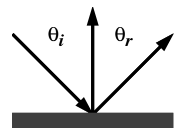
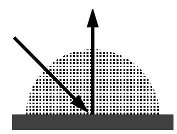
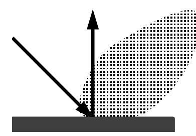
Types of Reflection Functions



Ideal Specular
- Mirror
- Reflection Law



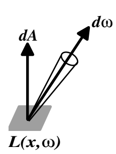
Ideal Diffuse
- Matte
- Lambert's Law



Specular
- Glossiness and Highlights
- Phong and Blinn Models

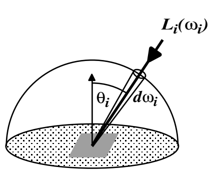
Radiometry

Radiometry **is the science of light energy measurement**



Radiance

The energy carried by a ray (energy/area*solidangle)



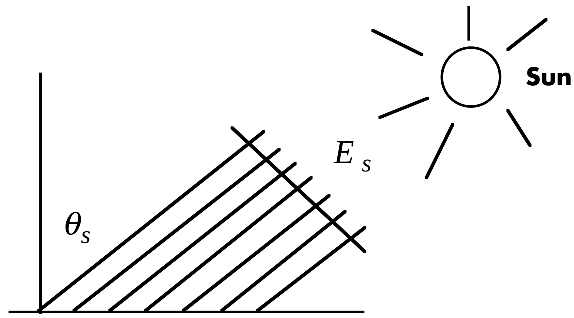
Irradiance

The energy per unit area falling on a surface

Radiosity

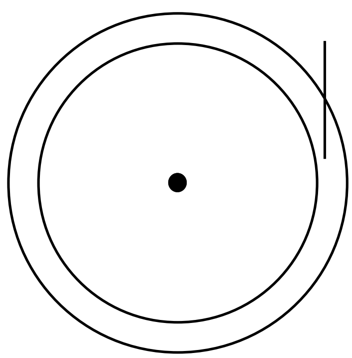
The energy per unit area leaving a surface

Irradiance: Distant Source



$$E = E_s \cos\theta_s$$

Irradiance: Point Source



- Note inverse square law fall off.
- Still has cosine dependency

Ideal Diffuse Reflection

Assume light is equally likely to be reflected in any output direction (independent of input direction).

Lambert's Cosine Law

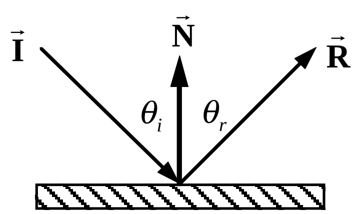
L =

Matte surfaces

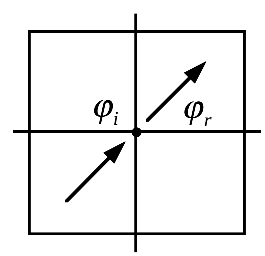
Diffuse Reflection is difficult to explain on first principles

- **Subsurface scattering**
- **Multiple surface reflections**

Law of Reflection



$$\theta_r = \theta_i$$



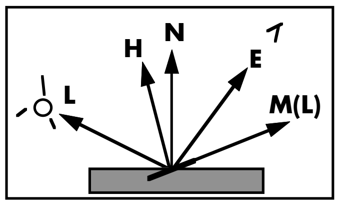
$$\varphi_r = \varphi_i \pm \pi$$

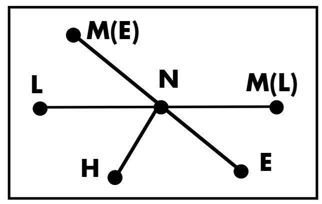
$$\vec{\mathbf{R}} + (-\vec{\mathbf{I}}) = 2\cos\theta\,\vec{\mathbf{N}} = -(\vec{\mathbf{I}} \bullet \vec{\mathbf{N}})\vec{\mathbf{N}}$$

$$\vec{\mathbf{R}} = \vec{\mathbf{I}} - (\vec{\mathbf{I}} \bullet \vec{\mathbf{N}})\vec{\mathbf{N}}$$

Reflection Geometry

$$\mathbf{H} = \frac{\mathbf{L} + \mathbf{E}}{|\mathbf{L} + \mathbf{E}|}$$

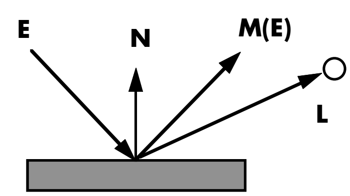




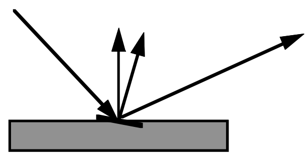
$$\cos\theta_i = \mathbf{L} \bullet \mathbf{N}$$
$$\cos\theta_r = \mathbf{E} \bullet \mathbf{N}$$

$$\cos\theta_g = \mathbf{E} \bullet \mathbf{N}$$
$$\cos\theta_s = \mathbf{M(L)} \bullet \mathbf{E} = \mathbf{L} \bullet \mathbf{M(E)}$$
$$\cos\theta_{s'} = \mathbf{H} \bullet \mathbf{N}$$

Phong Model: Distributed Light Source



Rough Surface: Microfacet Distribution



Blinn $D_1(\alpha) = \cos^{c_1} \alpha \qquad c_1 = \frac{\ln 2}{\ln \cos \beta}$