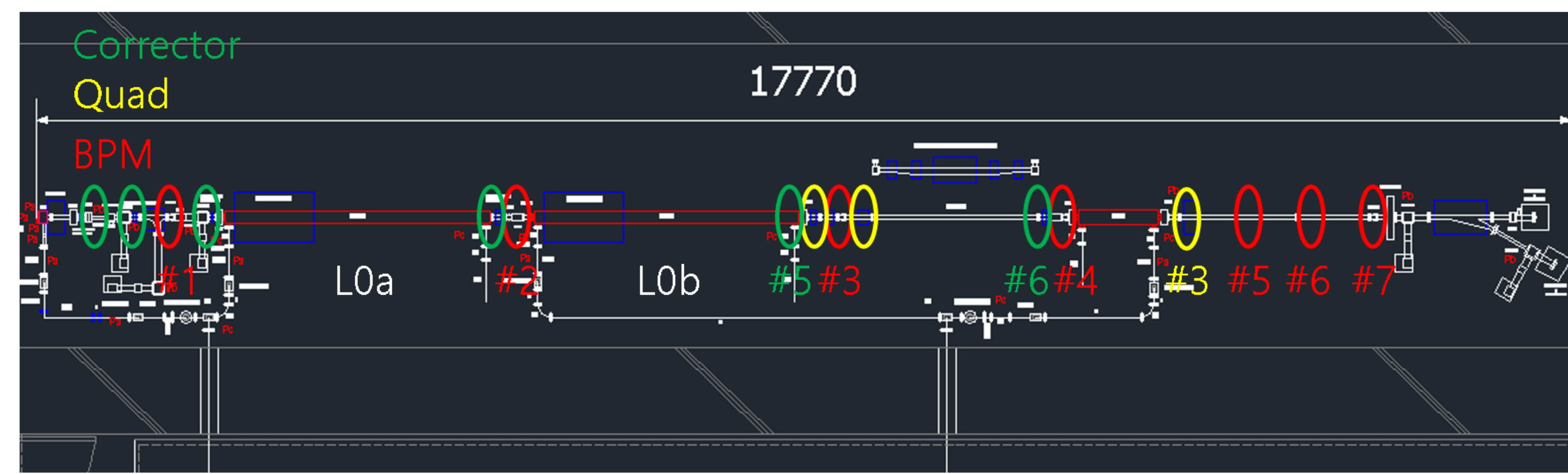# Beam Based Alignment using Double Correctors

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Abstract

Beam based alignment is a well-known technique for obtaining a small emittance beam which is critical in an injector of an accelerator or a matching section between two accelerators. The simplest beam based alignment can be performed with a corrector, a quadrupole, and a beam position monitor. This work presents a beam based alignment technique with double correctors located before the quadrupole magnet. The merit function was used to find the corrector settings of each beam based alignment. The measurement results showed that minimum corrector strengths could be achieved to have the ideal beam based alignment by using the fitting results of the merit function.

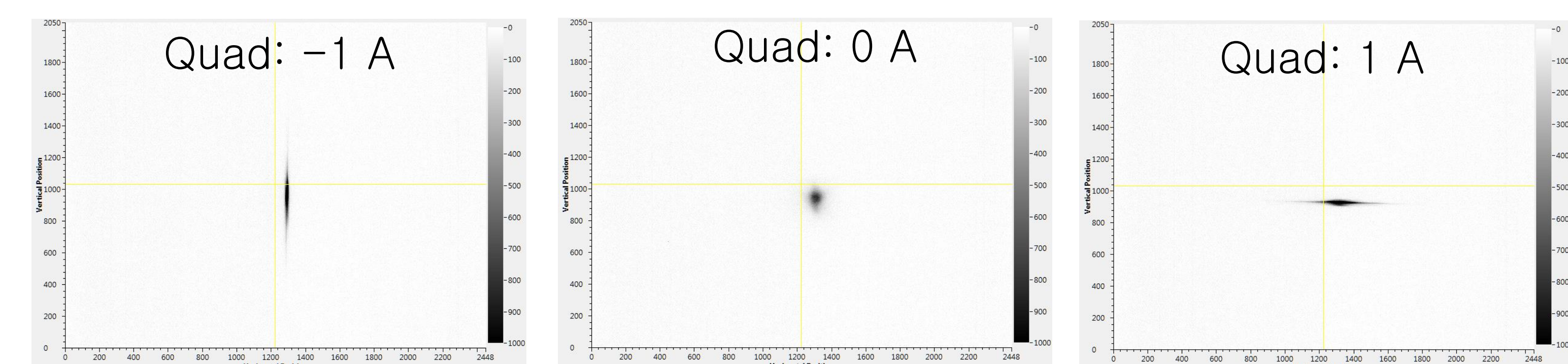## Layout of Electron Linear Accelerator for Basic researches (e-LABs)
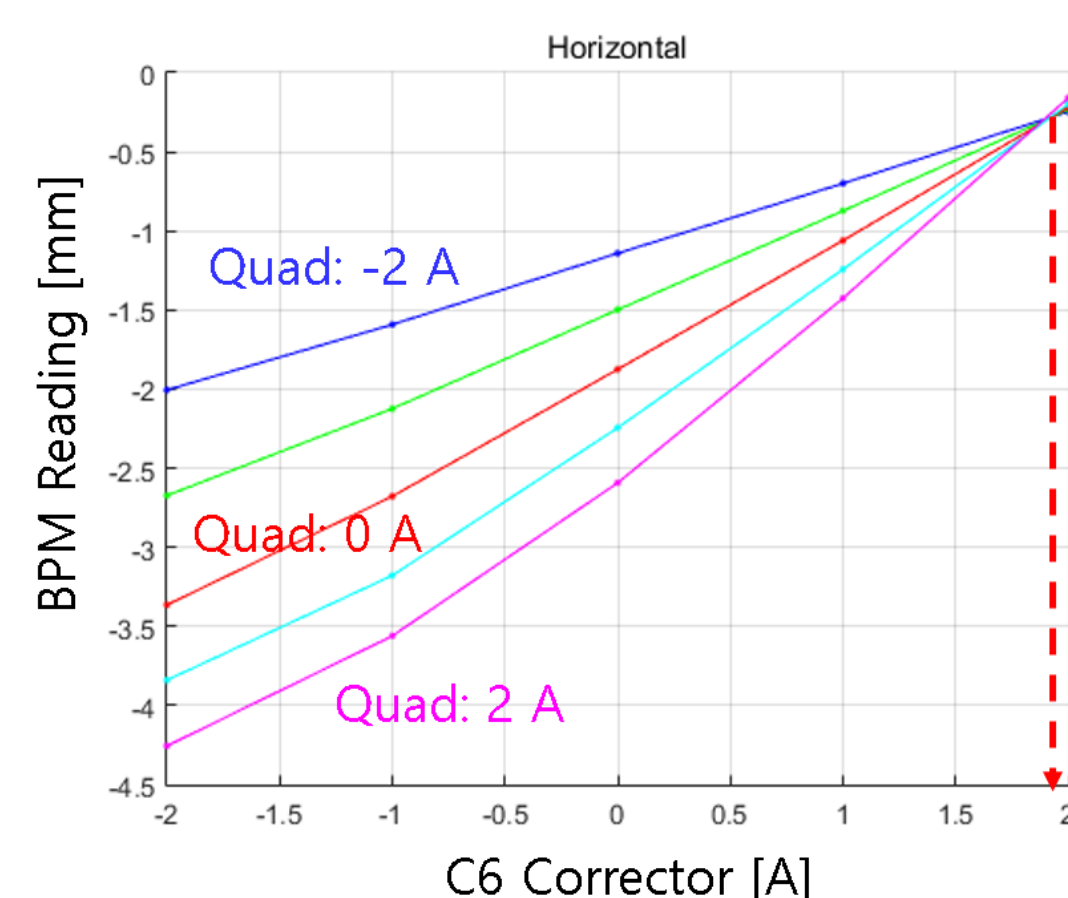

Beam Based Alignment (BBA)

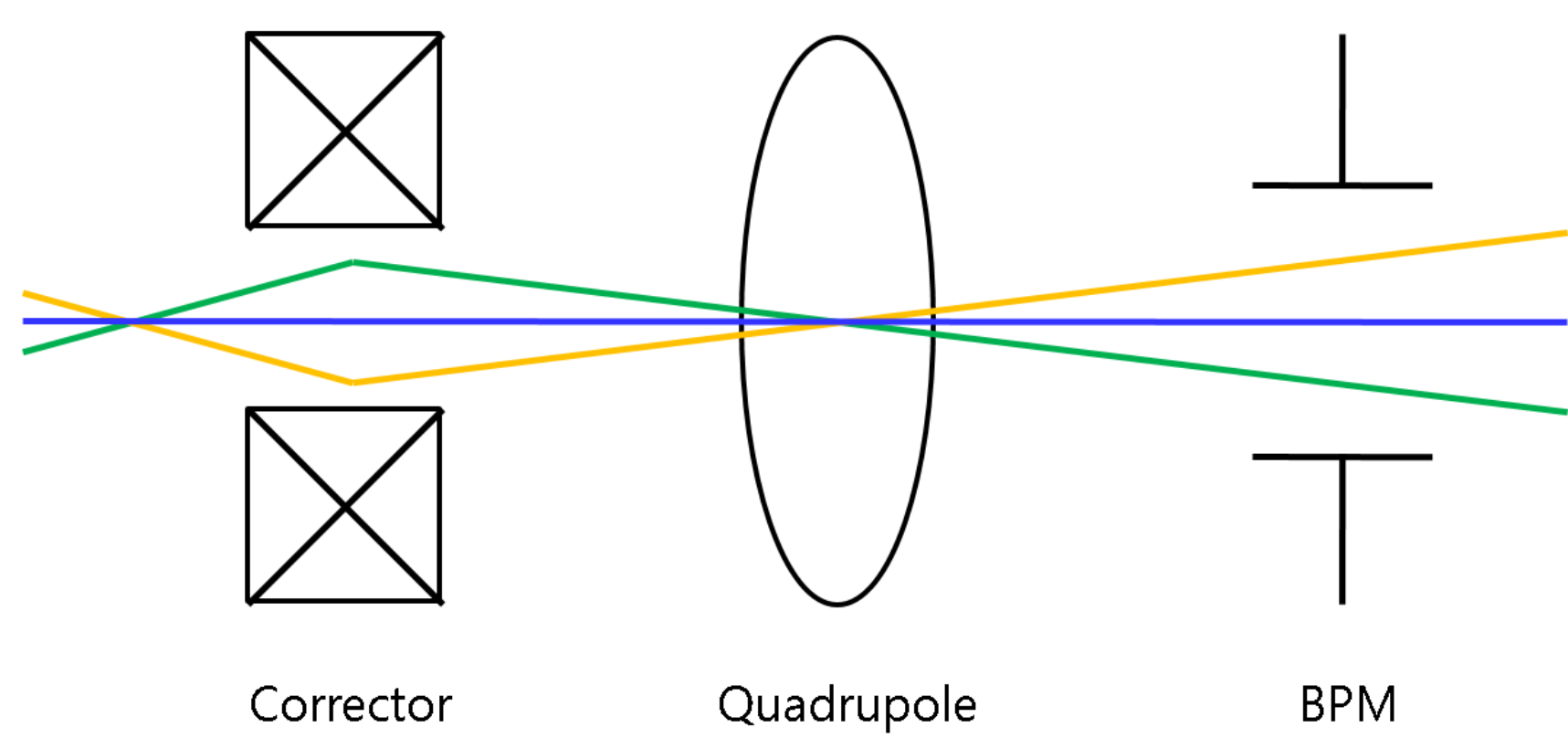Sending of the electron beam to the center of the quadrupole magnet.
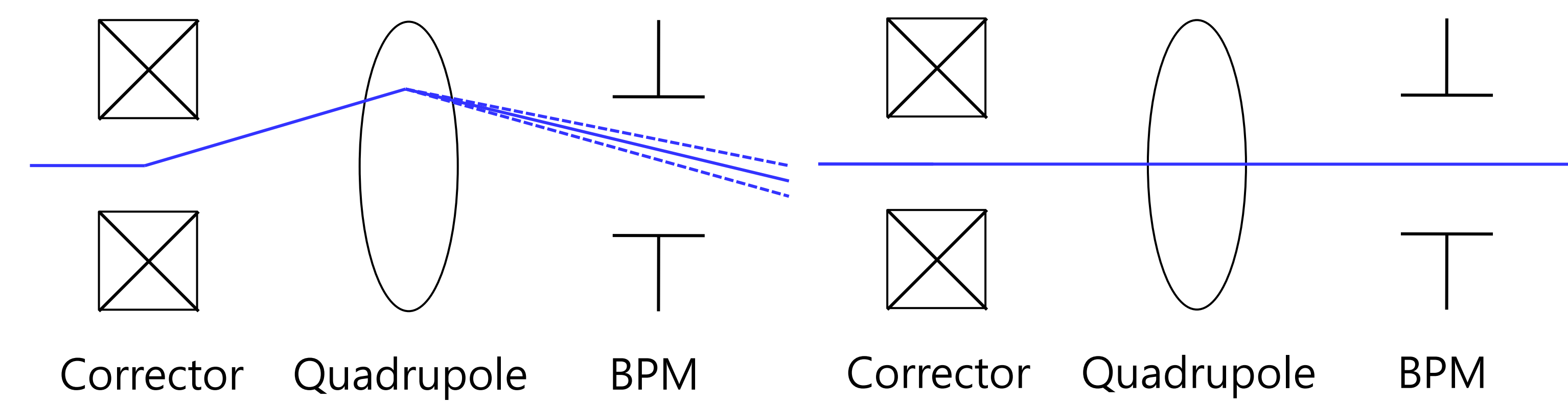
Beam Image after BBA

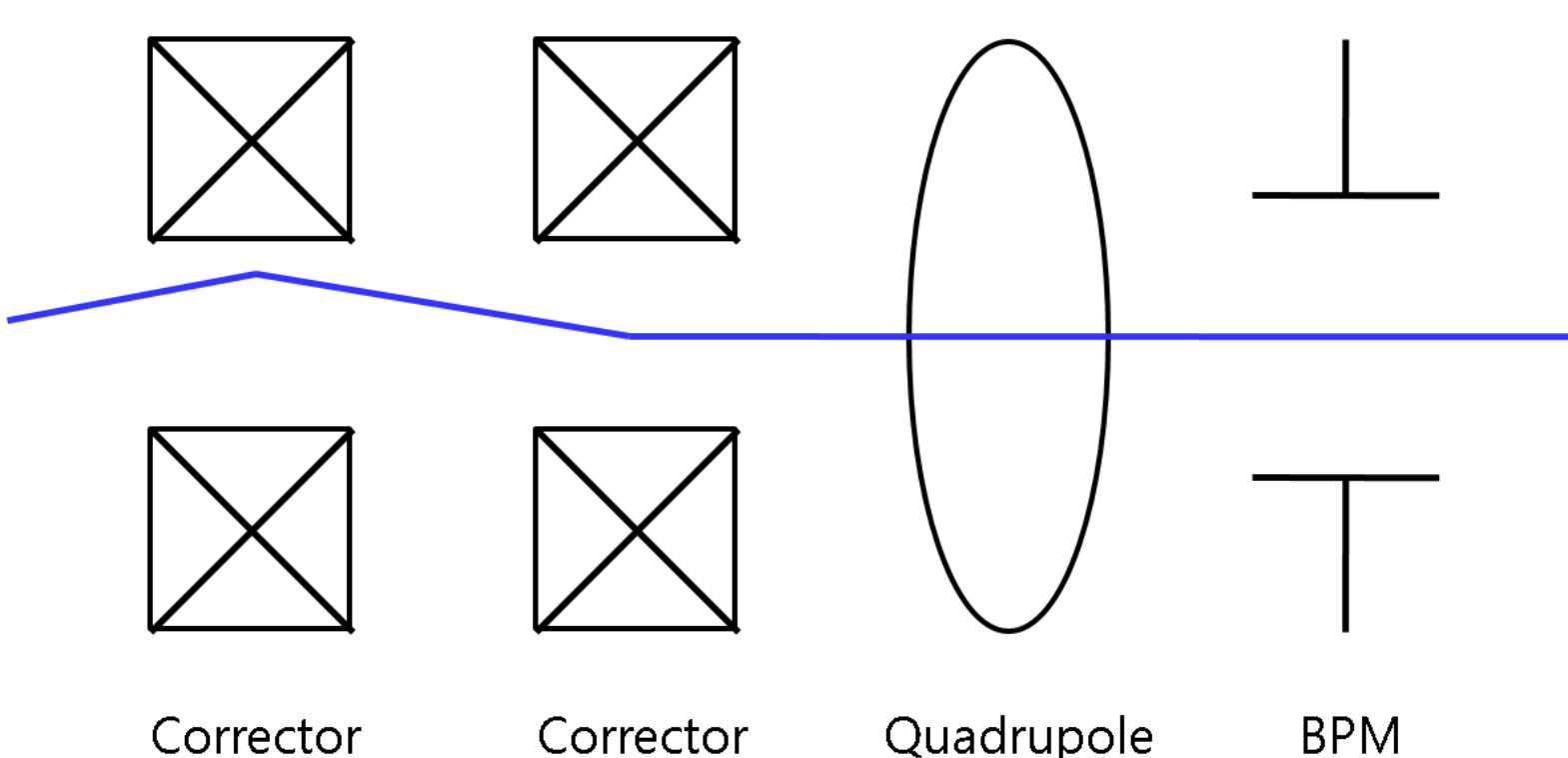
Quad: −1 A   Quad: 0 A   Quad: 1 A

First BBA Result

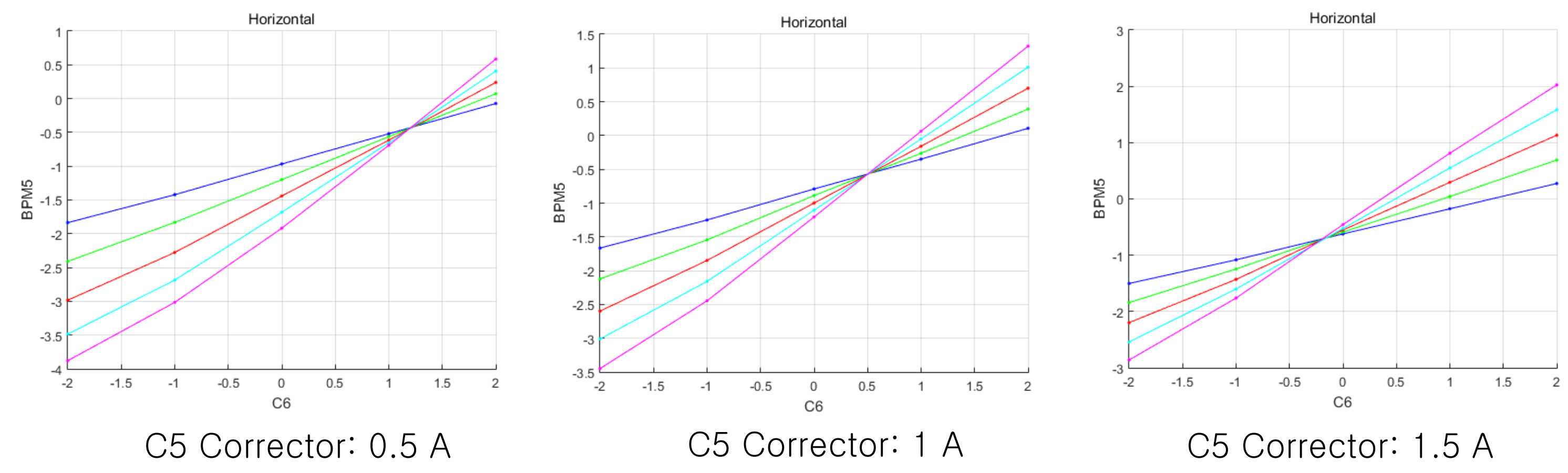## Different BBAs

Double Corrector BBA

Which one is the best BBA?

C5 Corrector: 0.5 A   C5 Corrector: 1 A   C5 Corrector: 1.5 A
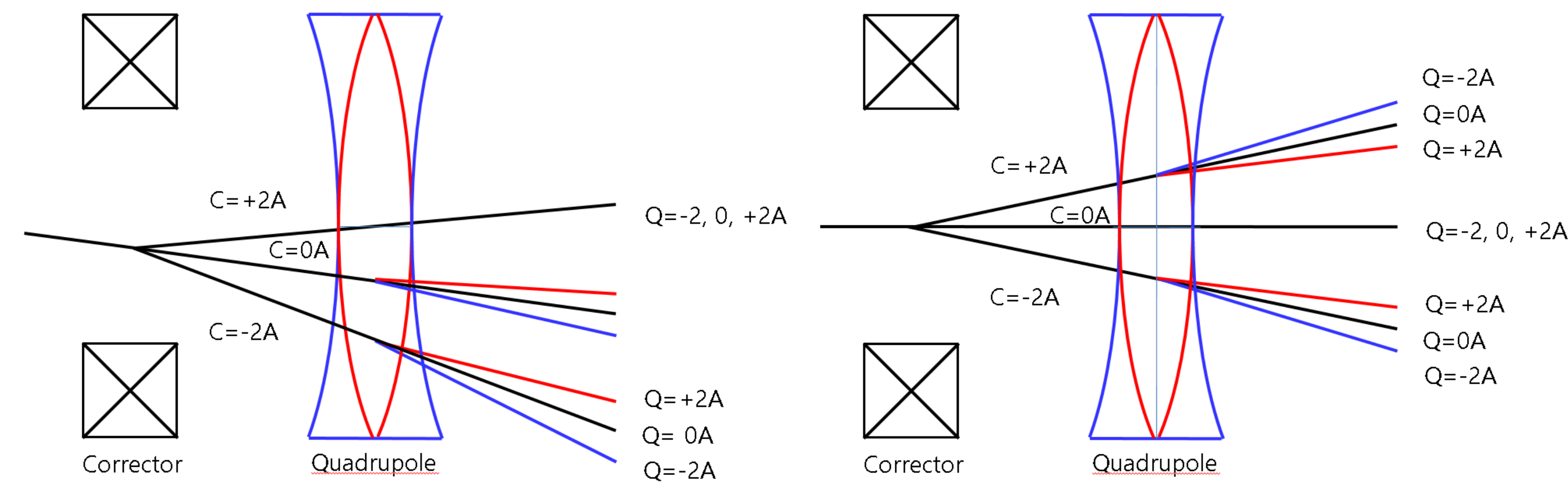
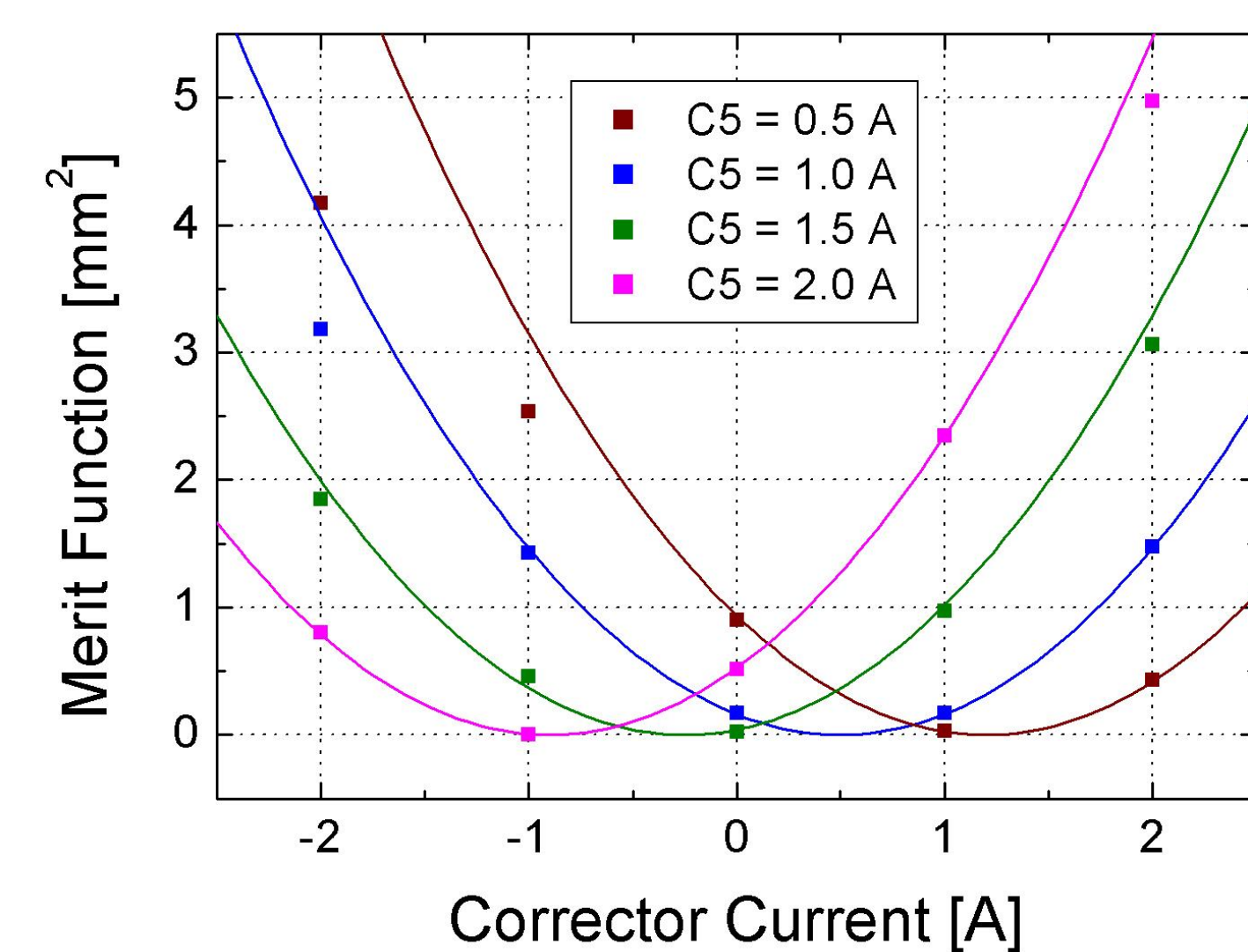## Merit Function

Merit function: $f(I_{cor}) = \dfrac{1}{N_{BPM}} \displaystyle\sum_{i=1}^{N_{BPM}} (x_i(+\Delta k) - x_i(-\Delta k))^2$
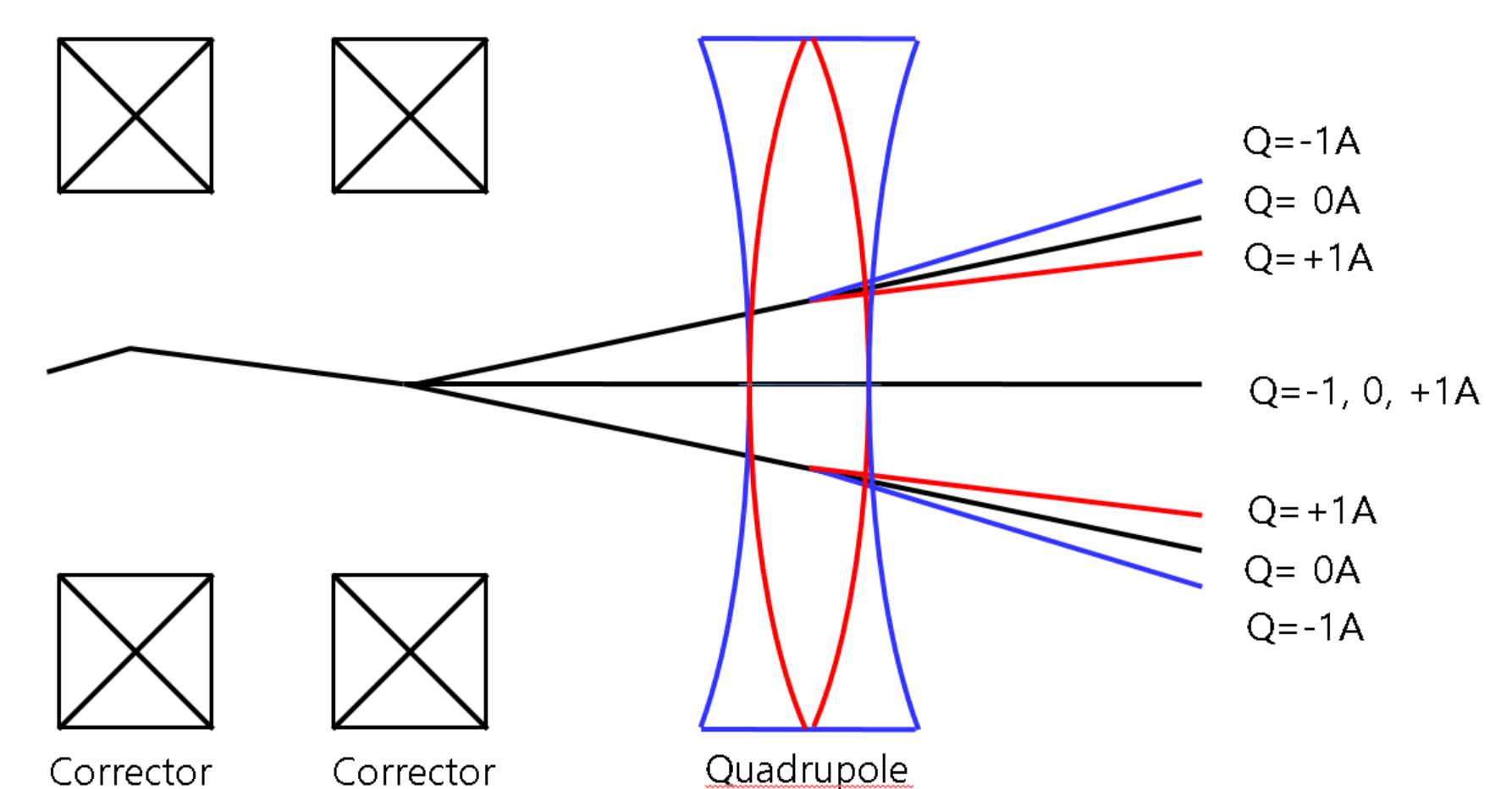
Merit function should be minimum, when the beam is passing the quadrupole center (Storage Ring)
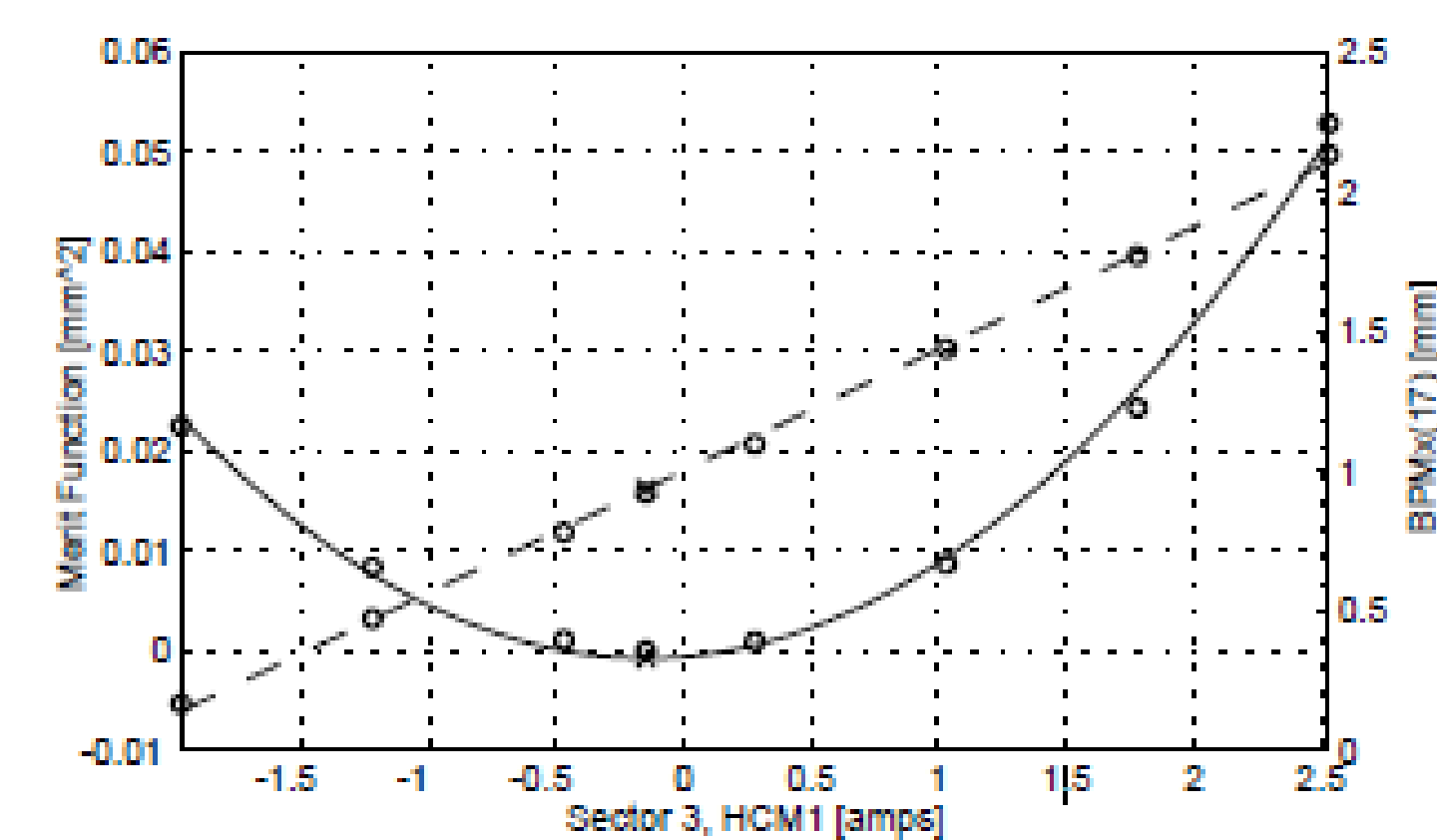
Fitting Result of Merit Function

Double Corrector BBA for Minimum Emittance

Summary

In the e-LABs of the Pohang Accelerator Laboratory, BBA was performed to minimize the beam emittance and a high current was noticed in the corrector setting after BBA was completed. To mitigate this, we tried double corrector BBA to obtain various sets of two corrector currents from different BBA. To determine the best BBA result, we applied the merit function fitting to each result to find the best fitting result. The best-fitting result was achieved with the lowest current value of the second corrector, where we can have the minimum emittance. In places such as the injector or the beam matching point where small emittance is required, a double corrector BBA could be applied to obtain minimum emittance from the charged particle beam.