IS THE PP OPTION AT FERMILAB INTERESTING FOR A B FACTORY ?

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This note speculates on the possibility of using the Fermilab Tevatron ring, in conjunction with the Main ring, as a pp machine, with the specific application of a B factory in mind. The general scheme envisaged is the following: proton beams are stored in both the Tevatron and the Main Ring, with the beam direction reversed in one or the other of the two machines. The beams are then made to collide in an appositely built intersection region. Assuming, for example, operation of the main ring as a storage device at 200 Gev[1] , and of the Tevatron at 800 Gev, one obtains $\sqrt{s}$= 800 Gev, which yields a crossection for b production of approximately 10 microbarns. Due to the asymmetry of the beam energies, rapidity distributions in the lab are shifted by approximately 0.8 units of rapidity with respect to those in the c.m. system.

The motivation for the scheme is, obviously, the quest for comparable or higher luminosity than that possible in the upgraded Tevatron collider design. If one were extremely optimistic, one might even hope to obtain sufficient luminosity with a non-zero crossing angle for the two beams, and thus a reduced interaction region. Such a feature could greatly simplify the problem of efficient vertex finding and tracking.

Private comunication with F.Nezrick informed me that a similar scheme has, of course, already been considered in Fermilab Proposals #491[2] and #493[3] (circa 1976). The conclusion of both groups was that a luminosity of several times 10^{31} could be obtained, using stacking to increase the intensity of the Tevatron beam. This alone would result in about half the yield of B's obtained with the 5×10^{31} luminosity envisaged for the upgraded Tevatron.

The question therefore comes to mind as to whether this is an interesting path to follow, and whether an update to these studies might be useful. Table I is the list of machine parameters assumed in Proposal # 491. For an analogous scheme, a luminosity estimate of 6×10^{30} was given in Proposal # 493. (For these estimates, no proton stacking in the Tevatron ring is assumed.) Inspection of the table raises several obvious questions, such as:

- What is the shortest bunch length achievable, and can one design a

low beta region to match it?

(For a given bunch length L_b, the lowest useful β is $\approx \frac{L_b}{2}$. In Table I: $\beta \approx 20 \times \frac{L_b}{2}$)

- For a given number of protons in each beam, the time averaged luminosity is, among other things, a function of:

  - the time required to achieve each beam
  - the lifetime of each beam.

  What scheme optimizes the above, and what is the resulting luminosity? Since, presumably, the time needed to achieve proton beams is short compared to that needed for preparing $\bar{p}$ beams, there may exist a regime of relatively high intensity, short lived beams, resulting in a significantly higher time averaged luminosity than that possible at the $p\bar{p}$ collider.

REFERENCES.

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Colliding Beam Devices at Fermilab
D.Cline,P.McIntyre,D.D.Reeder,C.Rubbia and L.Sulak

Table I - Colliding Beam Parameters

	Main Ring	Doubler	Units
Energy	150	1000	GeV
Intensity	2×10^{13}	2×10^{13}	
Interaction β	2.5	28	Meters
η	.14	.28	Meters
$\sigma_h = \sigma_v$	.023	.030	cm.
$\eta\ \sigma_p$	.0015	.0005	cm.
RF volts/turn	3	.45(?)	MeV/turn
σ_p	1.1×10^{-4}	$.17\times10^{-4}$	
σ_ℓ	9.6	9.6	cm.
Tune shift	.0004	.0010	
90% interaction length	22		cm.
Luminosity	2.0×10^{30}		$cm.^{-2}\ sec.^{-1}$