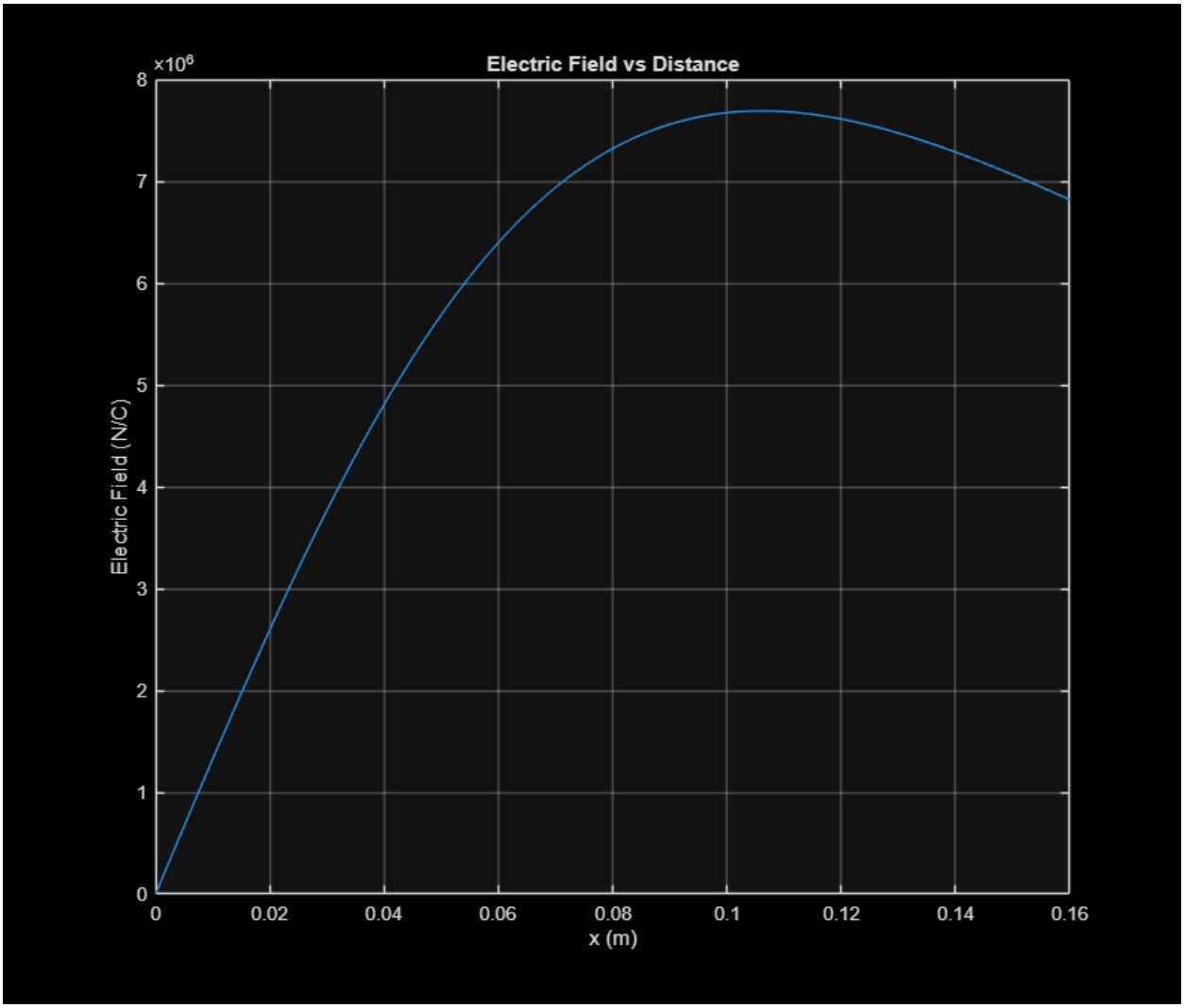
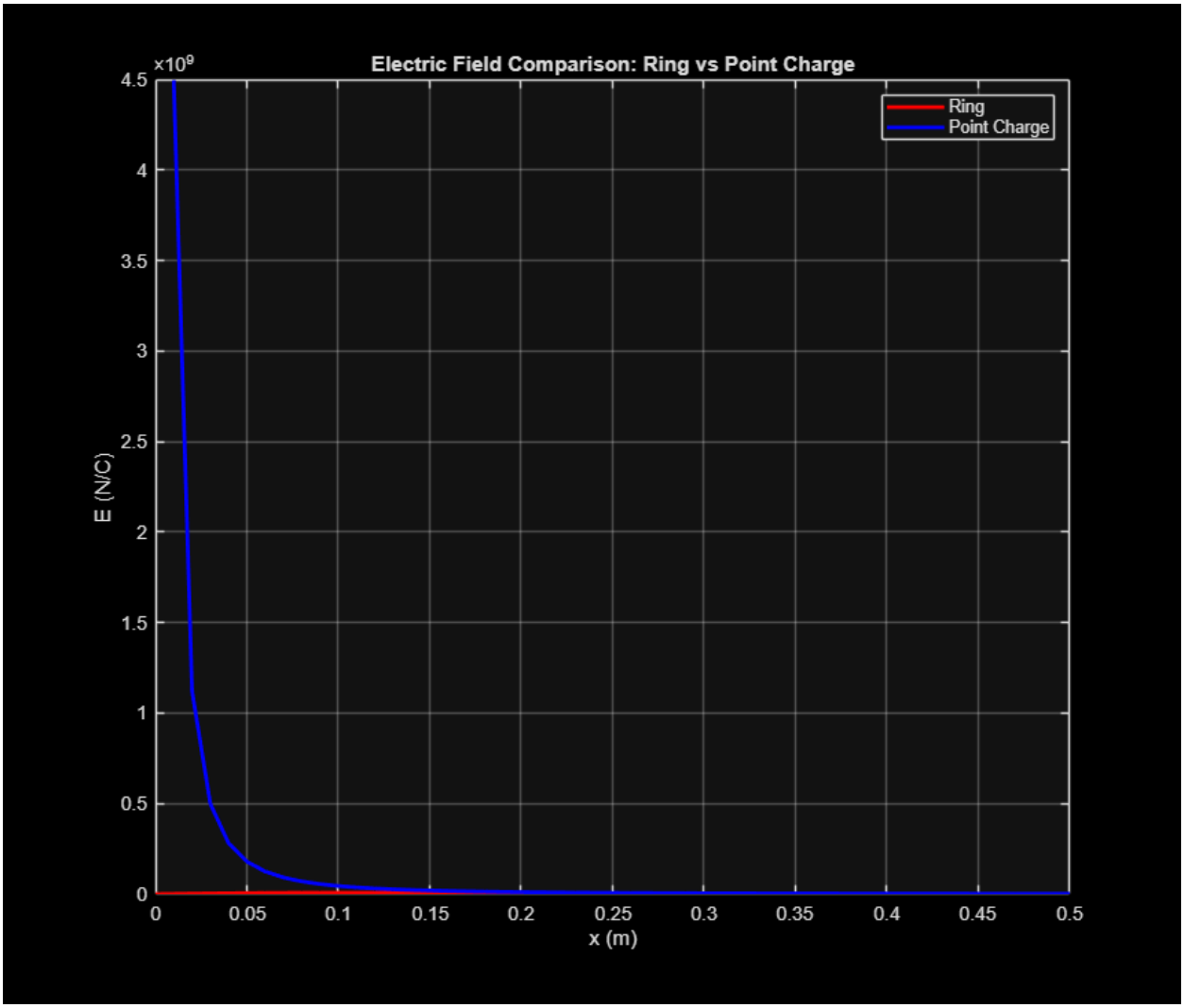
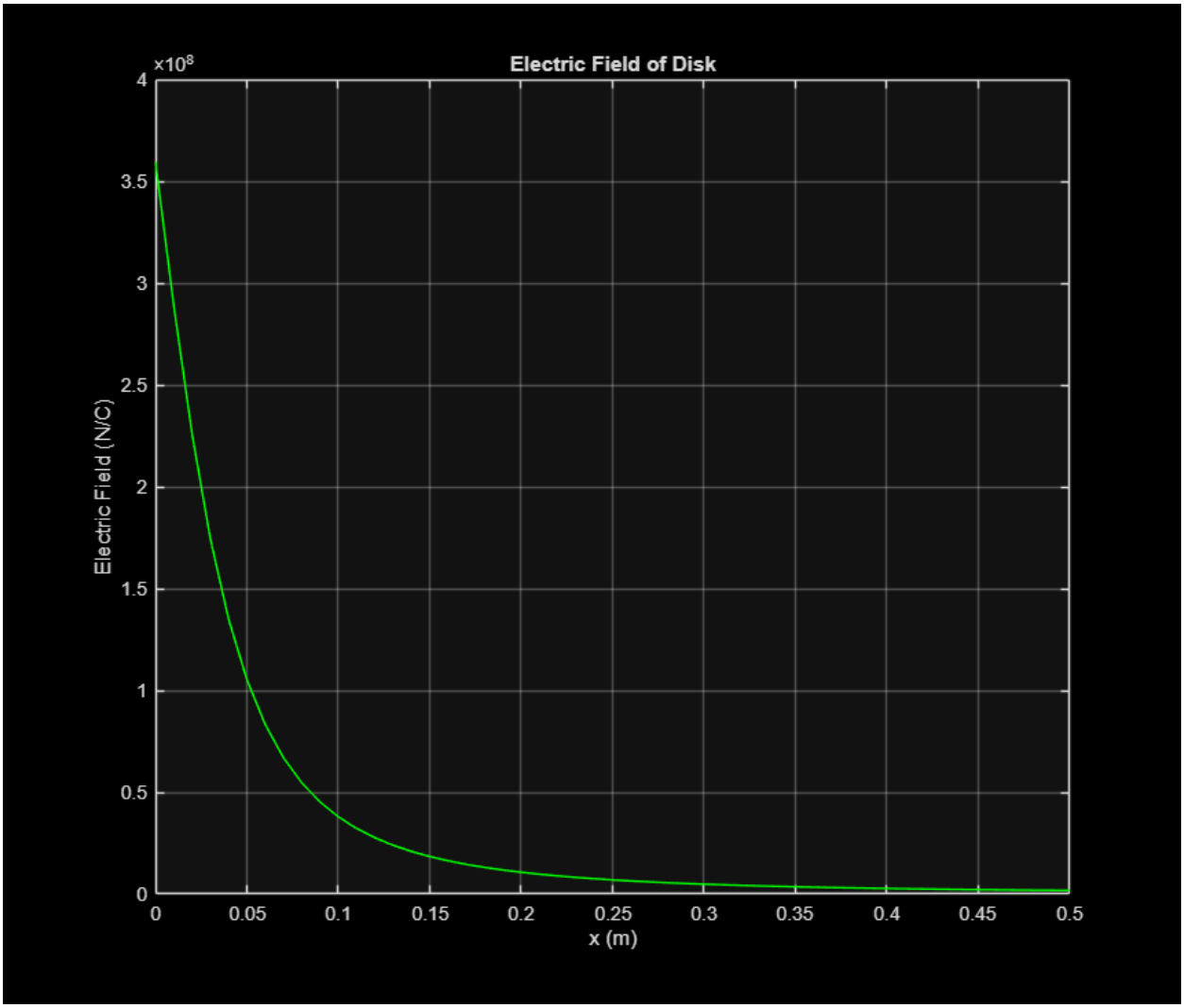
```
a = 0.15;
Q = 5.0e-5;
eo = 8.85e-12;
syms x;

%Q1
E1(x) = (1/(4*pi*eo))*((Q*x)/(x^2 + a^2)^(3/2));

dE = diff(E1, x);
max_point = solve(dE==0, x);

disp("Maximum value is at: ");
disp(double(max_point));

xvals = 0:0.001:0.16;
Evals = (1/(4*pi*eo)) * (Q .* xvals) ./ ( (xvals.^2 + a^2).^(3/2) );

figure();
plot(xvals, Evals);
xlabel('x (m)');
ylabel('Electric Field (N/C)');
title('Electric Field vs Distance');
grid on;

% Yes the maximum on the graph conicides with the maximum value we obtained
% anallytically

%Q2
xvals = 0:0.01:0.5;
ringField = (1/(4*pi*eo)) * (Q .* xvals) ./ ( (xvals.^2 + a^2).^(3/2) );
pointFeild = (1/(4*pi*eo)) * (Q ./(xvals.^2));

figure();
plot(xvals, ringField, 'r-', 'LineWidth', 2); hold on;
plot(xvals, pointFeild, 'b-', 'LineWidth', 2);
xlabel('x (m)');
ylabel('E (N/C)');
title('Electric Field Comparison: Ring vs Point Charge');
legend('Ring', 'Point Charge');
grid on;

% Observation: As x increases, the ring's field approaches that of a point
charge.
% This implies that at large distances, a ring looks like a point charge.

%Q3
Ro = 0.05;

xvals = 0:0.01:0.5;
diskE = (Q ./ (2*pi*eo*Ro^2)) .* (1 - (xvals ./ sqrt(xvals.^2 + Ro^2)));
% Plot the electric field of the disk
figure();
```

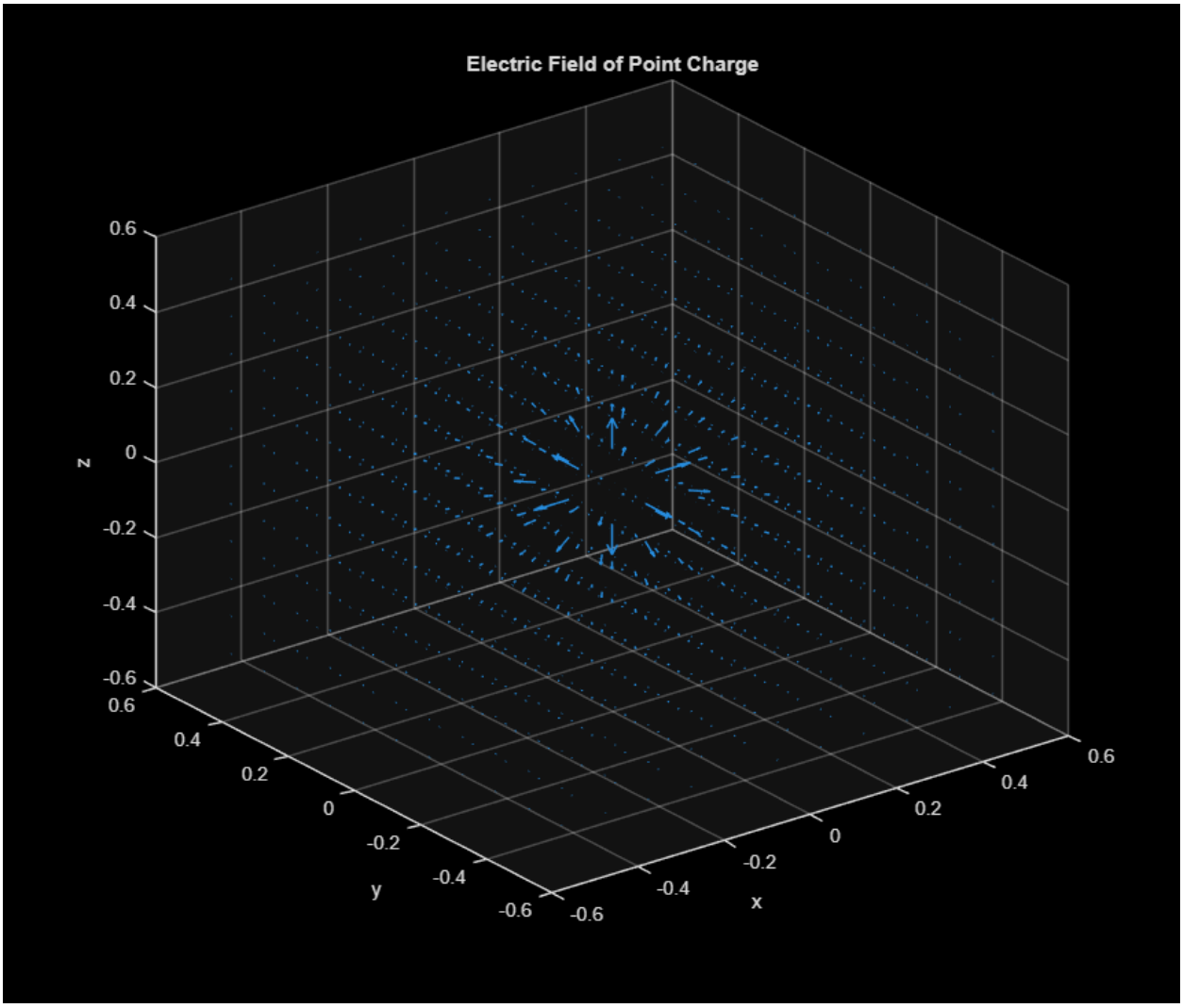
```
plot(xvals, diskE, 'g');
xlabel('x (m)');
ylabel('Electric Field (N/C)');
title('Electric Field of Disk');
grid on;

%Q4
q = 1e-10;

[x,y,z] = meshgrid(-0.5:0.1:0.5, -0.5:0.1:0.5, -0.5:0.1:0.5);

R = sqrt(x.^2 + y.^2 + z.^2);
Ex = (1/(4*pi*eo)) * (q .* x) ./ (R.^3);
Ey = (1/(4*pi*eo)) * (q .* y) ./ (R.^3);
Ez = (1/(4*pi*eo)) * (q .* z) ./ (R.^3);

figure();
quiver3(x,y,z,Ex,Ey,Ez);
xlabel('x'); ylabel('y'); zlabel('z');
title('Electric Field of Point Charge');
view(3);

figure();
quiver3(x,y,z,Ex,Ey,Ez);
xlabel('x'); ylabel('y'); zlabel('z');
title('Electric Field of Point Charge');
view(2);
```

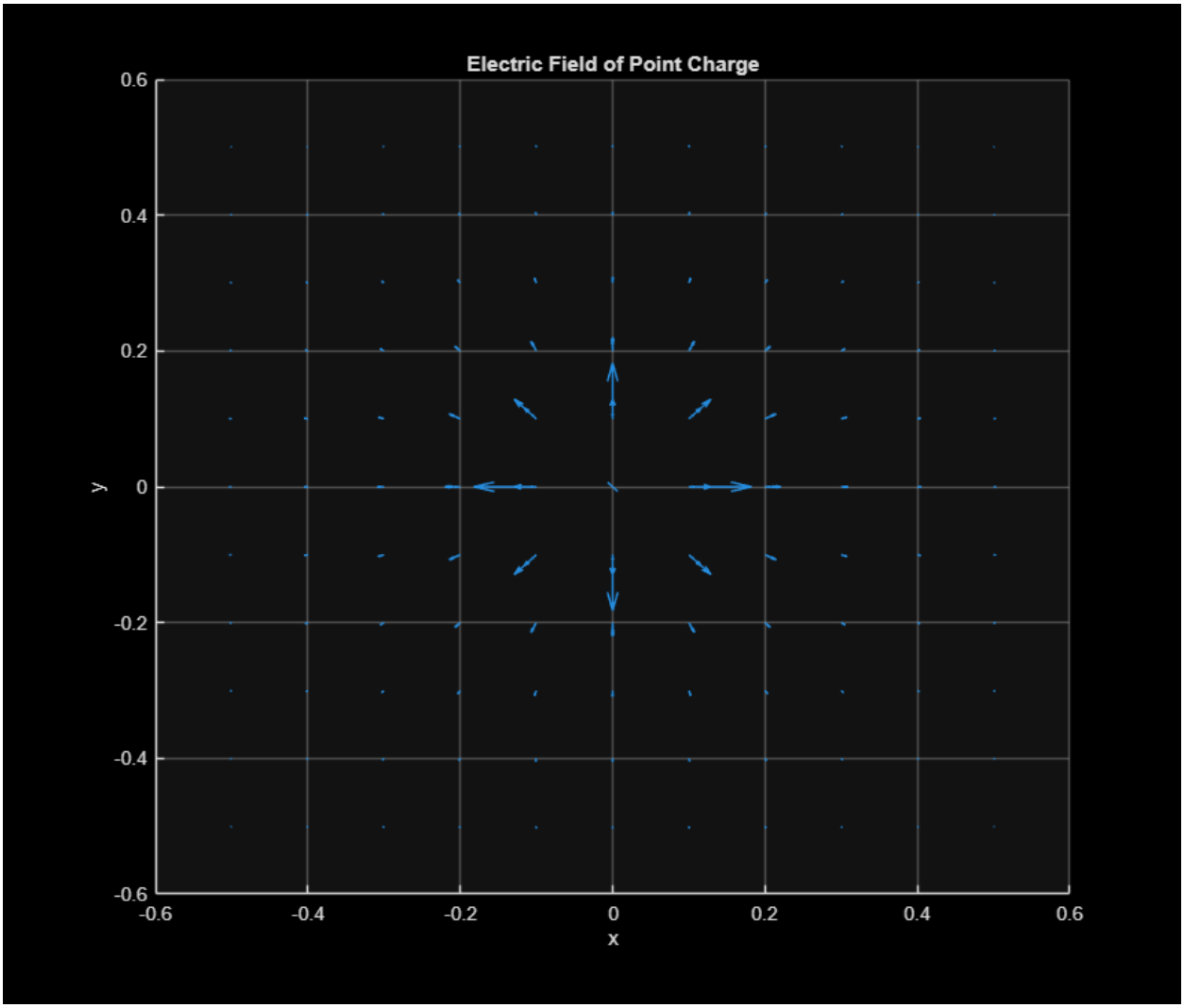
```
Maximum value is at:
   -0.1061
    0.1061
```


Electric Field vs Distance
×10^6
8
7
6
5
4
3
2
1
0
Electric Field (N/C)
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
x (m)


Electric Field Comparison: Ring vs Point Charge
×10⁹
Ring
Point Charge
E (N/C)
x (m)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5


Electric Field of Disk
×10^8
4
3.5
3
2.5
2
1.5
1
0.5
0
Electric Field (N/C)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
x (m)


Electric Field of Point Charge
z
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
y
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
x
0.6
0.4
0.2
0
-0.2
-0.4
-0.6



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