PH5023 – Monte Carlo Radiation Transfer
Non-assessed lab sessions on 3D Monte Carlo code
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Follow the instructions on the class website to download, compile, and run the grid code.

The code provided sets up a uniform density sphere and computes the average number of scatterings per photon. The density is discretised onto a linear Cartesian grid.

Download, compile, and run the code for the parameters that are in the input file. You should get output to the screen that states "Average number of scatterings = 57.35"

In the routine density.f, the density is set to be rho = 1 inside the sphere. In the paramaters file xmax is set to be 1.0 and kappa = 10.0, so the optical depth across a radius is then kappa * rho * xmax = 10. Run your own code for scattering in a uniform density sphere for an optical depth of 10 and compare the results with the grid code.

Change the input parameters file to simulate spheres of different optical depths and compare the results with your own code. Do this by changing kappa in input.params.

Change the Henyey-Greenstein phase function parameter in the input file to have values hgg = 0.3, hgg=0.6, hgg=0.9 and compare the average number of scatterings to those computed for isotropic scattering. Explain the results.

Introduce a new 3D array which will store estimates of the mean intensity: jmean(nxg, nyg, nzg). Modify the subroutine tauint2.f (and also where this subroutine is called from the main program mcpolar.f) to compute the mean intensity using the path length formula described in lectures. Modify grid.txt, iarray.f, mcpolar.f, tauint2.f – pass and receive the array to and from mcpolar.f, iarray.f, tauint2.f.

Write out the 3D mean intensity grid from a simulation and plot 2D slices. You may modify the fortran code provided on the course website to read in the grid and write out 2D slices that you can then read into a plotting package. Think about the units for mean intensity and how you convert your grid which contains the summation of pathlengths in each cell into the mean intensity (which is related to fluence rate).