RGK Trigger

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I. Trigger Rate vs PCAL+ECAL Energy Deposition

The W-distribution for different PCAL+ECAL energy deposition cuts is depicted in Figure 1. The data were collected at a beam energy of 10.6 GeV, but the general conclusion holds for lower energies as well. There's minimal distinction between the 150 and 200 MeV cuts, but the 300 MeV cut noticeably impacts the W distribution. A 200 MeV cut is recommended for production runs, considering the trigger rate reduction (15%), as discussed below. The calorimeter energy cut has a negligible impact on the x_B distribution (refer to Figure 2), primarily reducing the overall efficiency.

II. Luminosity scan in 2018

The 2018 Luminosity scan (Run 5875, taken on Dec 12, 2018, at 05:25:43 PM) was employed to assess the performance of the RGK trigger. The electron beam energy was 6.5 GeV. Two distinct triggers were examined: one with DC segments (trigger bit #0) and one without DC segments (trigger bit #7). A trigger with DC segments selects events that have at least 5 superlayers in the DC. In the 2018 trigger we had no DC roads, which is why the suppression factor is so modest, only 5%. We expect better suppression factor in 2023 due to the addition of DC roads to the trigger.

III. Trigger Rate vs Beam Current

Figure 3 illustrates trigger rates against beam current with a PCAL+ECAL cut of 300 MeV. Notably, the beam energy dependence appears linear with beam current for both triggers under investigation. The maximum trigger rate reaches approximately 30 kHz at a beam energy of 70 nA, with a high live time of 90% (refer to Figure 6).

Figure 4 displays the ratio R=Trigger Rate(with DC) / Trigger Rate(without DC) against beam current (in blue). This ratio remains constant approximately 0.97, demonstrating independence from beam current. The live time decreases from 100% to 89% at the maximum available beam current of 71 nA.

In Figure 3, the magenta line represents the rate of events going to tape, calculated as the product of the rate and live time Rate*LiveTime.

IV. 2023 RGK Trigger Versions

Several trigger files are prepared for commissioning and production runs, featuring two PCAL+ECAL cut versions (150 and 200 MeV). Triggers without DC roads are suitable for both TORUS configurations, inbending and outbending. In all trigger configurations, the first 7 bits are allocated for primary electron triggers with a prescale of 1. Two triggers will be utilized during the commissioning phase: alignment run and a random 30 kHz trigger run.

The 2023 RGK trigger files are detailed in Table I.

TABLE I. RGK trigger files

Trigger File	Description	PCAL+ECAl	TORUS
rgk_noDC_v1.0_150MeV	No DC roads	150 MeV	Any
rgk_noDC_v1.0_200MeV		200 MeV	
rgk_out_v1.0_150MeV	With DC roads	150 MeV	Outbending
rgk_out_v1.0_200MeV		200 MeV	
rgk_inb_v1.0_150MeV	With DC roads	150 MeV	Inbending
rgk_inb_v1.0_200MeV		200 MeV	
rgk_v1.0_zero_150MeV	No DC roads	150 MeV	Zero
rgk_v1.0_zero_200MeV		200 MeV	
rgk_v1.0_30kHz_150MeV	Random 30 kHz	150 MeV	Any
rgk_v1.0_30kHz_200MeV		200 MeV	

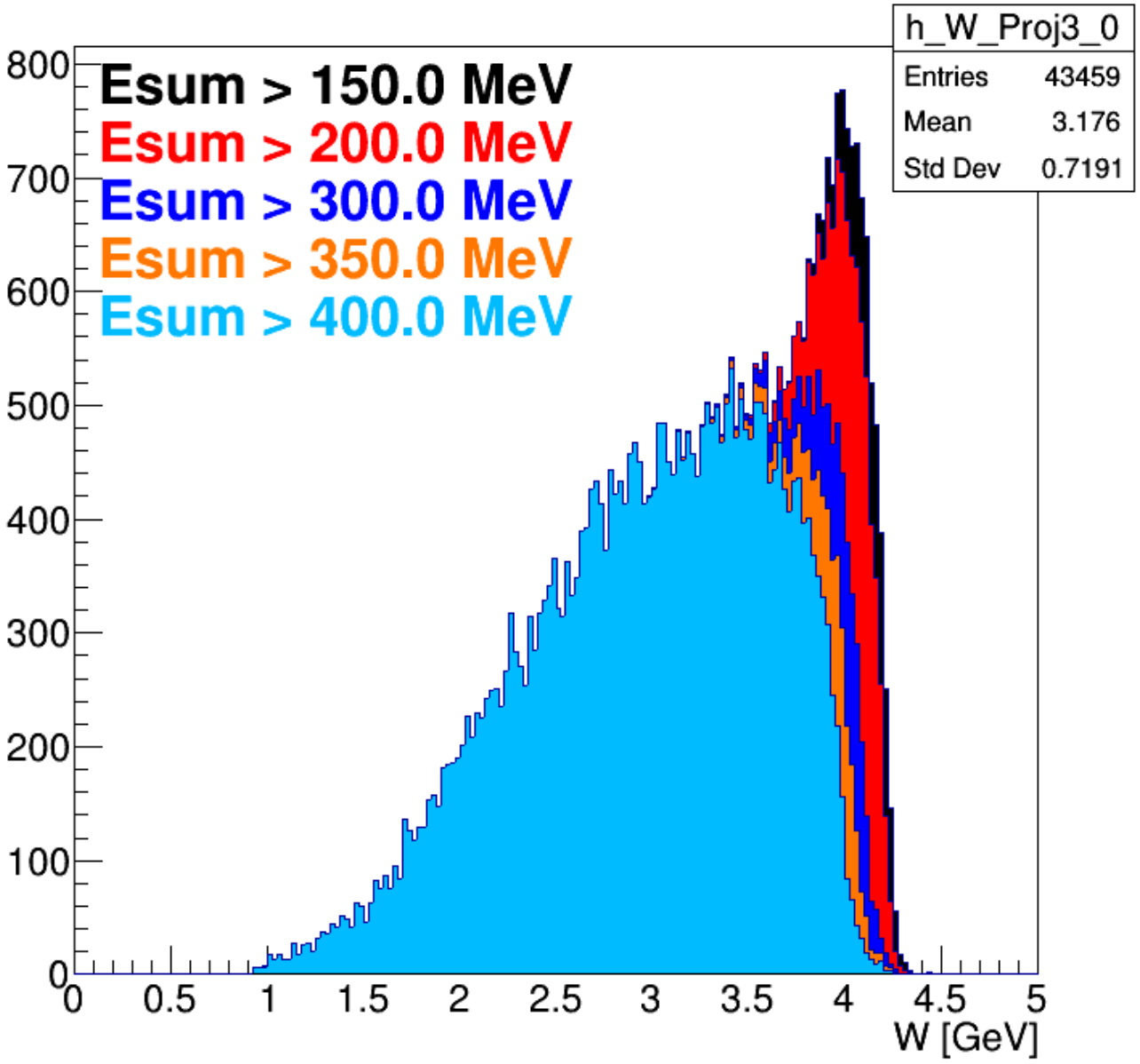

FIG. 1. W distribution for the different PCAL+ECAL threshold cuts. Bean energy is 10.6 GeV.

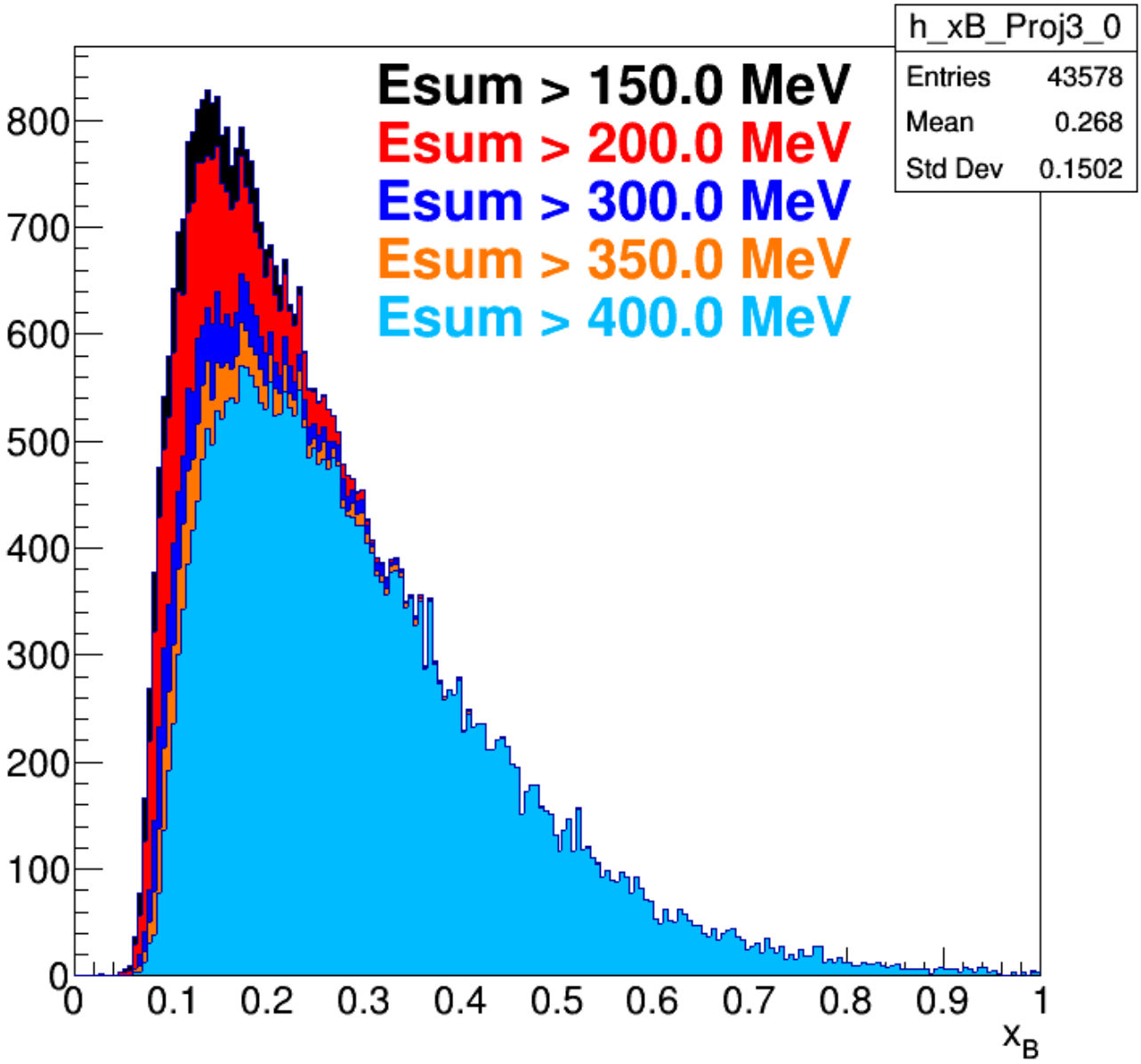

FIG. 2. x_B distribution for the different PCAL+ECAL threshold cuts. Bean energy is 10.6 GeV.

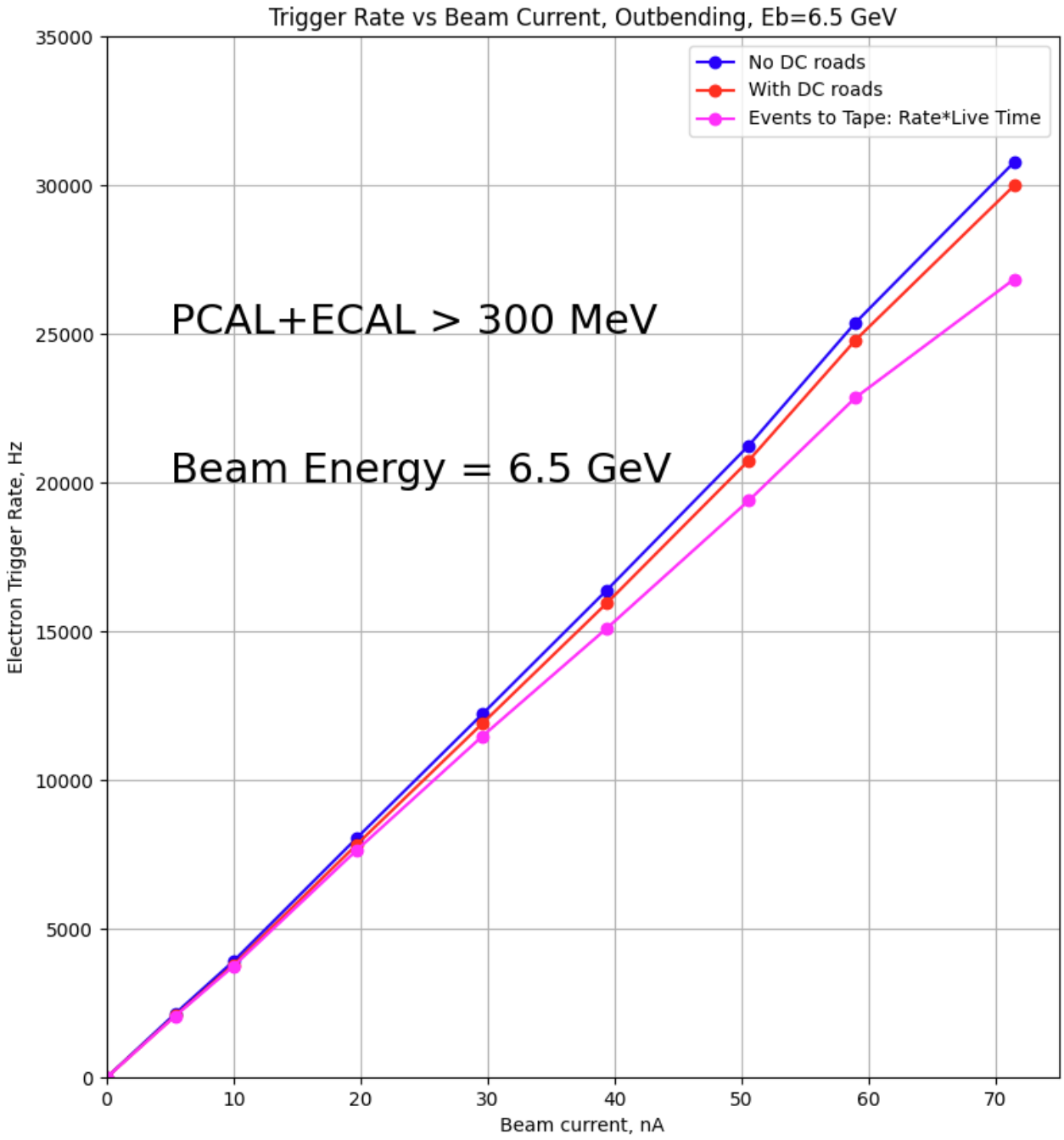

FIG. 3. Trigger rate vs beam current. Blue: without DC segments. Red: with DC segments.Magenta: Events to tape for the trigger with DC segments.

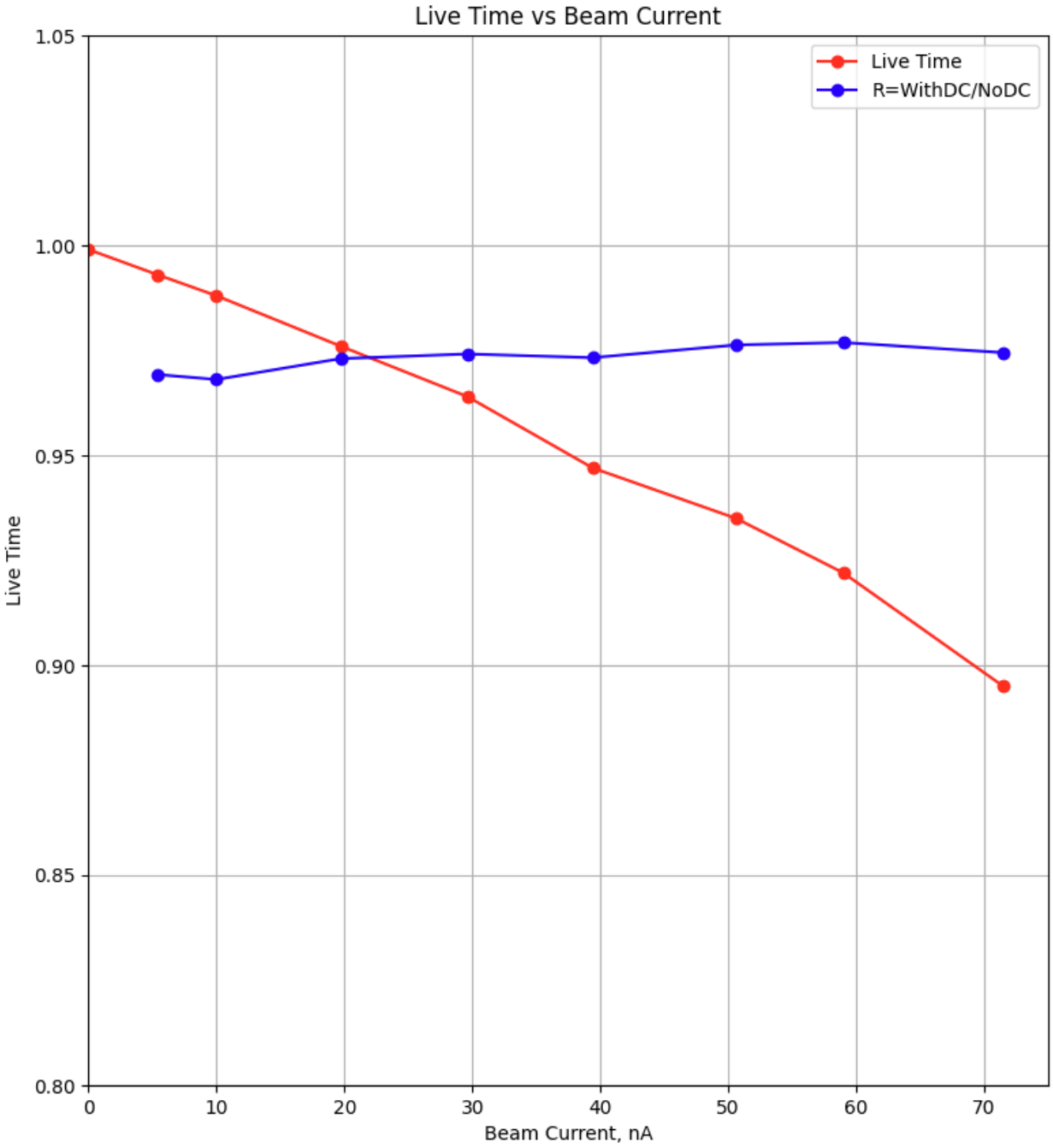

FIG. 4. Blue: Live time vs beam current fro the trigger with the DC segments. Red: Ratio=Trigger Rate(with DC) / Trigger Rate(without DC) vs beam current.

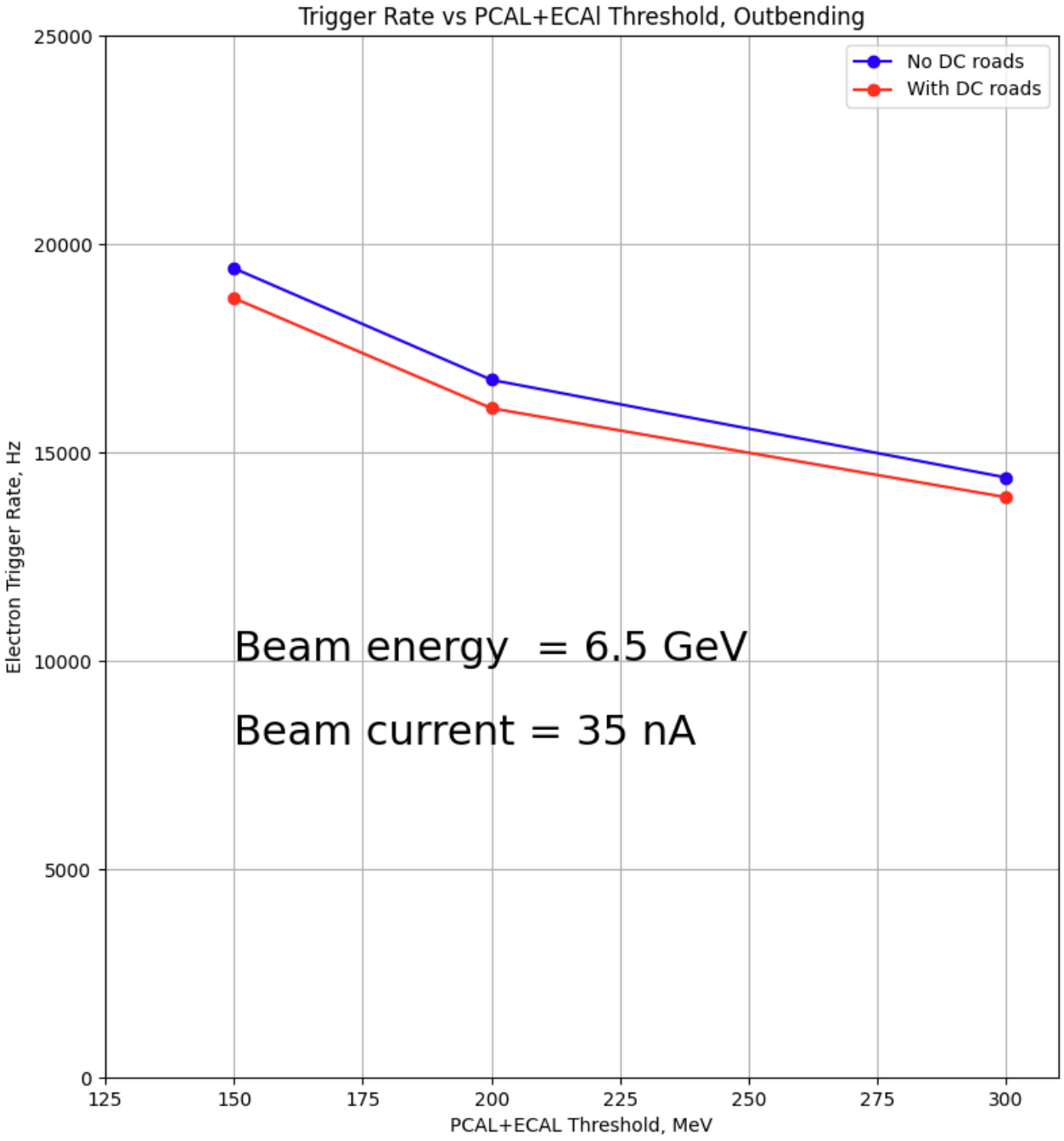

FIG. 5. Trigger rate vs threshold on PCAL+ECAL deposit energy. Beam energy = 6.5 GeV, Beam current = 35 nA. Blue: trigger with the DC segments. Red: trigger without the DC segments.

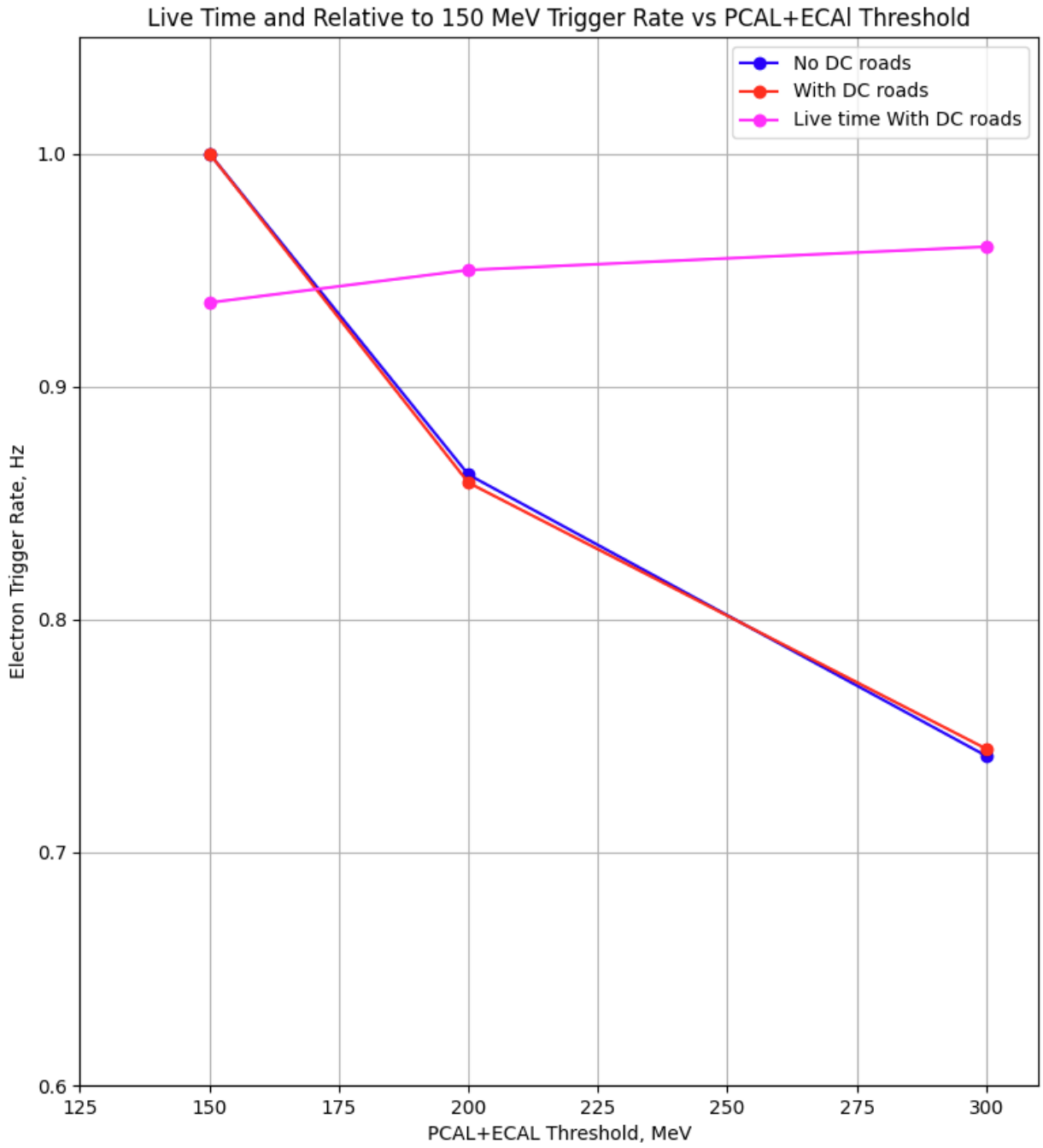

FIG. 6. Trigger rate vs on PCAL+ECAL deposit energy normalized to the Threshold = 150 MeV. Blue: without DC, Red: with DC, Magenta: Live time for the trigger with the DC segments.