

Radiation Levels in the 8GeV Beamline Arising from the Tevatron Beam Losses

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We have evaluated the radiation level at the 8GeV beam line arising due to muons produced by an accidental beam loss at a point in the E and/or F sectors of the Tevatron. Recently it has been pointed out that the tangential distances from the Tevatron to many points on the 8GeV beam line could be less than 820ft. For high energy direct muons (of energy more than about 100GeV) produced due to accidental Tevatron beam loss, the range is of the order of 656ft or more. Hence there is radiation concern especially during the construction of the 8GeV beam line.

The calculations made here are similar to those presented in MI note MI-0099. We emphasize the scenario corresponding to the fixed target operation of the Tevatron. During the fixed target runs the intensity of the circulating proton beam in the Tevatron will be about a factor of four to five times larger than one during the collider runs. Hence under accidental conditions of beam losses one can expect higher radiation levels.

The following assumptions will go into the estimation of the total radiation dose:

-Tevatron Beam Energy for fixed target operation = 800GeV
(Hence the Tevatron dipole field $B_T = 3.54$ Tesla)

-Total maximum beam loss at a point in the Tevatron = 3×10^{13} /accident

The Figure 1 displays the contours of equal radiation dose due to an 800GeV proton being lost in a Tevatron magnet. The Figure 2 shows the radiation level in the soil as a function of the distance along the primary beam direction if all 3×10^{13} protons are lost at a point in the Tevatron. The tangential distances (in feet) from the various points in the Tevatron E and F sectors to points in the presently designed 8GeV beam line are listed in the Table I (last column). The radiation levels at different points on the 8GeV beam line are shown by a band on Figure 2. The excavation, with OSHA slopes, decreases path length of the soil shielding by up to 65ft. Thus we find that, corresponding to the minimum tangential distance of 722ft

(which is 240m-20m), a maximum radiation is about 1.3mRem/accident.

In reality, losing 3×10^{13} 800GeV protons at a single point in the Tevatron is highly unlikely. But from the point of view of shielding we assume entire beam loss at a point. Hence above estimation is highly conservative. Besides, during the last fixed target run we had a maximum Tevatron beam intensity of 1.8×10^{13} protons per cycle. Before MI era we do not expect fixed target intensity per cycle will be far better than the last fixed target runs. Taking these efficiencies into account we expect the maximum radiation level at any point on 8GeV beam line excavation should be considerably less than 1mRem/accident.

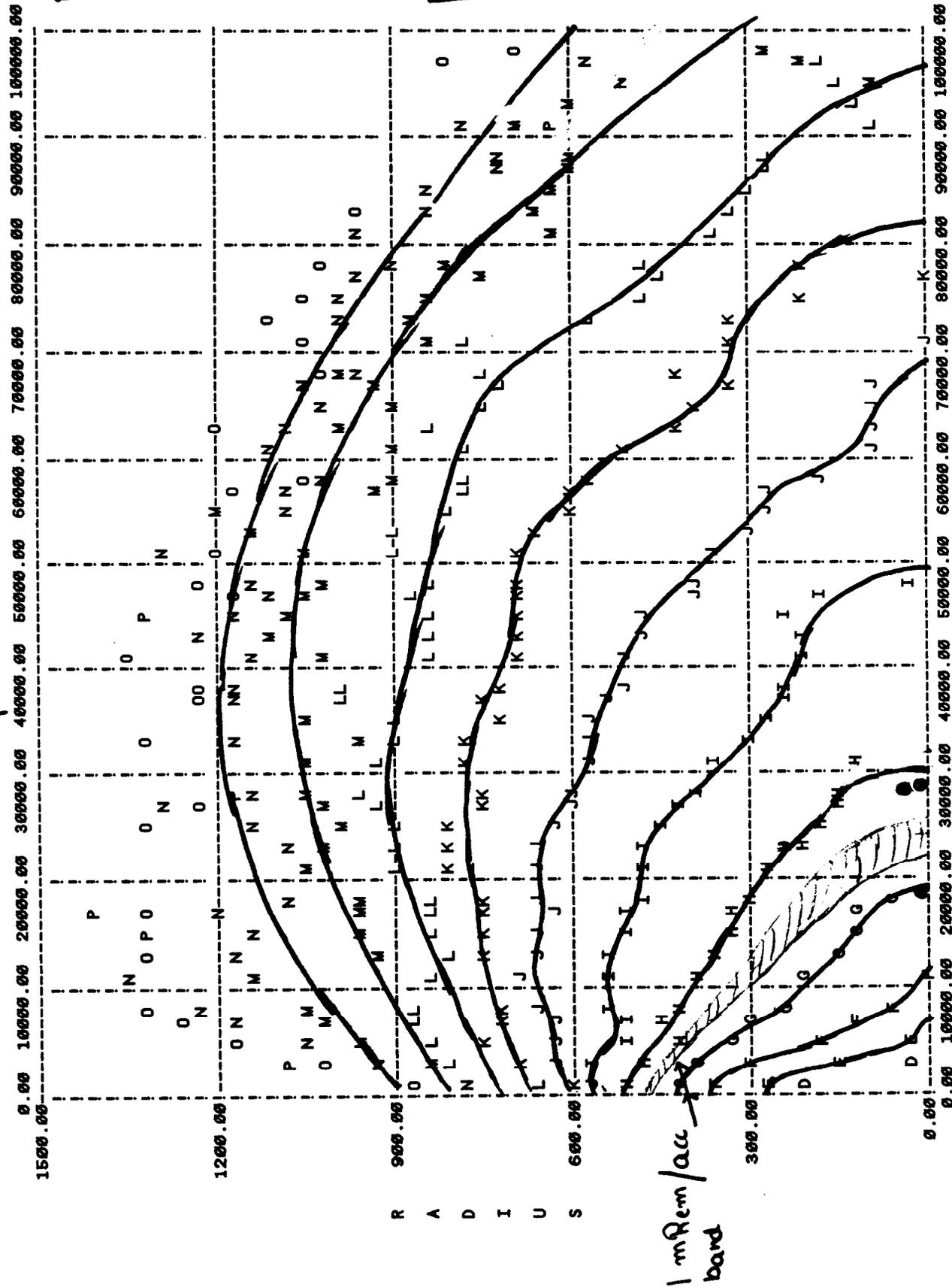
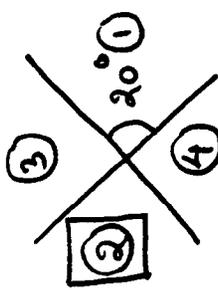
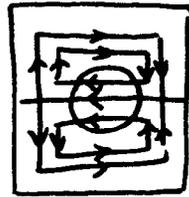
At F17 in the Tevatron, the ministraight with missing magnets presents a different geometry. However, the tangent to F17 connects to the 8GeV line between quads M829 and M830(see Table I), near the AP2 line. This construction will be done during machine downtime, and hence muons from F17 are not a concern. (If this construction were to be done during the fixed target operation, in which case the antiproton source experiments would be idle, the soil (of about 1000ft) would reduce dose rates to about 1mRem.)

CONTOURS OF EQUAL ABSORBED DOSE (RAD/INC.PTCLE) for regio = 2
 CONTOURS ARE SHOWN FOR INTEGRAL POWERS OF 10

μ - Dose

800 Gen

$B_x = B_z = 0$
 $B_y = 3.54 \text{ Tesla}$
 17. M. magnet



R-LABELS REFER TO SMALLER VALUES OF CORRESPONDING BINS
 LEGEND : NUMERICAL SYMBOLS REFER TO THE NEGATIVE POWER OF 10 OF THE STAR(ENERGY) DENSITY E.G., 5 REFERS TO THE 10⁻⁵ CONTOUR
 OTHER POWERS OF 10 (SYMBOLS) :-10(A), -11(B), -12(C), -13(D), -14(E), -15(F), -16(G), -17(H), -18(I), -19(J), -20(K), -21(L), -22(M)

μ -Radiation Level vs Tangential Distance from the Tevatron

For the Fix Target Beam Loss = $3.0E13$ ppp @ 800GeV

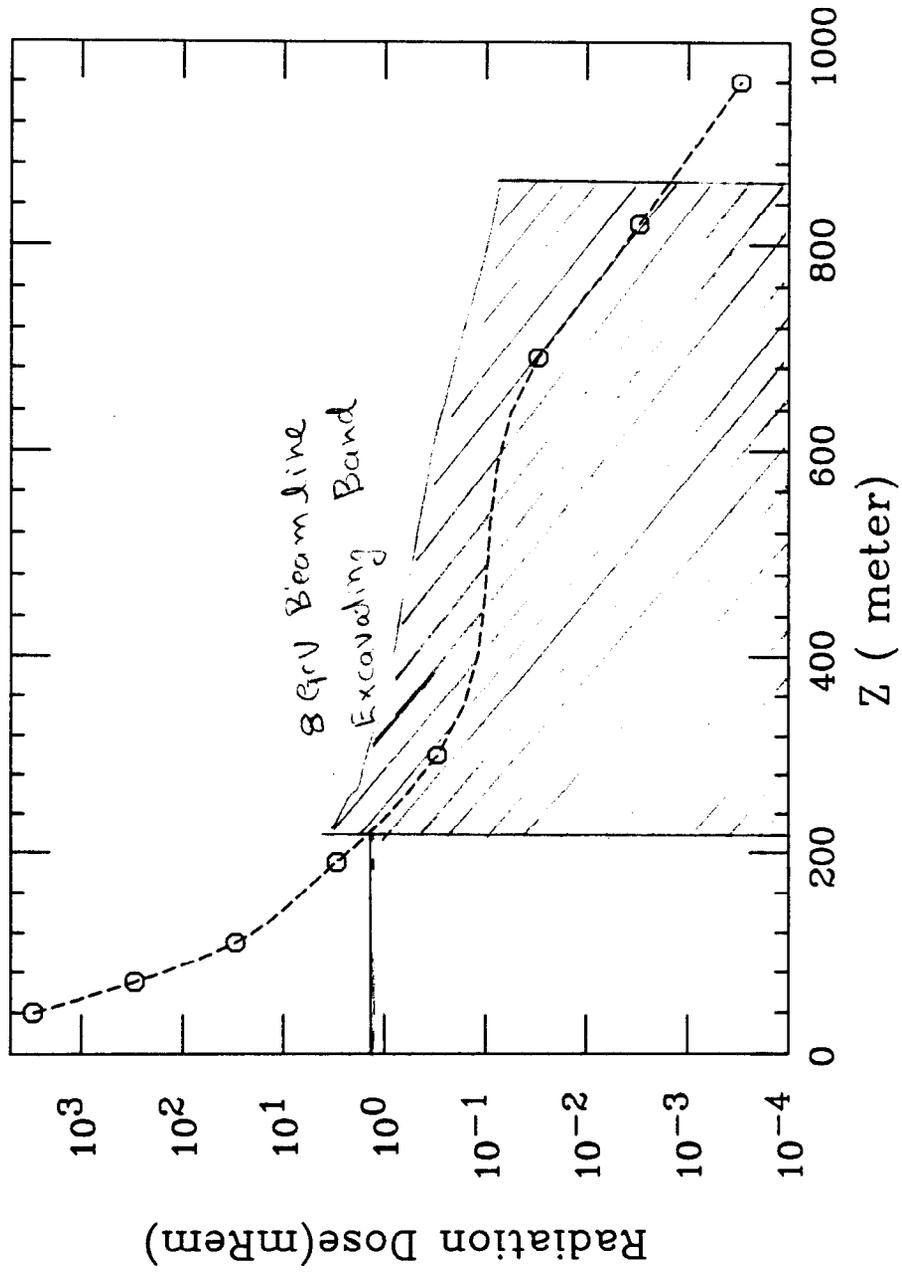


Fig. 2