Chromatic Correction Of RHIC when One or Two Insertions is at $\beta^* = 0.5$ m

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The experimental insertion of RHIC can be tuned to $\beta^* = 0.5m$ with the appropriate gradients of the insertion quadrupoles as shown Fig. 1. Under these conditions, proton beams with nominal emittance of 24 $\pi mm\text{-}mrad$ can still be accommodated in the inner triplet of $\beta^* = 0.5m$. However, the off momentum orbit functions are quite sizably distorted while the detuning with the relative momentum becomes large. Figures 2 and 3 show the behavior of the tunes as a functions of the relative momentum with one or two experimental insertions set to $\beta^* = 0.5m$.

A way to reduce the off momentum perturbation of the orbit functions is to introduce six families of chromatic sextupoles according to the following scheme[1]:

Outer Arc	SF	SD + ε_1 SD - ε_1
Inner Arc	SF - ε_2 SF + ε_2	SD

where in the outer arc a perturbation is added to the defocussing sextupoles and on the inner arc a perturbation is introduced on the focussing sextupoles. This is well suited to reduce the maximum sextupole excitations. As a result of the chromatic detuning of RHIC becomes reasonably smooth as shown in Fig. 3 and 4 for one or two insertions with $\beta^* = 0.5m$.

To limit the sextupole excitation to below 100$Amps$, it is suggest to use only one $\beta^* = 0.5m$ insertion for proton -proton collisions. The use of it for ions will be limited due to the larger emittances growths caused by intrabeam scattering.

No attempt was made to correct the chromatic effects of the insertion with a local correction scheme to avoid large sextupole excitations. There are many studies that need to be done including tracking to better understand this correction scheme.

References

[1] Conceptual Design of the Relativistic Heavy Ion Collider, May 1989, BNL-52195

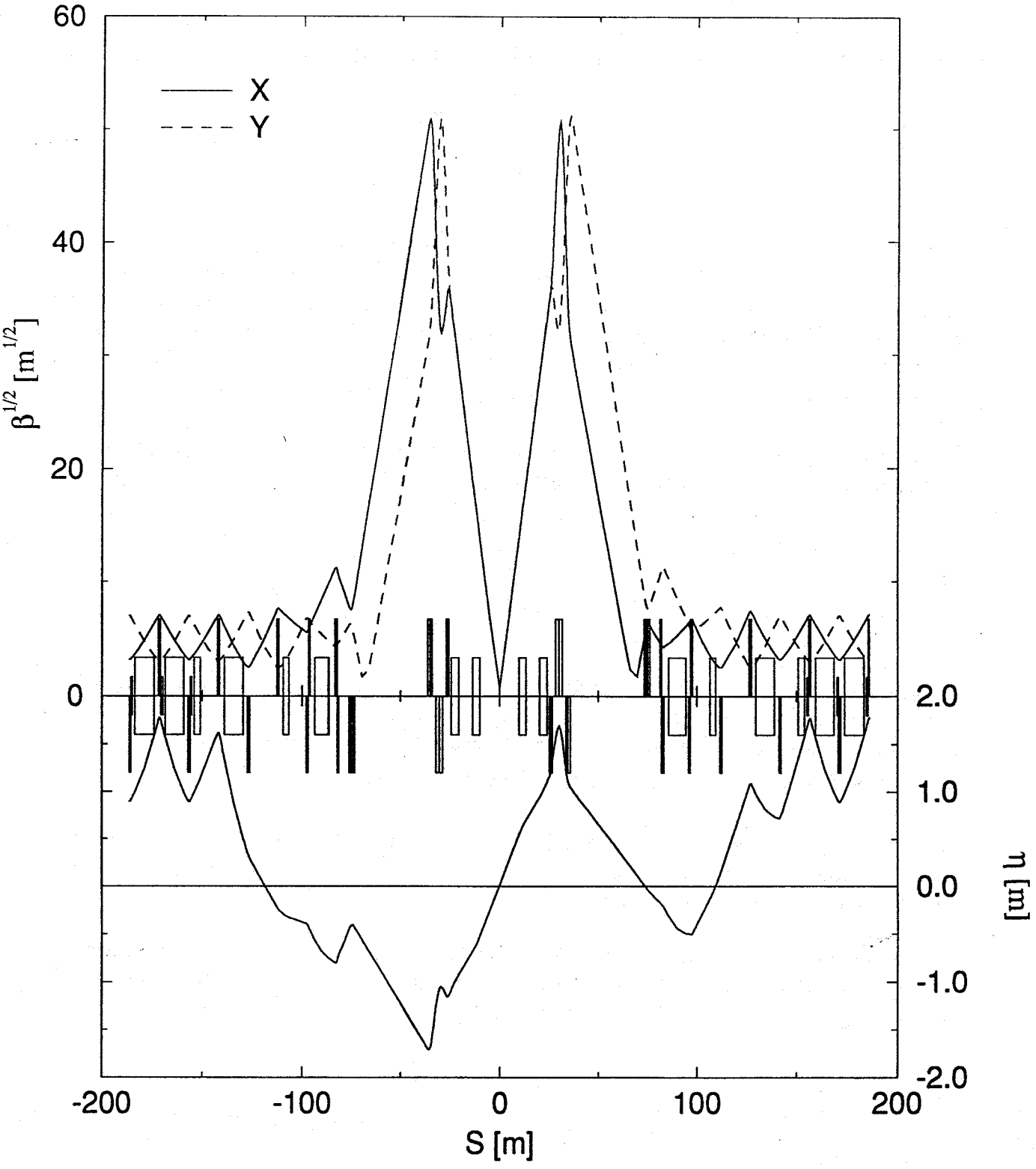

Figure 1. The beta and dispersion functions of a RHIC insertion at β*=0.5m.

Two Families of Sextupoles.

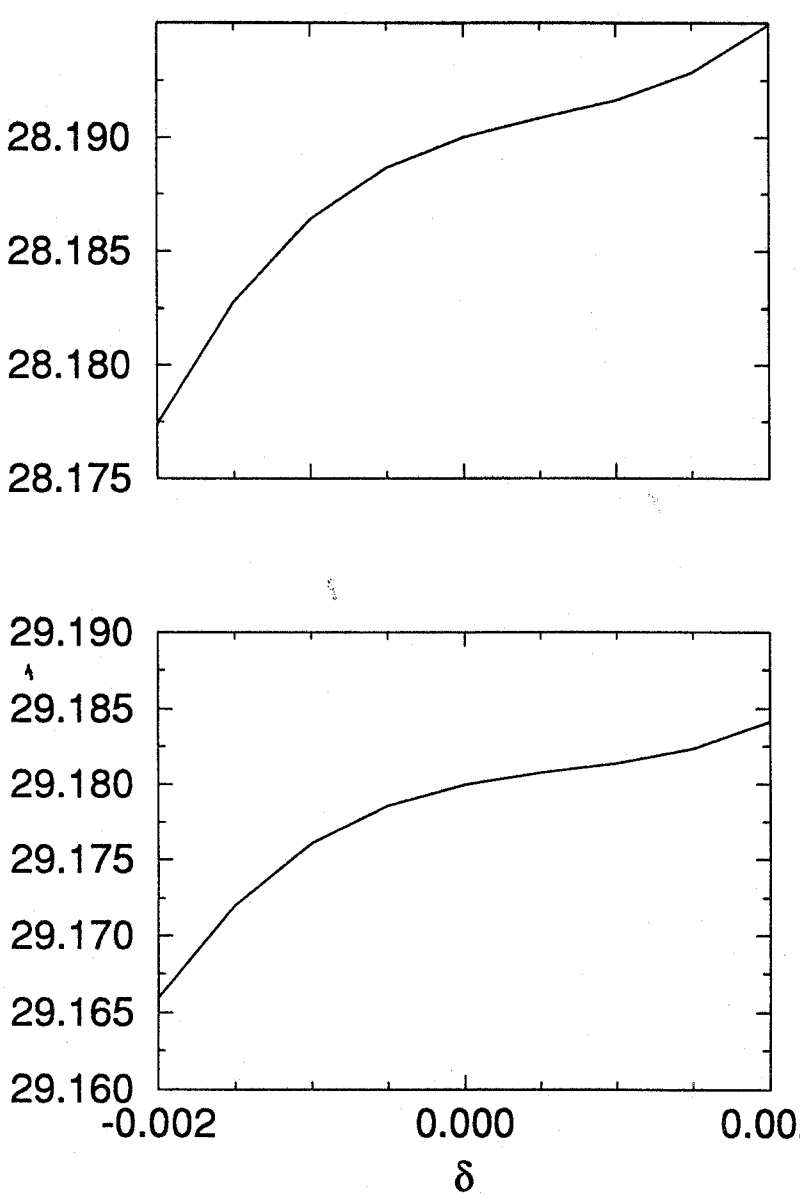

Figure 2 One insertion at $\beta^* = 0.5$m

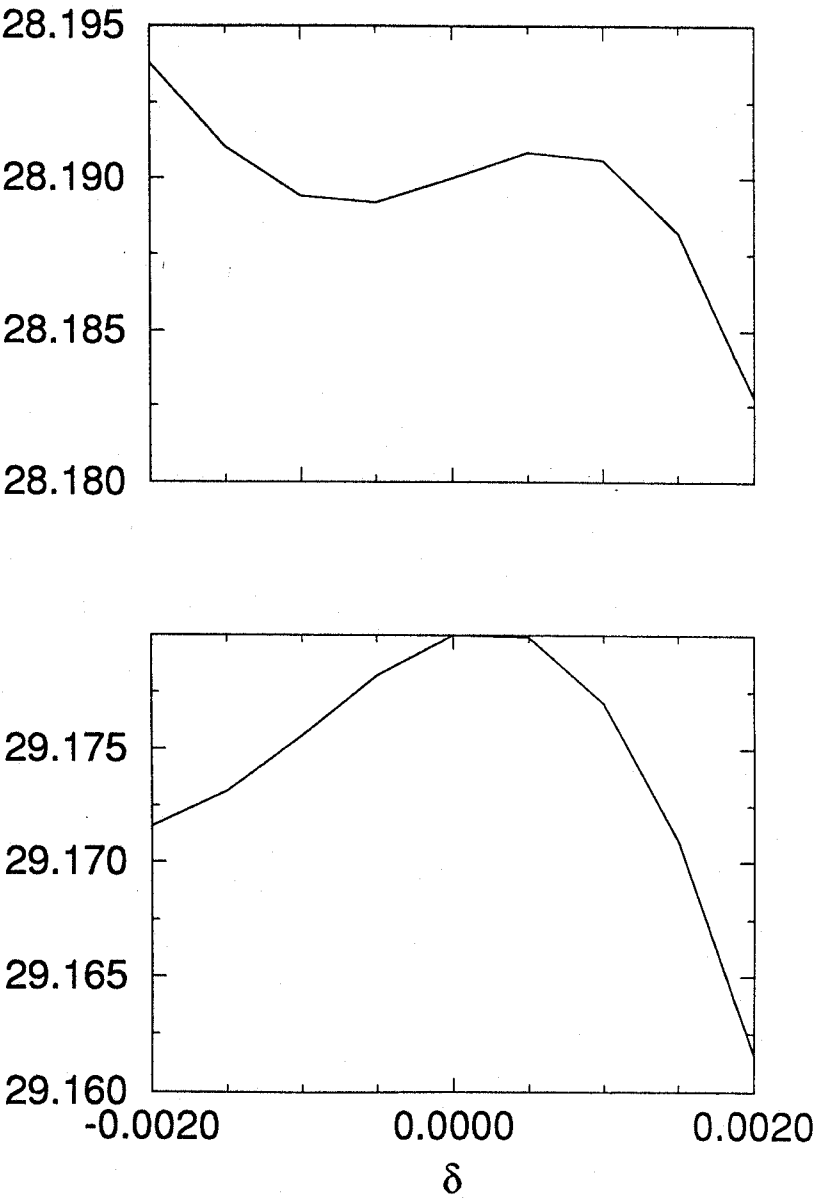

Figure 3 Two insertions at $\beta^* = 0.5$m

Six Families of Sextupoles

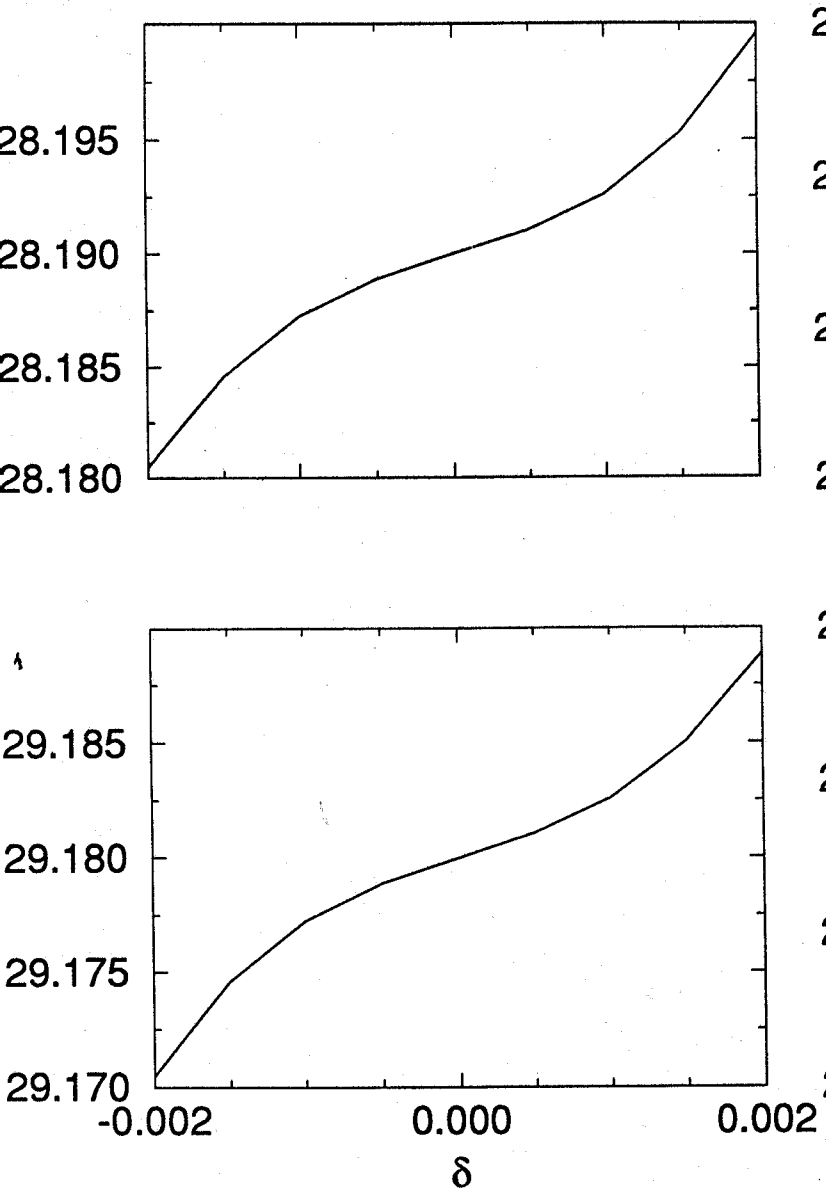

Figure 4 One insertion at $\beta^* = 0.5$m

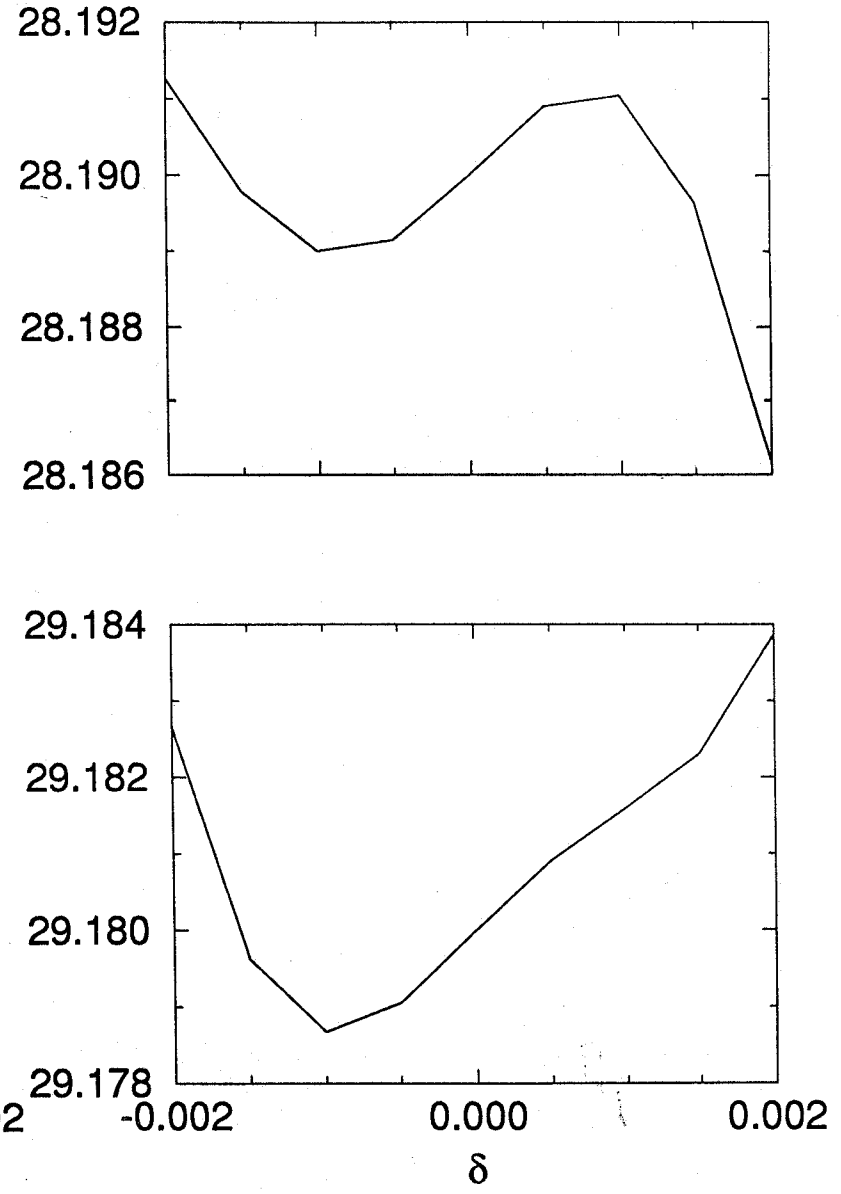

Figure 5 Two insertions at $\beta^* = 0.5$m