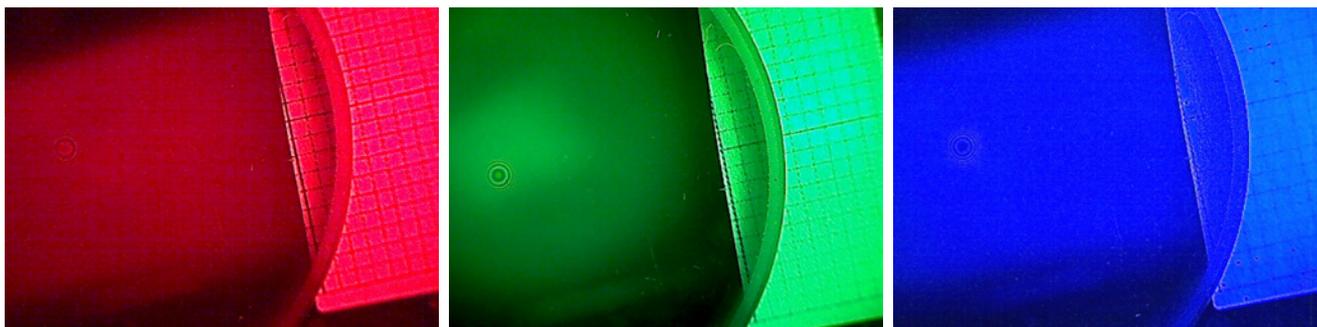


Newton's Rings experiment with a LED light source

We've had quite a few enquiries from schools recently asking where they can source a low pressure sodium light source to use in the Newton's Rings experiment in Advanced Higher Physics. The short answer is that these low-pressure sodium lamps are no longer available.



Figures 1, 2 & 3 - Newton's rings using a £6 RGB raybox.

Our first approach was to use a £6 RGB LED raybox [1] borrowed from our Early Years and Primary colleagues. We were able to produce rings using Newton's Rings Apparatus (A46229) by Philip Harris (see Figures 1, 2 & 3). We then set about making a simple yellow LED lamp and trying this out in the Newton's rings experiment.

We decided to use 20 yellow LED's to provide around the same brightness as our 18W Sodium Lamp.

Designed to be used with a smoothed 5V low voltage power supply, our design was simple and the circuit diagram is shown in Figure 4 below.

We constructed this on stripboard as shown in Figure 5. In use we used the white top of a margarine tub as a diffuser (see Figure 6).

We used the LED's shown in Figure 7 but with minor alterations to the circuit other yellow LED's would work. >>

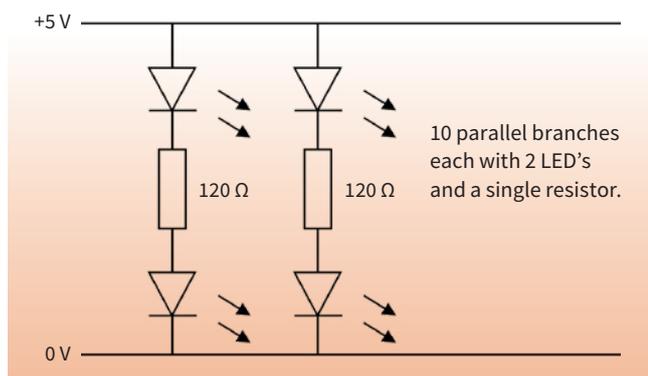


Figure 4 - Circuit diagram of the LED light source.

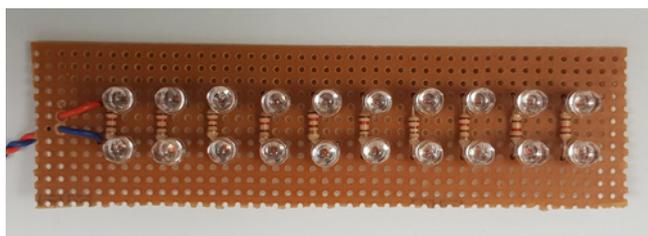


Figure 5 - Circuit constructed on stripboard.

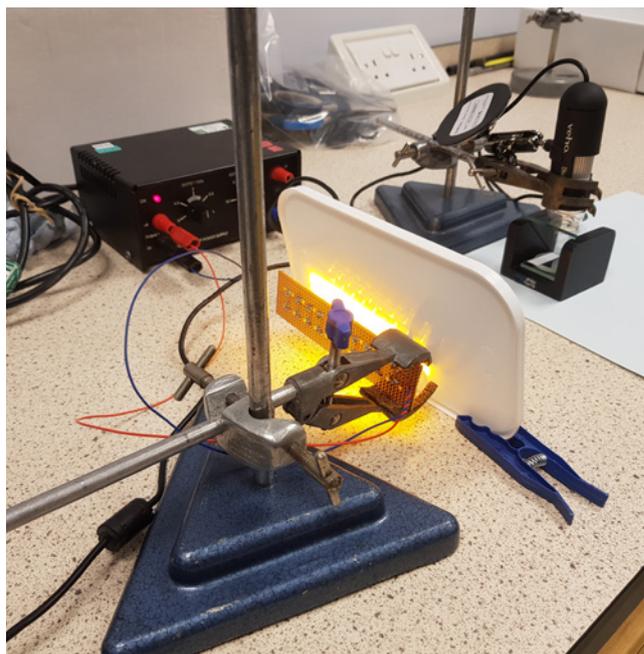


Figure 6 - In use - diffuser in place.

Activities & professional learning



Figure 7 - Pack of 25 yellow LED's as used for the LED light source.

So how did the LED lamp perform?

Figure 8 (LED light source) and Figure 9 (Sodium light source) show how the LED source compares with the Sodium light source.

We then compared the spectra from each light source using a spectrometer (Figures 10 & 11).

As expected both the λ and the FWHM (Full Width Half Maximum) values differ. The FWHM value is a measure of the width of a shape at half of its maximum height. It can be seen that the LED spectral response curve in Figure 10 looks 'broader' than the Sodium spectral response curve in Figure 11 (although the peak values differ) [2].

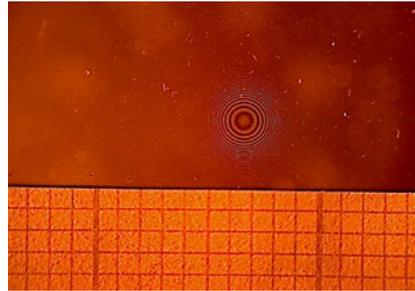


Figure 8 - LED light source.

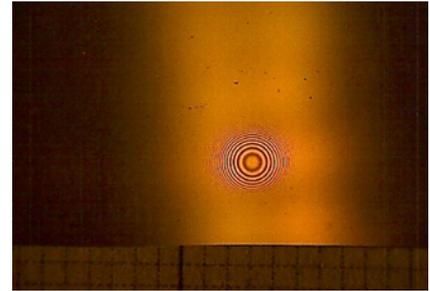


Figure 9 - Sodium Lamp light source.

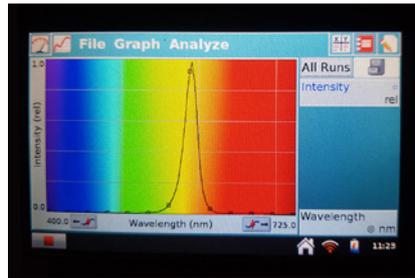


Figure 10 - LED light source.

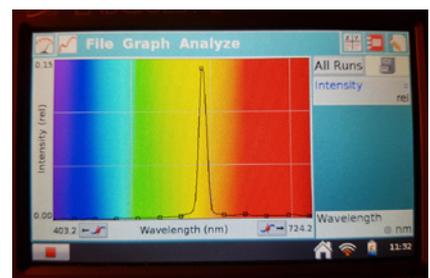


Figure 11 - Sodium light source.

A larger FWHM would likely lead to a greater uncertainty in calculated results. Figures 12 and 13 show the (differing) calculated results for the radius of curvature for the same lens. Figure 12 includes calculations for the stated LED max, min and typical λ .

We believe that a 'yellow LED' lamp is a suitable alternative to a now hard to find low pressure sodium lamp to show Newton's rings.

A cautionary note. We have not, as yet, been successful in using the LED lamp to show air fringes. This may be because of the 'broader' output spectrum of the LED. <<

References

- [1] <https://www.scichem.com/product/3-colour-led-light-source-set>
- [2] https://en.wikipedia.org/wiki/Full_width_at_half_maximum

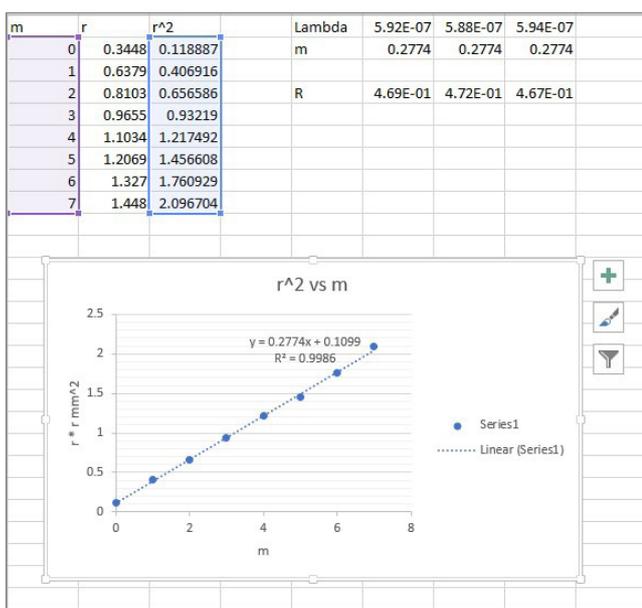


Figure 12 - LED results from image in Figure 8.

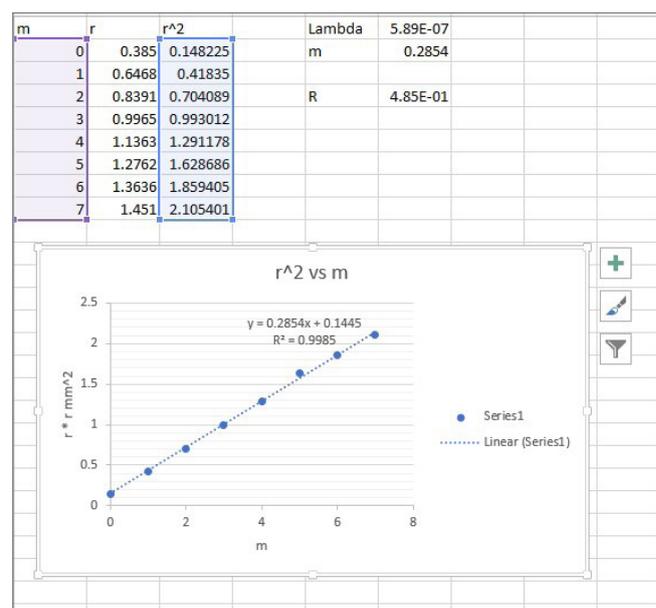


Figure 13 - Sodium results from image in Figure 9.