UE4050100 **INVERSE SQUARE LAW**

EXPERIMENT PROCEDURE

- **Calibrate an offset to compensate for ambient light.**
- **Measure the relative light intensity as a function of the distance.**
- **Plot a graph of *S* against $1/r^2$.**

OBJECTIVE

Verify the inverse square law for the intensity of radiation from a source of light

SUMMARY

According to the inverse square law, the intensity of radiation from a light source, i.e. the power per unit area, is inversely proportional to the square of the distance from the source. This will be investigated in an experiment using an incandescent light bulb. When the distance from the lamp is much greater than the size of the filament, such a bulb can be regarded as a point source of light. In order to measure the relative intensity of the radiation, a Moll thermopile is used.

REQUIRED APPARATUS

Quantity	Description	Number	
1	Stefan Boltzmann lamp	**1008523**	
1	Moll-Type Thermopile	**1000824**	
1	Measurement Amplifier (230 V, 50/60 Hz)	**1001022**	**or**
	Measurement Amplifier (115 V, 50/60 Hz)	**1001021**	
1	DC Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)	**1003312**	**or**
	DC Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)	**1003311**	
1	Digital Multimeter P1035	**1002781**	
1	HF Patch Cord, BNC/4 mm Plug	**1002748**	
1	Ruler, 1 m	**1000742**	
2	Barrel Foot, 500 g	**1001046**	
1	Set of 15 Safety Experiment Leads, 75 cm	**1002843**	

BASIC PRINCIPLES

The inverse square law describes a fundamental relationship which applies, among other things, to the intensity of light. The intensity of the light, i.e. the power detected within a unit area is inversely proportional to the square of the distance from the light source.

For this law to apply, the source needs to be radiating light uniformly in all directions and its dimensions must be negligible in comparison to its distance from the detector. In addition, there must be no absorption or reflection of light between the source and the point where the measurement is being made.
Since the source radiates uniformly on all directions, the emitted power *P* is distributed across the surface of a sphere at a distance *r* from the source.

(1) $$A = 4\pi \cdot r^2$$

The light intensity is therefore given by the following

(2) $$S = \frac{dP}{dA} = \frac{P}{4\pi \cdot r^2} \quad .$$

Equation (2) will be verified in this experiment using an incandescent bulb. When the distance from the lamp is much greater than the size of the filament, such a bulb can be regarded as a point source of light. In order to measure the relative intensity of the radiation, a Moll thermopile is used. Instead of the absolute intensity *S*, the thermopile voltage U_{th} is read off as a measure of the relative intensity.

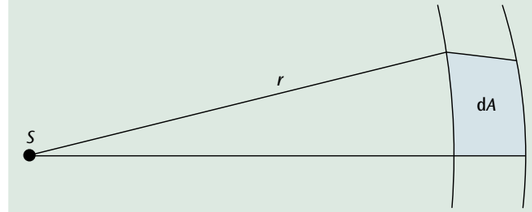

Fig. 1: Square of distance

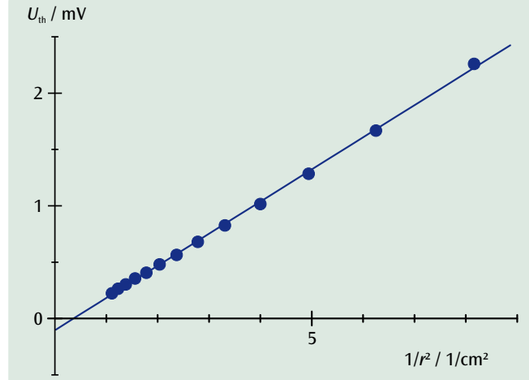

Fig. 2: Measurements plotted in a graph of U_{th} against $1/r^2$

EVALUATION

While making these measurements, it is unavoidable that the intensity of the ambient light will be detected as well as that from the source. For this reason, an offset is calibrated on the microvoltmeter before the actual measurements are made. To check the calibration, a general straight line is drawn through the measured points.