**The Herschel’s experiment**

This is based on the historical experiment by the Astronomer William Herschel.

He attempted to compare the intensity of different parts of the spectrum of sunlight by observing the temperature of a thermometer when illuminated by light of different colour dispersed by a prism. Beyond the red part of the spectrum, where no light was visible the thermometer was nonetheless heated to a higher temperature than the surrounding air.

To avoid the complications of focusing the constantly shifting sunlight on our temperature sensor we use a filament lamp of a sufficiently high wattage. (100W 12V i.e. 8A PS required)

The radiation from the lamp filament is focussed by a convex lens at a sufficiently long distance from the lens to allow good separation of the colours with a crown glass prism.

A slight improvement is achieved by using two lenses which focus more radiation into the spectrum on the screen, by placing one lens close to the lamp where intensity is high and a second lens further a way to focus with the suitable image distance.

These are distances which have been found to work:

Lens1 fl 12.5 cm at ca 6.5 cm from the bulb ( or a more commonly available 15cm focal length lens)

Lens2 fl 25 cm at ca 42cm from the bulb

prism as close as possible to lens2

screen at ca 40 cm from prism

variable PS capable of 12V, 8.5A (variable PS allows to set up with at lower voltage with a more comfortable low brightness)

100W 12V capsule (halogen) lamp (no reflector!) with filament in the shape of a rectangular coil ca 5x4mm

Aluminium plate with hole in size and shape of the lamp filament to be placed close to the bulb to block light from refections and leading in wires

The temperature sensors I use are Pasco fast response temperature probes PS-2135 because they are small (3mm diameter and 8mm length) and display temperature to at 0.1 deg C resolution.

The small size allows me to focus the available radiation into a small and therefore intense spectrum. It also means the sensor has low heat capacity and responds quickly to heating by the radiation it absorbs. The sensors are painted matt black to be good absorbers in the visible and short infrared wavelengths relevant here.

IR radiation of long wavelengths is known to be absorbed by glass and could not be projected by this method, but at the temperature of the halogen filament the shorter wavelengths are emitted with high intensity and this is what heats the sensor beyond the red visible light.

It is an important part of this demonstration that not only infrared radiation but also visible light (or any other electromagnetic radiation) results in heating when it is absorbed.



