Laser Pointer Safety

Training Lecture

Brisbane Astronomical Society

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Brisbane Astronomical Society has a duty of care for public safety at its astronomical events. One potential area of risk to BAS Members, and the public, is the use of laser pointers either attached to a telescope or operated by hand. This Laser Pointer Safety Training Lecture material, and 23-point Laser Safety Policy, is designed to alert BAS members to potential dangers and risks associated with laser pointer use, and to guide BAS members in laser operational procedures that should help minimize the potential for adverse incident or personal injury.

Why is BAS Laser Safety Training and Certification Necessary?

- The use of laser pointers, as part of astronomy activities, brings with it legal and safety obligations. In order to meet these obligations, BAS members must fully understand the risks associated with laser pointer use, and comply with, the 23-point BAS Laser Pointer Safety Policy, as set out in this document.
- A safety training and certification process also helps protect the Brisbane Astronomical Society from the consequences of legal action a BAS member, or member of the public, may take in the event of an incident involving the use of a laser pointer.

Before a BAS member can use a laser pointer at a BAS event, he or she must undertake training into laser pointer safety and be certified by the BAS Management Committee as having undertaken laser safety training. By Certifying members as having undertaken training on Laser pointer safety, BAS may be in a stronger legal position to survive any legal action that may be taken against it regarding the use of laser pointers.

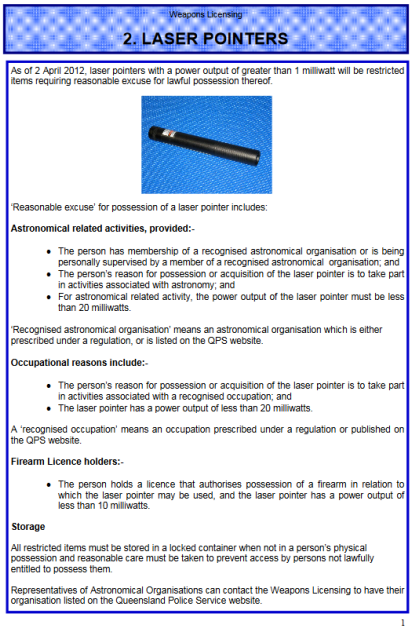
Queensland Police – Weapons Licensing

To satisfy Queensland Police regulations for using a laser pointer, you must:

- Be a current member of BAS
- Your laser pointer must have a power output of less than 20 mW
- Only use your pointer for activities associated with astronomy
- Store your pointer in a locked container when not in your physical possession.

However, as explained later in this document, notwithstanding Queensland Policing limiting laser pointers to less than 20 mW power output, BAS requires its certified pointer users must limit pointer power to no more than Class 3R and therefore no greater than 5 mW.

https://www.police.qld.gov.au/programs/weaponsLicensing/fees/Documents/Laser-Pointers.pdf



Weapons Licensing

2. LASER POINTERS

As of 2 April 2012, laser pointers with a power output of greater than 1 milliwatt will be restricted items requiring reasonable excuse for lawful possession thereof.

'Reasonable excuse' for possession of a laser pointer includes:

Astronomical related activities, provided:-

- The person has membership of a recognised astronomical organisation or is being personally supervised by a member of a recognised astronomical organisation; and
- The person's reason for possession or acquisition of the laser pointer is to take part in activities associated with astronomy; and
- For astronomical related activity, the power output of the laser pointer must be less than 20 milliwatts.

'Recognised astronomical organisation' means an astronomical organisation which is either prescribed under a regulation, or is listed on the QPS website.

Occupational reasons include:-

- The person's reason for possession or acquisition of the laser pointer is to take part in activities associated with a recognised occupation; and
- The laser pointer has a power output of less than 20 milliwatts.

A 'recognised occupation' means an occupation prescribed under a regulation or published on the QPS website.

Firearm Licence holders:-

- The person holds a licence that authorises possession of a firearm in relation to which the laser pointer may be used, and the laser pointer has a power output of less than 10 milliwatts.

Storage

All restricted items must be stored in a locked container when not in a person's physical possession and reasonable care must be taken to prevent access by persons not lawfully entitled to possess them.

Representatives of Astronomical Organisations can contact the Weapons Licensing to have their organisation listed on the Queensland Police Service website.

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BAS members must comply with the laser pointer regulations of the Queensland Weapons Act.

However, as explained later in this document, notwithstanding Queensland Policing limiting laser pointers to less than 20 mW power output, BAS requires its certified pointer users must limit pointer power to no more than Class 3R and therefore no greater than 5 mW. By limiting laser pointer power output to no more than 5 mW, pointer users will greatly reduce the potential for causing injury to the general public.

Classification of laser pointer power output

Most cheap green laser pointers rated around ~5 to ~20 mW output

	Class 3R	Class 3B
Visible light power, mW	1 to 5 mW	5 to 500mW
Nominal Ocular Hazard Distance, <1/4 second exposure	16m	150m
Maximum flashblindness distance	80m	800m
Eye hazard risk	Low risk	Retina damage risk

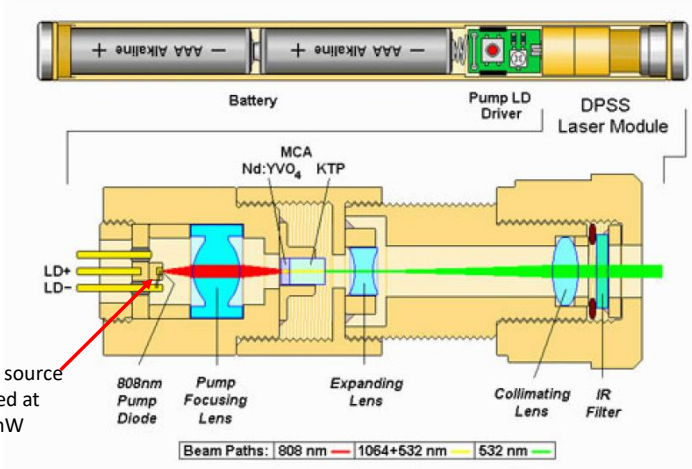
Most green laser pointers used by amateur astronomers fall into classifications 3R and the lower range of 3B. While 3R lasers are considered to carry a low risk of eye injury from accidental momentary direct exposure, it is difficult to know what the true power output of cheap lasers pointer actually is. Class 3B pointers with >5mW output carry greater risks of causing retinal damage.

In order to minimize the potential for permanent injury to the public, and BAS members, BAS requires its certified laser pointer users must limit pointer power to no more than Class 3R and therefore no greater than 5 mW.

A very real problem with cheap laser pointers is their quality of manufacture and the implications this holds for their true power output at visible and invisible wavelengths. While the label on a pointer may state 5mW output, users really have no idea whether this is correct. Are we pointing a 5mW or 35mW pointer, or perhaps even higher. Additionally, a laser pointer may emit a portion of its energy in invisible, but potentially damaging, infrared wavelengths. We just don't know.

Most green laser pointers emit light in at least three wavelength peaks, 532nm, 808nm and 1064nm. 532nm is green, the other two peaks are in invisible infrared radiation.

Infrared filters in cheap laser pointers may allow emission of more than double the rated power output, but at wavelengths the eye cannot detect or trigger the "blink response".



Common green laser pointers are constructed using an initial 808nm infrared light pump that may operate at 100mW to 300mW power output. Subsequent crystals in the light path convert the light to 1064nm infrared light and then halve the wavelength back to 532nm green light. However, infrared wavelengths still propagate along the light path. An infrared filter should be the last component in the light path and remove invisible infrared wavelengths. However, filters may be of poor quality, or omitted, in cheap pointers. Even when infrared filters are installed, green laser pointers will still emit radiation in three wavelength peaks, 532nm, 808nm and 1064nm. 532nm is green, the other two peaks are in invisible infrared radiation. The mW power output in the invisible wavelengths is typically not reported as a component in the nominal output, which may be labelled as 5mW. As a result, laser pointer users really have no idea what power their pointer can deliver to an accidentally "flashed" retina.

Laser pointer injury cases:

532nm green laser, <5mW

- <1 second exposure
- Short-term vision distortion
- Retina disruption after 6 months

532nm green laser, 5mW

- Exposure from 2-3m
- Vision disruption persisted after 6 months

Case 45 – A 25–year-old male with peer-inflicted laser eye injury (Hossein et al. 2011)

Laser power	Laser Wavelength	Distance	Exposure duration
3.5 – 4.5 mW	532 nm	5 cm	< 1 second

Year/country	Examination time frame	Symptom/injury	Remarks
2011/Iran	First: One day after the incident Last: 6 months later.	Metamorphopsia, right eye. Yellow-white spot at the centre of fovea	Blurred vision. Symptoms improved over time.

VA (corrected): 0.1, right eye, and 1.0 left eye, one day after the incident.

6 days later VA was 0.5, right eye and the yellow-white spot had disappeared.

After 6 months still a disruption of the retinal layers was observed.

Case 46 – A 22–year-old male with peer-inflicted laser eye injury at a laser show (Aras et al. 2009)

Laser power	Laser Wavelength	Distance	Exposure duration
5 mW	532 nm	2-3 m	Unknown

Year/country	Examination time frame	Symptom/injury	Remarks
2009/Turkey	First: One day after the incident Last: 6 months later.	Retinal lesion, nasal side of the fovea and haemorrhage temporal to the fovea.	Decreased vision in both eyes. The defect was unsolved 6 months later.

VA: 0.29, right eye, and 0.8 left eye, one day after the incident.

After two weeks VA was 0.63, right eye, and 1.0, left eye. VA improved to 0.8, right eye, and 1.0 left eye after 6 months.

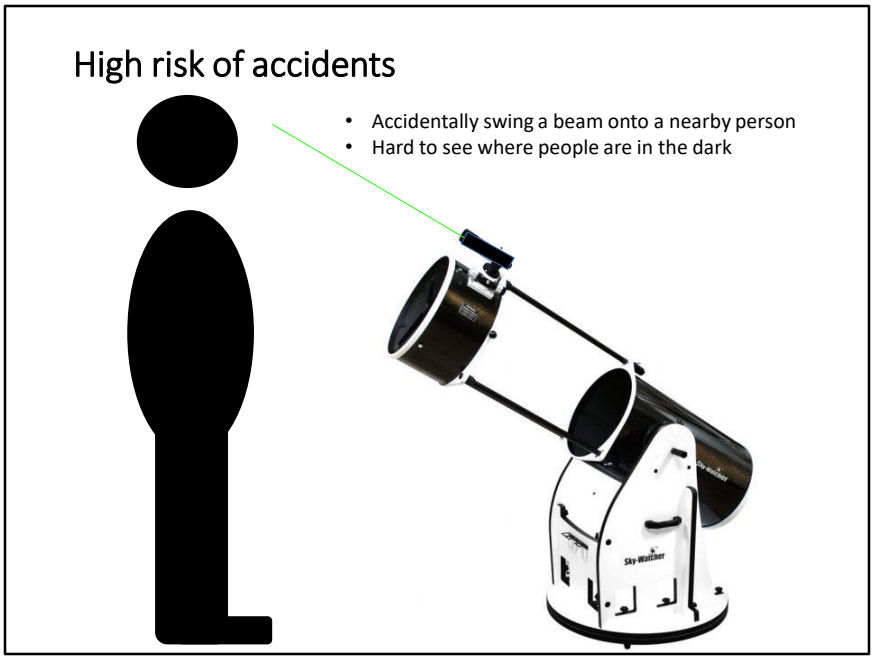
https://www.stralsakerhetsmyndigheten.se/contentassets/a945e4f1e4c84688b929dedf29fa79dc/201554-retinal-injuries-from-handheld-lasers-an-updated-report

There are cases of eyesight and retina damage from exposure to green laser pointers stated to be operate at around 5mW power output. So, the risk or injury to BAS members and the public are real. A case such as these would result in considerable legal and financial problems for the pointer operator and the BAS organization.

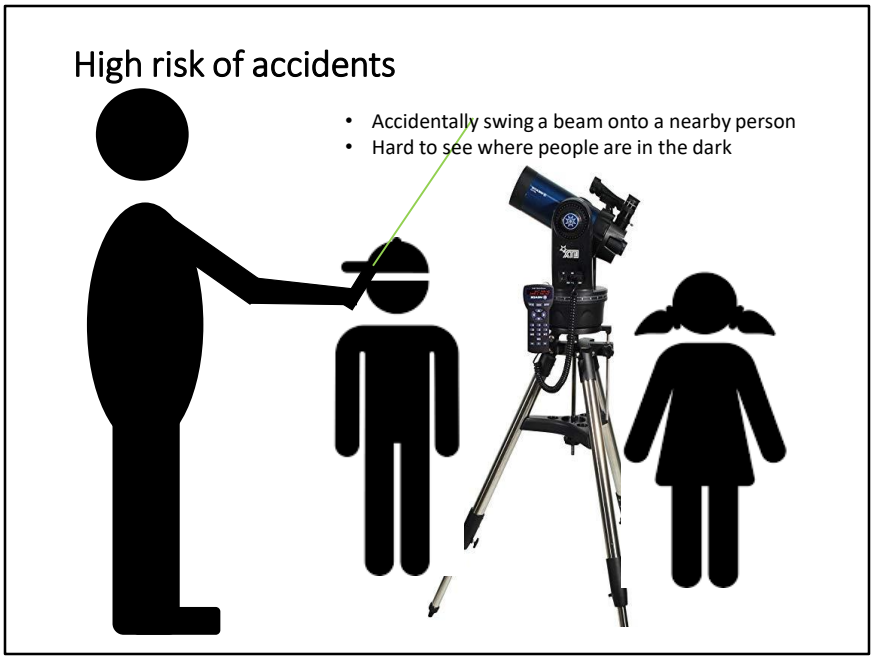
High risk of accidents

- Accidental button bumps at the wrong moment

It is very easy to accidentally press the power button at the wrong moment when pulling a pointer from a pocket or equipment box. This is one of the high-risk aspects of laser pointer use.



Using a laser pointers as “finder scope” is unnecessary and risky as the beam can be easily swung down to an elevation that may illuminate a person and cause eye injuries.



Where the public are involved, even more care is required as people move around in the dark and an incorrectly held pointer could easily hit an adult or child.
Before reaching for a laser pointer, we should ask ourselves, “is a laser pointer the only option?” In effect, with the exception of specific circumstances such as a designated BAS member conducting a “Sky Tonight Talk”, BAS asks that its members do not use laser pointers, particularly at astronomical events open to the public.

Laser Safety Incident Procedure

All reasonable steps must be taken by BAS members to ensure the safe operation of laser pointers at all times.
However, in the event of a laser pointer related incident occurring, the following actions should be taken by the operator of the laser pointer:

- Immediately cease use of the laser pointer and return it to secure storage.
- In the event of a laser pointer eye injury, the injured person should be directed to seek immediate medical attention.
- Comply with any instructions from law enforcement authorities.
- As soon as possible after the incident, provide a written report to the BAS President and Secretary documenting details of the incident. Provide information such as;
    - Date, time and location where the incident occurred.
    - Name of the laser pointer operator.
    - Name and contact details of persons injured or making complaint regarding laser pointer use.
    - Details of how the incident occurred.
    - Name and contact details or persons witnessing the incident.

If a BAS member becomes involved in a laser safety incident, the member must follow the Laser Safety Incident Procedure and attend to those claiming injury and provide written information to the BAS Management Committee detailing the incident.

BAS Laser Safety Policy

General policy requirements:

1. In order to be permitted to use a laser pointer at BAS events, members must attend a Laser Pointer Safety Training Lecture, or thoroughly read this Laser Pointer Safety Lecture document and submit a Laser Safety Certification Application form for approval by the BAS Management Committee, and be notified that their certification has been approved.
2. Laser Safety Certified members must carry their BAS membership card when using a laser pointer.
3. Certification expires three years from the date of approval. Retraining and reapplication is then required.
4. The BAS Management Committee has the right to cancel Laser Safety Certification at any time for any reason.
5. Certified users must comply with the laser pointer requirements of the Queensland Weapons Act.
6. Notwithstanding the Queensland Weapons Act permits laser pointers for astronomical use to have power output of up to 20 mW, BAS limits laser pointers used at its events to a power rating of no more than Class 3R and therefore no greater than 5 mW.
7. Laser pointers may not be mounted on telescopes or mounts to perform the role of a finderscope.
8. If requested by insurance providers, or law enforcement authorities, information regarding BAS member membership status, contact details and Laser Safety Certification status will be provided.
9. BAS does not provide legal indemnity to its members for their use of laser pointers.
10. An astronomical event or gathering not listed on the BAS Events calendar on the BAS website will not be recognized as a BAS event or gathering and will fall outside the scope of this BAS Laser Safety Policy.
11. In the event of a laser pointer related incident occurring, the operator of the laser pointer must follow the Laser Pointer Incident Procedure outlined in this document.

BAS members using laser pointers are required to abide by the 23 requirements of the BAS Laser Safety Policy.

BAS Laser Safety Policy - continued

General laser pointer usage requirements:

12. Before using a laser pointer, users should ask themselves if the use of a laser pointer is essential, and if there is another means of performing the task. Only if the use of a laser pointer is considered essential should one be actually used.
13. Laser pointers may only be used outdoors.
14. Always hold laser pointers overhead in an outstretched arm, above the eye-line of nearby people, before activating the power switch. Release the power switch before lowering the pointer.
15. Do not point the laser beam so low in the sky, or towards the horizon, such that it illuminates any terrestrial object.
16. Always cease using a laser pointer if an aircraft is heard or visible. Only turn the pointer on if the aircraft is confirmed to be well away from the target patch of sky and the beam will not be visible to the pilot.
17. When the laser pointer is not being used to point at celestial objects return it to its lockable case, or place it in a secure pocket, or cover the aperture from which the beam is emitted. If the pointer incorporates a key lock, secure the lock.
18. Store the pointer deactivated in a secure place away from the reach of children and anyone with a potential to misuse the device.
19. Do not lend a laser pointer to any other person that is not a Laser Safety Certified BAS member BAS.

School night and other public night requirements:

20. The BAS member conducting the event shall give due consideration to the relative merits of placing a warning "Laser Beam" sign on all approaches to the usage site.
21. A laser pointer may only be used by a single BAS member who is designated to conduct a “sky tonight” talk. The pointer may only be used as part of a “sky tonight” talk.
22. A laser pointer may not be used by any other BAS member for any other purpose.

BAS member’s-night requirements:

23. If requested to refrain from use of a laser pointer by other BAS members present, the user must do as requested.

BAS members using laser pointers are required to abide by the 23 requirements of the BAS Laser Safety Policy.

BAS Member Agreement and Application for 3-Year Laser Safety Certification

Full Name: _____
Membership Number: _____
Current RESIDENTIAL Address: _____
_____
_____
Email Address: _____

I agree that, as a member of Brisbane Astronomical Society, I will abide by the BAS policy for the safe operation of laser pointers.
I indicate here whether I have completed the BAS Laser Safety Training Lecture.
(Circle one) YES / NO If Yes, date completed _____/_____/_____
I indicate here that I have read and understand the Laser Safety Training Guide.
(Circle one) YES / NO If Yes, date completed _____/_____/_____
I understand my legal and safety obligations of owning and using a laser pointer.
I understand my use of laser pointers at non-BAS events is my sole responsibility.
I understand that my personal details may be provided to Queensland Police for the purposes of background checks to be completed.

Signature: _____ Date: _____
Return to: laser@bas.asn.au
Or in person to the President at any BAS meeting.
Office Use ONLY:

Laser Certification Approved: _____/_____/_____ Date This Certification will Expire: _____/_____/_____
Approved By: _____

BAS members seeking to use a laser pointer at BAS events must apply for, and be awarded, BAS Laser Safety Certification. This Certification must be renewed after three years, contingent upon undertaking renewed training on laser pointer safety.