Phys 6900 Assignment 4, due Wednesday, October 15

This assignment will require the use of Mathematica. Mathematica is available on numerous department computers, and it is possible to install on PCs in your lab/office. Check with your research advisor/supervisor.

(1) Mathematica Warm-up [5 points]
(a) Calculate the volume of a sphere of radius *R* by doing a definite integral in spherical coordinates.
(b) Do the same for a cuboid of sides *a*,*b*,*c*.
(c) Do the same for a cylinder of length *L* and cross-sectional radius *a*.

(2) Form factor for identical spheres [10 points]
(a) Calculate analytically the form factor for a system of identical dielectric spheres of radius *R*. Draw a clear figure showing the geometry and the q vector.
(b) Redo the above numerically.
(c) Plot *P(q)* vs. *q*. and *log(P(q))* vs *q*. You may choose *R=1*. Note that this is equivalent to plotting vs. *qR*.

(3) Form factor for cylindrical rods [15 points]
(a) Calculate the form factor $P(\vec{q})$ for a system of identical dielectric cylinders of length L and cross-sectional radius *a*. Assume the angle between the q vector and the cylinder axis is β . Draw a clear figure showing the geometry and the q vector.
(b) Consider the special cases of $\beta=0;\beta=\pi/2$. Write down the functional form of the form factor for these cases.
(c) Calculate the angle-averaged P(q).
(d) Redo (b) numerically.
(e) Plot *log(P(q))* vs *q* for the special cases of $\beta=0;\beta=\pi/2$. Do it for a=*1*, and L=*0.1*, *1.0* and *10.0*. This corresponds to varying the cylinder aspect ratio (*L/a*).