Australian Astronomy

ASA Factsheet No.22

The use of laser pointers in astronomy

This Factsheet is provided for information only and should not be regarded as legal advice.

Introduction

Green laser pointers are useful astronomical tools. On public astronomy nights the narrow beam from the laser can be used to unambiguously point to celestial objects. The beam is bright and clearly visible for several reasons:

- typical green lasers deliver at least 5 milliwatts (mW) of power,
- green light is scattered away from the beam direction by air molecules and dust particles (so you can see the beam from the side),
- the eye is particularly sensitive to the green colour of the laser.

In contrast, the ubiquitous red laser pointers used in lectures and public talks are often under 1 mW in power, plus the eye is less sensitive to the red colour and the longer wavelength red light is scattered less effectively. Bright Light Emitting Diodes (LEDs) are also available in various colours, but do not emit the narrow beam characteristic of a laser.

Unfortunately, in recent times, some people have misused laser pointers to shine into the cockpits of aircraft and at motor vehicles. The potentially catastrophic results of this practice prompted governments around Australia to set down restrictions on their import, possession and use.

What kinds of laser pointer are now restricted?

On 1 July 2008, the Australian Federal government banned the **importation** of any hand-held, battery operated, laser pointer with a power greater than 1 mW unless prior written permission has been granted. This applies to companies and also individuals ordering on the web. Information on obtaining an import permit is available at
http://www.customs.gov.au/webdata/resources/files/LaserPointers.pdf

Fig. 1 shows a typical laser pointer of the type used by astronomers and now subject to restrictions on import, possession and use.

Figure 1.
A typical hand held, battery operated laser pointer, shown in its case with batteries. The labelling on the laser should include the maximum power.

Figure 2.
Much higher power lasers are used by professional astronomers to provide artificial guide stars for adaptive optics systems on large telescopes. Here a beam is projected from one of the 'unit telescopes' of the ESO Very Large Telescope (VLT).

Image by Gerhard Hudepohl. Source: http://www.eso.org/gallery/v/ESOPIA/Paranal/phot-07a-06.tif.html

As of October 2008, New South Wales, Victoria, the Northern Territory, Western Australia and the ACT had laws in place to restrict the use of laser pointers. Similar legislation is currently being developed in the other states, i.e. South Australia, Tasmania and Queensland.

New state legislation

The legislation introduced by the NSW government on 1 July 2008 is typical of the state-based legislation dealing with laser pointers. Applying specifically to "*a hand-held battery-operated device…that may be used for the purposes of aiming, targeting or pointing*", the legislation makes it illegal to carry or use any laser pointer in a public place without a reasonable excuse - such as requiring the laser pointer for someone's occupation, education, training or hobby. These restrictions apply to laser pointers of any class or power output. The maximum penalty for being in possession of a laser pointer without a reasonable excuse is a $5,500 fine, a 2 year prison term, or both. The full text of the legislation is available at:
http://www.parliament.nsw.gov.au/prod/PARLMENT/nswbills.nsf/1d4800a7a88cc2abca256e9800121f01/204548f67373b317ca257441001e1813!OpenDocument

A regulation was also made in NSW to add laser pointers to the list of prohibited weapons. A permit from the NSW police is required from 1 December 2008 to possess or use a laser pointer greater than 1 mW in power. However, members of approved astronomical societies are exempt from requiring a permit.

For an astronomical society or club to be included on the list of approved astronomical organisations, they need to contact the Firearms Registry and ask to be included on the list. The Firearms Registry can be contacted on 1300 362 562 or visit the NSW Police web

page at http://www.police.nsw.gov.au/community_issues/firearms/laser_pointers where the new restrictions are described.

The NSW legislation concerning any laser pointer is similar to legislation controlling possession of knives in a public place. Although knives can be dangerous weapons, they are also useful tools. There is a clear difference between someone caught in possession of a knife when going fishing and someone caught with a knife when entering a public bar. Similarly, there is a clear difference between someone with a laser pointer on their way to an astronomical star party and someone with a laser pointer loitering in an airport car park.

What are the dangers of Laser Pointers?

Laser light from laser pointers can potentially burn the retina of the human eye. The danger is obviously greatest if the beam is aimed directly into the eye, rather than merely scattered from the beam and seen from the side. The danger is dependent on the wavelength of the laser light, the power of the laser pointer, the divergence of the laser beam, the distance of the person from the pointer, whether the beam is seen directly or via a reflection, how long the beam is viewed and whether the human eye's natural 'blink response' to bright light occurs.

Figure 2.
A typical laser warning label

The risk from a laser is often also expressed by the 'class' of the laser, although the definition is a little complicated and class definitions have changed in recent years. At one end of the scale, Class 1 lasers are safe for normal viewing. Eye damage from directly viewing the beam of a Class 2 laser is usually avoided by the blink response. Class 3 lasers can damage an eye before it has time to blink and have the potential to cause eye injury, especially in the hands of a careless or untrained operator. Class 4 lasers are even more dangerous, higher power devices.

The blink response should protect the human eye at any distance from any visible-light laser beam with a power under 1 mW, typical of a Class 2 laser. For more powerful lasers a greater distance is required to allow for blink response protection. For a given laser beam, a quantity called the *Nominal Ocular Hazard Distance* (NOHD) can be calculated. Serious eye damage is probable within the NOHD and less likely at greater distances. The NOHD depends on the power, wavelength, divergence and diameter of the beam and the length of time the laser beam will be viewed. For example, a 10 mW, collimated, continuous wave, green (532 nm) laser beam with a diameter of 1 mm and divergence of 10^{-3} radian, being viewed directly for 10 s has a NOHD of 55 m. Clearly this laser, typical of many green laser pointers, is a potential hazard to someone close to it and should be used with care.

Damage to the eyesight of a pilot or driver is unlikely from medium power (5 mW to 20 mW) laser pointers given that the typical distances involved are considerably greater than the relevant NOHD. However, the dazzle caused by the beam scattering off dust or scratches on a windscreen, or the blink response itself could still lead to loss of control of a vehicle. A laser beam could also potentially cause harm in other situations, for example by startling someone using a power tool.

Guidelines for the safe use of laser pointers in astronomy

It is the view of the ASA that the safe use of hand-held battery-operated laser pointers is possible in astronomy by following the guidelines presented below.

Note that a 5 mW laser pointer is sufficient for astronomical use at dark sites while a 10 or 20 mW laser pointer is sufficient at light polluted sites. **Any power over 20 mW is excessive for astronomical purposes.**

1. A laser pointer must only be used in accordance with the laws of the state or territory in which it is used.

2. Ensure that the laser pointer used requires a button to be held continuously to activate the beam. If the laser pointer is dropped the beam will automatically switch off.

3. Hold the laser pointer overhead in an outstretched arm before activating the switch and release the switch before lowering the pointer. This will help avoid accidental eye exposure.

4. Aim the beam only at celestial objects. Do not aim the beam at any object on the ground, nor at aircraft, motor vehicles, any person or any animal.

5. When the laser pointer is not being used to point at celestial objects return it to its case, place it in a pocket or cover the aperture from which the beam is emitted.

6. Store the pointer in a secure place away from the reach of children and anyone with a potential to misuse the device.

Some amateur astronomers and small observatories have similar lasers permanently fixed to telescopes, although not always in use. While technically not hand held laser pointers, they should be used with similar safety guidelines in mind.

Further details

The ASA would welcome further information or relevant links to specific legislation applying to the use of laser pointers in the various States and Territories of Australia. If you have any information that could usefully be included in this document, please contact ASA Secretary Dr John O'Byrne (j.obyrne@physics.usyd.edu.au).

This information was prepared for the ASA by various members of the Education and Public Outreach Chapter (EPOC) of the ASA. This sheet may be freely copied for wide distribution provided the Australian Astronomy and ASA logos are retained.

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