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```
close all; clear all; clc;
```

JPL Mission Parameters for REASON

```
%REASON transmit upper and lower bound (Watts)
    P_t_l = 8;
    P_t_u = 10;

%REASON boresight gain upper and lower bound (dBi)
    G_0_l = 9;
    G_0_u = 10;

%REASON Side lobe gain upper and lower bound (dBi)
    G_ts_l = 10^(-15/20);
    G_ts_u = 10^(0/20);

%REASON polarization loss
    L_pol = .7;

%REASON Coherence loss
    L_c = .5;

%REASON duty cycle
    d = .1;

%REASON allowable observation time for calibration (s)
    Obs = 4*60^2;

    Obs_a = .5:.5:8;
    Obs_a_s =Obs_a*60^2;
%Receive noise temperture upper and lower bound
    T_l = 2000;
    T_u = 5800;

%frequency badwidth upper and lower bound
    f_l = 50e6;
```

```
    f_c = 60e6;
    f_u = 66e6;
    B = f_u-f_l;

%min allowable seperation of CaliPer from Clipper
R = 1000e3;
```

CaliPer Parameters

```
%Receive gain
G_r_max = 2.15;

%%S11 Receive atenna effiency at a certain frequency
T = readtable('S11V3.csv','NumHeaderLines',3);
```

Antenna radiation efficeincy (reasonable place-holder efficiency constant)

```
episilon_r = .9;
```

Calulate Effective Area

Get the Antenna width and height

```
    w_a = 2*table2array(T(:,2));
    h_a = table2array(T(:,3));
    length = height(w_a);

% convert S11 dB for 54,60,66MHz to decimal
f_a_l = zeros(length);
f_a_c = zeros(length);
f_a_h = zeros(length);

for i = 1:height(T(:,3))

    f_a_l(i) = 1-10^(table2array(T(i,4))/10);
    f_a_c(i) = 1-10^(table2array(T(i,6))/10);
    f_a_h(i) = 1-10^(table2array(T(i,5))/10);
end

%find A_eff
    A_eff = zeros(length);
    for i = 1:length
        A_eff(i) = G_r_max*f_a_h(i)*episilon_r;
    end



%simulated atenna efficenty from .01 to 100%
eff = .01:0.01:1;
leneff = width(eff);
```

```
%number of atenna elements
N_elm = 1;
```

T_obs

```
T_obs = d*Obs;
T_obs_a = Obs_a*d;
```

Universal constants

```
%Boltzman Constant
    k = .380649e-23;
    c = 3e8;
```

Wavelenth upper and lower bound

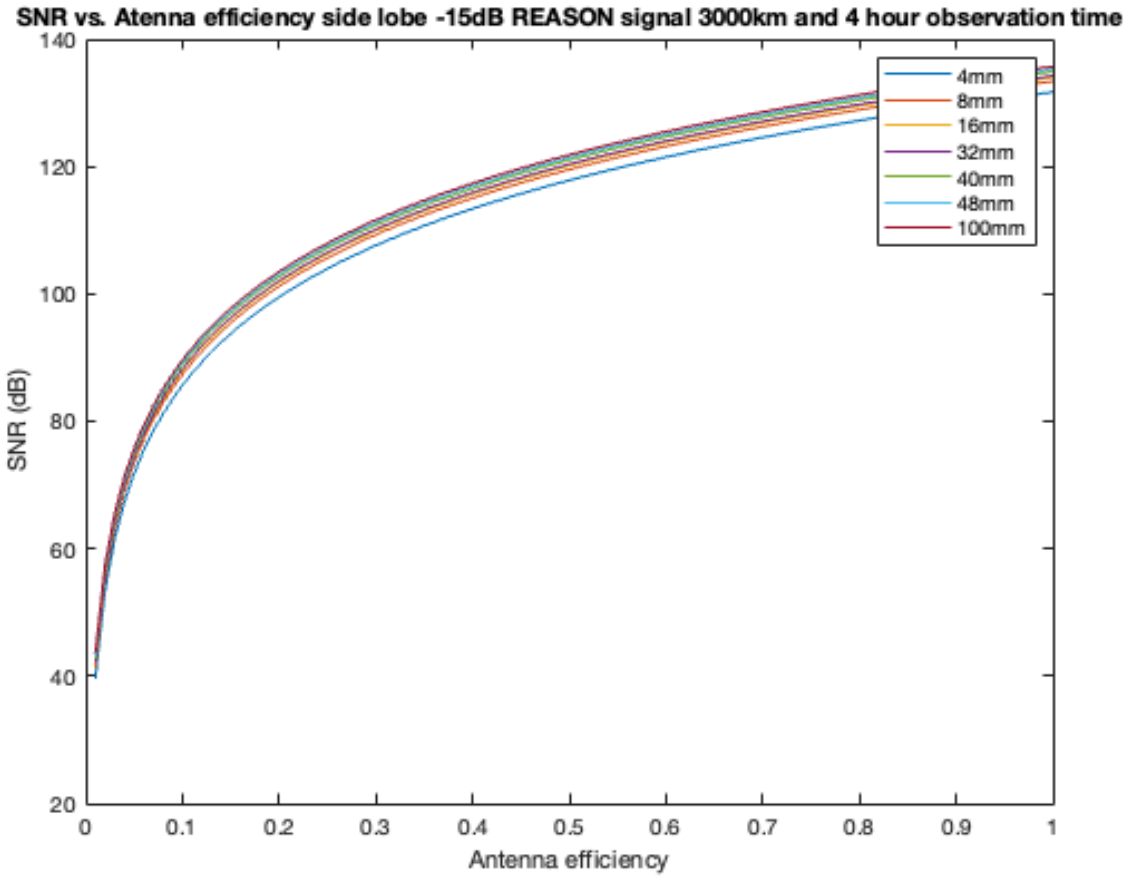
```
    lambda_l = c/f_l;
    lambda_u = c/f_u;
    lambda_c = c/f_c;
```

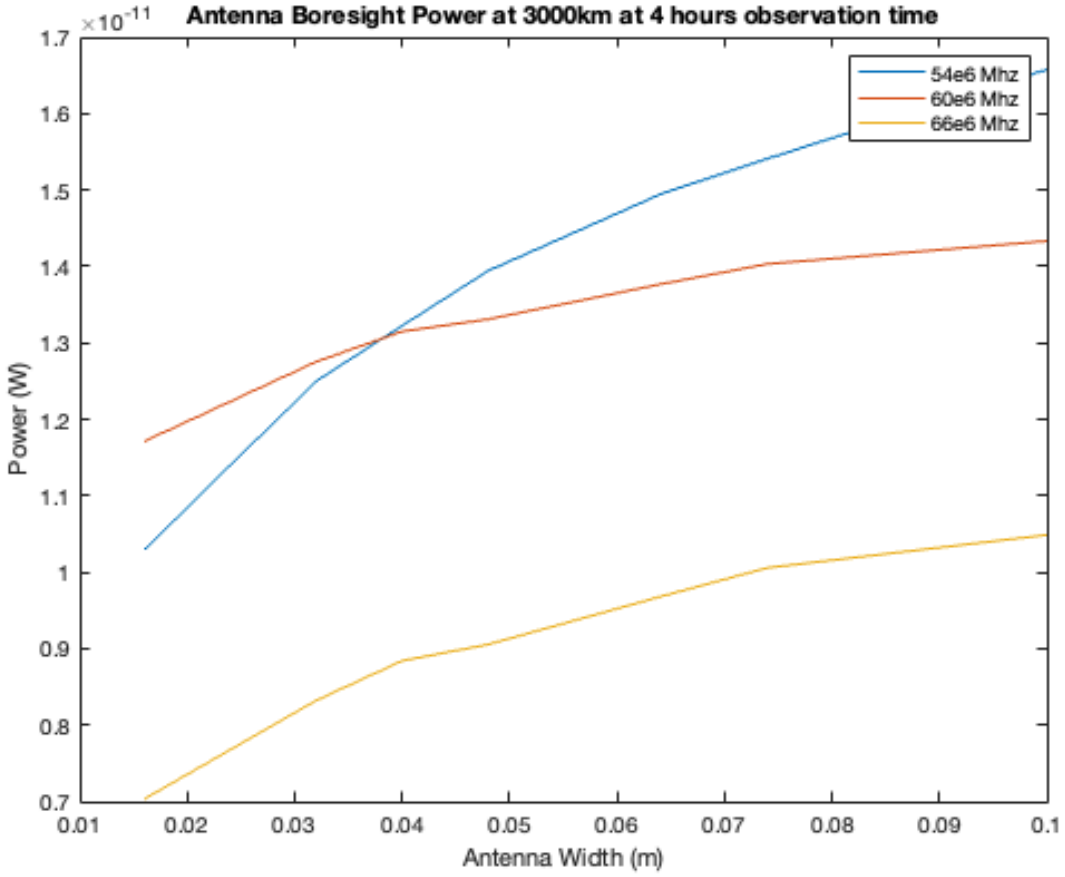
Power received by one RF emission from REASON upper and lower bound side lobe

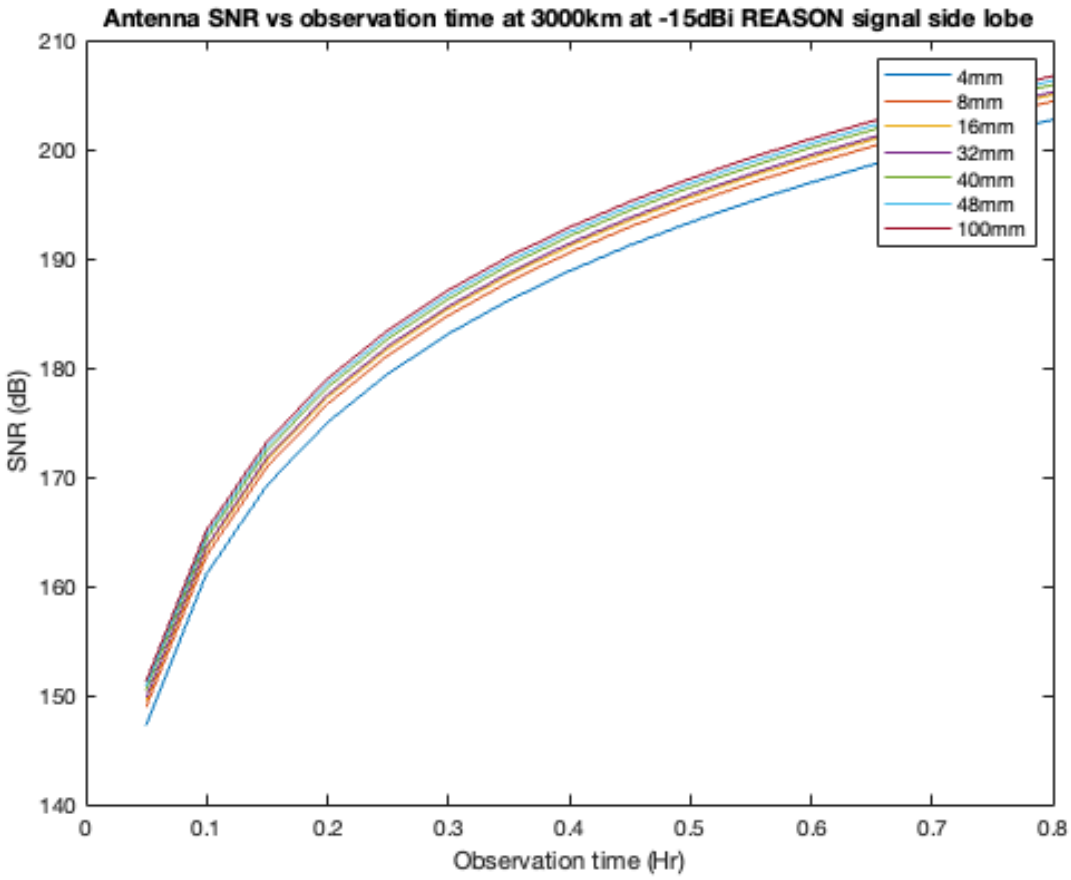
```
    P_r_l_e = zeros(length,leneff);

    for i = 1:length
        for j = 1:leneff
        P_r_l_e(i,j) = P_t_l*G_ts_l*(lambda_u)^2/(4*pi)*A_eff(i)*N_elm*(1/
(4*pi*R^2))*L_pol*eff(j);

        end
    end

%%Signal to Noise Power Ratio for tranmission (dB)
    SNR = zeros(length, leneff);
    for i = 1:length
        for j = 1:leneff

            SNR(i,j) = 20*log((2*P_r_l_e(i,j)*T_obs*L_c*(1/(k*T_u*B))));

        end
    end
figure()
plot(eff,SNR)
title("SNR vs. Atenna efficiency side lobe -15dB REASON signal 3000km and 4
 hour observation time")
xlabel("Antenna efficiency")
ylabel("SNR (dB)")
legend("4mm","8mm","16mm","32mm","40mm","48mm","100mm")
```

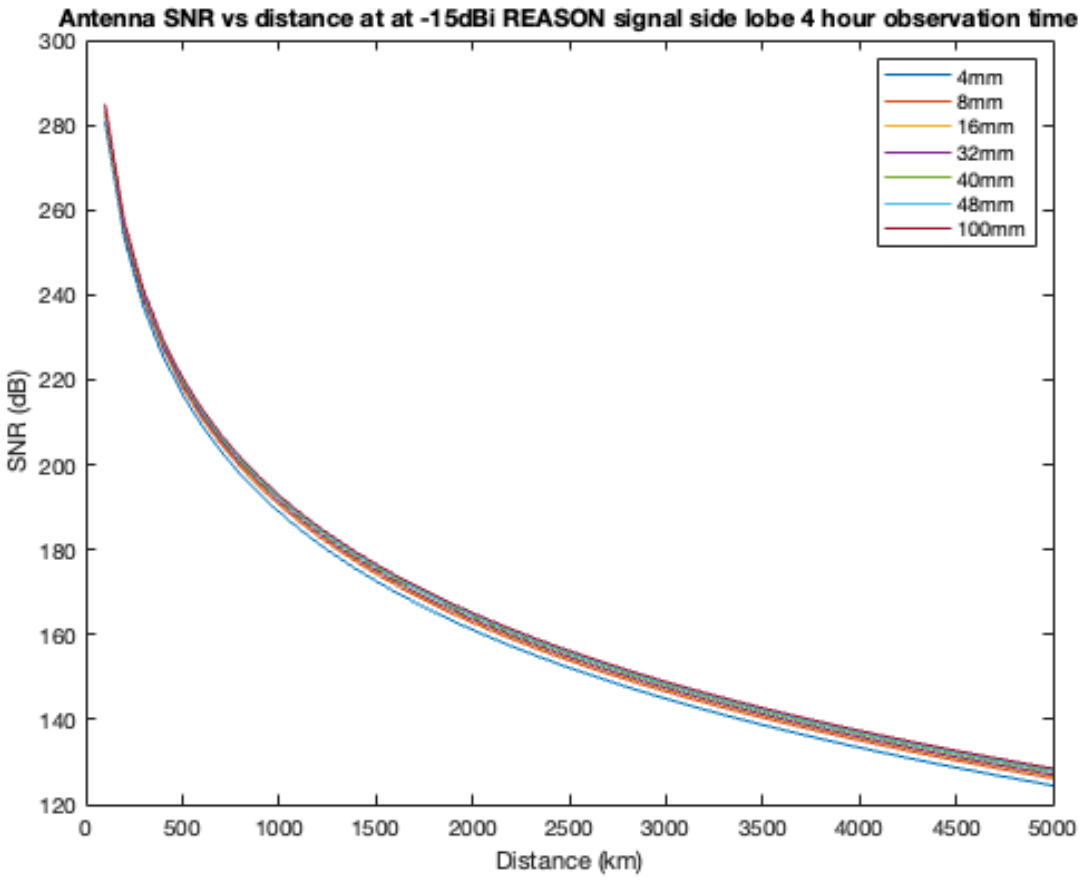
```
%%REASON Boresight power as a function of antenna diameter

for i = 1:length
            P_r_l_bor(i) = P_t_l*G_0_u*(lambda_l)^2/(4*pi)*A_eff(i)*N_elm*(1/
(4*pi*R^2))*L_pol*f_a_l(i);

end


for i = 1:length
            P_r_u_bor(i) = P_t_l*G_0_u*(lambda_u)^2/(4*pi)*A_eff(i)*N_elm*(1/
(4*pi*R^2))*L_pol*f_a_h(i);

end

for i = 1:length
            P_r_c_bor(i) = P_t_l*G_0_u*(lambda_c)^2/(4*pi)*A_eff(i)*N_elm*(1/
(4*pi*R^2))*L_pol*f_a_c(i);

end

figure()
plot(w_a,P_r_l_bor',w_a,P_r_c_bor',w_a,P_r_u_bor')
title("Antenna Boresight Power at 3000km at 4 hours observation time")
xlabel("Antenna Width (m)")
ylabel("Power (W)")
legend("54e6 Mhz","60e6 Mhz","66e6 Mhz")

%%SNR observation time, lower bound efficiency, width
   f_a_l_len = width(f_a_l);
   T_obs_a_len = width(Obs_a_s);


                for i = 1:length
                P_r_l_e(i) = P_t_l*G_ts_l*(lambda_l)^2/
(4*pi)*A_eff(i)*N_elm*(1/(4*pi*R^2))*L_pol;
                end
                for i = 1:length
                    for j = 1:T_obs_a_len
                        SNR1(i,j) = 20*log((2*P_r_l_e(i)*Obs_a_s(j)*L_c*(1/
(k*T_u*B))));
                    end
                end
figure()
 plot(T_obs_a,SNR1)
 title("Antenna SNR vs observation time at 3000km at -15dBi REASON signal side
 lobe")
 xlabel("Observation time (Hr)")
 ylabel("SNR (dB)")
 legend("4mm","8mm","16mm","32mm","40mm","48mm","100mm")

%%SNR vs. distance
R_a = 100:100:5e3;
R_a_m = R_a*1e3;
```

```
R_a_len = width(R_a);

                for i = 1:length
                    for j = 1:R_a_len
                     P_r_l_e(i,j) = P_t_l*G_ts_l*(lambda_l)^2/
(4*pi)*A_eff(i)*N_elm*(1/(4*pi*R_a_m(j)^2))*L_pol;
                    end
                end
                for i = 1:length
                    for j = 1:R_a_len
                        SNR1(i,j) = 20*log((2*P_r_l_e(i,j)*Obs*L_c*(1/
(k*T_u*B))));
                    end
                end


figure()
plot(R_a,SNR1)
title("Antenna SNR vs distance at at -15dBi REASON signal side lobe 4 hour
 observation time")
xlabel("Distance (km)")
ylabel("SNR (dB)")
legend("4mm","8mm","16mm","32mm","40mm","48mm","100mm")
```




Antenna Boresight Power at 3000km at 4 hours observation time
×10^-11
Power (W)
Antenna Width (m)
54e6 Mhz
60e6 Mhz
66e6 Mhz
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1


Antenna SNR vs observation time at 3000km at -15dBi REASON signal side lobe
SNR (dB)
Observation time (Hr)
4mm
8mm
16mm
32mm
40mm
48mm
100mm
210
200
190
180
170
160
150
140
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8



Effective Isotropic Radiation Power

```
%calbe loss (dB)
    %L_c = -5;
   % EIRP = 10*log(P_r_u) - L_c + 2.15



%equation variables


% P_r =
% G_0 =

% A_eff =

%
% R =
%
% G_a =
```

```
% T_obs =
% k =
```

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