Violet laser diode

In Bulletin 229 we rejoiced that at last an inexpensive Class 2 green laser diode module (LDM) was available [1]. The eye is particularly sensitive to green light, hence a green laser looks particularly bright. What is more, the laser in question had automatic power control - a negative feedback system monitors the output of the laser, ensuring that it never creeps above the 1 mW limit of a Class 2 device.

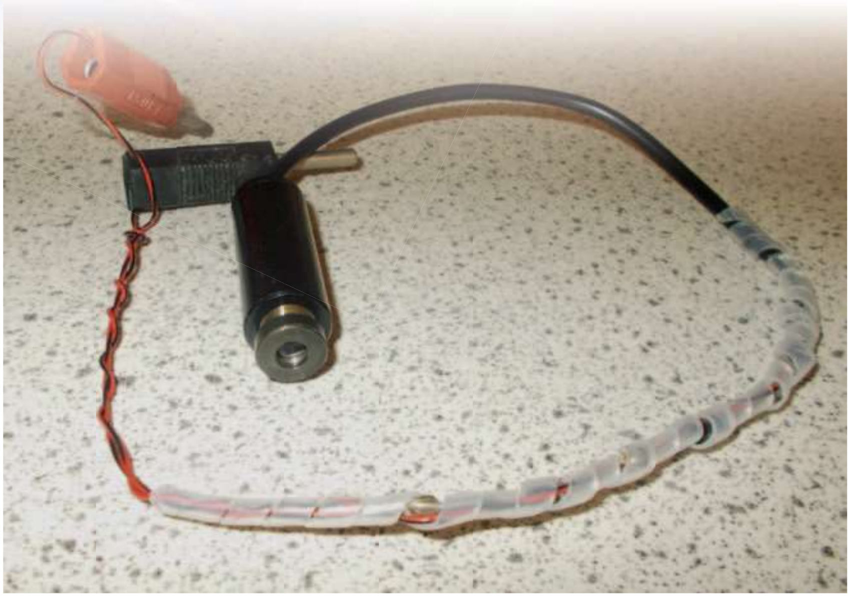

Figure 1 *- The violet LDM with chain of diodes.*

Now we have at last been able to buy a violet laser diode module (405 nm). As with the green unit, our violet LDM had automatic power control and came from the same reputable company, Roithner Lasertechnik in Vienna. Its part number is RLDD405-1-3 (Figure 1). Like most LDMs, its beam is polarised and the plane of polarisation remains stable with time, something that cannot be said for some school helium-neon lasers.

The cost was around €70, including postage. This is significantly more expensive than a violet laser pointer that you could buy online. Please don't be tempted by the latter.

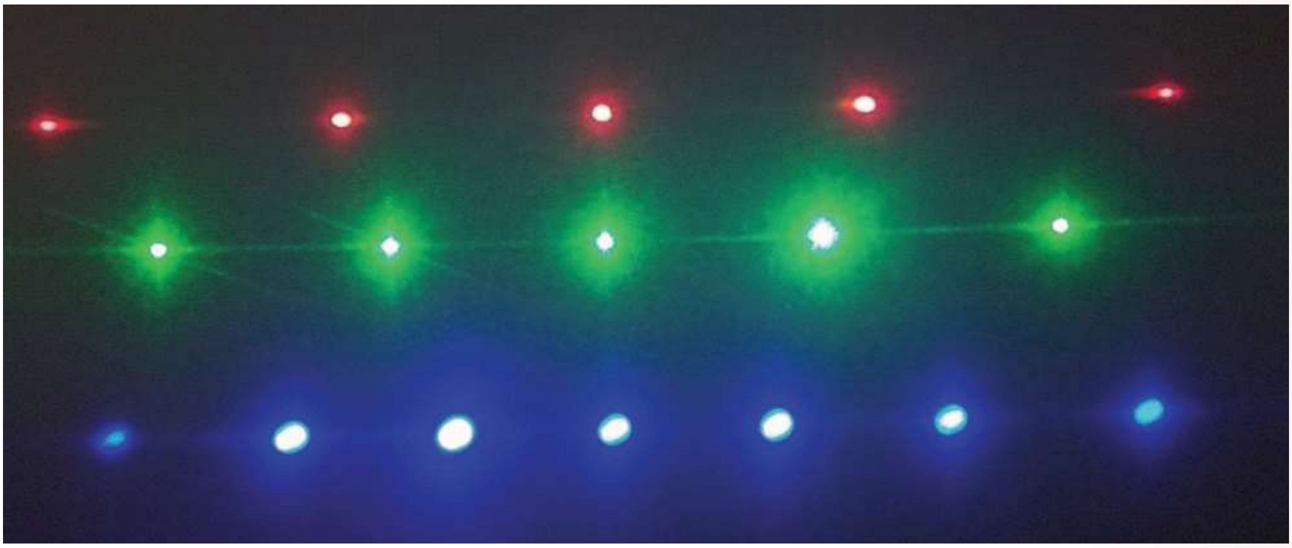

Figure 2*- Interference pattern from red, green and violet lasers, using a diffraction grating. Ethics prevented us from Photoshopping away the outermost violet fringes, but if you cover them with your fingers, the effect you're trying to show is more pronounced.*

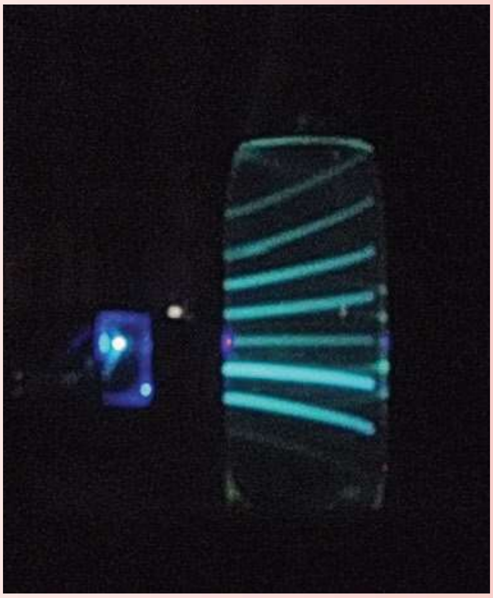

Figure 3 - *Fluorescence in tonic water.*

We are quite convinced about the reasons for not using laser pointers for experiments. You can read more in our guide to Optical Radiation in the Health and Safety section of our website, Physics subject area [2]. Just in case we were being draconian, we bought a violet pointer from eBay. It was labelled as Class 2, but proved to be twice as powerful as it ought to be.

The LDM (Figure 1) runs from a 3 V supply. We felt that a 5 V supply was more likely to be available and so we soldered a chain of three IN4001 diodes, each of which drops the voltage by about 0.7 V, in series with it. The circuit is the same as that in Bulletin 229. If you did not want to do this, you could run the module from two 1.5 V batteries.

So why would you want a violet laser if you already had a red and or a green one? It is tempting to state glibly that you can never have too many lasers. As well as being able to use your lasers with a grating to compare the fringe spacing of the interference pattern when different wavelengths are used (Figure 2), this light is energetic enough to cause fluorescence in certain substances.

One of these is tonic water. Figure 3 shows fluorescence in tonic water from violet light that has passed through a diffraction grating.

You can also make some quite lovely total internal reflection patterns in tonic water, but do look out for stray beams - use beam stops where appropriate.

If you look at Figure 2, the violet light appears blue. This is because the paper screen we shone the beams on to contained fluorescing "optical brighteners". This gave us an idea. Could we colour mix red, green and violet (fluorescing to blue) laser light to give white? We used a similar set up to that used in the laser colour mixing article in the aforementioned Bulletin 229 - Light-Shaping Diffuser to spread the beams, and polarisers to adjust the brightness. A strategically-placed plastic dinosaur created some interesting shadows as shown in Figure 4.

We will finish with a question: Laser light is highly monochromatic. Would you expect the light from fluorescence to be so too?

Figure 4 - *Lasers and dinosaurs, the perfect combination.*

References

[1] http://www.sserc.org.uk/images/Bulletins/229/229_Complete.pdf.

[2] http://www.sserc.org.uk/index.php/health-safety/health-a-safety-home136/optical-radiation-safe-use81.