

Summary of Muon Calculation Results

LEW KELLER (TRANSCRIBED BY ELTON S. SMITH)
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Lew has hand-written notes with more details, but here is a summary for the record. Figure 1 shows the calculated muon flux generated in the electron dump. Figure 2 shows the muon flux generated in the collimator by the incident photon beam. Muon fluxes are recorded at the scoring plane.

1 Electron Beam Dump

model:

1.5m Al dump proper / 1m Bldg concrete / 10 m Fe dump
/ 3 m earth / scoring plane

12 GeV electron, 3 muA (1.8×10^{13} e/s)

Study effect of transverse size:

a) Fe mu-stopper 60cmx60cm transverse:

MUCARLO: $\mu/e(\text{source}) = 1.56 \times 10^{-5}$, $\mu/e(\text{scoring plane})$
= 1.54×10^{-9}
--> Rate(scoring plane) = 2.8×10^4 mu/s (too high)
Momentum spectrum: $P_{\text{min}} \sim 6-7$ GeV, $P_{\text{peak}} \sim 10$ GeV/c

b) Fe mu-stopper 92cmx92cm transverse:

MUCARLO: Rate(scoring plane) = 2.8×10^2 mu/s
Worst case is $1\mu/2500\text{cm}^2$ or $0.05\mu/\text{cm}^2 \cdot \text{s}$ and
use $1\mu/\text{cm}^2 \cdot \text{s} \sim 0.1$ mrad/hr
==> dose rate is 0.005 mrad/hr

Conclude: 1m x 1m x 10m long mu-stopper provides acceptable dose rate for muons.

2 Photon beam collimator

2.1 Rate at Entrance to Hall D

12 GeV electron, 3 muA into 0.01% radiator

model:

W,Ni collimator / 1m sweep / 5m Fe / 1m sweep / 4m /scoring plane (4mx4m)

MUCARLO results: 1.2×10^{-9} mu/e produced in collimator
 0.81×10^{-10} mu/e (scoring plane)

Rate muons in detector (scoring plane)
= 1.4×10^3 mu/s (4mx4m) plane.

2.2 Behind Hall D

model:

W,Ni collimator / 1m sweep / 5m Fe / 1m sweep / 34m /scoring plane (4mx4m)

same as above: mu/e(source) = 1.2×10^{-9} mu/e

MUCARLO: worst place is 41 mu (of 100,000 mu produced)/2500cm²
= 3.5×10^{-3} mu/cm²*s
-> dose = 3.5×10^{-4} mrad/hr = 350 micro rad/hr

(this does not include any photon beam dump)

3 Photon Dump Behind Hall D

model:

back wall of hall D / 50cm Cu / 10m earth / scoring plane

Use 0.36 W on photon dump, 0.18×10^{13} e/s on 0.01% radiator

MUCARLO: source = 1.7×10^{-9} mu/e
Worst case at scoring plane = 1.2×10^{-13} mu/cm²/e
-> Flux = 0.2 mu/cm²*s
-> dose = 0.02 mr/hr = 20 micro rem/hr

Conclusion: need a few m Fe behind Hall D dump covered by earth to stop neutrons.

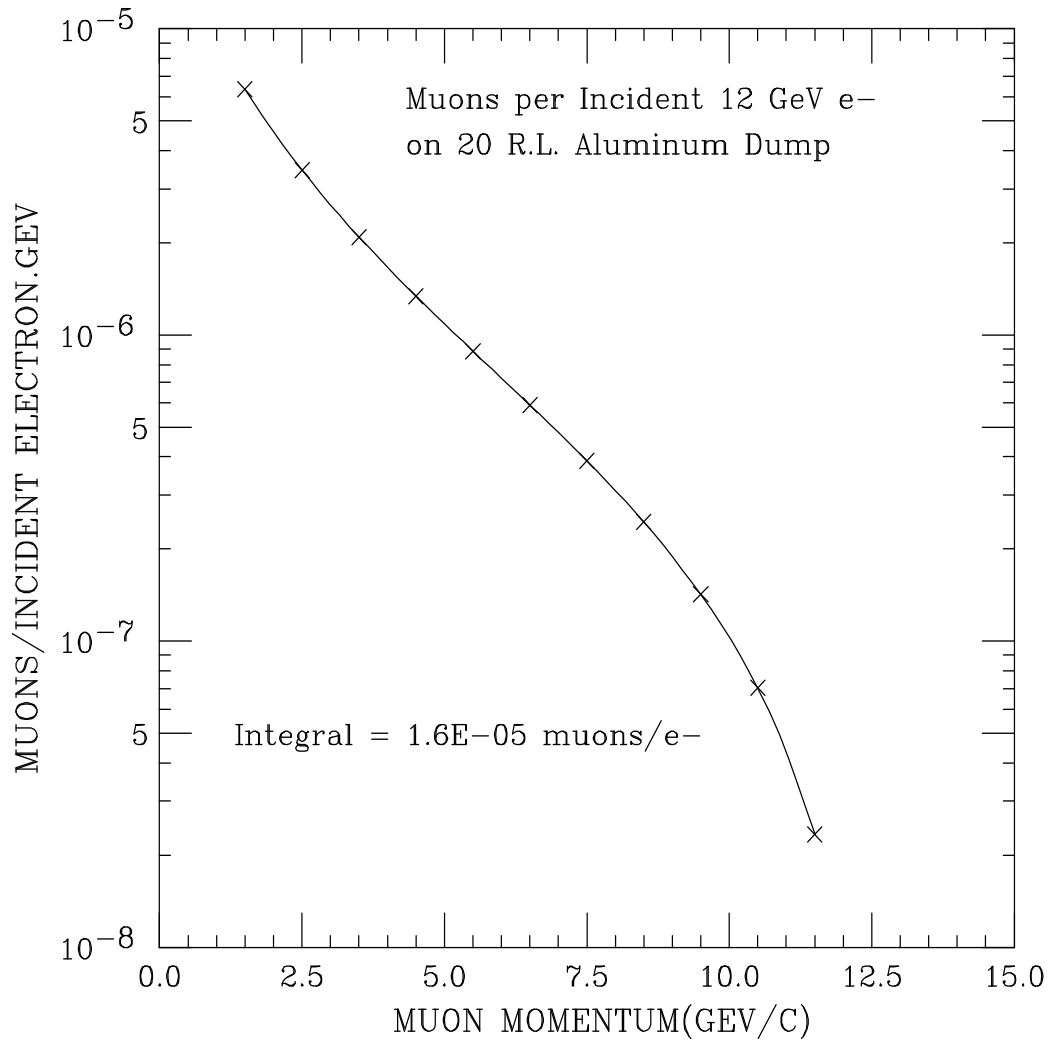


Figure 1: Number of muons per 12 GeV electron incident on 20 radiation lengths of Al to simulate the electron beam dump. The simulation is from the MUCARLO program.

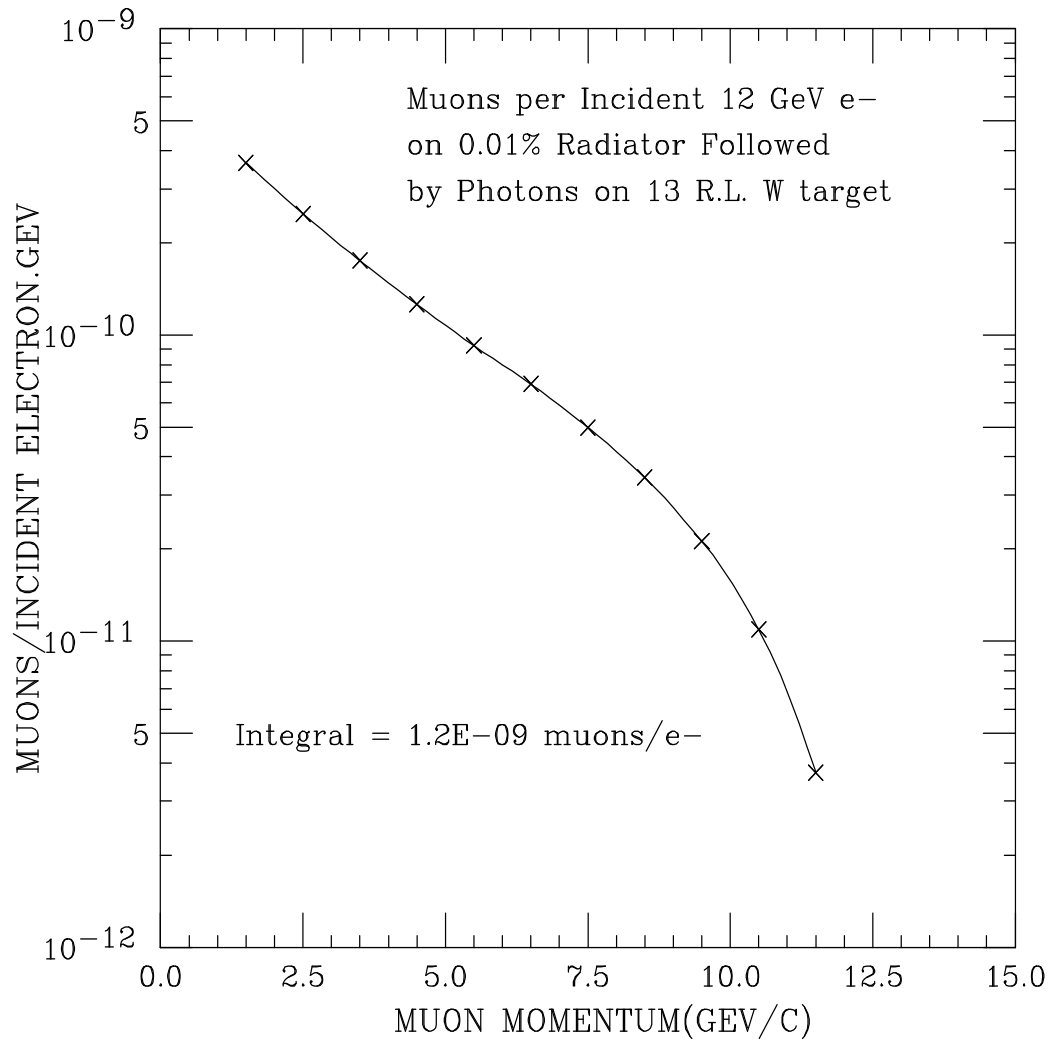


Figure 2: Number of muons per 12 GeV electron incident on a 0.01% radiator, followed by photons incident on 13 radiation lengths of a tungsten collimator. The simulation is from the MUCARLO program.