The Federation of Astronomical Societies

FAS Guidelines on Laser Pointers

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Document History

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1 Introduction

Laser pointers have been used in amateur astronomy for many years for various activities such as identifying astronomical objects and use of a sky laser pointer and can greatly enhance the enjoyment of the night sky to visitors at public star party session. Consequently, there has been an increase in the use of laser pointers by amateur astronomers over recent years.

Sadly the increased use of laser pointers by miscreants to shine at aircraft (military and civil), pointing at other vehicles and pointing at people has meant that a new law[1,2] was brought in on the 1st July 2018 which imposes much tougher penalties[3] on people caught using them for purposes outside those for which they were designed.

Although there is no ban on the purchase of laser pointers, even to the under 18's, there is an issue with the wide scale availability and misuse of these devices.

Consequently, there is some confusion within the amateur astronomy community regarding the use of these devices, with some societies stating that they are illegal to possess. The FAS understands that they are not illegal to possess, but their inappropriate use is.

Disclaimer

The following guidelines are intended to assist and are offered only as an aid to the safe and responsible use of a laser pointer. These guidelines should not be relied upon in a court of law. If a society wishes to obtain definitive legal position regarding their use of laser pointers, the FAS would in these circumstances, recommend the astronomical society seek independent legal advice.

2 Types of Laser

Laser pointers come various differing power ratings (see Appendix A) and in a number of colours – the most widely used appear as, green and red. Green laser pointers have given a particular cause for concern. Many of these are not suitable for use in a lecture hall as they cause afterimages or experience a grey 'comet tail' when viewing the beam on a projection screen.

Some of these green laser pointers produce beams that consist of a series of bursts (or pulses) of light with high peak powers in each pulse. The manufacturers often quote average power, which gives a misleading indication of the risk. Because of the way the green beam is generated, there may also be additional, invisible, laser light emitted. Specialist equipment is needed to identify these problems.

From studies undertaken in other countries, it would seem that there is an inverse relation between the cost of a device and the accuracy of the labelled power output in that the more expensive the device the more likely it is to be accurately labelled. This is of course an issue where people do not want to pay for a proper device but purchase one from a less reputable dealer or from the internet. Societies are therefore urged to purchase their laser pointer from a reputable dealer.

Additionally the FAS has been made aware that some users have altered the electronics thus rendering the beam more powerful than that stated on the device.

A 5mW laser can cause eye damage if there is prolonged exposure.

3 What is the recommended use of a pointer?

Laser pointers are useful in an educational setting. Many lecturers will use a low power laser to point out specifics on a screen using a low power red laser (often incorporated with the computer advance slide controls)

From an astronomical point of view it is much easier to use a laser to point to an object in the night sky than to try and identify that object with your hand. The FAS recommends that laser pointers in use at a star party, are

only used for pointing out astronomical objects in the night sky. It is further recommended that the laser used is of good quality, and properly calibrated which conforms to industry standards (see Appendix A).

4 Risk Assessment

Before undertaking a star party, the use of laser pointers should be considered within the society's overall risk assessment for the event.

The recommendation is that as few people use a laser pointer at a star party as possible, preferable one, and that the laser be no more than Class 3R.

It should be obvious to all, that laser pointers must not be aimed at any aircraft of any kind even if the type of aircraft/object cannot be identified. Any moving object in the night sky should be considered as an area of avoidance in respect to laser pointers.

Therefore, immediately before any society member uses a laser pointer they should conduct a risk assessment of their environment. The assessment should be a formal assessment at the beginning of a star party and it is recommended that during the star party the member using the laser pointer is acutely aware of possible hazards such as the identification of the position of any flying aircraft – airplanes and helicopters, people, *etc*.

The Civil Aviation Authority is also concerned about laser pointers as they could be dangerous or distracting to pilots.

The assessment should:

1. Consider the of the height of any aircraft, speed and direction. These factors will inform the member on where and when to use, or *not* use, the laser pointer.
2. Involve identifying the presence of wildlife such as birds, bats, *etc*. Equal care should be afforded to wildlife as is given to humans with the use of laser pointers. Some nocturnal animals have acute and highly sensitive eyesight and care must be afforded to such creatures.
3. Involve a judgment of the group of visitors with the member. The reaction to the use of a sky laser pointer by senior citizens may be very different from that of an excited group of youngsters who may wish to put their hand in the beam or try to look into the beam. The society member will have to take any appropriate action when using the laser pointer in such circumstances.
4. If involved with an outreach activity, then the assessment will take into account the vicinity of buildings and in particular whether they are occupied and a consideration of their function.

A society should seriously consider whether it would be appropriate to use a laser pointer at all near to an airport or airfield. Similarly, their use near buildings and other types of transport facilities should be carefully considered; non-exhaustive examples are: transport facilities such as ports, railway tracks and stations, *etc*. A society may have a specific facility nearby in which would prohibit the use of a laser pointer. The FAS cannot describe all such situations and the individual society must therefore consider their local environment when making the decision on whether to use laser pointers or not.

5 Society Controls

Many astronomical societies already have developed their own guidance documents on how and how not to use a laser pointer; however they may not be aware of the increased penalties for misuse[3]**Error! Bookmark not defined.**. It is also true that police forces may be looking to bring prosecutions to test the new Act. Unfortunately, despite the fact that astronomers generally will use these devices responsibly, consideration must be given to the fact that some people may not.

The laser pointer should be kept secured and out of the reach of children and the general public. During the star party, the user of the laser pointer should keep the device on their person at all times.

The society could consider the user of the laser pointer sign a document (Appendix B) stating that they understand what a laser pointer is, how it should be used, agree to use it responsibly and that they will not

give it to anyone else to use. The user of the laser should also be aware that they are responsible for their own actions.

If it is felt necessary to develop some form of disclaimer document, then the example form (Appendix B) could be amended by the society and which reflects any local areas of concern (an example might be a nearby airfield). This should then be signed by the user stating that they understand their responsibilities.

If possible, a society should also try and obtain a laser pointer that is calibrated and rated within the guidelines (Appendix A).

6 Use of a laser pointer as a finder

The FAS recommends that the use of a laser for this purpose should be discouraged. The rationale for this is when pointing a telescope it could well sweep across fellow observers and visitors and destroy the dark adaption of visual observers and the images taken by others.

It is also possible that, when observing at some locations, there may well be aircraft and the random use of using a laser as a finder could cause an issue.

Many star parties ban the use of laser pointers for this purpose as there are more appropriate methods for finding objects with a telescope, instead of a laser.

7 Use of a laser as a main optic collimator

Collimating the main optics of a telescope is a very popular use of lasers. Here the laser beam is shone into the telescope so the dangers here are not to other people but to the user. The use of lasers here should fall under normal health and safety considerations, *i.e.* do not look directly into the main beam of the laser and make sure that the laser power is within specification.

If the telescope is significantly out of collimation then the beam may miss the secondary and this could cause an issue but generally a collimation laser is not that powerful.

Appendix A accurately describes the power of a laser.

8 Other considerations on the safe use of lasers

Users of laser pointers should also note that even a Class 1 or Class 2 laser pointer could cause injury if shone into a person's eye. Even though direct damage to the eye may be unlikely, the temporary blinding effect would be distressing and could lead to an accident.

Reflections from reflective surfaces can also be a cause for concern. Whist it would appear sensible to use a laser pointer and direct the beam away from individuals, a highly reflective surface may reflect the laser beam back and cause harm.

Some projection screens are covered in a reflective material. Even if the reflected laser light is not strong enough to cause damage, higher powered laser pointers can leave after-images on the viewers' eyes which are uncomfortable and distracting.

Categorisation of laser devices (Appendix A) takes into account the natural human responses. Staring into a laser device, or causing a laser device to illuminate a person's eye for an extended period, may bypass these responses and cause permanent damage.

Ambient light levels can also affect the dose received by a human eye. If light levels are low, the iris opens up to allow more light to enter and, under these conditions, the dosage received from a laser pointer could be considerably larger than that received under normal room lighting.

By their nature, laser beams are very narrow. Water droplets and dust in the atmosphere will eventually cause the laser beam to disperse but laser beams can be dangerous over a considerable distance.

9 Conclusion

The FAS wishes to encourage the enjoyment and appreciation of the night sky and see the appropriate use of a laser pointer as a potential to enhance that enjoyment.

The Federation, like many astronomical societies across the UK wishes to promote the safe and sensible use of laser pointers and does not wish to see anyone's enjoyment of the night sky blighted by inappropriate use of laser pointers which may in extreme circumstance could lead to injury, a claim for damages or prosecution.

10 Disclaimer

As previously described in this document, this document is intended as guidance only and cannot be relied upon in a court of law. In these circumstances, societies are advised to seek independent legal advice for a definitive position on the matter.

Appendix A

There is no specific legislation covering the use of lasers in the UK. However, general safety legislation will apply, such as the Health and Safety at Work, *etc* Act 1974, the Management of Health and Safety at Work Regulations 1999, the Provision and Use of Work Equipment Regulations 1998 and the Personal Protective Equipment at Work Regulations 1992.

The HPA considers the professional use of a Class 1 or Class 2 laser pointer as a training aid in the workplace to be justified, and regards these Classes of laser product as being generally adequate for such use. The use of Class 3R laser pointers up to 5 mW may be justified for some applications in the workplace where the user has received adequate training including guidance to the user on the risks from laser beams and advice not to point the beam at anyone.

The Following is taken from Public Health England Published Aug 2014

The British Standard sets out seven Classes of laser, these are Class 1, Class 1M, Class 2, Class 2M, Class 3R, Class 3B and Class 4. The higher the Class number, the greater the laser radiation hazard posed by the laser. Class 4 lasers are high power devices, usually needing a mains power supply. Class 4 lasers are used for specific applications in research, medicine and industry. They are also used in the entertainment industry. Class 4 lasers are not designed to be used as laser pointers.

The classification system uses the concept of an Accessible Emission Limit (AEL). An AEL is the maximum value of accessible laser radiation to which an individual could be exposed during the operation of a laser and is dependent on the laser Class.

The AEL values are in turn based on Maximum Permissible Exposure (MPE) levels. An MPE is a level of laser exposure which it is believed an individual could be exposed to without incurring an injury. An MPE may therefore be considered as a maximum safe level of exposure. MPE levels are specified for both the eye and skin as a function of the wavelength of the laser radiation and the duration of exposure. These MPE values are internationally agreed

Class 1

Class 1 lasers are products where the radiant power of the laser beam accessible (the Accessible Emission Limit) is always below or equal to the Maximum Permissible Exposure value. Therefore, for Class 1 lasers the output power is below the level at which it is believed eye damage will occur. Exposure to the beam of a Class 1 laser will not result in eye injury. Class 1 lasers may therefore be considered safe. However, Class 1 laser products may contain laser systems of a higher Class but there are adequate engineering control measures to ensure that access to the beam is not reasonably likely during normal use. Examples of such products include laser printers and compact disc players.

Class 1M

Class 1M lasers are products which produce either a highly divergent beam or a large diameter beam. Therefore, only a small part of the whole laser beam can enter the eye. However, these laser products can be harmful to the eye if the beam is viewed using magnifying optical instruments. Some of the lasers used for fibre-optic communication systems are Class 1M laser products.

Class 2

Class 2 lasers are limited to a maximum output power of 1 milliwatt or one thousandth of a watt (abbreviated to mW) and the beam must have a wavelength between 400 and 700 nm. A person receiving an eye exposure from a Class 2 laser beam, either accidentally or as a result of someone else's deliberate action (misuse) will be protected from injury by their own natural aversion response. This is a natural involuntary response which causes the individual to blink and avert their head thereby terminating the eye exposure. Repeated, deliberate exposure to the laser beam may not be safe. Some laser pointers and barcode scanners are Class 2 laser products.

Class 2M

Class 2M lasers are products which produce either a highly divergent beam or a large diameter beam in the wavelength range 400 to 700 nm. Therefore, only a small part of the whole laser beam can enter the eye and this is limited to 1 mW, similar to a Class 2 laser product. However, these products can be harmful to the eye if the beam is viewed using magnifying optical instruments or for long periods of time. Some lasers used for civil engineering applications, such as level and orientation instruments are Class 2M laser products.

Class 3R

Class 3R lasers are higher powered devices than Class 1 and Class 2 and may have a maximum output power of 5 mW or 5 times the Accessible Emission Limit (AEL) for a Class 1 product. The laser beams from these products exceed the maximum permissible exposure for accidental viewing and can potentially cause eye injuries.

Class 3B

Class 3B lasers may have an output power of up to 500 mW (half a watt). Class 3B lasers may have sufficient power to cause an eye injury, both from the direct beam and from reflections. The higher the output power of the device the greater the risk of injury. Class 3B lasers are therefore considered hazardous to the eye. However, the extent and severity of any eye injury arising from an exposure to the laser beam of a Class 3B laser will depend upon several factors including the radiant power entering the eye and the duration of the exposure. Examples of Class 3B products include lasers used for physiotherapy treatments and many research lasers.

Class 4

Class 4 lasers have an output power greater than 500 mW (half a watt). There is no upper restriction on output power. Class 4 lasers are capable of causing injury to both the eye and skin and will also present a fire hazard if sufficiently high output powers are used. Lasers used for many laser displays, laser surgery and cutting metals may be Class 4 products.

Laser pointers currently available on the market

The HPA Radiation Protection Division has examined many laser pointers available to the general public in order to assess their laser Class and have found a significant proportion of these products to be Class 3R lasers and several Class 3B. The body's natural aversion responses are unlikely to provide adequate protection from eye injury for Class 3B laser pointers.

Although the risk of a permanent eye injury from a laser pointer may be small, an individual receiving even a transient eye exposure from a laser pointer will experience a bright flash, a dazzling effect, which is likely to cause distraction and temporary loss of vision in the affected eye and possibly after-images. The time taken to recover from these effects will vary for different individuals and will also be dependent on the ambient light level at the time of exposure. Medical attention should only be sought if after-images persist for hours, or if a disturbance in reading vision is apparent.

Many of the laser pointers assessed by the HPA were either incorrectly labelled or not labelled at all. It was also unusual to find any information on laser safety or warnings on the implications of potential misuse supplied with the products.

A number of high-power laser pointers, generally emitting green beams, are available over the internet. The laser beam powers may be up to a few hundred milliwatts and higher. The FAS considers these devices extremely dangerous and not suitable for sale to the public.

Appendix B

Only Class 1 or 2 RED lasers will be used when giving lectures or talks, taking into account guidance on use below.

A class 3R laser may be used during star parties and similar provided approval has been given by the committee and that they:

1. Use only laser pointers approved by the Society, with positive action momentary switches
2. Agree to undertake a risk assessment and follow guidelines regarding the safe use of laser pointers
3. Do not leave laser pointers where other people, especially children, can handle them.
4. Do not use the laser to be used as a finder/pointer on a telescope.
5. Ensure that all fellow astronomers/society members on site are happy for the laser to be used for training/demonstration purposes.

The signing of this document and subsequent approval for use does not preclude the user from sole responsibility and liability in the event of any improper use and subsequent injury/damage.

Member Name: _____

Member Signature: _____

Date: _____

References

[1] http://www.legislation.gov.uk/ukpga/2018/9/contents/enacted

[2] https://www.gov.uk/government/news/government-to-clamp-down-on-unsafe-lasers

[3] https://www.gov.uk/government/news/tough-new-penalties-for-misuse-of-lasers

