Soft Lights Foundation

9450 SW Gemini Drive
PMB 44671
Beaverton, OR 97008

January 8, 2022

BY EMAIL

Allen Baldwin, Chief
Emergency Responder Safety Institute
info@respondersafety.com

Re: LED Flashing Lights

Dear Allen Baldwin,

LED radiation devices emit non-uniform radiation that is exceedingly intense in the middle of the chip. While human tolerance is approximately 50,000 nits of peak uniform luminance, today's LED chips can have a peak non-uniform luminance exceeding 100,000,000 nits.[1]

The Emergency Responder Safety Institute study titled "*Effects of Emergency Vehicle Lighting Characteristics on Driver Perception and Behavior: Study Report*"[2] found the following:

1) High intensity lights are no more visible than lower intensity lights.
2) Blue and white lights were the most glaring.
3) The minimum intensity standards such as from NFPA are too high.
4) High reflectivity markings on the first responder reduce vision for the oncoming driver.
5) LED devices are designed to capture driver attention (which is dangerous).
6) The photometric requirements for flashing lights have not been updated to include spatially anisotropic LEDs.
7) There are no upper limits for intensity in standards such as those from the Society of Automotive Engineers.
8) Detection times are better when using high-to-low flashing patterns inherent to incandescent, versus the on-off pattern of LEDs.
9) The study did not investigate the quantity of flashing lights at the scene; for example, one flashing light on one vehicle versus ten flashing lights on each of three vehicles.

These results confirm our real-life experiences. LED flashing light beams are too intense and therefore dangerous. What the study is missing, however, is a discussion of the spatially anisotropic shape of LED light beams, and a detailed study how different peak luminance values reduce or increase vision. The Soft Lights Foundation therefore offers additional information for ERSI.

[1] https://www.laserfocusworld.com/test-measurement/research/article/16555223/nonlaser-light-sources-highluminance-leds-target-emerging-automotive-lighting-applications
[2] https://www.respondersafety.com/Download.aspx?DownloadId=f31a5f73-7b95-44c7-bd25-1e4cdfce5229

The focus of this letter is on the dangers of LED flashing lights which have a dangerous peak radiance and turn on and off instantly. These LED flashing lights are being used on police cars, ambulances, utility trucks, tow trucks, and fire engines. The non-uniform radiation and intense peak radiance triggers seizures, causes migraines, interferes with human nerve functioning, reduces vision, increases agitation, and endangers the lives of the public and first responders.

The left side of Figure 1 shows a spherical emitter that sends light in all directions in space. Because of the curvature of the emitter, the light rays do not overlap, and the radiation is spatially, spectrally, and temporally uniform. Every single point on the sphere is the same as any other point. On the other hand, the right side of Figure 1 shows a flat surface emitter such as an LED, which has a middle and edges. This flat surface creates a situation where the middle of the chip has different energy than the edges of the chip. LEDs send light only in the forward direction and the light rays are confined to an 'escape angle' which is determined by the physical characteristics of the chip. Thus, there are overlapping rays, with the most overlap being in the center of the chip, and the least overlap being on the edges. The result is that every point in space has different spatial, spectral, and temporal properties.

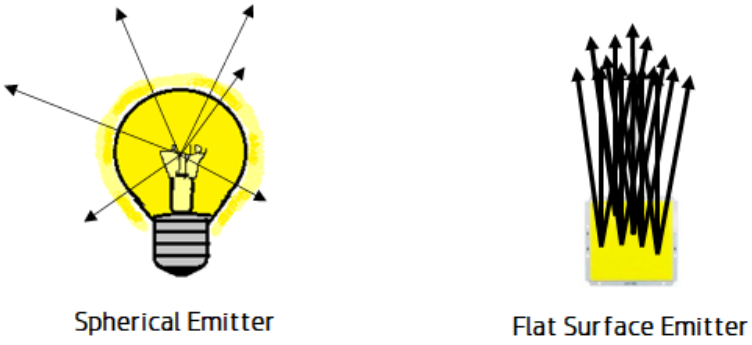


Figure 1 - Spherical vs. Flat Surface Emitter

Figure 2 shows the uniform spatial energy from candles, incandescent and High-Pressure Sodium versus the non-uniform spatial energy from an LED and LASER. The intense peak of energy will cause eye damage and will overload the nerve signals to the brain because the information is not uniform.

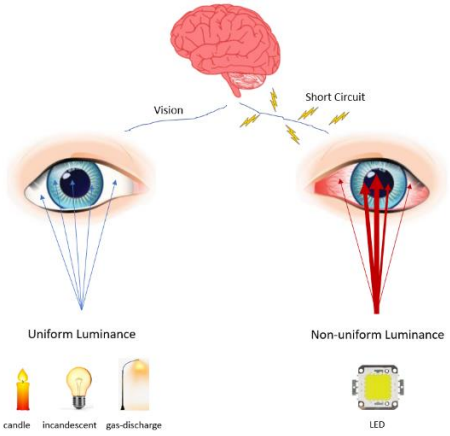


Figure 2 - Spatially Uniform v. Non-Uniform Radiation

Figure 3 is a diagram showing the categorization of radiation and shows that *light* and *illumination* are spatially isotropic radiation in the human visible portion of the electromagnetic spectrum. Electromagnetic radiation emitted by LEDs do meet the regulatory meaning of or comply with standards for the use of light as illumination.

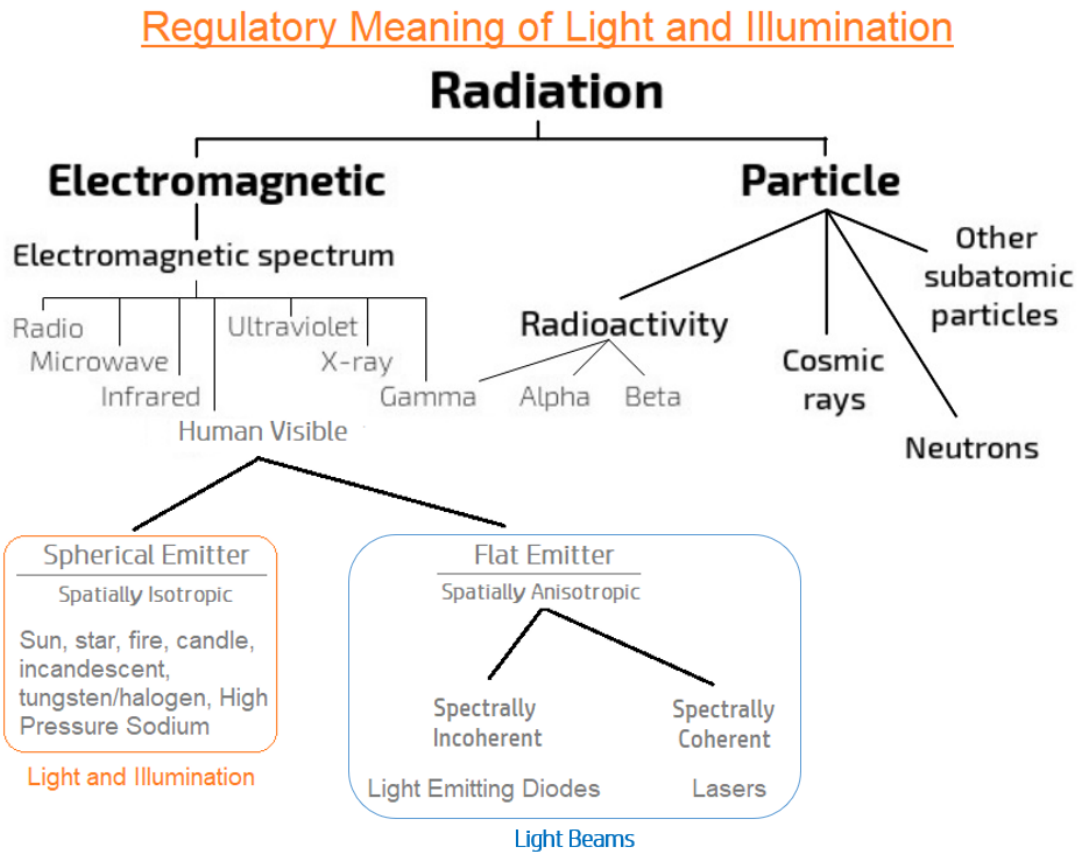
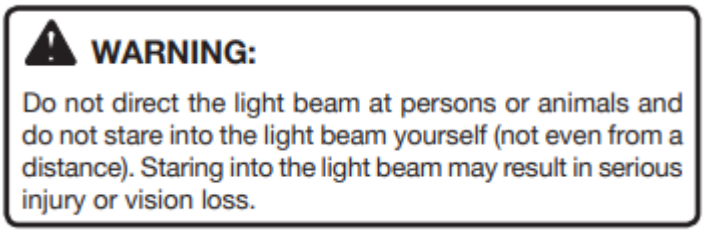


Figure 3 - Radiation Types

As an example of how dangerous LED electromagnetic radiation is, the operator's manual for the Ryobi P705 Flashlight includes the following: "WARNING: Do not direct the light beam at persons or animals and do not stare into the beam yourself (not even from a distance) Staring into the light beam may result in serious injury or vision loss."



The warning also refers to children, who along with infants are an identified high-risk population vulnerable to LED-exposure harm. Babies often lack an adult's automatic, self-protective aversion response to bright or intense light, and will stare directly at the source.

The first video example below shows how incandescent hazard lights work. They give a slow, general, soft warning and let people know that the vehicle is in an unusual situation without detracting from the task of driving or walking.

Non-LED Hazard Lights: https://youtu.be/DHJZTb7qXQo

Figure 4 - Non-LED Hazard Lights

The remaining videos show the misuse of technology, where flashing LED radiation devices do not carefully warn, but rather assault people, violating their civil rights, damaging their eyes, interfering with the functioning of their nerves, and endangering their lives.

Utility Truck: https://youtu.be/ma0hGwHivO4

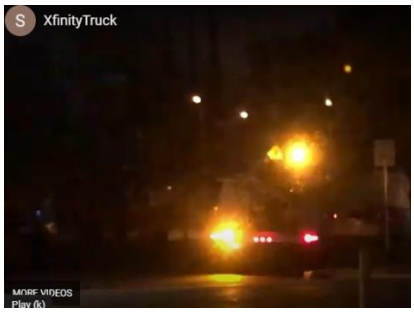


Figure 5 – Utility Truck

Highway Patrol: https://youtu.be/bhEkxtKbtks

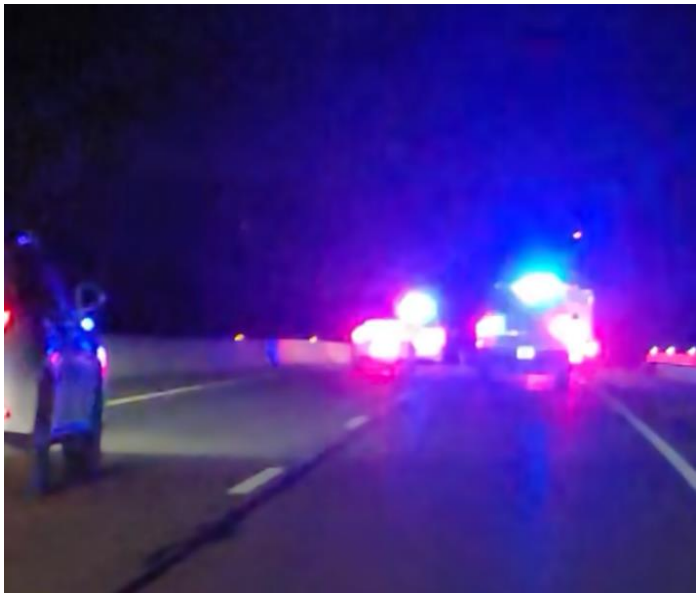


Figure 6 - Highway Patrol

Fire Truck: https://youtu.be/910_J5xhrTk

Figure 7 - Fire Truck

Tow Truck: https://youtu.be/cJKgMtXJ-lE

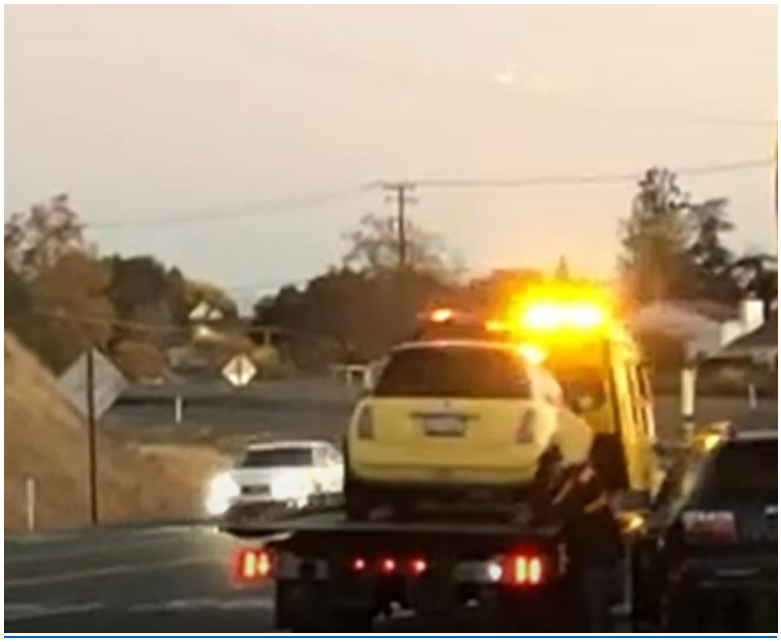


Figure 8 - Tow Truck

Ambulance: https://youtu.be/S6-wZDtTMfA

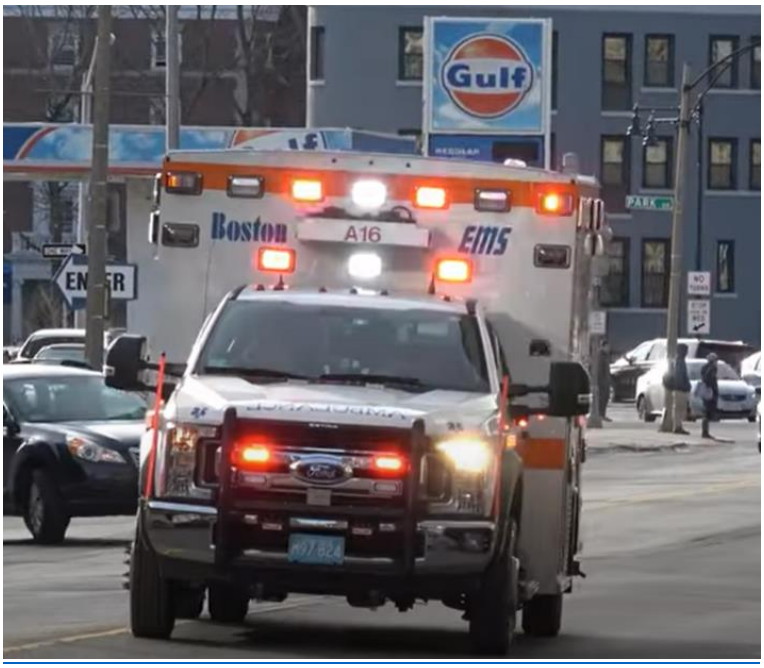


Figure 9 - Ambulance

Utility Truck: https://youtu.be/0MLDA6too1Q

Figure 10 - Utility Truck

Figure 11 is a diagram showing why the spatial distribution of LED radiation is to toxic and dangerous. The peak luminance of an LED can be hundreds of thousands or even hundreds of millions of nits, far exceeding human thresholds, and the non-uniform shape interferes with the human nervous system.

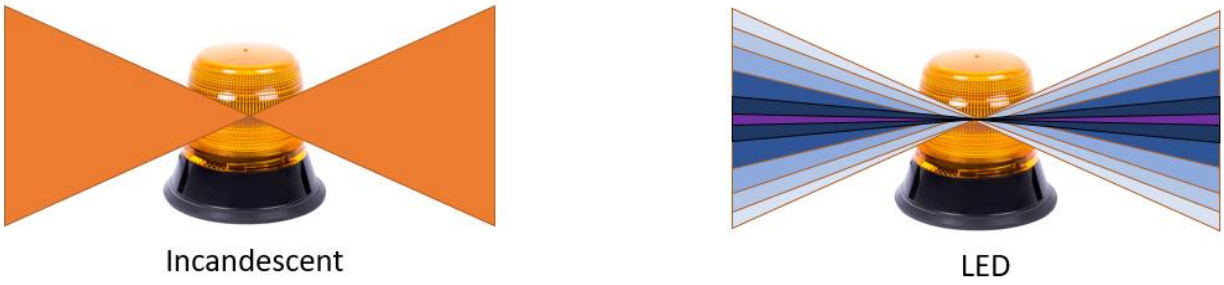


Figure 11 - Incandescent vs. LED Flashing Lights

In addition to the spatial characteristics of LED radiation, the spectral and temporal characteristics also make LED radiation dangerous. LEDs turn on and off immediately, giving the brain no time to adapt to change. An LED can also have a peak of 450nm blue wavelength that causes glare and eye damage.

NHTSA currently has no regulations for the quantity of LED flashing devices on a vehicle or in a geographic location, their flash rate, peak radiance, or protection for eyes, vision, or neurology and

NHTSA has made no effort to ensure that LED flashing lights do not violate the Americans with Disabilities Act.

Both human drivers and Artificial Intelligence drivers rely on sensors to receive input from the world about them and a communication channel to send that input to a processing center. LED flashing lights interfere with this system, degrading vision, and increasing the likelihood of vehicle crashes, injury, and death.

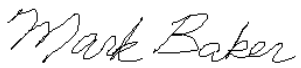
The result of exposure to LED radiation is immediate sickness in the form of headaches, nausea, eye pain, loss of balance, migraines, panic response, altered vision, epileptic seizures, disorientation, and other neurological disturbances. Each of these symptoms is being verifiably reported by an increasing number of individuals and constitute medical evidence of LED-induced harm. LED visible radiation exposure is causing catastrophic physical harm, subjecting at-risk individuals to illness and injury, and plunging formerly healthy, independent people into crisis levels of stress, hopelessness, psychological trauma, and persistent thoughts of suicide.

LED radiation is discriminatory because it interferes with human nerves and disrupts major life functions such as seeing, thinking, and concentrating for people with disabilities, such as those with epilepsy, autism, PTSD, migraines, bipolar disorder, and others. Electromagnetic LED radiation prevents safe access to public services such as roads, sidewalks, and government facilities. Use of LED radiation devices violates the federal Americans with Disabilities Act.

The ERSI study "*Effects of Emergency Vehicle Lighting Characteristics on Driver Perception and Behavior: Study Report*" is a worthwhile first attempt, but is insufficient in capturing the toxicity, hazards, and discriminatory nature of LED light beams, especially flashing LED light beams. The ERSI study is missing the source peak luminance specifications that were used in the study.

The key point from the ERSI study and from our own observations and research is that these high intensity LED flashing lights, now installed on practically every emergency vehicle in America, has made everyone less safe, and they must be eliminated from our roadways. We must return to using spatially isotropic devices with slow, low-to-high, smooth flashing patterns, or no flashing at all. LED light beams exceed human senses.

Sincerely,



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