

# Scattering Kernels in 3D

This is code to accompany the book:

A Hitchhiker's Guide to Multiple Scattering

© 2020 Eugene d'Eon

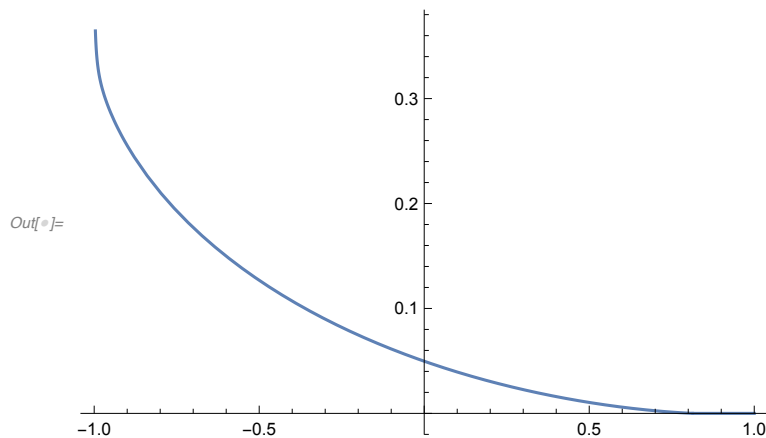
[www.eugenedeon.com/hitchhikers](http://www.eugenedeon.com/hitchhikers)

---

## Callisto

[Porco et al. 2008] - doi: 10.1088/0004-6256/136/5/2172

```
In[ ]:= pCallisto[u_] := HeavisideTheta[2.521 - ArcCos[-u]]  
      
$$\frac{2.2}{4 \text{ Pi } (1.0004369822233856)} (2 - 0.79333 \text{ ArcCos}[-u] + \text{Exp}[-21.2 \text{ ArcCos}[-u]])$$
  
      
$$\left(1 + \text{Sin}\left[\frac{\text{ArcCos}[-u]}{2}\right] \text{Tan}\left[\frac{\text{ArcCos}[-u]}{2}\right] \text{Log}\left[\text{Tan}\left[\frac{\text{ArcCos}[-u]}{4}\right]\right]\right)$$
  
In[ ]:= Plot[pCallisto[u], {u, -1, 1}]
```



### Normalization condition

```
In[ ]:= NIntegrate[2 Pi pCallisto[u], {u, -1, 1}]  
Out[ ]:= 1.
```

### Mean cosine (g)

```
In[ ]:= NIntegrate[2 Pi pCallisto[u] u, {u, -1, 1}]  
Out[ ]:= -0.560001
```

## Legendre expansion coefficients

```
In[ ]:= NIntegrate[
  2 Pi (2 k + 1) pCallisto[Cos[y]] LegendreP[k, Cos[y]] Sin[y] /. k -> 0, {y, 0, Pi}]
```

```
Out[ ]:= 1.
```

```
In[ ]:= NIntegrate[
  2 Pi (2 k + 1) pCallisto[Cos[y]] LegendreP[k, Cos[y]] Sin[y] /. k -> 1, {y, 0, Pi}]
```

```
Out[ ]:= -1.68
```

```
In[ ]:= NIntegrate[
  2 Pi (2 k + 1) pCallisto[Cos[y]] LegendreP[k, Cos[y]] Sin[y] /. k -> 2, {y, 0, Pi}]
```

```
Out[ ]:= 0.851712
```

```
In[ ]:= NIntegrate[
  2 Pi (2 k + 1) pCallisto[Cos[y]] LegendreP[k, Cos[y]] Sin[y] /. k -> 3, {y, 0, Pi}]
```

```
Out[ ]:= -0.285211
```

```
In[ ]:= NIntegrate[
  2 Pi (2 k + 1) pCallisto[Cos[y]] LegendreP[k, Cos[y]] Sin[y] /. k -> 4, {y, 0, Pi}]
```

```
Out[ ]:= 0.182995
```

```
In[ ]:= NIntegrate[
  2 Pi (2 k + 1) pCallisto[Cos[y]] LegendreP[k, Cos[y]] Sin[y] /. k -> 6, {y, 0, Pi}]
```

```
Out[ ]:= 0.0908047
```

```
In[ ]:= NIntegrate[
  2 Pi (2 k + 1) pCallisto[Cos[y]] LegendreP[k, Cos[y]] Sin[y] /. k -> 8, {y, 0, Pi}]
```

```
Out[ ]:= 0.064234
```

```
In[ ]:= NIntegrate[
  2 Pi (2 k + 1) pCallisto[Cos[y]] LegendreP[k, Cos[y]] Sin[y] /. k -> 10, {y, 0, Pi}]
```

```
Out[ ]:= 0.0552028
```