G4 Simulation of Polyethylene Collimator's Influence

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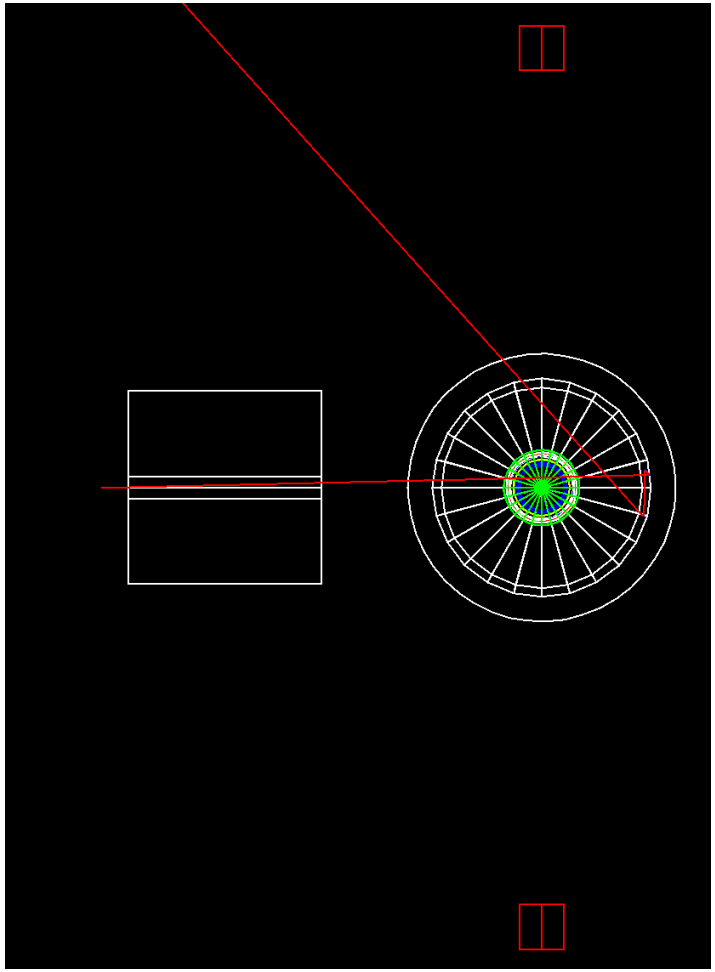
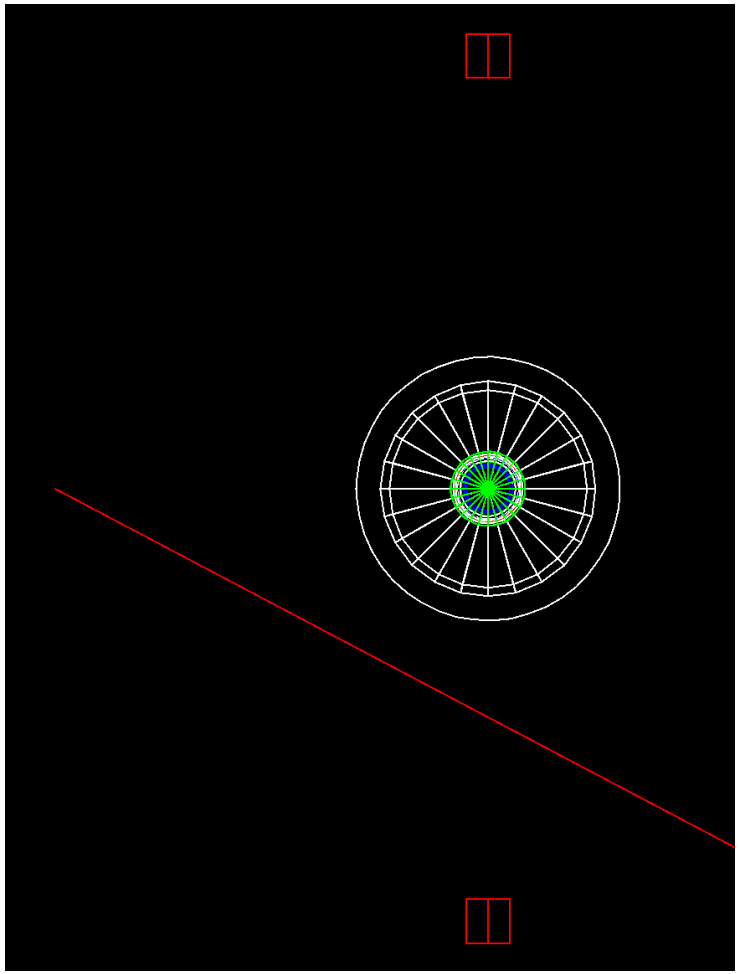
April 16th

G4 Geometry Used in Simulation



Case#1 with PE Collimator



Case#2 without PE Collimator

Condition and Parameters Used in G4 Simulation

1. total 100 million neutron Event are simulated in G4 in both geometry respectively.

2. both LAr and 2 x EJ301 are used as sensitive volume for detection

3. angular dependent energy and flux (x-section) distribution of neutron beam are taken into consideration.

4. various values of trigger threshold (unit in keV) for LAr and EJ301 are used for comparison.

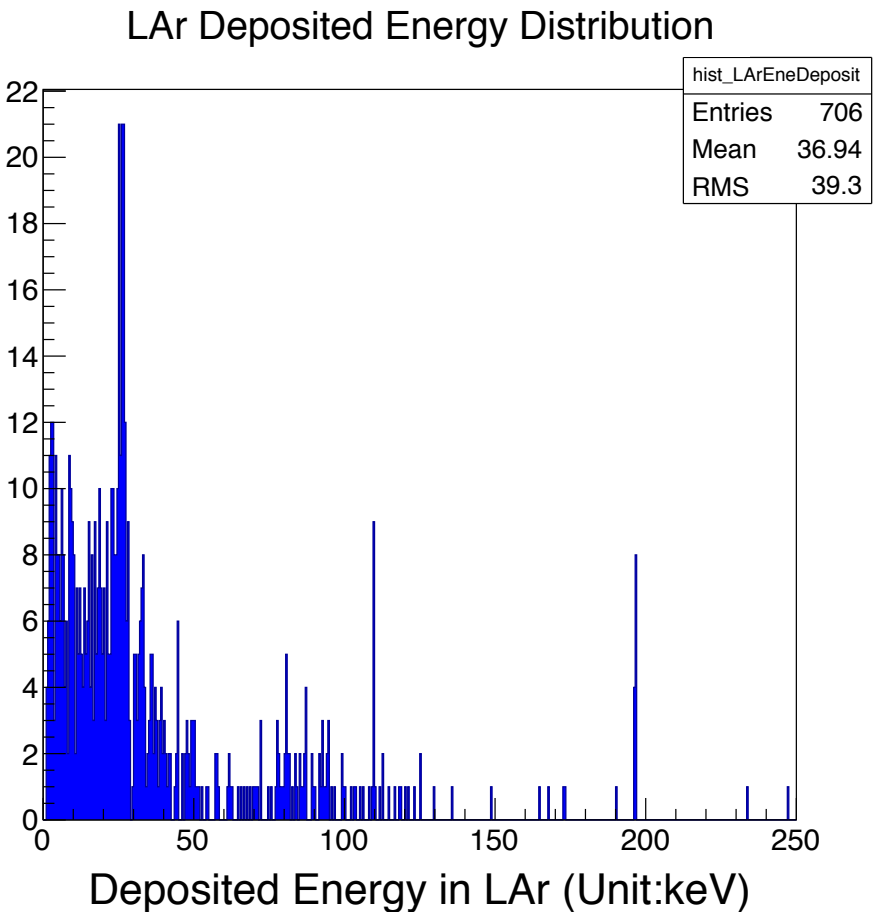
5. polyethylene collimator dimension: 22cm x OD 22cm and ID 2.54cm (1 inch)

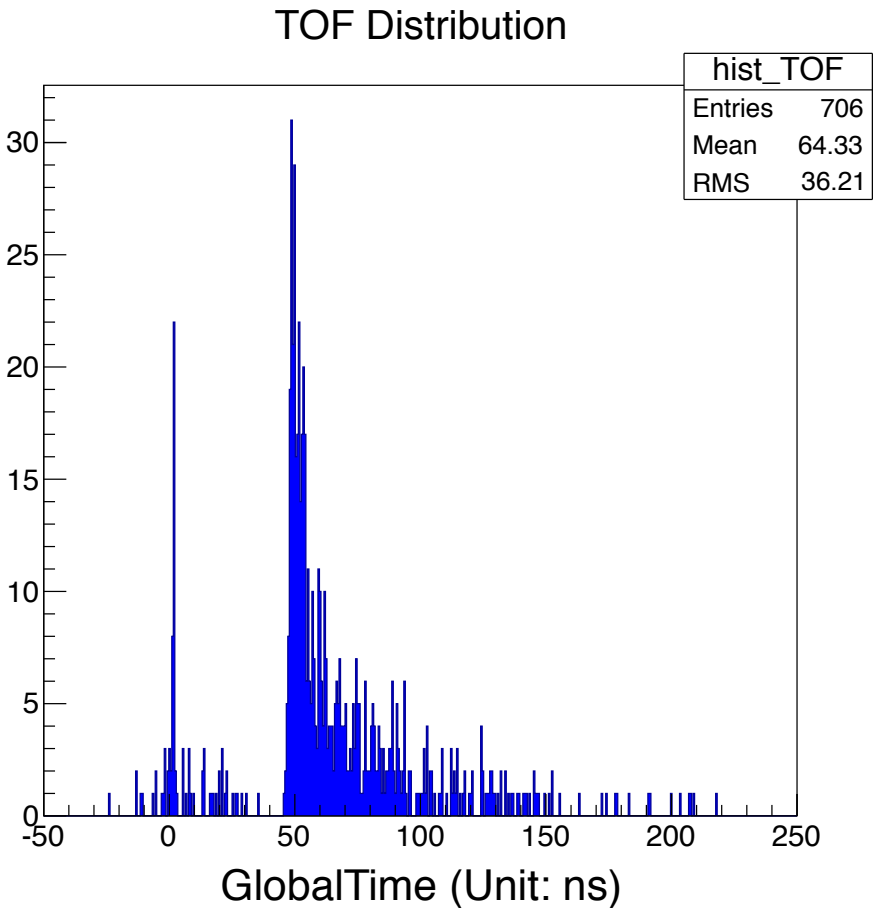
6. geometry set-up:

a. collimator is 3cm away from neutron source
b. LAr TPC is 50cm away from neutron source
c. Distance between EJ301 and LAr TPC is 50cm

Case Comparison: Case#1. With Polyethylene Collimator and Case#2. Without Polyethylene Collimator

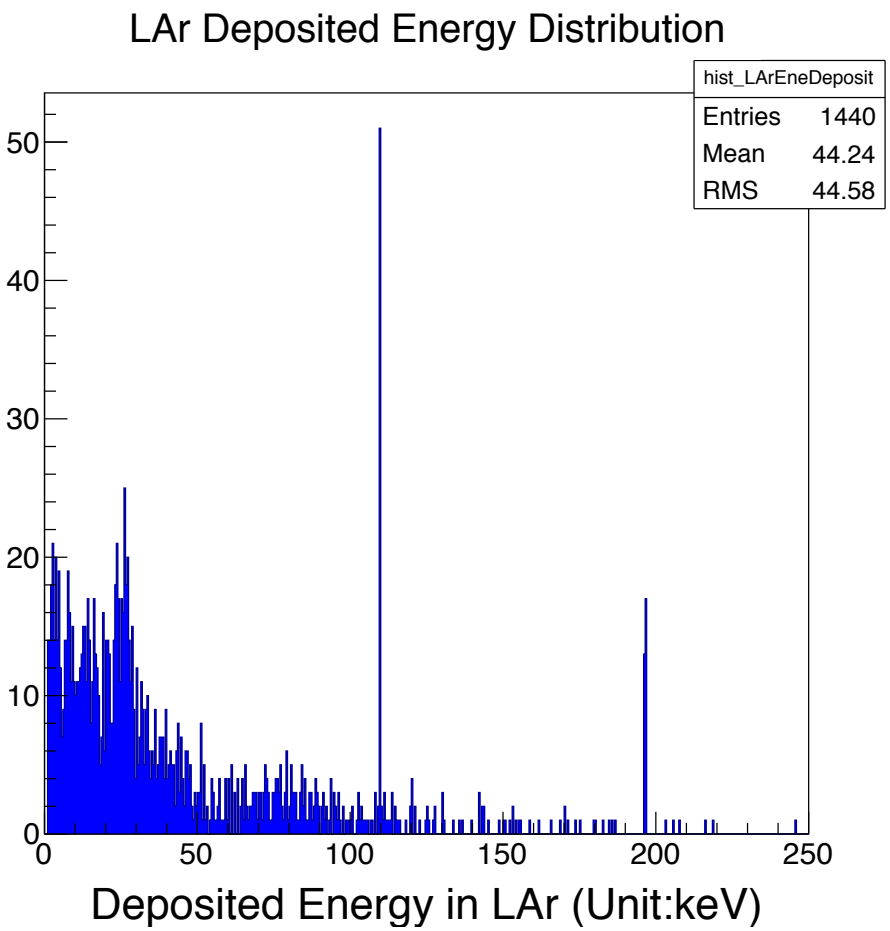
Case#1 with PE Collimator

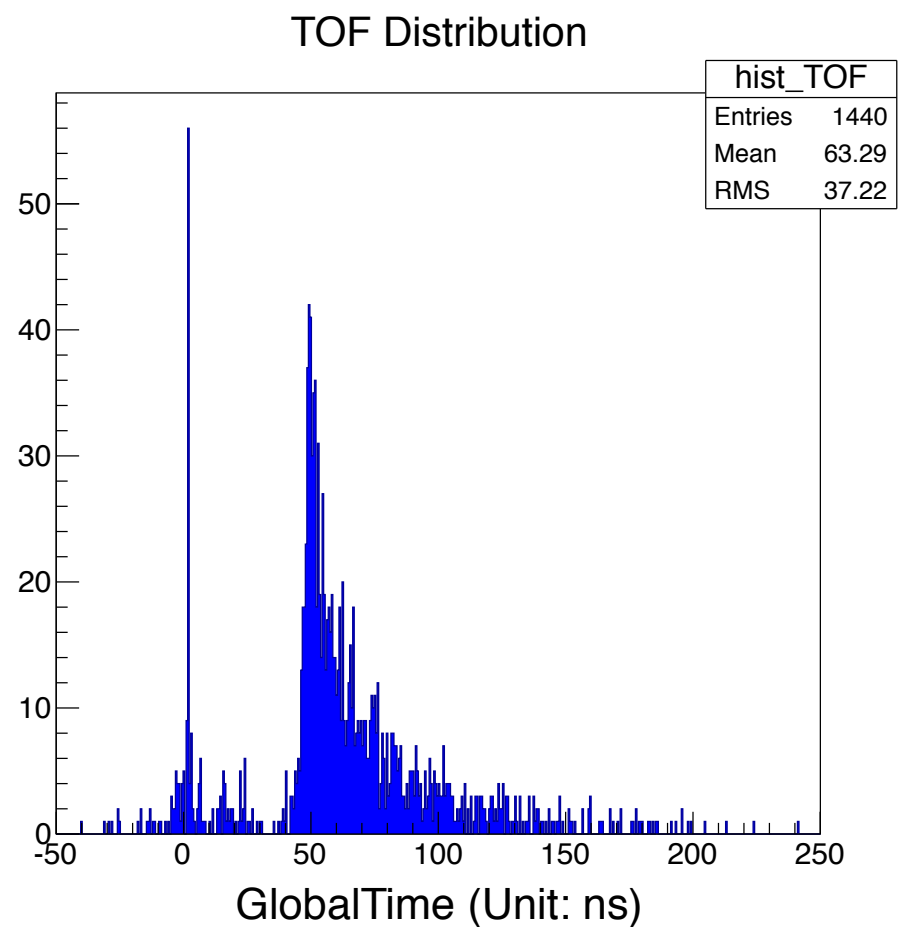




Requirement: event triggered in both LAr TPC by 1keV and EJ301 by 20keV

Case#2 without PE Collimator

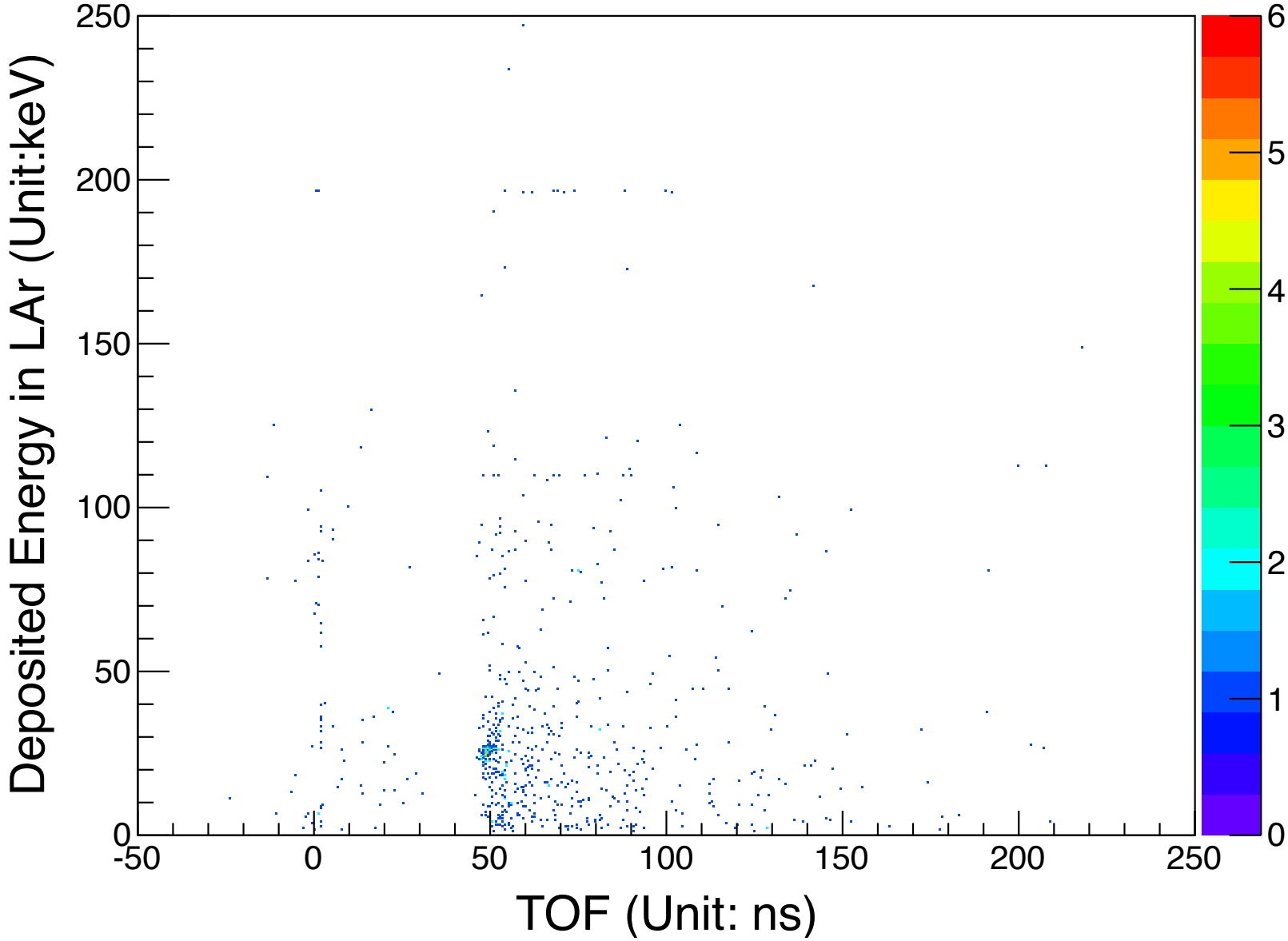




Requirement: event triggered in both LAr TPC by 1keV and EJ301 by 20keV

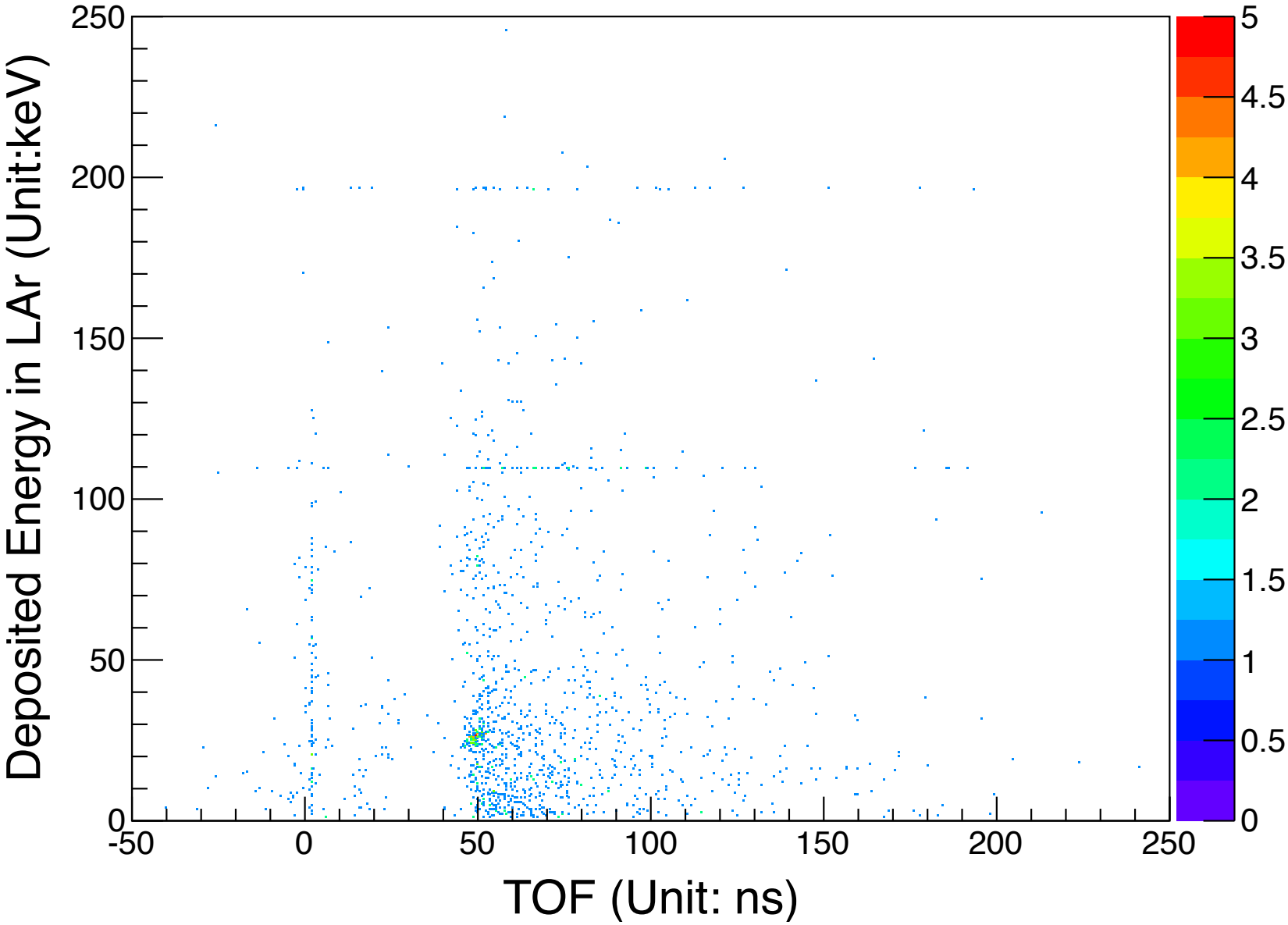
Case#1 with PE Collimator

TOF vs. LAr Deposit Energy

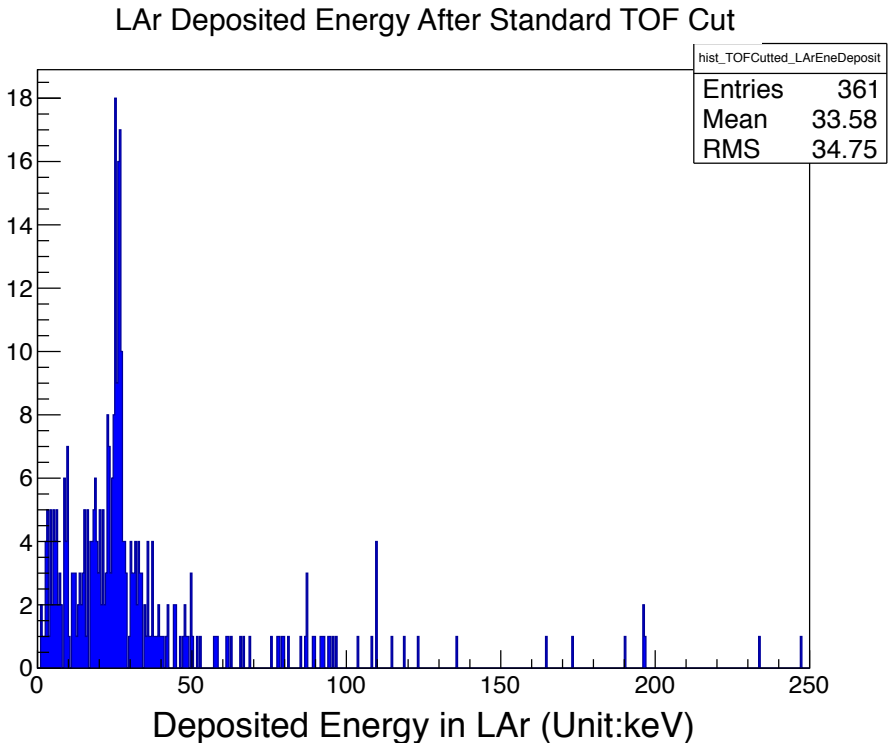


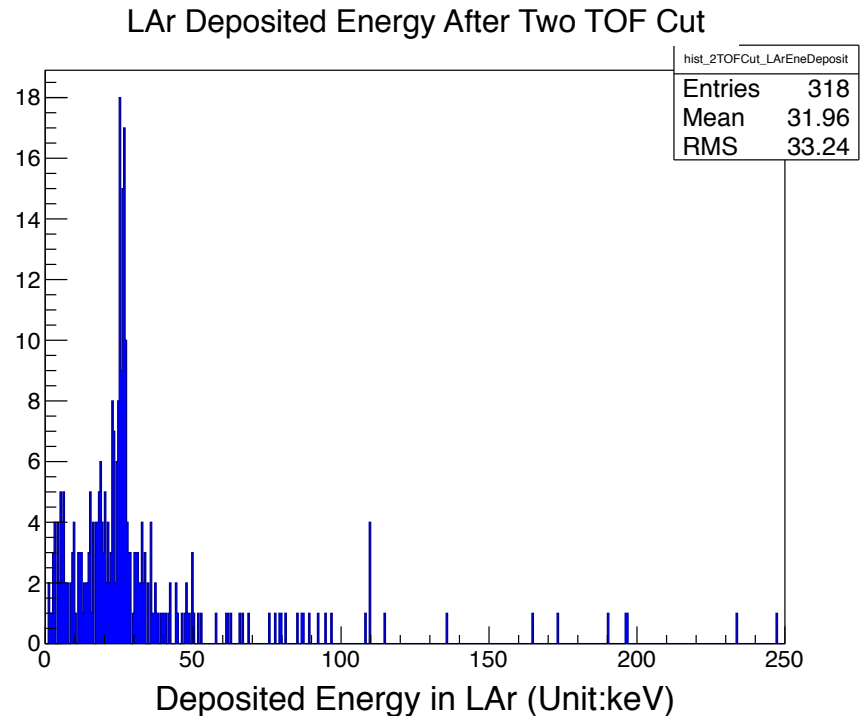
Case#2 without PE Collimator

TOF vs. LAr Deposit Energy



Case#1 with PE Collimator



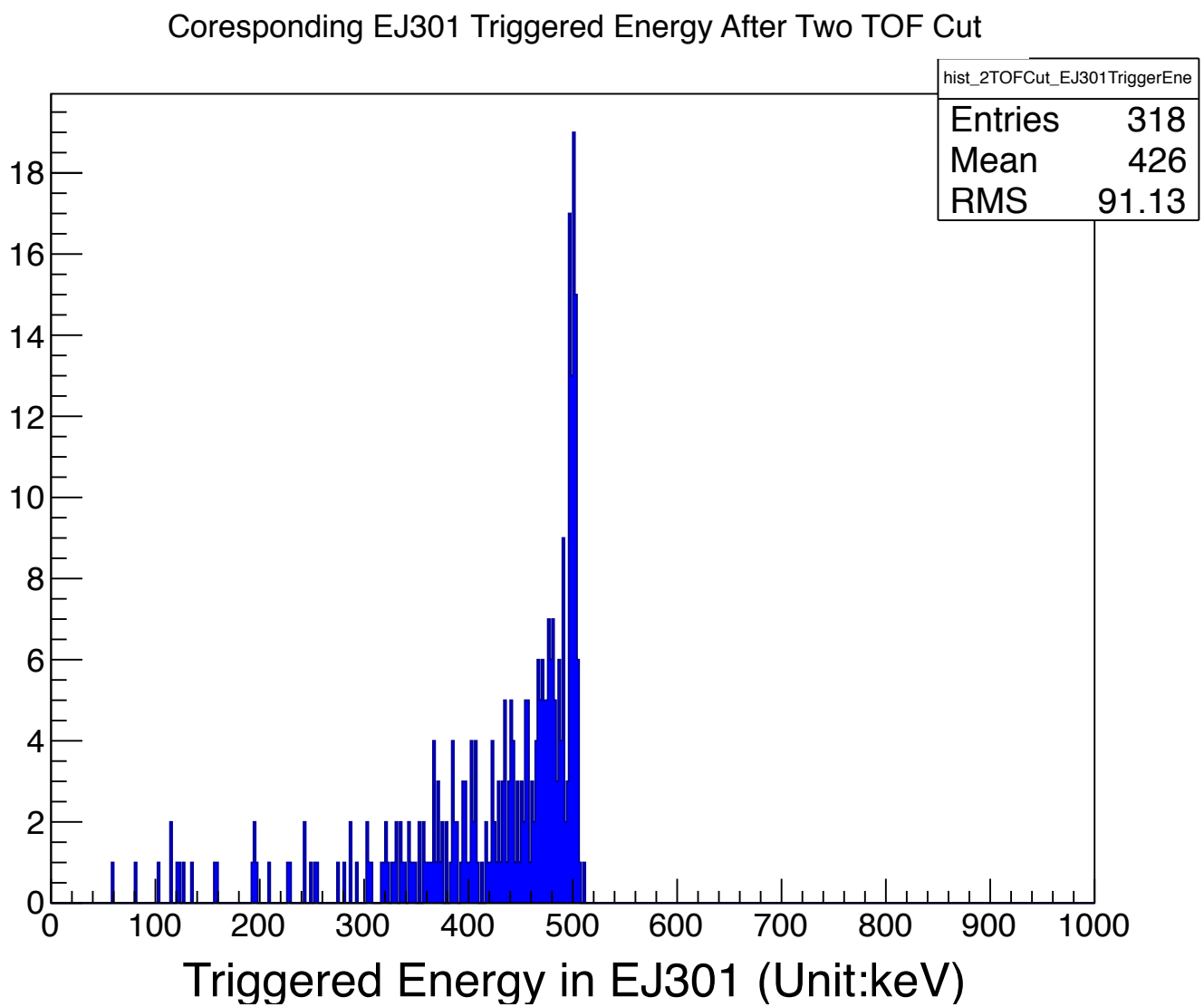


Requirement: event triggered in both LAr TPC by 1keV and EJ301 by 20keV

Left picture: extra standard TOF cut is applied with [-5ns, 15ns] a 20ns window.

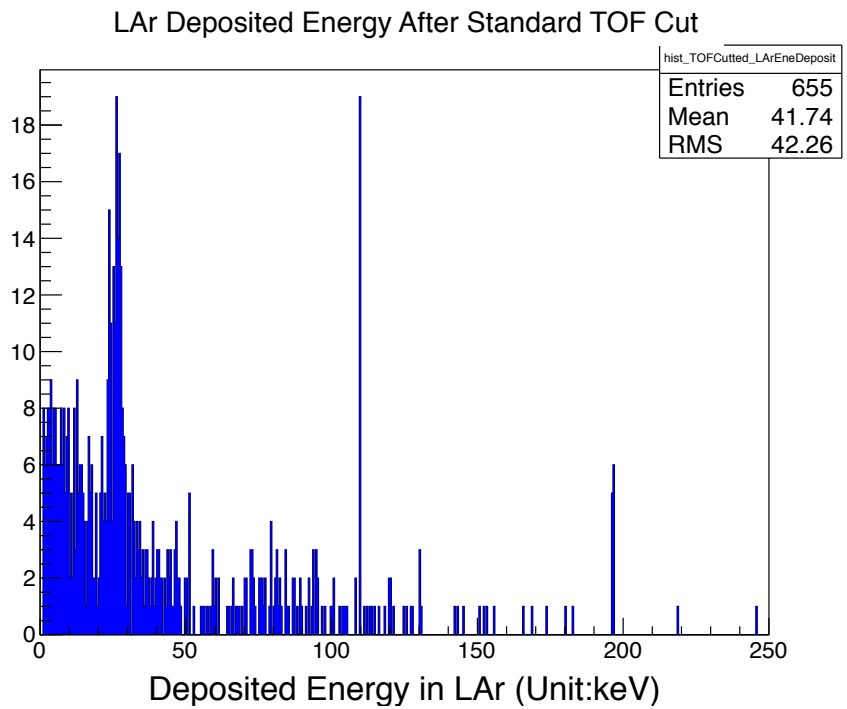
Right picture: a. standard TOF cut: [-5ns, 15ns] the 20ns window
b. neutron TOF limit to LAr TPC: [-5ns, 5ns] the 10ns window

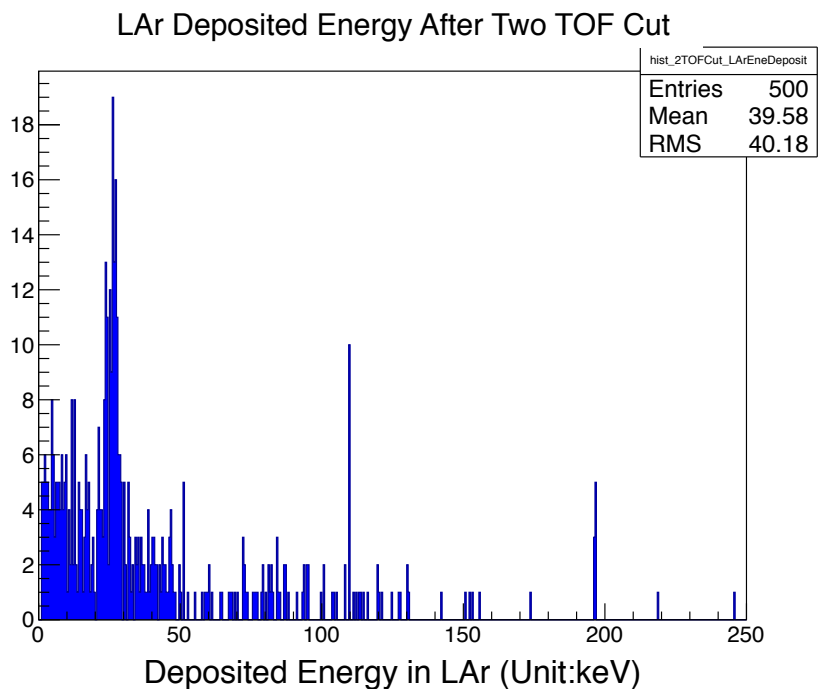
Case#1 with PE Collimator



triggered energy in EJ301 of events which passes 2 TOF cuts (1. TOF between neutron source and LAr TPC 2. TOF between LAr and EJ301)

Case#2 without PE Collimator



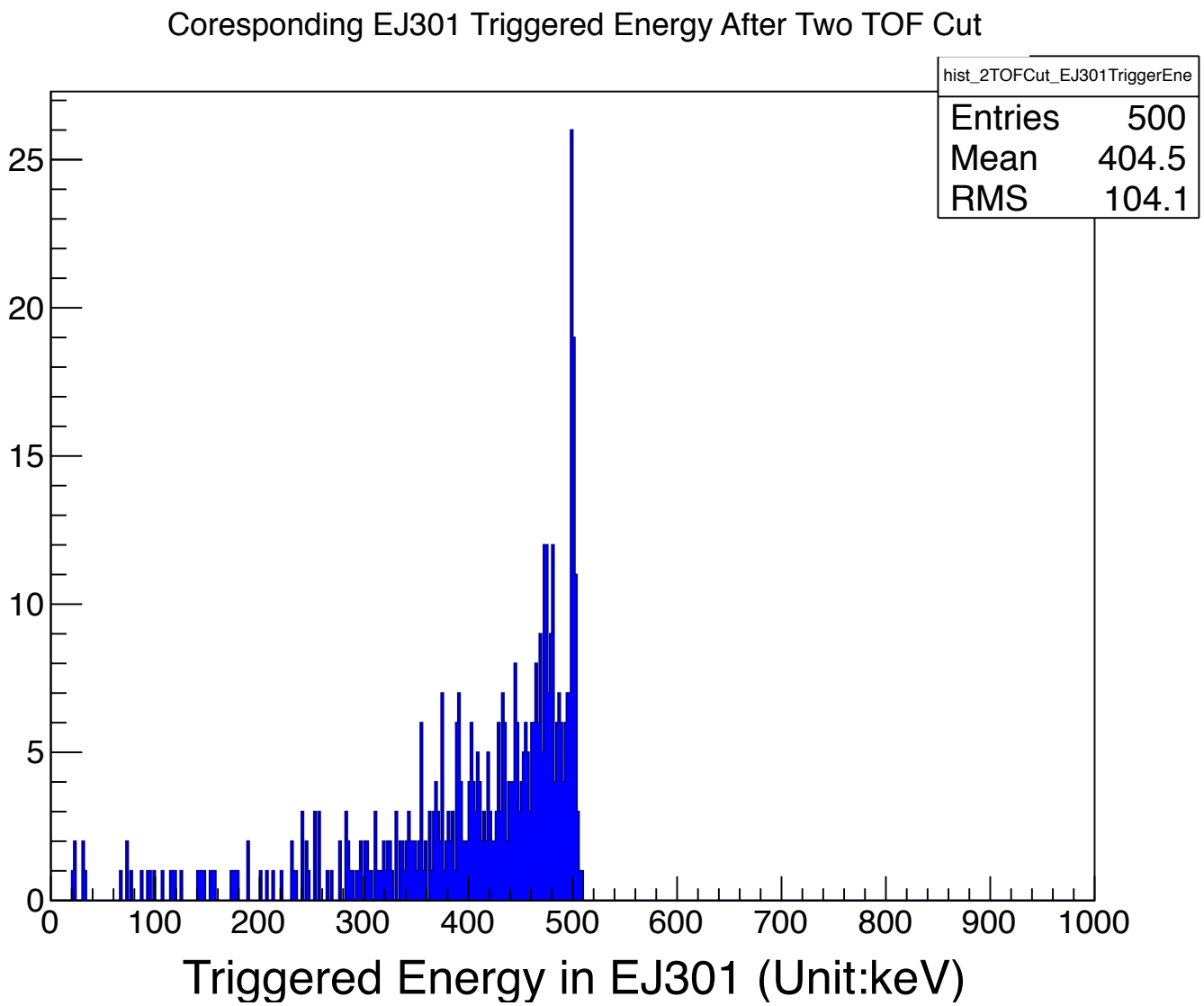


Requirement: event triggered in both LAr TPC by 1keV and EJ301 by 20keV

Left picture: extra standard TOF cut is applied with [-5ns, 15ns] a 20ns window.

Right picture: a. standard TOF cut: [-5ns, 15ns] the 20ns window
b. neutron TOF limit to LAr TPC: [-5ns, 5ns] the 10ns window

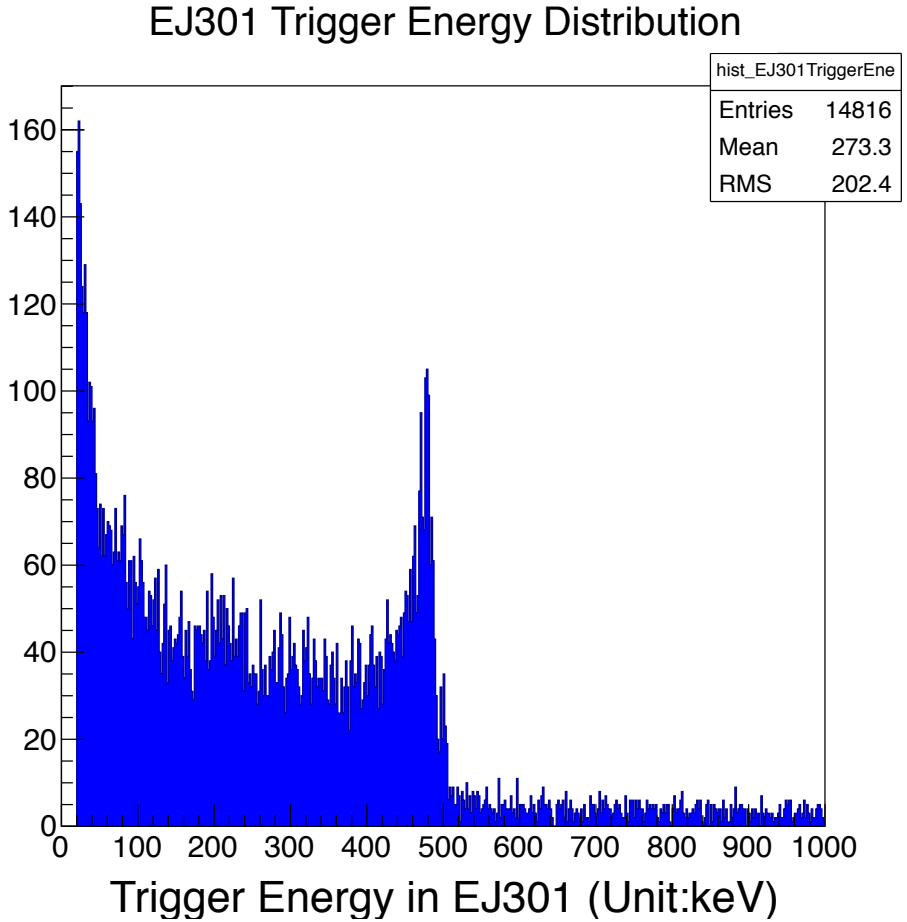
Case#2 without PE Collimator

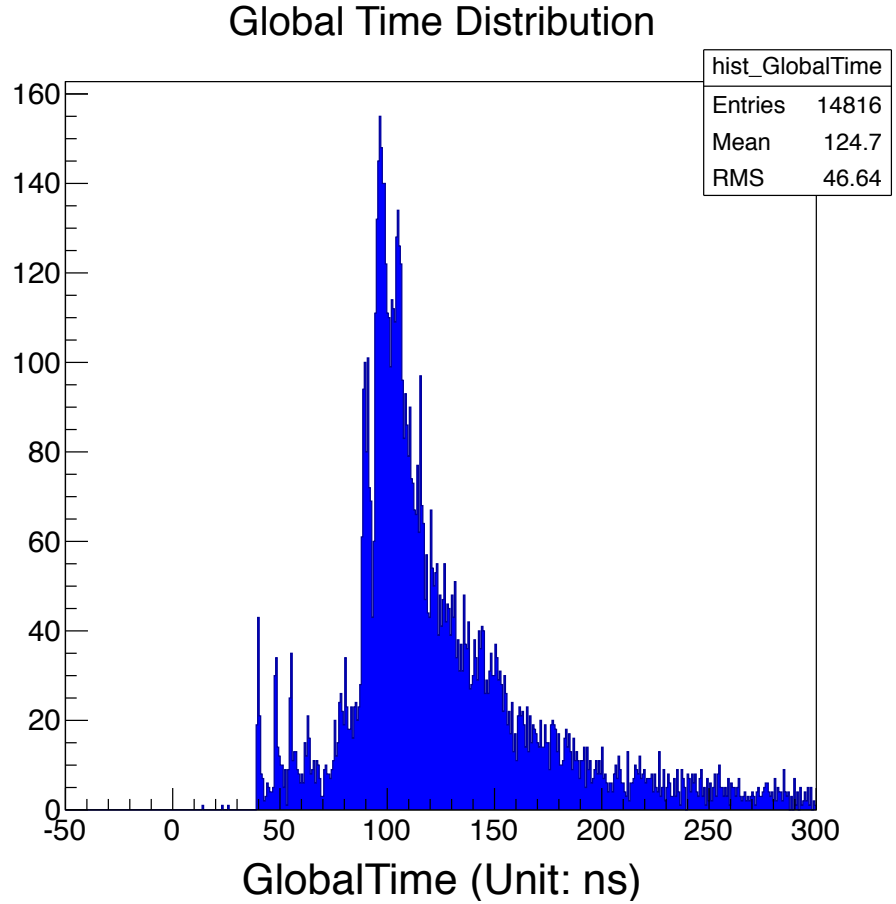


triggered energy in EJ301 of events which passes 2 TOF cuts (1. TOF between neutron source and LAr TPC 2. TOF between LAr and EJ301)

EJ301 Neutron Detector’s Trigger Threshold and Background Event Rate Study

EJ301 Study Case#1 with PE Collimator

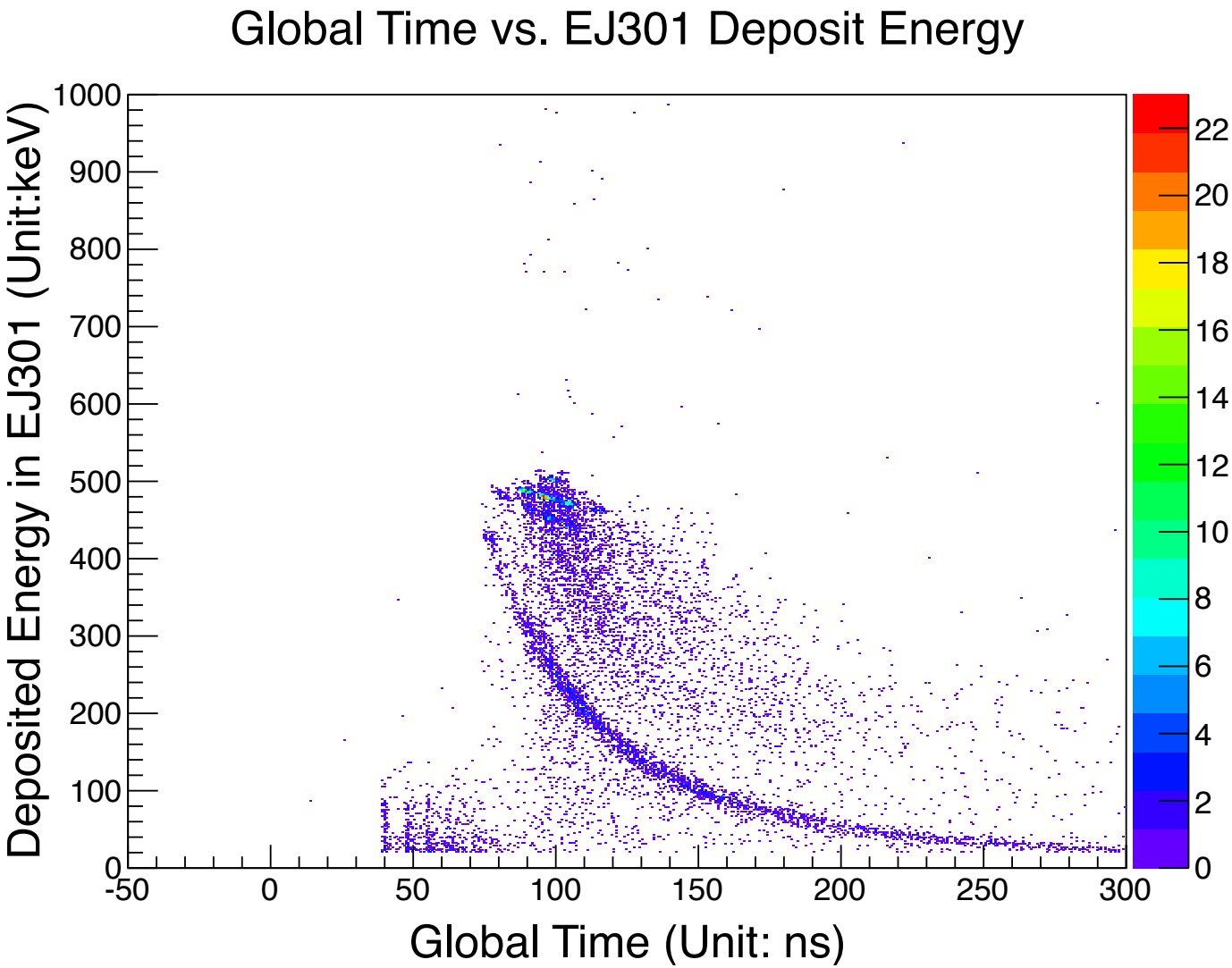




Requirement: event triggered in EJ301 by 20keV energy threshold

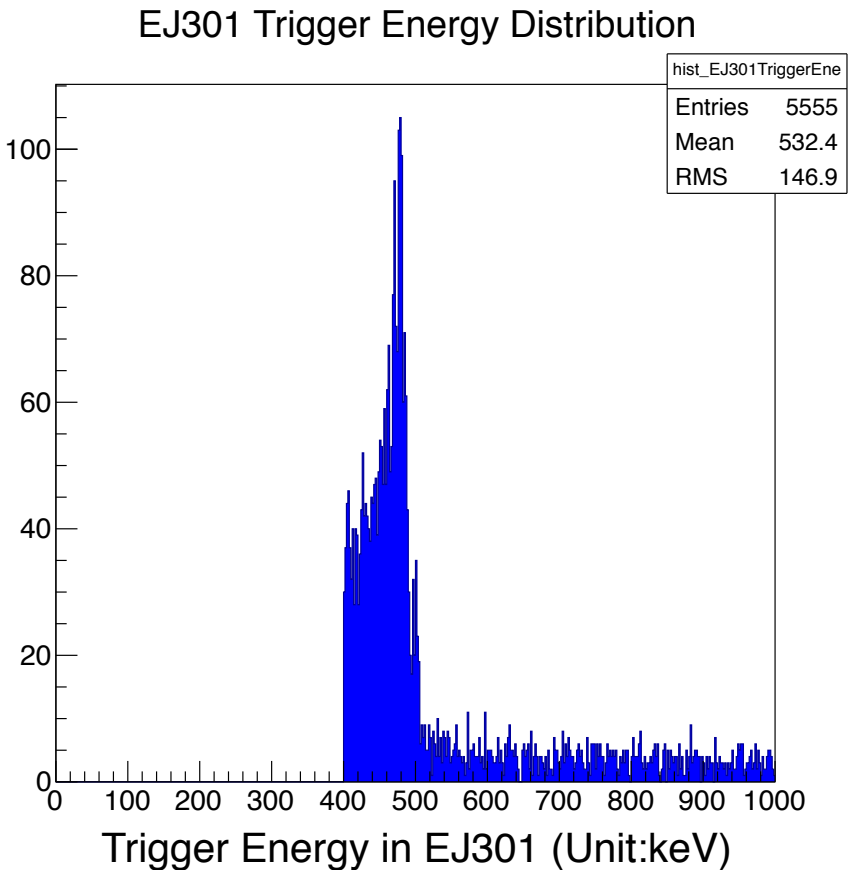
18109 particles (includes neutron and charged particles generated by neutron) passed through either EJ301, 14816 events were triggered. detection efficiency is 81.8%

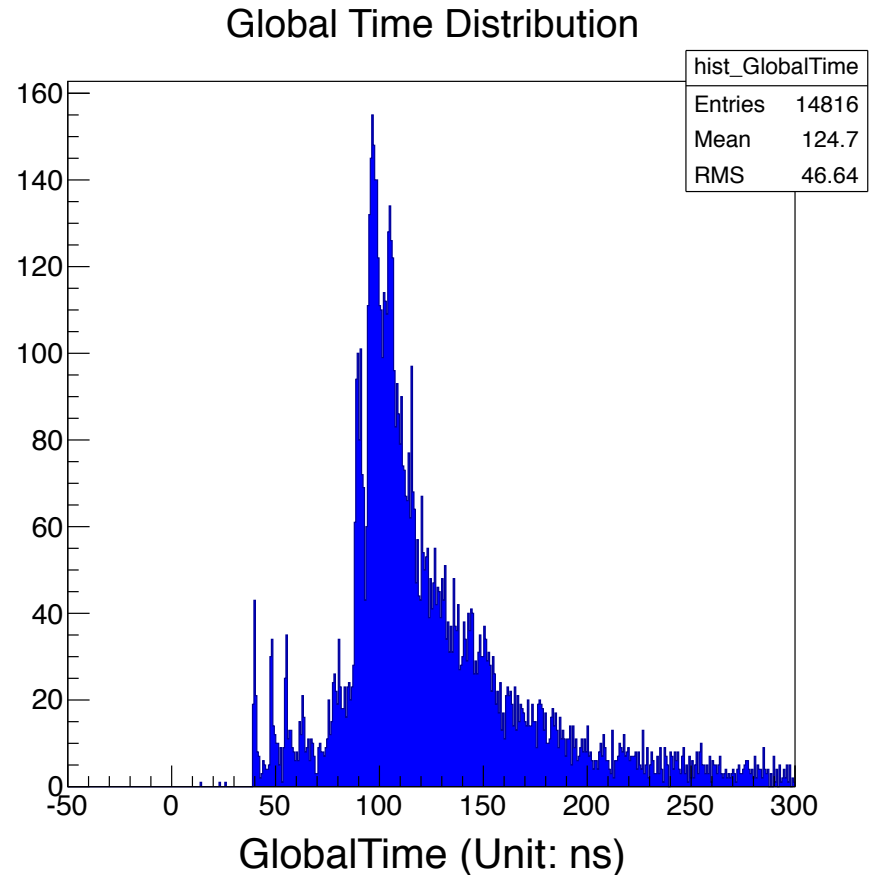
EJ301 Study Case#1 with PE Collimator



Requirement: event triggered in EJ301 by 20keV energy threshold

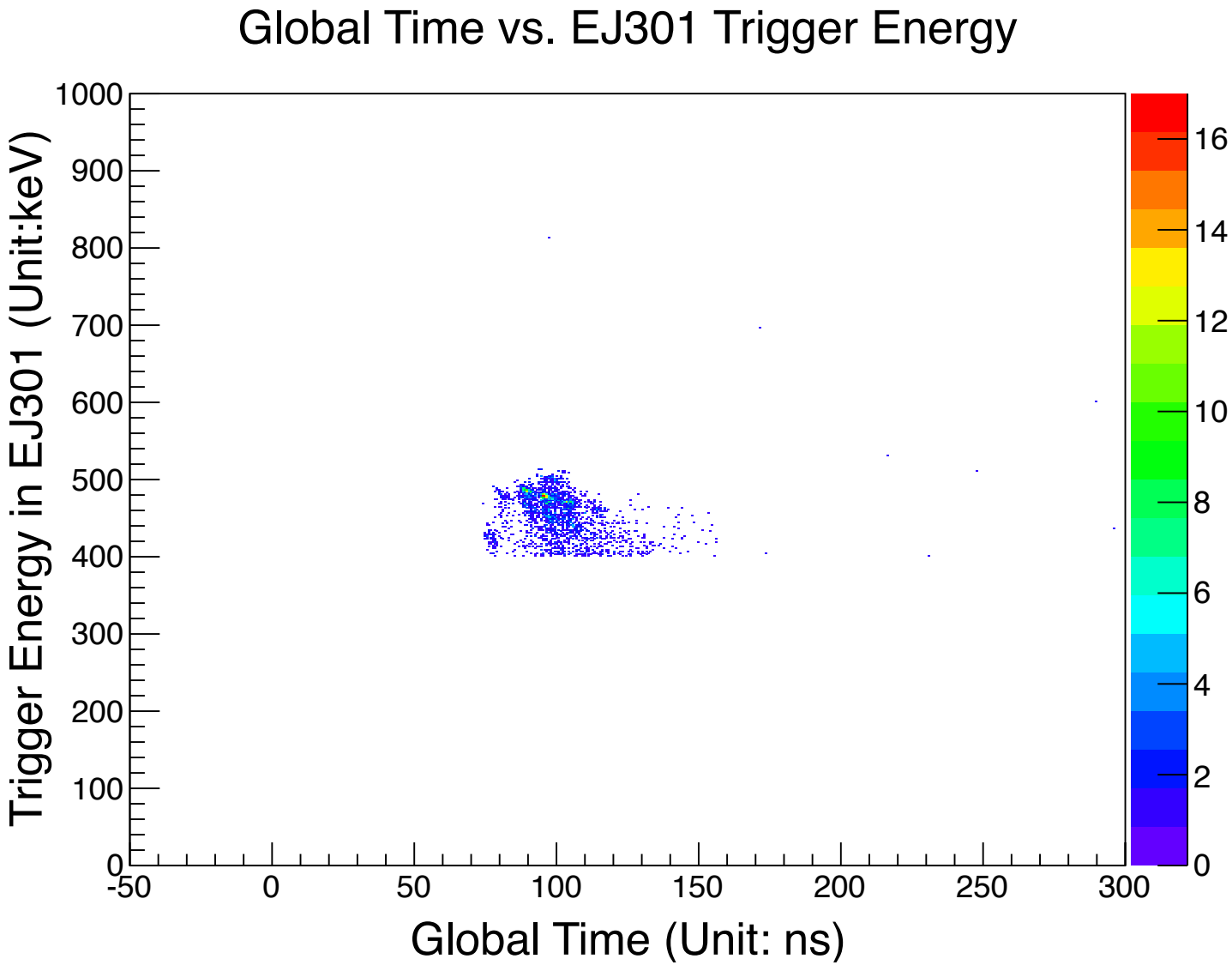
EJ301 Study Case#1 with PE Collimator





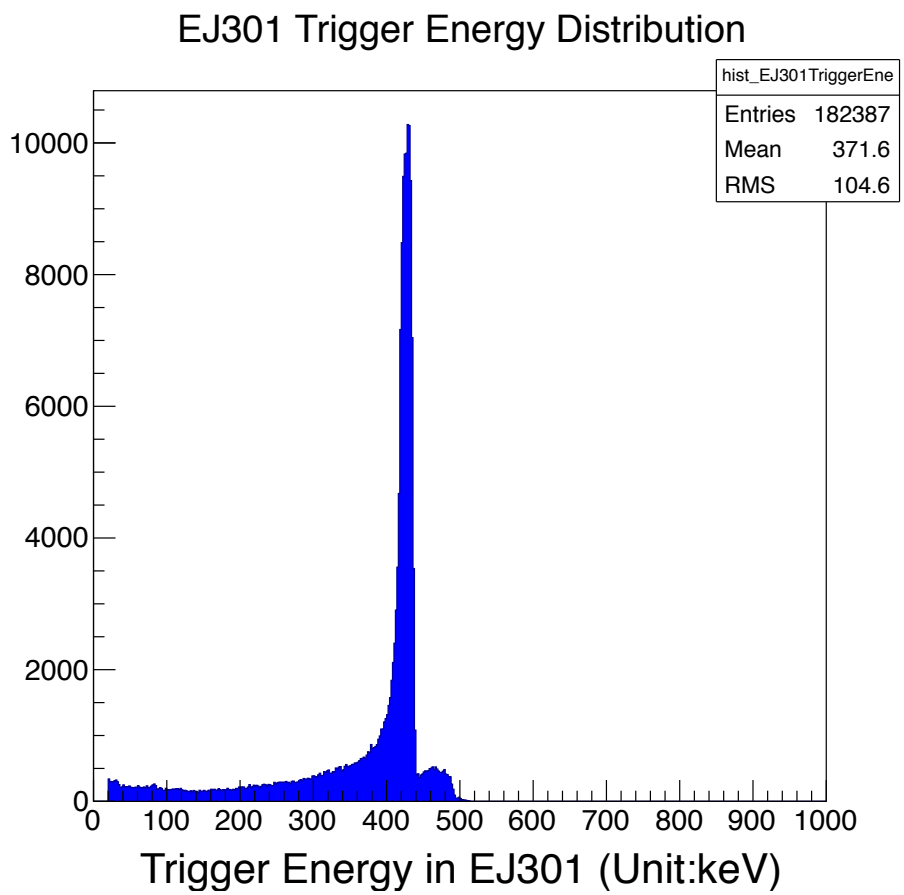
Requirement: event triggered in EJ301 by 400keV energy threshold

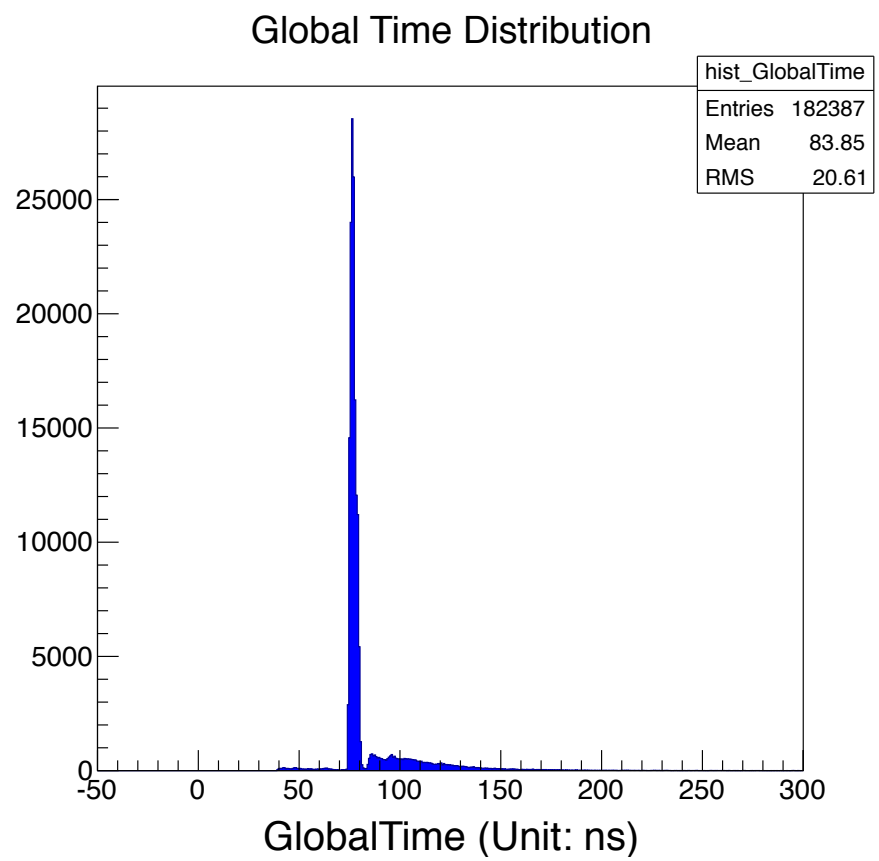
EJ301 Study Case#1 with PE Collimator



Requirement: event triggered in EJ301 by 400keV energy threshold

EJ301 Study Case#2 without PE Collimator

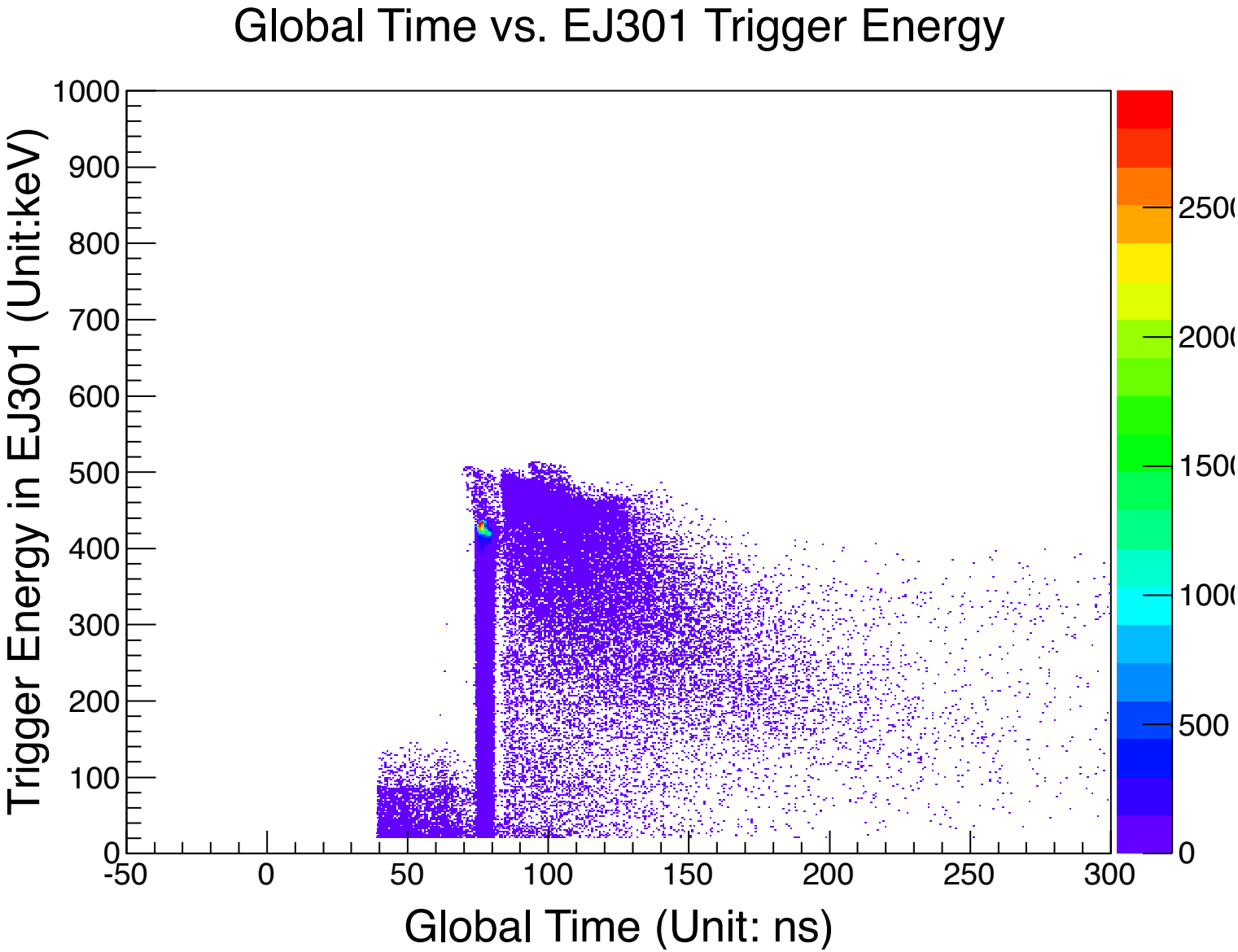




Requirement: event triggered in EJ301 by 20keV energy threshold

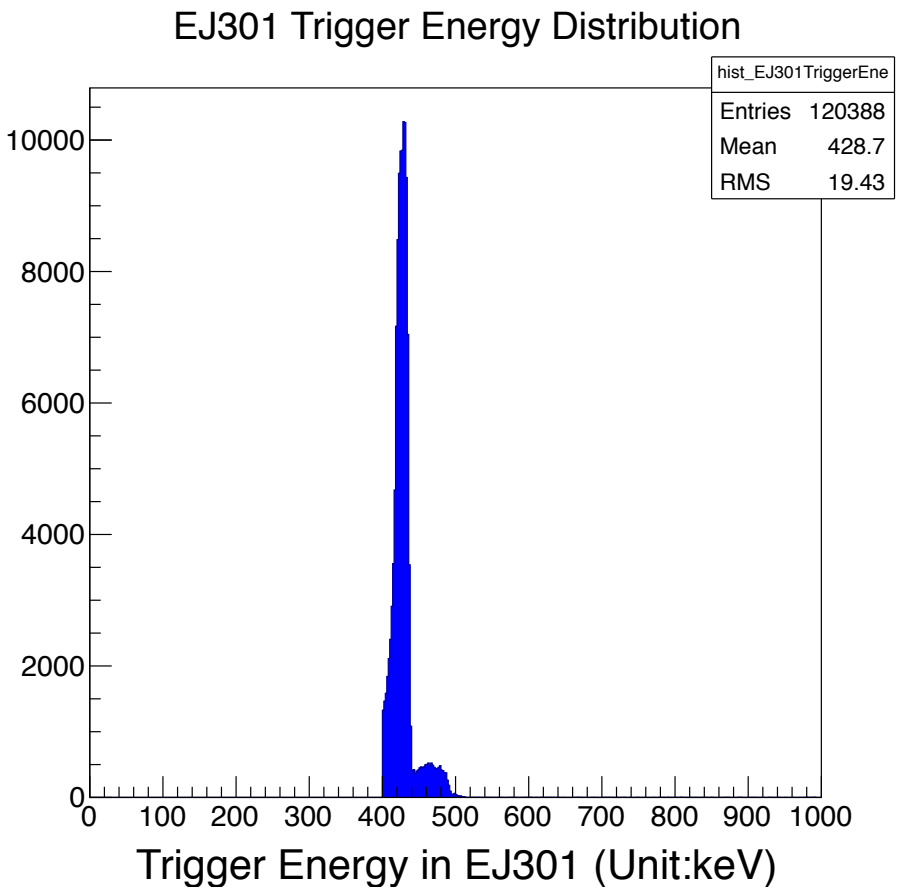
185929 particles (includes neutron and charged particles generated by neutron) passed through either EJ301, 182387 events were triggered. detection efficiency is 98.0%

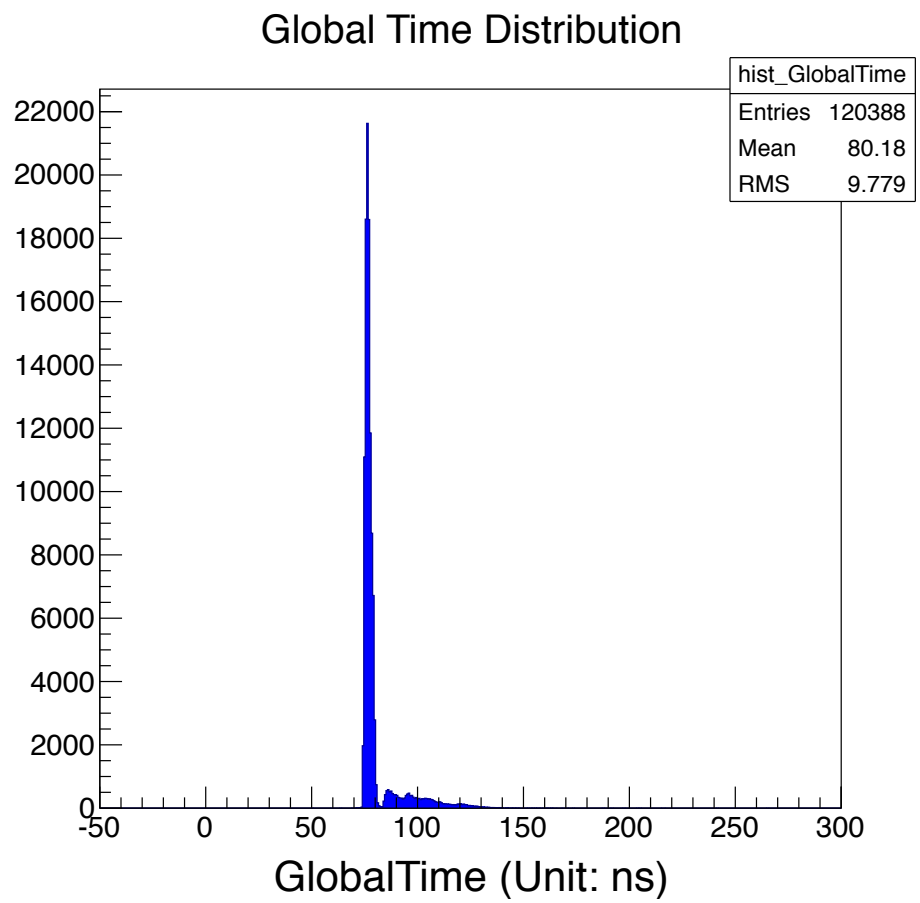
EJ301 Study Case#2 without PE Collimator



Requirement: event triggered in EJ301 by 20keV energy threshold

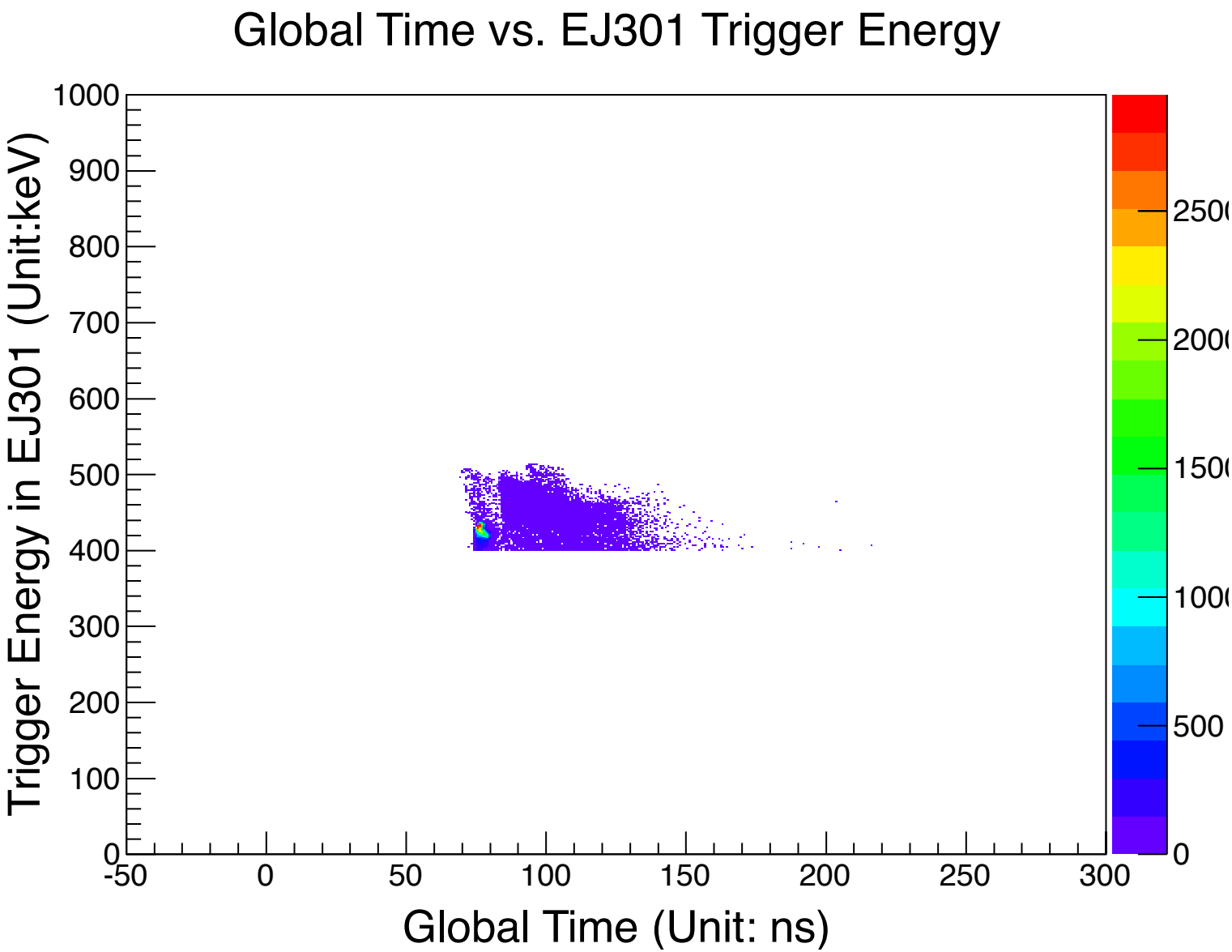
EJ301 Study Case#2 without PE Collimator





Requirement: event triggered in EJ301 by 400keV energy threshold

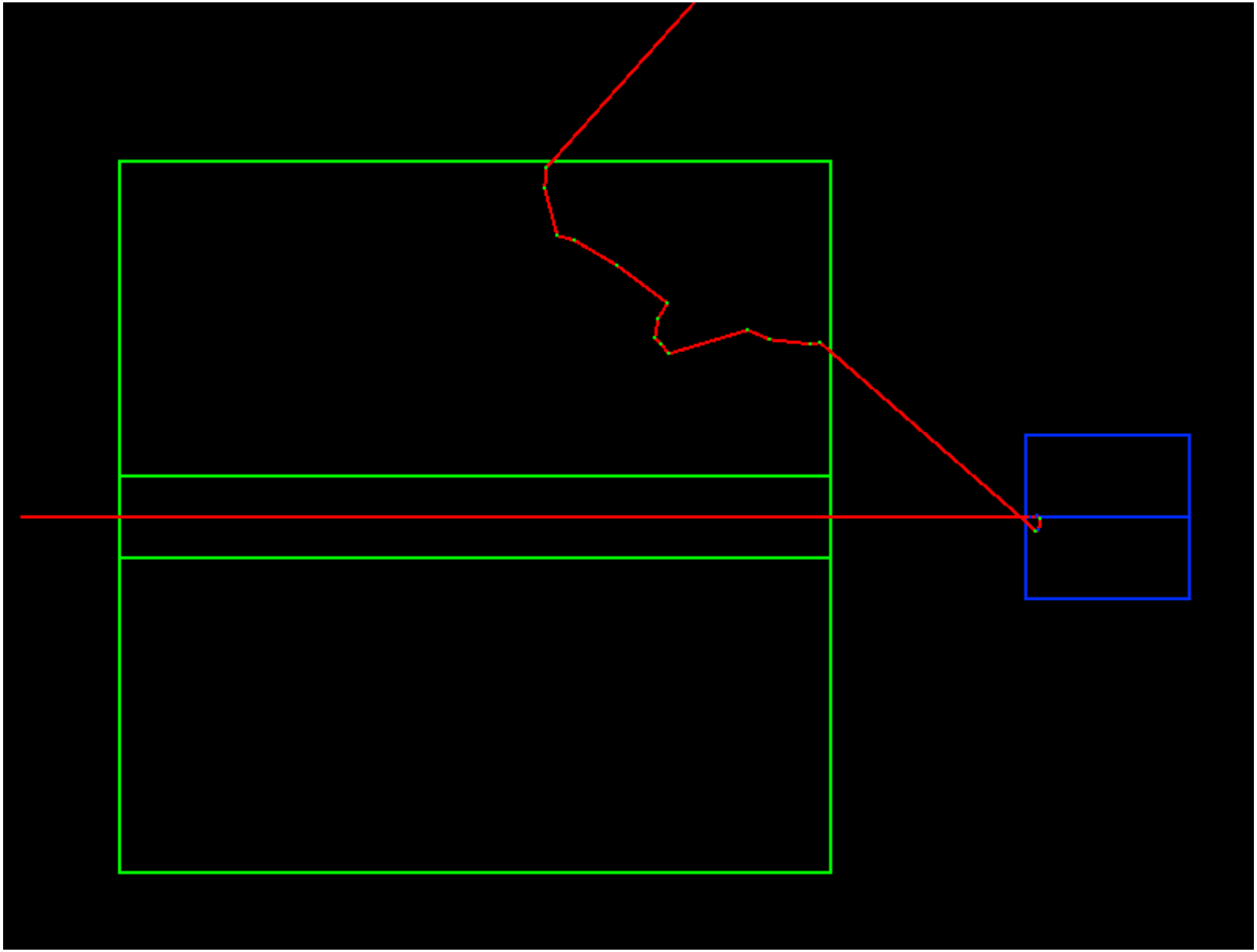
EJ301 Study Case#2 without PE Collimator

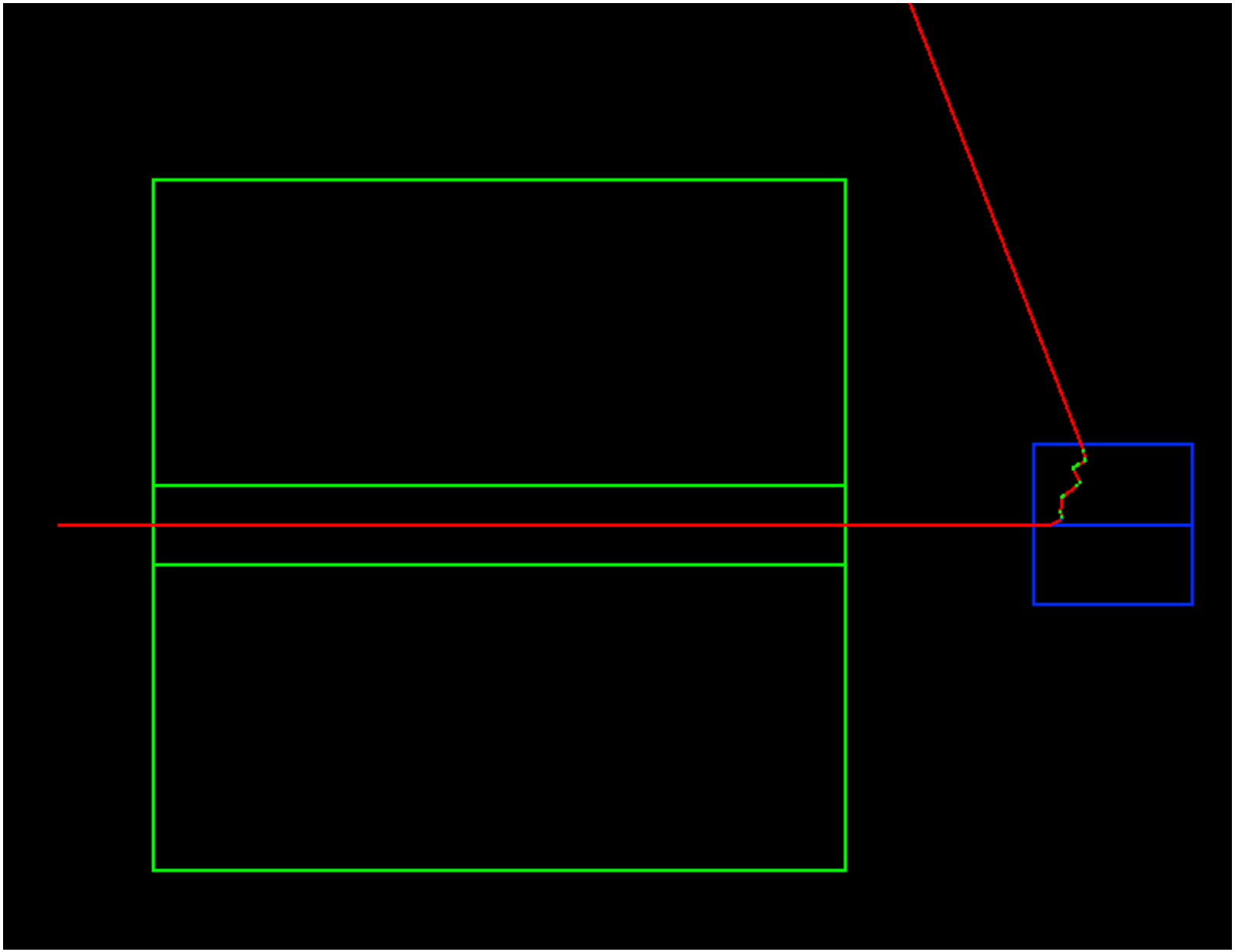


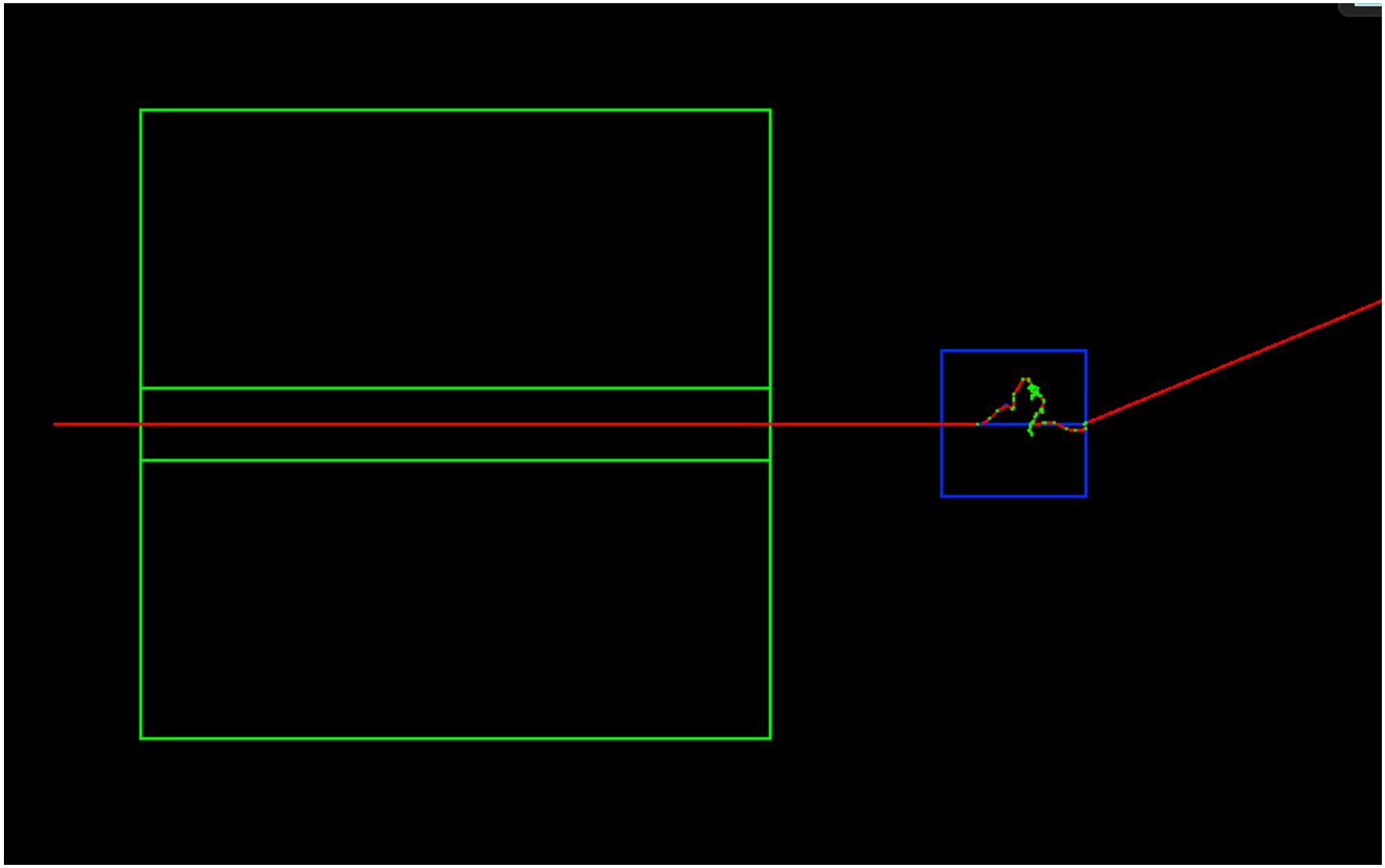
Requirement: event triggered in EJ301 by 400keV energy threshold

Appendix

Section#1 GEANT4 Simulation of Neutron Propagation in EJ301







Some Nuclear Interactions in EJ301 that Explain the Events with Trigger Energy Larger than 520 keV:

2H(d, n)3He
12C(n, p)12B