Positron beam study report
Capturepart energy gain

2022. 10. 17

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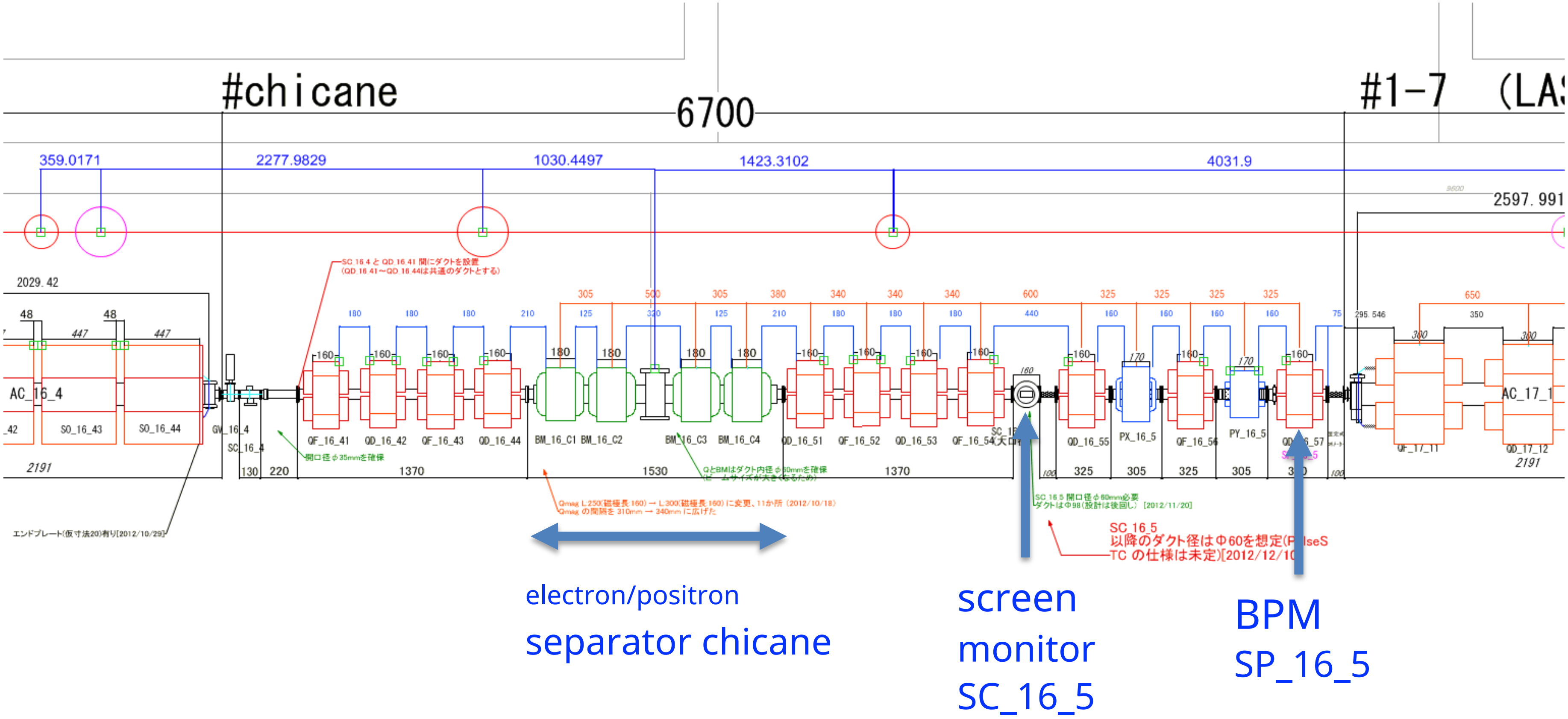
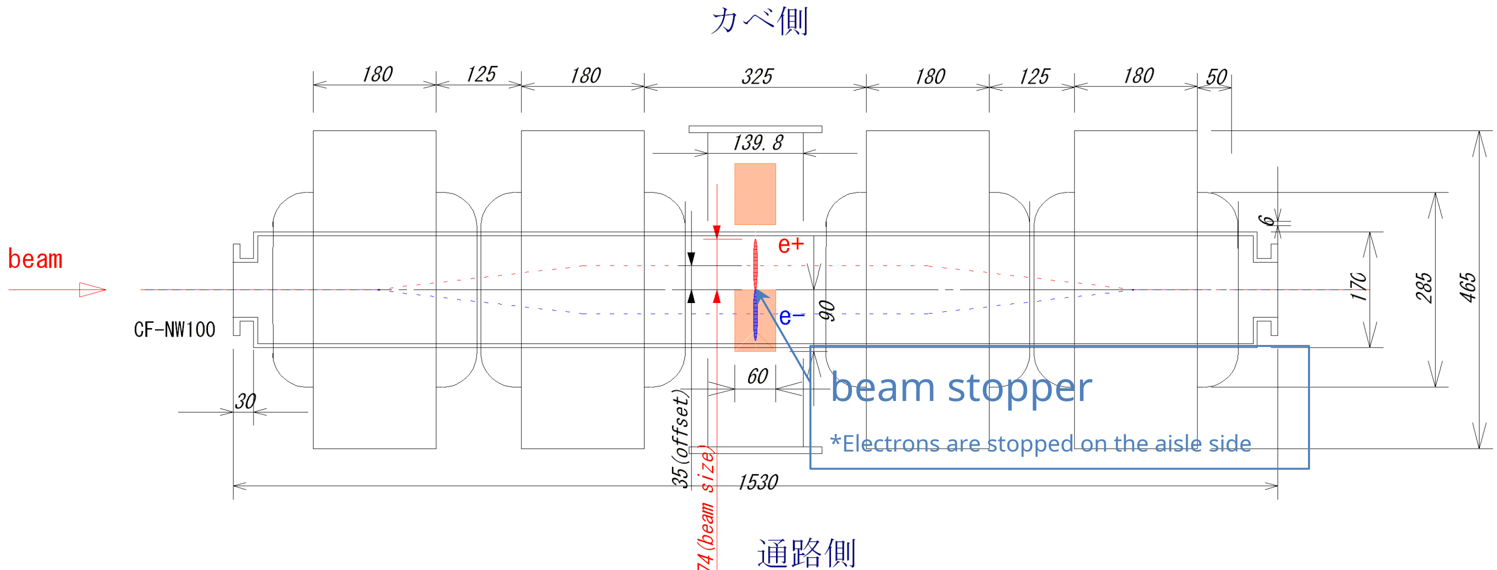
Positron Capture Secondnear the exit

- The part that exits the Positron Capture Section 1-5, 1-6 units is the target.
  - To separate the generated electrons and positrons and discard the electronsseparator chicaneand a quadrupole magnet system for optical matching downstream.
- Also for measuring the beam sizeScreen monitor SC_16_5and for measuring beam position & chargeBPM SP_16_5is placed.



16_5part beam stopper

- to stop secondary electrons from the targetMovable stopper blockis inserted into the electron path. On the other hand, although there is a stopper block in the path of positrons, it is usually evacuated so as not to disturb the positrons.



For each positron momentum

The position to pass in the chicane is

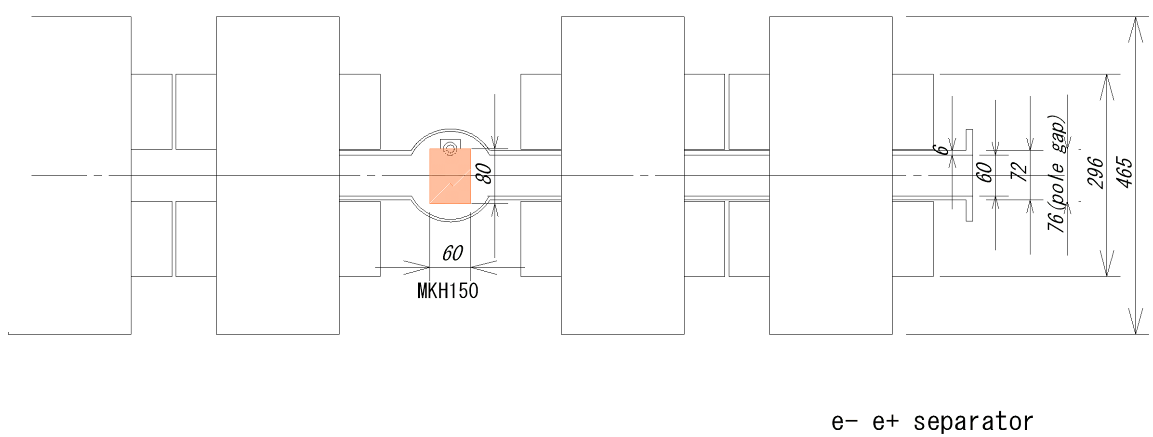
differentfor positrons

while inserting blocks

Observation of changes in passing electric charge

ThenPositron momentum distribution

information can be obtained.



positronEnergyBasic data for estimation (1)

- Bending magnet for chicaneBM_16_C1~C4excitation characteristics, effective length data

  Than

  - Excitation characteristic measurement data (current valuevsintegral magnetic fieldBL)polynomial fitting coefficients of

    BL_polycoeff_BM16C1 = [3.02498341E-04, 1.40824195E-03, 3.27158016E-06, - 3.30463704E-07, 1.98297043E-08, -5.94488393E-10, 8.36119007E-12, - 4.43822468E-14, 0.00000000E+00, 0.00000000E+00]

    The coefficients are in order of ascending powers.c0, c1, c2,,, c9,

    polynomials:BL(I) = c0 + c1*I + c2*I**2 +

  - effective length:Leff_BM16C1 = 0.2533 [m]
  - Operating current value:Icur_BM16C1 = 34.00 [A]
  - Substitute the current value into the polynomial and divide by the effective lengthcentral magnetic field strengthis

    Boper_BM16C1 =0.1936[T] becomes.

positronEnergyBasic data for estimation (2)

- positron momentumpWhen

  Displacement at chicanexconnection of

  - Momentump [GeV/c]

    Curvature radius ρ [m]

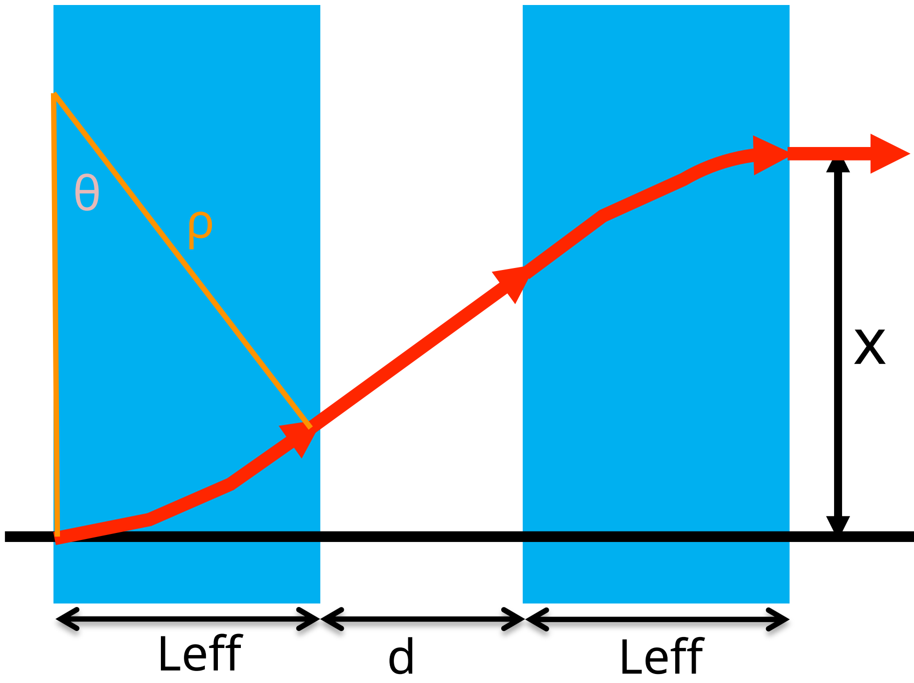
    Deflection angle θ [rad]

    magnetic field strengthB[T]

    Effective magnetic field lengthLeff [m]

    Distance between magnetsd[m]

    However, it must be calculated from the effective length.



- Relationship between momentum and radius of curvature

$$p = eB\rho$$

- Relationship between effective length and deflection angle

$$\rho \sin\theta = L_{\text{eff}}$$

- Calculation formula for displacement amount

$$x = 2\rho(1 - \cos\theta) + d\tan\theta$$

- firstpθ is obtained from the following formula.

$$\theta = \sin^{-1}\left(\frac{eBL_{\text{eff}}}{p}\right)$$

- Using that θ, the following formulaxAsk for

$$x = 2L_{\text{eff}}\left(\frac{1 - \cos\theta}{\sin\theta}\right) + d\tan\theta$$

block positionvsBeam throughput data

The positron block is almost fully opened (x=76mm)to fully closed (x=0 mm)Insert until

Data on the amount of transmitted electric charge when it is turned on is shown. (xis the position of the tip of the block)

This data ispositron

x-Differentiated position distribution

has become

Disparate data

Since it is difficult to differentiate

Integral form of Gaussian function

Common name for"error function"erf(x)

fitting with do

from the obtained parameters

center value of the original Gaussian function

Whensigmasought the value.

In addition, the block position

EPICSraw data valuesteeth

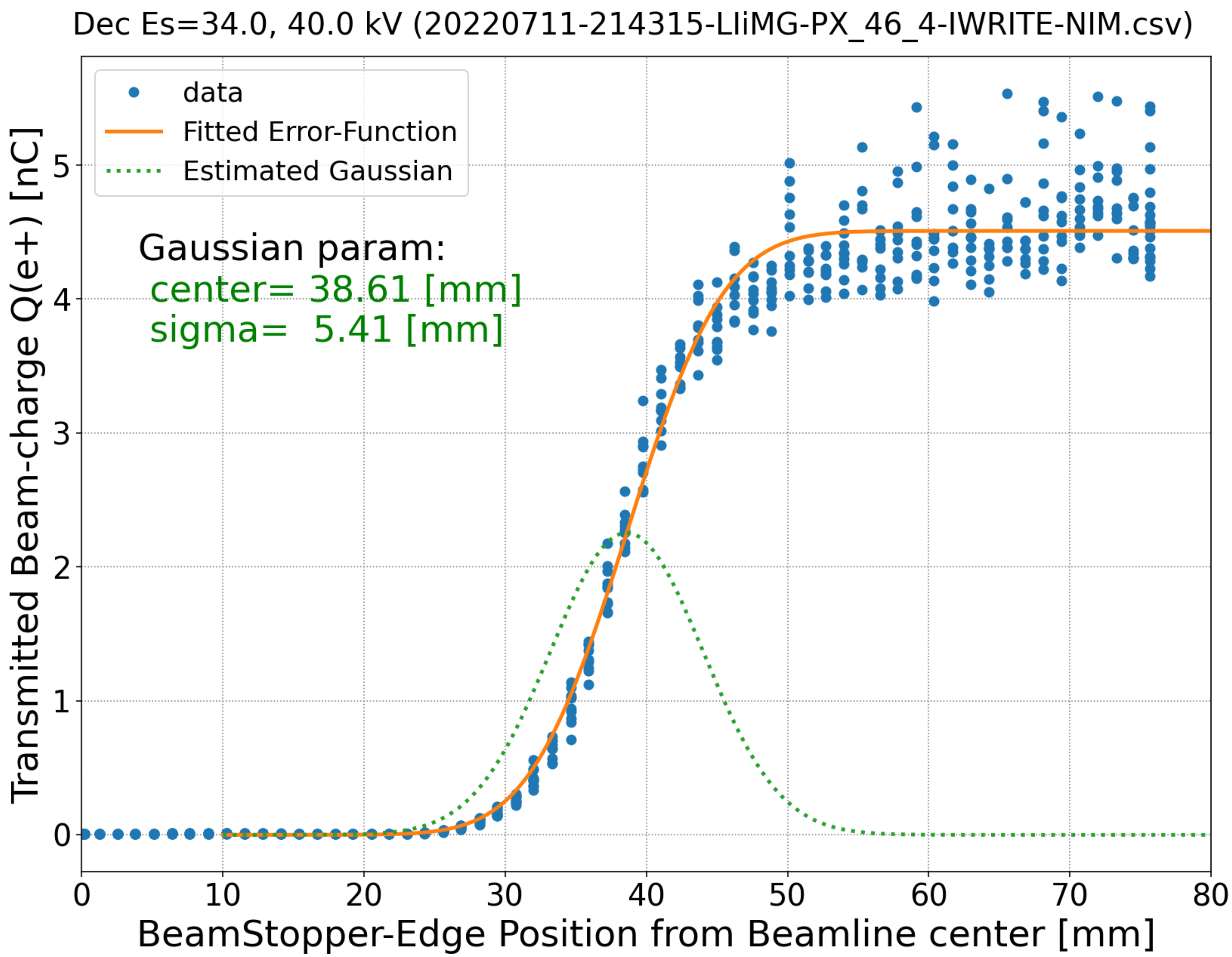
Origin in fully open states = 0

in the fully closed state as

s = 80.3 mmBecause it

becomes x = 80.3 - sneed

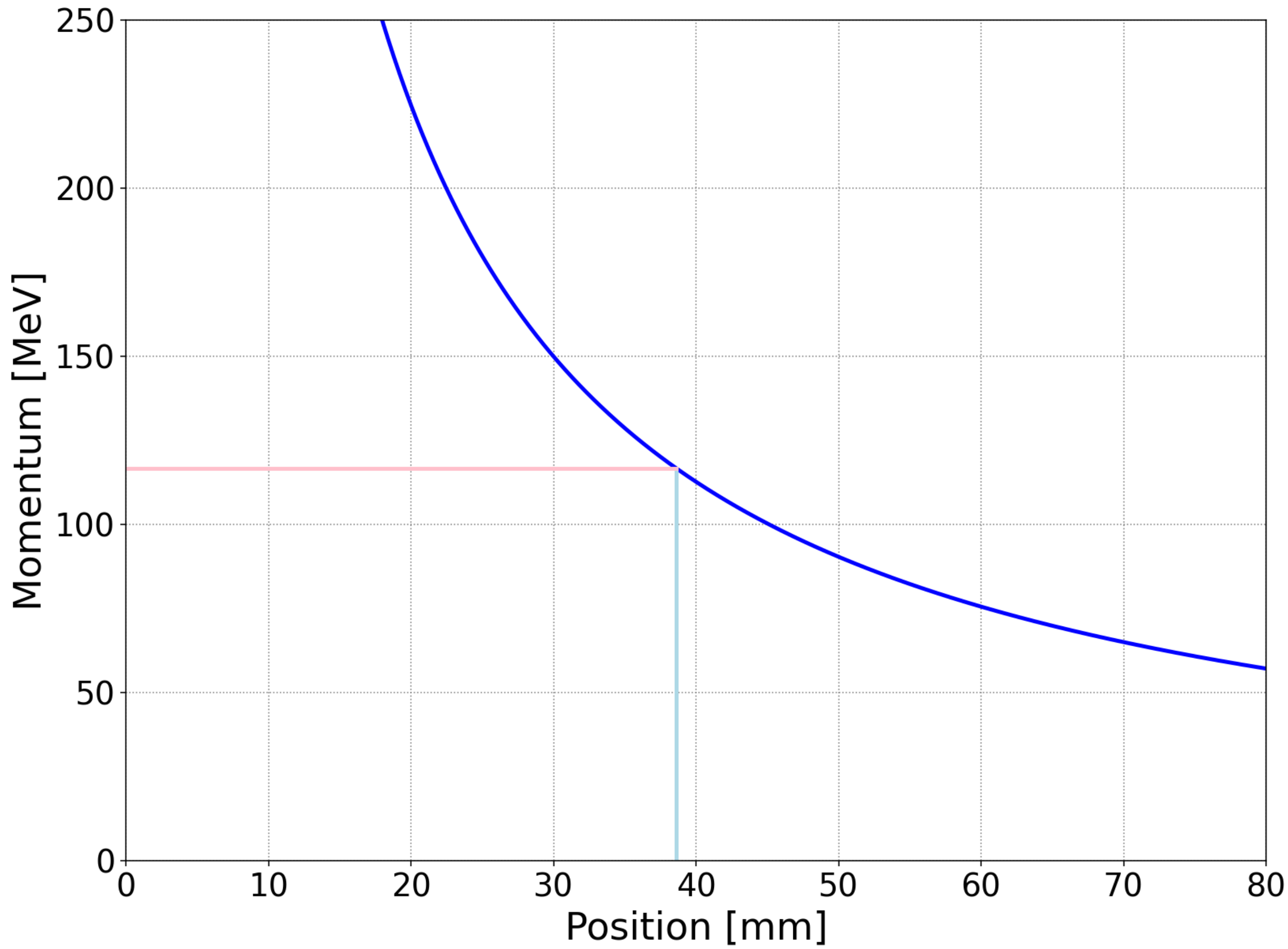
conversionSo be careful!



block positionvsMomentum relationship

Beam passing position (tip position of positron blockx)When

The figure below shows the relation of positron momentum.



For example, for the previous data

distribution center position

x = 38.60 mm

is converted to momentum

p = 116.8 MeV/c

will be equivalent to

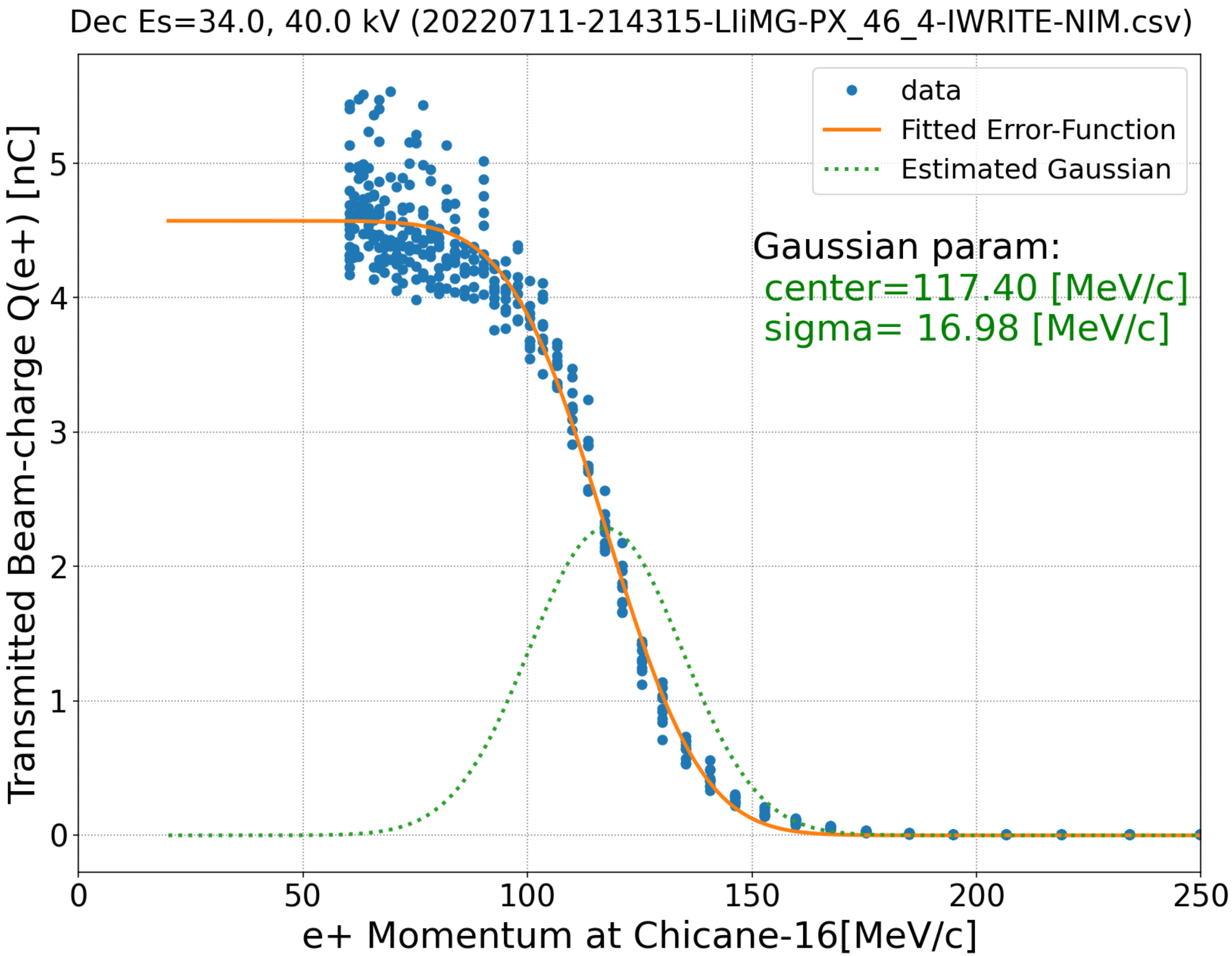
Momentumvs.Beam throughput data

Using the relational expression between passing position and momentum in the slide on the previous page,

Momentumvs.Data plotted with the amount of transmitted charge are shown.

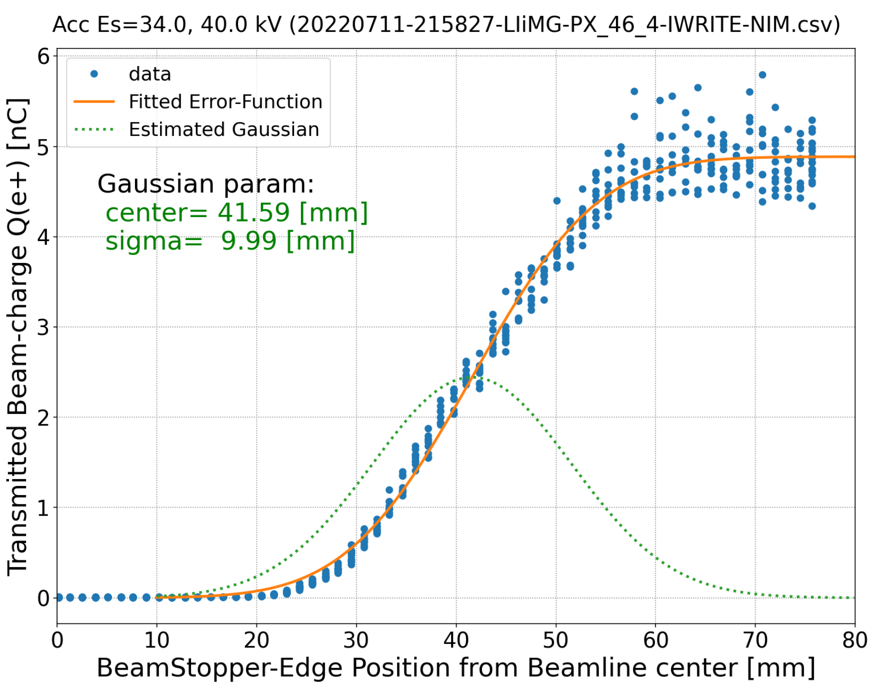
similarlyDistribution for Momentum
with the error function
center value of the original Gaussian function
Whensigmasought the value.

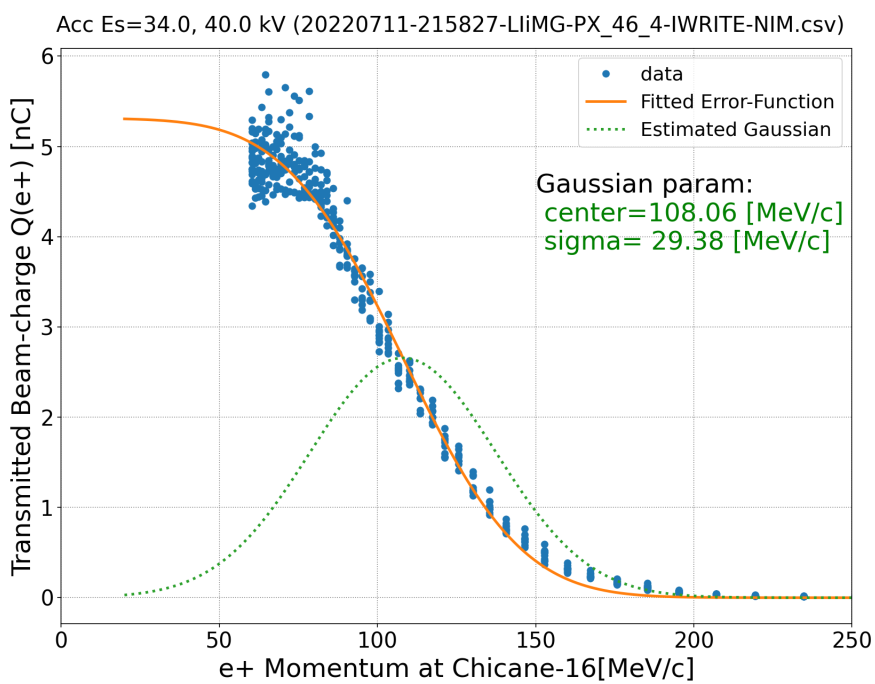
Note that the position distribution
was obtained by fitting
center positionx = 38.60 mm
converted to momentum
p = 116.8 MeV/c
and this plot directly
Fitted momentum
median value of
p = 117.4 MeV/c Although there is
a slight deviation in
0.5%to the extent that the problem is
I don't think so.



Decelerated capture and accelerated capture

- The data above are1-5, 1-6For the phase of the unit the positron
  deceleration phaseIt was in a state to be captured byacceleration phase captureThe same measurement was performed by changing to the state of
- Central Momentum in Decelerated Capture117.4 MeV/cagainst accelerated capture
  But108.1 MeV/cand lower values.
- This is because accelerated capture has a longer tail in the lower momentum distribution.
  It seems that it is for the sake of (Mr. Miyahara)

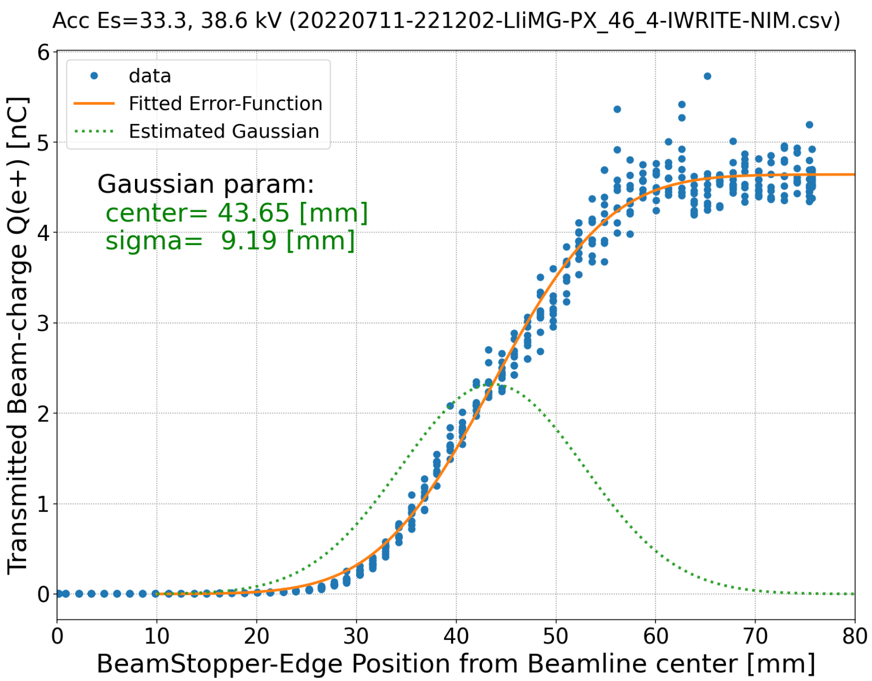


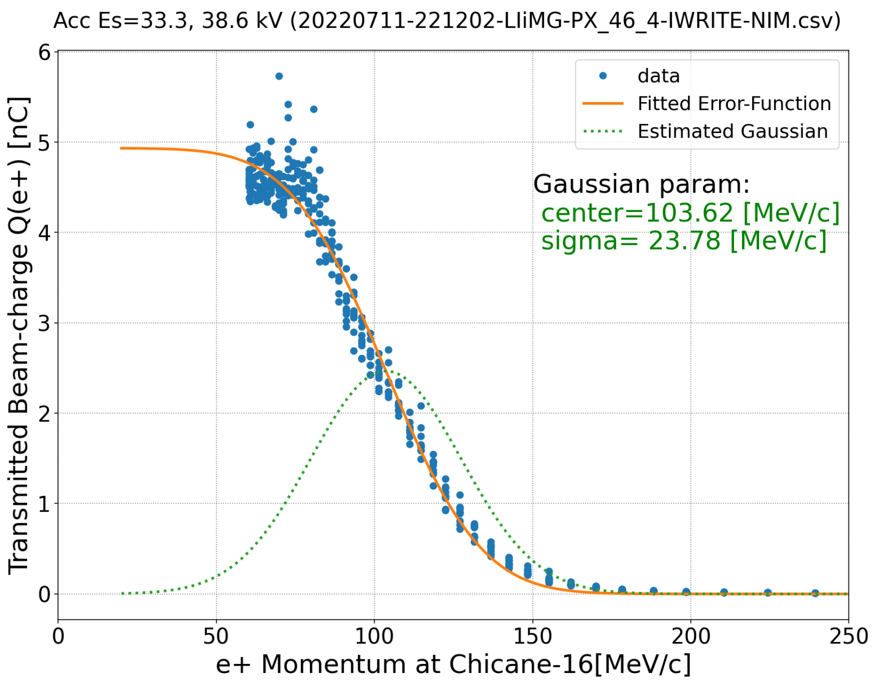


1-5, 1-6of the unitRF powerdata that changed

- Furthermore, the previous data both deceleration and acceleration capture,1-5, 1-6the unit is normalRF power(Esvalue is1-5: 34kV,1-6: 40kV), but EsThe value 1-5: 33.3kV,1-6: 38.6kVlower toRF powerDeceleration and acceleration capture were measured while
- The bottom plot is for accelerated capture.

Accelerated capture:Esvalue1-5: 33.3kV,1-6: 38.6kV

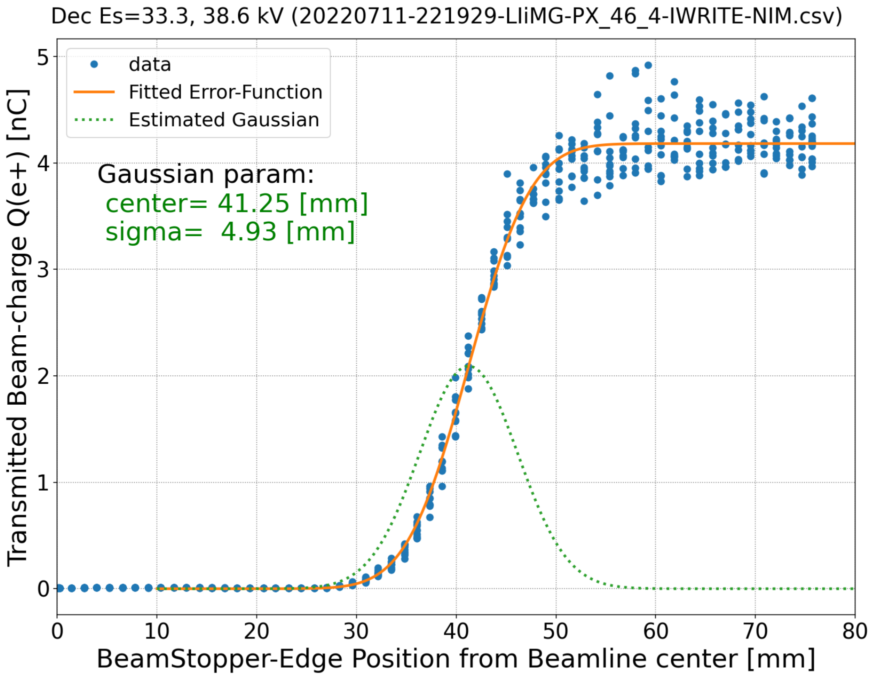


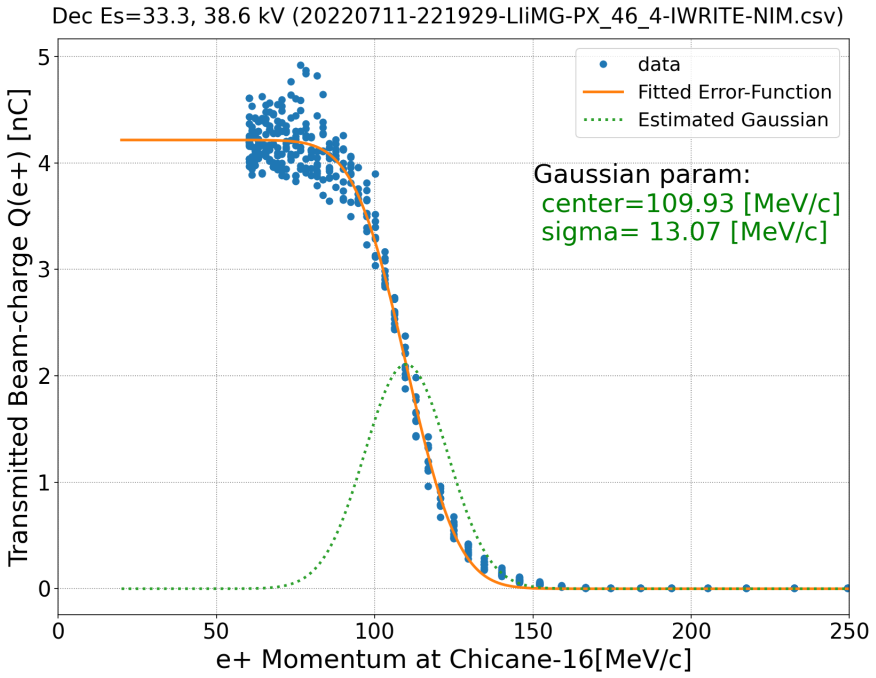


1-5, 1-6of the unitRF powerdata that changed

- It is also a plot for deceleration capture.

Slow capture:Esvalue1-5: 33.3kV,1-6: 38.6kV





Summary of measured positron energies

- 16_5Measured using the beam-stopper chicane in the
  The positron beam energy estimates are tabulated.
- RF powerThe energy value is higher than the estimated value from
- Looking at the central value, the energy value in the acceleration phase is lower than in the deceleration phase
  becomes. However, the energy spread is wider in the acceleration phase.
- RF powerlowering the positron energy correctly
  Therefore, it seems that the direction of high energy and low energy is not mistaken in this analysis.

	Es 34.0 kV 40.0 kV deceleration capture	Es 34.0 kV 40.0 kV accelerated capture	Es 33.3 kV 38.6 kV accelerated capture	Es 33.3 kV 38.6 kV accelerated capture	RF powerfrom energy gain estimate 1-5 + 1-6total
positron energy (Unit: MeV)	117.4	108.1	109.9	103.6	109.5
			6.4% decrease		
				4.2% decrease	