Scattering Kernels in 3D

This is code to accompany the book:

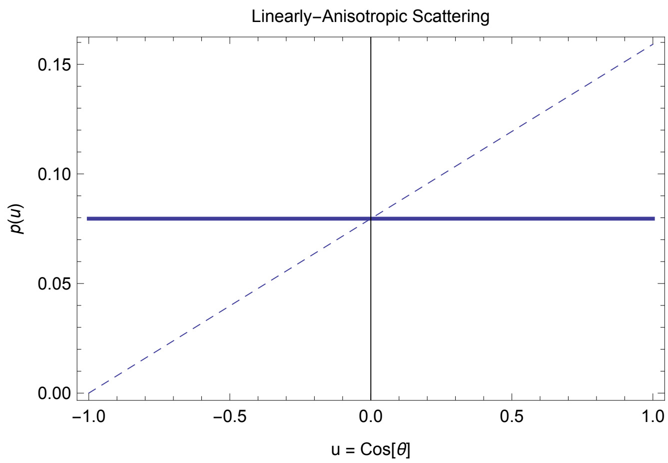
A Hitchhiker's Guide to Multiple Scattering

www.eugenedeon.com/hitchhikers

Linearly-Anisotropic Scattering (Eddington)

```
pLinaniso[u_, b_] := 1/(4 Pi) (1 + b u)
```

```
Clear[u];
Show[
 Plot[pIsotropic[u], {u, -1, 1}, PlotStyle → Thick],
 Plot[pLinaniso[u, 1], {u, -1, 1}, PlotStyle → Dashed]
 , Frame → True,
 FrameLabel → {{p[u],}, {"u = Cos[θ]", "Linearly-Anisotropic Scattering"}}]
```



Normalization condition

```
Integrate[2 Pi pLinaniso[u, b], {u, -1, 1}, Assumptions → b > -1 && b < 1]
```

1

Mean cosine (g)

```
Integrate[2 Pi pLinaniso[u, b] u, {u, -1, 1}, Assumptions → b > -1 && b < 1]
```

$\frac{b}{3}$

Legendre expansion coefficients

```
Integrate[
 2 Pi (2 k + 1) pLinaniso[Cos[y], b] LegendreP[k, Cos[y]] Sin[y] /. k → 0, {y, 0, Pi}]
```

1

```
Integrate[
 2 Pi (2 k + 1) pLinaniso[Cos[y], b] LegendreP[k, Cos[y]] Sin[y] /. k → 1, {y, 0, Pi}]
```

b

sampling

```
cdf = Integrate[2 Pi pLinaniso[u, b], {u, -1, x}]
```

$$\frac{1}{2} - \frac{b}{4} + \frac{x}{2} + \frac{b\,x^2}{4}$$

```
Solve[cdf == e, x]
```

$$\left\{\left\{x \to \frac{-1 - \sqrt{1 - 2\,b + b^2 + 4\,b\,e}}{b}\right\}, \left\{x \to \frac{-1 + \sqrt{1 - 2\,b + b^2 + 4\,b\,e}}{b}\right\}\right\}$$

```
b = 0.7;
Show[
 Plot[2 Pi pLinaniso[u, b], {u, -1, 1}],
 Histogram[
  Map[(-1 + Sqrt[1 - 2 b + b^2 + 4 b #])/b &, Table[RandomReal[], {i, 1, 100 000}]], 50, "PDF"]
]
Clear[b];
```