Trigger efficiency evaluation in the xenon run of the BM@N experiment with a beam kinetic energy of 3.8 AGeV

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SCIENCE BRINGING NATIONS TOGETHER VBLHEP Seminar April 2025

#### 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. Interface for getting trigger efficiency in BmnRoot
- 8. Conclusion

## Trigger system







## **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<sub>BD</sub>: numerator divided by

denominator



#### **FD parameters** Trigger window

Signal amplitude



## BD efficiency



70



- 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<sub>FD</sub><4250)</li>
- $\epsilon_{FD}$ : 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 TML 40 perior shown as entimeday.
- The window TW±40 ns is chosen as optimal

8

#### Dependence of trigger system parameters on run id







**10<sup>5</sup>** 

10<sup>4</sup>

 $10^{3}$ 



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<sub>BD</sub>, the BC2 cat rejects 0.5% of events, for ε<sub>FD</sub> – 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%)



# Interface for getting trigger efficiency

#### git.jinr.ru/nica/bmnroot/-/tree/dev/physics/run8?ref\_type=heads Update ~ $\rightarrow$ C Explore Sign in Register Q Search or go to ... NICA / - BmnRoot M Project 2 dev ~ bmnroot / physics / run8 Find file Code v Man BmnRoot clang-format fix 2 88 Manage ß cebd6b83 History Vasily Plotnikov authored 4 weeks ago 🔁 Plan <>> Code 5 Name Last commit Last update Deploy > ... -11 Monitor 5 C++ BmnTriggerEfficiencyRun8.cxx clang-format fix 2 4 weeks ago Analvze h BmnTriggerEfficiencyRun8.h Add fNBd field 1 month ago

- ✓ Added BmnTriggerEfficiencyRun8 class to BmnRoot
- ✓ Allows to obtain the  $\epsilon_{Tr}$ , its statistical and systematic uncertainties by the run id and the NTrPV
- $\checkmark$  Allows to select events for analysis
- Example of use in a macro CheckTriggerEfficiencyInterfaceRun8.C





- 1. The methodology for assessing the trigger efficiency has been developed
- 2. The efficient way to filter pile up events using BC2 beam counter has been found
- 3. The analysis of the stability of the key trigger detectors during the Xe run was carried out
- 4. Added interface to BmnRoot to get trigger efficiency
- 5. The correctness of the estimate of  $\varepsilon_{Tr}$  was verified by calculating the cross section of inelastic interactions Xe + CsI based on the BM@N data
- 6. Planned for publication in **PEPAN Lett**, reviewer needed

#### Thank you for attention!





### Pile up suppression using 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)</li>
  - 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))
- ✓  $h2 \rightarrow Add(h3)$

## 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%