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**The Dependence of the Dynamic Aperture  
on  $\beta^*$  in RHIC**

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# The Dependence of the Dynamic Aperture on $\beta^*$ in RHIC

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Tracking studies were done to study the dependence of the dynamic aperture of  $\beta^*$ , the beta function at the crossing points, in RHIC92. RHIC92 can be tuned over a wide range<sup>1</sup> of  $\beta^*$ , roughly  $\beta^* = 1$  to  $\beta^* = 16$ . For low  $\beta^*$ ,  $\beta^* \simeq 2$ , one expects the dynamic aperture to increase with  $\beta^*$  roughly like  $\sqrt{\beta^*}$ . However at higher  $\beta^*$ ,  $\beta^* \geq 6$ , the dynamic aperture increases fairly slowly with  $\beta^*$ . This is shown in Fig. 1 where the dynamic aperture as measured by  $A_{SL}$  is plotted against  $\beta^*$ .  $\beta^*$  is assumed to be the same at all six crossing points. Tracking runs for 1000 turns at  $\Delta p/p = 0$  were done to find  $A_{SL}$ .

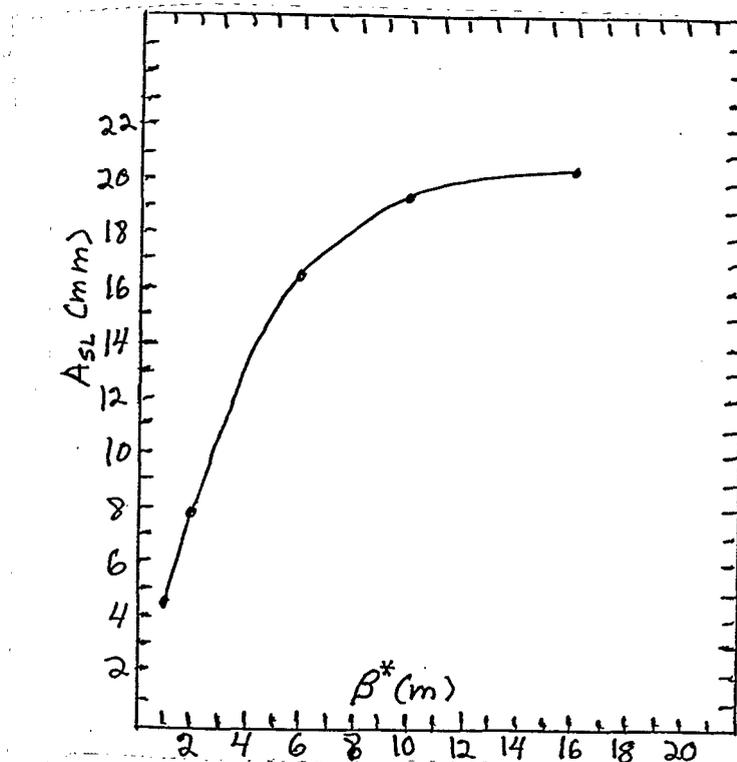


Fig. 1: Dynamic aperture versus  $\beta^*$ .

At low  $\beta^*$ ,  $\beta^* \sim 2$ , the dynamic aperture is dominated by the high beta magnets in the insertions, Q2, Q3 and D0. In this region the dynamic aperture increases roughly like  $\sqrt{\beta^*}$  since the beta function in the high beta magnets goes roughly as  $1/\beta^*$ . For higher  $\beta^*$ ,  $\beta^* > 6$ , the beta function in the high beta magnets has decreased sufficiently that the arc magnets begin to dominate. In this region the dynamic aperture does not change much with  $\beta^*$ , as changing  $\beta^*$  does not change the beta function in the arc magnets.

One reason for doing this study is that long term tracking studies with synchrotron oscillations<sup>2</sup> indicate that the dynamic aperture is getting tight at low  $\gamma$ ,  $\gamma \simeq 30$ . This study indicates that going to even higher  $\beta^*$  will not help a great deal.

A table of  $A_{SL}$  versus  $\beta^*$  is given below

$\beta^*$ (m)	$A_{SL}$ mm	$\pi A_{SL}^2/\beta_x$ $\pi$ mm·mrad
1	4.25	0.36
2	7.75	1.20
6	16.5	5.44
10	19.5	7.60
16	20.5	8.40

I wish to thank S. Tepikian and G. Fritz Dell for help in getting the different  $\beta^*$  lattices.

## References

1. S. Tepikian, M. Harrison, Conceptual Design of the RHIC92 Insertion, AD/RHIC/AP-103 (1992).
2. G. Parzen, Long Term Tracking with Synchrotron Oscillations and the Momentum Aperture in RHIC, Memo to M. Harrison and S. Ozaki (1992).