PARTICLE YIELD AND RADIATION FIELDS IN FEASIBILITY STUDY-2 TARGET/CAPTURE SYSTEM

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I. YIELD

Detailed MARS14(2000) simulations have been performed for the optimized Study-2 target-capture system configuration of the beginning of February 2001. A 24 GeV kinetic energy proton beam (sigma_x = sigma_y = 1.5 mm, sigma_z = 3 ns, 67 mrad) on a 5 mm radius mercury jet tilted by 100 mrad, which is ejected from the nozzle at z=-45 cm, crosses the z-axis at z=-15 cm and hits a mercury pool at z=234 cm, x=-25 cm. All particles are collected in the aperture at z=18.62 m and r<30 cm. Results for two runs, 400000 protons on target each, are in the following files:

1) A kinetic energy cut-off of 0.1 MeV

   http://www-ap.fnal.gov/~mokhov/target/fs2/marsfile-fs2-18.62m-0.1mev

   221019 particles total, 166862 pi/K/mu, 28.5 MB

2) A kinetic energy cut-off of 21 MeV

   http://www-ap.fnal.gov/~mokhov/target/fs2/marsfile-fs2-18.62m-21mev

   211413 particles total, 163853 pi/K/mu, 27.3 MB

One can certainly combine the two files, if one is interested in particles above 21 MeV only, that is of the main interest for our applications.

The files are written as

```
         WRITE(IUNIT,101)NI,JJ,X,Y,Z,PX,PY,PZ,ET,CTOFF,W
 101     FORMAT(I8,I3,3F11.3,6(1PE14.6))
```

where

NI is proton number
JJ is particle ID:

1	2	3	4	5	6	7	8	9	10	11	12	18	19	20	21
p	n	pi+	pi-	K+	K-	mu+	mu-	g	e-	e+	ap	num	nuam	nue	nuae

X,Y,Z are particle coordinates (cm)
PX,PY,PZ are particle momentum components (GeV/c)
ET is its total energy (GeV)
CTOFF is c*time-of-flight (cm)
W is particle statistical weight.

Note that the right-hand coordinate system is used, i.e. X is up, Y is to the right from the beam, and beam/jet are moving along the positive Z-direction.

II. RADIATION FIELDS

A file of particles with kinetic energy E>0.1 MeV crossing a R=1.6 m surface at-2 < z < 36 m, for 400000 protons on target, is also available for radiation shielding calculations as http://www-ap.fnal.gov/˜mokhov/target/fs2/marsfile-fs2-r1.6m-0.1mev

156349 particles total, 21 MB

The file is written as

```
      WRITE(IUNIT,102)NI,JJ,E,W,X,Y,Z,DCX,DCY,DCZ,TOFF
102   FORMAT(I8,I3,5(1PE13.5),3(1PE15.7),1PE12.4)
```

where

E is particle kinetic energy (GeV),
DCX, DCY, DCZ are direction cosines,
the rest is as above.

Results on radiation loads can be found in the same place

http://www-ap.fnal.gov/˜mokhov/target/fs2/

```
geo1.eps,geo2.eps,geo3.eps - details of the MARS model geometry
be-window-pd.eps            - P (W/g) in 2-mm Be-window at z=6.1 m
be-window-dose.eps          - D (GGY/yr)  in 2-mm Be-window at z=6.1 m
sc12-pd-slice.eps           - P (mW/g) and D (MGy/yr) vs radius at z=20 cm
sc12-flux-slice.eps         - F (cm^-2 yr^-1) vs radius at z=20 cm
fs2-ts-dose.eps             - D (MGy/yr) in the target station
fs2-ts-nflux.eps            - F (cm^-2 yr^-1) for neutrons in the target station
fs2-tardec-dose.eps         - D (MGy/yr) in the entire system
fs2-tardec-nflux.eps        - F (cm^-2 yr^-1) for neutrons in the entire system
```

where

P is power dissipation
D is annual absorbed dose
F is annual flux

III. ENERGY DEPOSITION IN JET

Energy deposition distribution in the mercury jet is also available
in graphical and numerical forms as

http://www-ap.fnal.gov/˜mokhov/target/fs2/edjet.eps
http://www-ap.fnal.gov/˜mokhov/target/fs2/edjet.dat

for 1.7e13 protons per bunch. Total power dissipation in the jet
at -45 < z < 20 cm is 99.822 kW for 6 bunches at 2.5 Hz.