Summary of Muon Calculation Results

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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

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

12 GeV electron, 3 muA (1.8x10**13 e/s)

Study effect of transverse size:

a) Fe mu-stopper 60cmx60cm transverse:
MUCARLO: mu/e(source) = 1.56x10**-5, mu/e(scoring plane)
         = 1.54x10**-9
         --> Rate(scoring plane) = 2.8x10**4 mu/s (too high)
         Momentum spectrum: Pmin~6-7 GeV, Ppeak ~ 10 GeV/c

b) Fe mu-stopper 92cmx92cm transverse:
MUCARLO: Rate(scoring plane)  = 2.8x10**2 mu/s
Worst case is 1mu/2500cm2 or 0.05mu/cm2*s and
      use 1mu/cm2*s ~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.
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2 Photon beam collimator

2.1 Rate at Entrance to Hall D

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12 GeV electron, 3 muA into 0.01% radiator

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

MUCARLO results: 1.2x10**-9 mu/e produced in collimator
                 0.81x10**-10 mu/e (scoring plane)

Rate muons in detector (scoring plane)
           = 1.4x10**3 mu/s (4mx4m) plane.
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2.2 Behind Hall D

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

same as above: mu/e(source) = 1.2x10**-9 mu/e

MUCARLO: worst place is 41 mu (of 100,000 mu produced)/2500cm2
         = 3.5x10**-3 mu/cm2*s
         -> dose = 3.5x10**-4 mrad/hr = 350 micro rad/hr

(this does not include any photon beam dump)
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3 Photon Dump Behind Hall D

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

Use 0.36 W on photon dump, 0.18x10**13 e/s on 0.01% radiator

MUCARLO: source = 1.7x10**-9 mu/e
         Worst case at scoring plane = 1.2x10**-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.
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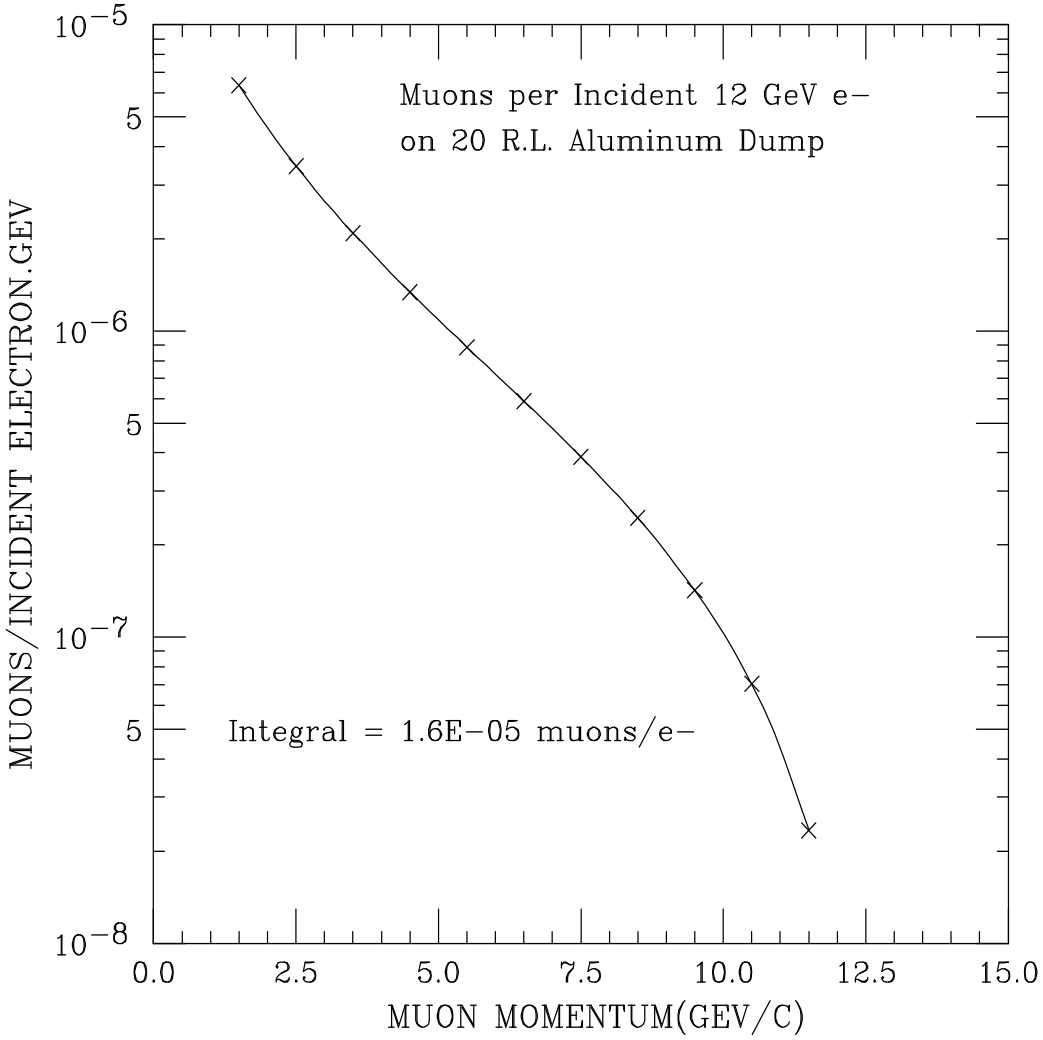

Figure 1: Number of muons per 12 GeV electron incident on 20 radiation lengths of Al to simulate the electron beam dump. The simulation is from the MUCARLO program.

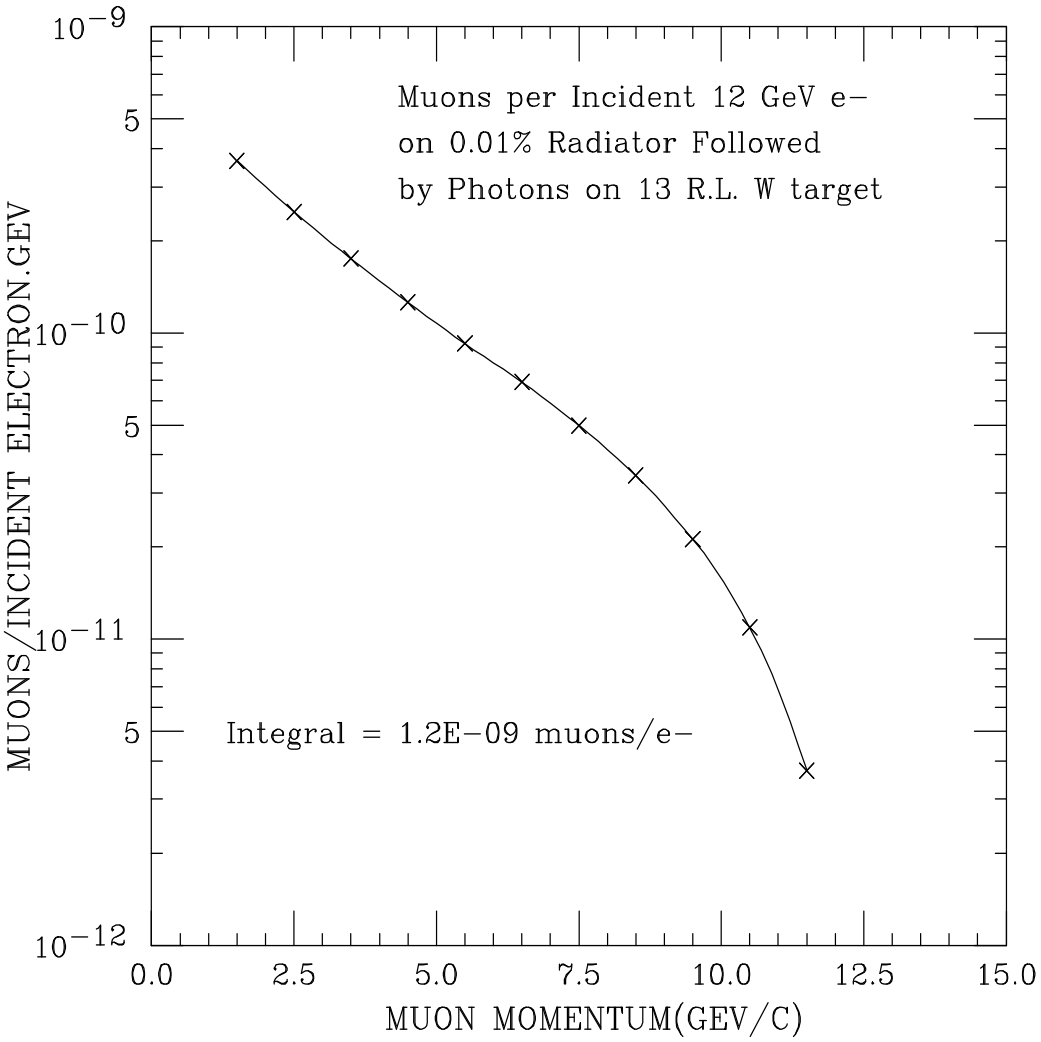

Figure 2: Number of muons per 12 GeV electron incident on a 0.01% radiator, followed by photons incident on 13 radiation lengths of a tungsten collimator. The simulation is from the MUCARLO program.