Electron Modelling - Part 1

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Question 1

The purpose of this code is to simulate electrons in an N type Si semiconductor crystal. The electrons bounce off the y axis. As for the x-axis, they go through the x axis and appear on the opposite side.

```
global C



C.q_0 = 1.60217653e-19;             % electron charge
C.hb = 1.054571596e-34;             % Dirac constant
C.h = C.hb * 2 * pi;                    % Planck constant
C.m_0 = 9.10938215e-31;             % electron mass
C.kb = 1.3806504e-23;               % Boltzmann constant
C.eps_0 = 8.854187817e-12;          % vacuum permittivity
C.mu_0 = 1.2566370614e-6;           % vacuum permeability
C.c = 299792458;                    % speed of light
C.g = 9.80665; %metres (32.1740 ft) per sÂ²


nSim = 500;
noe = 20;
r2 = randi(360,noe,1);
xbound = 200;
ybound = 100;
x = randi(200,noe,1);
y = randi(100,noe,1);
```

Thermal Velocity

The thermal velocity is calculate using the below equation which is

$$vth = \sqrt{((KT/(0.26m))}$$

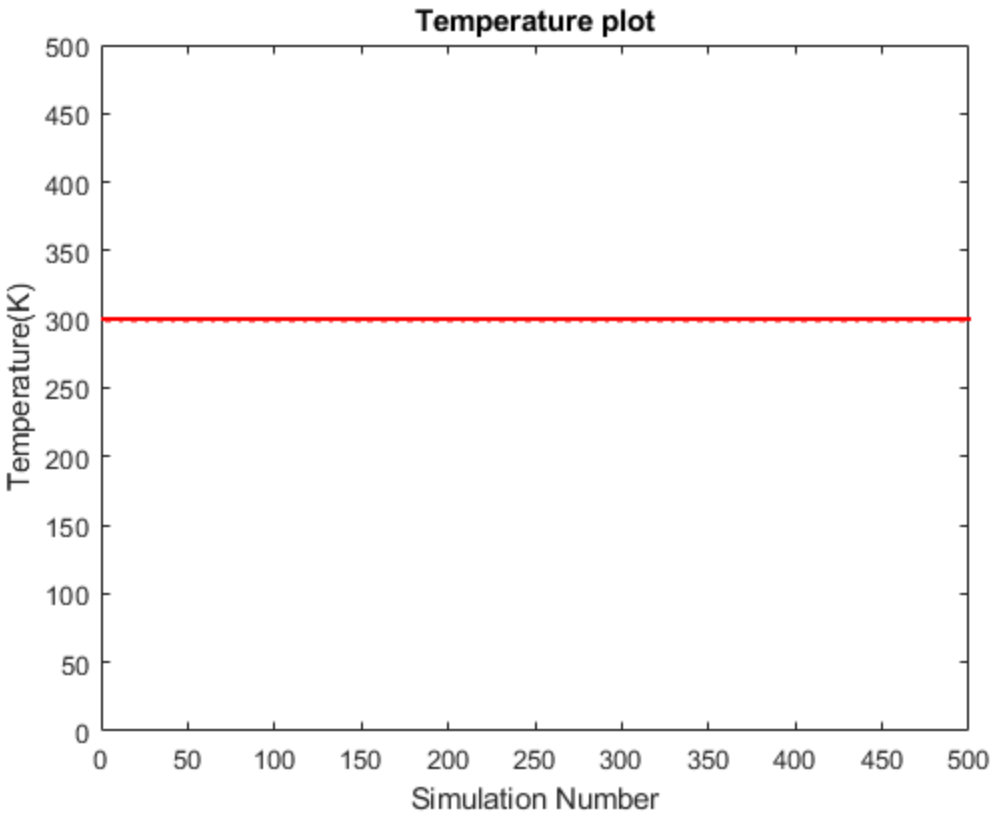
The mean free path is simply

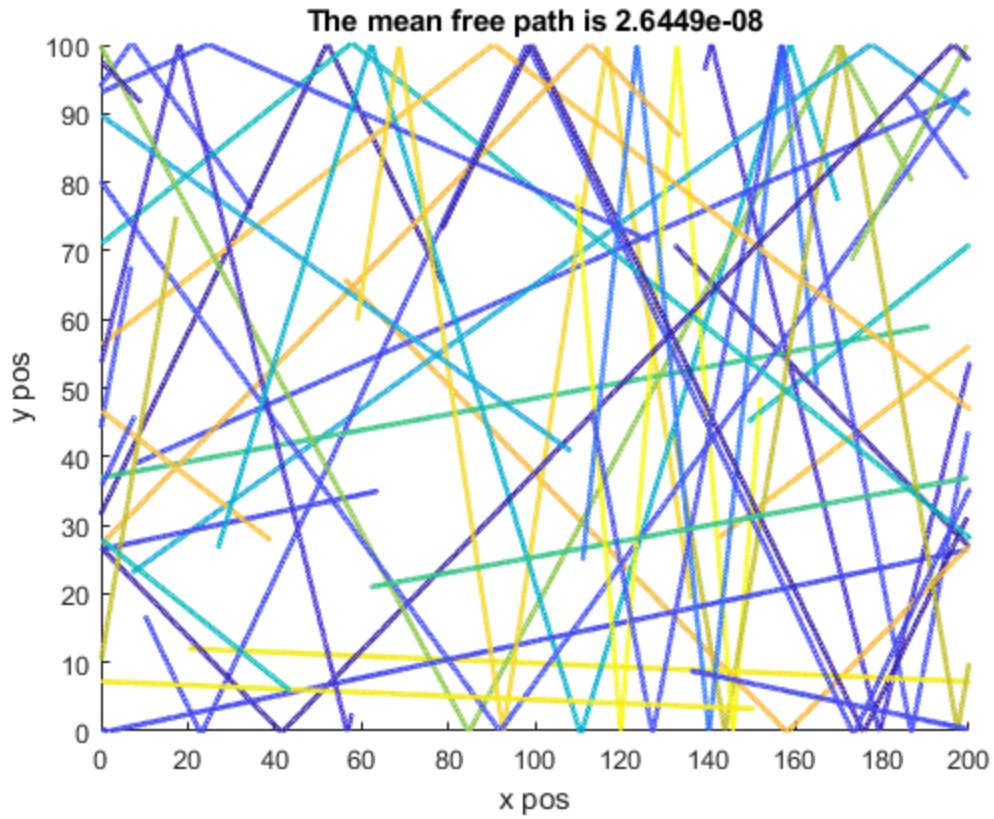
$$MFP = vth * 0.2ps$$

```
vth = sqrt((C.kb * 300)/(C.m_0 * 0.26));
```

```
vx = vth * cos(r2) ;
vy = vth * sin(r2);

MFP = vth * 0.2 * 10^-12;

colourArray = rand(noe,1);


for n = 1:nSim
    %Reflecting for y bounds%
    temp = y >= ybound ;
    temp1 = y < ybound ;


    temp = temp * -1;

    tempHigher = temp + temp1;


    temp2 = y <= 0;
    temp3 = y > 0;

    temp2 = temp2 * -1;
    tempLower = temp2 + temp3;

    vy = vy .* tempHigher;
    vy = vy .* tempLower;

    %%%%%%%%%%%%%%%%%%%

    % when x > 200%%%%%
    tempx1 = x <= 200;

    x = x .* tempx1;
    %%%%%%%%%%%%%%%%%%%

    %%When x goes less than zero , come from 200 %%%%%

    tempx2 = x < -0.1;


    tempx2 = tempx2 * 200;
    tempxFinal = x + tempx2;

    x = tempxFinal;

    %%%%%%%%%%%%%%%%%%%
    dx = vx * (1/200000);
    dy = vy * (1/200000);

    x = x + dx;
    y = y + dy;
    vsq = (vy).^2 + (vx).^2 ;
    average = mean(vsq);
```

```
    semiCTemperature = (average *(0.26)* C.m_0)/(C.kb);
    figure(1)
    plot(n , semiCTemperature,'.r')
    title("Temperature plot");
    xlabel("Simulation Number")
    ylabel("Temperature(K)")
    axis([0 nSim 0 500]);
    hold on


    figure(2)
    scatter(x,y,3,colourArray);
    axis([0 200 0 100]);
    xlabel("x pos")
    ylabel("y pos")
    title("The mean free path is " + MFP);
    hold on;


    pause(0.01);


end
```





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