Anti-square of Luminosity

I. **Experiment purpose:**

Test luminance and prove the inverse-square law of luminance.

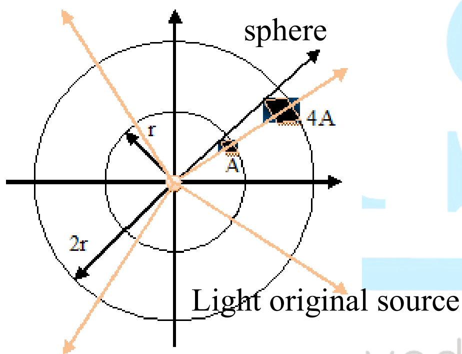
II. **Experiment theory:**

- luminous intensity: The brightness of the light source is called **luminous intensity** and the unit is **candela** with Cd sign to present the **luminous flux** of the visible light.

- luminous flux, it means that light source emits light energy in a period. It is the amount of light. The unit is **Lumen** with lm sign. The bright can be felt by eyes.

- illuminance, the darkness when the object is lightened that we call illuminance. Illuminance = Luminous flux/ dimension. The lightened surface of object in per unit of dimension can receive the luminous flux of visible light. The unit is **Lux** with lx sign.

To calculate illuminance: if a bulb



As image, dimension A with the radius r, the steradian angle of this dimension from center of sphere Ω is.

$$\Omega = A / r^2 \quad (\text{unit: steradian angle})$$

the total dimension of the sphere is $4\pi r^2$, so the steradian angle of the full sphere is 4π steradian. We set that light source I as amount of candela, and F is amount of luminous flux by lumen unit., so we can get

$$F = 4\pi I \qquad (1)$$

When lightening on surface of object, the amount of lumen of lightening luminous flux on unit area A that called illuminance E.

$$E = F / A \qquad (2)$$

the unit is lumen/square meter that we call **LUX**. If I is the brightness of light source and light source is center and r is radius, then the luminous flux of unit area on sphere that E is the luminance in interior of a sphere.

$$E = F / A = 4\pi I / 4\pi r^2 = I / r^2 \qquad (3)$$

When the visible light lightens vertically, the luminance has inverse ration to the distance and proportional to brightness I.

III. Experiment device:

No.	Name	Qty	No.	Name	Qty
1	multi- function optics slide platform	1	2	fixable join slider	2
3	Led power light with holder (attached power supply 3DCV/1A)	1	4	Luminance sensor (attached steady rack)	1
5	Luminance data capture (attached power supply 12DCV/1A 、USB wire)				

Image 3-1: accessory of experiment

IV. Experiment method and steps

Image 4-1: Experiment of installation image

1．Image 4-1 installation, we plug in light source that can fix on the join on the slider. We use steady rack to fix luminance sensor with another fixable join slider and adjust the vertical source of irradiated face.

2．20cm far away from light source, we use USB transmission wire to link to luminance data capture and plug in power supply.

3．We move luminance sensor gradually. We measure by every 5cm distance and record the location and value of luminance. We repeat until the light source has 60cm far away to photoreceptor.

Note: About actual location of luminance sensor and light source, sensor point of luminance is the black point in the tip of sensor, not the scale on fixable join slider.

4．We use formula to prove that the luminance is inverse square proportion to the distance.

V. Result and record

experiment record list (one)			
	First time	Second time	Average
distance(cm)	luminance (Lux)	luminance (Lux)	luminance (Lux)
20			
25			
30			
35			
40			
45			
50			
55			
60			

Experiment record graph (one)

Relation between luminance and distance

Note: $I = E r^2$

VI. Question and discussion:

1. Explain luminance inverse-square law.
2. Should we operate this experiment in dark room? What is the benefit?

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