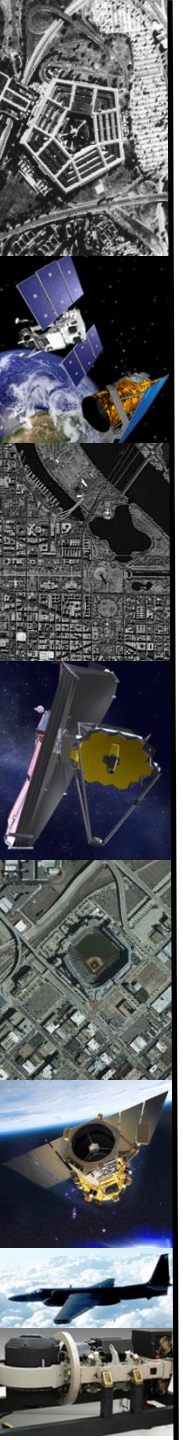
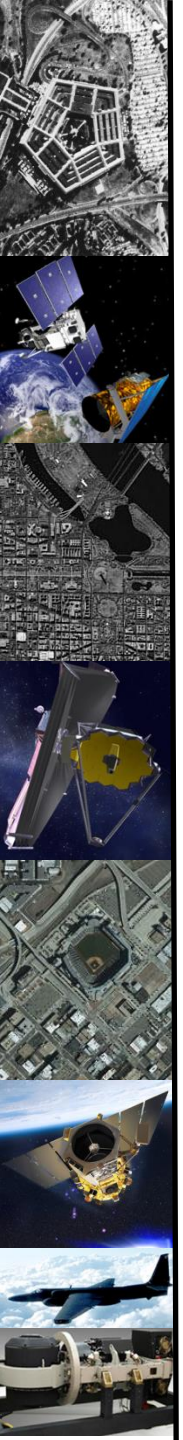


MODTRAN Input and Output File Overview

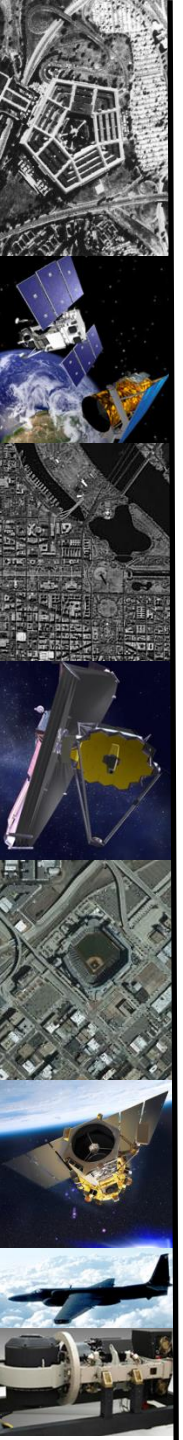
Feb 3, 2021



Contents

- TAPE5 file configuration for this task
- Running MODTRAN yourself
- Understanding the MODTRAN output

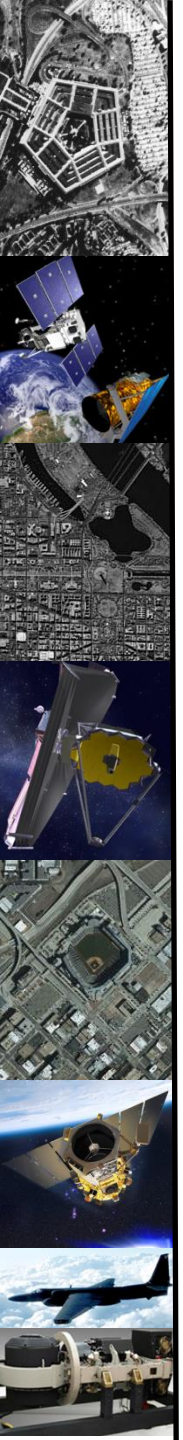
TAPE 5 Overview



tape5

CARD 1	M 2 2 2 -1 0 0 0 0 0 0 1 1 1 286.500 LAMBER
CARD 1a	tt 8f 0 330.0000 f f f 0.000
CARD 2	1 0 0 1 0 0 0.00000 0.00000 0.00000 0.00000 0.00000
CARD 3	100.000 0.000 180.000 0.000 0.000 0.000 0 0.000
CARD 3A1	12 2 236 1
CARD 3A2	30.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
CARD 4	0.4000 0.9000 0.0050 0.0050 mraa
CARD 4A	2 0.
CARD 4L1	./spec_alb.dat
CARD 4L2	25
CARD 4L2	20
CARD 5	0

Tape 5: Card 1



CARD 1

tape5

```
M   2    2    2   -1    0    0    0    0    0    0    1    1    1 286.500 LAMBER
tt  8f   0  330.0000                    f f f          0.000
    1    0    0    1    0    0  0.00000   0.00000   0.00000   0.00000   0.00000
  100.000     0.000   180.000     0.000     0.000     0.000     0           0.000
   12    2  236    1
   30.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.4000    0.9000    0.0050    0.0050          mraa
2        0.
./spec_alb.dat
25
20
    0
```

TPTEMP
Target surface temperature [K]

Atm. Model
1 Tropical
2 Mid-latitude Summer
3 Mid-latitude Winter
4 Sub-artic Summer
5 Sub-artic Winter
6 1976 US Standard Atmosphere

Multiple scattering
0 No multiple scattering
1 Multiple scattering using observer solar geometry
-1 Multiple-scattering using target solar geometry

Target Albedo
Number 0 to 1
-or-
LAMBER

TAPE 5: Card 1a

CARD 1a

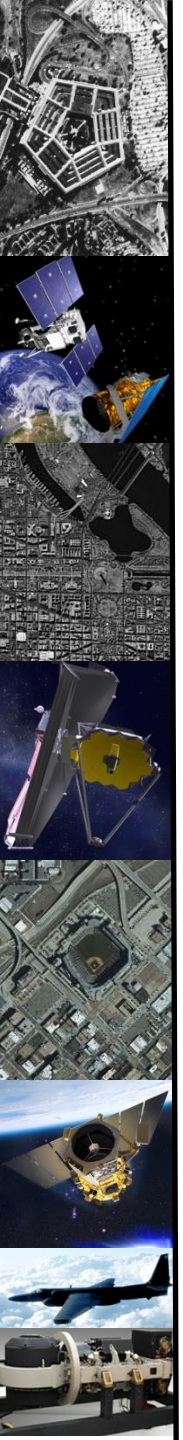
tape5

```
M   2    2    2   -1    0    0    0    0    0    0    1    1    1 286.500 LAMBER
tt  8f   0  330.0000                      f f f          0.000
    1    0    0    1    0    0  0.00000   0.00000   0.00000   0.00000   0.00000
   100.000     0.000   180.000     0.000     0.000     0.000     0           0.000
   12   2  236    1
    30.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
    0.4000    0.9000    0.0050    0.0050          mraa
2        0.
./spec_alb.dat
25
20
    0
```

DISORT option
‘t’ TRUE
‘f’ FALSE (use Isaacs 2-stream, much faster!)

DISORT Azimuthal Dependence
‘t’ TRUE
‘f’ FALSE (much faster!)

TAPE 5: Card 2



CARD 2

tape5

```
M   2    2    2   -1    0    0    0    0    0    0    1    1    1 286.500 LAMBER
tt  8f   0  330.0000                    f f f          0.000
    1    0    0    1    0    0  0.00000   0.00000   0.00000   0.00000   0.00000
   100.000     0.000   180.000     0.000     0.000     0.000     0            0.000
   12    2  236    1
    30.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
    0.4000    0.9000    0.0050    0.0050          mraa
2        0.
./spec_alb.dat
25
20
    0
```

IHAZE
0 No aerosol model
1 Rural extinction, 23km vis
2 Rural extinction, 5km vis
3 Navy Maritime extinction, vis depends on windspeed
4 Maritime extinction, 23km vis
5 Urban extinction, 5km vis
6 Tropospheric extinction, 50km vis
7 User defined aerosols
8 FOG1, 0.2km vis
9 FOG2, 0.5km vis
10 Desert extinction, vis depends on wind speed

HAZE
0 Default haze value of vis [km]
non zero Visibility through atmosphere [km], overrides HAZE value

TAPE 5: Card 3

CARD 3

tape5

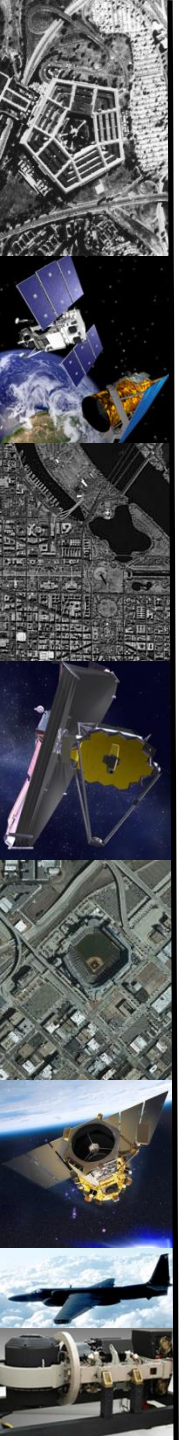
```
M   2    2    2   -1    0    0    0    0    0    0    1    1    1 286.500 LAMBER
tt  8f   0  330.0000                      f f f          0.000
    1    0    0    1    0    0  0.00000   0.00000   0.00000   0.00000   0.00000
  100.000    0.000  180.000    0.000      0.000      0.000    0            0.000
   12    2  236    1
   30.000     0.000    0.000    0.000      0.000      0.000      0.000      0.000
    0.4000    0.9000   0.0050   0.0050           mraa
2       0.
./sped_alb.dat
25
20
    0
```

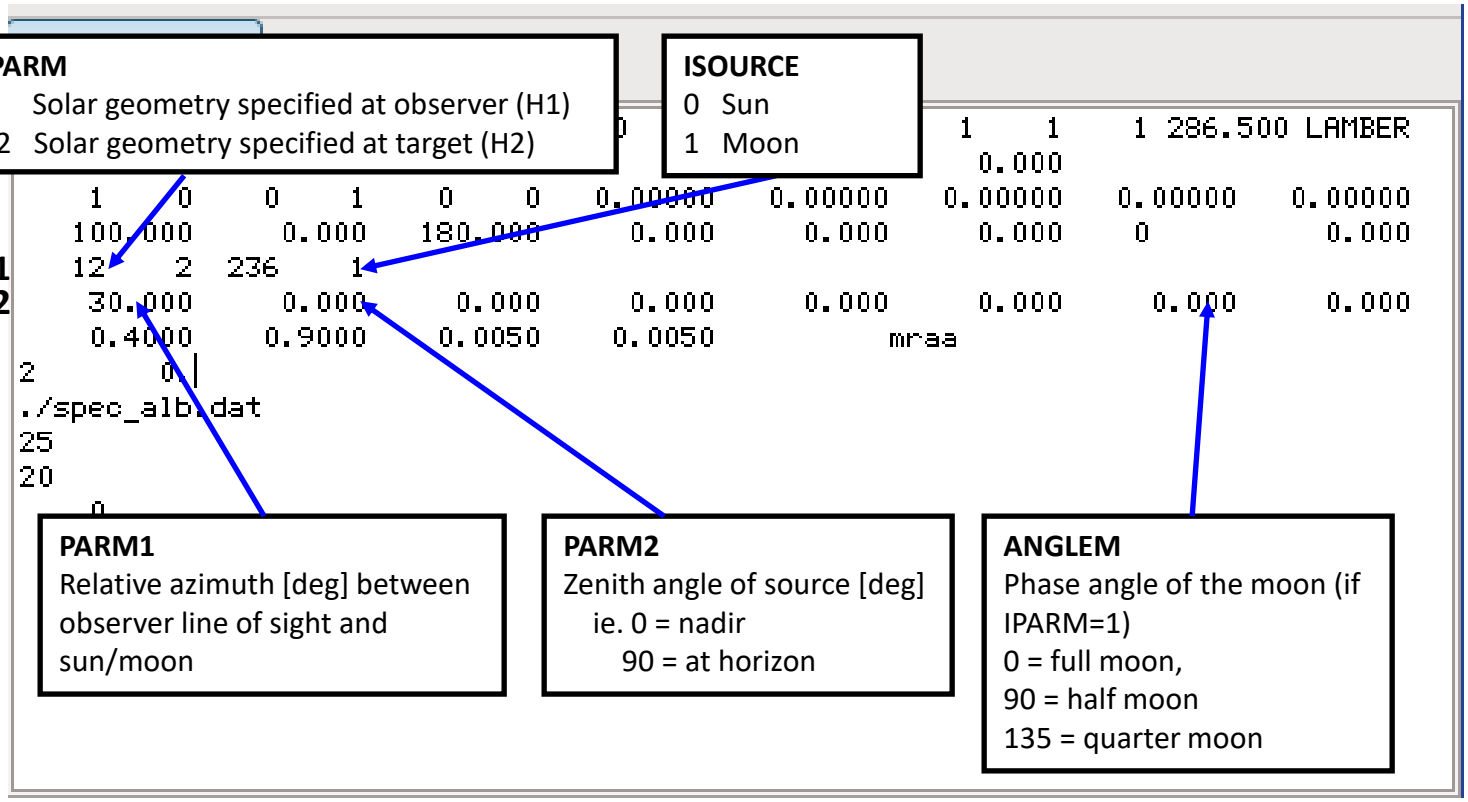
H1
Observer altitude in km

H2
Target altitude in km

ANGLE
Imager elevation angle from uplooking NADIR
i.e. downlooking NADIR = 180
downlooking oblique = 100

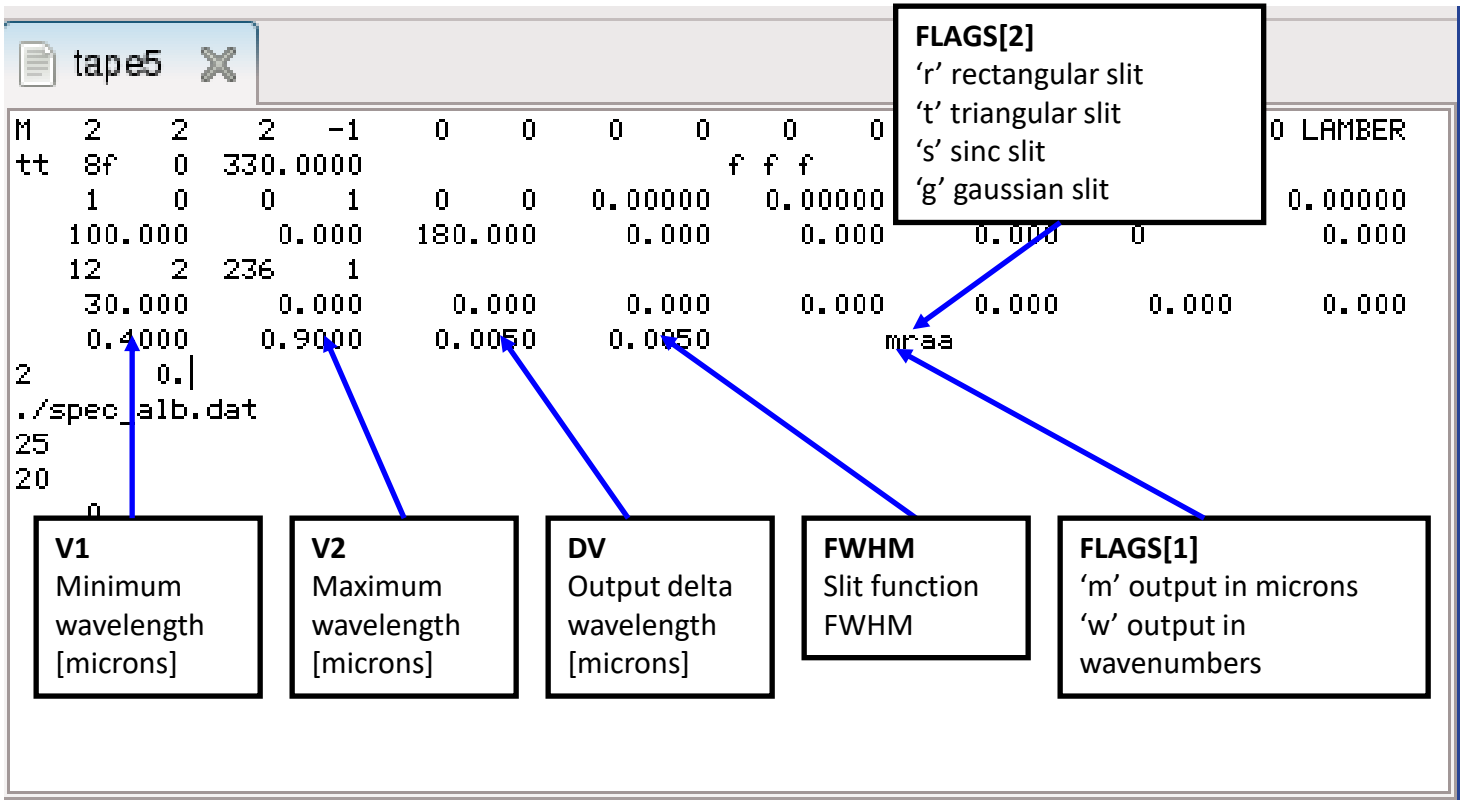
TAPE 5: 3A1/3A2



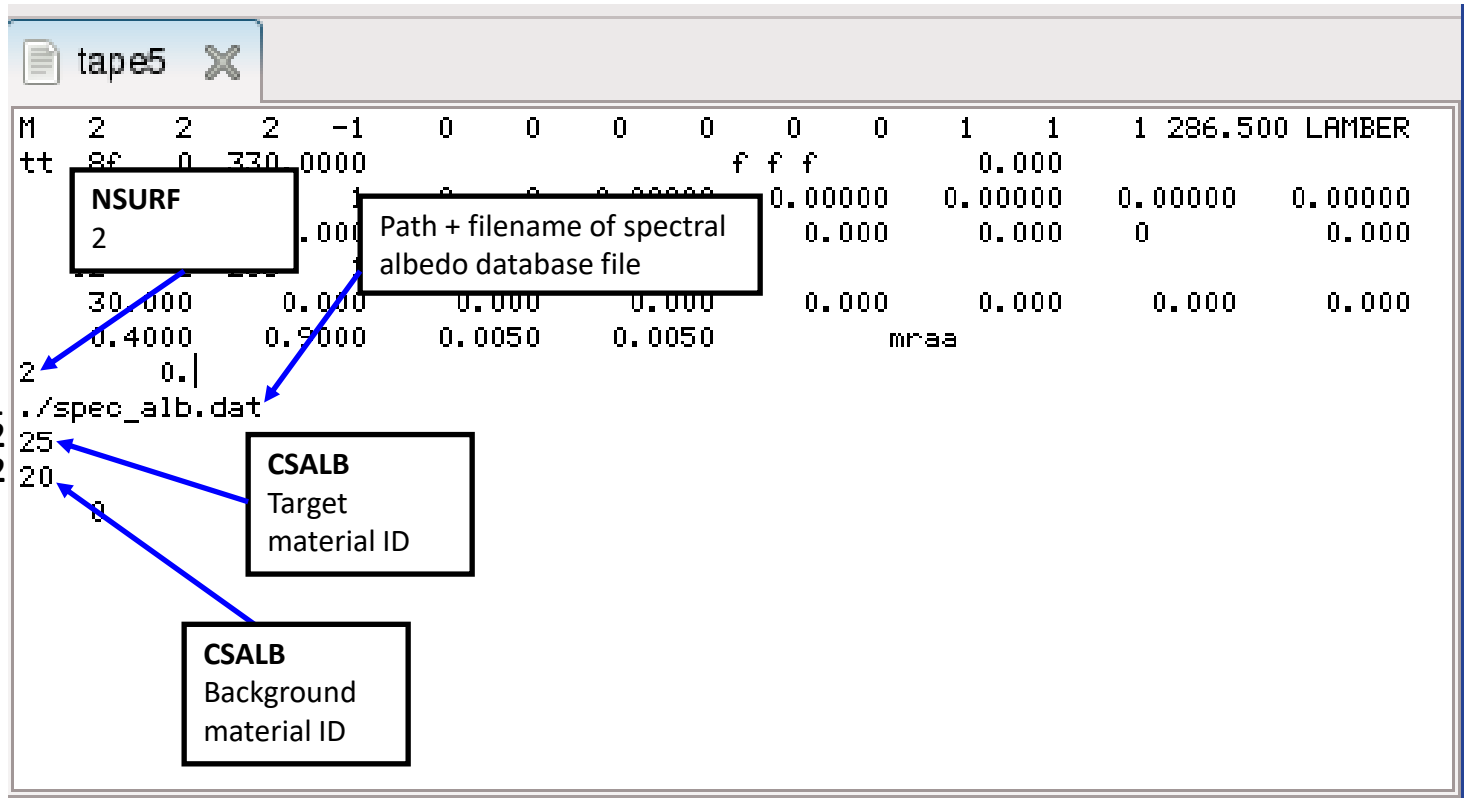


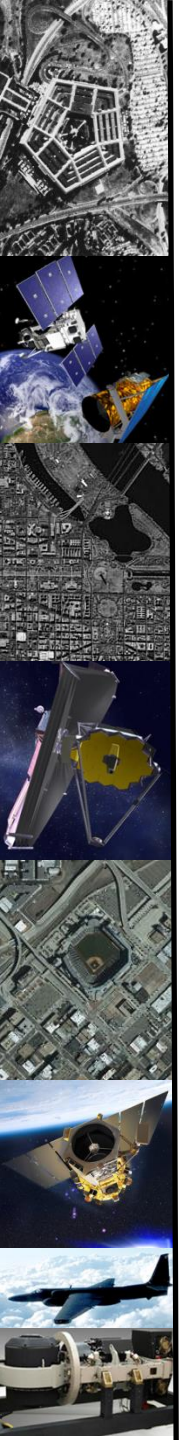
TAPE 5: Card 4

CARD 4



TAPE 5: Card 4A/4L1/4L2

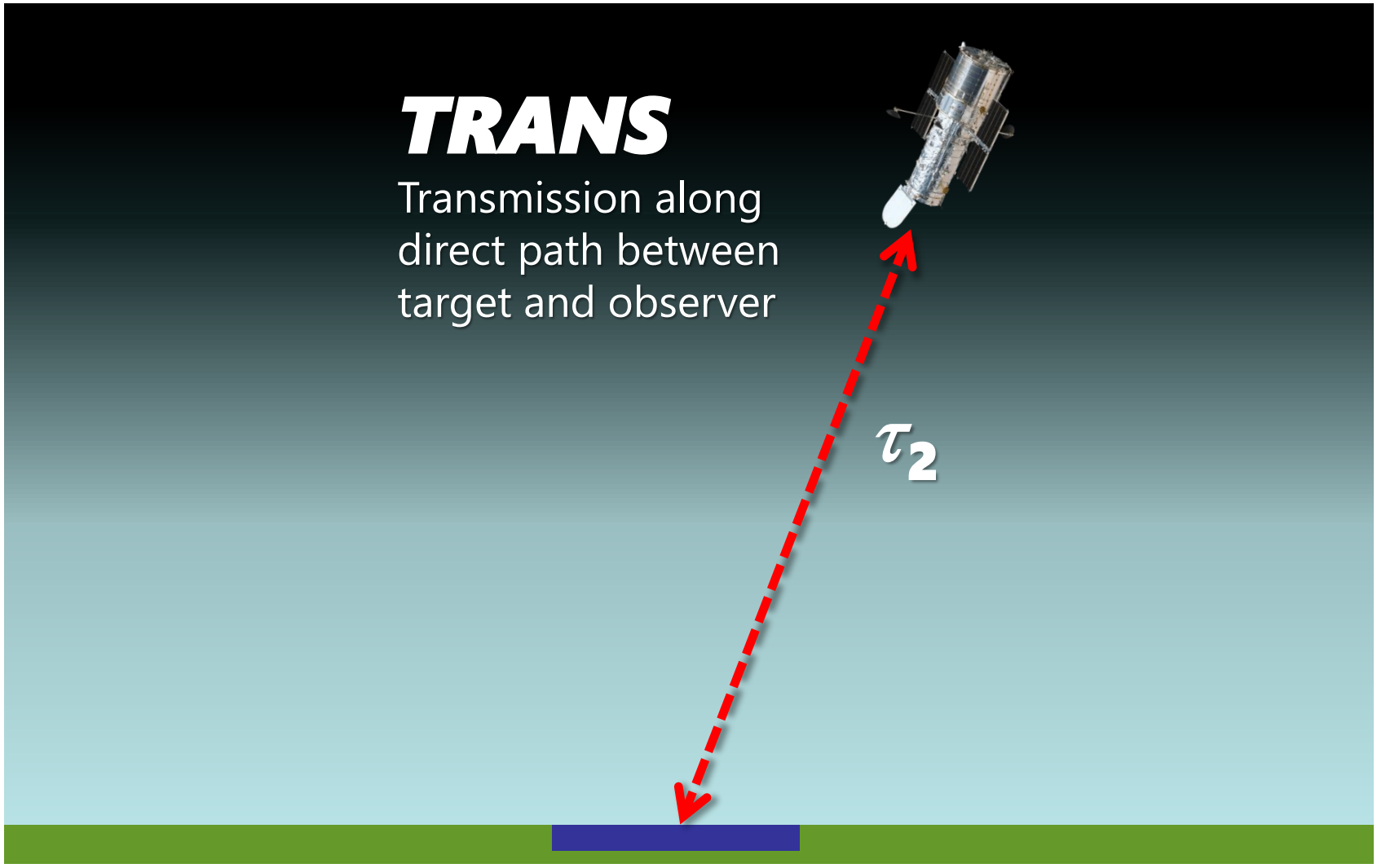




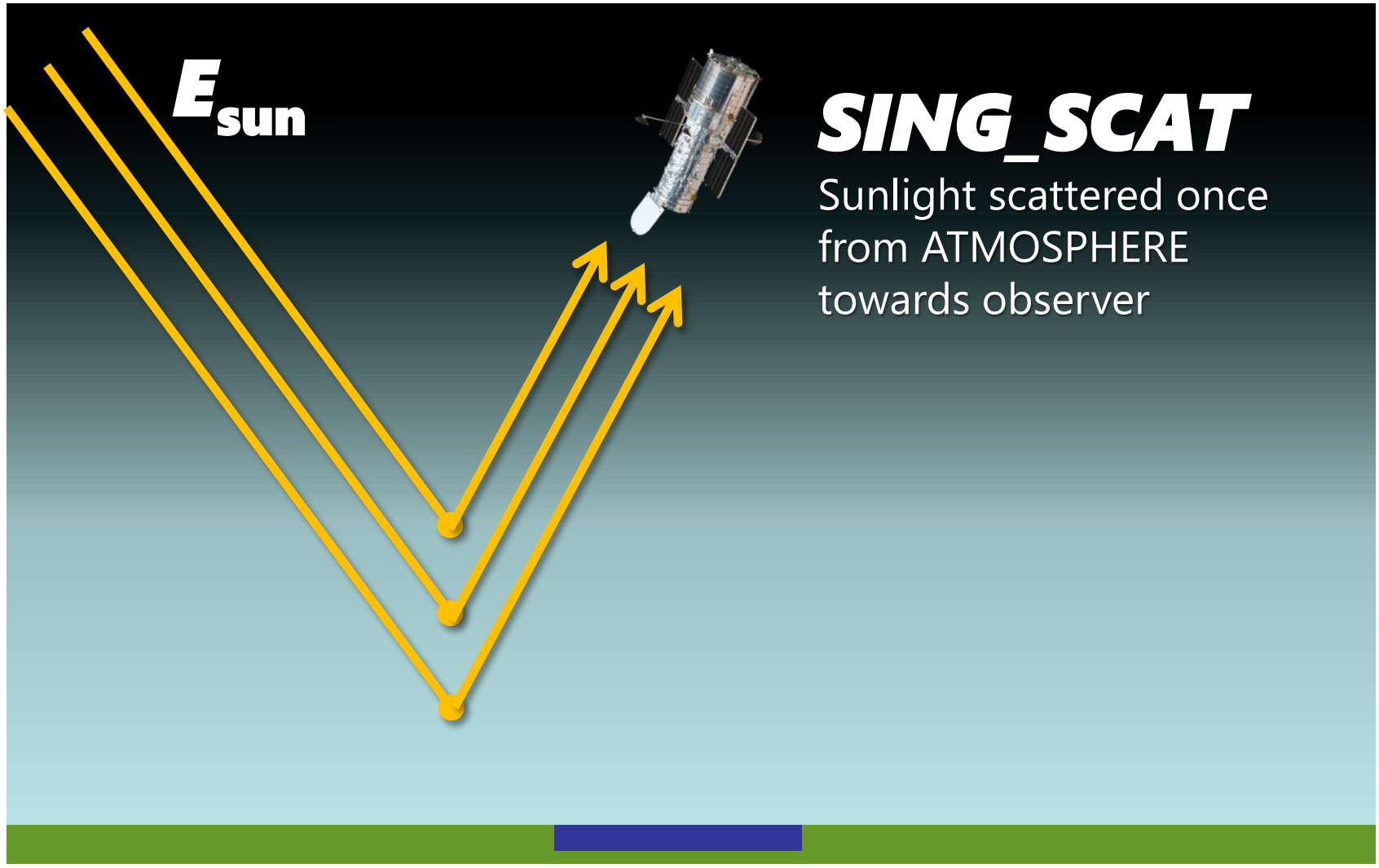
Running MODTRAN

- Login to a Linux server (i.e. grissom)
- Create symbolic link to MODTRAN DATA directory (one time operation):
  `ln –s /dirs/pkg/Mod4v3r1/DATA DATA`
- Edit tape5 file and save as ‘tape5’
- Execute MODTRAN4
  `/dirs/pkg/Mod4v3r1/Mod4v3r1.exe`
- Your output resides in tape7.scn when MODTRAN finishes running

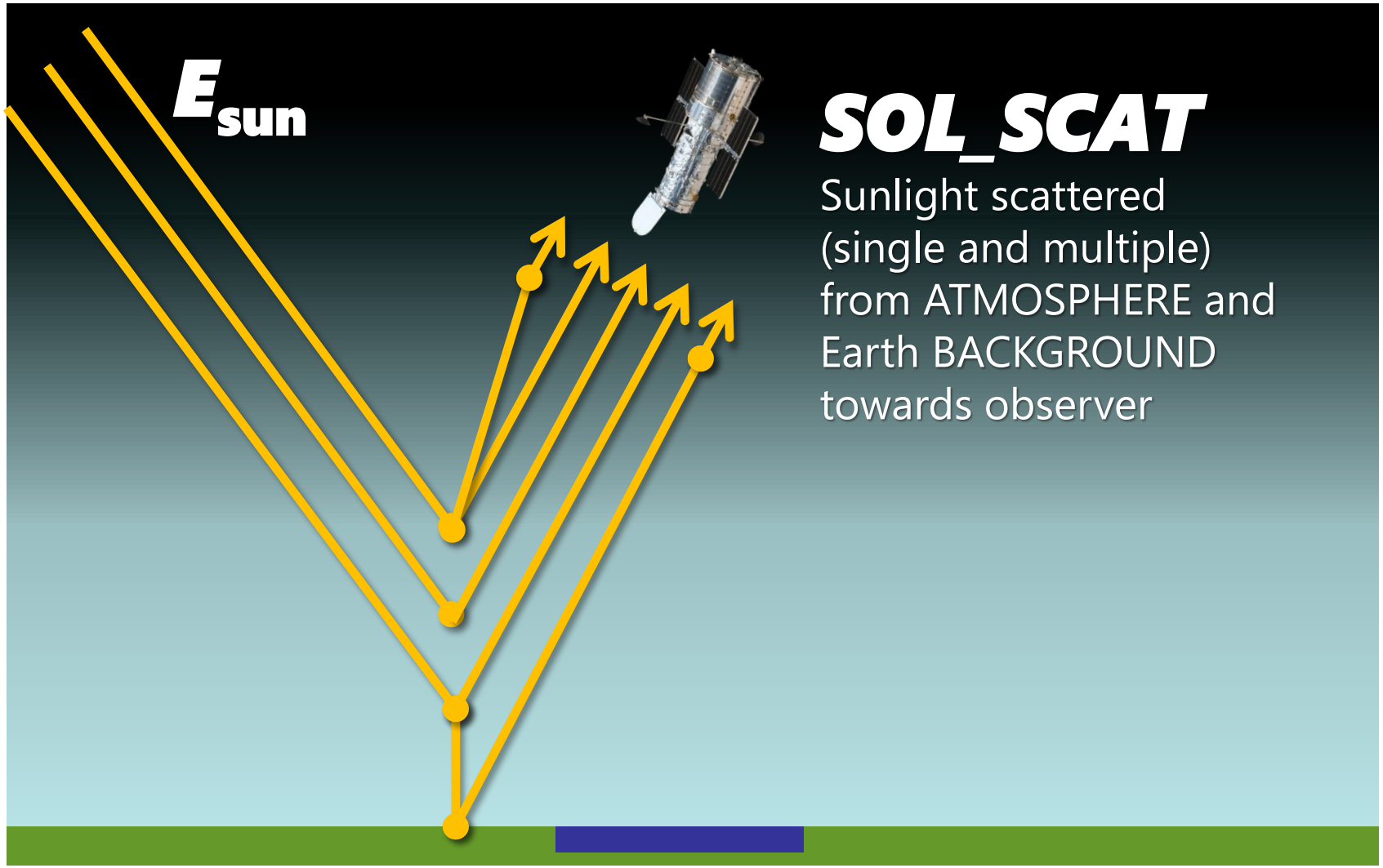
MODTRAN OUTPUT QUANTITIES



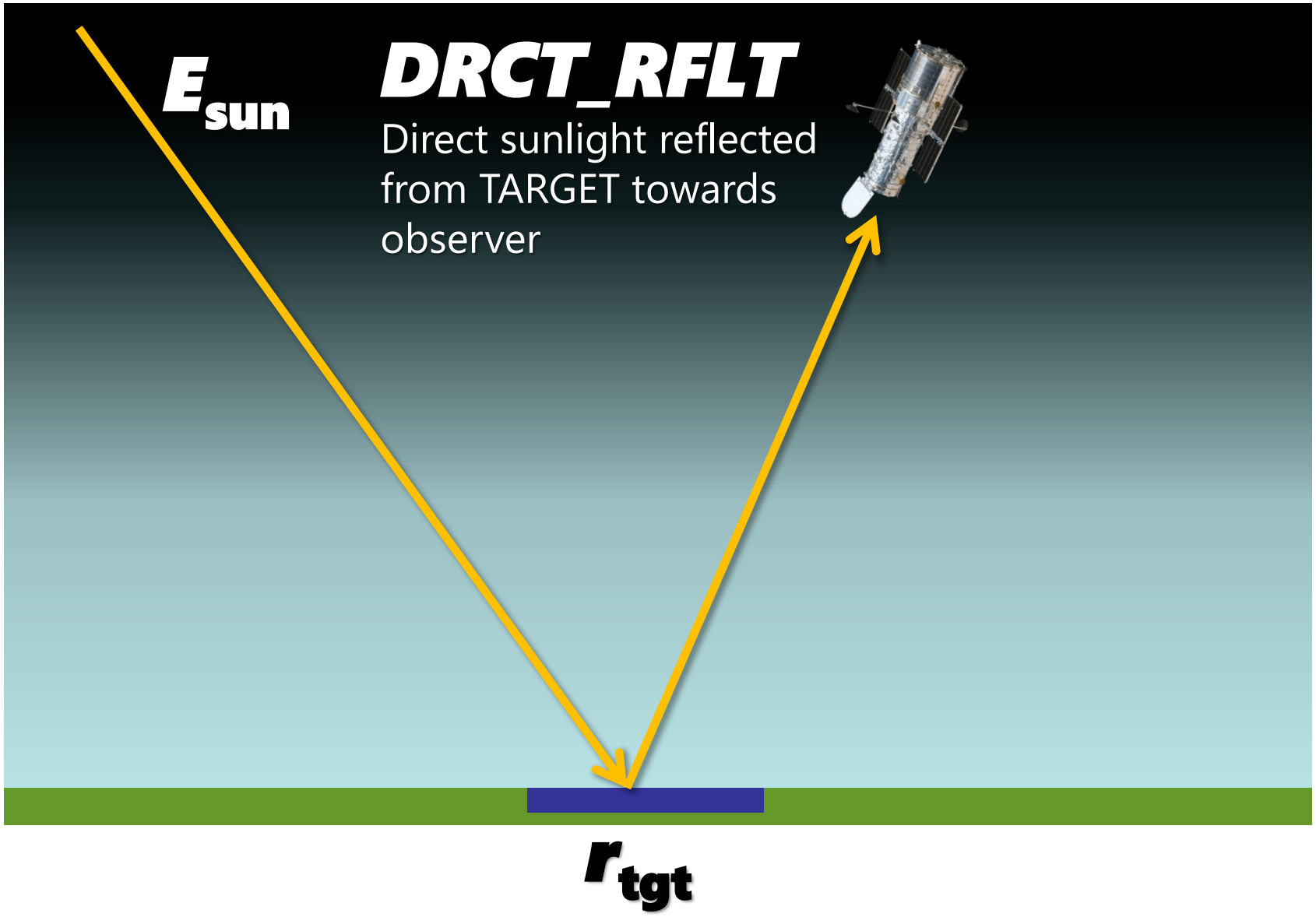
MODTRAN OUTPUT QUANTITIES



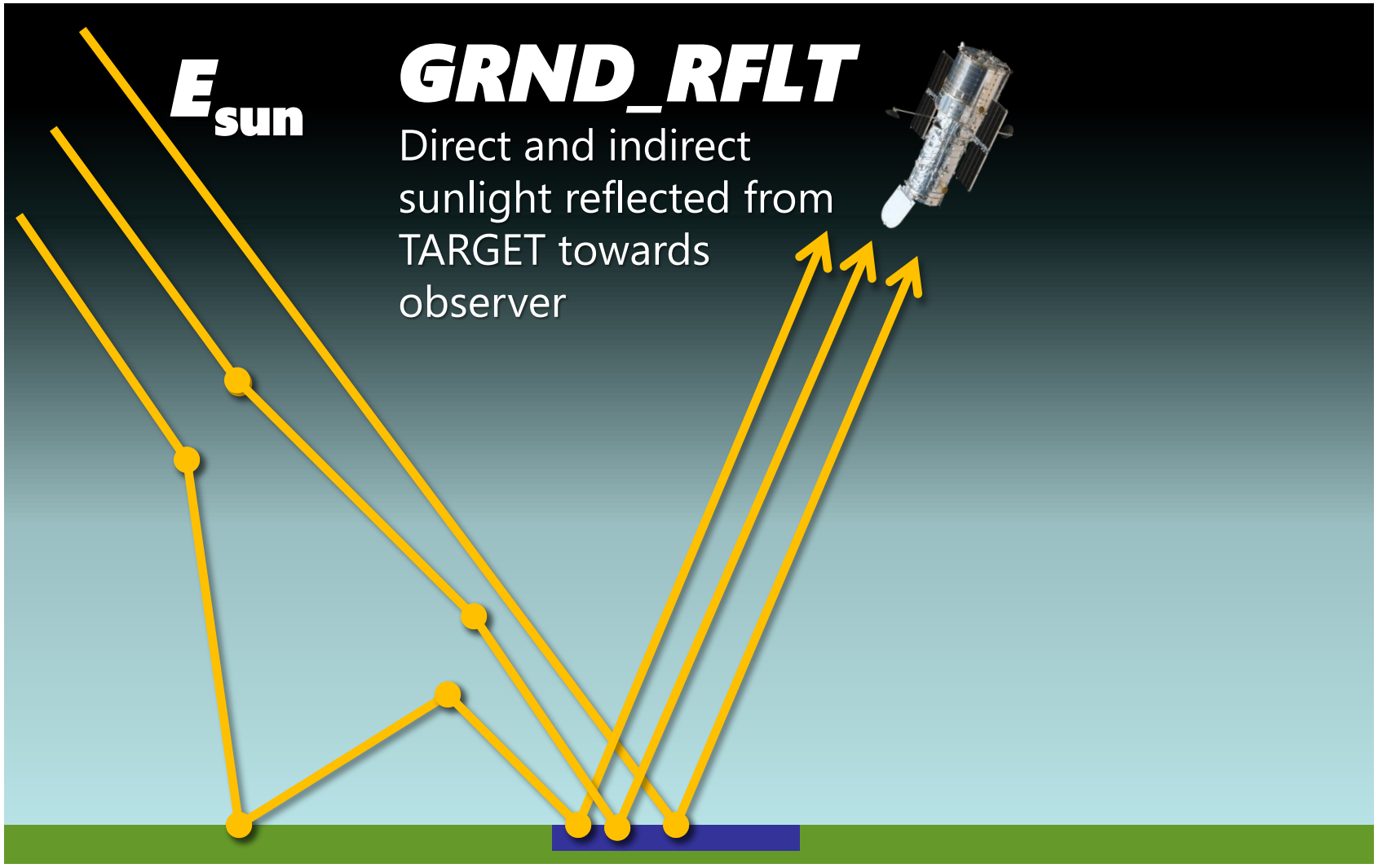
MODTRAN OUTPUT QUANTITIES



MODTRAN OUTPUT QUANTITIES



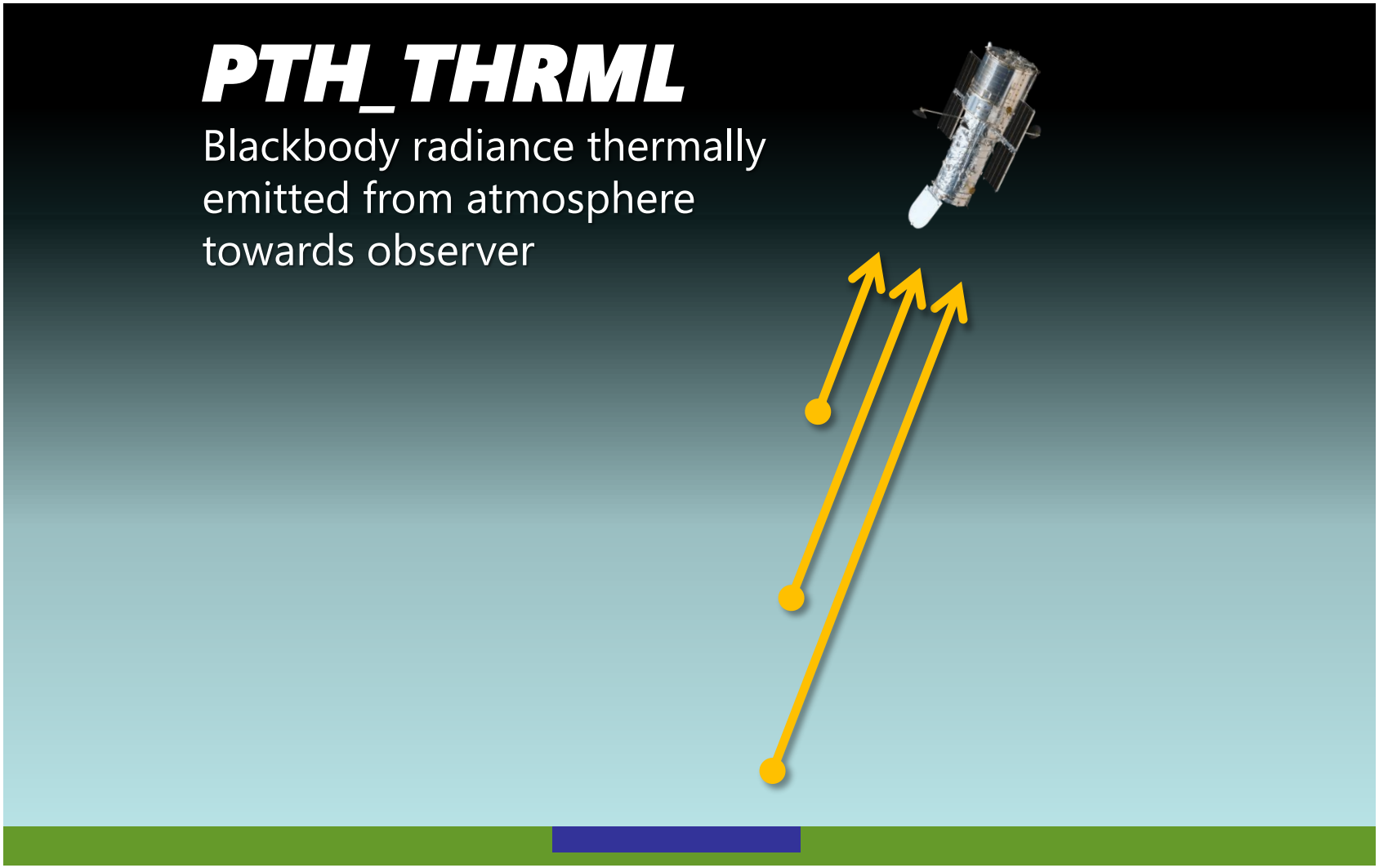
MODTRAN OUTPUT QUANTITIES



MODTRAN OUTPUT QUANTITIES

PTH_THRML

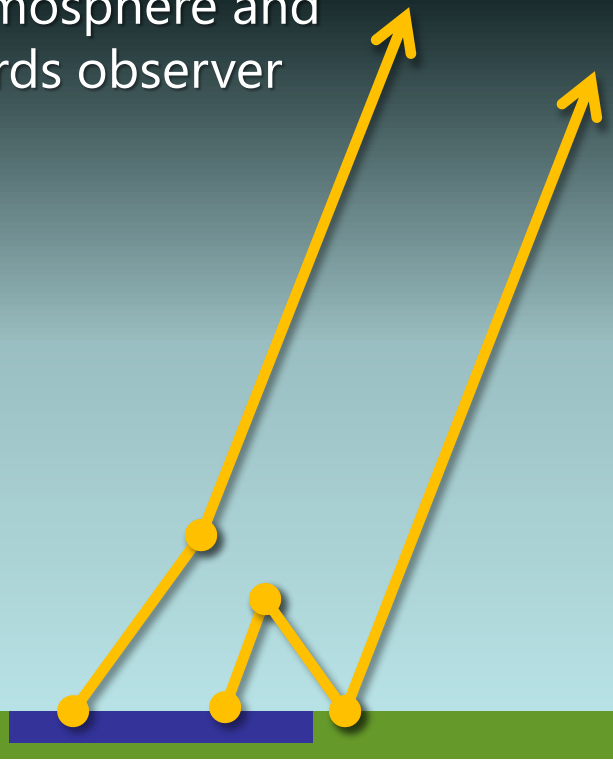
Blackbody radiance thermally emitted from atmosphere towards observer



MODTRAN OUTPUT QUANTITIES

THRML_SCT

Blackbody radiance thermally emitted from target surface and scattered from atmosphere and background towards observer

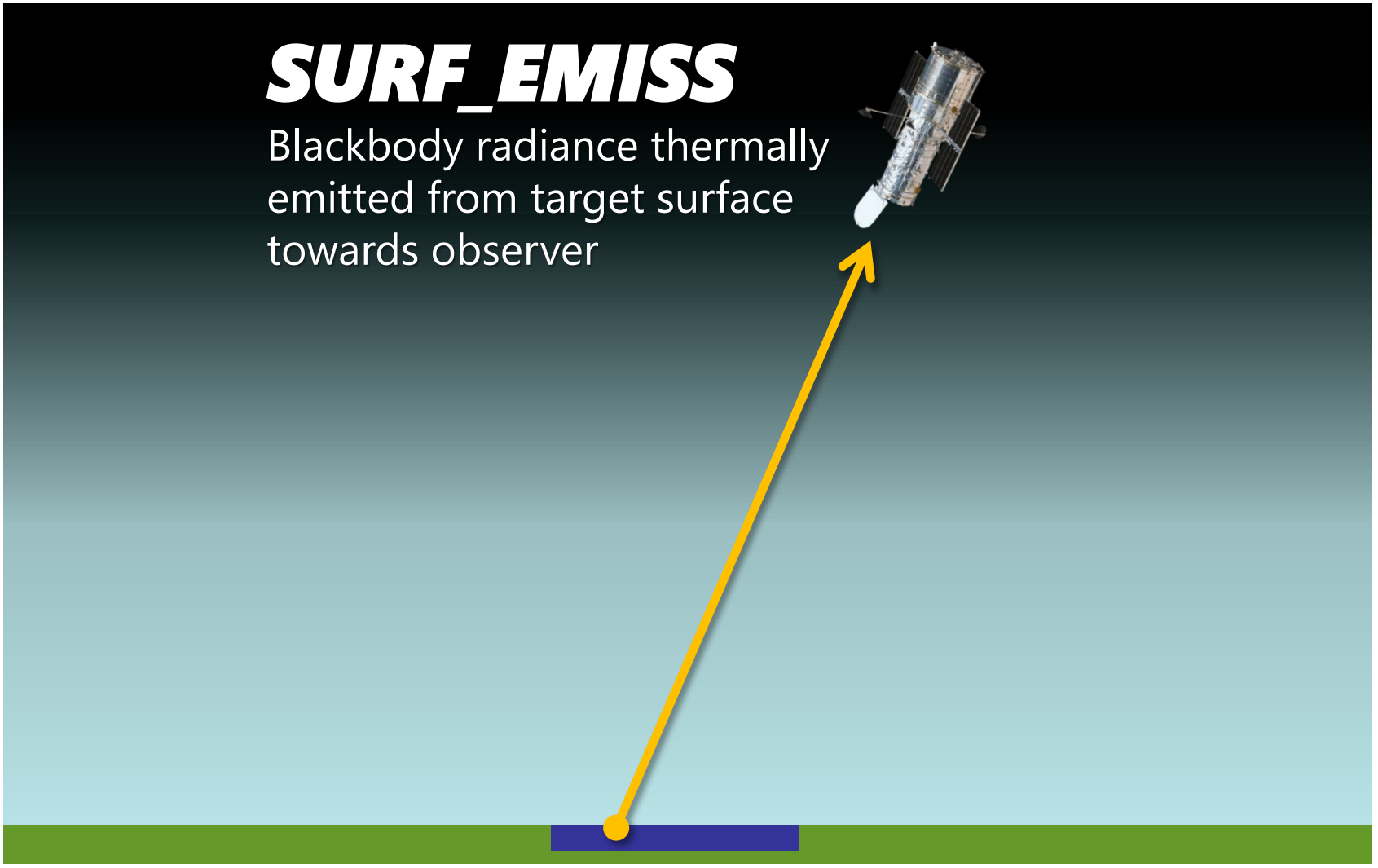


$$\varepsilon_{tgt} = 1 - r_{tgt}$$

MODTRAN OUTPUT QUANTITIES

SURF_EMISS

Blackbody radiance thermally emitted from target surface towards observer



$$\varepsilon_{tgt} = 1 - r_{tgt}$$

TAPE7.SCN Overview

$$L_{EAR} = L_{PTH\_THRML} + L_{SOL\_SCAT} + \tau_2\left(\frac{r_{tgt}}{\pi}\left(\tau_1 E_{sun}\cos\theta_{sun} + E_{sky}\right) + \varepsilon L_{BB}\right)$$

xterm

```
M   2    2    2   -1    2    2    2    2    2    2    1    1    1 286.500LAMBER
    1    1    1    1    0    0 23.00000   0.00000   0.00000   0.00000   0.00000
 -99.000 -99.000 -99.000 -99
 -99.00000 -99.00000 -99.00000
   36MIDLATITUDE SUMMER
 100.00000   0.00000 180.00000 100.00000   0.00000   0.00000    0
    0    2  236    1
   0.00000   0.00000   0.00000   0.00000   0.00000  60.00001   0.00000   0.00000
     11075      25160          1          1N          MRAA
    0   0    0.000  0    0.000  0    1.000
 WAVLEN MCRN  TRANS  PTH THRML  THRML SCT  SURF EMIS   SOL SCAT  SING SCAT  GRND RFLT  DRCT RFLT  TOTAL RAD  REF SOL  SOL@OBS   DEPTH
   0.400000 0.4454 0.0000E+00             0.0000E+00 1.6876E-08 7.6436E-09 2.9659E-09 1.5908E-09 1.9842E-08 5.00E-08 2.52E-07
   0.405000 0.4562 0.0000E+00             0.0000E+00 1.652[illegible] 7.4895E-09 3.0815E-09 1.6792[illegible] 1.9603E-08 5.28E-08 2.54E-07
   0.410000 0.4663 0.0000E+00             0.0000E+00 1.733[illegible] 7.8617E-09 3.4322E-09 1.8999E-09 2.0765E-08 5.97E-08 2.74E-07
   0.4[illegible]   0.4764 0.0000E+00             0.0000E+00 1.729[illegible] 7.8454E-09 3.6248E-09 2.0358E-09 2.0922E-08 6.39E-08 2.82E-07
   0.4[illegible]   0.4860 0.0000E+00             0.0000E+00 1.643[illegible] 7.4522E-09 3.6394E-09 2.0729E-09 2.0077E-08 6.51E-08 2.76E-07
   0.4[illegible]   0.4952 0.0000E+00             0.0000E+00 1.507[illegible] 6.8279E-09 3.5184E-09 2.0306E-09 1.8591E-08 6.38E-08 2.60E-07
   0.4[illegible]   0.5042 0.0000E+00             0.0000E+00 1.298[illegible] 5.8723E-09 3.1893E-09 1.8639E-09 1.6170E-08 5.86E-08 2.30E-07
   0.435000 0.5128 0.0000E+00             0.0000E+00 1.5657E-08 7.0717E-09 4.0455E-09 2.3933E-09 1.9702E-08 7.52E-08 2.86E-07
   0.440000 0.5212 0.0000E+00             0.0000E+00 1.5801E-08 7.1240E-09 4.2830E-09 2.5630E-09 2.0084E-08 8.05E-08 2.96E-07
   0.445000 0.5287 0.0000E+00             0.0[illegible]             4E-08 7.6007E-09 4.7835E-[illegible]                                -07
   0.450000 0.5372 0.0000E+00             0.0[illegible]             3E-08 8.2288E-09 5.4461E-[illegible]                                -07
   0.455000 0.5449 0[illegible]             0.0[illegible]             6E-08 7.9422E-09 5.5086E-[illegible]                                -07
   0.460000 0.5516 0[illegible]             0.0[illegible]  1.7[illegible]6E-08 7.9194E-09 5.7442E-[illegible] 3.5[illegible] 2.3[illegible] 1.12E-07 3.70E-07
   0.465000 0.5588 0[illegible]             0.0000E+00 1.7491E-08 7.7752E-09 5.8961E-09 3.7083E-09 2.3387E-08 1.16E-07 3.73E-07
   0.470000 0.5655 0[illegible]             0.0000E+00 1.7606E-08 7.8026E-09 6.1740E-09 3.9179E-09 2.3780E-08 1.23E-07 3.85E-07
   0.475000 0.5720 0.0000E+00             0.0000E+00 1.[illegible]                09 6.3727E-09 4.0776E-09 2.3846E-08 1.28E-07 3.92E-07
   0.480000 0.5773 0.0000E+00             0.0000E+00 1.[illegible]                09 6.5731E-09 4.2400E-09 2.3931E-08 1.33E-07 4.00E-07
   0.485000 0.5834 0.0000E+00             0.0000E+00 1.[illegible]                09 6.1932E-09 4.0258E-09 2.1972E-08 1.26E-07 3.72E-07
   0.490000 0.5894 0.0000E+00             0.0000E+00 1.[illegible]                09 6.4711E-09 4.2384E-09 2.2370E-08 1.33E-07 3.83E-07
   0.495000 0.5948 0.0000E+00             0.0000E+00 1.6221E-08 7.0429E-09 6.8370E-09 4.5102E-09 2.3058E-08 1.42E-07 4.00E-07
   0.500000 0.5989 0.0000E+00             0.0000E+00 1.5005E-08 6.4896E-09 6.5373E-09 4.3418E-09 2.1543E-08 1.36E-07 3.80E-07
   0.505000 0.5981 0.0000E+00             0.0000E+00 1.5129E-[illegible]                                43E-07 3.99E-07
   0.510000 0.6065 0.0000E+00             0.0000E+00 1.5176E-[illegible]                                49E-07 4.05E-07
   0.515000 0.6132 0.0000E+00             0.0000E+00 1.3836E-[illegible]                                41E-07 3.76E-07
   0.520000 0.6173 0.0000E+00             0.0000E+00 1.3884E-[illegible]                                47E-07 3.86E-07
   0.525000 0.6199 0.0000E+00             0.0000E+00 1.3775E-08 5.8238E-09 7.0169E-09 4.8090E-09 2.0792E-08 1.51E-07 3.93E-07
   0.530000 0.6223 0.0000E+00             0.0000E+00 1.4493E-08 6.0982E-09 7.6030E-09 5.2403E-09 2.2096E-08 1.65E-07 4.25E-07
   0.535000 0.6262 0.0000E+00             0.0000E+00 1.3746E-08 5.7534E-09 7.4196E-09 5.1416E-09 2.1165E-08 1.62E-07 4.12E-07
>
```

τ_2

$\tau_2 \varepsilon L_{BB}$

$\tau_2\left(r_{tgt}\left(\tau_1 E_{sun}\cos\theta_{sun}\right)\right)$

L_{PTH_THRML}

L_{SOL_SCAT}

$\tau_2\left(r_{tgt}\left(\tau_1 E_{sun}\cos\theta_{sun} + E_{sky}\right)\right)$