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% By Huanyu Liu

% 100986552

% For elec4700 assignment1 part1


% Initialize the parameters

n=10; % number of particles

T=300; % temperture of the background

L=200e-9; % length of the frame (figure 1)

H=100e-9; % height of the frame

tao=0.2e-12; % the given mean time between collisions

m0=9.109e-31; % mass of a particle

mn=0.26*m0; % effective mass

kb=1.38e-23; % constant coeffient

vth=sqrt(2*kb*T/mn); % average speed of each particle

% Initialize the positions of each particle

Pox = L*rand(1,n);

Poy = H*rand(1,n);

% Initialize the speed of each particle and measure the initial temperature

for num=1:n

Vx(num) = randn()*vth/sqrt(2);

Vy(num) = randn()*vth/sqrt(2);

end

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Tmeasured = sum(Vx.^2 + Vy.^2).*mn./(2*kb*n);

% draw the first locations of the particles and the blocks

figure(1)

plot(Pox,Poy,'.');

xlim([0 L]);

ylim([0 H]);

hold on

% more parameters that will be used in the loop

TStop = 1e-11; % max running time

t=0; % start time

dt=1e-14; % step time

path=0; % initialize the path length

while t < TStop

    z=round(1+t/dt); % index, the z-th interval between collisions

    Tmeasured = sum(Vx.^2 + Vy.^2).*mn./(2*kb*n);

    Vact=sqrt(sum(Vx.^2+Vy.^2)/n); % the average speed of all the particles

    path=path+Vact*dt;

    tPx = Pox + Vx.*dt; % predict the position

    tPy = Poy + Vy.*dt;

    % when the particles go to the right and left border

    pxl = Pox >= L;

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Pox(px1) = Pox(px1) - L;

px2 = Pox <= 0;

Pox(px2) = Pox(px2) + L;


py1 = tPy <= 0;

Vy(py1) = Vy(py1) .* (-1);

py2 = tPy >= H;

Vy(py2) = Vy(py2) .* (-1);


    % now all velocity have been modified to the correct direction,

    % update the position

Pox = Pox + Vx.*dt;

Poy = Poy + Vy.*dt;


figure(1)

plot(Pox,Poy,'.');

xlim([0 L]);

ylim([0 H]);

hold on


figure(2)

plot(t,Tmeasured,'.r');

title('temperature plot');

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hold on

fprintf(' time: %g (%5.2g %) temperature: %g \n', t/dt, t / TStop * 100, Tmeasured);

pause(0.01)

t=t+dt;

end

fprintf(' vth: %g\n',vth);

MFP=path;

fprintf(' MFP:%g m \n ', MFP);

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