Soft Lights Foundation

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January 17, 2022

BY EMAIL

John Bullough, Program Director
Light and Health Research Center, Icahn School of Medicine, Mount Sinai
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Re: LED Flashing Lights

Dear John Bullough,

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

The study that you authored for 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) LED devices are designed to capture driver attention (which is dangerous).
5) The photometric requirements for flashing lights have not been updated to include spatially anisotropic LEDs.
6) There are no upper limits for intensity in standards such as those from the Society of Automotive Engineers.
7) Detection times are better when using high-to-low flashing patterns inherent to incandescent, versus the on-off pattern of LEDs.
8) 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

[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

shape and extreme variability between the peak luminance and the edge luminance of LED light beams. Also missing is a detailed study how non-uniform luminance values and rapid flashing degrade vision.

MarieAnn Cherry is an adult who has epilepsy, a formally recognized disability, and who has been sickened by LED light beams many times. Her exposures to LED light beams, even for a fraction of a second, has led to hundreds of seizures resulting in broken bones, lost teeth, and psychological trauma. MarieAnn has researched the issue and has written up a synopsis of how the safety of LEDs has been ignored by the authorities.[3] MarieAnn's document also contains links to 40 studies on the toxic effects of LEDs.

While it is unethical to directly study whether a technology triggers a life-threatening seizure in humans by exposing the person to the possible trigger and it is also unethical to involuntarily subject humans to medical experiments,[4] a study does not necessarily have to be carried out in a laboratory. A study of verifiable reports of incidents related to LED light beam exposure is a valid study. MarieAnn has compiled a list of verifiable quotes from persons who have been injured by LED exposure.[5]

MarieAnn's efforts highlight the toxic effects of LED light beams on people with epilepsy, but the toxicity of spatially non-uniform electromagnetic visible radiation impacts all members of the public and all other creatures such as owls because of the way it interferes with the proper functioning of nerves, and the damage to the eye caused by chemical and thermal damage.

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.

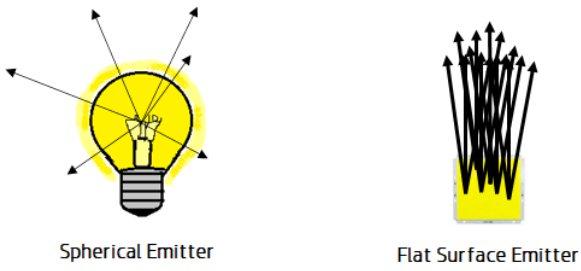


Figure 1 - Spherical vs. Flat Surface Emitter

[3] http://www.softlights.org/wp-content/uploads/2022/01/One-Third-of-us-at-Risk_-The-Medical-science-of-LEDs.pdf

[4] https://media.tghn.org/medialibrary/2011/04/BMJ_No_7070_Volume_313_The_Nuremberg_Code.pdf

[5] http://www.softlights.org/wp-content/uploads/2022/01/Quotes-from-individuals-harmed-by-LED-exposure.pdf

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

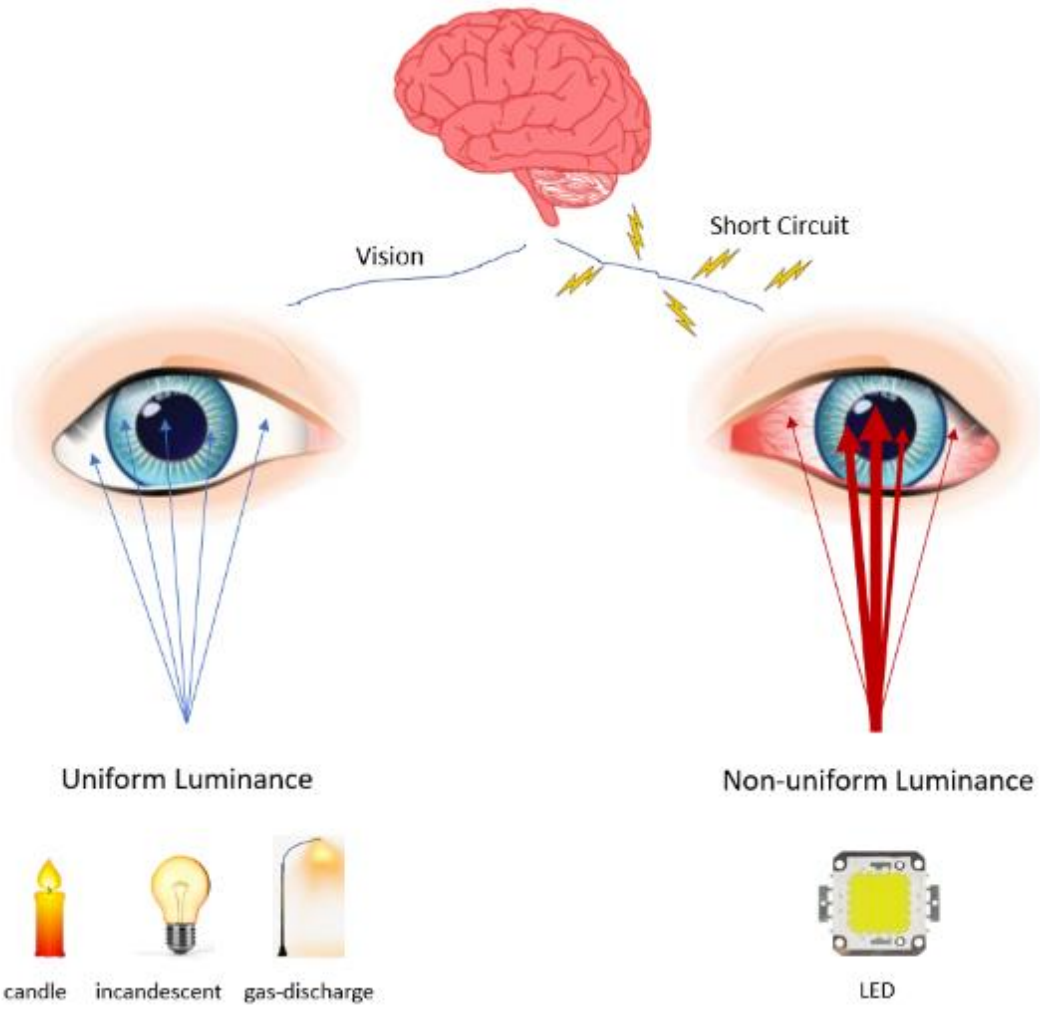


Figure 2 - Spatially Uniform v. Non-Uniform Radiation

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.

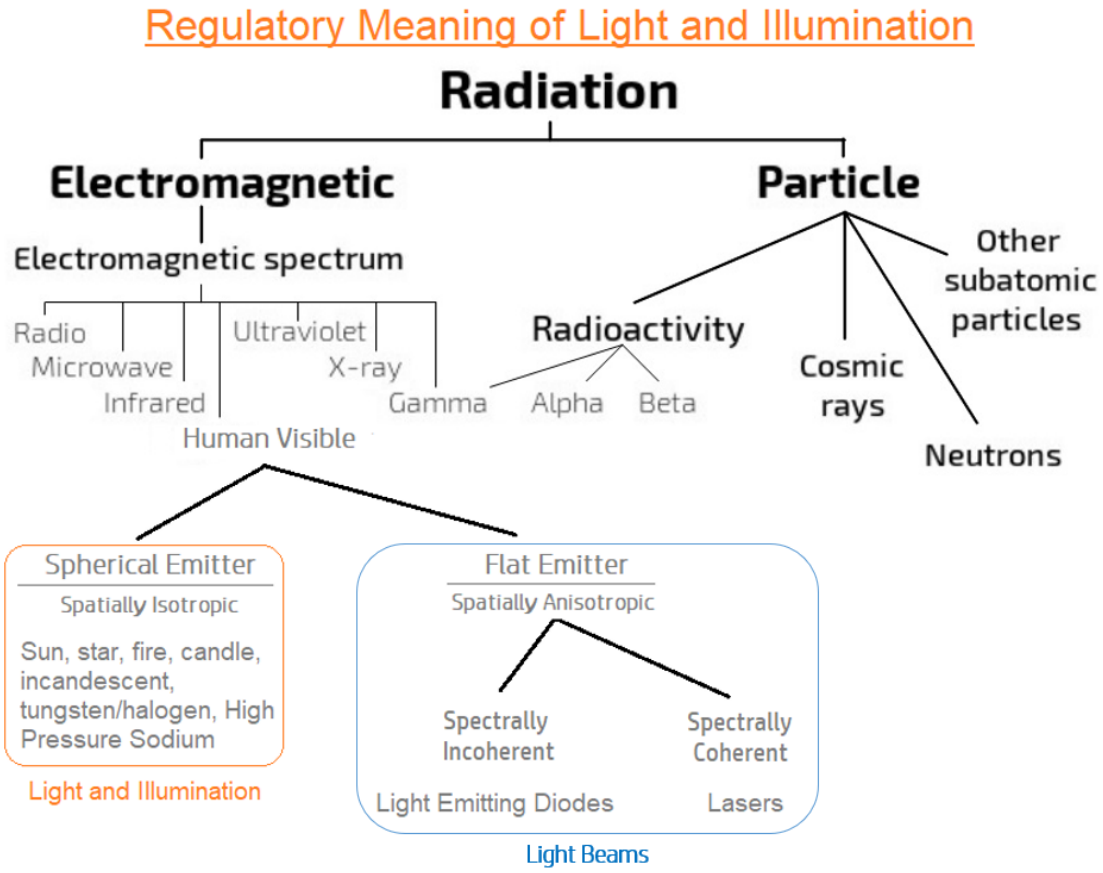
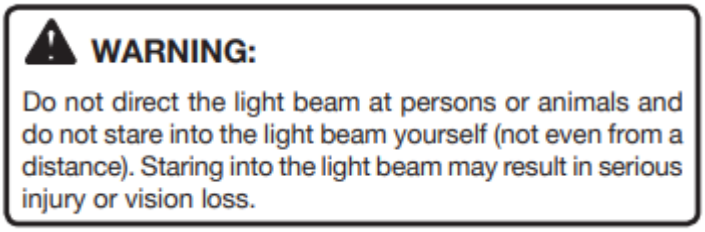


Figure 3 - Radiation Types

As an example of how dangerous LED 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 parenthetical "(not even from a distance)" indicates a high level of danger.



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.

Rectangular Rapid Flashing Beacon: https://youtu.be/KBltx0Argag

Figure 5 - RRFB

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

Figure 6 – Utility Truck

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

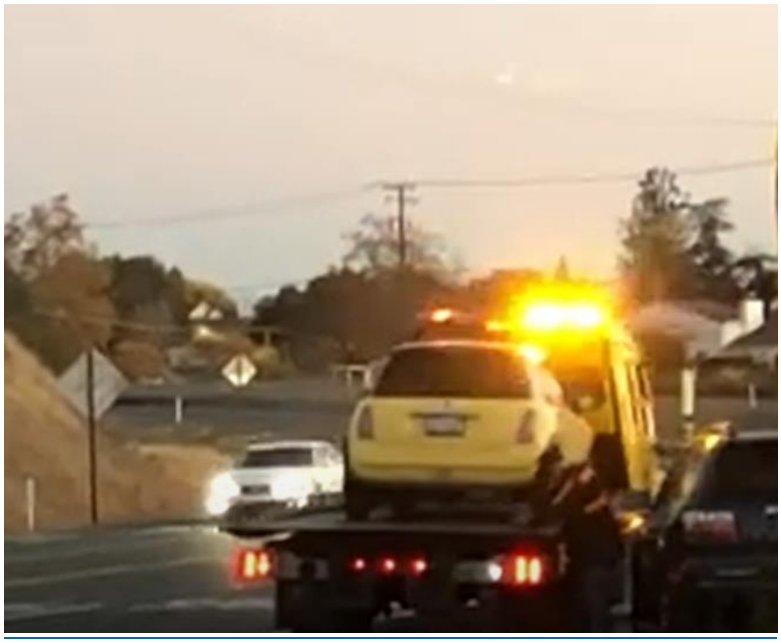


Figure 7 - Tow Truck

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

Figure 8 - Utility Truck

Unmarked Police Car from 2011: https://youtu.be/6c0EpVDXaKU

Figure 9 - Unmarked Police Car

Figure 10 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 and extreme variability of luminance interferes with the human nervous system.

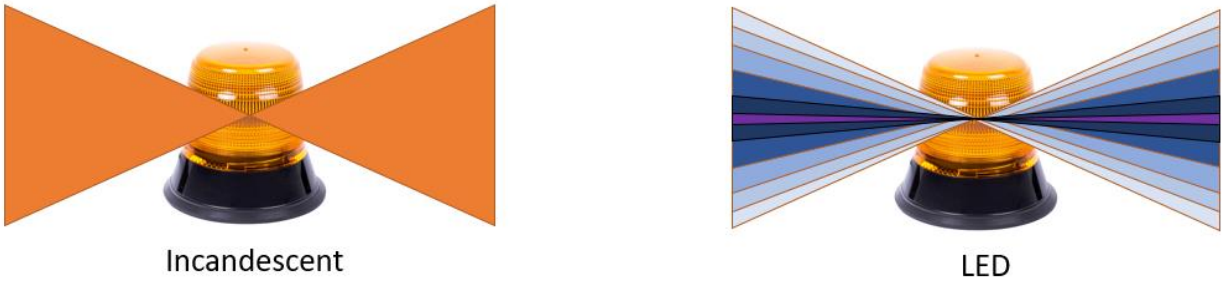


Figure 10 - Incandescent vs. LED Flashing Lights

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. The extreme variability between the exceedingly dense peak radiance and the edge radiance triggers seizures, causes migraines, interferes with human nerve functioning, reduces vision, increases agitation, and endangers the lives of the public and first responders.

Neither the FHWA nor NHTSA currently have regulations for the quantity of LED flashing devices, their flash rate, peak radiance, or protection for eyes, vision, or neurology and neither agency has made an 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 electromagnetic radiation devices violates the federal Americans with Disabilities Act.

A small number of people who have an outsized influence on society. You are one of those people. Your research and reports published during your tenure at the Rensselaer Polytechnic Institute Lighting Research Center and now at Mount Sinai have given cover to the LED Cartel to sell, install and operate toxic, hazardous, and discriminatory LED devices that have injured and harmed thousands or

millions of people. Your refusal to acknowledge the differences between a uniform emitter such as an incandescent and the non-uniform spatial shape and extreme luminance variability between the peak and edges of a flat surface emitter such as an LED has invalidated your research results but has allowed the industry to make billions of dollars. Your failure to correctly account for the spatial shape of LED devices in your research makes you liable for the injuries and discrimination caused by use of LED devices that relied on your research.

Sincerely,

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