

Luz, Reflexão e Cor

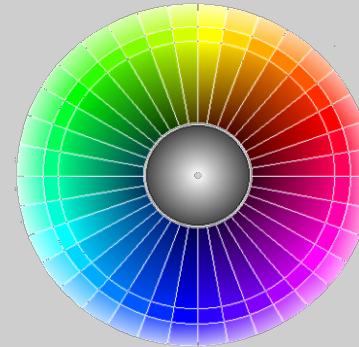
*fontes
luminosas
geram
luz*



Luz natural



Percepção de cor

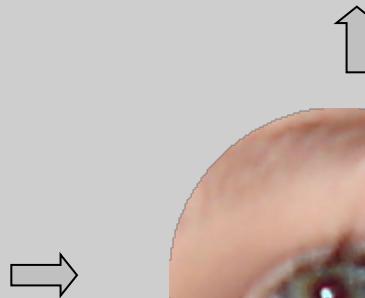


*que
produzem
sensações
no nosso
cérebro*

*que
interagem
com
o meio
(superfícies)*



Superfícies



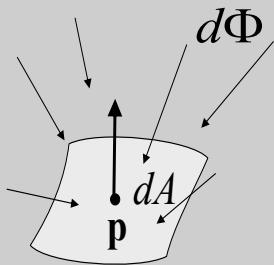
Visão humana

Potências de uma fonte luminosa

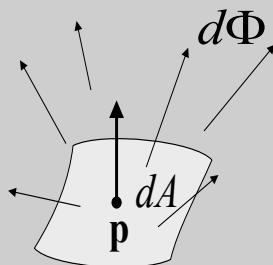
$$\Phi \quad \text{Watts} = \text{Joule/seg}$$

exemplos:

- lâmpadas: $\sim 100 \text{ W}$
- Sol: $3.91 \times 10^{26} \text{ W}$



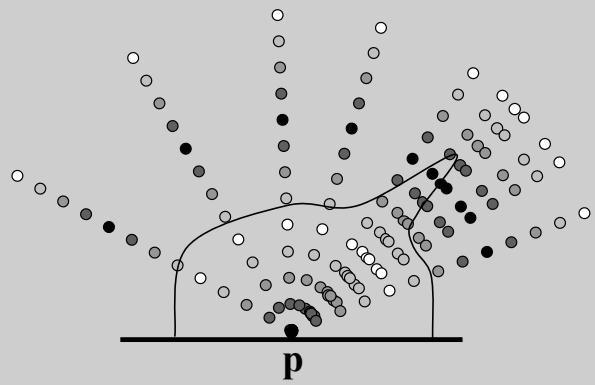
irradiação



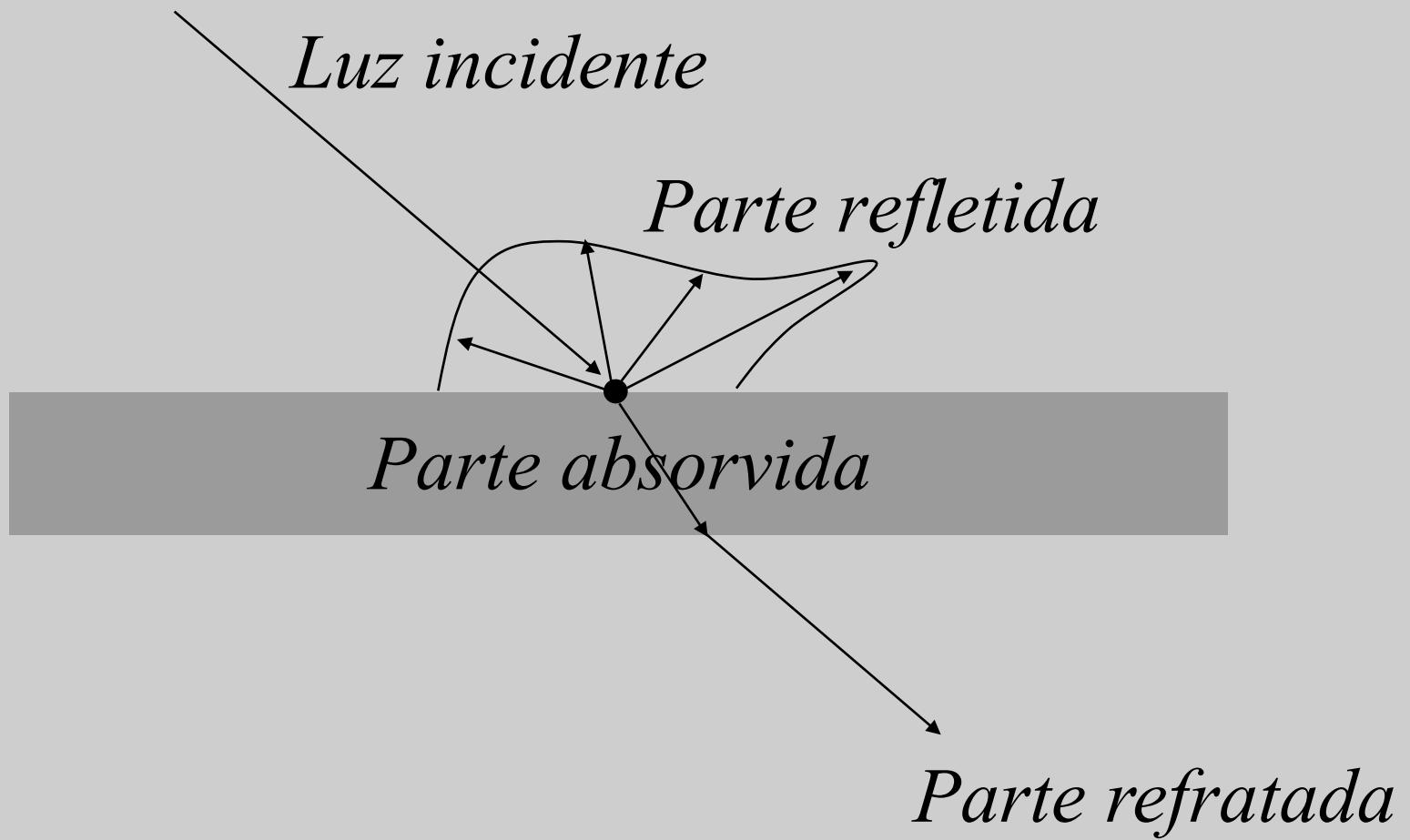
radiosidade

$$E(\mathbf{p}) = \frac{d\Phi}{dA} \quad \left[\frac{\text{W}}{\text{m}^2} \right]$$

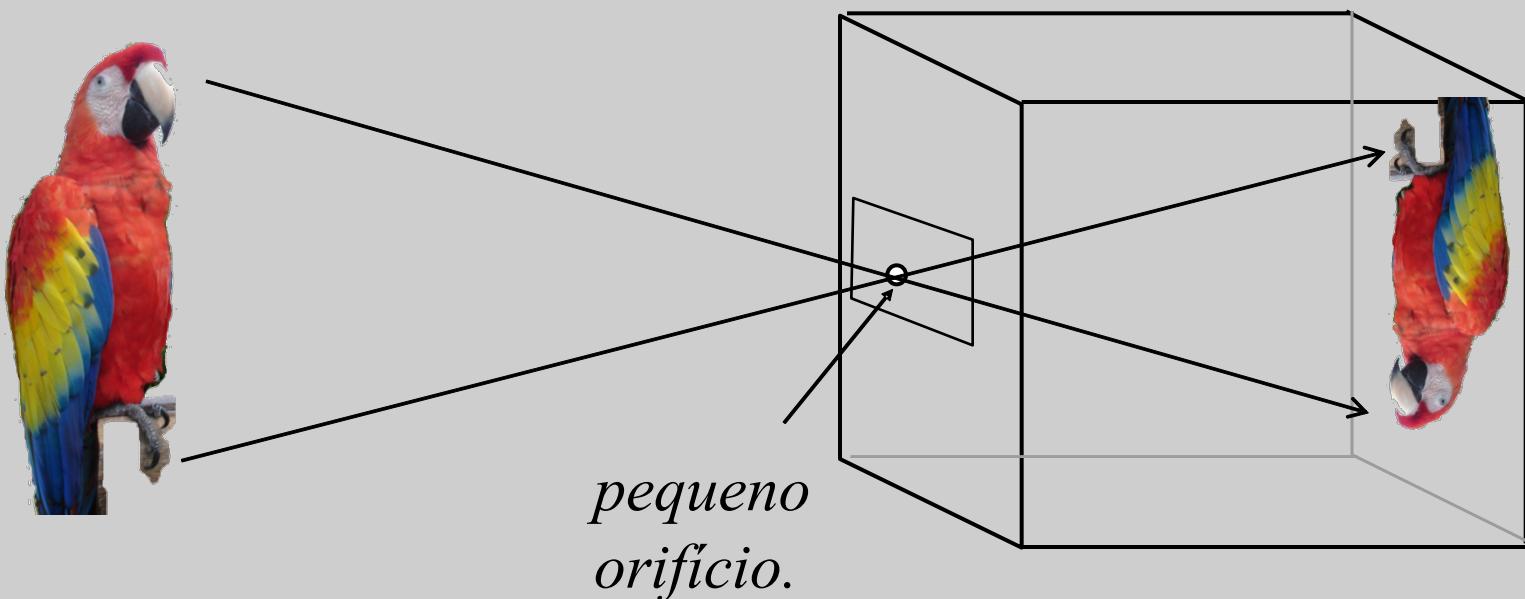
$$B(\mathbf{p}) = \frac{d\Phi}{dA} \quad \left[\frac{\text{W}}{\text{m}^2} \right]$$



Luz ao atingir uma superfície

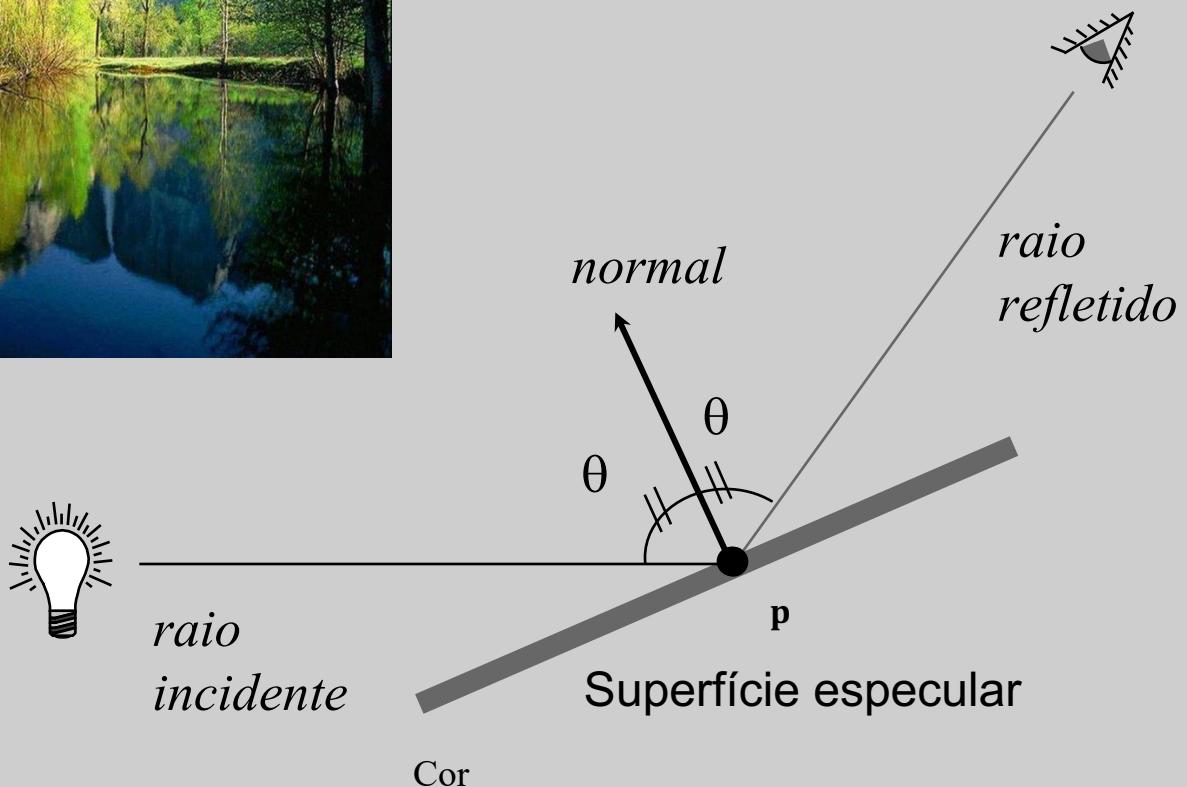


Propriedades básicas da luz

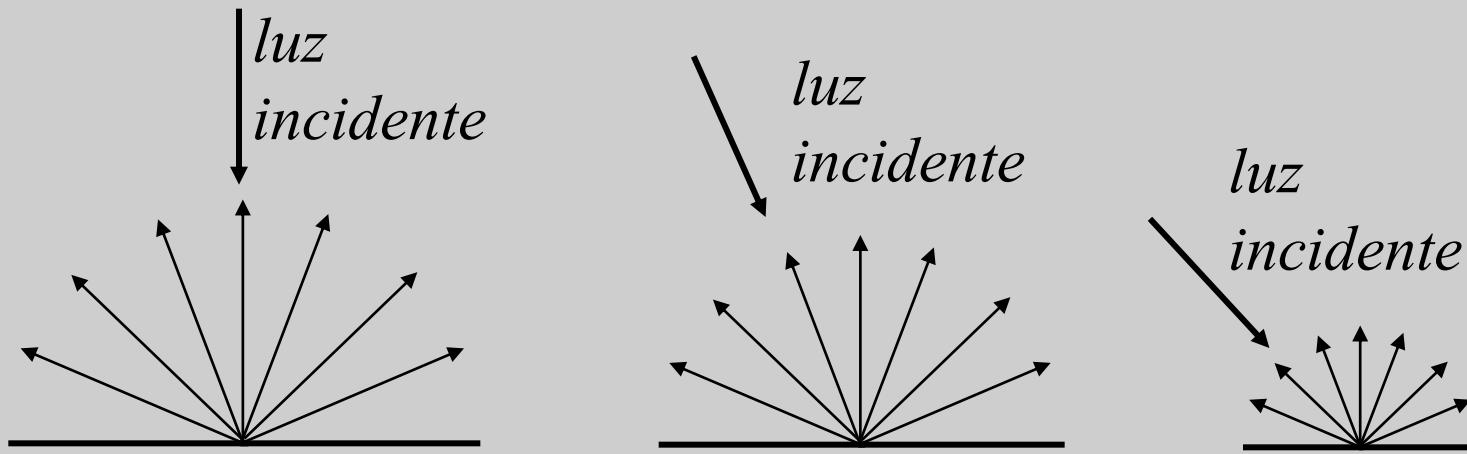


A luz viaja em linha reta.

Reflexão especular

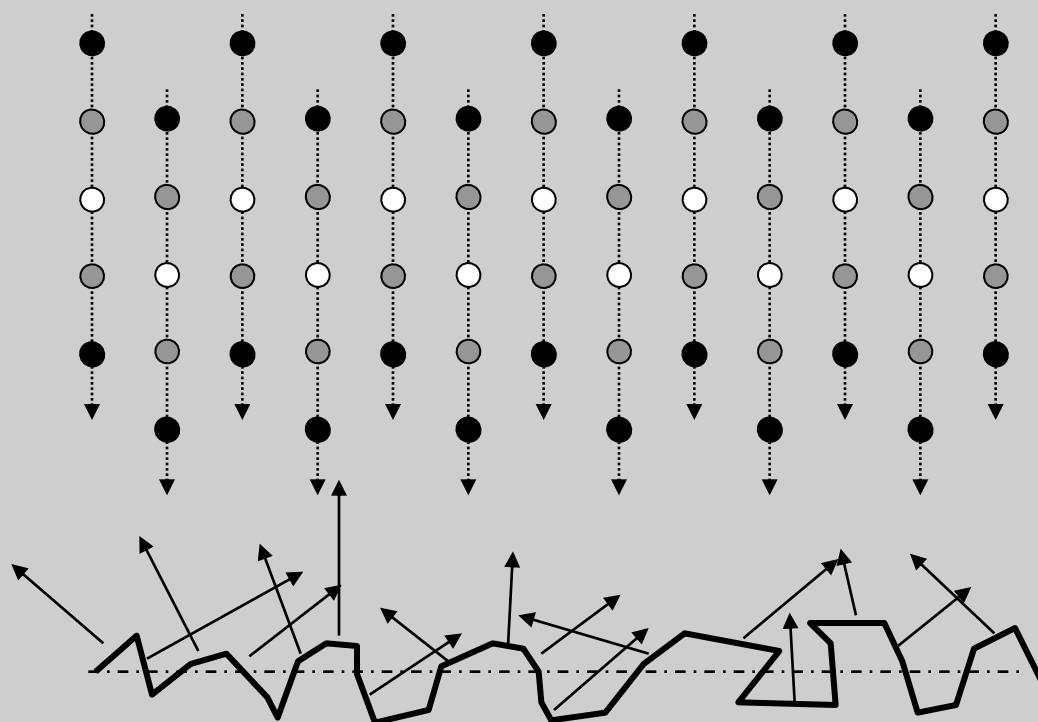


O modelo de mais simples de reflexão - superfícies Lambertianas



1. Reflete igualmente em todas as direções
2. A intensidade é proporcional ao co-seno [área aparente]

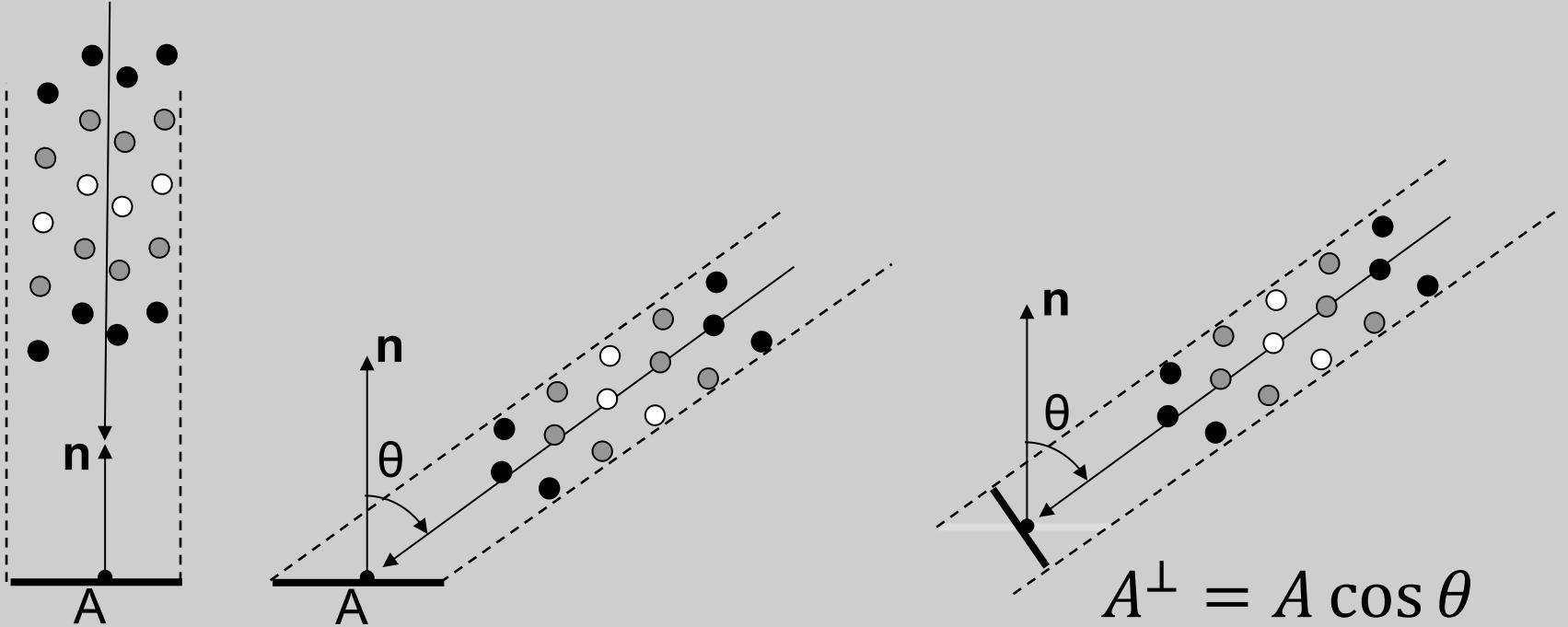
Razão do espalhamento



Cor

7

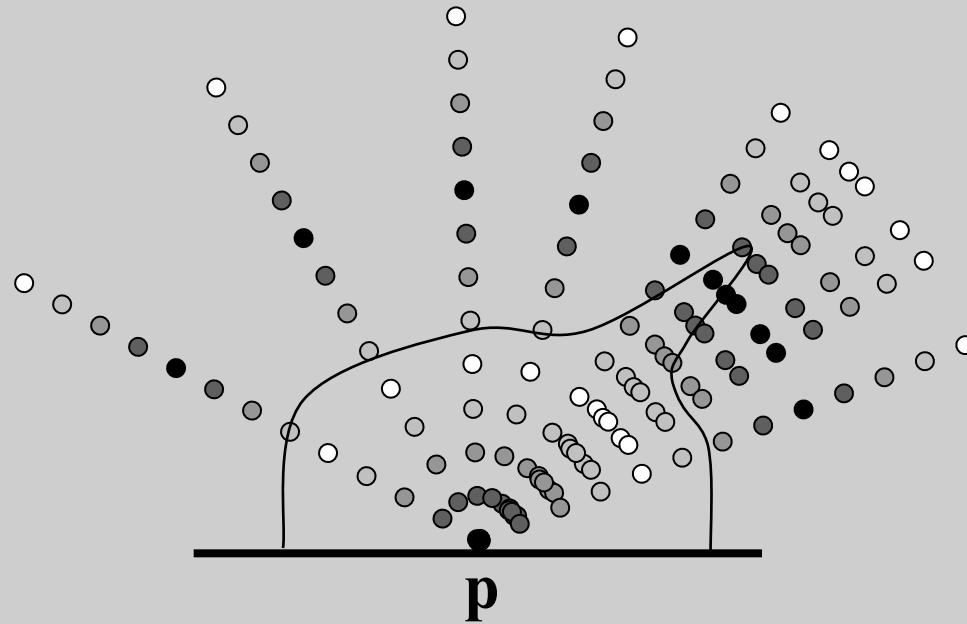
Área aparente (A^\perp)



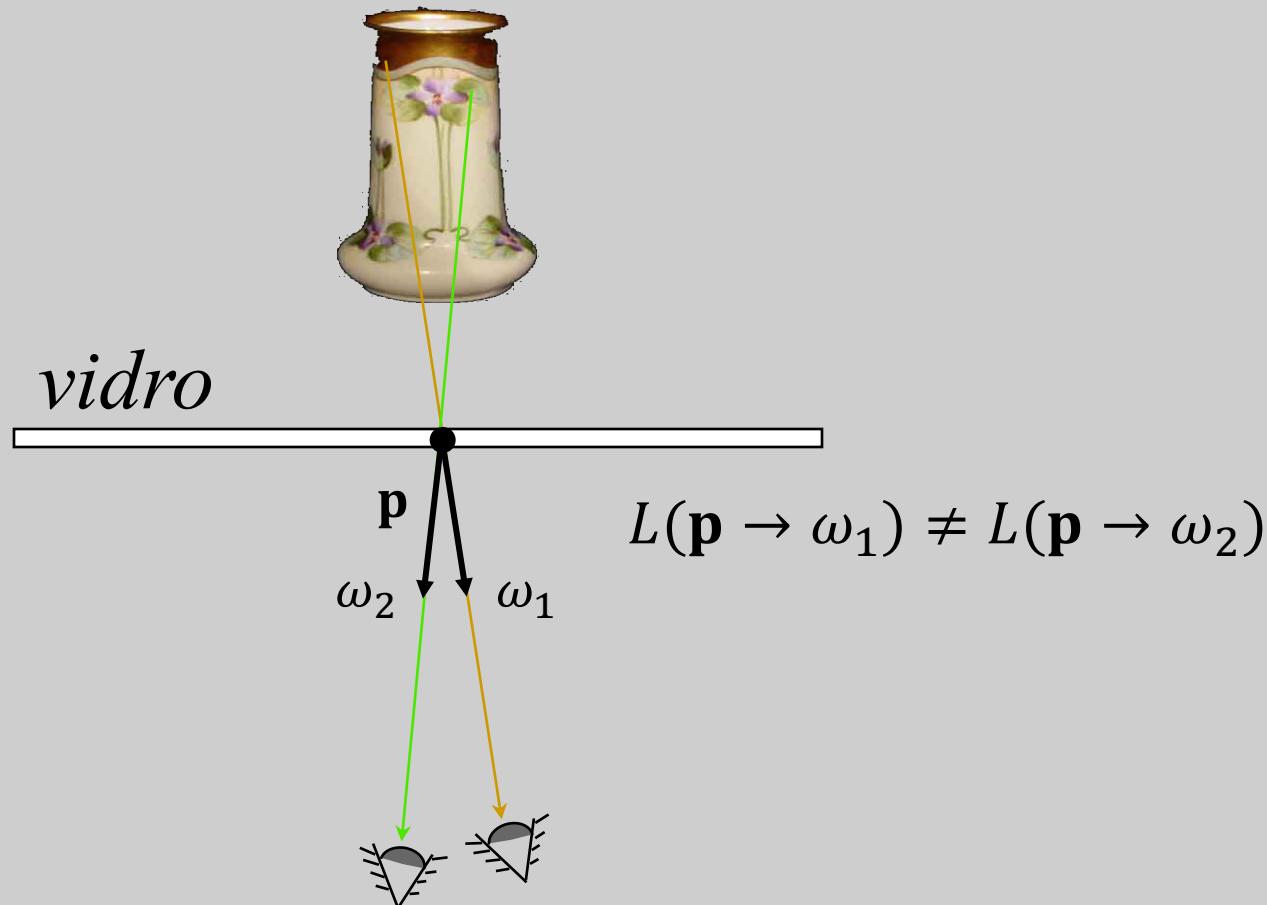
Área aparente (*foreshortening*)

Uma área A vista de um ângulo θ é equivalente a uma área menor, $A \cos\theta$, tanto para emitir quanto para receber radiação luminosa.

Energia da luz: varia com a direção



O que os olhos veem?



Olhos são sensíveis a radiância de pontos da cena

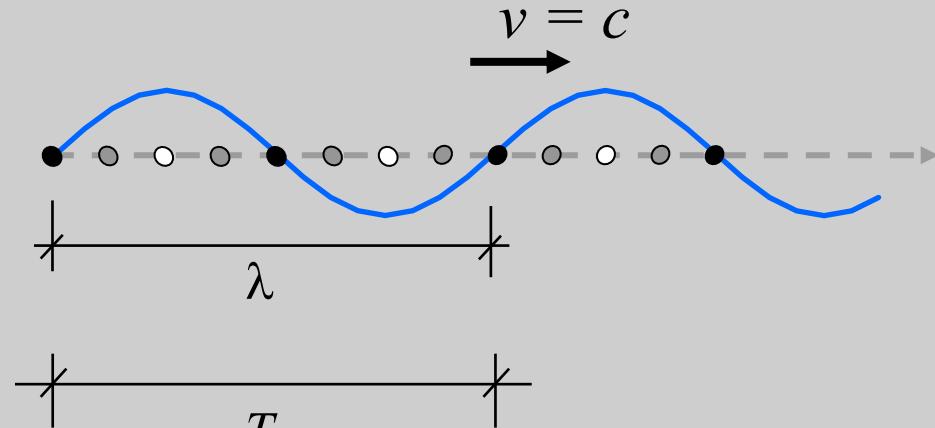
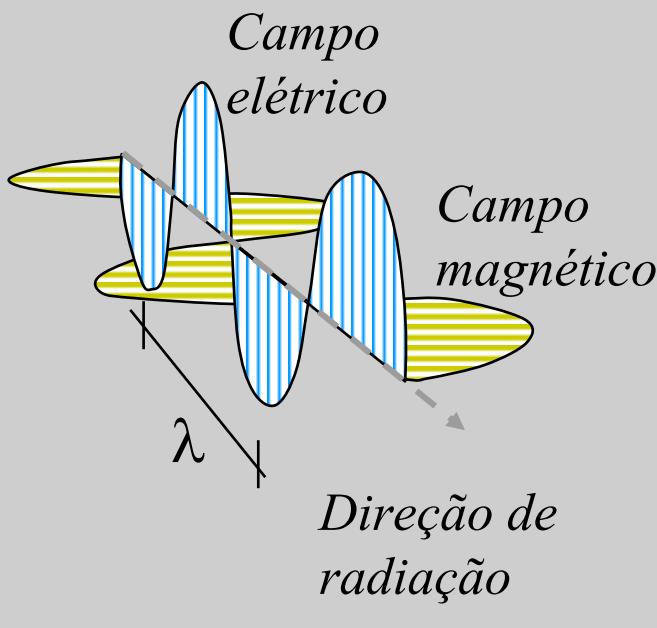
Fluxo radiante em uma superfície em função da direção



Olhos são sensíveis a radiância de pontos da cena

Natureza ondulatória

$$c = \text{velocidade da luz} = 2.997925 \times 10^8 \text{ m/s} \cong 300.000 \text{ km/s}$$

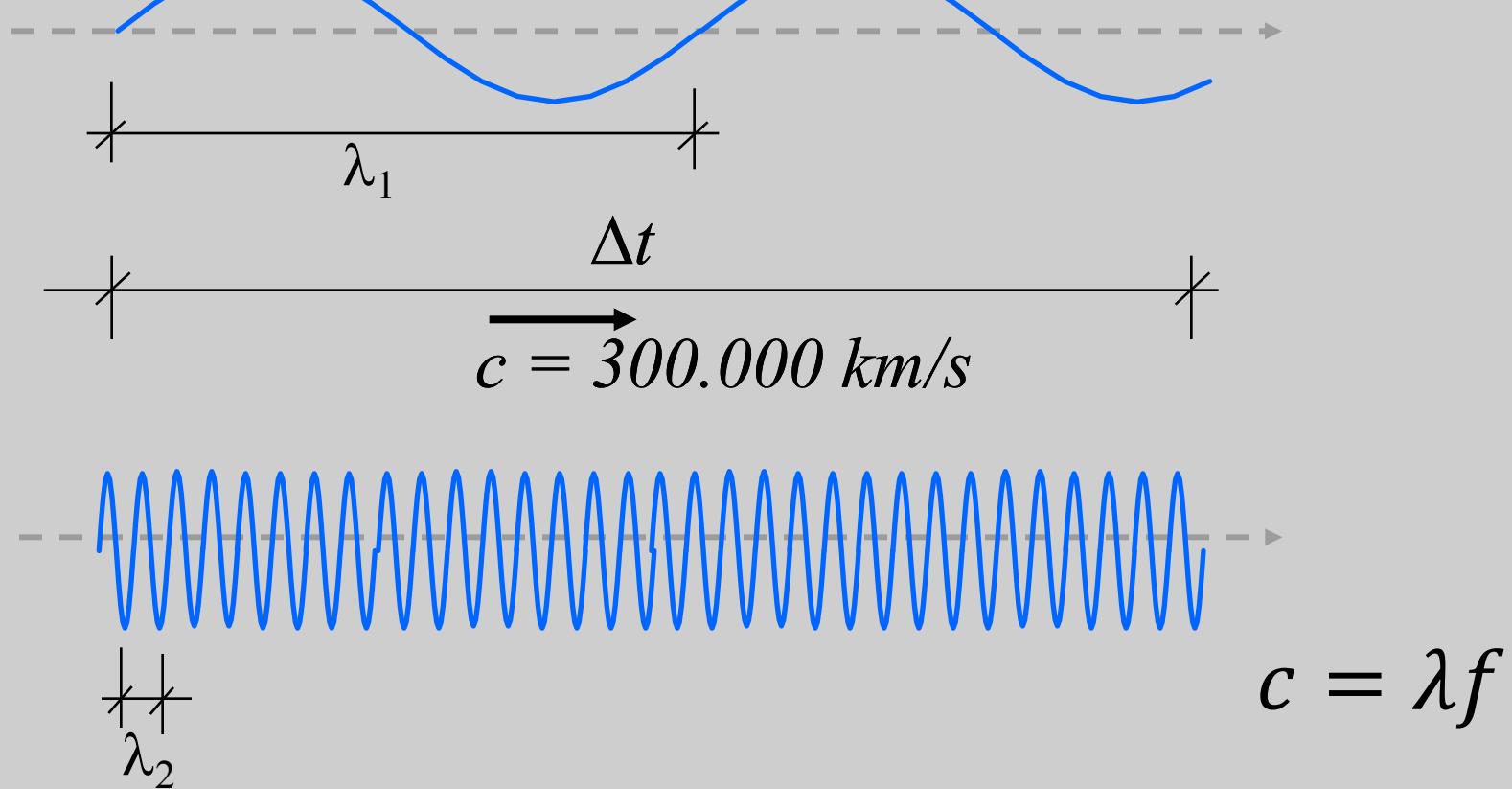


$$v = \frac{\text{distância}}{\text{tempo}} = \frac{\lambda}{T}$$

freqüência

$$f = \frac{1}{T} \text{ (Hz)}$$

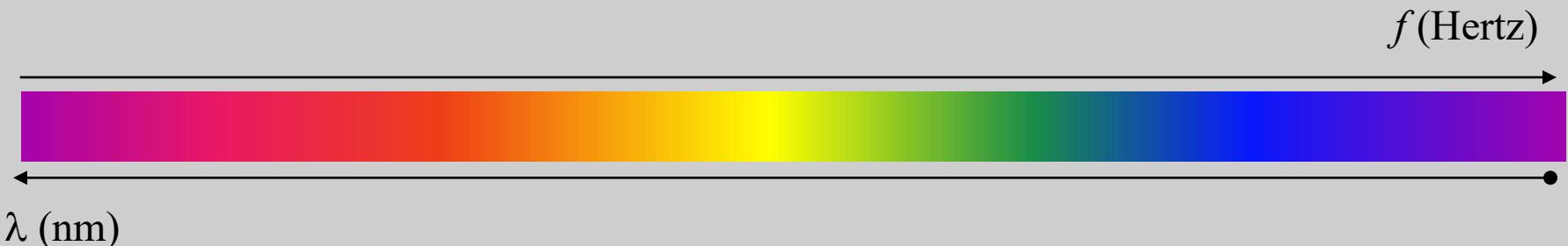
Ondas de comprimentos diferentes



Cor

13

Luzes mono freqüênciā [mono λ]

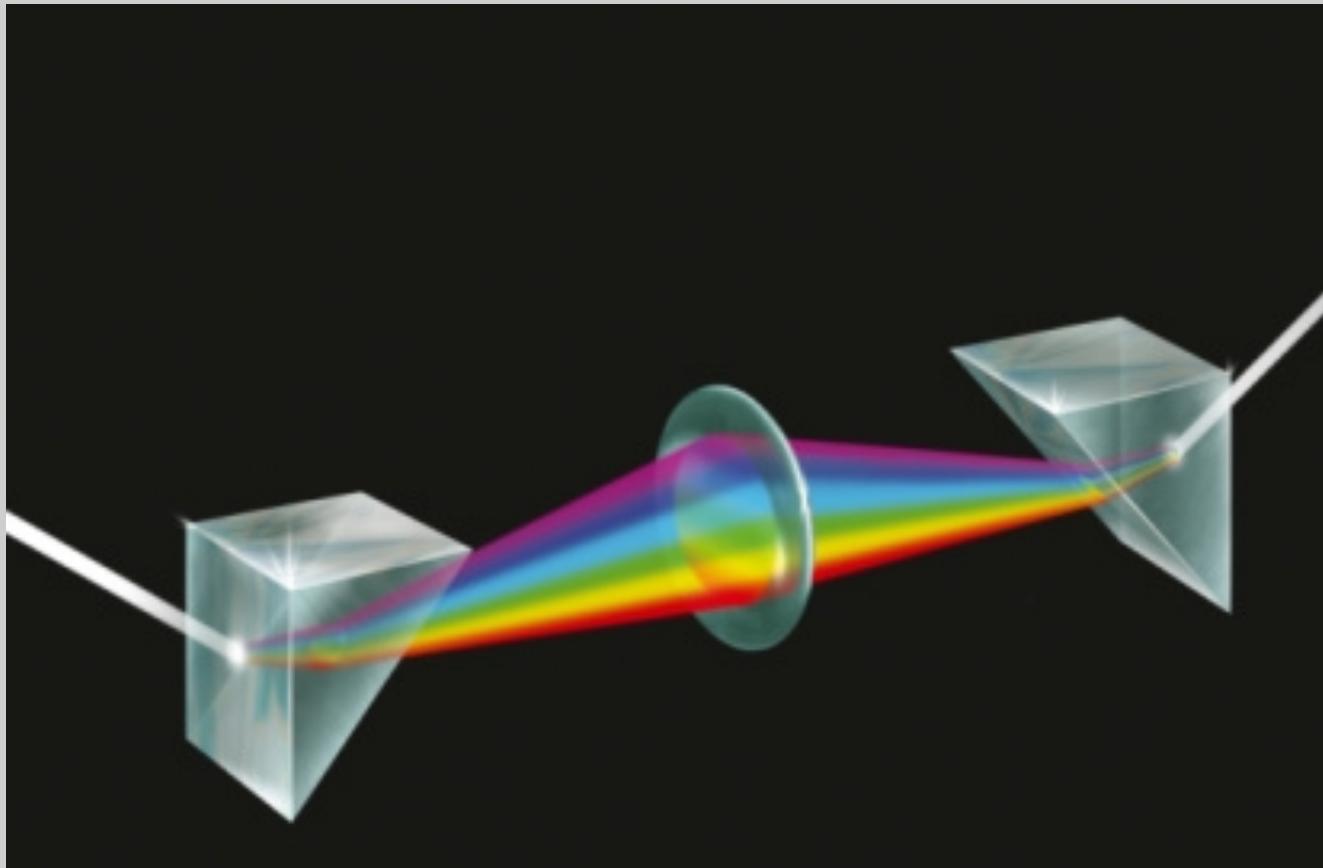


$$c = \frac{\lambda}{T} = \lambda f \quad \lambda = \frac{c}{f} = \frac{3 \times 10^8 \text{ m/s}}{f \text{ Hz}} = \frac{3 \times 10^{17} \text{ nm/s}}{f \text{ Hz}} = 3 \times 10^{17} \frac{1}{f} \text{ nm}$$

λ	Cor
380 - 440 nm	Violeta
440 - 490 nm	Azul
490 - 565 nm	Verde
565 - 590 nm	Amarelo
590 - 630 nm	Laranja
630 - 780 nm	Vermelho

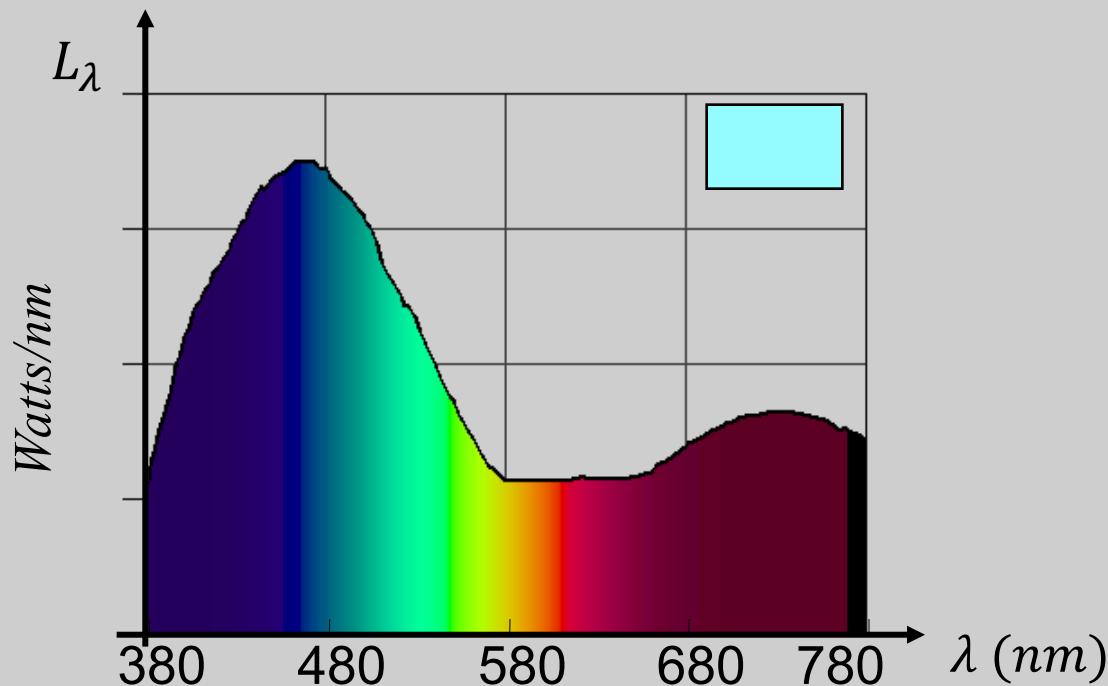
$$1 \text{ nm} = 10^{-9} \text{ m}$$

Prisma de Newton





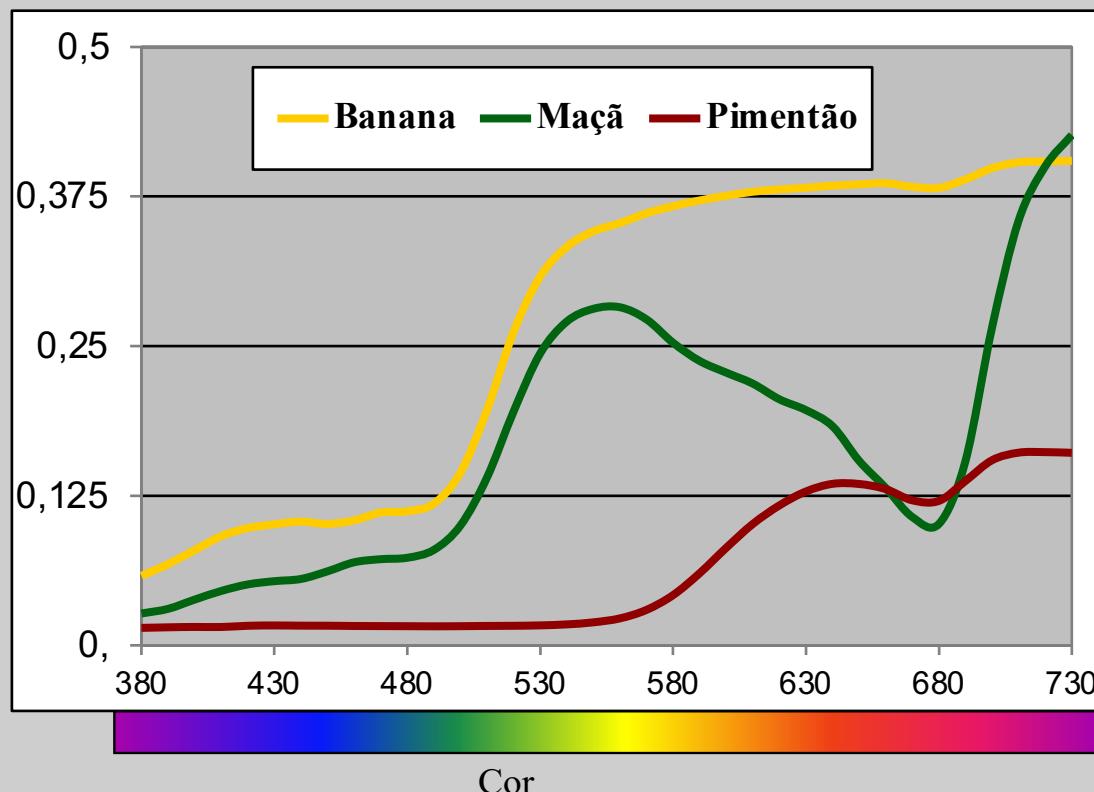
Espectro da luz



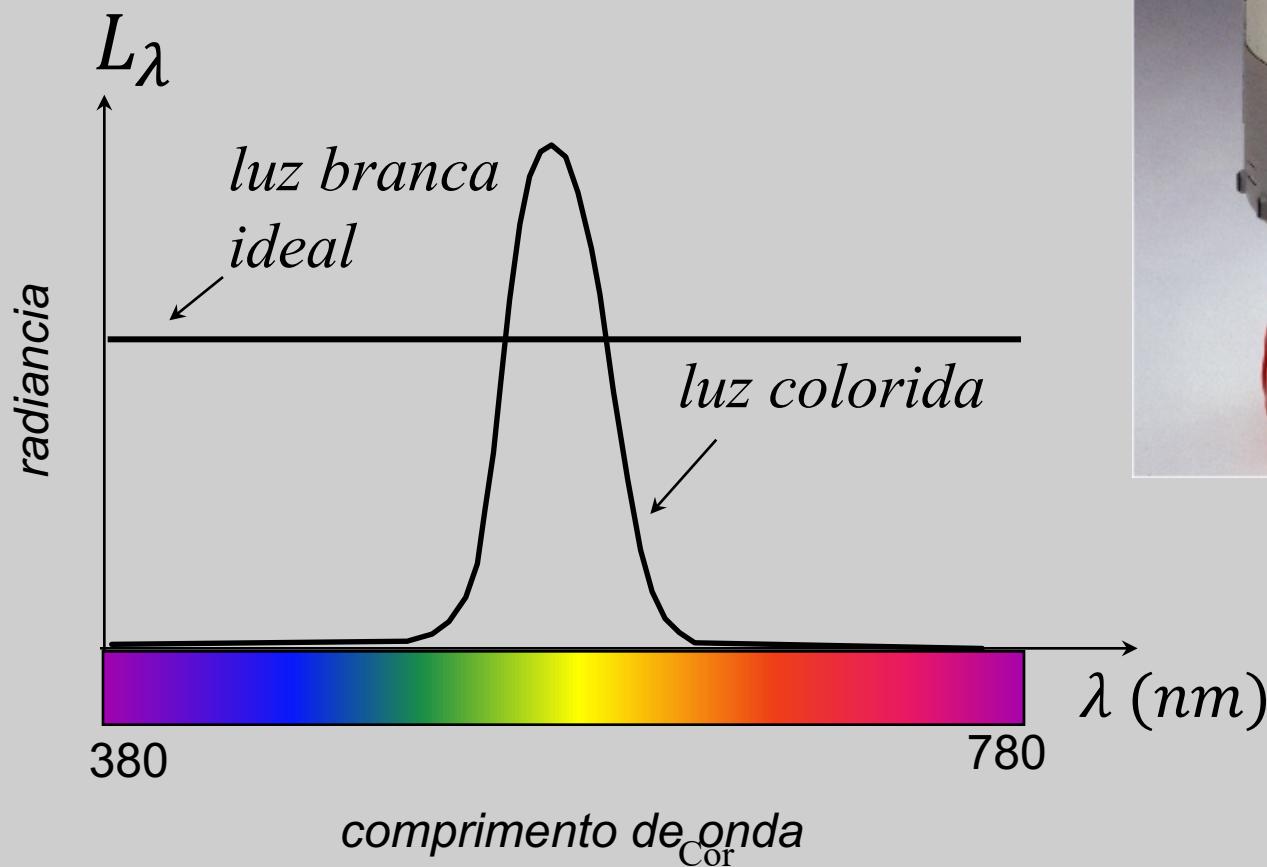
Espectro da luz refletida em objetos



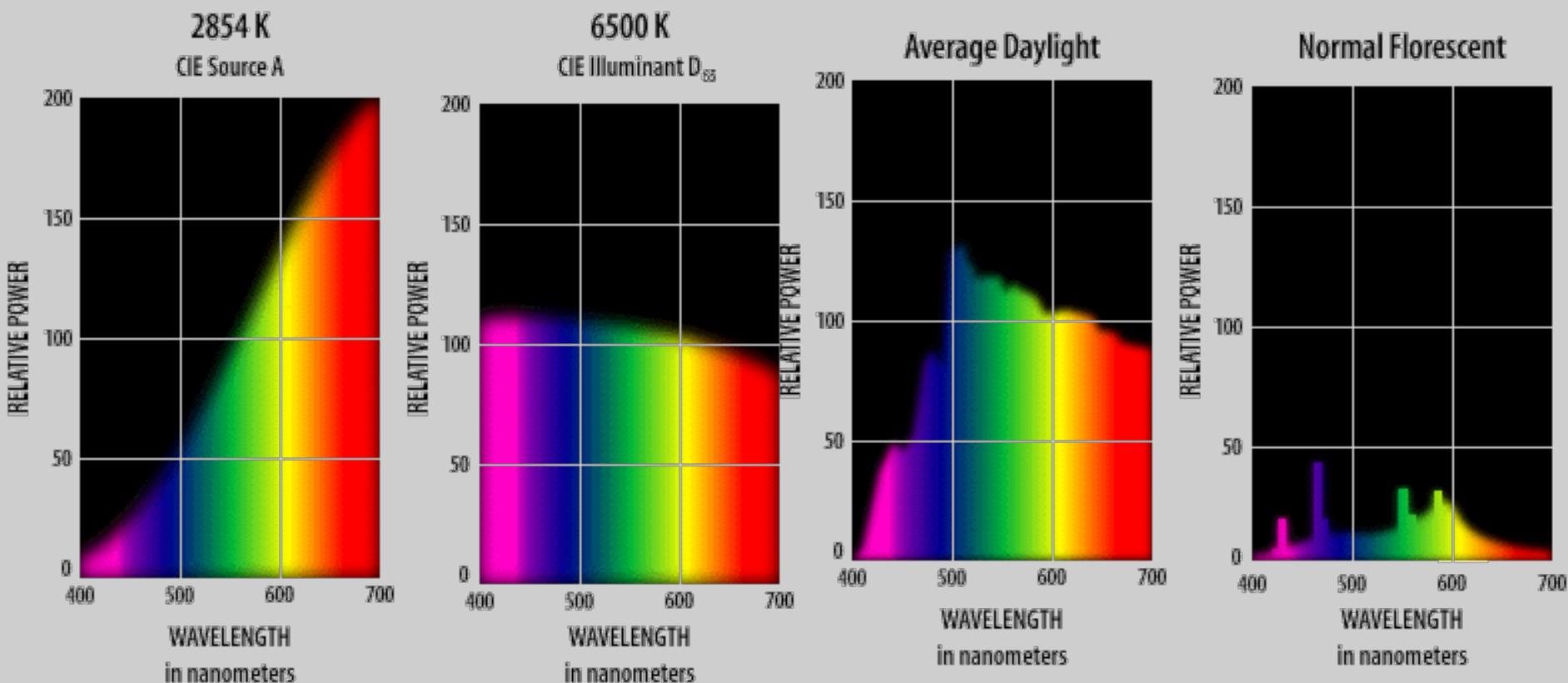
Espectro da luz refletida em objetos



Caracterização do espectro de fontes luminosas



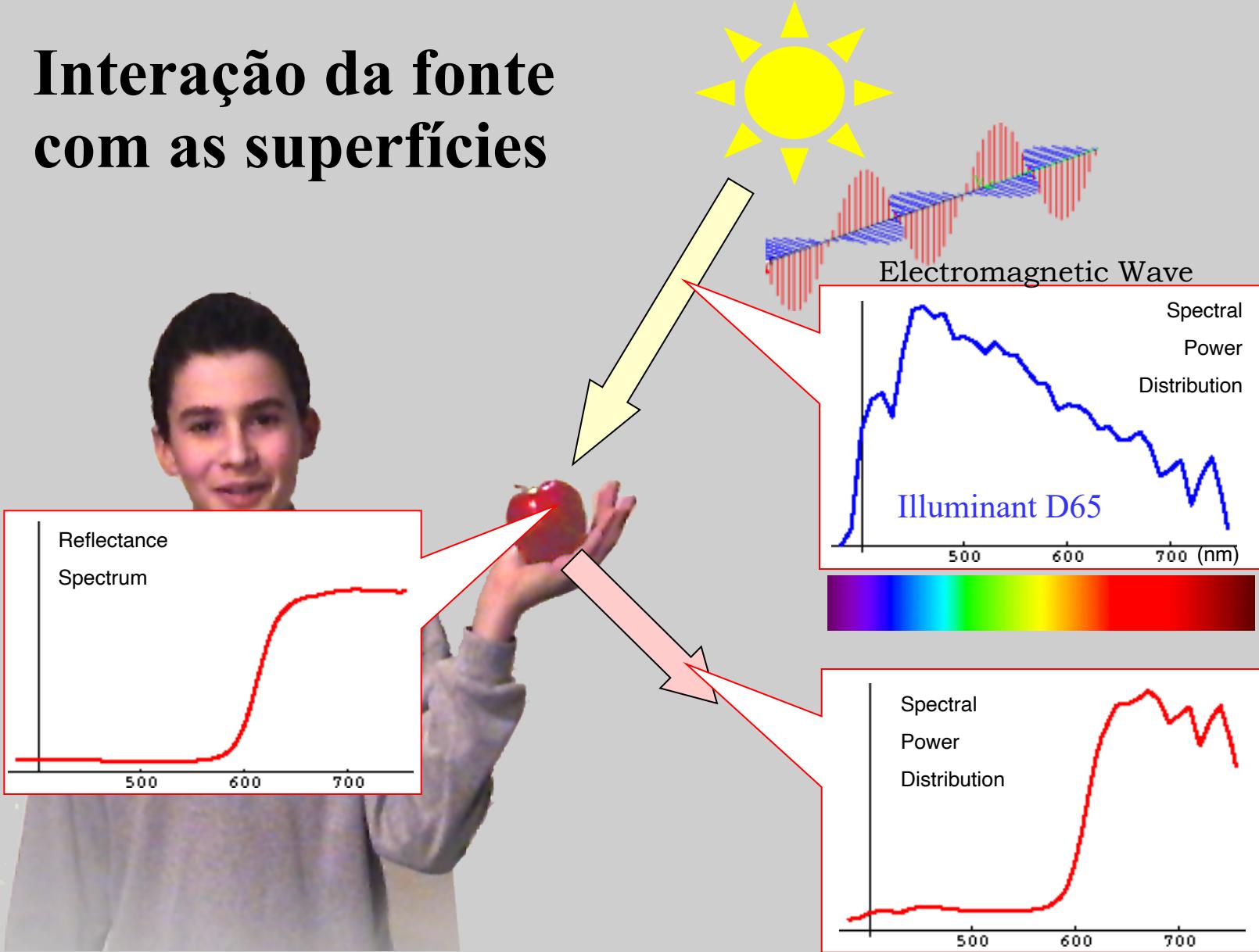
Espectros de luz “branca”



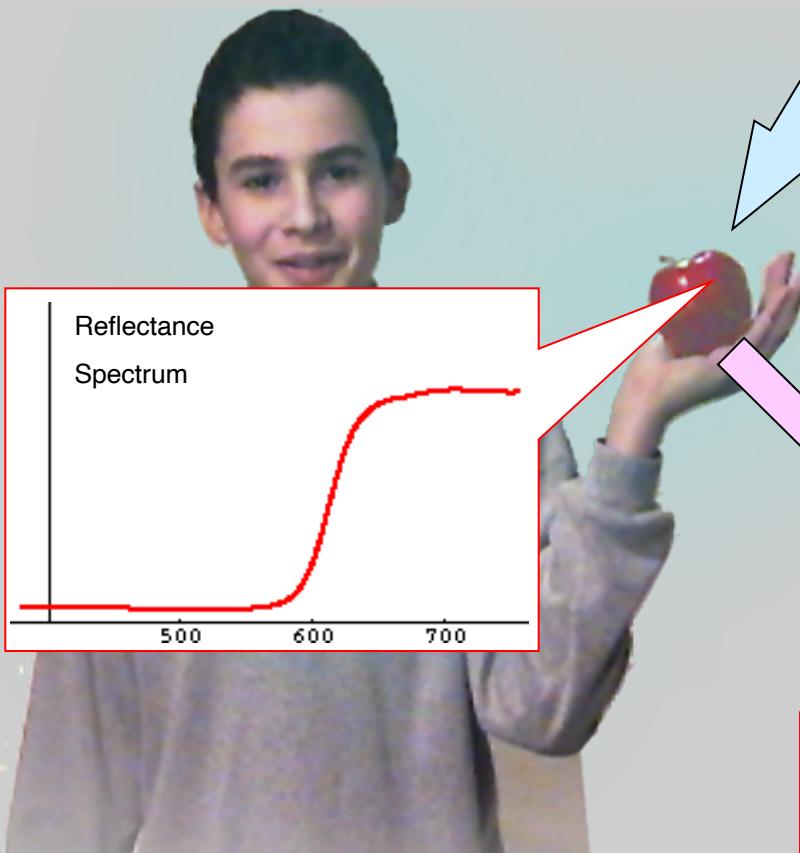
Cor

Idit Hagan

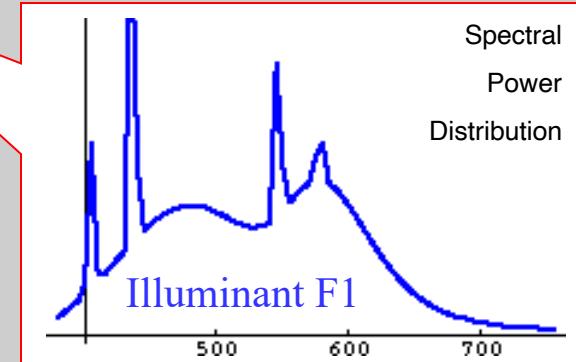
Interação da fonte com as superfícies



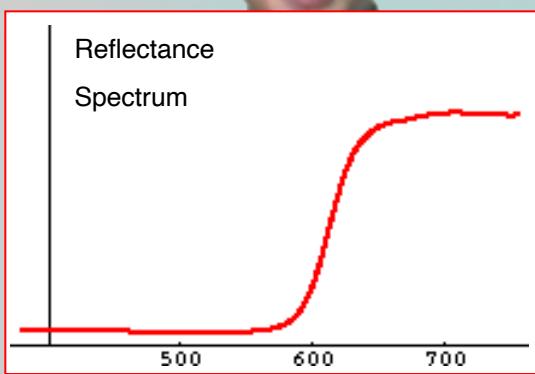
Interação da fonte com as superfícies



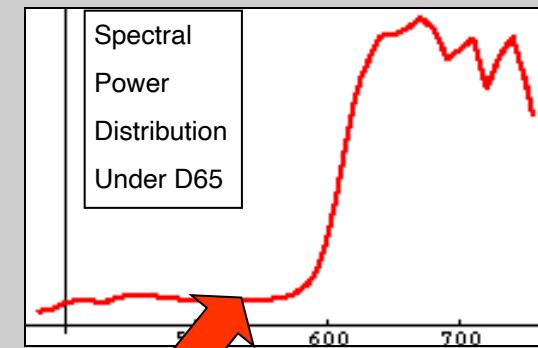
Neon Lamp



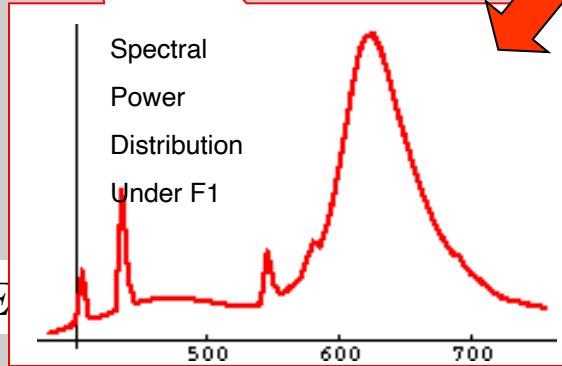
Reflectance Spectrum



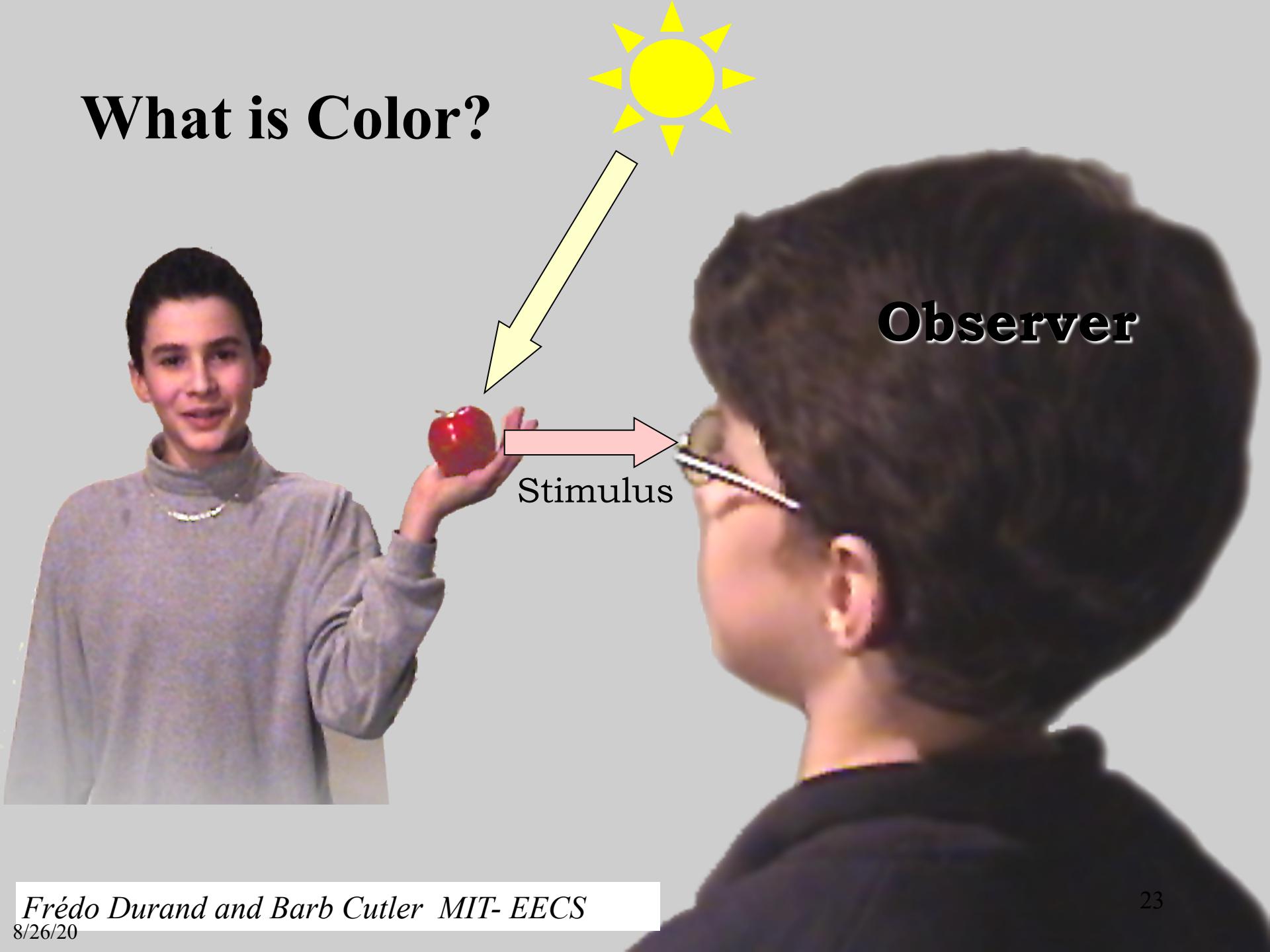
Spectral Power Distribution Under D65



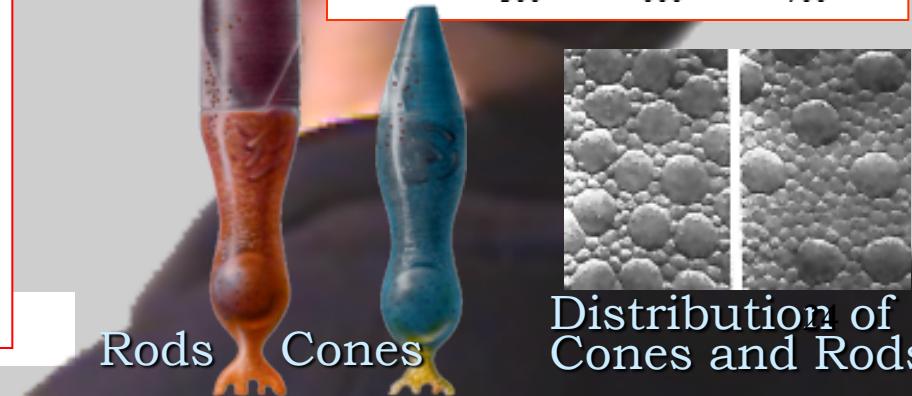
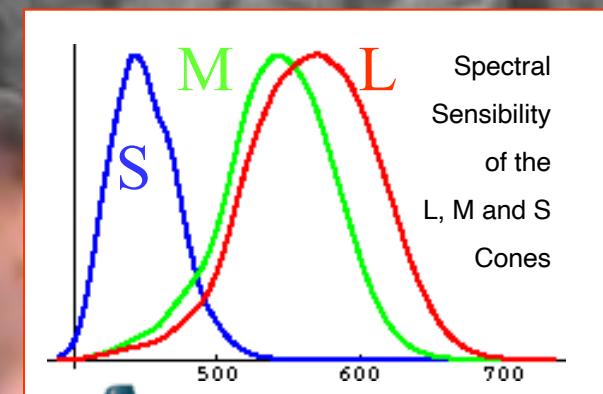
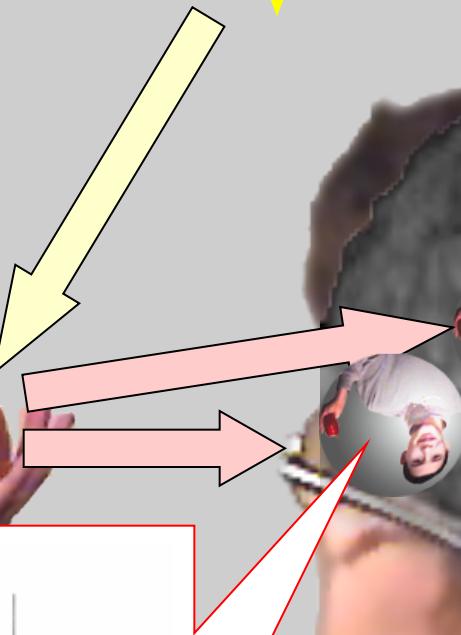
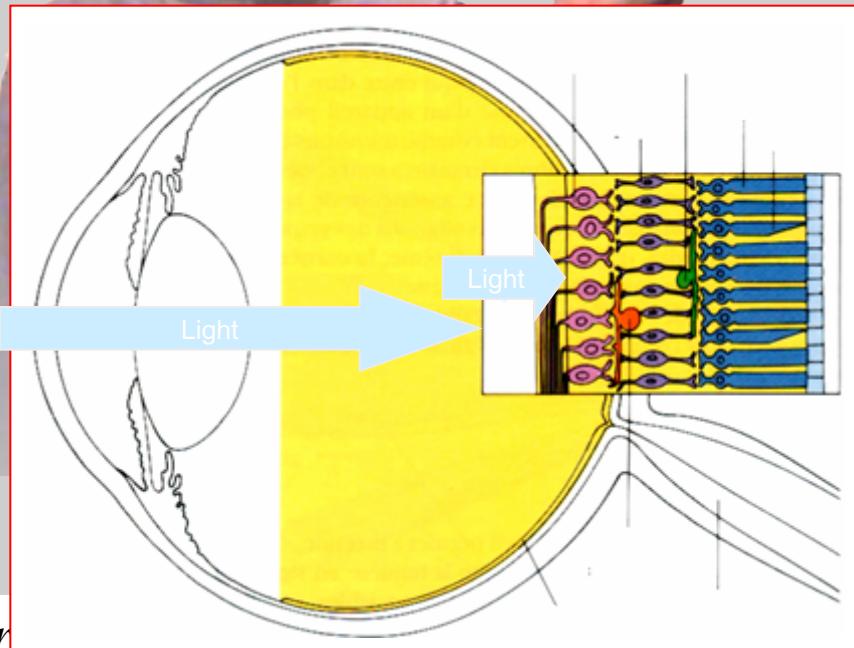
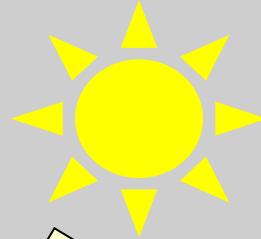
Spectral Power Distribution Under F1



What is Color?

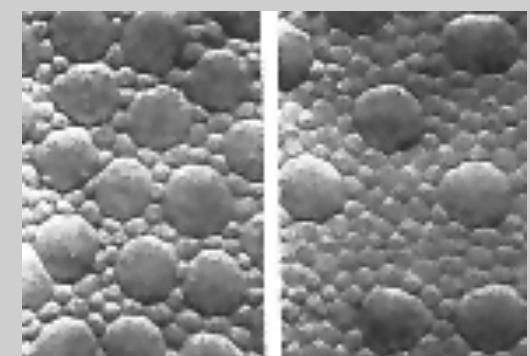
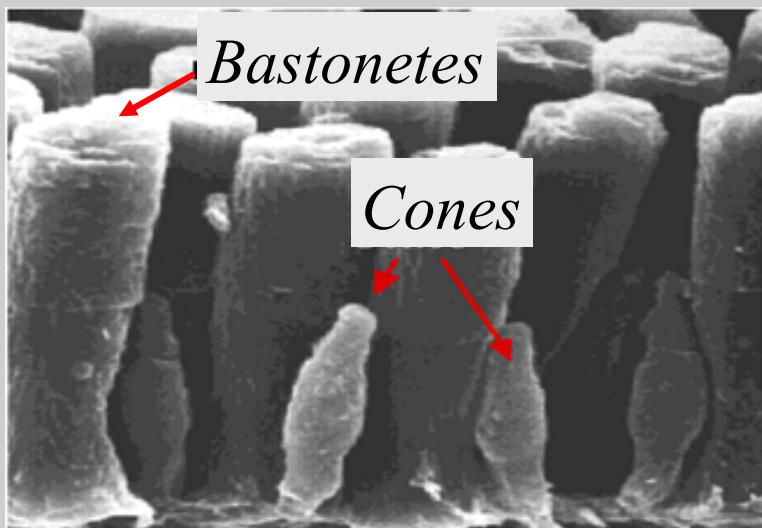
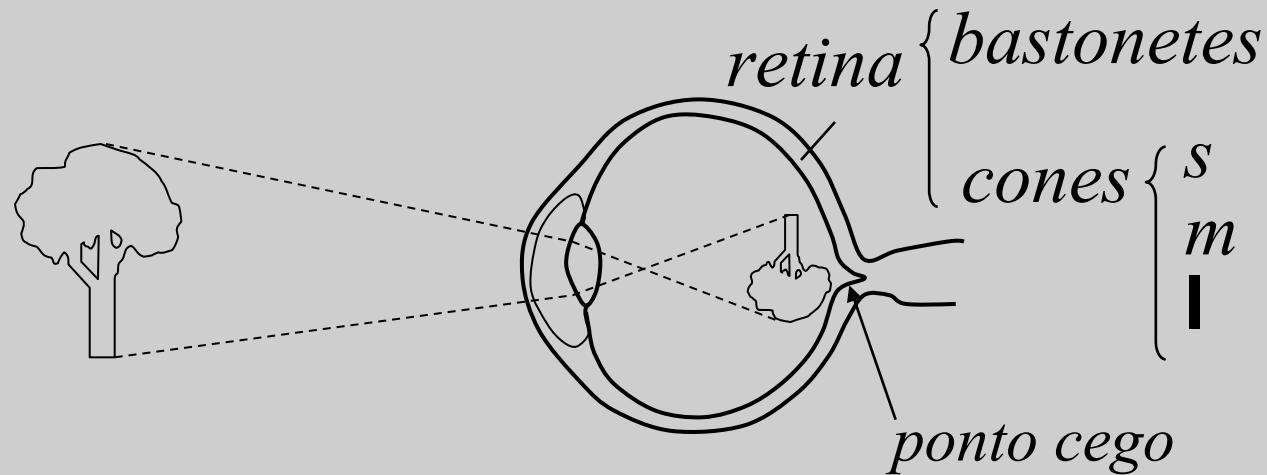


What is Color?



Distribution of Cones and Rods

Anatomia simpificada do olho humano



fovea
10%

Sensibilidade dos cones do olho humano

