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Some Pointers on the Use of Laser Pointers

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by Richard Tresch Fienberg



This is a typical amateur-astronomer's green laser pointer, shown with a simulated beam. The 5-milliwatt laser is powered by two AAA batteries and emits an intense, narrow beam of light at a wavelength of 532 nanometers. At night the beam is visible for hundreds or even thousands of meters, depending on sky conditions. Devices like this can be purchased for less than \$20 from many sources.

Sky & Telescope: Craig Michael Utter

which television stations you watched, you may have heard that hand-held laser pointers — commonly available for less than \$100 from a host of retailers and online dealers — are either perfectly harmless or capable of bringing down a jumbo jet. Naturally, the truth lies somewhere in between. Used properly, laser pointers are quite safe. But used improperly or maliciously, they can be dangerous indeed.

A recent addition to the backyard astronomer's toolkit has been flagged as a potential weapon in the terrorist's arsenal. The humble laser pointer, used by thousands of skygazers to show beginners the way to stars and constellations, is coming under fire from US federal and state authorities following several recent incidents in which laser beams have "painted" aircraft in flight.

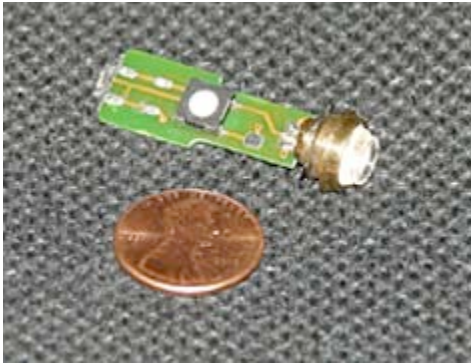
In the most notorious case, on January 4, 2005, a New Jersey stargazer was charged with interfering with the operation of a passenger aircraft and lying to federal investigators. He had been arrested the preceding week after allegedly shining a green laser at a private jet on approach to a nearby airport and then at a police helicopter dispatched to search for the culprit. According to the criminal complaint, after first blaming his 7-year-old daughter, the suspect admitted that he had been giving her a guided tour of the night sky. Formally indicted on March 23rd, he now faces a possible 20-year jail term.

The incident sparked a media frenzy, with many articles and broadcasts appearing alongside other news from the War on Terror. Depending which newspapers you read or

Here is some basic information about the laser pointers typically used by amateur astronomers, along with some tips on using them safely.

Laser-Pointer Basics

The pointers favored by stargazers use a neodymium diode laser and emit a green beam at a wavelength of 532 nanometers. At a given power setting, such lasers appear much brighter than the more common diode lasers that produce a red beam at wavelengths longer than 630 nm. The reason is simple: the human eye is much more sensitive to green light than it is to red light.



A laser pointer is a very simple device. Aside from the case and batteries (typically two AAA cells) not shown here, the electronics consist of a tiny circuit board with only a handful of components. The key piece is a laser diode capped by a lens (at right); the white dot at center is an on-off switch.

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Except on nights of exceptional clarity and near-zero humidity, if you shine a green laser pointer into the sky, you can follow the beam hundreds of meters up. To you and anyone standing around you, it looks like the beam ends at whatever star or planet you're aiming at. This makes it really easy to show someone a particular celestial object. Just point the laser at it and say, "Look there!"

Most laser pointers shine only as long as you hold down a button. But some models have a "constant-on" setting. These are becoming popular as pointing aids for telescopes. Once the laser is mounted and coaligned with the scope, you just move the scope around till it's pointing at your target star, and when you look in the eyepiece, there it is.

The green laser pointers in common use among astronomers and the general public have a power output of a little less than 5 milliwatts; in the US, these are called Class 3a lasers. Lower-wattage lasers, such as those in CD players and laser printers, are Class 1 or 2, while higher-wattage units, such as those in medical or industrial equipment, are Class 3b or 4. The higher the class, the more severe the warning label required by the US Food and Drug Administration (FDA).



Laser pointers sold in the United States are required to carry a warning label. The label on a Class 1 or 2 laser with a power output less than 1 milliwatt (mW) reads "Caution." The label on a more powerful Class 3a laser, such as the 5-mW green (532-nanometer) pointer shown here, reads "Danger."

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such a bright light very uncomfortable and would instinctively blink and/or turn away.

The Class 3b and 4 lasers used in industrial applications and outdoor light shows are vastly more powerful than personal hand-held units. There is no question that such lasers can be harmful to pilots, so their use is regulated, and airline pilots are trained to avoid them. The problem with personal laser pointers is that there are millions of them in consumers' hands, and there is no way to guarantee their safe use. In many states, it is already a crime to shine a laser pointer at a person or vehicle (as one careless stargazer in New Jersey is learning the hard way). Now that these devices are being talked about in the context of airplanes and terrorists, there's a very real chance that they will be tightly regulated or banned outright. In the United Kingdom, sales of 5-mW green lasers to the general public have been restricted for some time. In March 2005, a subcommittee of the House of Representatives convened a hearing to consider possible new laser-pointer regulations in the US.

Safety First

Direct viewing of a laser-pointer beam, even briefly at a considerable distance, can cause temporary flashblindness — the same effect you get right after a flash photo is taken — or afterimages. These effects last anywhere from seconds to minutes. Glare, a reduction or loss of central vision, lasts only as long as exposure to the beam.

In 2004 the US Federal Aviation Administration conducted tests on volunteers to determine how exposure to lasers affects pilots during final approach to the runway. The FAA found that a 5-mW green laser pointer can cause retinal burns at distances up to 14 meters (50 feet) and flashblindness, afterimages, or glare problems up to 350 meters (nearly a quarter mile). Even at a range of 3 kilometers (2 miles), a green laser pointer can still interfere with a pilot's vision badly enough to

Compared with incandescent light bulbs, which draw tens to hundreds of watts (not milliwatts), 5 mW sounds like very little. But laser light is highly concentrated into a very narrow beam. Moreover, this beam is highly collimated, meaning it diverges (spreads out) very slowly. Laser pointers typically emit a beam about a millimeter in diameter. Even as far as a kilometer away, the beam is no more than a meter across.










If you were to look directly into the beam of a 5-mW laser at close range — which you definitely should *not* do! — the spot you'd see would appear brighter than the Sun (and everybody knows you should never stare at the Sun). A laser's intensity at any distance is much higher than that of a similarly energetic ordinary light source, which spreads its emissions over a much wider angle.


According to engineer Samuel M. Goldwasser, who maintains an extensive Web site about lasers called [Sam's Laser FAQ](#), if you were to look directly into a laser-pointer beam from a mile away, it would appear as bright as a 100-watt bulb seen at a distance of less than 100 feet. Most people would find


prompt an aborted landing.

Exposure to a laser-pointer beam could have a disastrous effect not only on a pilot but also on a person operating machinery or driving a car or truck. There have already been several reports of laser-related accidents of this type; fortunately, none have involved fatalities. To help keep it that way, we offer the following safety tips for amateur astronomers and anyone else using a laser pointer. These are based on suggestions from the [Laser Institute of America](#):

Laser-Pointer Safety Tips

-  Laser pointers are designed to illuminate inanimate objects. Never shine a laser pointer toward any person, aircraft, or other vehicle.
-  Never look directly into the beam of a laser pointer of any type.
-  Do not allow children to use a pointer unsupervised. Laser pointers are not toys.
-  If your telescope is equipped with a laser pointer that has a "constant-on" setting, do not leave the instrument unattended with the laser switched on.
-  Do not aim a laser pointer toward mirrors or other shiny surfaces. The reflected beam may inadvertently strike someone in the eye.
-  Do not aim a laser pointer in the direction of anyone using a telescope or binoculars for either astronomical or terrestrial viewing.
-  Do not aim a laser pointer skyward if you hear or see an aircraft of any kind flying overhead.
-  Do not use a laser pointer within 3 kilometers (2 miles) of an airport.
-  The use of laser pointers is prohibited at some star parties and other astronomy gatherings. Always comply with such restrictions.


 Be aware of irresponsible uses of pointers so that the psychological effect will be minimized if you happen to be illuminated by one.

 Do not purchase a laser pointer if it does not have a "caution" or "danger" sticker on it identifying its class. Report suspicious devices to the authorities.

"Green laser pointers are the best way we have found to point out objects in the night sky to the public," says Monty Robson, a commercial airline pilot and avid amateur astronomer. He regularly conducts observing sessions for high-school students and their families at the [John J. McCarthy Observatory](#) in Connecticut. "I would be very disappointed," Robson adds, "if these useful educational tools became restricted by law." Amateur astronomers can help minimize the risk of such an outcome by using common sense, following the safe practices outlined above, and educating others about the safe use of laser pointers.

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