Construct, Conduct & Comprehend Physics Experiments

LEOK-3-10 Verifying Lambert's Law of Radiation

- *Complete set*
- *Cost effective solution*
- *Detailed instructional manual*
- *Easy alignment*

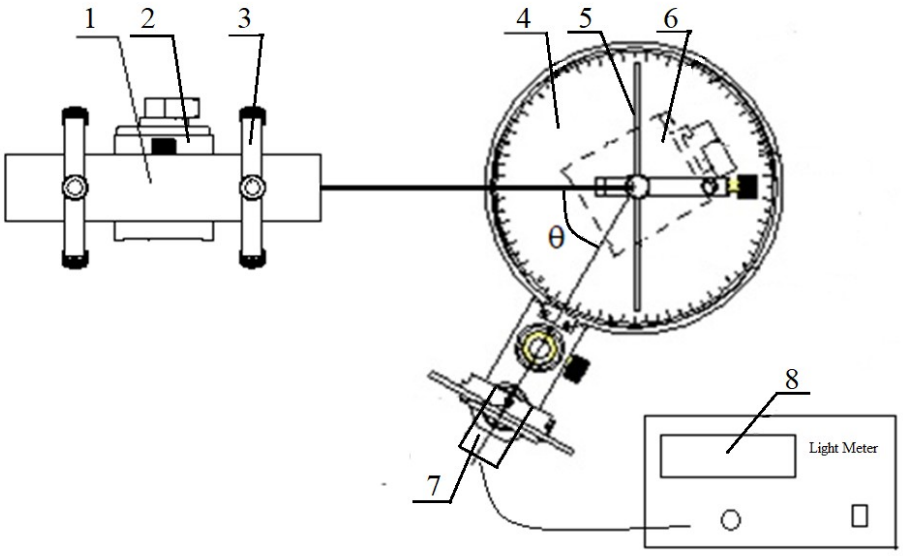


Figure 10-1 Schematic of experiment setup

1: He-Ne laser (LLL-2)
2: Magnetic base (SZ-04)
3: Laser tube mount (SZ-42)
4: Optical goniometer (SZ-47)
5: White paper plate
6: Magnetic base (SZ-04)
7: Photo sensor with mount
8: Light meter

Theory

Named after Johann Heinrich Lambert, a Swiss polymath, Lambert's law of radiation says that the radiant intensity or luminous intensity observed from an ideal diffusely reflecting surface or ideal diffuse radiator is directly proportional to the cosine of the angle ϑ between the direction of the surface normal and the direction of observation. It is also called as the cosine emission law. The expression is :

$$I = A * I_0 * \cos(\theta) \quad . \qquad (10\text{-}1)$$

where A is a constant that relates to the area of the illuminated surface and the area of the measuring sensor; I_0 and I are respectively the intensities of the incident and the reflected beams.

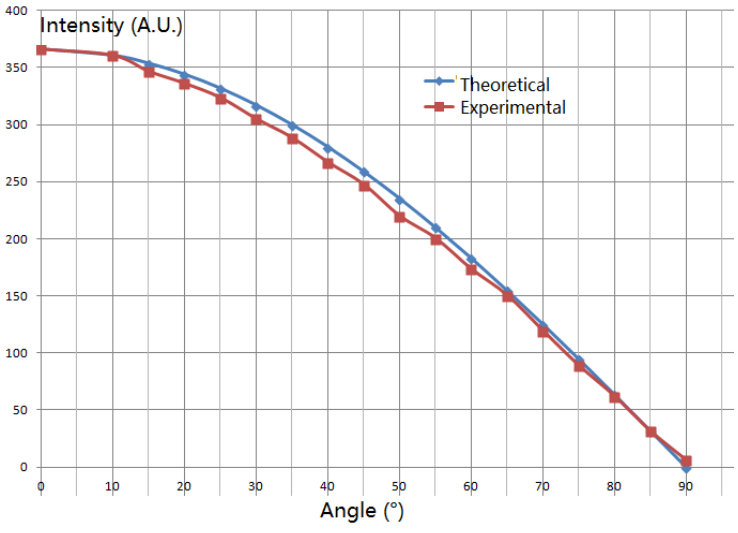
The surface obeying Lambert's law is said to be Lambertian, and exhibits Lambertian reflectance. It has the same radiance for any viewing angle. Since the observed transverse cross area of the radiator is the projection of the original radiator area in the direction of angle ϑ, it results a reduced factor of *cos(ϑ)* . Due to this reason, Equation (10-1) is derived.

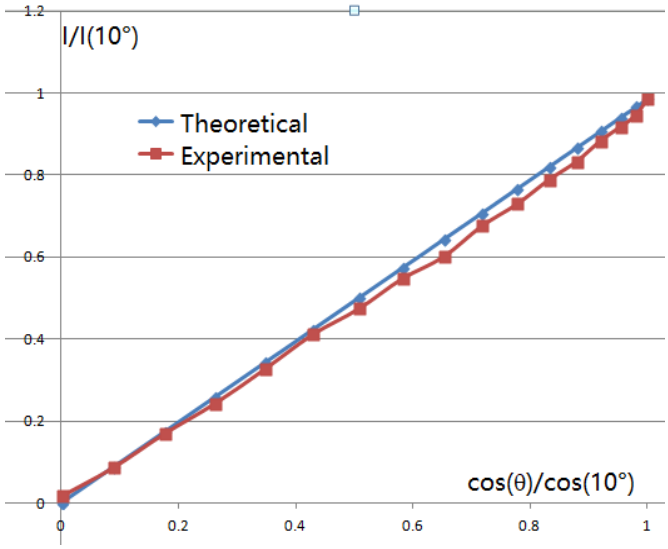
Experiment Procedures

1. Cut a piece of white paper plate and mount it vertically in the center of the optical goniometer (SZ-47) along the 90°-90° line. Mount the receiving sensor of the light meter to the front hole on the arm (i.e. the hole closer to the center) of the goniometer.
2. Refer to Figure 10-1, align all the components at same height on an optical table.
3. Let the laser beam incident onto the white paper surface normally at the center of the goniometer (i.e. along the 0° line).
4. Fix the arm of SZ-47 at a relatively small observation angle; finely adjust the direction of the photo sensor to point it to the center of the goniometer till the maximum meter reading is achieved. Note, to reduce the influence of stray light, make the room as dark as possible.
5. Measure light intensity at various angles by rotating the arm of the goniometer. From 10° to 90° with step 5°, record the measurement data into the Table below.

θ (°)	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
Cos(θ)																	
I (a.u.)																	

6. Plot the relationship curve between θ and I. Compare the theoretical results and experimental results.
7. Plot the relationship curve between $Cos(\theta)/Cos(10°)$ and $I/I(10°)$. If the curve is a straight line, Lamberts' law is verified.
8. Below shows an example of the results of data process (with angle step 5°).





Example of measured and theoretical results

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