## II.A. $b\bar{b}$ AND $c\bar{c}$ PAIR EVENT RATES FOR PROTON, PHOTON AND NEUTRON BEAMS AT THE TEVATRON

In this section we estimate the number of produced $b\bar{b}$ and $c\bar{c}$ (pairs) events produced by three of the available beams at the Tevatron. As the basis for this estimate we assume the cross section on nuclear material goes as A and hence quote our numbers for event rates in terms of the number of events per gram. However, for the total interaction rate, the cross section goes as $A^{2/3}$. Therefore, it is convenient to calculate the total interaction rate on the basis A = 1. Hence if a heavy target is used the total interaction rate must be divided by $A^{1/3}$. For example, if the target is silicon, the total interaction rate must be divided by 3.

In order to be useful for the design of experiments we have used a beam intensity and energy appropriate for each beam. For the photon and neutron beams we have integrated the cross section over the appropriated energy distributions. The final numbers are given in terms of an "ideal" hour of accelerator time. This implies 60 pulses per hour, each with a ten second flat top and each with $2 \times 10^{13}$ protons circulating in the machine. The estimated spot size at the target for each beam has been based on present and past experience. The Table I summarizes our estimates.

We can draw some general conclusions from this table. We will assume a useful experiment would yield 150 "analyzed" $b\bar{b}$ events in 1000 hours of running time. The table indicates that the total event triggering efficiency, which includes the geometric acceptance, must be of the order or better than 5%. The goal of an experiment design should include an overall efficiency of the order of 10%.

We must note that in the Tevatron region $b\bar{b}$ cross sections are rapidly changing with energy, hence all estimates are subject to factors of $\pi$ error at least.

| Beam | Intensity | Energy | σ $B\bar{B}$ | σ $c\bar{c}$ | Spot Size | Total # Interactions per Gram per Hour x A 1/3 | Total # $B\bar{B}$ Pairs per Gram per Hour | Total # $c\bar{c}$ Pairs per Gram per Hour | Maximum "Practical" Intensity | Maximum Total# Interactions per Gram per Hour x A 1/3 | Maximum Total # $B\bar{B}$ Pairs per Gram per Hour | Maximum Total # $c\bar{c}$ Pairs per Gram per Hour |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Proton | $10^{6}$/sec incident | 1000 GeV | $10^{-32}$ | $10^{-29}$ | Small | $1.2 \times 10^{7}$ | 3.6 | 3,600 | $1.2 \times 10^{7}$/sec (Detector Limit) | $1.2 \times 10^{8}$ | 36 | 36,000 |
| Gamma | $7.5 \times 10^{6}$ Photons per $10^{12}$ Protons | Eγ >200 $\frac{dk}{k}$ spectrum | $\bar{\sigma}_{33}$ | $\bar{\sigma}_{30}$ | 1"x1" | $2.7 \times 10^{4}$ (only hadronic) | 0.27 | 270 | $9 \times 10^{7}$ (Proton Limit $1.2 \times 10^{13}$ protons) | $3.2 \times 10^{5}$ | 3.2 | 3,200 |
| Neutron | $6.0 \times 10^{8}$ per $10^{12}$ Protons | E peak =750 E > 500 | $\bar{\sigma}_{4x10^{-33}}$ | $\bar{\sigma}_{4x10^{-30}}$ | 1"x1" | $8.7 \times 10^{8}$ | 87 | 87,000 | $2.5 \times 10^{8}$ per $4.1 \times 10^{11}$ Protons | $1.2 \times 10^{8}$ | 36 | 36,000 |