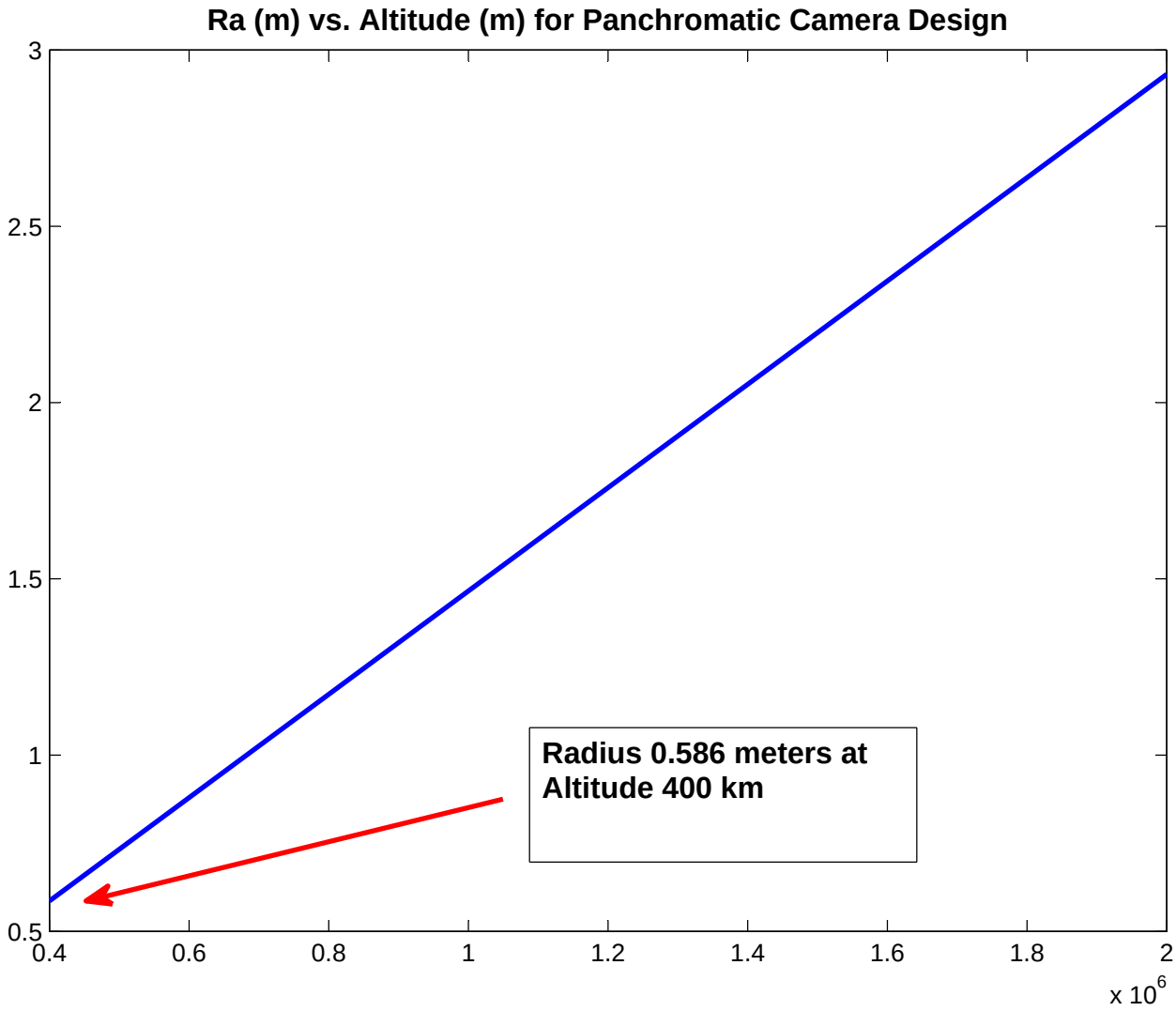
Ra (m) vs. Altitude (m) for Panchromatic Camera Design
3
2.5
2
1.5
1
0.5
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
x 10^6
Radius 0.586 meters at
Altitude 400 km

```
% hw1.m  23-jan-08
% matlab script to compute irradiance at top of earth
% atmosphere from the sun, in the visible range
% that is 0.4um - 0.7um  (1um = 1e-06m)
% and finish the design problem for hw1

lam1=0.4e-06 % lower bound visible
lam2=0.7e-06 % upper bound visible
L=quad(@planckv,lam1,lam2) % compute the radiance
D=1.5e11 % earth-sun distance (m)
Rs=6.96e08 % sun radius (m)
e=0.99  % sun emissivity

Ms=pi*L*e % sun emittance (watts/m^2)
Phis=4*pi*Rs^2*Ms % total power generated by sun in visible (watts)
Ee=Phis/(4*pi*D^2) % irradiance at top of atmosphere of earth (w/m^2)

% iris document gives 377.4 w/m^2 for this quantity
% visible range should be larger, it is

Me=Ee*0.7*(0.64)^2 % apparent emittance of brightest scene object
                   % 0.7 reflectance and 2x through the atmosphere
                   % 0.64 * 0.64
Le=Me/pi % radiance of scene element

% now left side of equation, energy of full well capacity, 100,000e
% of green light

lambda=0.550e-06 % meters wavelength
c=3e08 % speed of lightd:
v=c/lambda % frequency of green light
h=6.626e-34 % m^2 kg/s  =  Js
Q=100000.0*h*v % max energy for a single detector element

qe=0.4 % quantum efficiency
k=0.7 % 30 percent loss
line_rate=24000/10
S=0.25 % meters per pixel
Vg=line_rate*S % ground velocity of footprint
Tl=1/line_rate
Te=0.5*Tl % exposure time for proper sampling
Tee=Te*32 % 32 TDI stages
```

```
H=400000:100000:2000000;
Ra=sqrt(Q*(H.^2)/(qe*k*Le*pi*Tee*S^2));
disp('Table of H & Ra (both meters)');
[H' Ra']


plot(H,Ra);
title('Ra (m) vs. Altitude (m) for Panchromatic Camera Design');
```

```
hw1
lam1 =
                    4e-007
lam2 =
                    7e-007
wavelength range meters
L =
           7510971.5860946
w/m^2/sr
D =
               150000000000
earth - sun distance, meters
Rs =
   696000000
sun radius meters
e =
                      0.99
sun emissivity
Ms =
          23360449.0246345
sun emittance/exitance w/m^2
Phis =
     1.42203252439146e+026
total power sun, in visible w
Ee =
          502.941123320771
irradiance at top of atmosphere w/m^2
Me =
          144.203278878532
apparent emittance of brightest scene object after 2 atm passes
w/m^2
Le =
          45.9013292871548
radiance of brightest scene element w/m^2/sr
lambda =
                   5.5e-007
wavelength green light m
c =
   300000000
speed of light m/s
v =
           545454545454545
frequency of green light hz
h =
                6.626e-034
plancks constant m^2 kg/s  = Js
Q =
     3.61418181818182e-014
max energy single detector J
qe =
                      0.4
quantum efficiency
k =
                      0.7
30 percent losses
```

```
line_rate =
        2400
lines per second
S =
                      0.25
meters/pixel
Vg =
   600
ground velocity m/s
Tl =
      0.000416666666666667
time per line
Te =
      0.000208333333333333
exposure time per line (half of above)
Tee =
       0.0066666666666667
extended exposure time = Te * 32 (TDI stages)
Ra=sqrt(Q*(H.^2)/(qe*k*Le*pi*Tee*S^2)) Ra linear function of H
Table of H & Ra (both meters)
ans =
                    400000         0.586278579845408
                    500000          0.73284822480676
                    600000         0.879417869768112
                    700000          1.02598751472946
                    800000          1.17255715969082
                    900000          1.31912680465217
                   1000000          1.46569644961352
                   1100000          1.61226609457487
                   1200000          1.75883573953622
                   1300000          1.90540538449758
                   1400000          2.05197502945893
                   1500000          2.19854467442028
                   1600000          2.34511431938163
                   1700000          2.49168396434298
                   1800000          2.63825360930434
                   1900000          2.78482325426569
                   2000000          2.93139289922704
diary off
```