Energy Deposition in the Tevatron Electron Lens *

M.A. Kostin

Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510

January 25, 2005

Abstract

1 Model

The energy deposition in the Tevatron electron lens was simulated with the MARS15 code [1],[2]. The model includes two last quadrupoles upstream of the proton dump (proton direction), proton kickers, proton and antiproton dumps and the electron lens. An extra shielding element was added to the model to check out how the shielding affects the energy deposition in the electron lens. The extra shielding element was assumed to be made of iron with the same aperture as the aperture of a drift pipe. The transverse dimensions were same as the ones of the beam dumps. An elevation view of the model with beam tracks is shown in Fig. 1. The energy deposition due to dumped proton beam only was simulated, since that due to albedo of the antiproton beam is negligible compared to the above. The proton beam intensity was 10^{13} protons per dump.

2 Simulation Results

Energy distribution plots with and without the extra shielding block are shown in Figs. 2–5. The maximal energy deposited in the super-conductive coil of the lens are:
115 ± 3 mJ/g for no-shielding model and
1.12 ± 0.11 mJ/g with the shielding block.
A word of caution is here. Even through the last number is below the quench limit of 1.6 mJ/g, prediction uncertainty due to simplified geometry representation can be as high as a factor of 2-3. Given the proximity of the quench limit and the prediction it would not be conservative enough to guaranty the normal lens operation during the beam abort.

*This work was supported by the Universities Research Association, Inc. , under contract DE-AC02-76CH03000 with the U.S. Department of Energy.

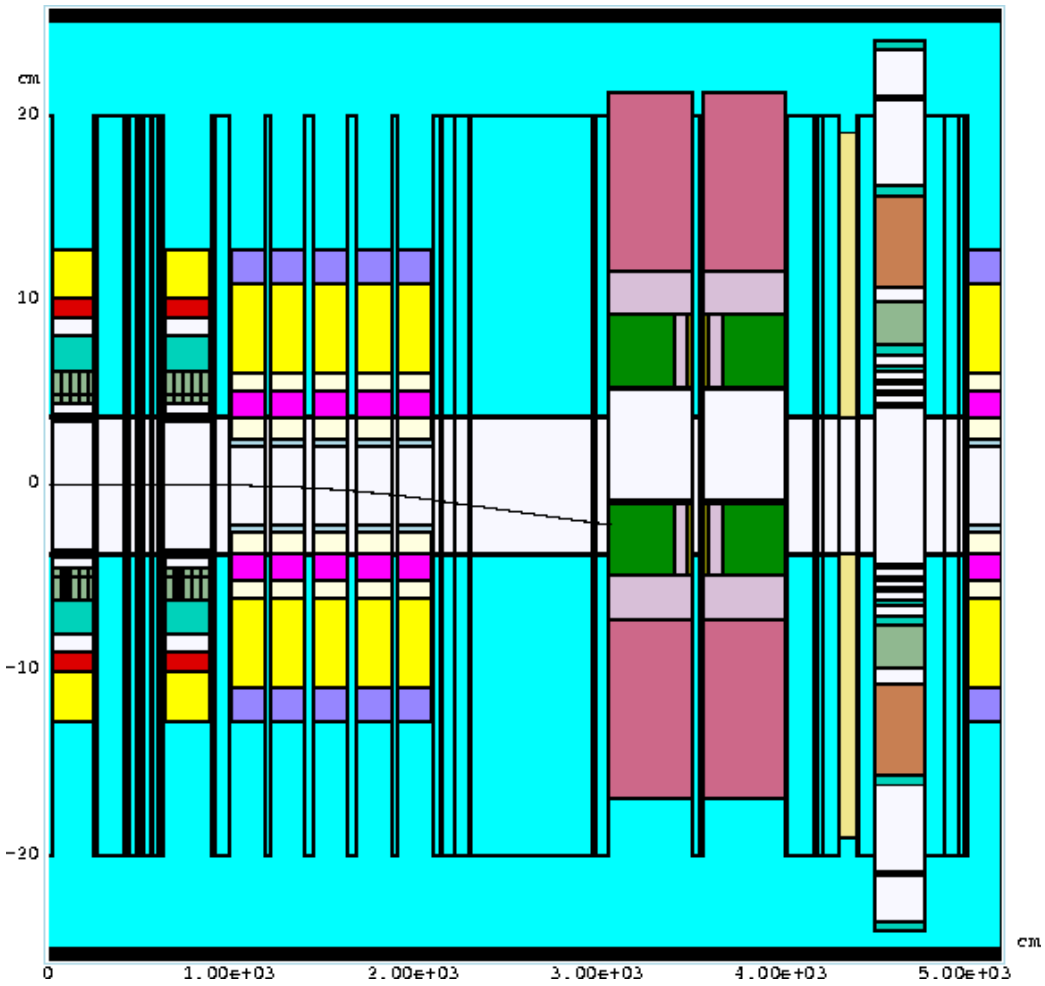

Figure 1: Elevation view of model.

3 Recommendations

It is recommended to add extra shielding. The shielding should be as close to the pipe as possible. Generally speaking, the shielding block should cover the coil of the lens. The shielding should extend at least 10 cm over each side. The length of the shielding is maximal possible. See if the lens quenches during the beam abort, and if it does then turn it off before a planned beam dump.

References

[1] N.V. Mokhov, "The MARS Code System User's Guide", Fermilab-FN-628 (1995); N.V. Mokhov, O.E. Krivosheev, "MARS Code Status", in *Proc. Monte Carlo*

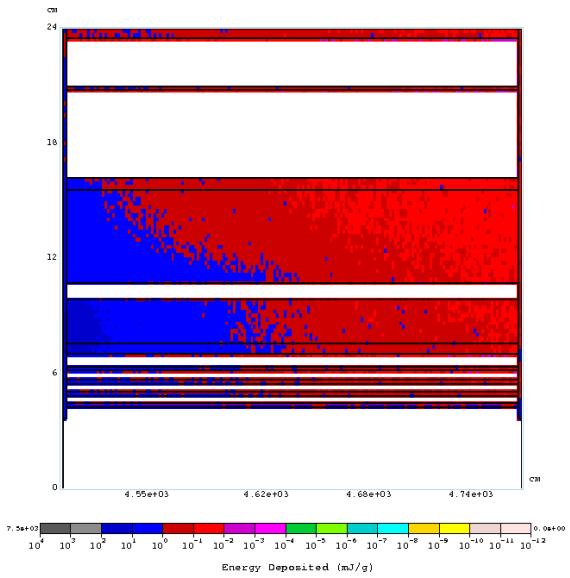

Figure 2: Energy deposited in the electron lens. Elevation view.

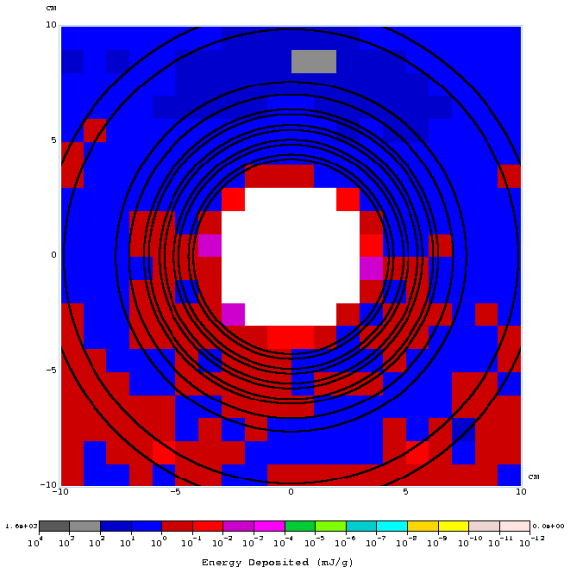

Figure 3: Energy deposited in first 30 cm of the electron lens. Cross-section.

2000 Conf., pp. 943-948, Lisbon, October 23-26, 2000; Fermilab-Conf-00/181 (2000); N.V. Mokhov, "Status of MARS Code", Fermilab-Conf-03/053 (2003); `http://www-ap.fnal.gov/MARS/`.

[2] N.V. Mokhov et al., "Recent Enhancements to the MARS15 Code", FERMILAB-Conf-04/053-AD, April 2004; Presented paper at the 10^{th} *International Conference on Radiation Shielding*, Funchal (Madeira), Portugal, May 9-14, 2004. e-Print Archive: nucl-th/0404084.

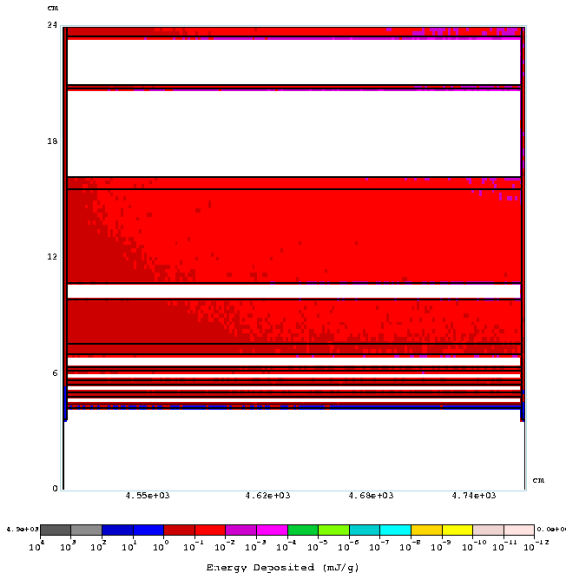

Figure 4: Energy deposited in the electron lens in model with the shielding block. Elevation view.

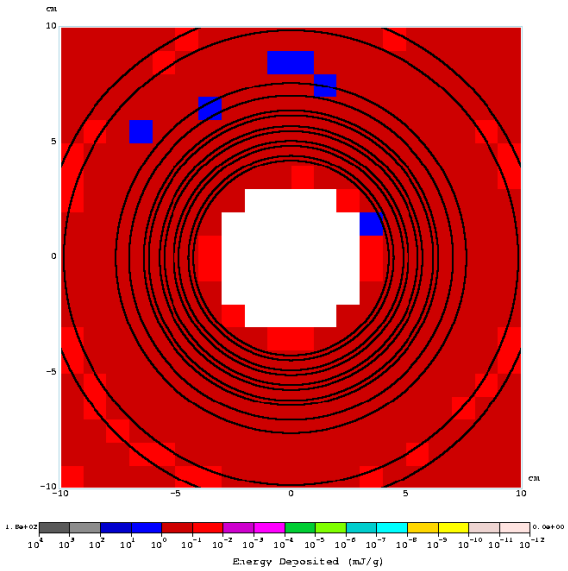

Figure 5: Energy deposited in first 30 cm of the electron lens in model with the shielding block. Cross-section.