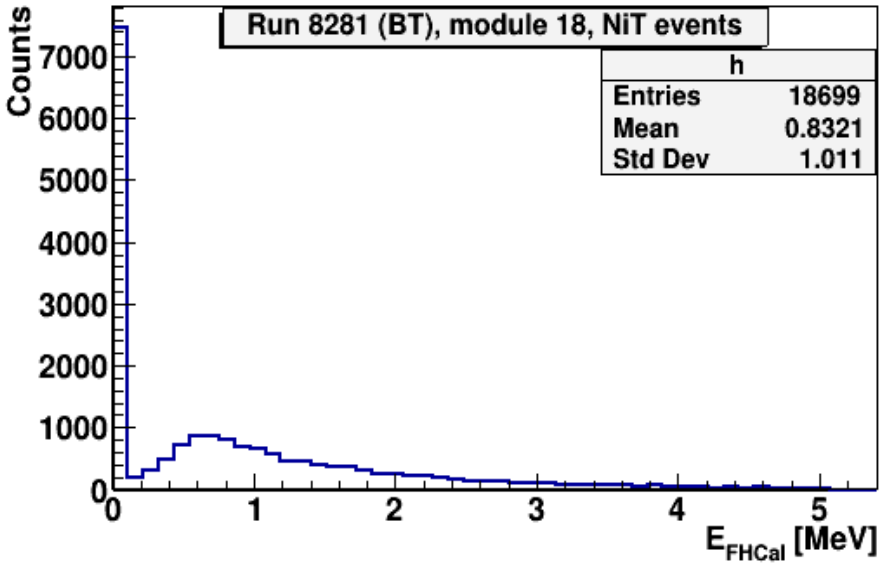


- ✓ Efficiency reaches a plateau (90-95%) above 15 NTrPV and below 9 fm according to b
- ✓ Peripheral events are recorded with less efficiency (down to 20%)



FHCal efficiency

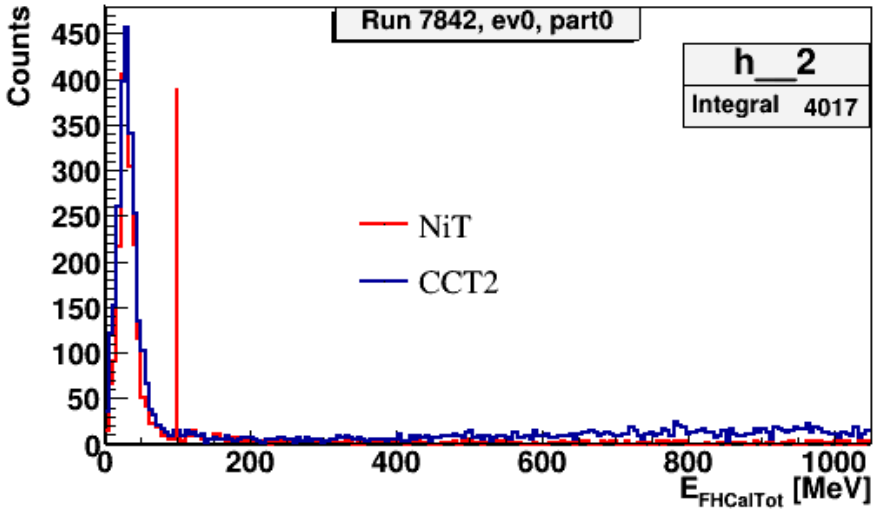


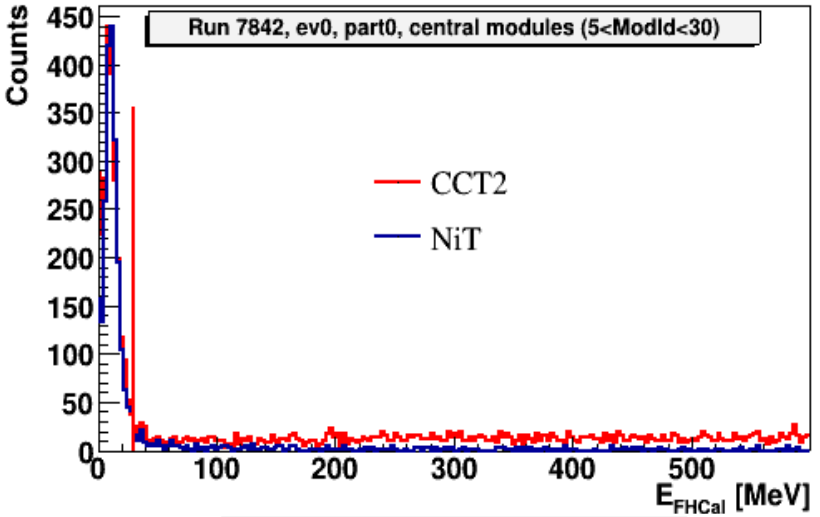


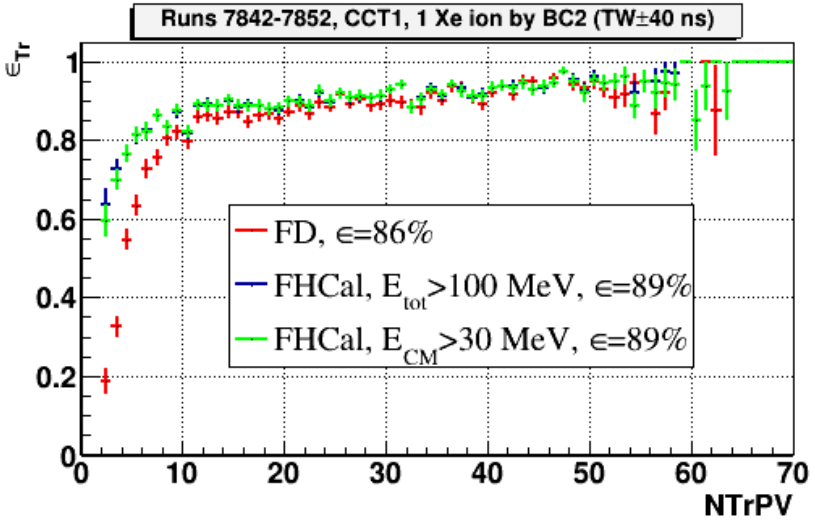
- ✓ Small modules and central modules

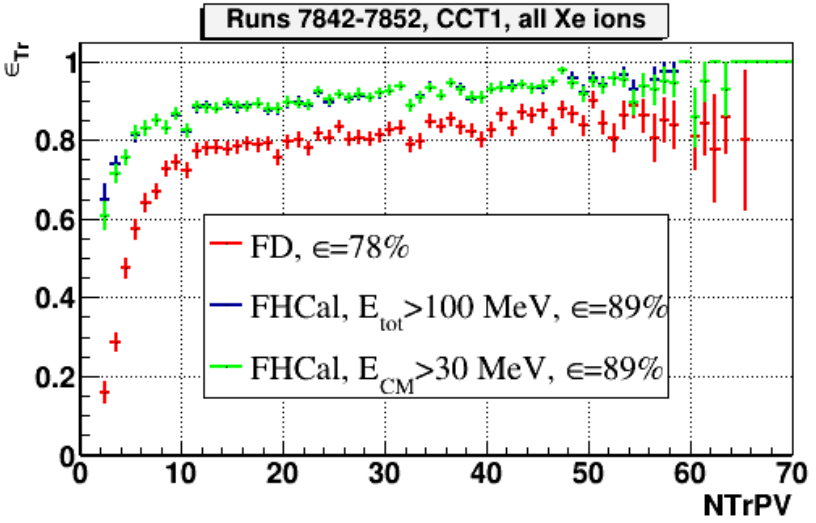
- ✓ Typical energy distribution in one of the FHCal modules in non-interaction events
- ✓ By modules, the maximum varies from 0.4 to 0.8 MeV

FHCal efficiency









✓ FHCal efficiency is not dependent on pile up

Plans

1. Add to BmnRoot class to get information about BD and FD efficiency in Xe run

2. This class will give the trigger efficiency, as well as the statistical and systematic uncertainty, by run id and NtrPV

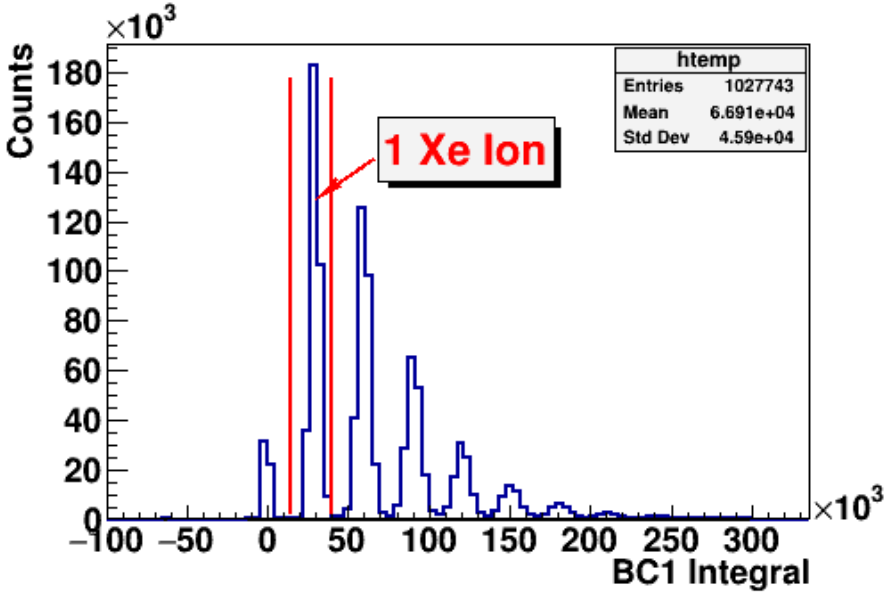
3. It will also allow you to check whether the event meets the analysis conditions or not

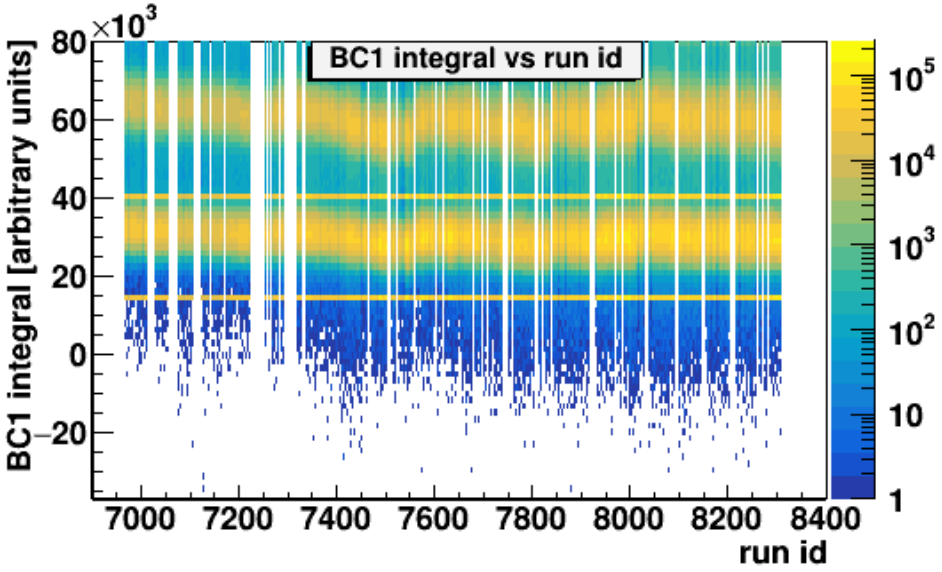
4. Further, perhaps this class will provide efficiency for other selection criteria for pile up (for example, without the condition on BC2)

Thank you for attention!

Backup

Pile up suppression using BC1





- ✓ Pile up with BC1

NBD<4 correction procedure

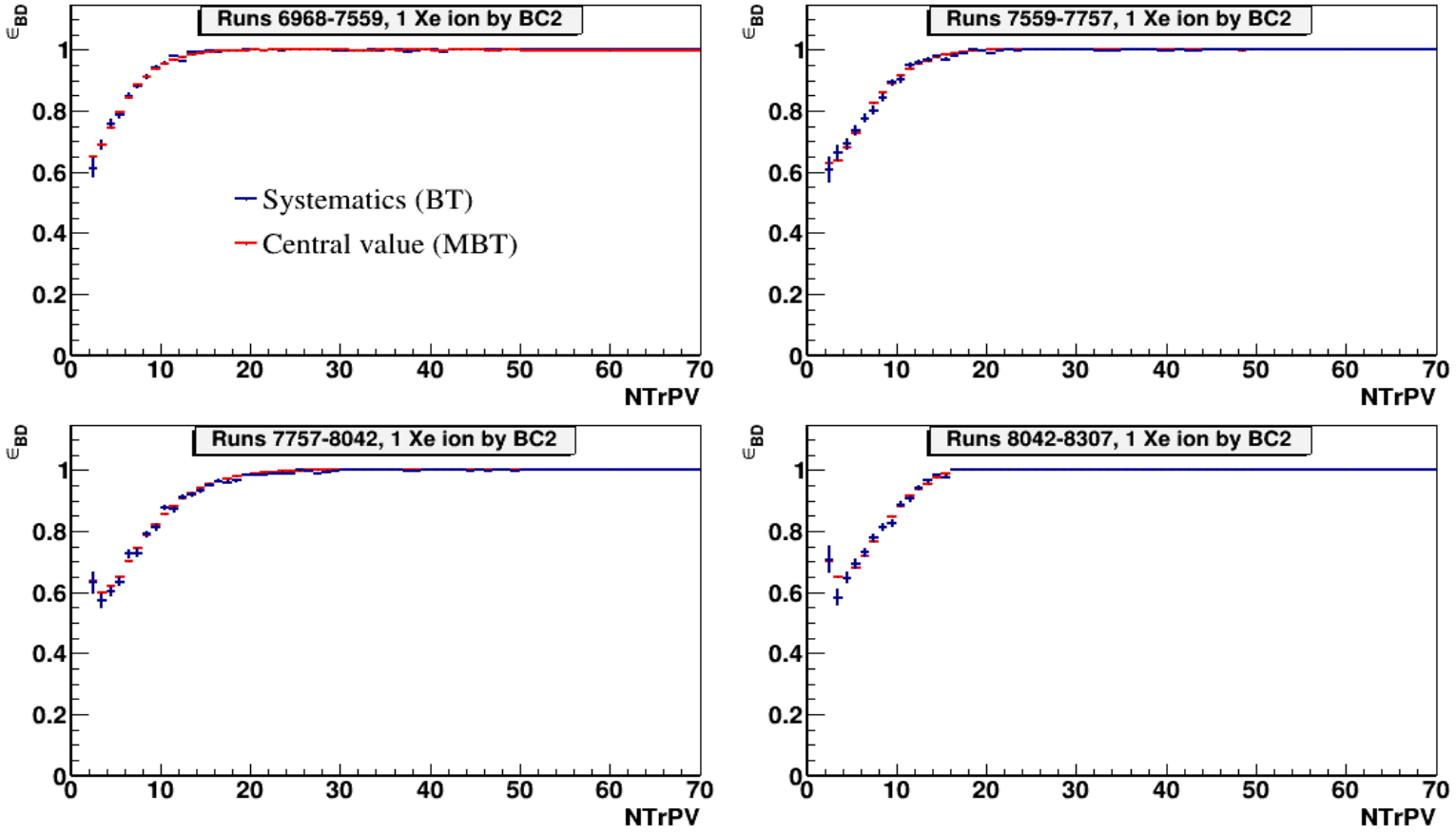
Base procedure

- ✓ Denominator (h1): events with MBT flag (AR) && FD signals in TW
- ✓ Numerator (h2): as denominator && BD signals in TW
- ✓ Numerator divided by denominator

Correction for h2

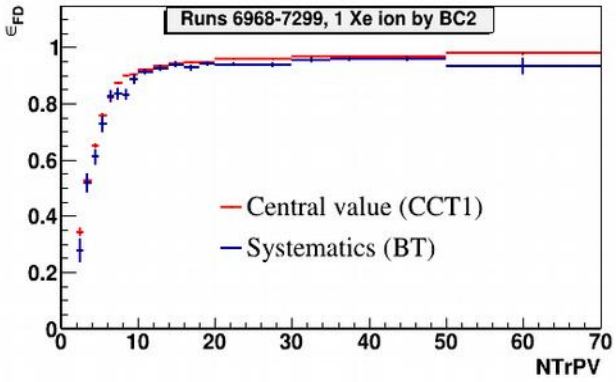
- ✓ h3: events with CCT2 flag (AR) && NBD<4 (signals in TW)
- ✓ h4: events with MBT flag (AR) && (NBD==4 || NBD==5)
- ✓ h5: events with CCT2 flag (AR) && (NBD==4 || NBD==5)
- ✓ h3 → Scale(NEvents(h4)/ NEvents(h5))
- ✓ h2 → Add(h3)

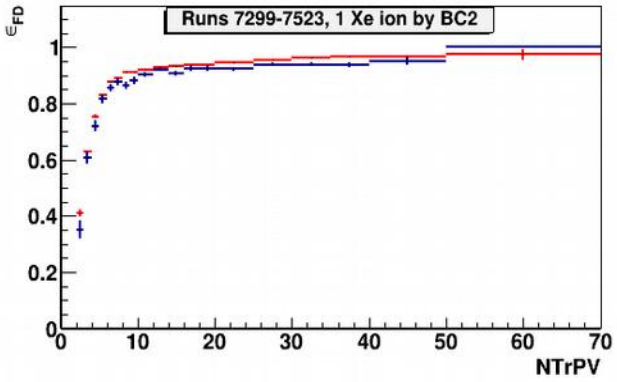
BD efficiency and systematics

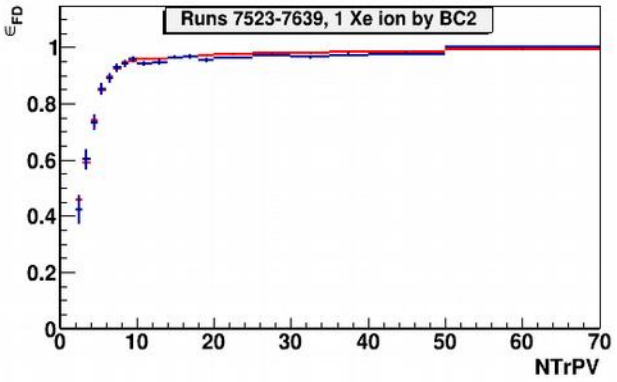


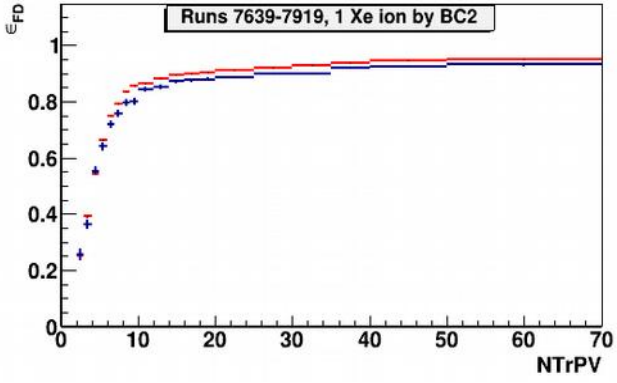
- ✓ The central value is explored in more detail (in 13 run ranges)
- ✓ The statistical uncertainty in each NTrPV bin does not exceed 5%

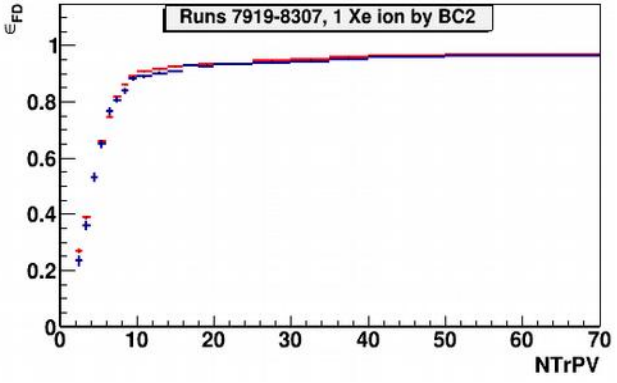
FD efficiency and systematics











- ✓ The central value is explored in more detail (in 62 run ranges)
- ✓ The statistical uncertainty in each NTrPV bin does not exceed 5%