FØ LAMBERTSON LINER HEATING DUE TO BEAM LOSS

Nikolai Mokhov
Fermilab

Review of the FØ Lambertson Liner

Fermilab

June 19, 2003

OUTLINE

- Beam Loss Scenario and Parameters
- MARS14 Monte Carlo Simulations
- Energy Deposition and Temperature Rise

BEAM LOSS SCENARIO AND PARAMETERS

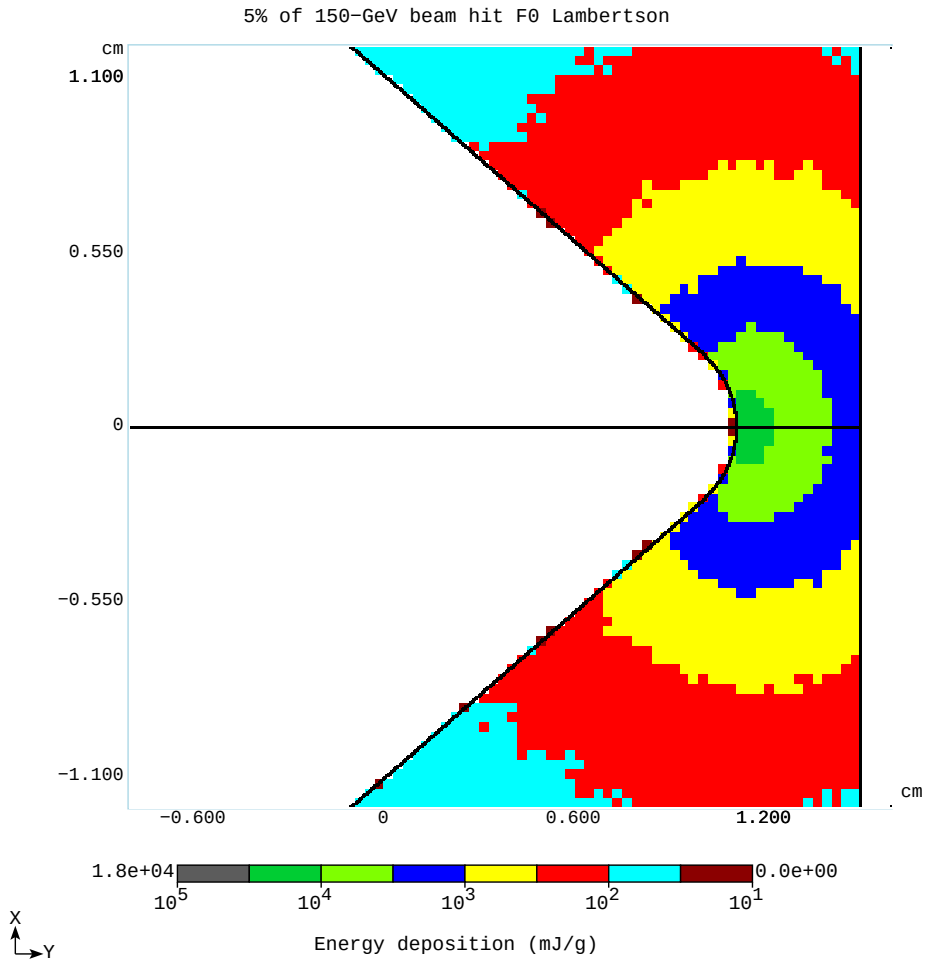
The Tevatron FØ Lambertson geometry and beam parameters at injection were provided by Peter Ivanov and implemented into the MARS14 model. 150-GeV proton beam RMS spot sizes are σ_x=1.9 mm and σ_y=1.15 mm. The total proton beam is 10^{13} ppp. The 0.4-mm thick liner is made of the Cu-Be bronze C17200 (Be 1.9%, Co 0.2%, Cu 97.9%, ρ=8.25 g/cm^3). An effective horizontal distance from the beam center to the liner is $3\sigma_x$=5.7 mm. It follows from measurements that some fraction η of the proton beam is lost on the Lambertson over first 100 turns. It means that one can estimate an instantaneous temperature rise ΔT from a calculated energy deposition distribution.

MARS14 SIMULATIONS

Three-dimensional energy deposition distribution in the FØ Lambertson and bronze liner at injection is calculated with the MARS14 code. A corresponding instantaneous temperature after a fast "scraping" is calculated then as $T = T_0 + \Delta T$, where $T_0 = 20°C$. Two values were assumed for the number of protons lost on the Lambertson: $\eta_1 = 5\%$ or 5×10^{11}, and $\eta_2 = 1\%$ or 10^{11}. Two conservative assumptions were made: a beam density distribution in the tail outside of the 3σ envelope is Gaussian, and these "tail" protons hit normally the upstream face of the Lambertson's first module.

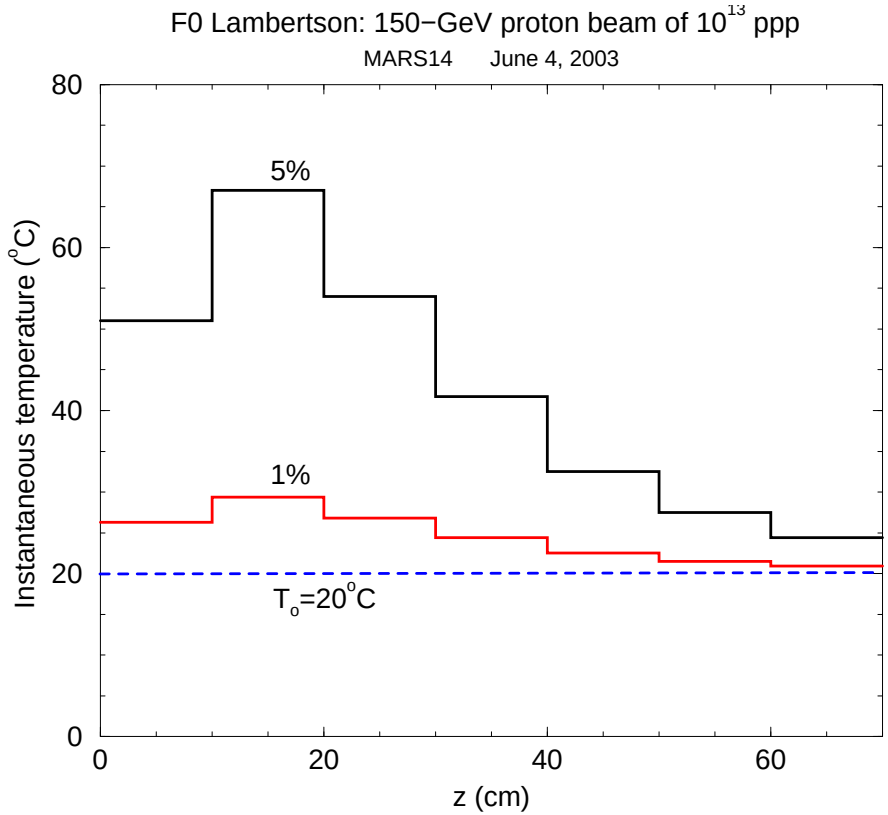
The calculations reveal that the maximum energy deposition – and temperature rise respectively – takes place in the liner in the horizontal plane at z $\sim$ 15 cm from the entrance to the first module.

ENERGY DEPOSITION ISOCONTOURS



Energy deposition isocontours at shower maximum (z ∼ 15 cm) for 5% of a 150-GeV beam hitting the FØLambertson.

TEMPERATURE RISE



Longitudinal profi les of maximum instantaneous temperature in the liner for 5% and 1% of the beam hitting the Lambertson.

Even with rather conservative assumptions, the maximum temperatures do not exceed 67°C and 29°C in these two cases, respectively.