Boğaziçi University
Department of Physics

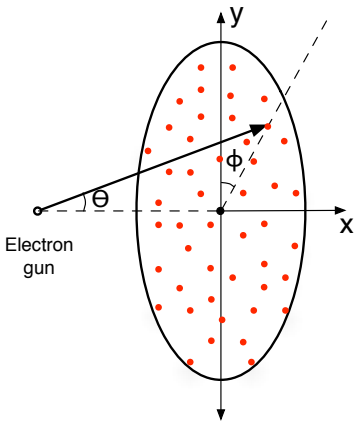
Phys 443 Fall 2011

Problem Set 2

Due on October 28th, 2011

Problem 1 – *10 pts*

You want to bombard a circular metal sheet with radius of 1 m with an electron gun 0.5 m away from the center of the sheet as shown below:



Direction of the gun can be defined using θ and ϕ. We want to hit the sheet with a uniform distribution, i.e. electron marks (red dots) on the sheet are uniformly distributed.

a) Write down $P_\theta(\theta)P_\phi(\phi)d\theta\, d\phi$ which yields such a distribution.

b) Find $\theta = f(x_1)$, and $\phi = g(x_2)$ functions which yields the desired $P_\theta(\theta)d\theta$ and $P_\phi(\phi)d\phi$ distributions for $x_{1,2}$ uniform random numbers between $[0, 1]$.

c) Write a code to create 5000 (θ, ϕ) direction pairs, and mark them on a plot on the x–y plane.

Problem 2 – *10 pts*

Consider the following probability distribution:

$$w(x) = C(x^2 + 2x + 2)e^{-x}$$

where C is the normalization constant, x is defined between $[0, 10]$.

a) Find the normalization constant C.

b) Write a code to generate 10,000 numbers with this probability distribution using Metropolis *et. al.* algorithm.

c) Make a histogram with 100 bins of these numbers.

d) Make a plot of $w(x)$ for $0 < x < 10$, and superimpose the normalized histogram with this curve to check the validity of your distribution.