December 1, 1978/L. C. Teng

ENERGY DOUBLER CIRCUMFERENCE - pp colliding beams considerations

1. Proper orbit length in ED for pp.

Depends on MR energy T_{MR} (ED energy of 1000 GeV is essentially ∞).

For colliding beams

$$\frac{\Delta f}{f} = \frac{\Delta\beta}{\beta} - \frac{\Delta L}{L} = 0 \qquad L = 2\pi R = \text{orbit length}$$

$$\frac{\Delta R}{R} = \frac{\Delta L}{L} = \frac{\Delta\beta}{\Delta} \cong \frac{1}{2\gamma_{MR}^{2}} \qquad \Delta R = \text{average displacement}$$

$$\frac{\Delta p}{p} = \gamma_t^{2}\frac{\Delta R}{R} = (18.75)^2\frac{\Delta R}{R} \qquad \Delta p = \text{momentum deviation}$$

$$\Delta x_{max} = \eta_{max}\frac{\Delta p}{p} = \eta_{max}\gamma_t^{2}\frac{\Delta R}{R} = \frac{5.91\times(18.75)^2}{1000}\Delta R$$

$$= 2.08\,\Delta R \qquad \Delta x_{max} = \text{max displacement.}$$

T_{MR} (Gev)	ΔR (cm)	Δx_{max} (cm)	$\Delta p/p$ (%)
100	4.32	8.99	1.52
150	1.93	4.01	0.68
200	1.09	2.27	0.38
250	0.70	1.46	0.25

2. Conclusion

Build in $\Delta R \sim 1$ cm (ED larger) so that for 200 GeV x 1000 GeV both beams are on center. This way one can probably go down to 150 GeV x 1000 GeV.

For injection from MR to ED one gives the MR beam a $\frac{\Delta p}{p}$ = 0.38% ($\Delta R \sim 1$ cm) before extraction. The beam will then enter the ED on center. Or one can split the difference; namely give the MR beam $\frac{\Delta p}{p}$ = 0.19% before extraction. The beam will then enter the ED with $\frac{\Delta p}{p}$ = - 0.19%.

For future stacking injection into ED we give the MR beam $\frac{\Delta p}{p}$ = 0. The beam goes into ED 1 cm off center which is proper for stacking.