Vernier Analysis Update

Run 12

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May 18, 2016

UC Riverside

Outline

Analysis Overview

Analysis Overview

Data Extraction	Correlation and Calculation	Systematic Corrections	Cleaning Data
PRDF ➢ GL1P Scalers ➢ Bunch Numbers ➢ Scaler Events ➢ Trigger Scalers ➢ Time Stamp ➢ ATP Number **WCM/DCCT** ➢ Individual bunch populations, blue and yellow beams ➢ Total beam ion population (bunched + not bunched) ➢ Time stamp **BPM** ➢ Beam position (x,y) for blue and yellow beams at sector 7 and 8	**PRDF** ➢ Calculate scaler rates ➢ Correct scaler rates for live-time fluctuation (use clock-scaler if available, scaler-events if not) ➢ Calculate systematic, statistical errors associated with constant-beam-position scaler rates ➢ Correlate beam displacement & rates, fit distribution for beam width **WCM/DCCT** ➢ Calculate corrected beam populations using WCM/DCCT **BPM** ➢ Use BPM data to identify absolute time for constant-beam-position-steps	**Simulation** ➢ Hourglass effect / Crossing Angle **PRDF** ➢ Use time synchronization to correct for rate losses due to ion loss in real time ➢ BBC Efficiency (trigger acceptance + vertex correction) **WCM/DCCT** ➢ Rate correction (overall correction done, but correlation is better) **BPM** ➢ Use average RMS of fluctuation of beam position about each step average to assign systematic ➢ Additional systematics from magnet current ➢ Discussion with Angelika – is BPM data even viable, or should we use programmed step values? (Try both, compare results)	**PRDF** ➢ Synchronize network time stamps from ATPs ➢ Separate data into bunches, and bunch integrate ➢ Sum scalers down to single time stamps **WCM/DCCT** ➢ Data is ready to use, ensure synchronization to PRDF time stamp **BPM** ➢ Data is ready to use, ensure synchronization to time stamps

From Last Time

From Last Time

- Discussed timeline, concerns with convergence
- Link to last talk: Last Talk or direct URL: https://www.phenix.bnl.gov/cdsagenda/askArchive.php?base=agenda&categ=a16198&id=a16198s1t80/moreinfo

From Last Time

Homework: Investigate convergence of simulations

Progress: Hand tuning solves the issue

Progress

Root Finding And Simulation Convergence

- **Requirements:**
  - Well-behaved search domain
  - Clear global minimum in convergence test
- **Realizations:**
  - With χ^2 test and residual test, there are many local minima, not one strong global minima
  - Beam displacement measurement has unaccounted for uncertainty
  - BBC Rate differences caused by beam displacement, not luminosity loss, which was shown to be on order of 1% previously.
  - Allow beam displacement to vary within uncertainty, obtain better results.

BBC Rate, Run 360879

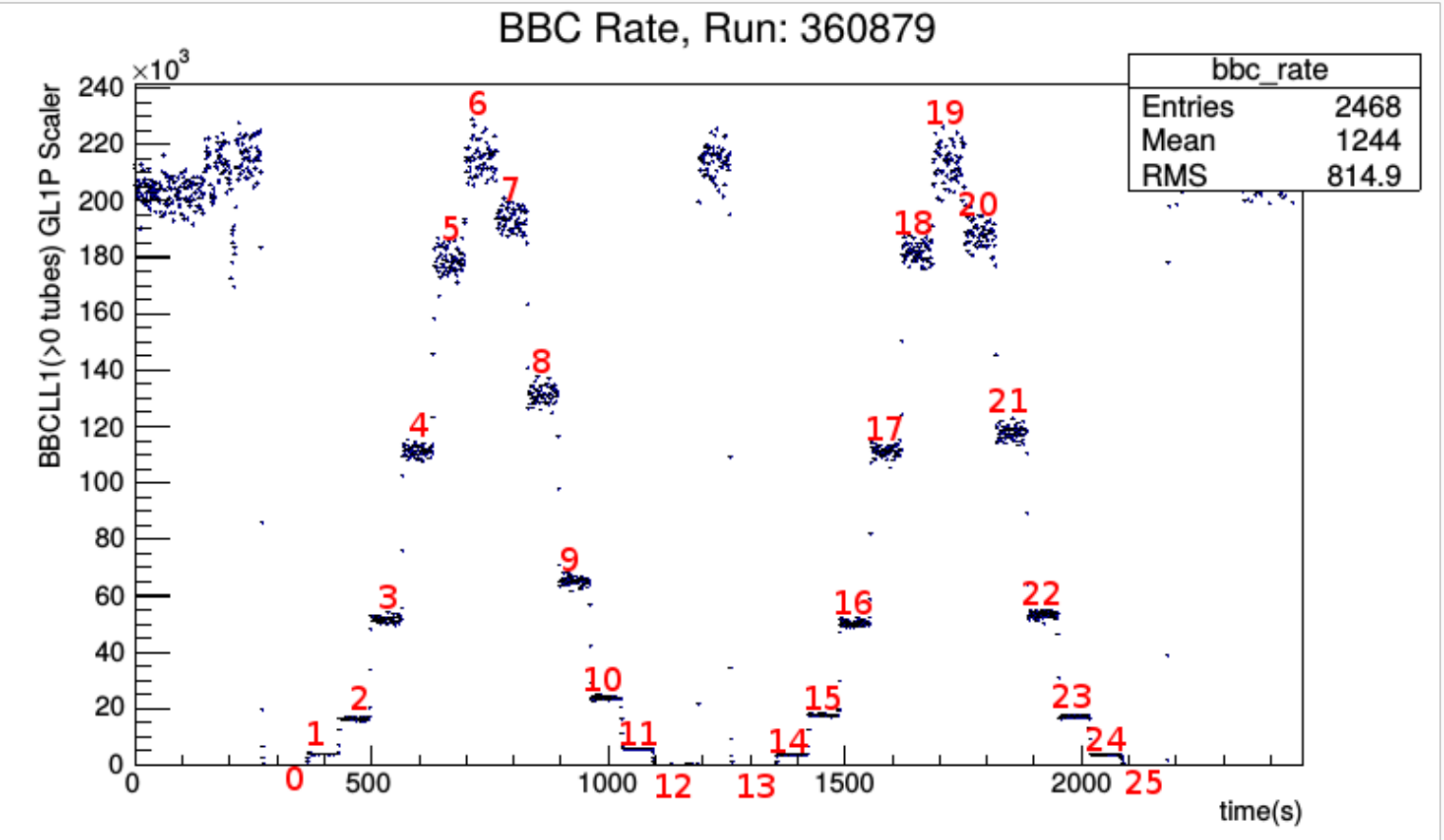
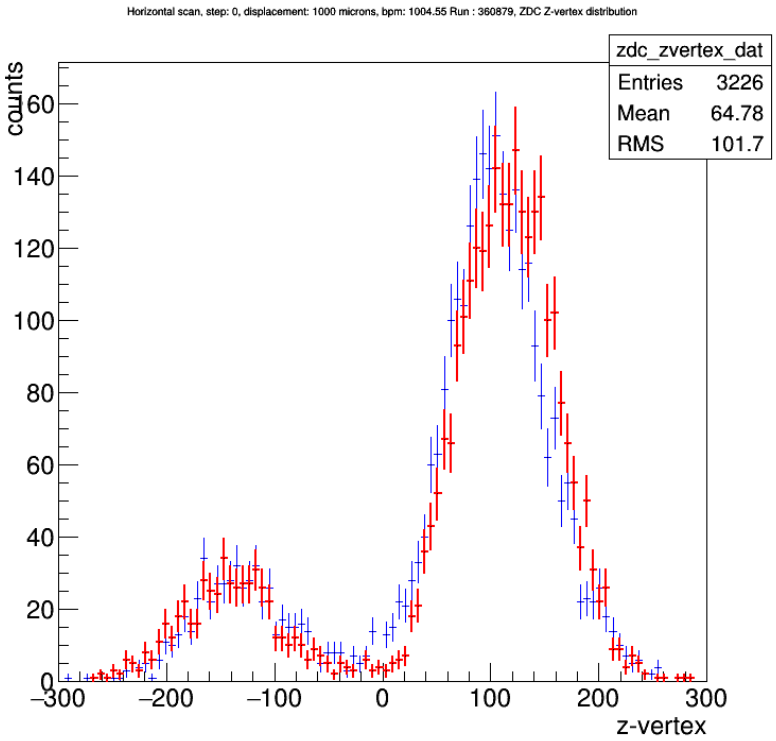


Figure 1: Rates hint that beam displacement is not consistent. See difference between step 5 and 7. Small deviations in displacement have a large effect on the observed z-vertex profile.

Results From Tuning - Horizontal Scan

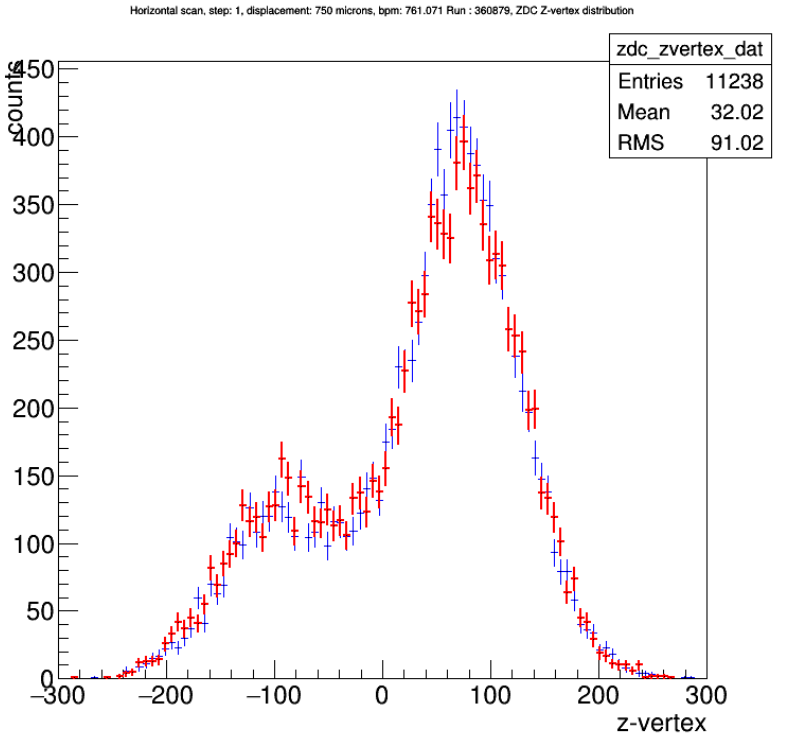
Step 0

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 83.198731
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ 0.000163
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.000813
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET -0.100455
Y_OFFSET 0
ZDC_COUNTS 3226
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_0
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



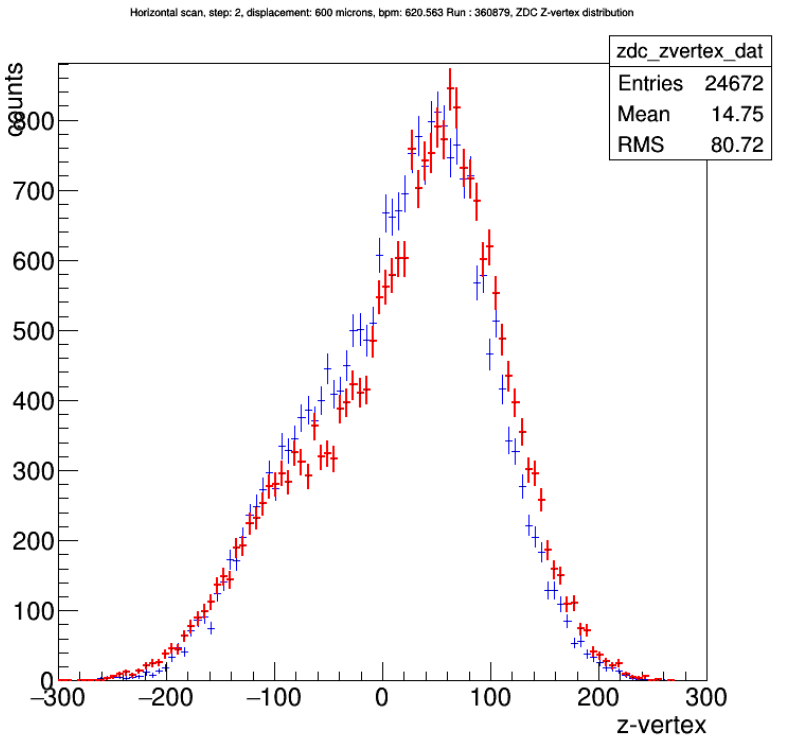
Step 1

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 85.688965
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ 0.000150
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.012142
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET -0.06
Y_OFFSET 0
ZDC_COUNTS 11238
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_1
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



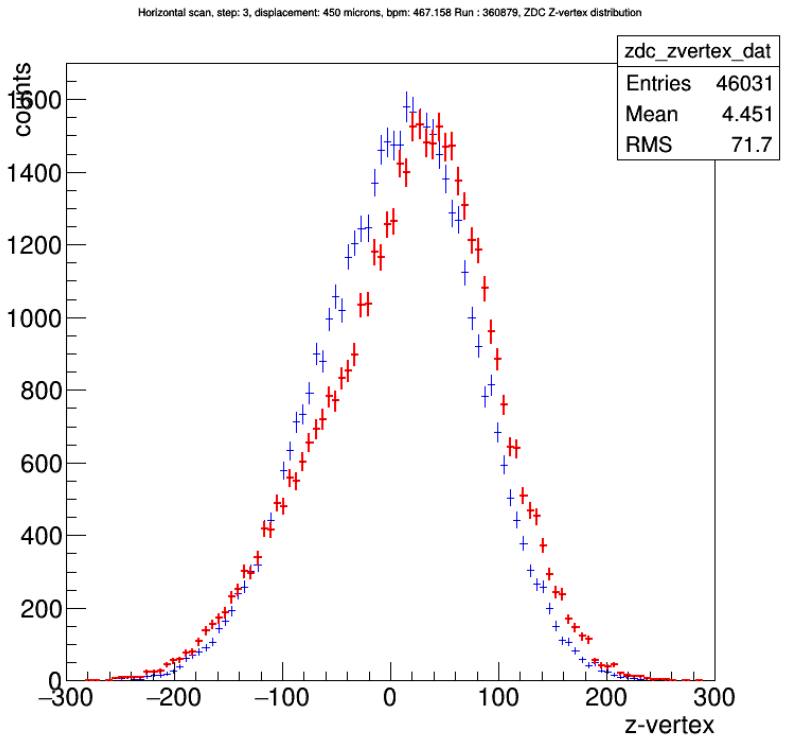
Step 2

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 85
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ 0.000195
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.028605
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET -0.045
Y_OFFSET 0
ZDC_COUNTS 24672
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_2
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



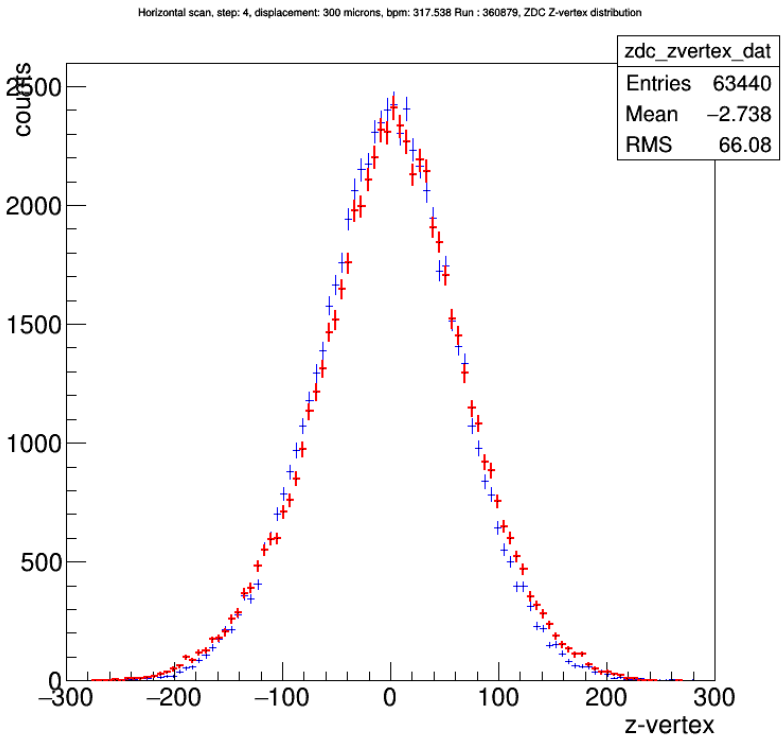
Step 3

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 85
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ 0.00024
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.103220
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET -0.032
Y_OFFSET 0
ZDC_COUNTS 46031
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_3
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



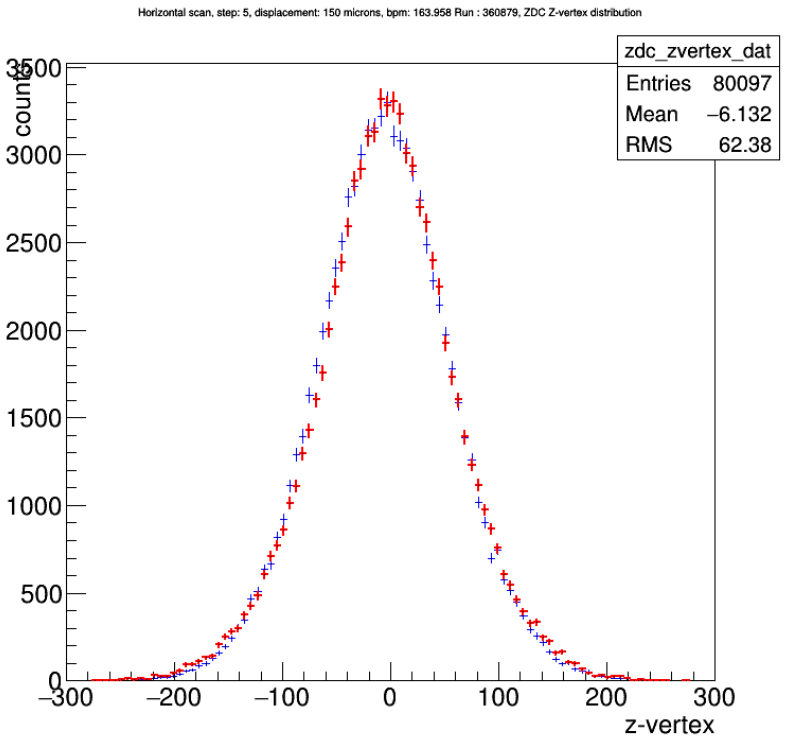
Step 4

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 85
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ 0.0004
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.193873
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET -0.01
Y_OFFSET 0
ZDC_COUNTS 63440
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_4
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



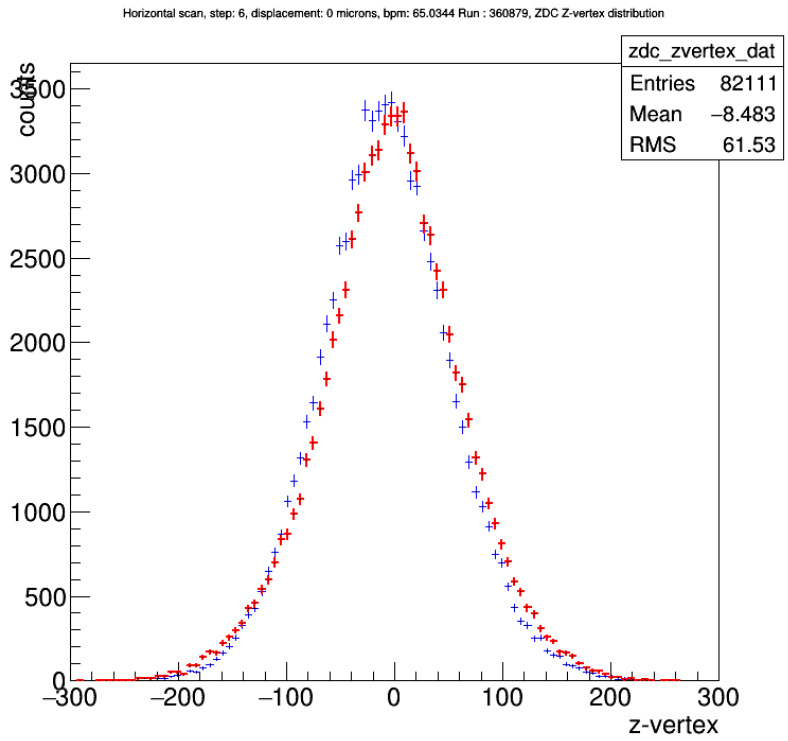
Step 5

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 89
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ 0.0005
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.414231
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET -0.005
Y_OFFSET 0
ZDC_COUNTS 80097
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_5
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



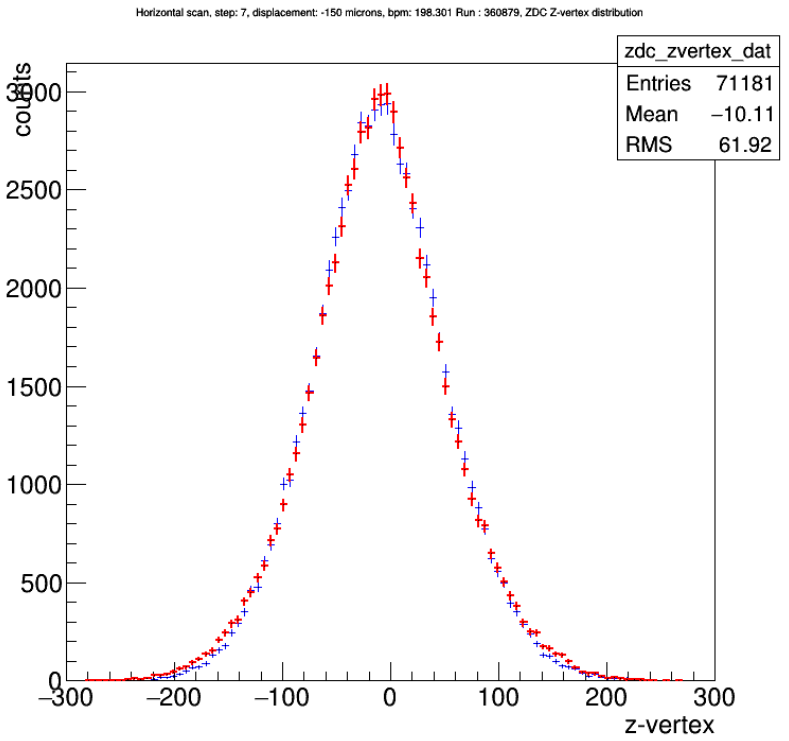
Step 6

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 82.169434
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ 0.000505
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.545801
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET 0.006503
Y_OFFSET 0
ZDC_COUNTS 82111
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_6
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



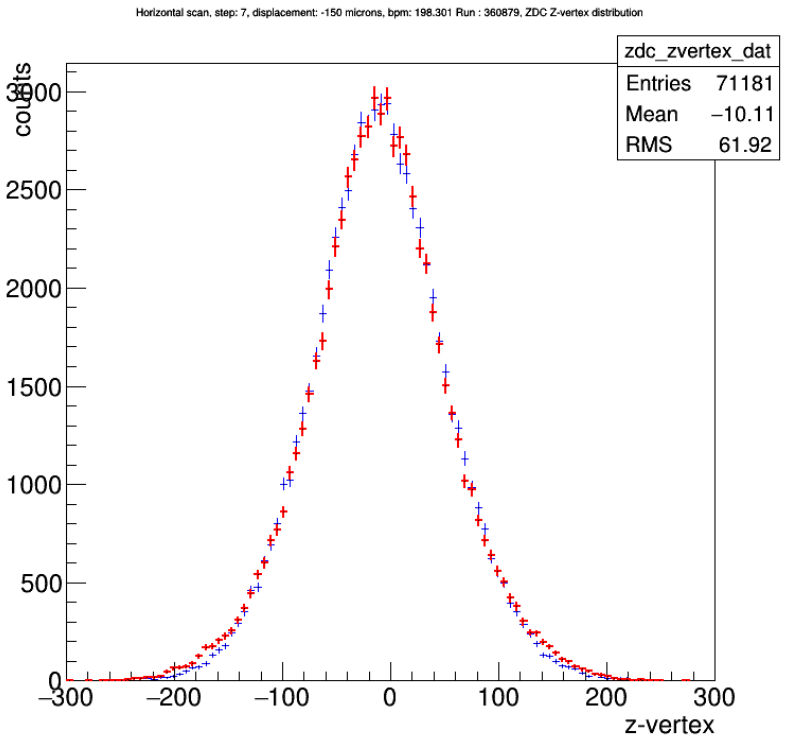
Step 7

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 85
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ -0.0005
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.201315
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET 0.00
Y_OFFSET 0
ZDC_COUNTS 71181
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_7
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



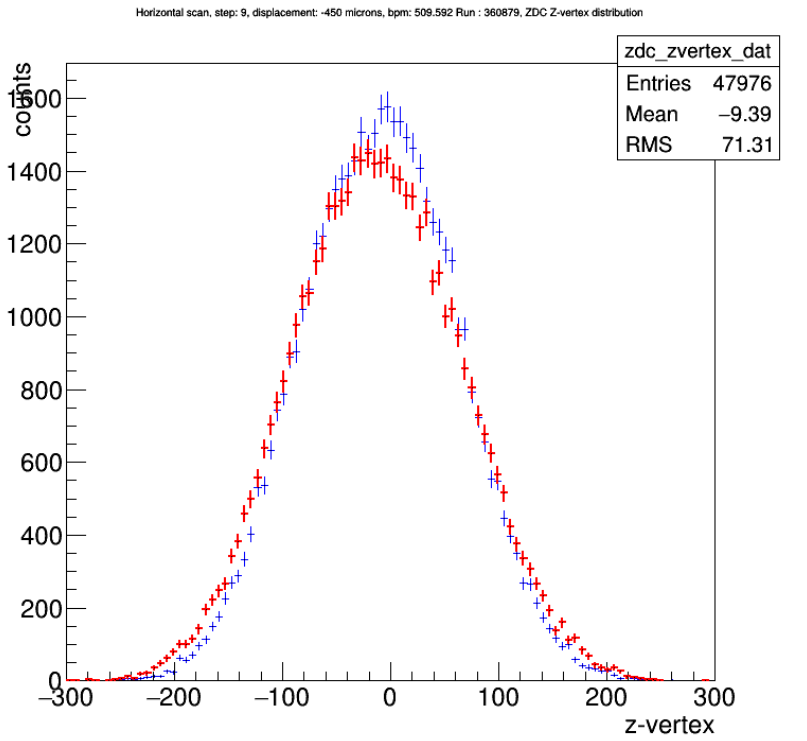
Step 8

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 85
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ -0.0005
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.201315
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET 0.00
Y_OFFSET 0
ZDC_COUNTS 71181
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_7
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



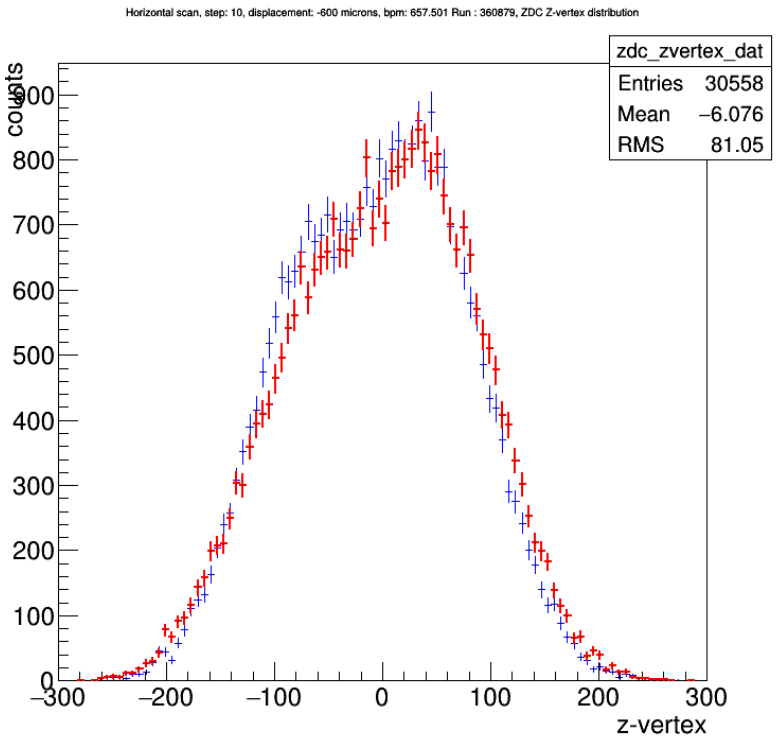
Step 9

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 89
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ -0.00009
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.092878
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET 0.01
Y_OFFSET 0
ZDC_COUNTS 47976
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_9
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



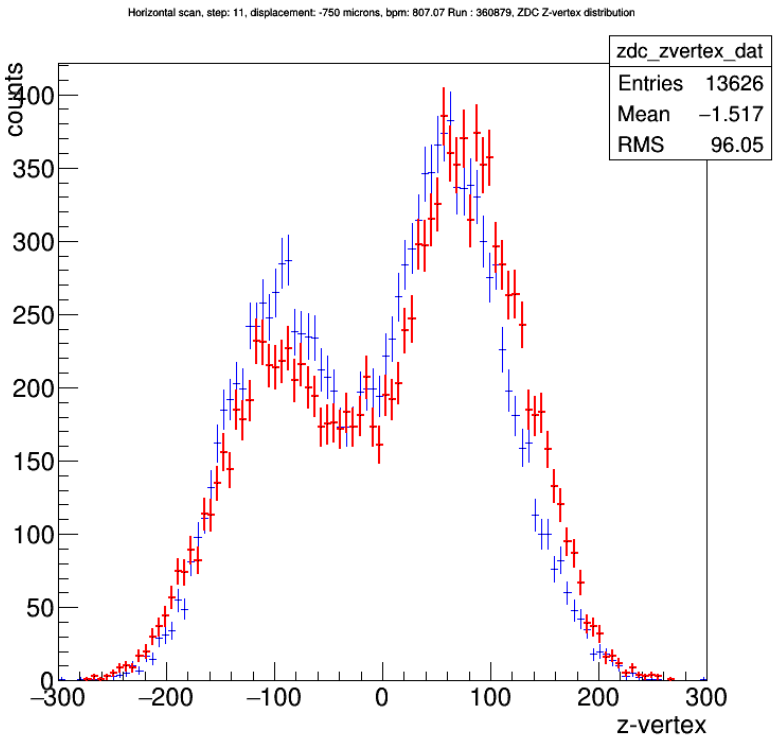
Step 10

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 85
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ 0.00007
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.019254
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET 0.033
Y_OFFSET 0
ZDC_COUNTS 30558
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_10
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



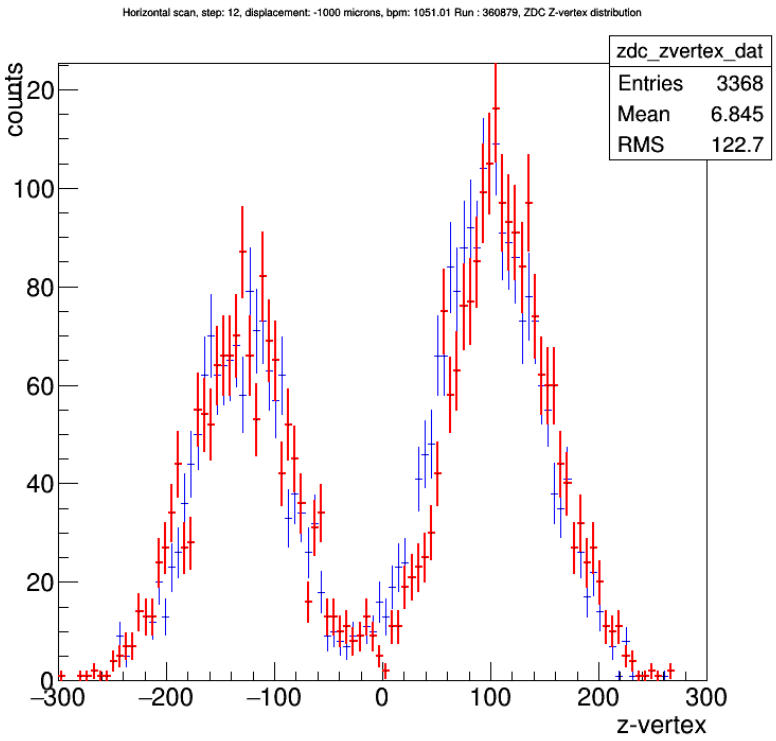
Step 11

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 87.830567
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ 0.00007
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.012922
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET 0.06
Y_OFFSET 0
ZDC_COUNTS 13626
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_11
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



Step 12

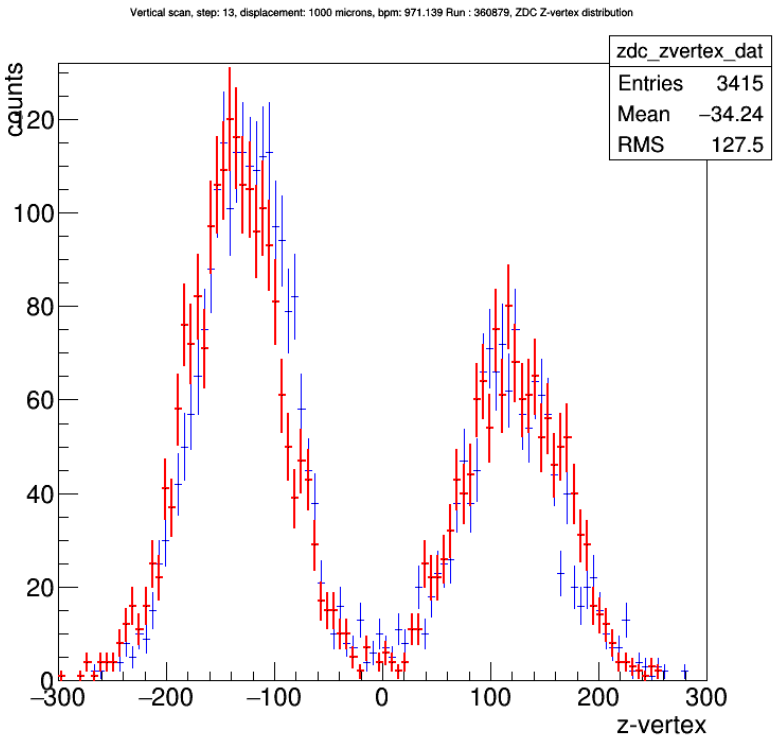
AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 77.819825
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ 0.000036
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.000681
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET 0.09
Y_OFFSET 0
ZDC_COUNTS 3368
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_12
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



Results From Tuning - Vertical Scan

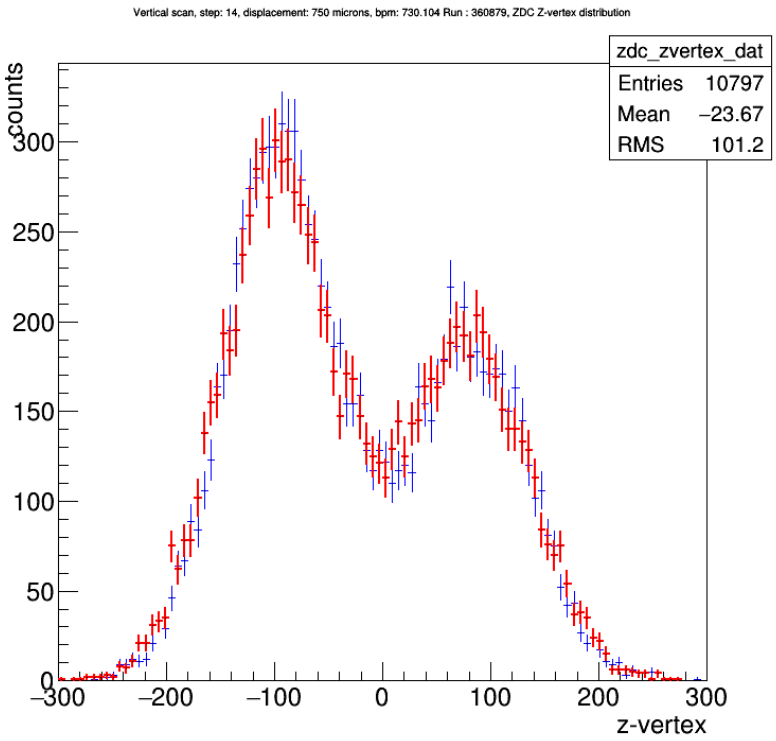
Step 13

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 76.657714
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ -0.000046
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.001298
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET 0
Y_OFFSET -0.097114
ZDC_COUNTS 3415
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_13
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



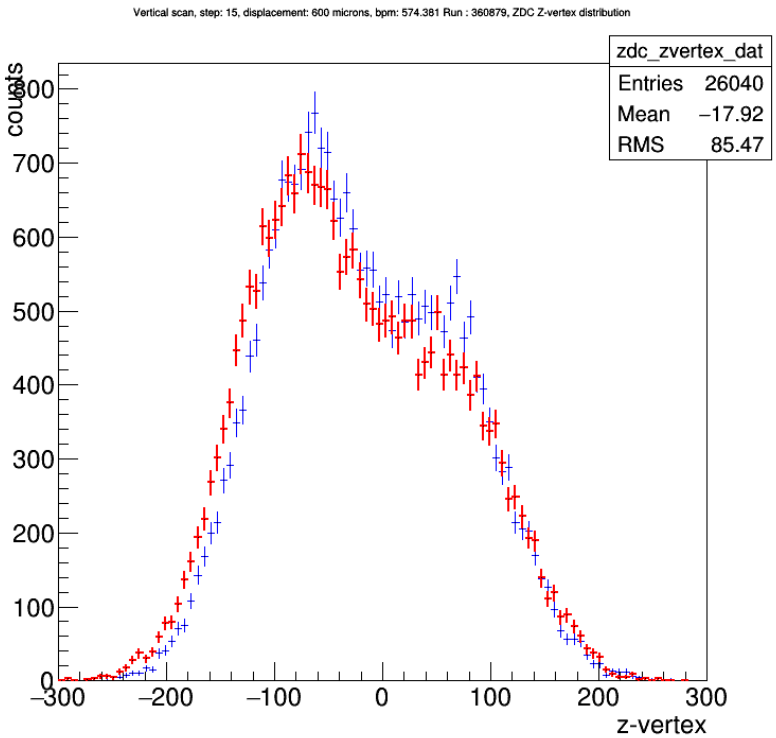
Step 14

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 84.576660
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ -0.00005
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.016914
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET 0
Y_OFFSET -0.06
ZDC_COUNTS 10797
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_14
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



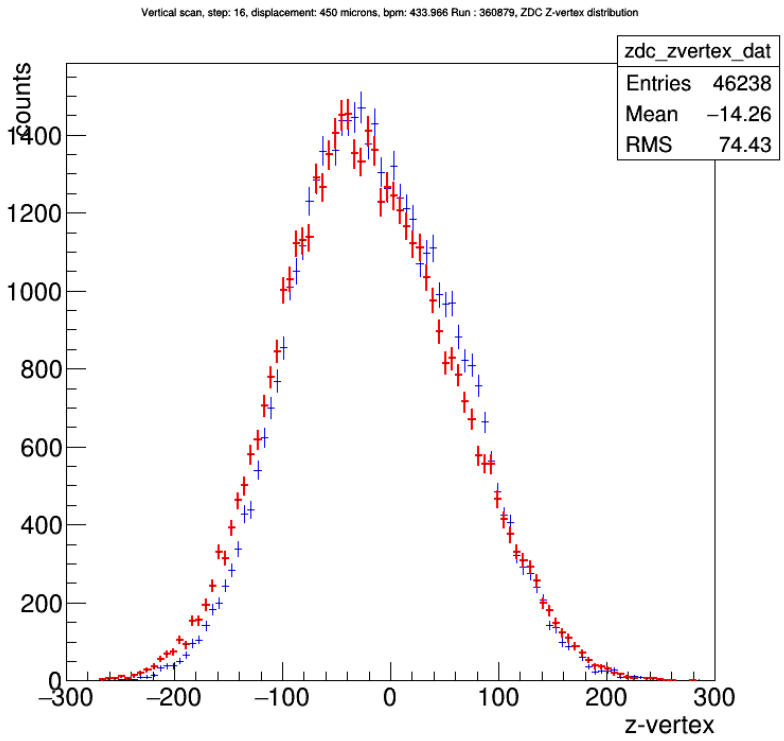
Step 15

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 87.448732
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ -0.00009
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.036174
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET 0
Y_OFFSET -0.044
ZDC_COUNTS 26040
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_15
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



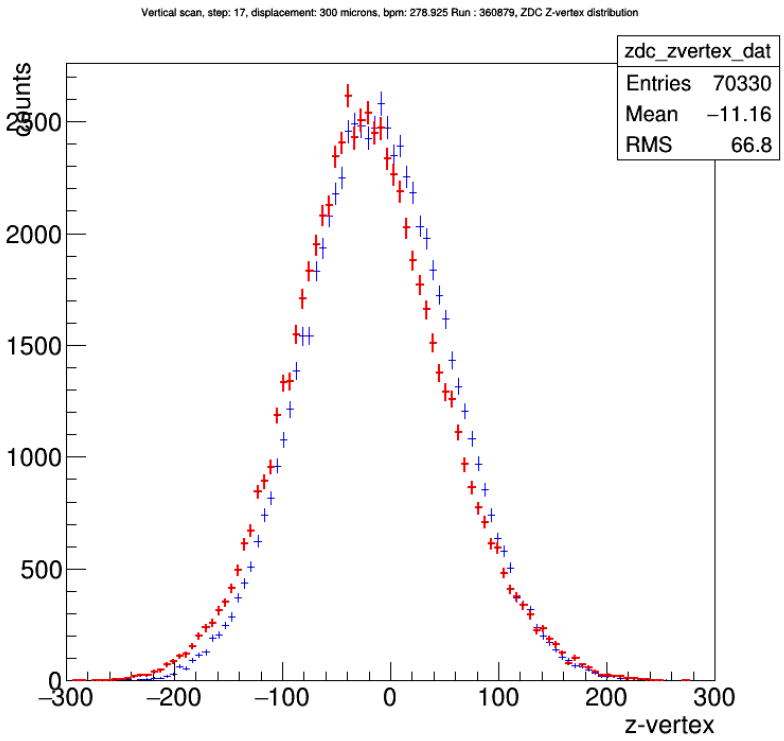
Step 16

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 91.184083
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ -0.00015
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.070320
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET 0
Y_OFFSET -0.02
ZDC_COUNTS 46238
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_16
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



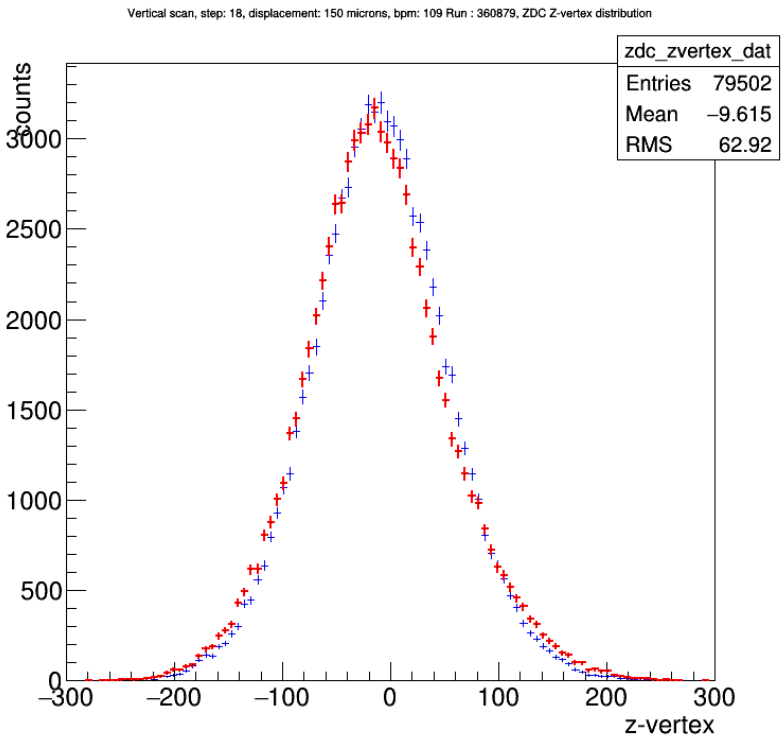
Step 17

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 89.
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ -0.00035
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.334313
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET 0
Y_OFFSET -0.01
ZDC_COUNTS 70330
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_17
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



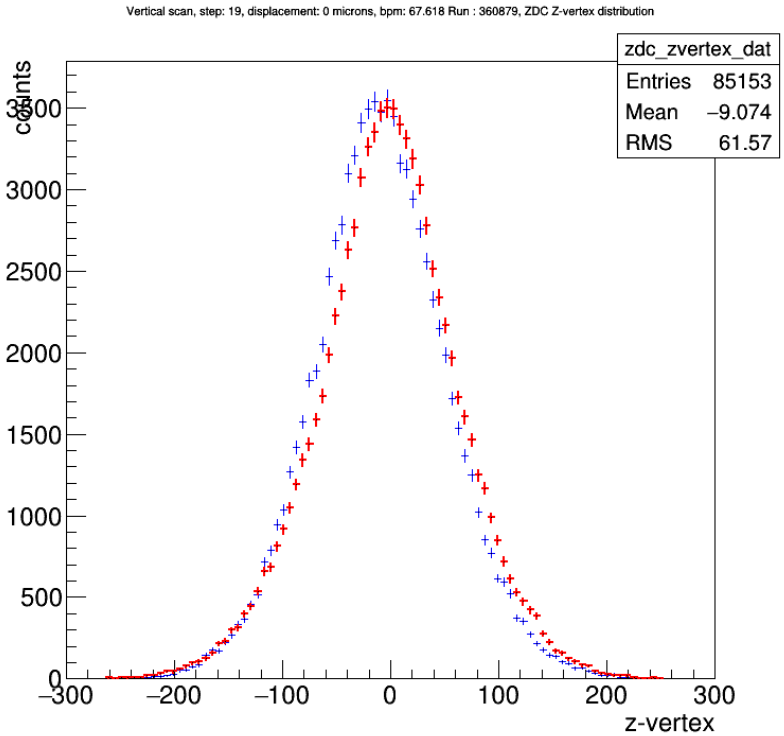
Step 18

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET 0.
BETA_STAR 86.319824
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ -0.00045
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.419094
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET 0
Y_OFFSET -0.010900
ZDC_COUNTS 79502
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_18
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



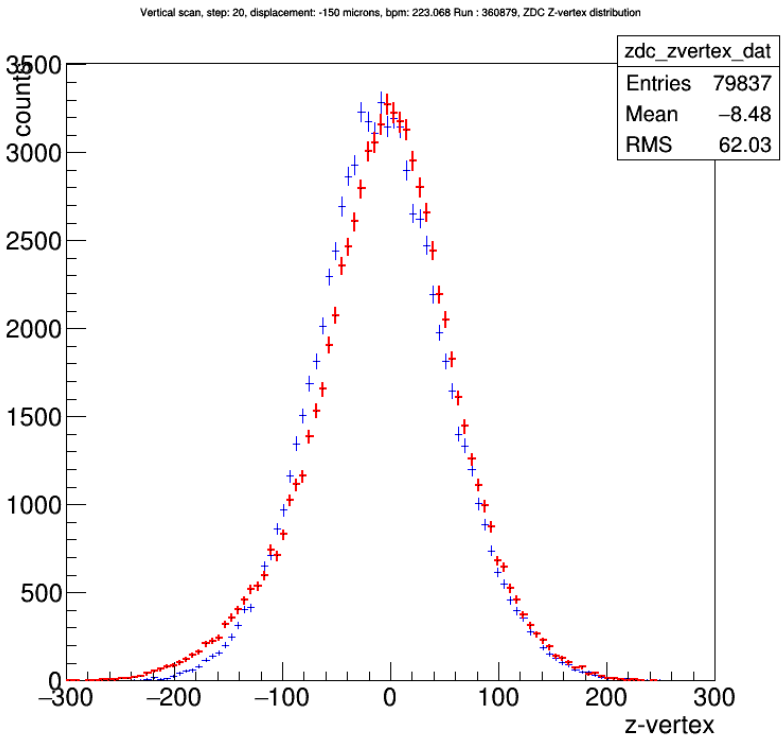
Step 19

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 88.046388
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ 0.000475
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.261758
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET 0
Y_OFFSET 0.006762
ZDC_COUNTS 85153
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_19
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



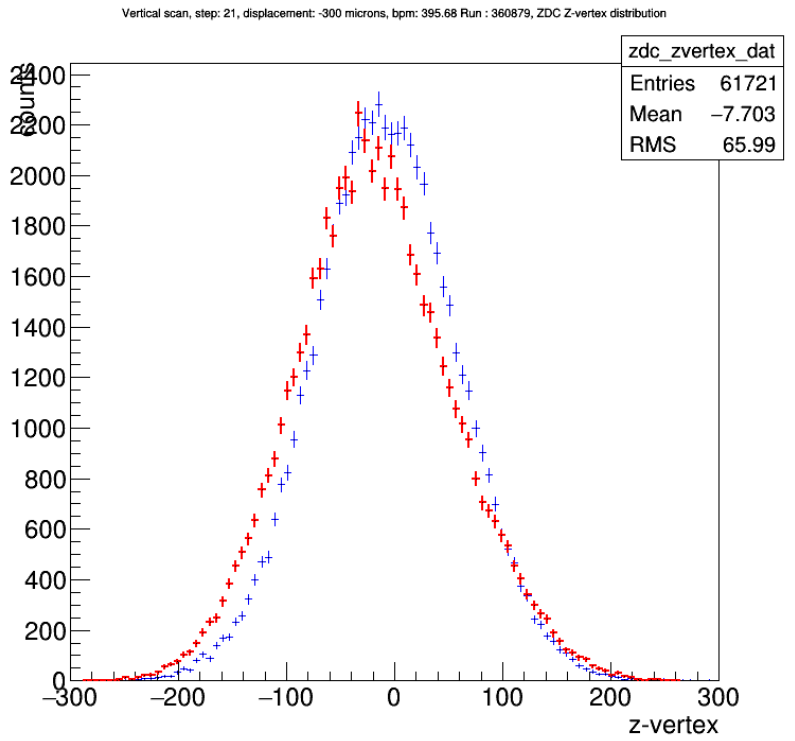
Step 20

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -30.7391
BETA_STAR 85
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ 0.00045
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.264361
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET 0
Y_OFFSET 0.02
ZDC_COUNTS 79837
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_20
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



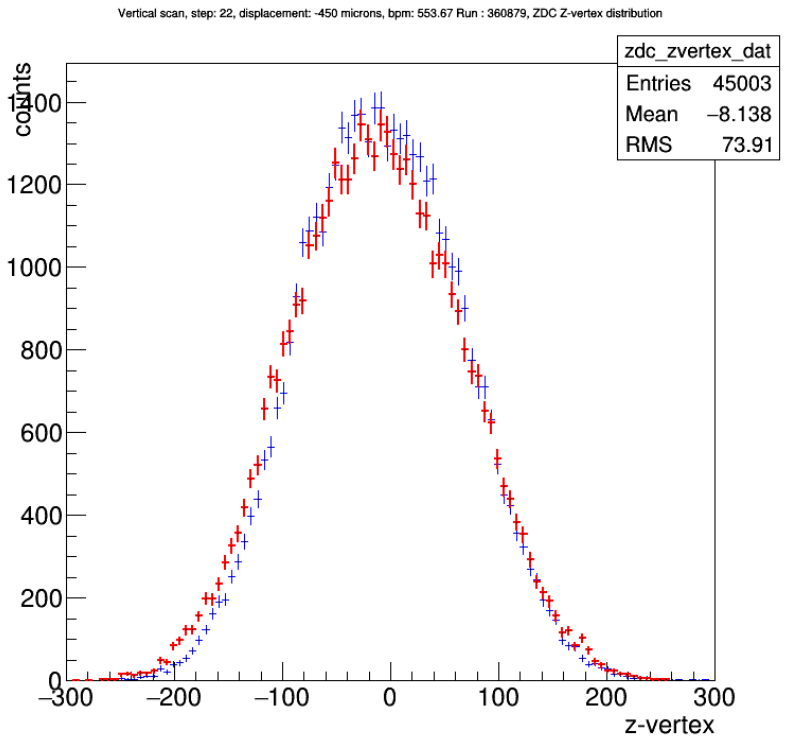
Step 21

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 80
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ -0.0003
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.179534
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET 0
Y_OFFSET 0.01
ZDC_COUNTS 61721
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_21
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



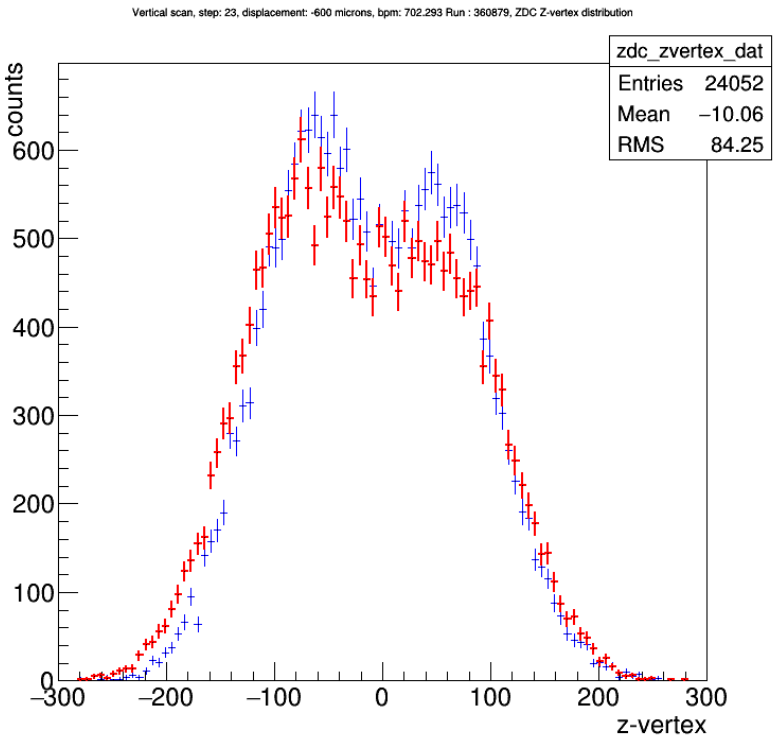
Step 22

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 85
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ -0.00005
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.042497
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET 0
Y_OFFSET 0.015
ZDC_COUNTS 45003
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_22
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



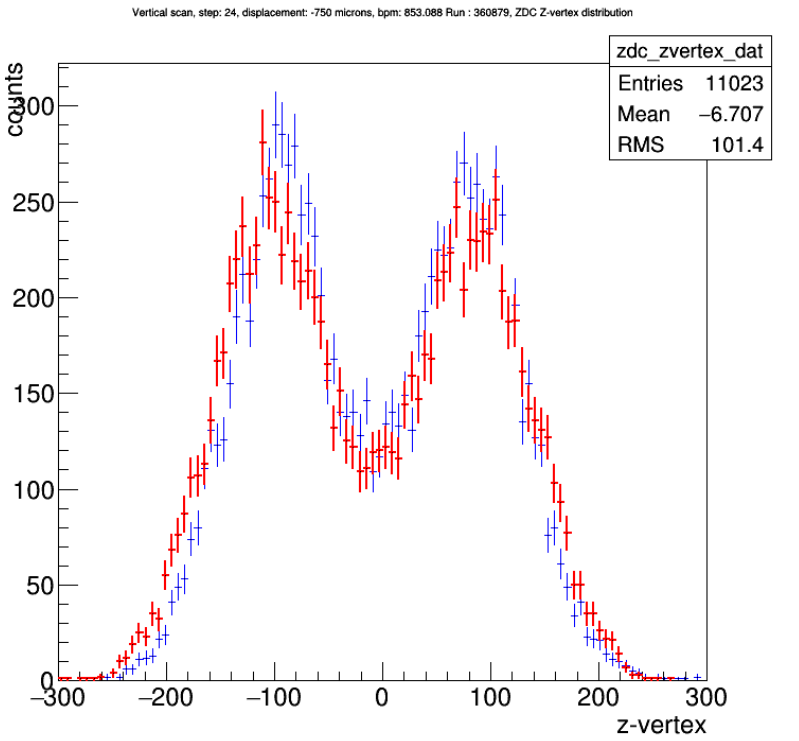
Step 23

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 95.
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ -0.00003
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.011786
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET 0
Y_OFFSET 0.044
ZDC_COUNTS 24052
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_23
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



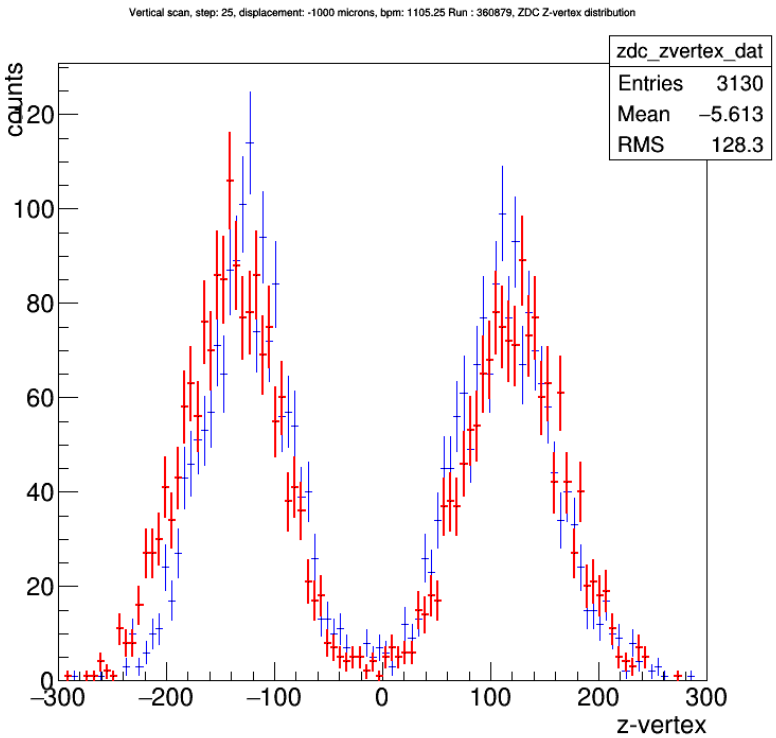
Step 24

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 85.622558
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ -0.00001
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.006142
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET 0
Y_OFFSET 0.063
ZDC_COUNTS 11023
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_24
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



Step 25

AVG_NUMBER_IONS_BLUE_BEAM 119.837e9
AVG_NUMBER_IONS_YELLOW_BEAM 119.243e9
BBC_ZDC_Z_VERTEX_OFFSET -10.7391
BETA_STAR 78.185058
BUNCH_CROSSING_FREQUENCY 78213.
CROSSING_ANGLE_XZ -0.000008
CROSSING_ANGLE_YZ 0.
FILLED_BUNCHES 107
HORIZONTAL_BEAM_WIDTH 0.027369
MAX_COLLISIONS 5
MULTIPLE_COLLISION_RATE 0.000839
RUN_NUMBER 360879
VERTICAL_BEAM_WIDTH 0.0265107
X_OFFSET 0
Y_OFFSET 0.1
ZDC_COUNTS 3130
ZDC_VERTEX_DISTRIBUTION_NAME zdc_zvtx_step_25
Z_BUNCH_WIDTH_CENTRAL_GAUSIAN 55.95
Z_BUNCH_WIDTH_LEFT_GAUSSIAN 35.15
Z_BUNCH_WIDTH_LEFT_OFFSET -70.2
Z_BUNCH_WIDTH_RIGHT_GAUSIAN 27.65
Z_BUNCH_WIDTH_RIGHT_OFFSET 56.7
Z_PROFILE_SCALE_VALUE 2.0



Conclusion

Conclusion - 360879

- With tuning, we find that β^* is within a reasonable range compared to the advertised value of 85, varying between 75 - 89.
- With tuning, we find that θ_{xing} varied within its acceptable range of ± 2 milli-radians, ranging generally from -0.4 milli-radians to 0.4 milli-radians.
- Next up: a $500 GeV$ run for comparison.