HW 5 - ASTR510

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Q2)

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a)

Function to move a photon one step forward

In[294]:=
```
move[dx_, τ_] := Function[v, {v[[1]] + dx #, #} &@
    If[RandomReal[] < τ, {Cos[#], Sin[#]} &@RandomReal[{0, 2 Pi}], v[[2]]]];
```

Function to compute the final angles of *n* photons

In[347]:=
```
data[n_] :=
  data[n] = Mod[Pi / 2 + #, 2 Pi] &[ArcTan @@@ ParallelTable[NestWhile[move[.01, .01],
      {{0, -1}, RandomPoint@Circle[]}, Total[#[[1]]^2] ≤ 1 &][[2]], n]];
```

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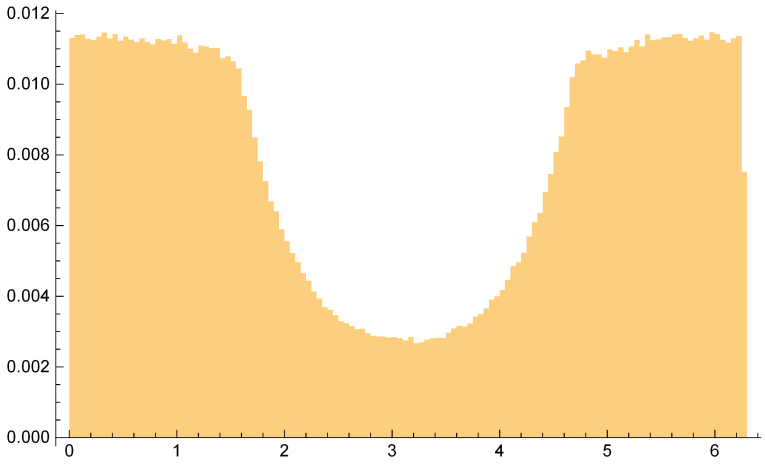
b)

Plotting intensity as a fraction of brightness vs angle for 10^6 photons

In[346]:=
```
Histogram[data[10^6], 100, "Probability"]
```

Out[346]=



c)

Computing histograms for number of photons = $\{5*10^5,\ 10^5,\ 5*10^4,\ 10^4,\ 5*10^3,\ 10^3\}$

In[364]:=
```
hdata[n_] := hdata[n] = HistogramList[data[n], 100, "Probability"][[2]]
```

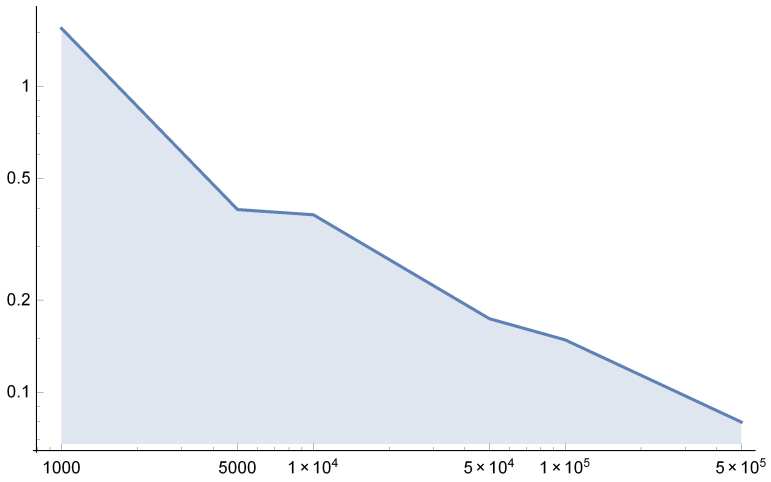
Finding maximum relative error with respect to histogram for 10^6 photons

In[370]:=
```
err = Max[1. Abs[hdata[#] - hdata[10^6]] / hdata[10^6]] & /@
    {10^6, 5*10^5, 10^5, 5*10^4, 10^4, 5*10^3, 10^3};
```

Log-log plot of maximum relative error vs number of photons

In[378]:=
```
ListLogLogPlot[
 Transpose@{{10^6, 5*10^5, 10^5, 5*10^4, 10^4, 5*10^3, 10^3}, err},
 Joined → True, Filling → Bottom]
```

Out[378]=



Finding slope of best fit line to the log-log plot

In[375]:=
```
f[x_] =
 Fit[Log@Transpose@{{5*10^5, 10^5, 5*10^4, 10^4, 5*10^3, 10^3}, err[[2 ;;]]},
  {1, x}, x]
```

Out[375]=
```
3.24070025316 - 0.450743299346 x
```

The slope of the line is approximately -0.5. Therefore the maximum relative error in the intensity decreases as $N^{-0.5}$.