Anti-Matter Analysis update

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Pre-selection

➤ $E_{dep} > 0.01$ GeV

➤ STK track selection:
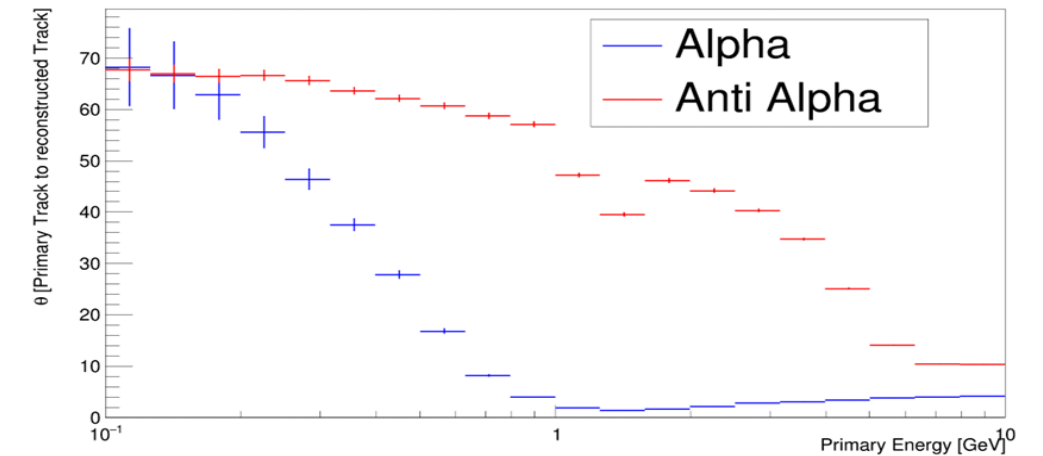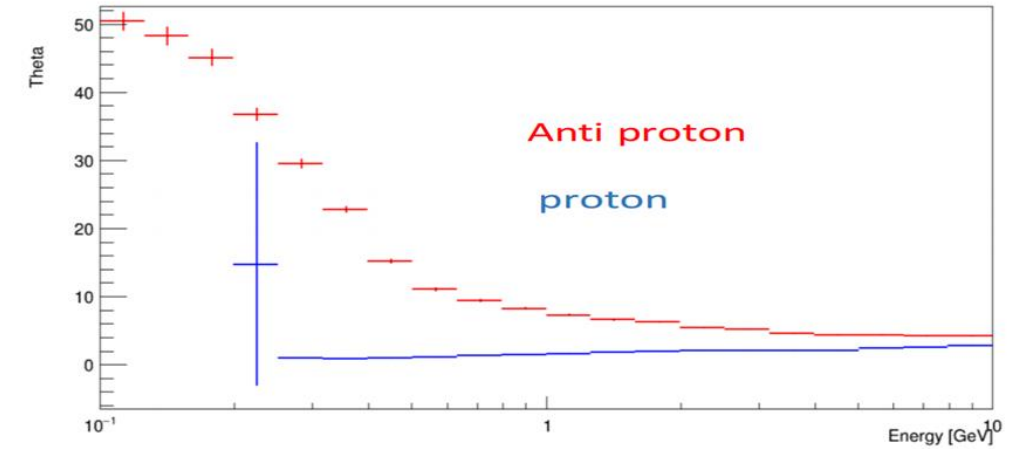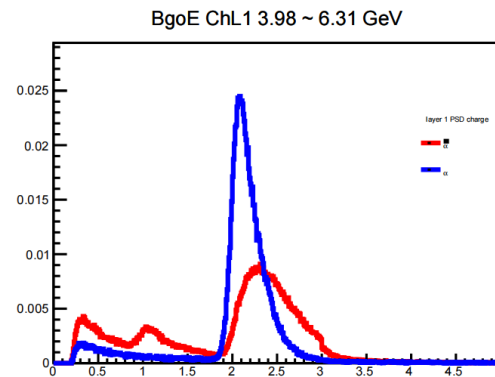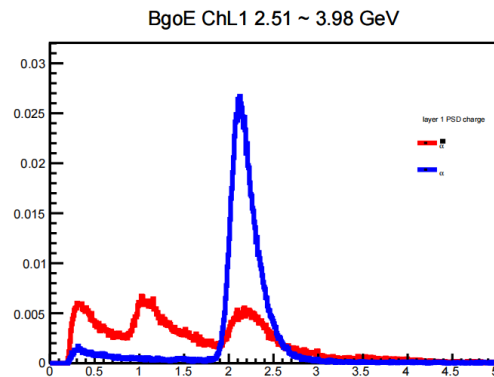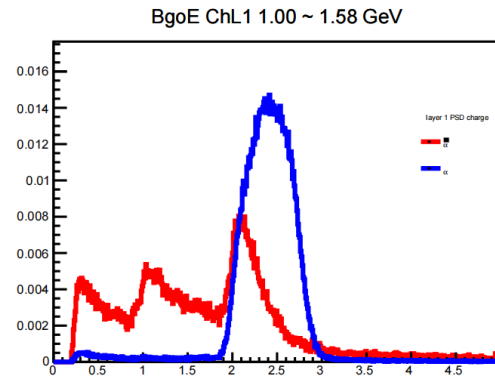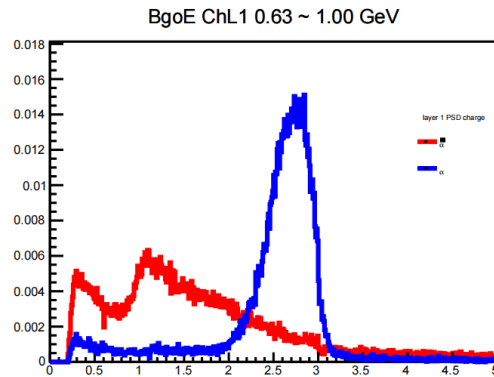
   a) $chi^2/ndf < 50$ `&` Angle to BGO track $< 15°$

   b) Match with MGO shower

   c) Selected the track with max Energy deposition in STK detector

   d) Track Pass PSD top and BGO buttle

➤ PSD selection
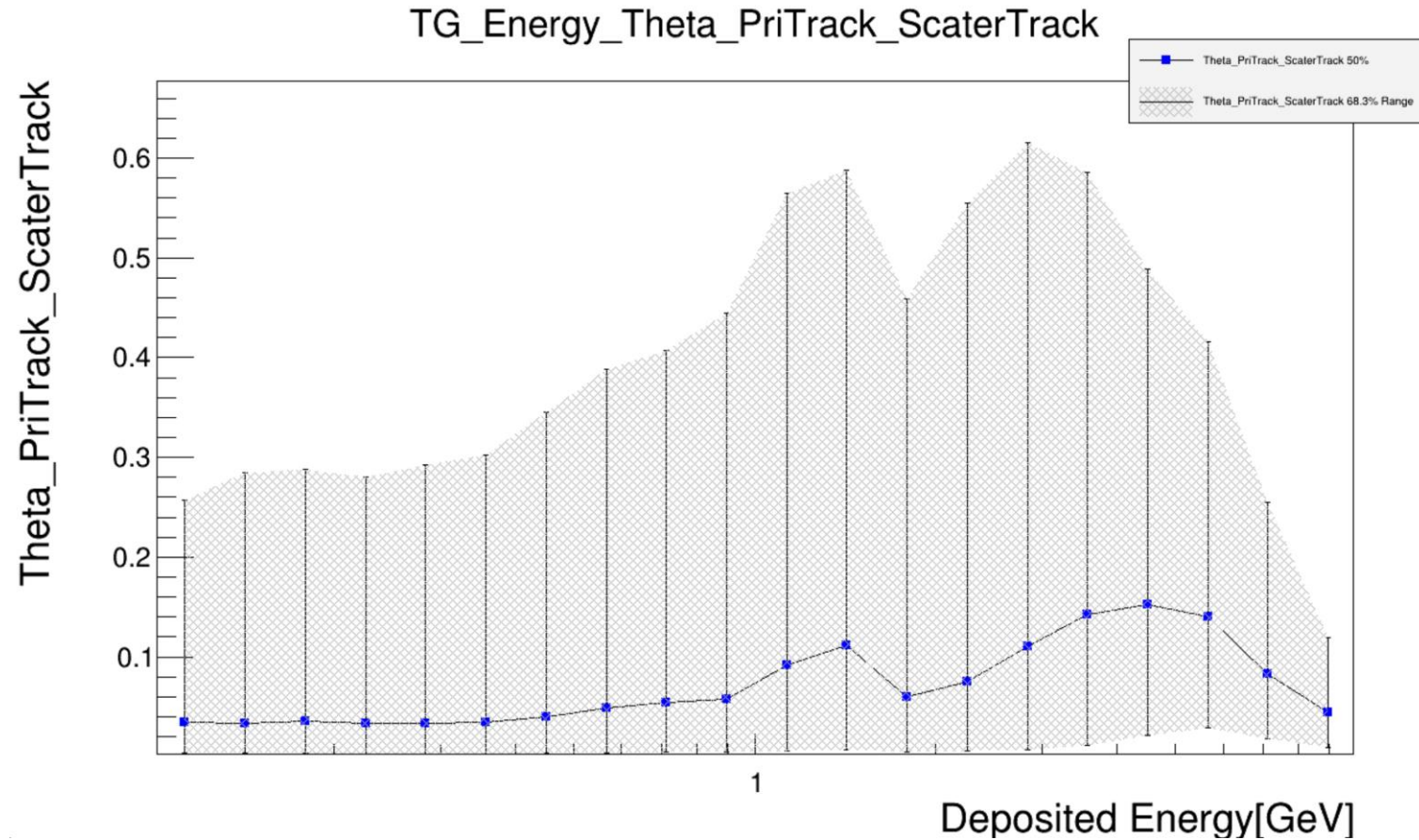
   ①   PASS two layer PSD, $Q_0 < 3 \parallel Q_1 < 3$

   ②
$$Q_i = \begin{cases} \frac{(q_{i1}+q_{i2})}{2}, & for \ \frac{|q_{i1}-q_{i2}|}{Max\{q_{i1},q_{i2}\}} < 0.1 \\ Max\{q_{i1}, q_{i2}\}, & for \ \frac{|q_{i1}-q_{i2}|}{Max\{q_{i1},q_{i2}\}} > 0.1 \end{cases} \quad , \quad i = 0 \text{ or } 1$$

PSDQ1 between Anti-Helium and Helium

The errors from the previous report can be found in the previous presentation (indico.pmo.ac.cn/event/689/).
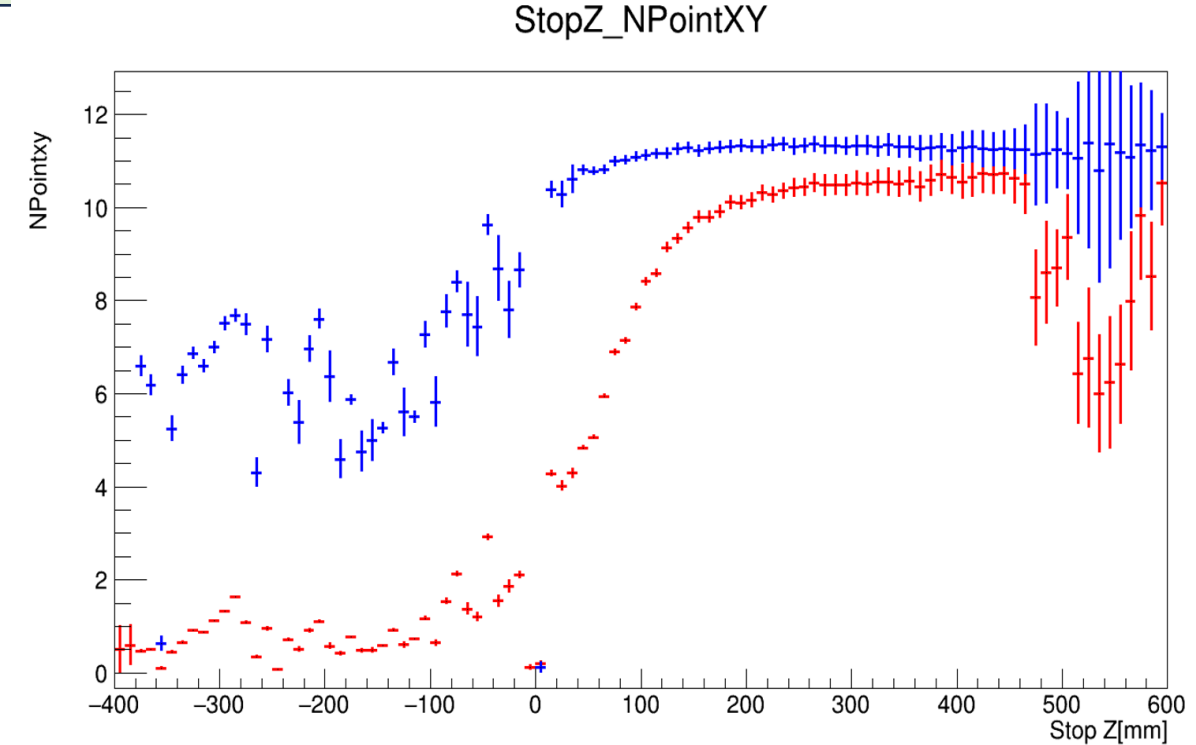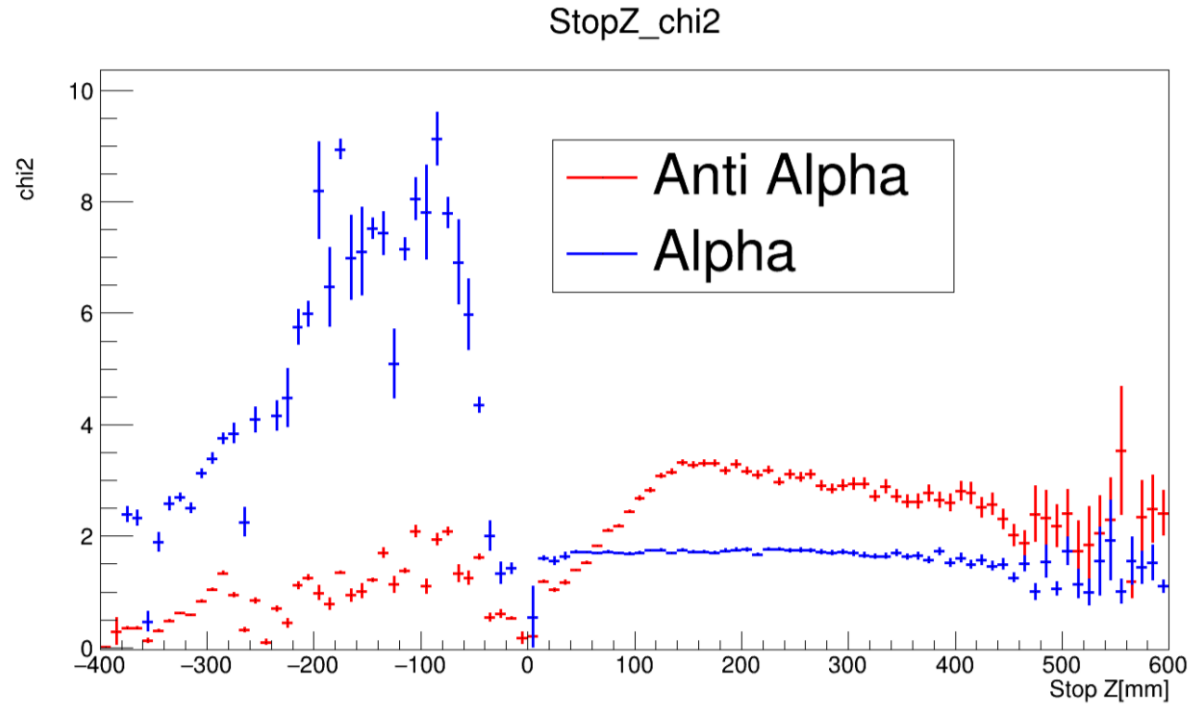
Primary track to Scatter Track

TG_Energy_Theta_PriTrack_ScaterTrack

Scatter Track = Stop Position – Start Position

Angle between Primary track and the actual track before the first non-elastic scattering.

Errors in the previous :
1) Use BGO tracks
2) Not Consider triggering conditions.

Chi2 VS Stop-Z

The previous analysis inadvertently employed the BGO track, resulting in the selection of particles undergoing fragmentation in both the PSD and STK. However, during the computation of track chi2 and Hits Point, these particles did not contribute, causing a decrease in the calculated average values of these quantities.

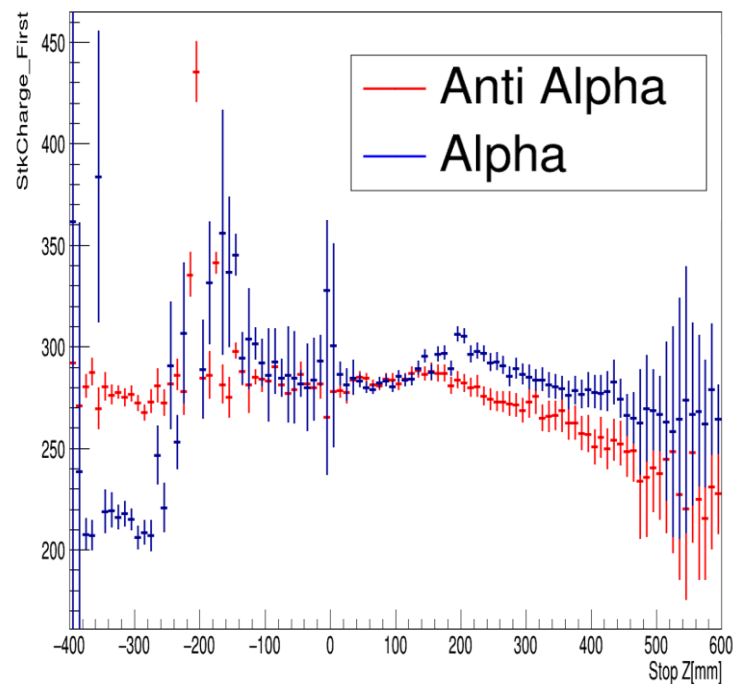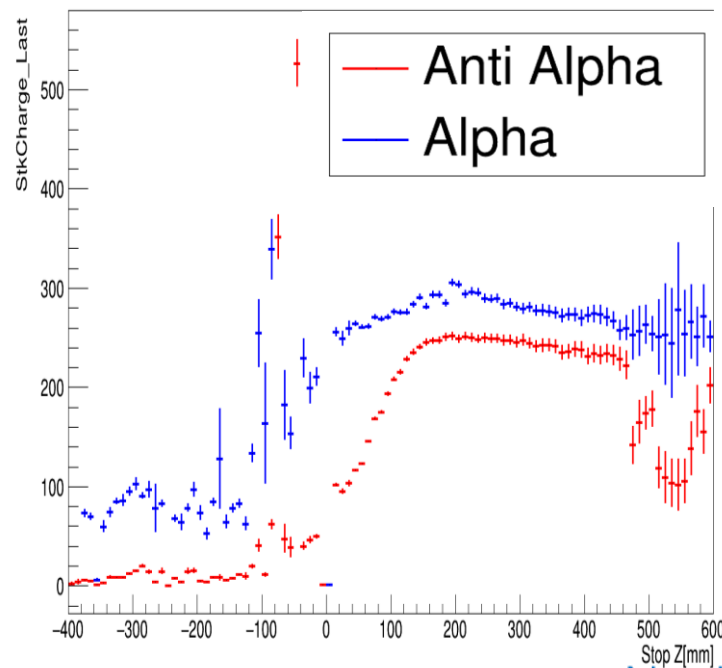# Angle (Reconstructed to Primary) VS Stop-Z
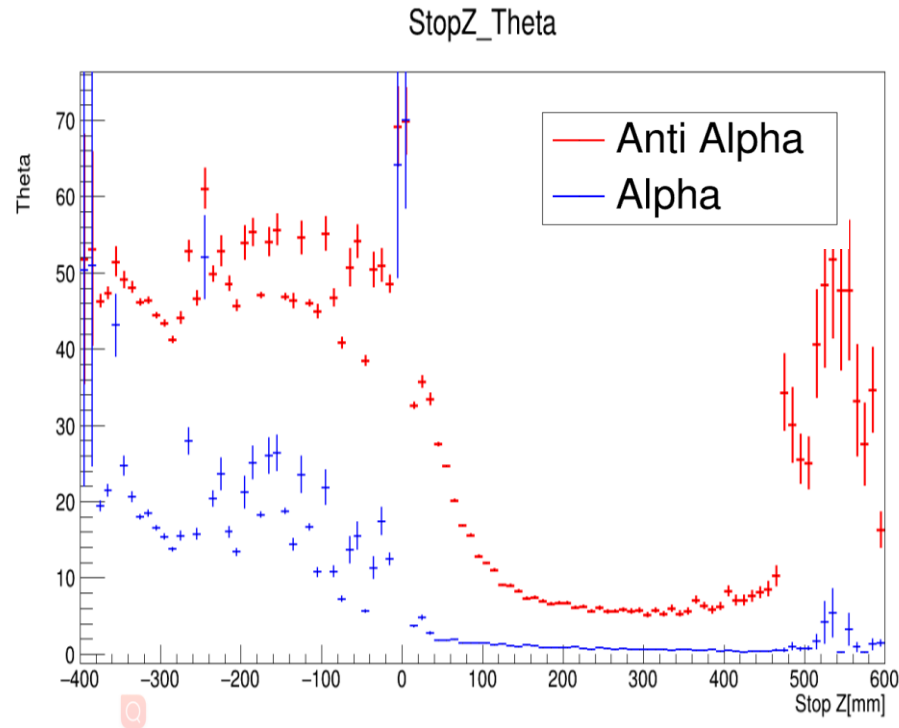
Not Use BGO Track
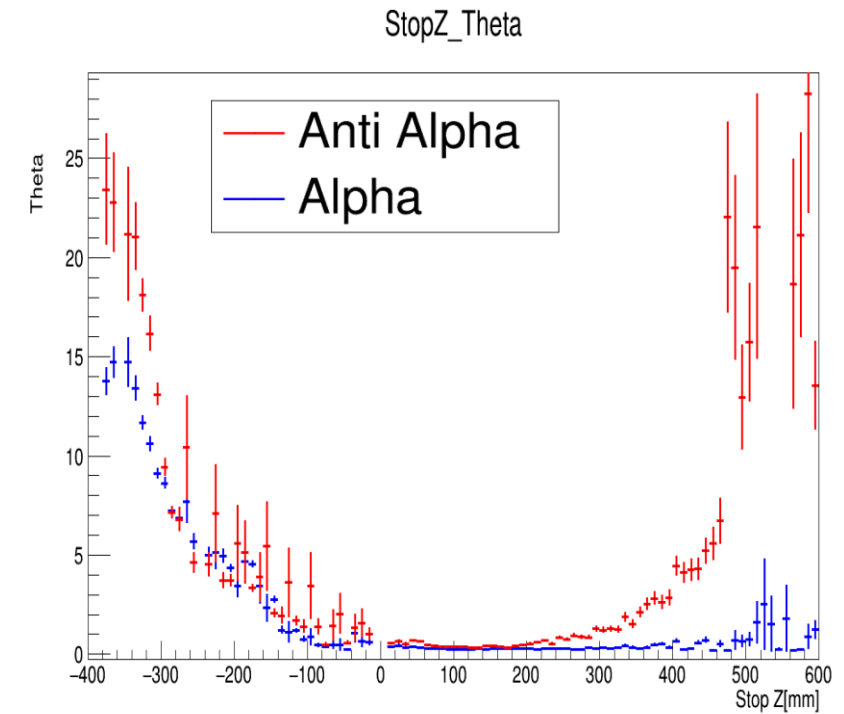
After excluding particles using the BGO track, there is a noticeable reduction in the angle.
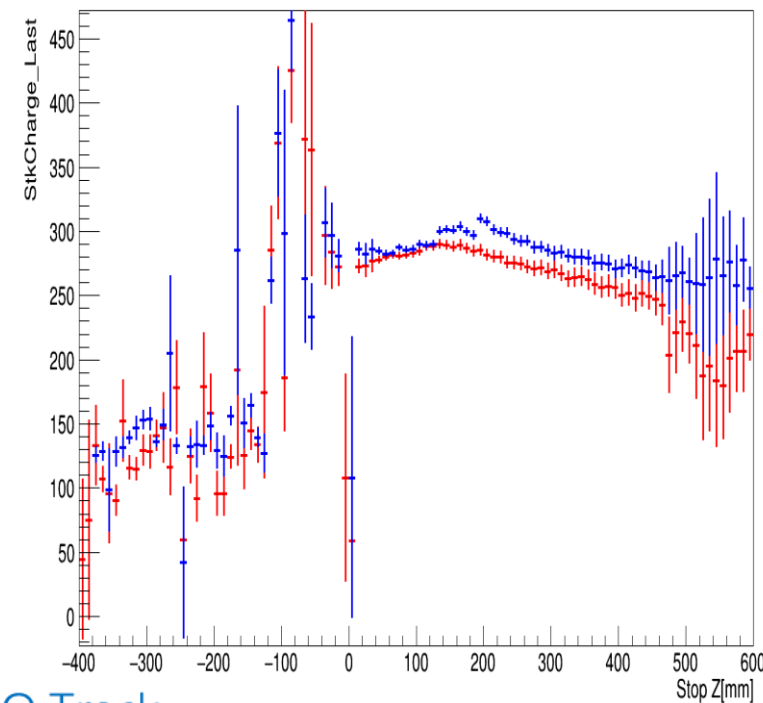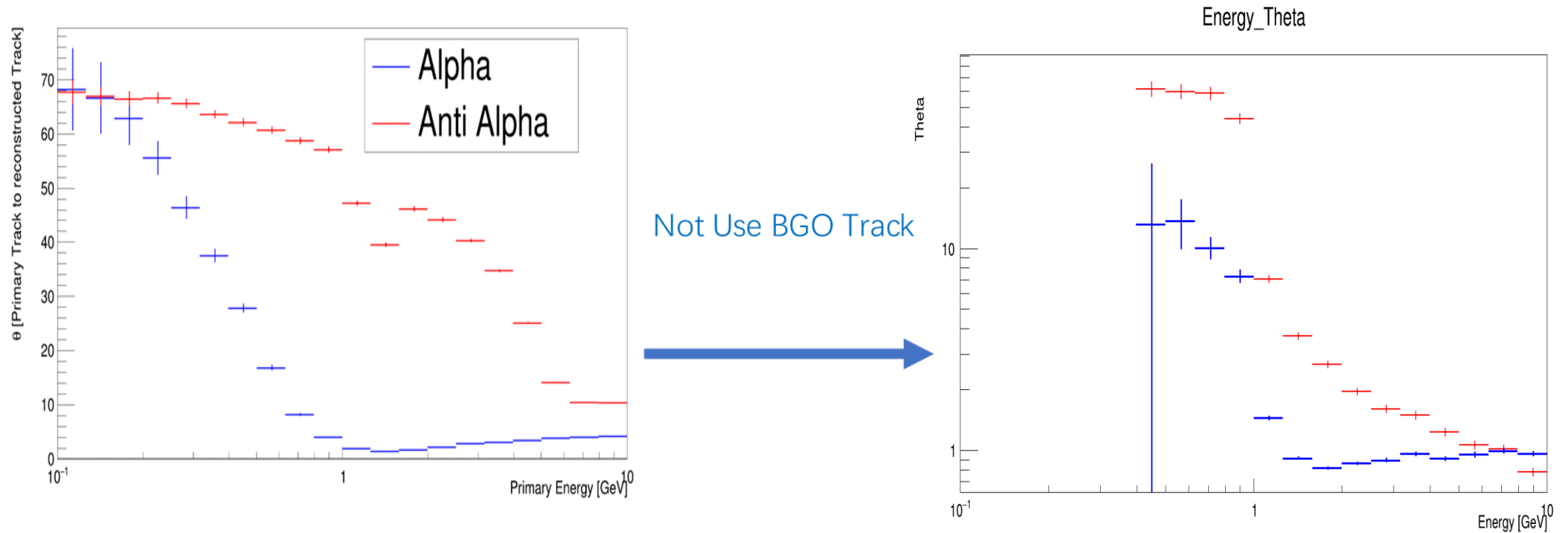
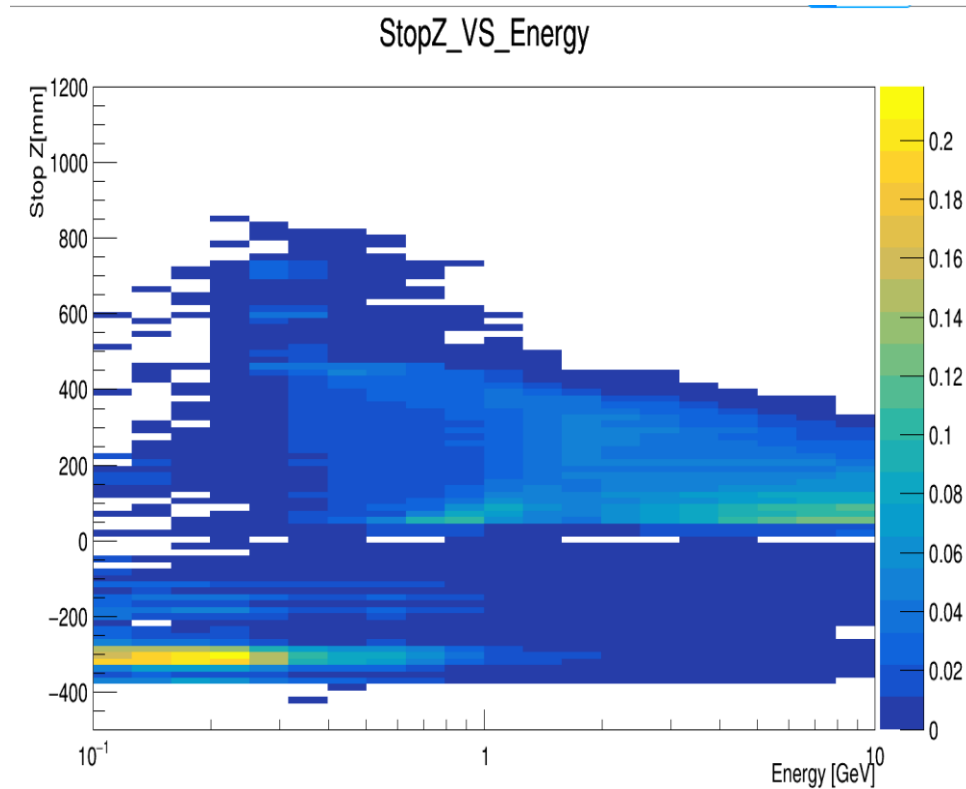# STK charge[-1] VS Stop-Z

Not Use BGO Track

After excluding the BGO tracks, there is a noticeable increase in the readout of the charge in the final layer of the STK.
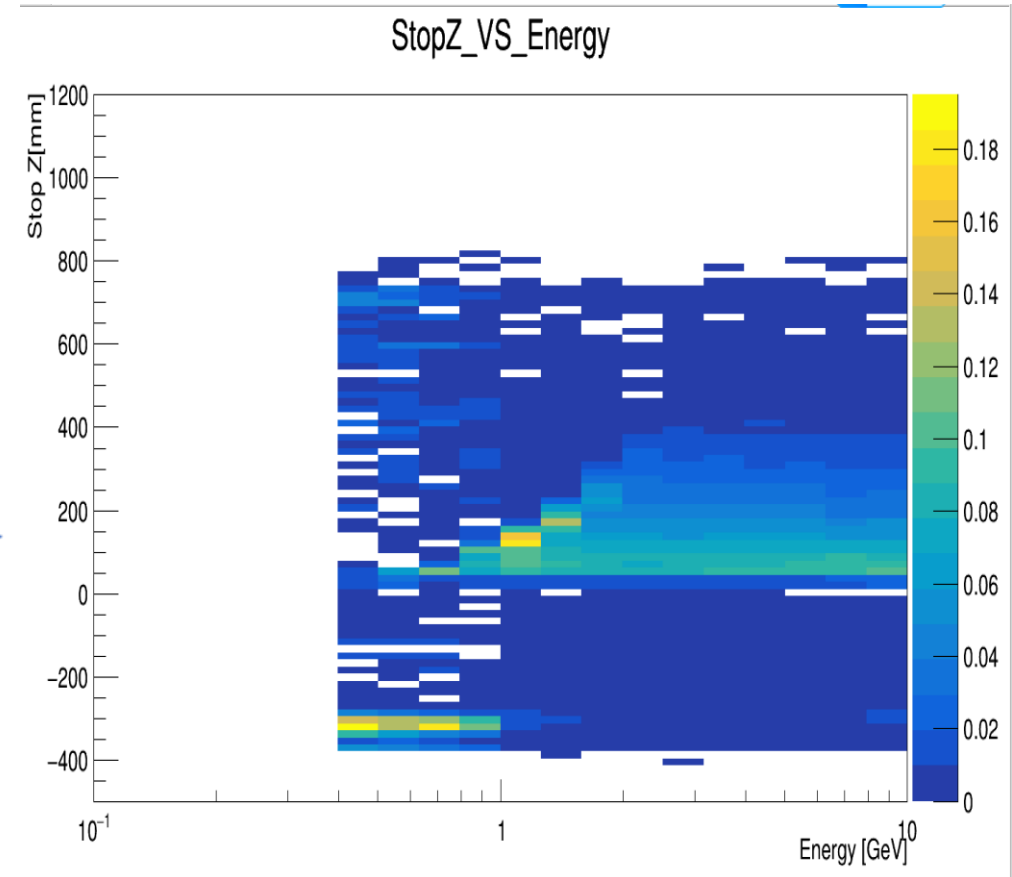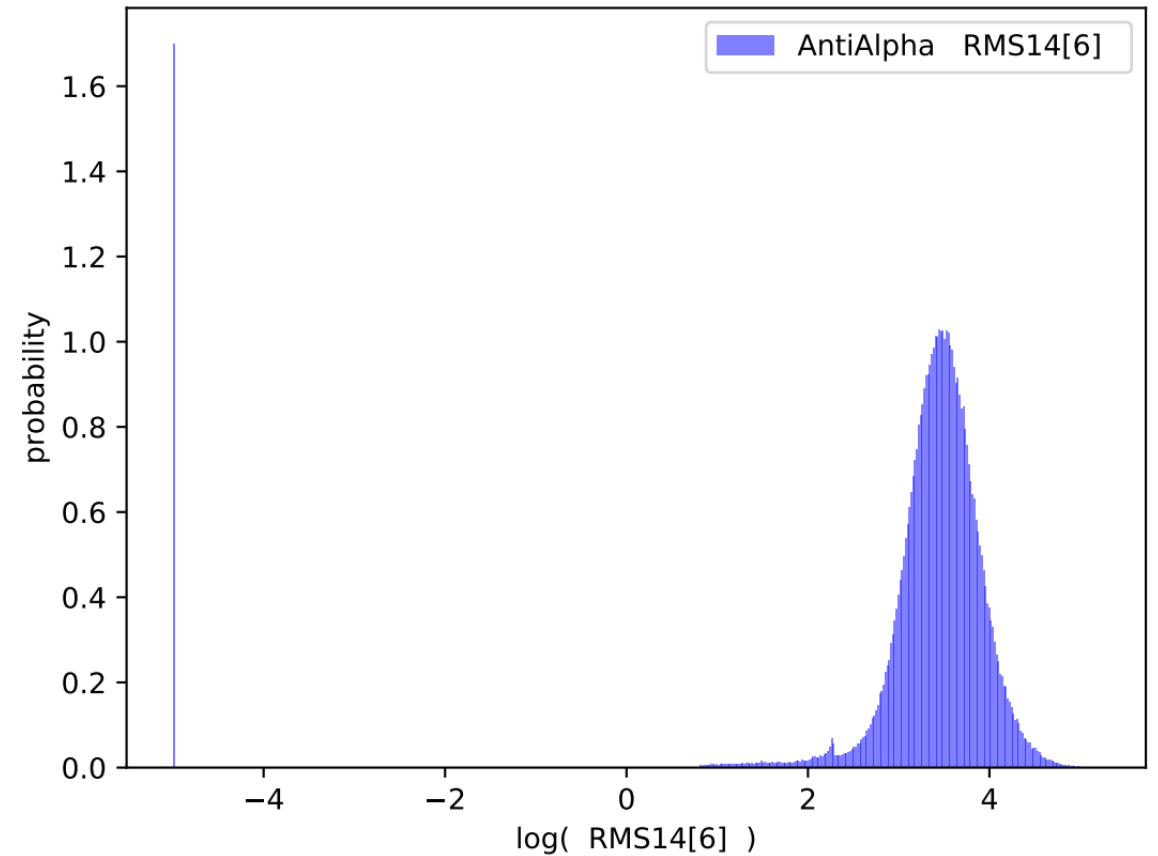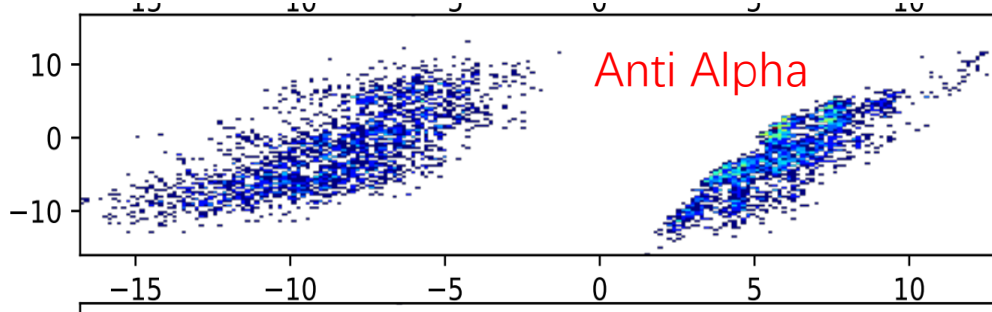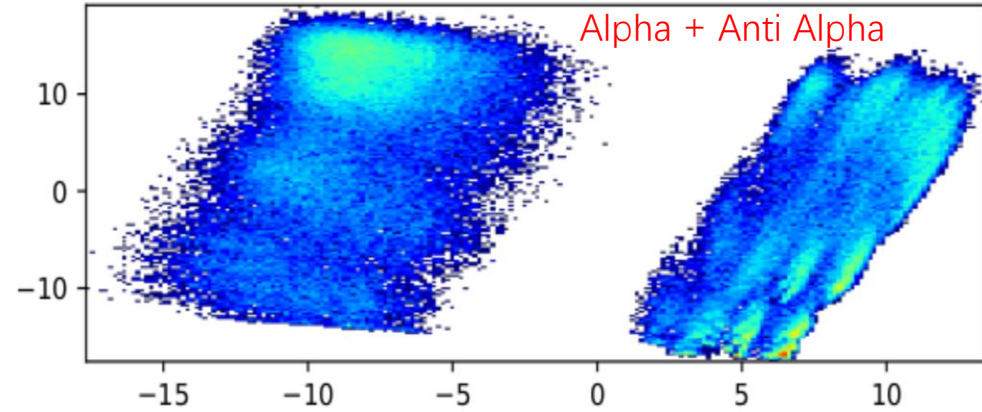
Primary track to reconstructed Track

Not Use BGO Track

Stop-Z VS Energy

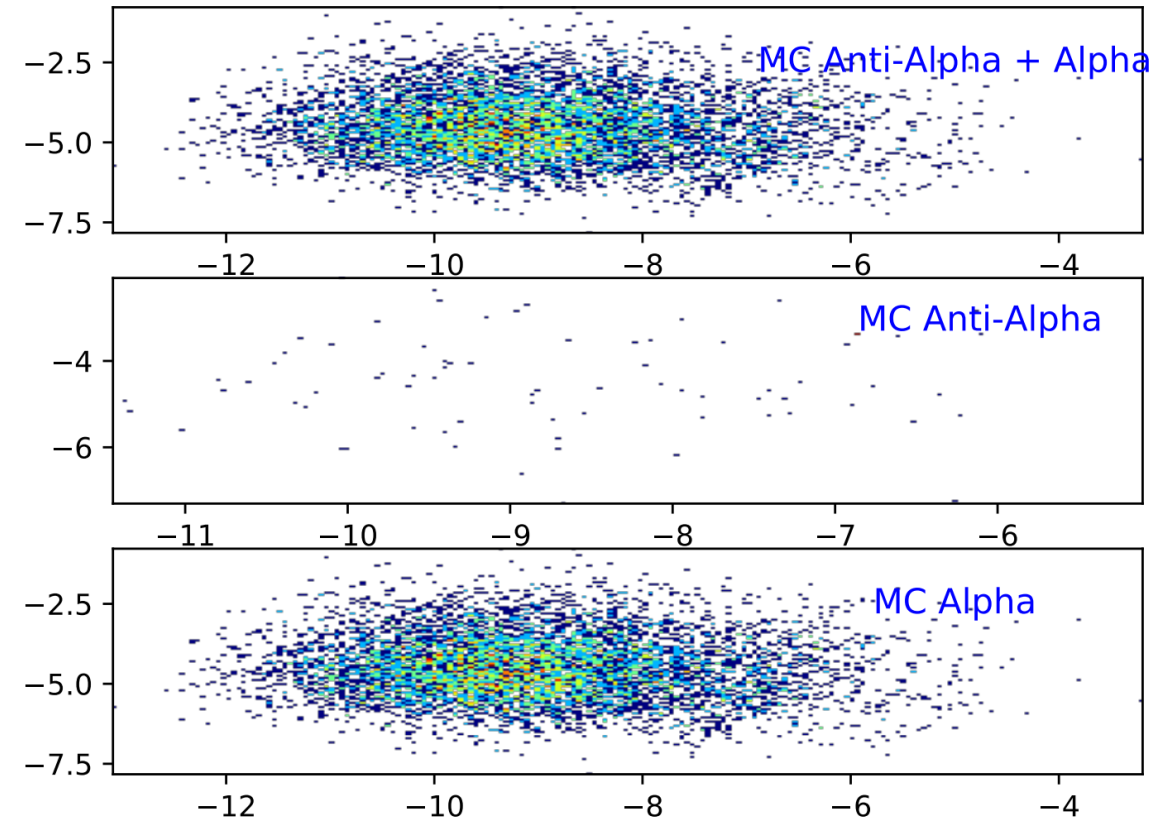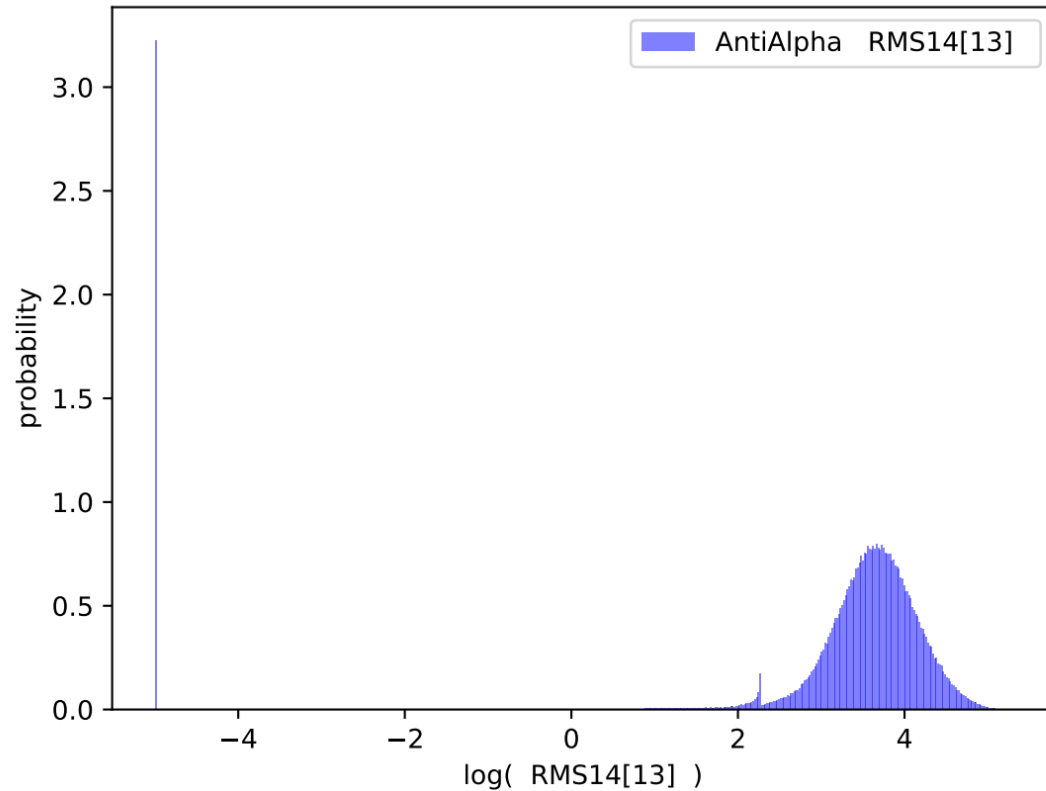
An additional selection condition: STK Charge[-1] > 1.5.
However, this significantly reduces our statistical sample size.

PCA result (Similar to previous e/p)

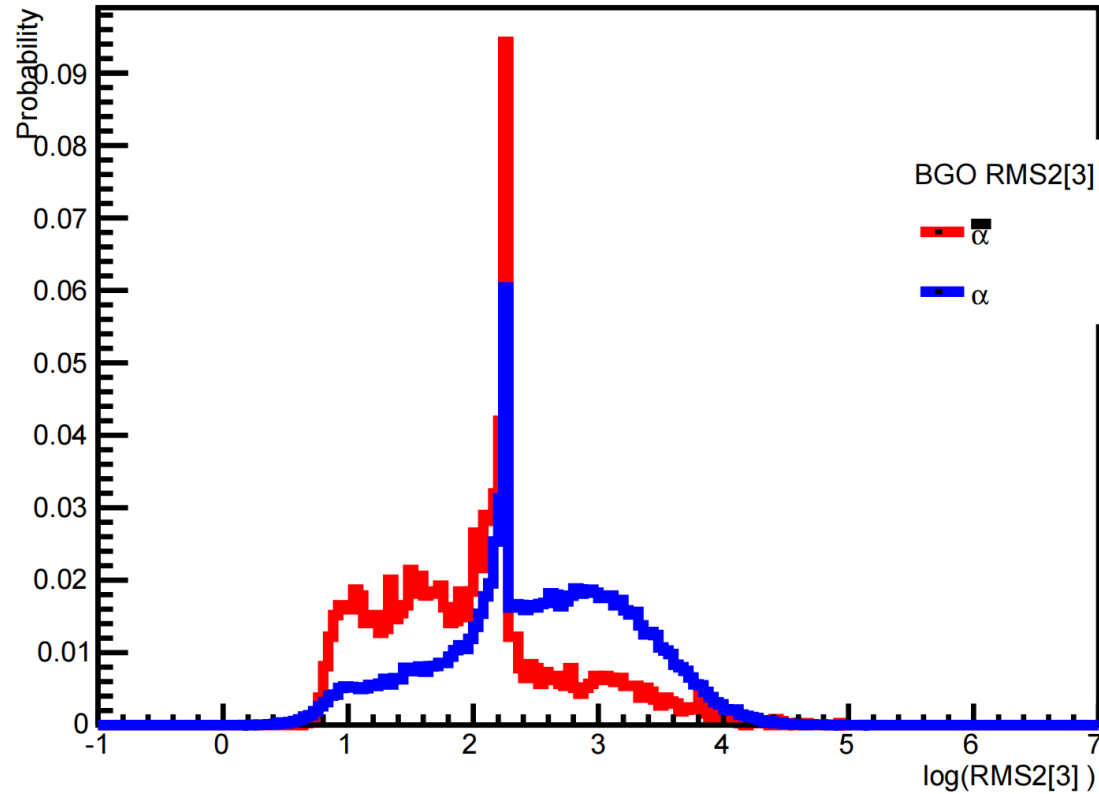Alpha + Anti Alpha

Anti Alpha

PCA result (exclude RMS2[i]==0)

After excluding particles of the type RMS2[i]==0, the statistical count significantly decreased, rendering the analysis infeasible.
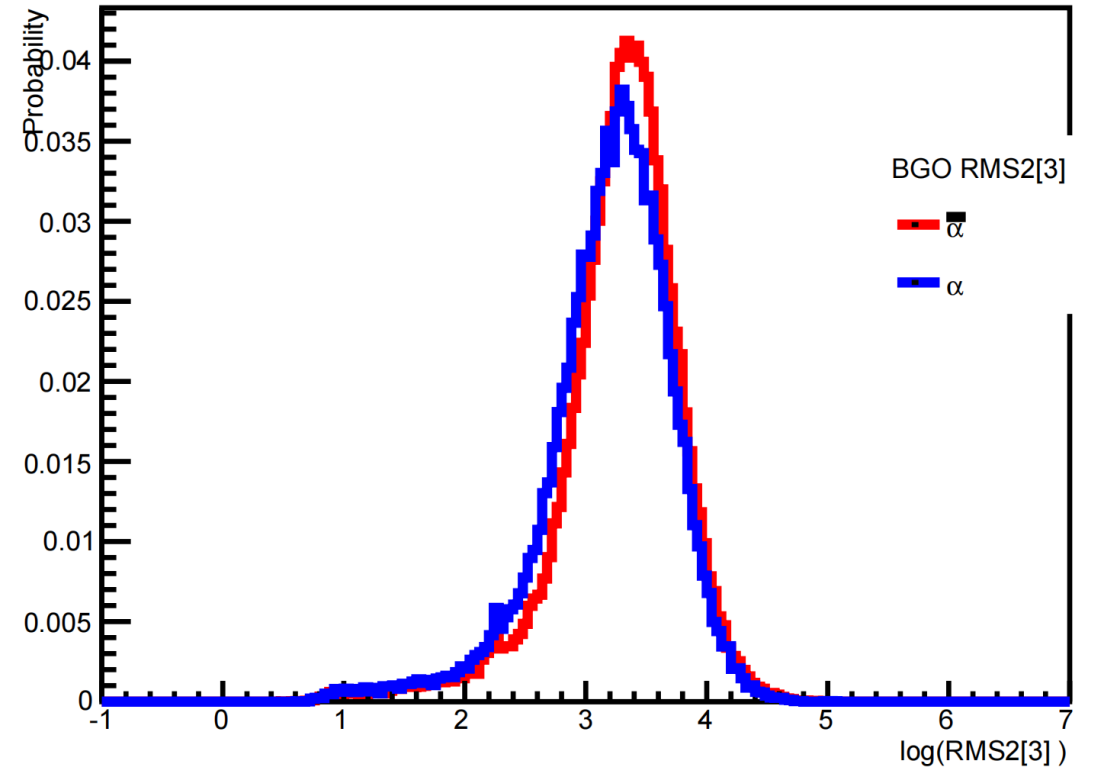We assigned these RMS2[i]==0 values to the minimum non-zero RMS2 value.

RMS2 in low Enrgy

Character value after Correction
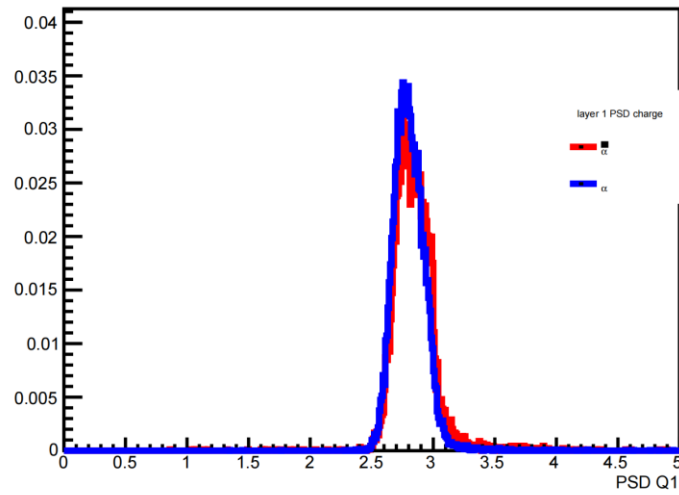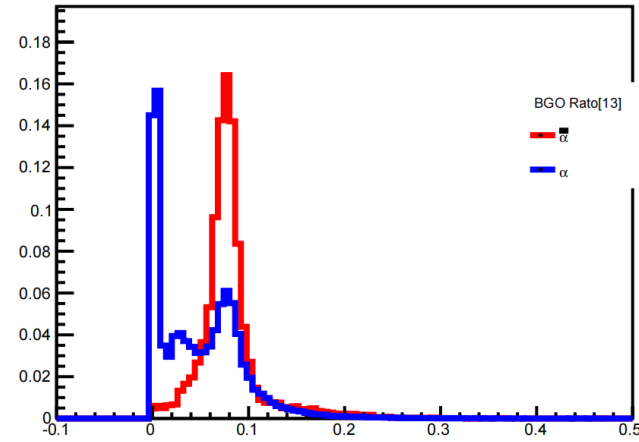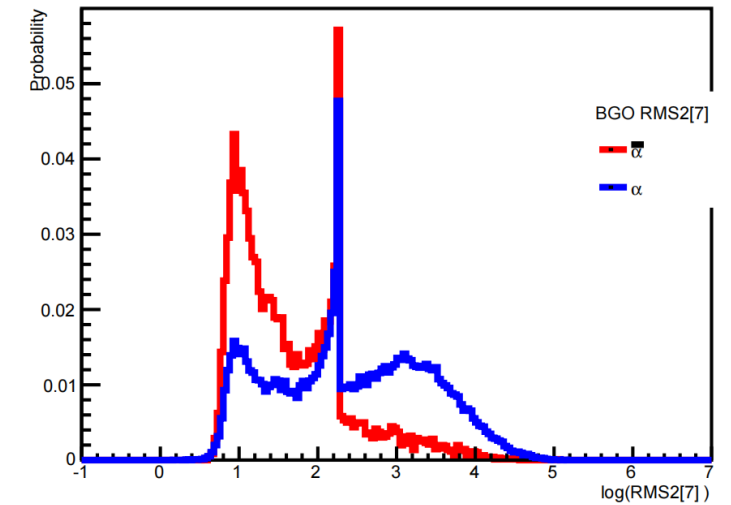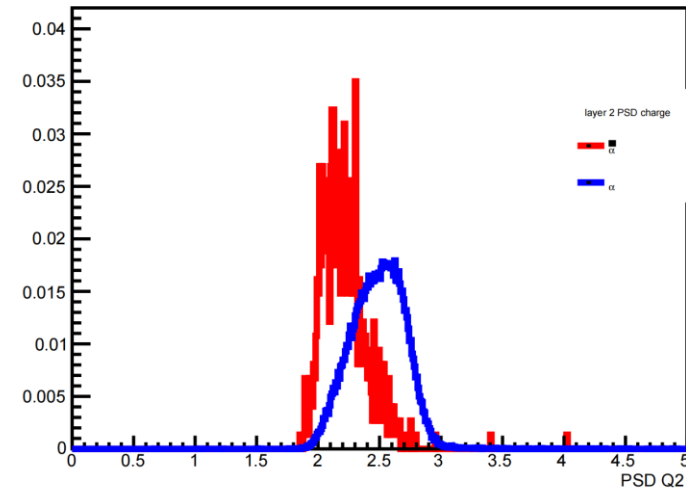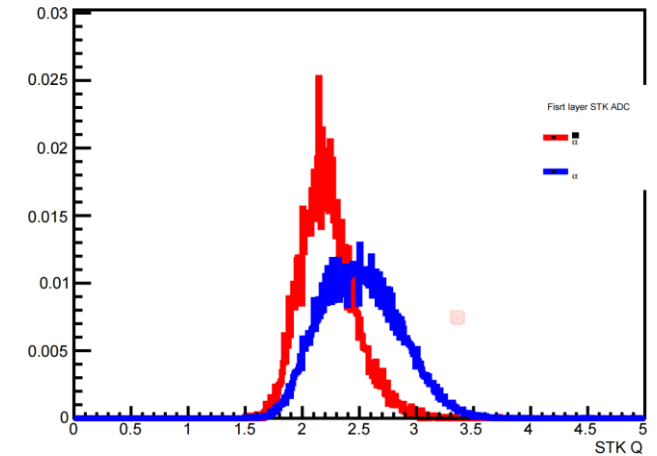
AntiProton MaxEnergy Bar and Stop position
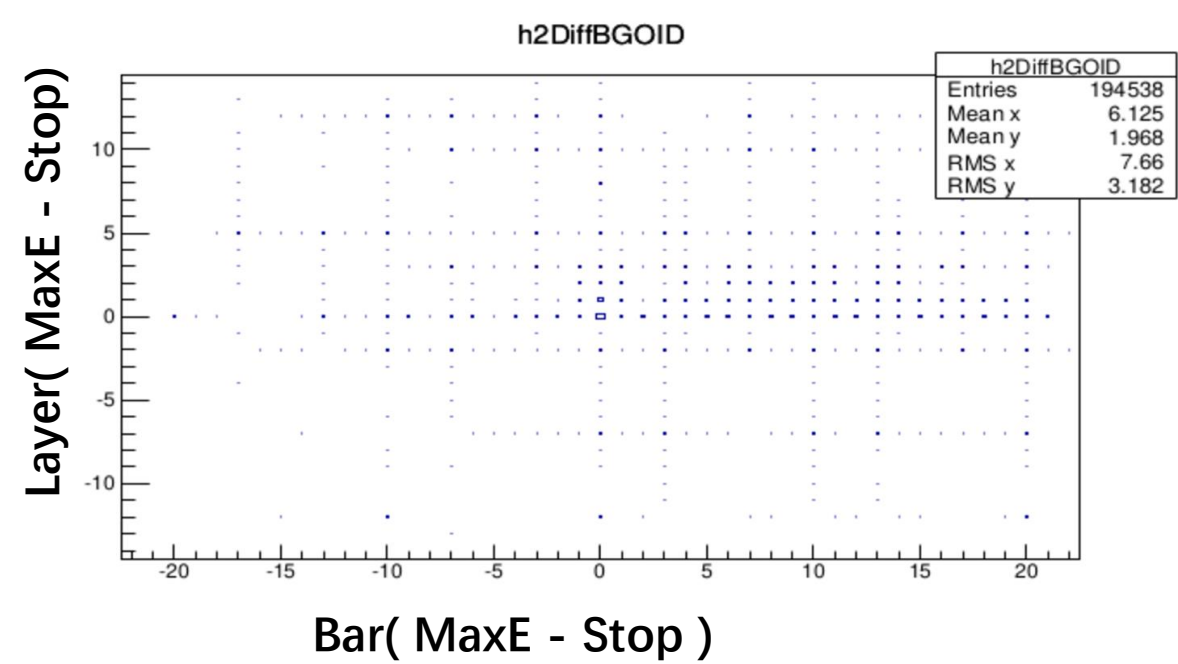
When constraining Stop_Z within the BGO detector, a statistical analysis reveals that in many cases, there is inconsistency between the MaxE's Bar and Stop_Z's Bar. In the vast majority of cases, MaxE's Bar is located 1-3 layers below StopZ's Bar.
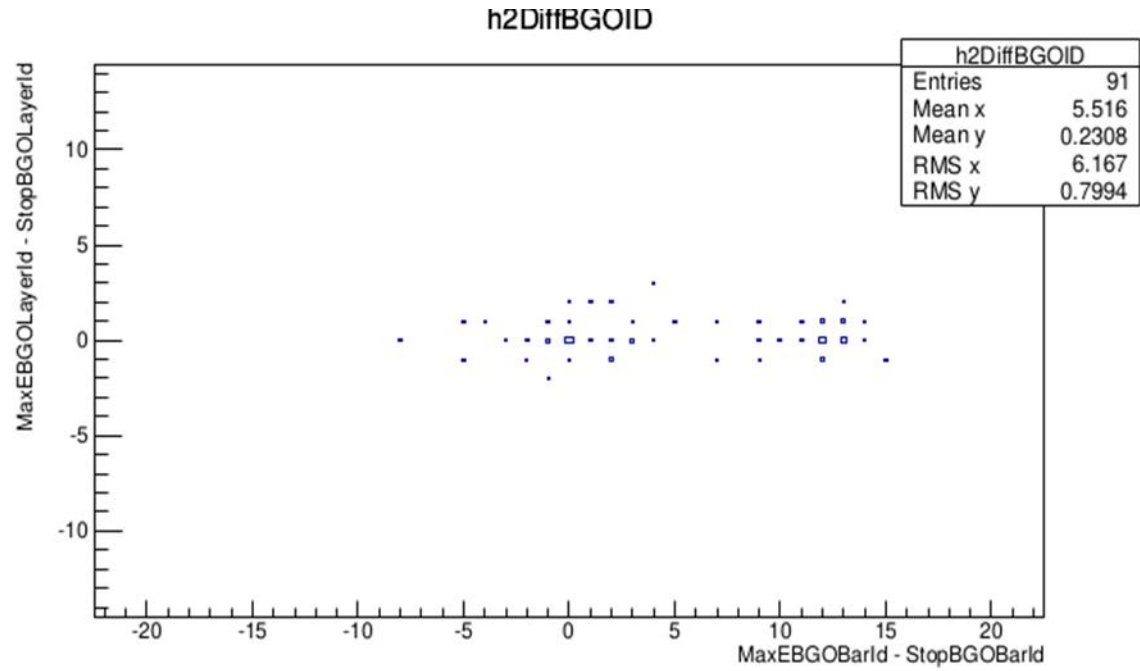
Continuing the validation of previous analyses with new simulated data: a spherical source with a radius of 10cm is simulated within the BGO, with particle kinetic energy close to zero. The findings align with our expectations.

Summary

➢More statistical data is needed.

➢Identified a bug in the RMS2 readout.

➢Further research on algorithms to distinguish anti-helium nuclei is ongoing.

Thanks