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Possible Orbit Separator for the IP in RHIC

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To avoid the beam-beam effect of unwanted collisions in the collider, Beam-Beam separators are usually used to separate two beams. For RHIC operation in the high luminosity mode, the practice is also important. There are many methods to separate the beams at the interaction points. In the following, we shall describe an efficient ~~method~~ way of using the phase advance of 90° from the IP to the high β quadrupole for beam separation. Since there are dipole correctors (B_0) in each quadrupole, we shall use a_0 next to the defocusing quadrupoles Q4I, Q2I, Q30 and Q50.

The phase advance from IP to Q2I and IP to Q30 are $\pi/2$ respectively with a kicker arm of $\sqrt{\beta_i \beta_f} \sin \Delta\mu \simeq \sqrt{1250} \simeq 35$ m. Thus a kicker strength of 0.1 mrad can create about 3.5 mm of orbit distortion. The orbit however should be corrected to nearly zero elsewhere. The a_0 correctors at Q4I and Q50 are then excited to eliminate the residual vertical orbit excursion. Fig. 1 shows the orbit bump for the $\beta^* = 6$ m lattice at superperiodicity 3. The residual closed orbit excursion is less than 0.13 mm.

Fig. 2 shows the γ_{co} in the lattice with five $\beta^* = 6$ m insertions and one $\beta^* = 2$ m insertion. The closed orbit a_0 dipoles are excited to reach proper beam separation at these $\beta^* = 6$ m insertion

The effect of $\beta^* = 2m$ insertion gives the residual effect of $Y_{co} \leq 0.5$ mm at the $\beta^* = 2m$ insertion. Due to the antisymmetric structure of the insertion, the $Y_{co} \simeq 0.02$ mm at the IP of $\beta^* = 2m$. We feel that the effect to the collision rate should be small. This effect can however be corrected by the orbit correctors in the $\beta^* = 2m$ insertion,

Fig. 3 shows the Y_{co} as a function of the kicker strength at Q2I. The strength of other kickers is related to Θ_{2I} by

$$\Theta_{4I} = \frac{1.15}{2.15}\,\Theta_{2I}$$

$$\Theta_{3O} = \frac{1.95}{2.15}\,\Theta_{2I}$$

$$\Theta_{5O} = \frac{.89}{2.15}\,\Theta_{2I}$$

Because of these orbit bumps, the beam may move into the nonlinear region of the magnets. One should compromise between large beam-beam separation for minimizing beam-beam interaction and the nonlinear effect due to the magnets. Some types of tracking study/calculation may be useful

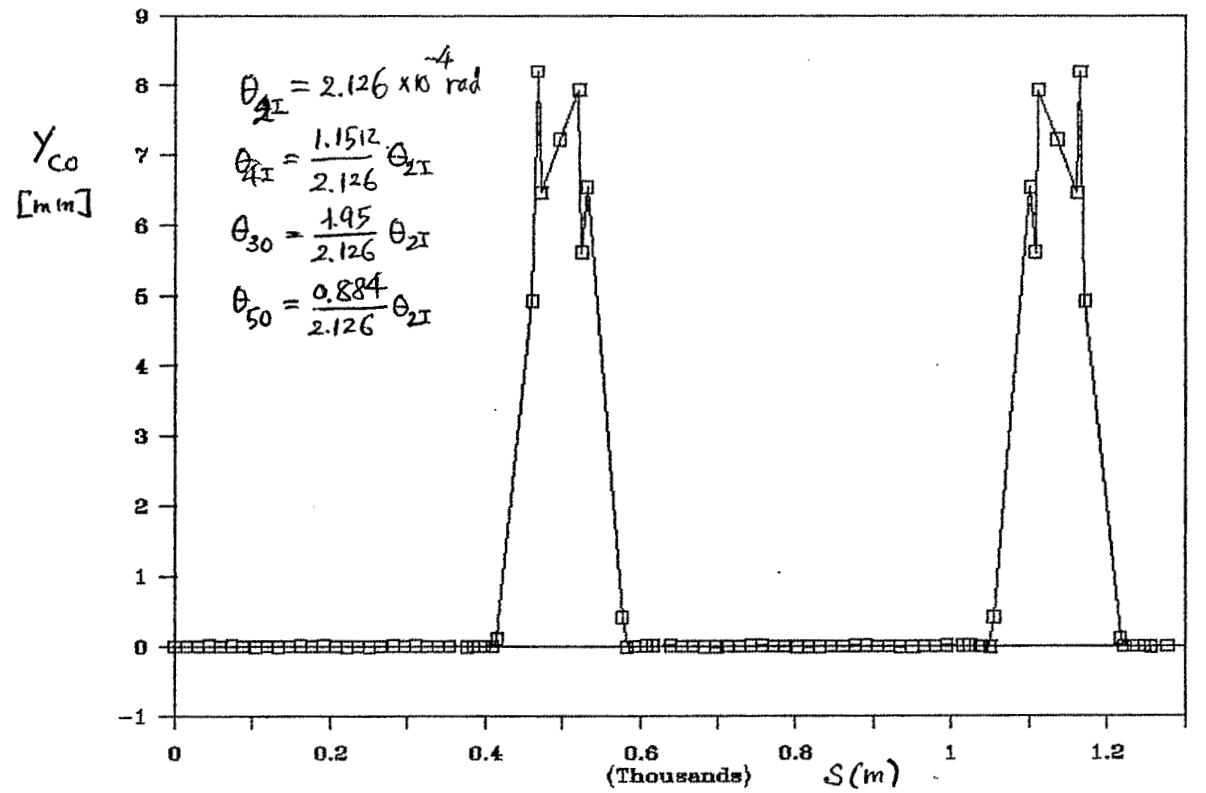
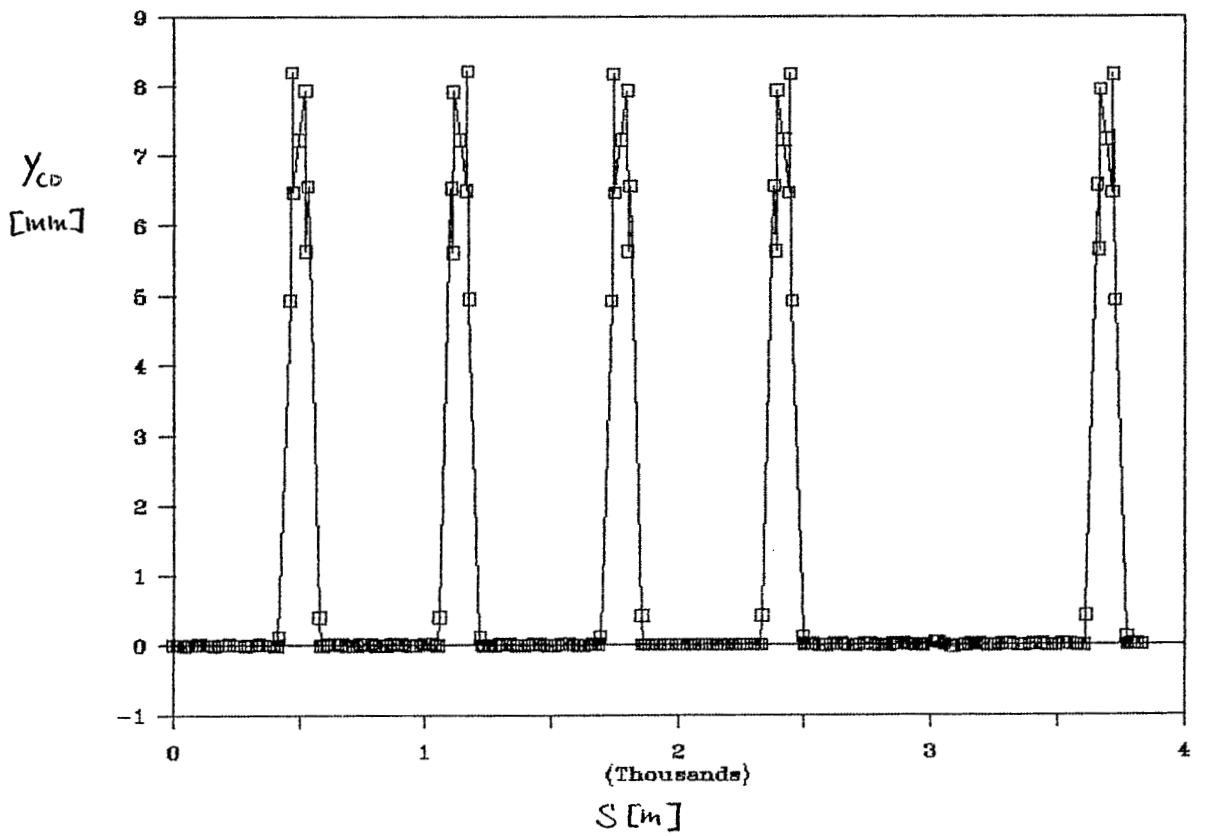


Fig.1 Y_{co} for $\beta^*=6m$ with 3 superperiod

Fig.2 Y_{co} for 5 $\beta^*=6m$ insertions and one $\beta^*=2m$ insertion



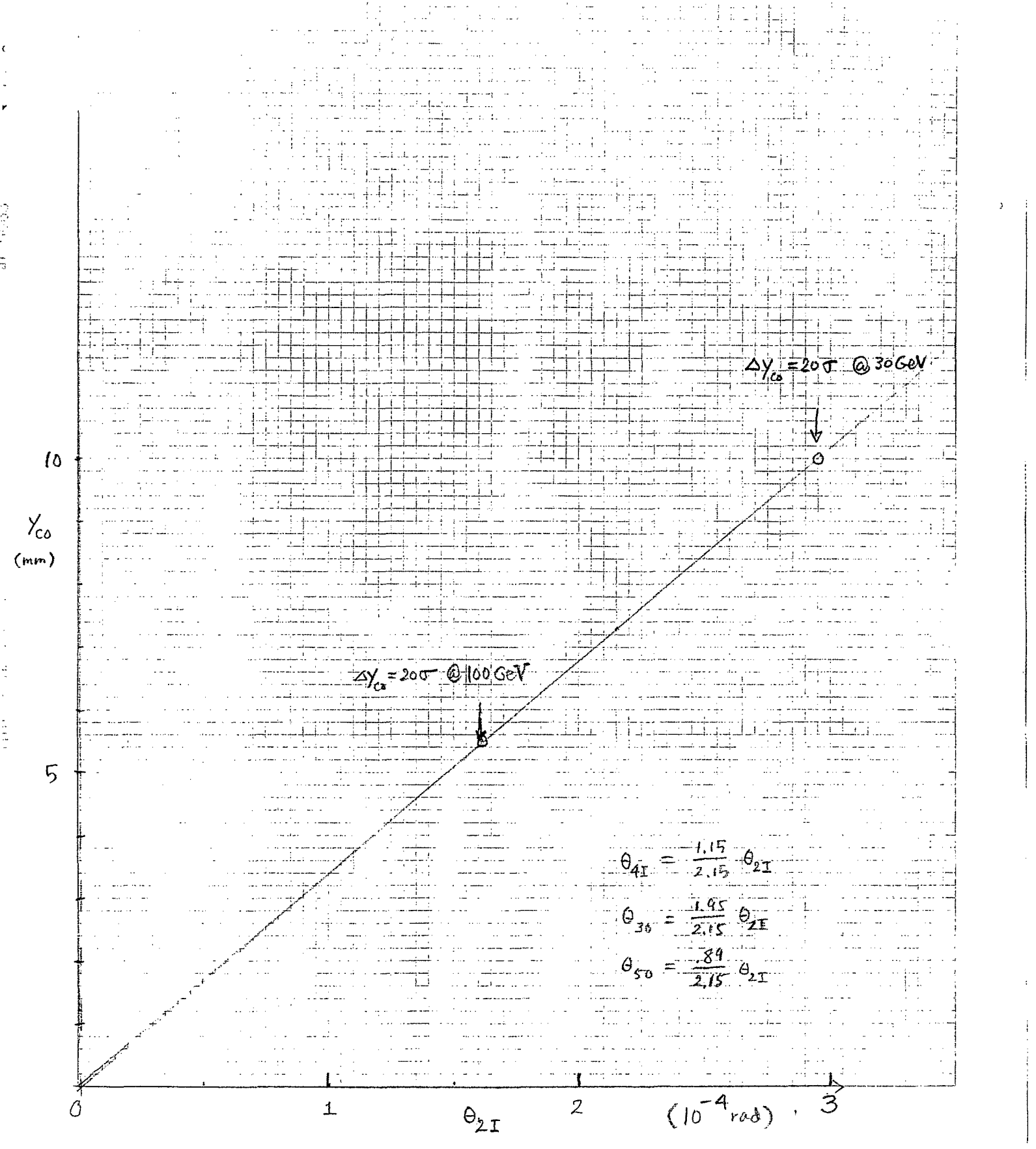


Fig. 3 Y_{co} (mm) vs θ_{2I}