

Germicidal UV Lighting Patents: Are You Protected?

December 8, 2020

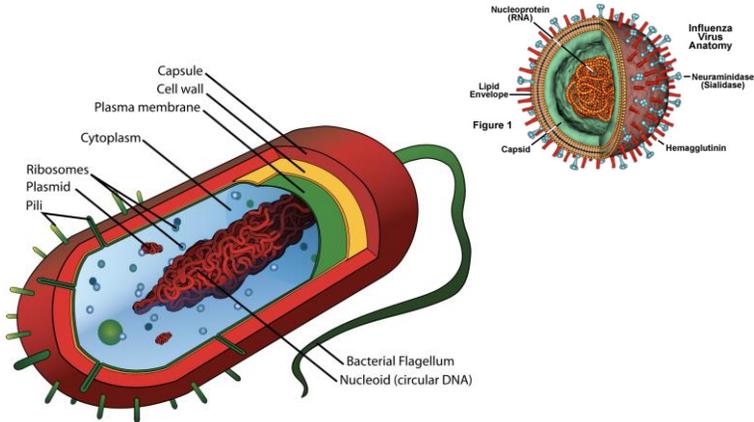
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[EXCERPTS FOR EdisonReport]

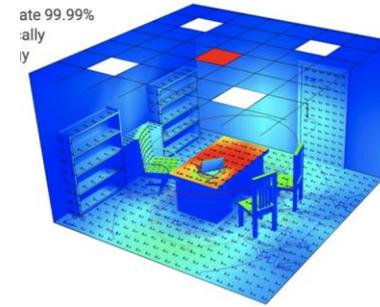


Introduction & Overview

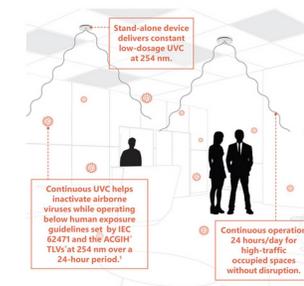
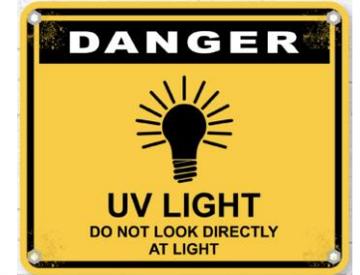
Bacteria vs. Viruses



Air vs. Surface Disinfection

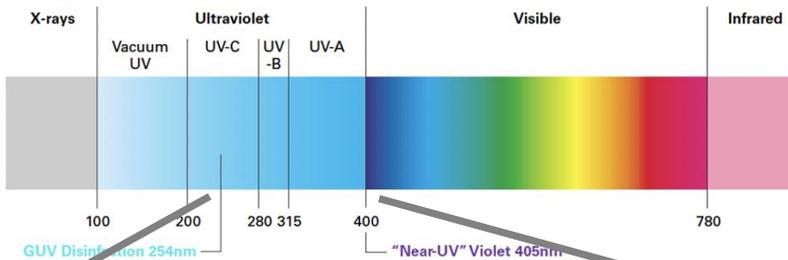


Human Hazards



Vacant vs. Occupied Space

UV-C vs. UV-A



222 vs. 254 vs. 365 vs. 405

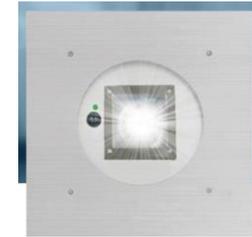
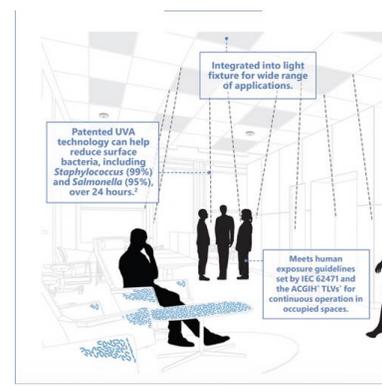
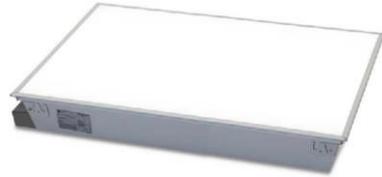
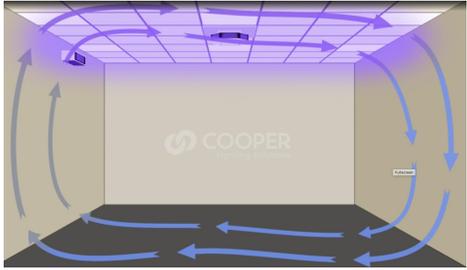


Lawsuits:
Patent vs. Class Actions
(False/Deceptive Advertising)

Safety Regulations/Standards

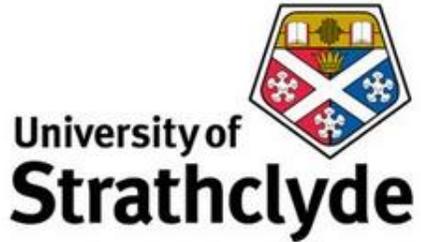


Commercial Products, Patents & IP Licensing



Legal Landscape

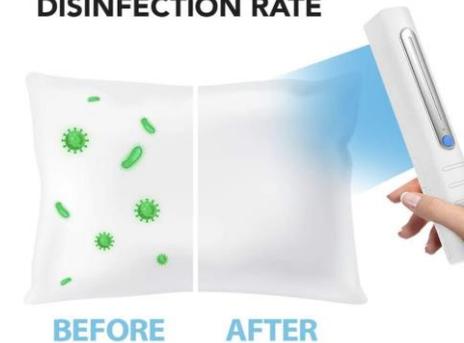
Patent Lawsuits



Class Action Lawsuits (Safety & False/Deceptive Advertising)



99.9% LAB-TESTED
DISINFECTION RATE



Background:

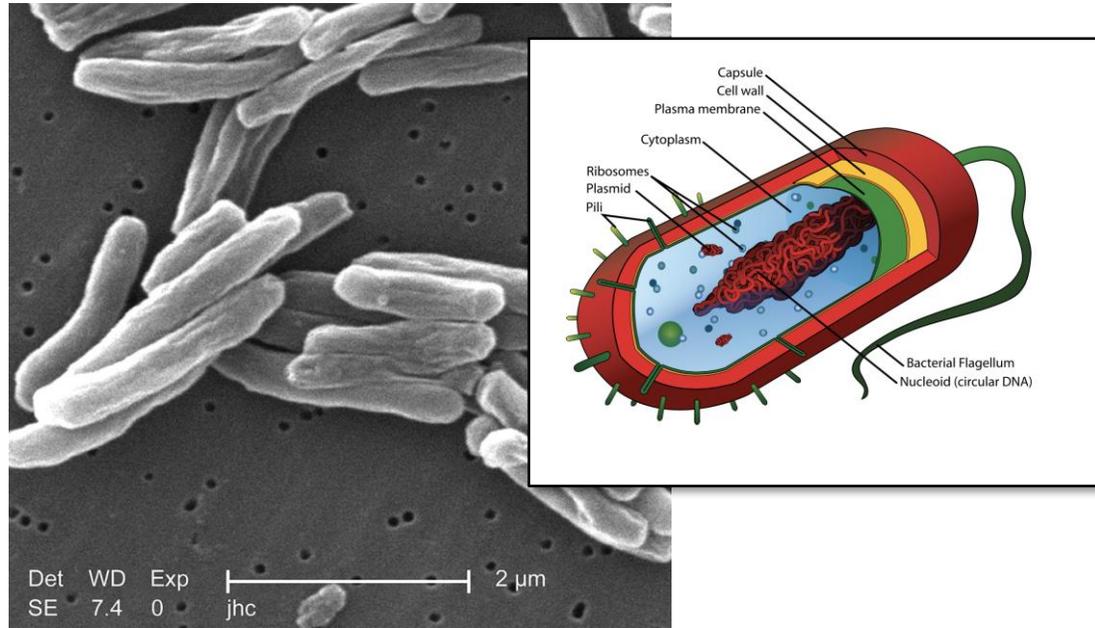
Bacteria vs. Viruses

UV Light

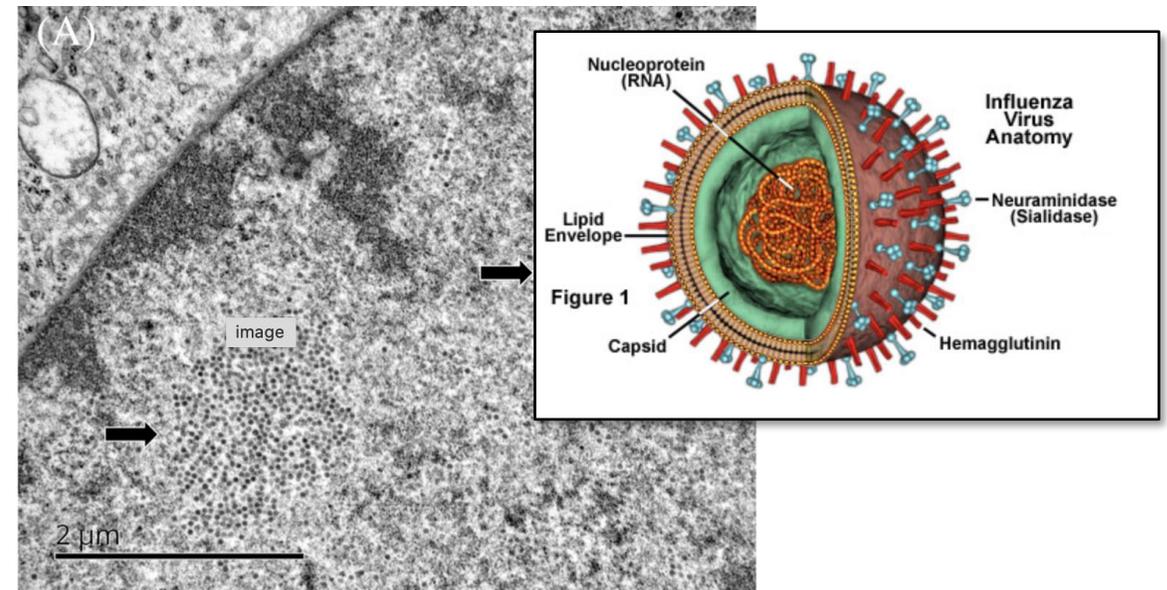
Germicidal UV Light

UV Safety

Bacteria versus Viruses

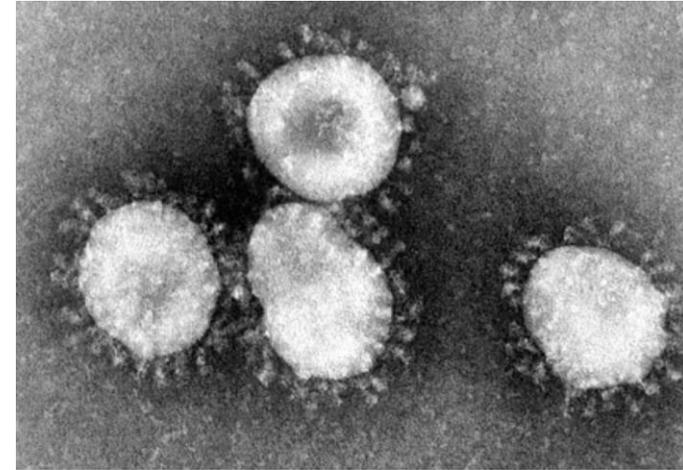
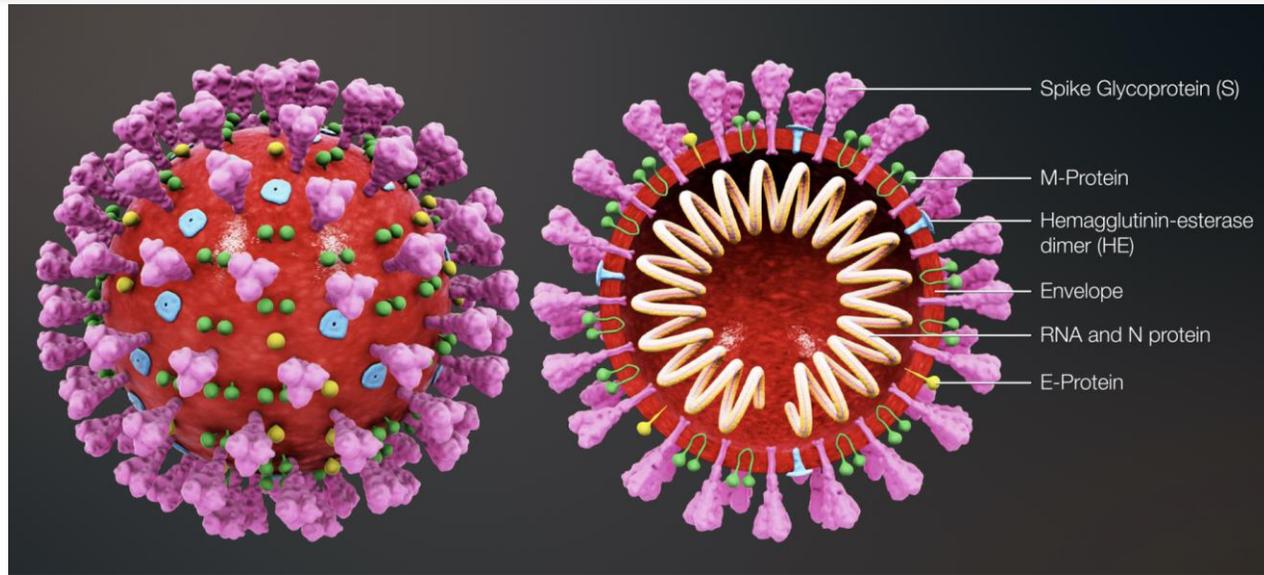


Bacteria: Single-cell micro-organisms that can be found virtually everywhere. Vital to maintain living world, but can be infectious (e.g., MTB, E-coli).



Viruses: Sub-microscopic, infectious parasites that, unlike bacteria, require a host to replicate via DNA/RNA. Examples include Influenza (flu) and Rhinovirus (a cold).

Coronaviruses



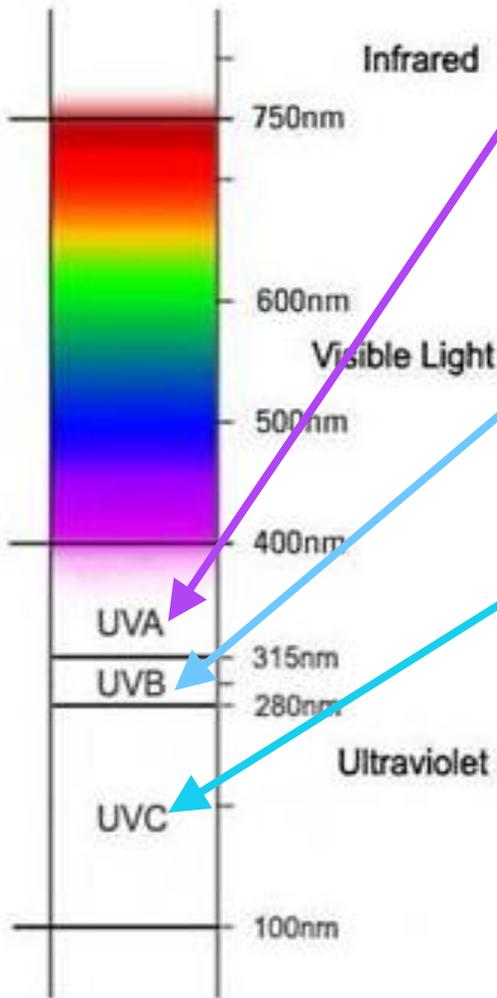
Size = ~ 120 nm = ~ 0.12 μ m

Coronaviruses, named for the crown-like projections, are a type of virus.

- (1) Severe Acute Respiratory Syndrome (SARS-CoV);
- (2) Middle East Respiratory Syndrome (MERS-CoV); and
- (3) SARS-CoV-2 [\rightarrow Covid-19]).

Spectrum and Ultraviolet (Germicidal) Light

Electromagnetic Spectrum



UVA – Long-wavelength UVA covers the range 315–400 nm. Not significantly filtered by the atmosphere. Approximately 90% of UV radiation reaching the Earth's surface. UVA is again divided into UVA-I (340 nm - 400 nm) and UVA-II (315 nm - 340 nm).

UVB – Medium-wavelength UVB covers the range 280–315 nm. Approximately 10% of UV radiation reaching the Earth's surface.

UVC – Short-wavelength UVC covers the range 100–280 nm. All solar UVC radiation is absorbed by the ozone layer.

UVC: Not ordinarily encountered. Although it can kill germs, it can also cause skin cancer and severely damage our eyes and even our DNA .

Methodology to Identify Relevant Germicidal Lighting Products & Patents

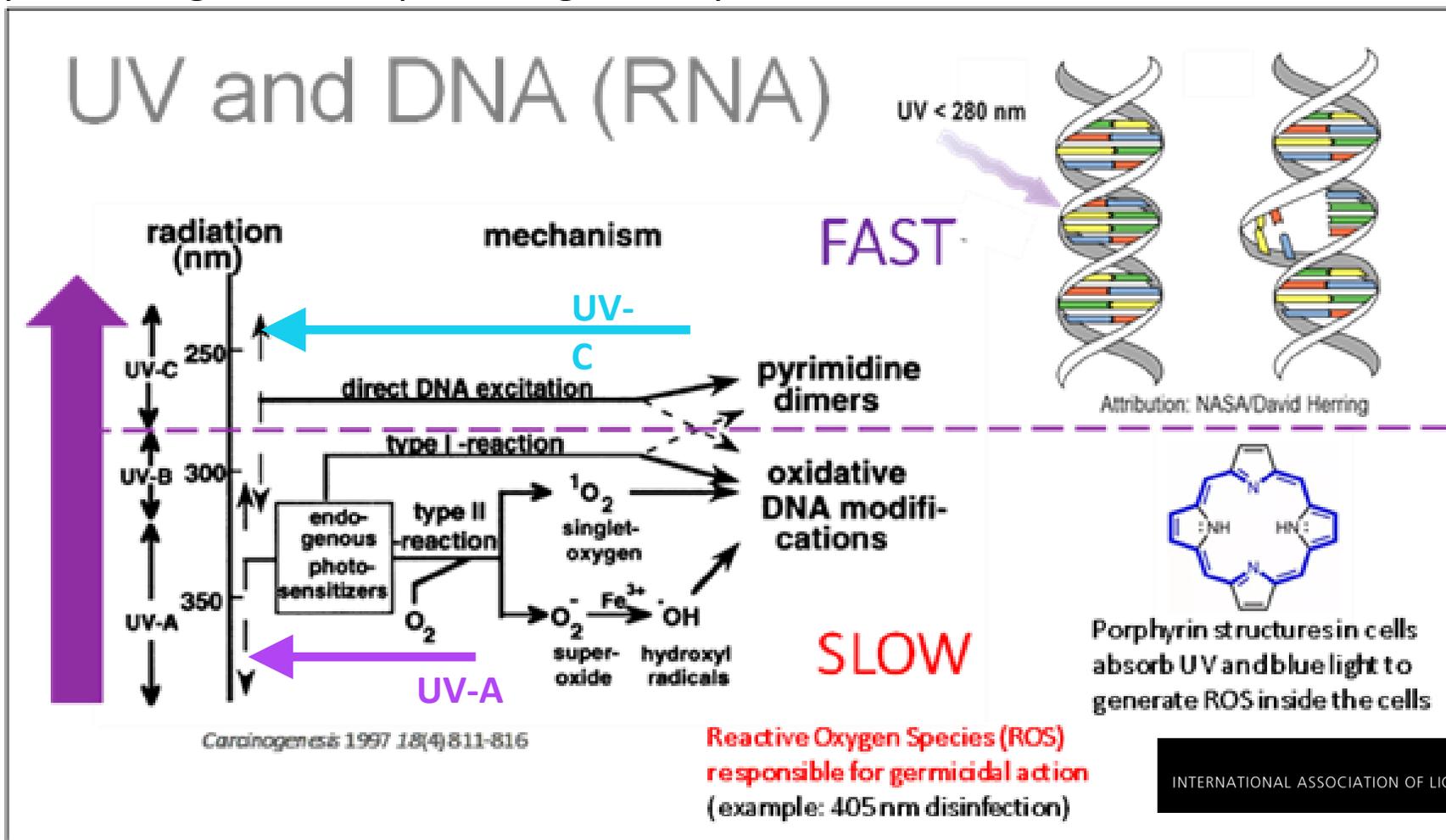
- (1) Manual searching of product descriptions referencing “patented” germicidal lighting technology
 - a) Focus on recent products and/or LED-based technology
- (2) Manual searching of USPTO patent database
 - a) Search terms: Light; fixture; UV-C/UVC; disinfection; sterilization; etc.
 - b) About 200 Patents—too many to summarize
- (3) Focus of talk: What does a lighting company need to know about this new field (from a tech, safety & legal perspective)
 - a) Multi-disciplinary: biology, physics, lighting and law

Light Sources for Germicidal Products

	Far UV-C 222 nm	UV-C 254 nm	UV-A 365 nm	405 nm
		✓		
		✓	✓	
		✓		
	✓ 	✓ 		
	Broad Spectrum UV-A + B + C ✓ 			
 		✓		

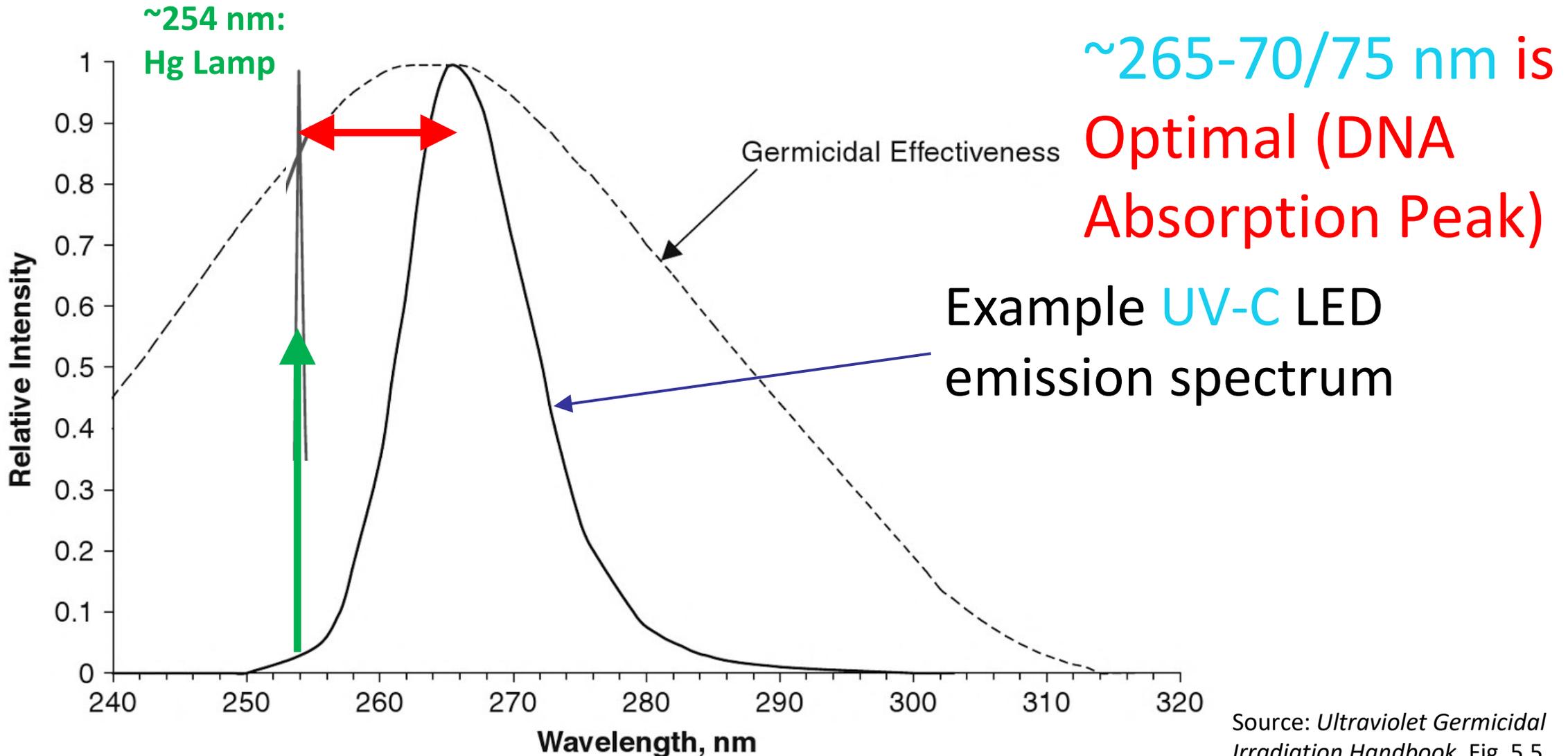
“Germicidal” UV Light (GUV)

- **UV-C** radiation is energetic enough to break bonds of DNA/RNA which disables virus from reproducing. Lower energy **UV-B/A** germicidal process generally too slow to be effective for deactivating viruses.



UV-C Germicidal Effectiveness (Bacteria)

- Well-known action spectrum curve based on *E.coli* effectiveness



UV-C Germicidal Effectiveness (Viruses)

- Considering RNA phage MS2 (surrogate for viruses incl SARS-CoV-2, more resistant to UV-C), highly cited 2015 study from Beck et al. (UC Boulder, NIST, others)
- Compared with *E.coli*, MS2 is deactivated by shorter wavelengths

Shorter may be Better? (MS2)

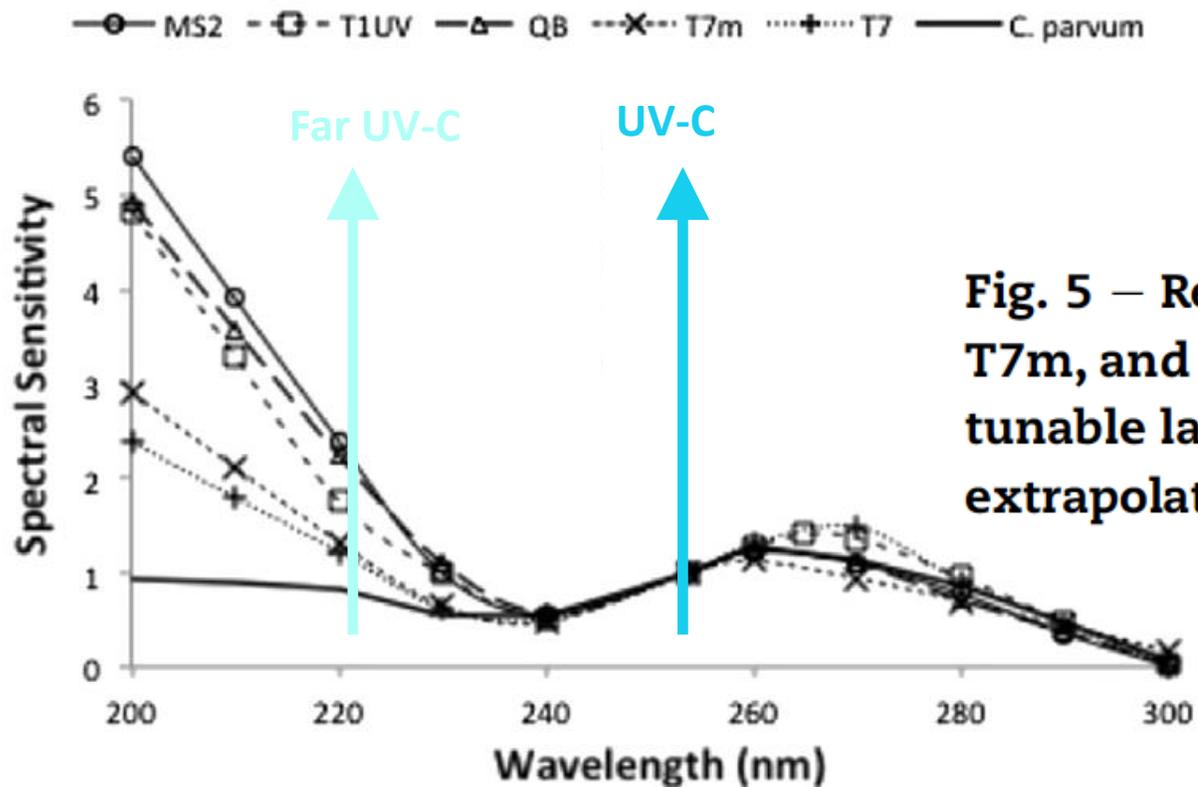
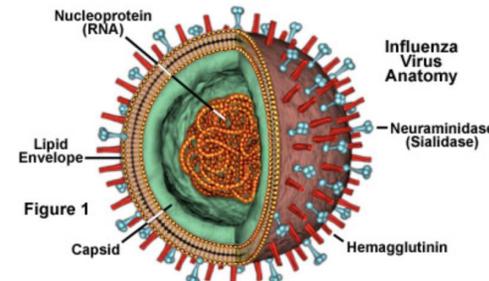
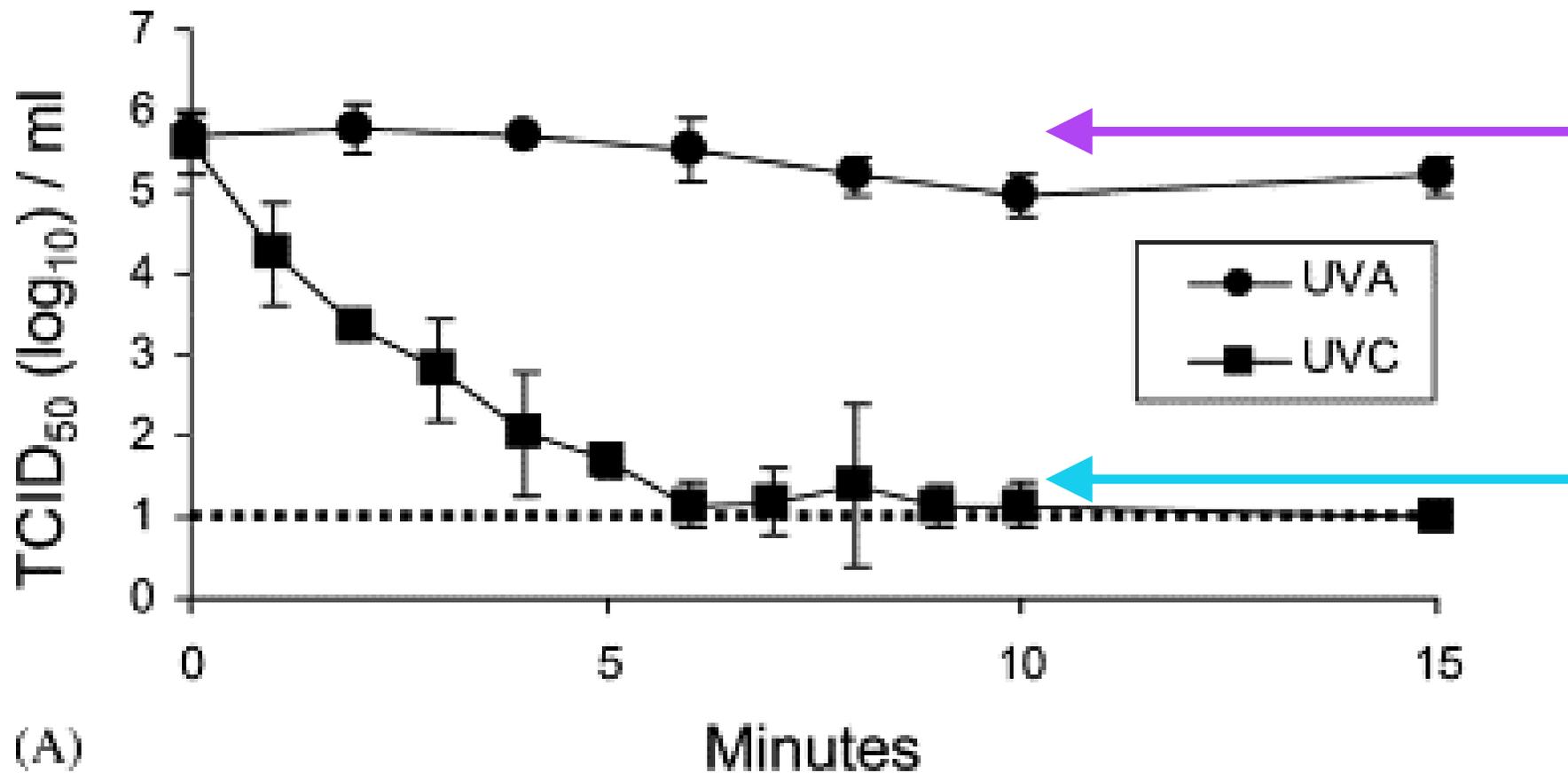


Fig. 5 – Relative spectral sensitivity of MS2, T1UV, Q Beta, T7m, and T7 Coliphages and *C. parvum* to UV light from the tunable laser. Note data points at 200 and 300 nm are extrapolated.



UV Effect on Coronaviruses [SARS-CoV]

- UV-C (at 254 nm) has been studied against other coronaviruses such as SARS-CoV (vs. UV-A at 365 nm)



Dangers of GUV

HONG KONG

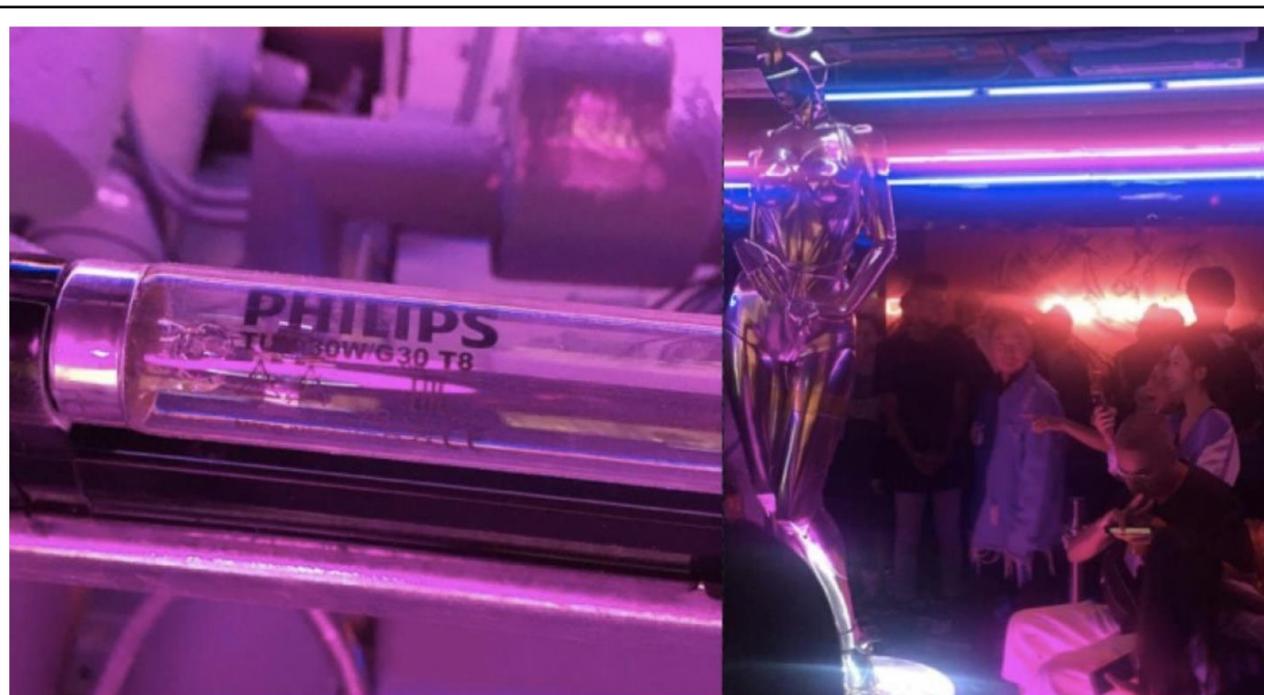
Partygoers left with burns and light sensitivity after Hypebeast event at The Landmark



by KAREN CHEUNG
17:50, 26 OCTOBER 2017



DJ: “The event was decked out in blue and pink neon lights all over the place.”



A close up of the lightbulb (L) and the venue of the event (R). Photo: James Acey.

Dozens of kindergarten pupils suffer burns to their EYES after their teachers turned on ultraviolet lights by mistake

- **More than 30 children in north China suffered burns to their eyes and face**
- **A teacher unintentionally left UV disinfection lamps on for 20 minutes**
- **The students experienced deteriorated eyesight, some reported nosebleeds**

By [KELSEY CHENG FOR MAILONLINE](#)

PUBLISHED: 06:17 EST, 5 December 2018 | **UPDATED:** 06:31 EST, 5 December 2018

Benefits of Safe GUV Lighting

RESEARCH ARTICLES

PUBLIC HEALTH REPORTS / JANUARY–FEBRUARY 2008 / VOLUME 123

Safety of Upper-Room Ultraviolet Germicidal Air Disinfection for Room Occupants: Results from the Tuberculosis Ultraviolet Shelter Study

EDWARD A. NARDELL, MD^a
SCOTT J. BUCHER, MA^b
PHILIP W. BRICKNER, MD^b
CHARLES WANG, BA^b
RICHARD L. VINCENT, BSc^b
KATHLEEN BECAN-McBRIDE,
EdD^c
MARK A. JAMES, PhD^d
MAX MICHAEL, MD^e
JAMES D. WRIGHT, PhD^f

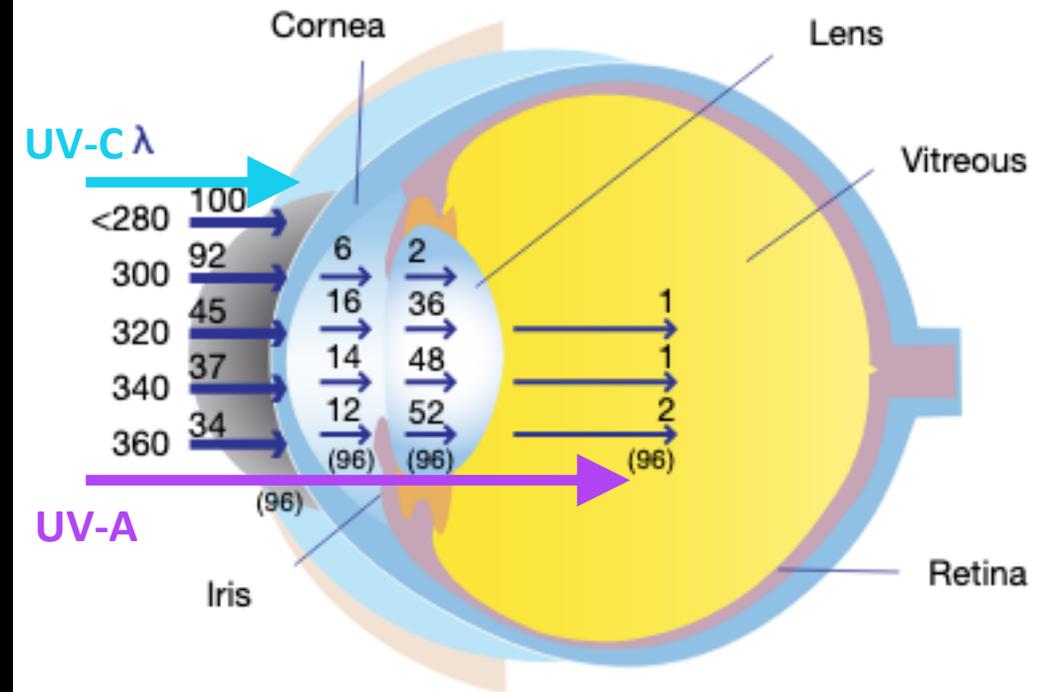
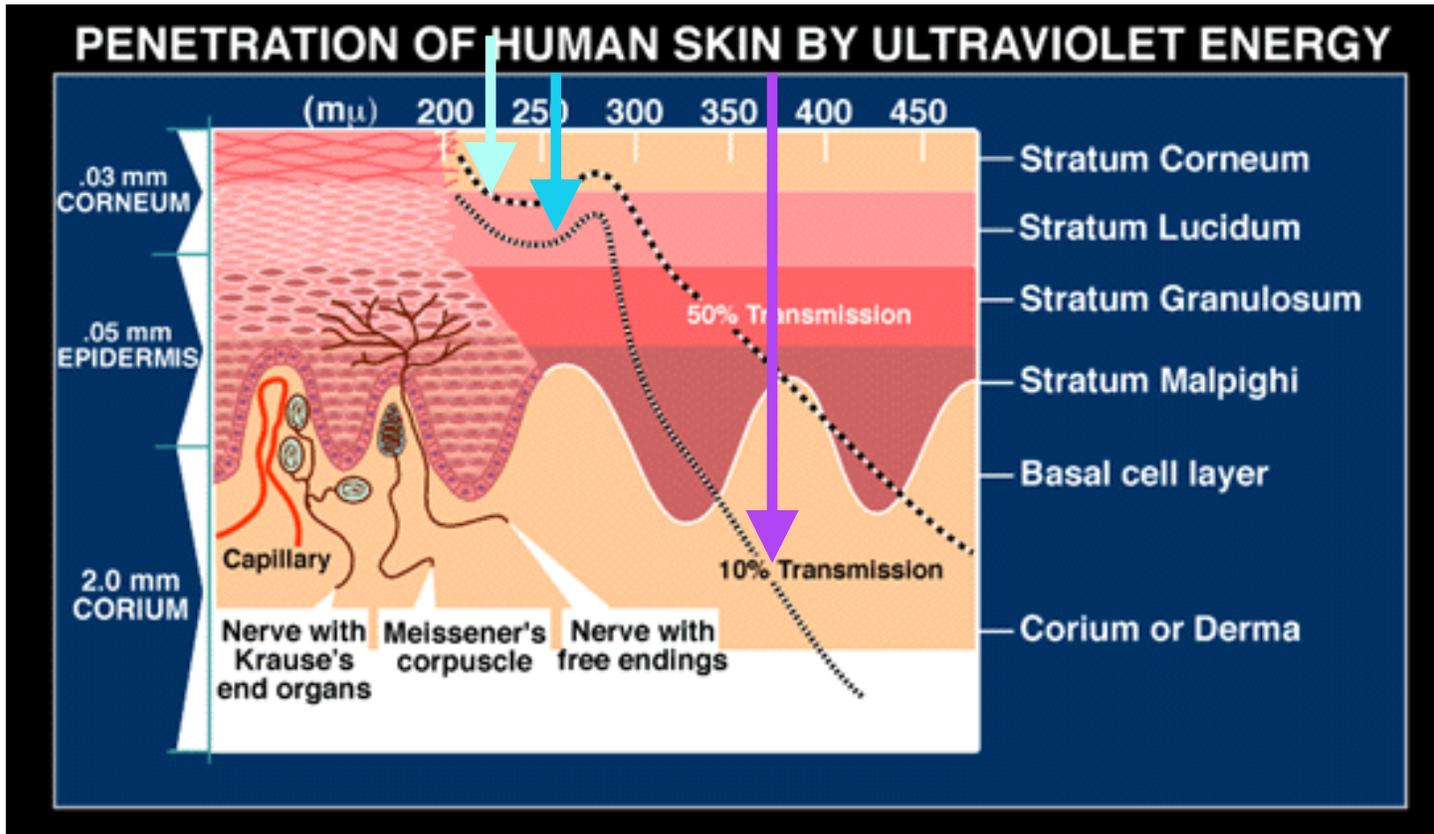


Tuberculosis Ultraviolet Shelter Study New York City shelter in a church basement. Note the ultraviolet germicidal irradiation fixtures located on the upper wall, directly below the vents. Photo: ©Randall Perry Photography.

Conclusions. These findings demonstrate that careful application of upper-room UVGI can be achieved without an apparent increase in the incidence of the most common side effects of accidental UV overexposure.

Ultraviolet Light: Human Hazards

- Different wavelengths have different penetration depths (e.g., 365 vs. 254 vs. 222 nm)

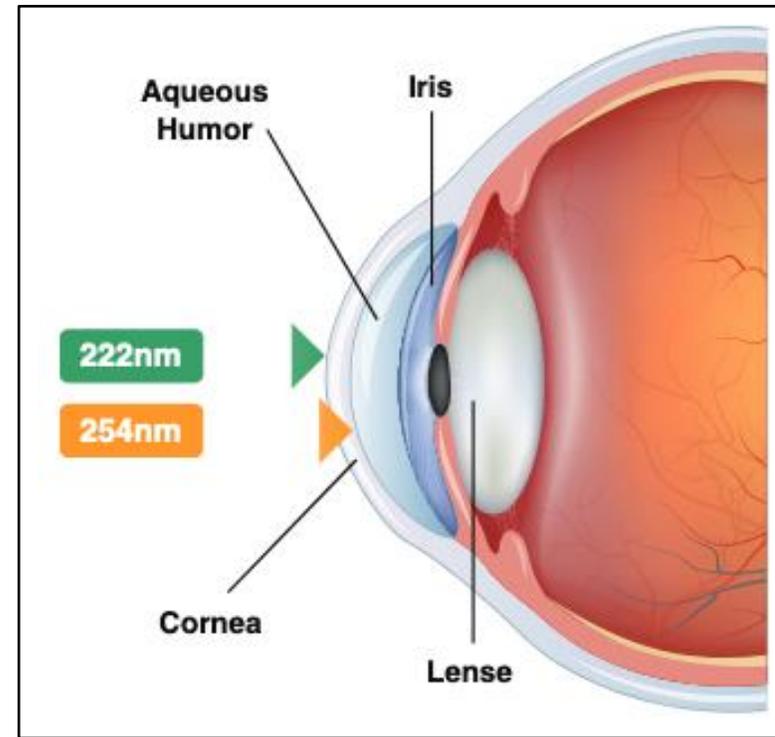
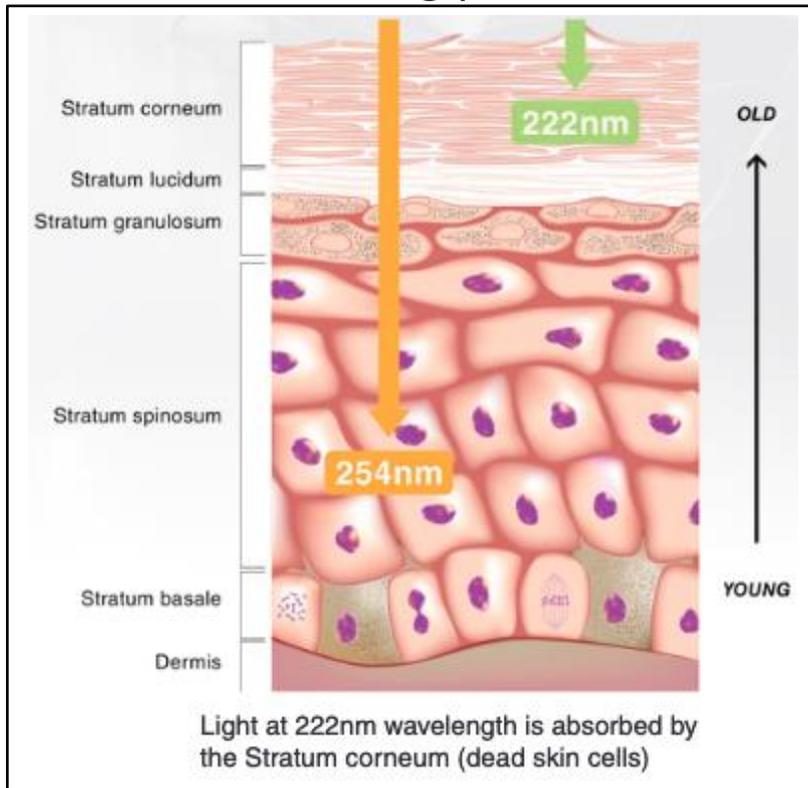


Sources: https://library.med.utah.edu/kw/derm/pages/meet_2.htm;

https://www.jnjvisioncare.co.uk/sites/default/files/public/uk/documents/tvci_uv_radiation_and_the_eye.pdf

UV-C Safety – 222 nm vs. 254 nm

- According to some sources, 254 nm penetrates deeper into human skin/eyes than 222 nm but have comparable germicidal effects.
- Some manufacturers advertising products emitting 222 nm (“Far UV-C”).



Source: <https://www.ushio.com/files/brochure/care222-filtered-far-uv-c-excimer-lamp-module.pdf> (citing Buonanno et al., J. Germicidal Efficacy and Mammalian Skin Safety of 222nm UV Light. Radiation Research. 2017 April; 187(4): 483-491; Kolozsvári et al., UV Absorbance of the Human Cornea in the 240- to 400-nm Range. Investigative Ophthalmology & Visual Science July 2002, Vol.43, 2165-2168)

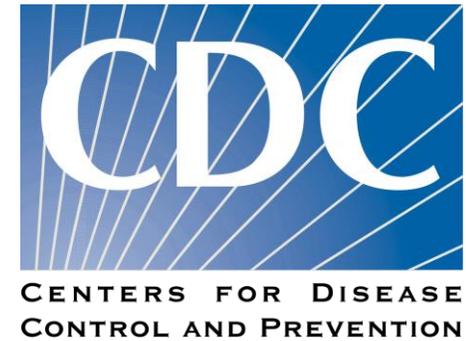
UV Effect on Coronaviruses [far UVC-222 nm]

- One recently published study (cited by FDA) studied far-UVC (222 nm) since 254 nm can be hazardous but “far-UVC light (207-222 nm) efficiently kills pathogens potentially without harm to exposed human tissues.”
- “Low doses of 1.7 and 1.2 mJ/cm² inactivated 99.9% of aerosolized coronavirus 229E and OC43, respectively. As all human coronaviruses have similar genomic sizes, far-UVC light would be expected to show similar inactivation efficiency against other human coronaviruses including SARS-CoV-2.”
- “Based on the beta-HCoV-OC43 results, continuous far-UVC exposure in occupied public locations at the current regulatory exposure limit (~3 mJ/cm²/hour) would result in ~90% viral inactivation in ~8 minutes, 95% in ~11 minutes, 99% in ~16 minutes and 99.9% inactivation in ~25 minutes.”

Source: Buonanno et al., Far-UVC light (222 nm) efficiently and safely inactivates airborne human coronaviruses, Scientific Reports (2020) 10:10285, available at <https://www.nature.com/articles/s41598-020-67211-2.pdf>

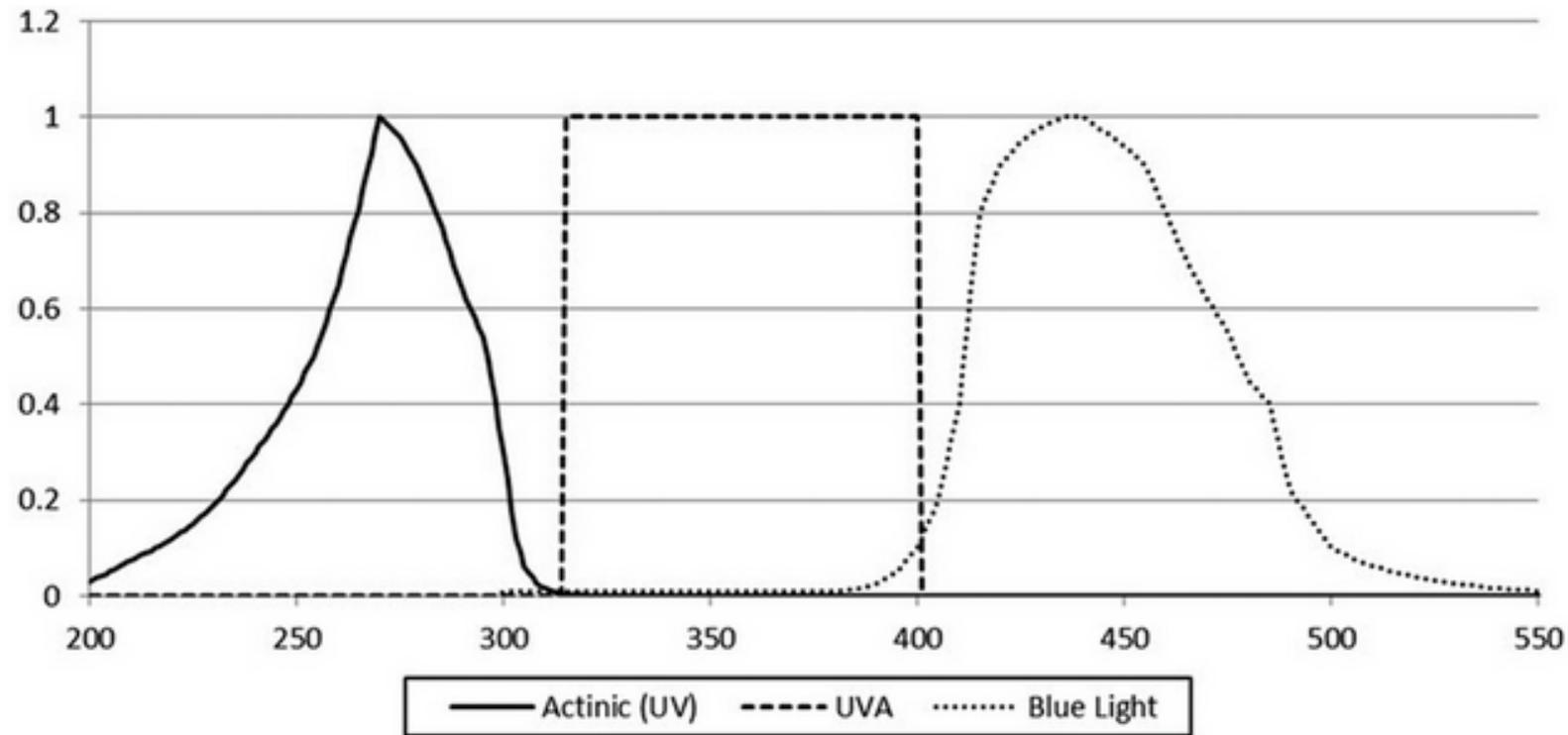
UV Safety – Guidelines & Regulations

- Potential guidelines and regulatory agencies implicated for GUV lighting devices and testing include:



IEC 62471

- IEC 62471 defines hazard levels for actinic UV (primarily UV-C and UV-B), UV-A, and blue light. Spectral weighting functions for each shown in the figure below (the closer to 1, the more impactful the relative effect associated with the wavelength range)



IEC 62471

- Human exposure limits are governed by wavelength, irradiance and exposure time
- IEC 62471 sets forth safety limits for irradiance (W/m^2) and radiant exposure (J/m^2) (irradiance of a surface integrated over time or irradiation) based upon 8 hrs. exposure in 24 hrs. Gives rough idea of power output limits.

Hazard	Safety Limit (Exempt)	Bio-effects
Actinic (200-400 nm)	0.001 W/m^2 30 J/m^2 (weighted)	Skin and eye
Near-UV (~300-400 nm)	10 W/m^2 288,000 J/m^2	Eye (cataracts)
Blue light (400-500 nm)	100 $\text{W}/\text{m}^2\text{-sr}$	Eye (photoretinitis)

Irradiance measured for skin and outer eye (lens, cornea) to radiation exposure.

Radiance measured to assess retinal exposure.

IES and IUVA Collaborate to Publish ANSI Standards for Measuring Ultraviolet C-Band (UV-C) Sources Used for Disinfection

New York, NY – The Illuminating Engineering Society (IES, est. 1906) and the International Ultraviolet Association (IUVA, est. 1999) have partnered to assemble experts in the measurement of ultraviolet C-band emissions (UV-C) to develop American National Standards for the measurement and characterization of UV-C device performance. UV-C devices for healthcare and personal care have proliferated in recent years, particularly during the COVID-19 pandemic, despite the absence of standards to enable accurate measurements and comparisons of the products. Through this partnership IES and IUVA aim to cooperatively promote awareness of and improve the application of ultraviolet “disinfection” technology in the healthcare system, initially through the development of standardized methods of measurement of ultraviolet “disinfection” products including UV lamps, luminaires and lighting/radiating systems, utilizing both discharge (e.g. low-pressure mercury and xenon) and solid-state (e.g. light-emitting diode) technologies.

FDA

- Warns that direct exposure to UVC required for inactivation. On surfaces, radiation may be blocked (dust, other contaminants).
- Warns that “currently there is limited published data about the wavelength, dose, and duration of UVC radiation required to inactivate the SARS-CoV-2 virus.”
- Warns that “[t]here have been reports of skin and eye burns resulting from improper installation of UVC lamps in rooms that humans can occupy.”
- Has published “Enforcement Policy for Sterilizers, Disinfectant Devices, and Air Purifiers During the Coronavirus Disease 2019 (COVID-19) Public Health Emergency: Guidance for Industry and FDA Staff” (March 2020) at <https://www.fda.gov/media/136533/download>. On UV disinfecting devices:

UV disinfecting devices are devices that use UVA or UVC light to produce a germicidal effect. They are intended to augment disinfection of health care environmental surfaces after manual cleaning has been performed. UV disinfecting devices include UV radiation chamber disinfection devices, which are regulated as Class II devices under 21 CFR 880.6600 (product code OSZ).⁸

- EPA does not routinely review safety or efficacy claims of “pesticidal devices” defined as “an instrument or other machine that is used to destroy, repel, trap or mitigate any pests, including bacteria and viruses.” See 40 CFR § 152.500(b).
- However, EPA notes:

Selling or distributing pesticidal devices with false or misleading claims about their safety or efficacy may subject the seller or distributor to penalties under FIFRA.

Note: The claim “Kills SARS-CoV-2” may be true and not misleading where a device has been tested against the coronavirus SARS-CoV-2. “SARS-CoV-2” refers to a virus. “COVID-19” refers to a disease and diseases cannot be “killed.” Therefore, the claim “Kills COVID-19” is always considered false and misleading.

Commercial UV Lighting Products & Patents:

Cooper Lighting;

GE Current;

Signify;

Acuity/Puro/Violet Defense;

Applied UV/SteriLumen/Axis;

University Patents

Types of Light Sources for GUV Products

- Most products designed for **either surface/object or air** disinfection.
- **Low-pressure mercury lamps**: Historically most common, emission peak of 254 nm.
- **Far-UVC lamps**: Also called “excimer lamps,” e.g., krypton-chloride, emission peak of 222 nm.
- **Pulsed xenon lamps**: Emit short pulses of broad spectrum light including UV and others, then filtered to emit largely UVC. Have been employed in hospitals to treat surfaces with no one occupying space.
- **LEDs**: Becoming more commonly available. Currently available or upcoming products have peak wavelengths including: 222 nm (far-UVC, potentially safer), 254 nm (historical GUV peak), 265 nm (one of most effective peaks for certain pathogens).
 - **Potential advantages**: No mercury, lifetime, improving technology, selectable wavelength peaks without filters, highly controllable (e.g., low power may allow for occupancy during use)
 - **Potential disadvantages**: Small surface area and higher directionality -> less coverage area, initial costs, less mature.

Existing or Upcoming Commercial Products



Light Sources for Germicidal Products

	Far UV-C 222 nm	UV-C 254 nm	UV-A 365 nm	405 nm
		✓		
		✓	✓	
		✓		
	✓ 	✓ 		
	Broad Spectrum UV-A + B + C ✓ 			
 		✓		

Air Disinfection: Occupied Space with UV-C

GAC GERMICIDAL AIR CEILING MOUNT

The GAC Germicidal UV Air Ceiling Mount is ideal for smaller spaces with walls greater than 6' apart and on ceilings above 9'.



Ideal for
RETAIL, COMMERCIAL, EDUCATION AND HOSPITALITY

GAW GERMICIDAL AIR WALL MOUNT

The GAW Germicidal UV Air Wall Mount is ideal for larger spaces with walls that are greater than 20' apart and with ceilings greater than 9'.



Ideal for
RETAIL, COMMERCIAL, EDUCATION AND HOSPITALITY



Featured
GUV Air: GAW-2-1GUV20W-UNV-R1-W and 22GAC-4GUV9W-UNV-R1-W
GUV Surface: 24GTR-WGD-4GUV4-R1
General Lighting: 24FP4740C

Fail-Safe GUV Disinfecting Solutions 6



Sources:

<https://www.cooperlighting.com/content/dam/cooper-lighting/brands/fail-safe/brochures/fail-safe-guv-disinfecting-brochure.pdf>

Air Disinfection: **Occupied** Space with **UV-C**

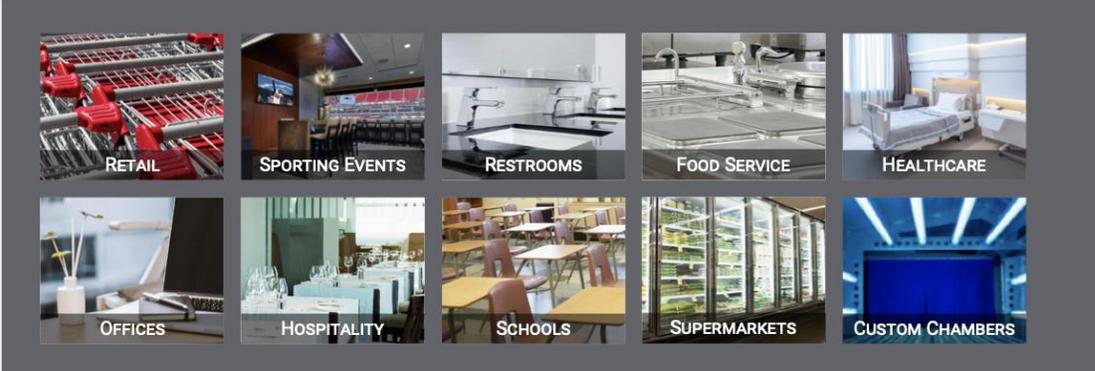


Surface Disinfection: **Vacant** Spaces with **UV-C**

Surface Disinfection - Applications

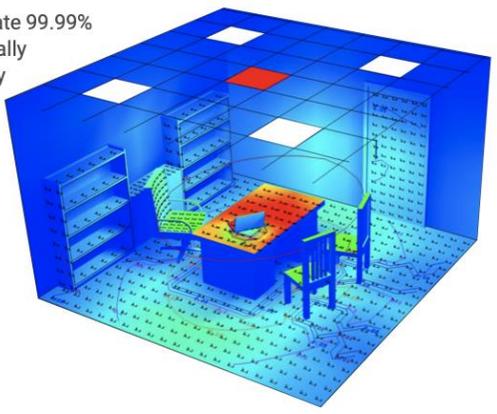
DEAR MICROBES,
YOU DON'T STAND
A CHANCE.

Cooper Lighting Solutions' GUV disinfection solutions take the guesswork out of disinfecting, getting the job done quickly and effectively.



Planning GUV - Surface Disinfection in a Private Office

- Every pathogen tested to date is susceptible to UV-C and the dosing needed to eliminate these pathogens is known.
- Our system is powerful - designed to eliminate 99.99% of pathogens. This is based upon scientifically proven dosing – the product of UV-C energy over a period of time. Typically, the room surfaces are disinfected in less than 20 minutes!
- Cooper Lighting's team of experts have created optical tools to effectively determine proper fixture type and placement to maximize the disinfection.
- Using these outputs, we can effectively determine the time needed to operate the GUV system to eliminate the pathogens.



GUV Fixtures - Surface Disinfection

-  **GLR** GERMICIDAL UV LOUVERED RECESSED **Pg. 9**
-  **GSL** GERMICIDAL UV STRIPLIGHT **Pg. 10**
-  **GH** GERMICIDAL UV HIGHBAY **Pg. 11**
-  **GUC** GERMICIDAL UV UNDERCABINET **Pg. 12**
-  **GTR** GERMICIDAL UV TROFFER **Pg. 13-14**

Click to visit page

Fail-Safe GUV Disinfecting Solutions 8



Sources:
<https://www.cooperlighting.com/content/dam/cooper-lighting/brands/fail-safe/brochures/fail-safe-guv-disinfecting-brochure.pdf>

GE Current (for **Occupied Rooms**)

- Two **LED** products under the 365DisInFx brand:
UV-A (365 nm) and **UV-C (254 nm)**.
- **UV-A**: disinfecting surfaces;
UV-C: disinfecting air
- **UV-C** puck, advertised as predicting a 90% reduction in < 3 hrs and 99% reduction in < 6 hrs in SARS-COV-2.
- **UV-C** puck advertised to work in occupied rooms, not limited to upper air.

365DisInFx[™]
UVA technology
Surface Disinfection

UVA solutions can help reduce bacteria and fungi on surfaces. Our in vitro testing has shown significant reductions in common pathogens associated with hospital-acquired infections (HAIs), such as MRSA, *Staphylococcus aureus*, *Enterococcus faecalis*, *Escherichia coli*, *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, *Candida albicans* and *auris*.²

UVA PRODUCTS

Integrated into light fixture for wide range of applications.

Patented UVA technology can help reduce surface bacteria, including *Staphylococcus* (99%) and *Salmonella* (95%), over 24 hours.²

Meets human exposure guidelines set by IEC 62471 and the ACGIH[®] TLVs[®] for continuous operation in occupied spaces.

365DisInFx[™]
UVC technology
Air Disinfection

UVC solutions can help reduce viruses in air. Based on testing using a bacteriophage MS2 model system, Current predicts that 365DisInFx[™] UVC technology will provide 99% inactivation with less than 6 hours of exposure for seasonal coronaviruses, including SARS-CoV-2, the virus that is known to cause COVID-19, when used as directed.¹

UVC PRODUCTS **UVC FAQs**

Stand-alone device delivers constant low-dosage UVC at 254 nm.

Continuous UVC helps inactivate airborne viruses while operating below human exposure guidelines set by IEC 62471 and the ACGIH[®] TLVs[®] at 254 nm over a 24-hour period.¹

Continuous operation 24 hours/day for high-traffic occupied spaces without disruption.

¹ View UVC Testing, Lab Results & Notes

GE Current: UV-A (365 nm)

Patented UVA technology can help reduce surface bacteria, including *Staphylococcus* (99%) and *Salmonella* (95%), over 24 hours.²



365DisInFx™ LBU Series UVA Technology

Current's 365DisInFx™ LBU Series Recessed LED Luminaires offer a conventional look similar to the LBT Series, but with significantly more capability. In addition to delivering a smooth uniform lit appearance with LED technology, LBU series also provides Current's 365DisInFx™ disinfection lighting technology in areas where both conventional light is needed and people are present.

Features

- Helps reduce the potential spread of bacteria, mold and fungi on surfaces
- Meets human exposure guidelines set by IEC 62471 and the ACGIH® TLVs® for continuous operation in occupied spaces
- 365nm UV-A for continuous disinfection of occupied spaces
- Shown to reduce a number of common bacteria (up to 99.7%)*
- White light for general illumination
- 365DisInFx™ UVA technology is virtually invisible with no impact on CRI or CCT
- Available with White Antimicrobial Paint Finish

GE Current: UV-A (365 nm)

- Advertised not only for bacterial reduction but also MS2 (proxy for viruses) on surfaces. Unlike UV-C product, however, no advertisement for predicted reduction in SARS-COV-2.

Current's 365DisInFx™ LBU Series Recessed LED Luminaires offer a conventional look similar to the LBT Series, but with significantly more capability. In addition to delivering a smooth uniform lit appearance with LED technology, LBU series also provides Current's 365DisInFx™ UVA disinfection lighting technology in areas where both conventional light is needed and people are present. Lab and clinical testing has shown this product has the ability to significantly reduce HAI-causing pathogens including MRSA, bacteriophage MS2, Staphylococcus aureus, Enterococcus faecalis, Escherichia coli, Acinetobacter baumannii, Pseudomonas aeruginosa, Candida albicans and auris.

American Journal of Infection Control 48 (2020) 337–339



ELSEVIER

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Brief Report

Efficacy of an ultraviolet-A lighting system for continuous decontamination of health care–associated pathogens on surfaces

Scott H. Livingston MD^a, Jennifer L. Cadnum BS^b, Kevin J. Benner BS^c, Curtis J. Donskey MD^{a,d,*}

^a Case Western Reserve University School of Medicine, Cleveland, OH

^b Research Service, Louis Stokes Cleveland Veterans Affairs Medical Center, Cleveland, OH

^c Current, powered by GE, Cleveland, OH

^d Geriatric Research, Education, and Clinical Center, Louis Stokes Cleveland Veterans Affairs Medical Center, Cleveland, OH



GE Current: UV-A (365 nm)

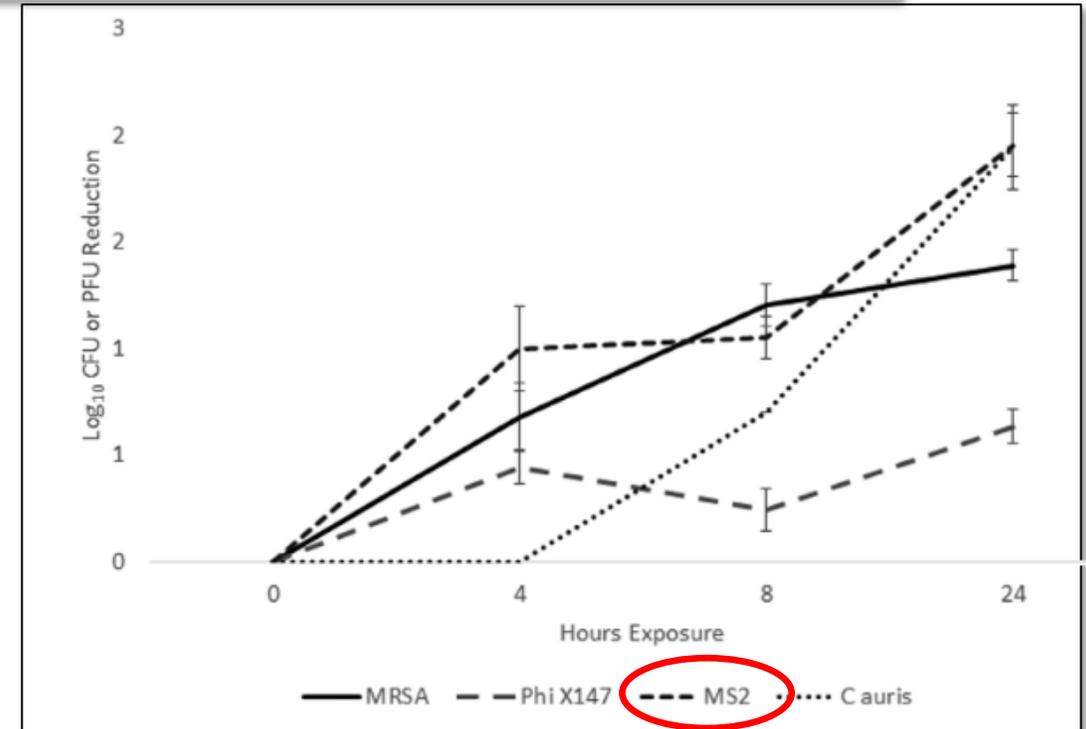
Cited source (Livingston et al. 2020):

We found that ultraviolet-A (UV-A) light exposure resulted in a modest reduction in recovery of methicillin-resistant *Staphylococcus aureus* (MRSA), *Candida auris*, bacteriophage MS2, and bacteriophage Phi X174, but not *Clostridioides difficile* spores, on steel disk carriers. Four hours of UV-A exposure from a ceiling light fixture resulted in a significant reduction in pathogenic microorganisms recovered from in-use medical equipment. These findings suggest that UV-A could be useful as a means to provide continuous low-level decontamination of surfaces in health care facilities.

Safety:

photobiological hazard to humans. According to the manufacturer, a person exposed to the maximum irradiance of the UV-A light system at 85 cm from the light source for 8 hours would receive total near and actinic UV-A doses equivalent to direct mid-day sunlight exposures of 2 hours and 17 minutes and 2 minutes and 40 seconds, respectively. If

Source: Livingston et al., Efficacy of an ultraviolet-A lighting system for continuous decontamination of health care-associated pathogens on surfaces, Am. J. Infection Control 48 (2020) 337-339



GE Current: UV-C (254 nm)

Technology: Current has completed in-situation testing of 365DisInFx™ LPU Series devices on the aerosolized virus, bacteriophage MS2.* Bacteriophage MS2 is a nonenveloped virus that is commonly used as a surrogate for viruses that are pathogenic to humans. MS2 is more resistant than enveloped viruses to UVC. These results predict a 1-log reduction (90%) in less than 3 hours or a 2-log reduction (99%) in less than 6 hours for seasonal coronaviruses and SARS-CoV-2 in a typical room application with 365DisInFx™ LPU devices operating 24 hours a day at levels below the limits specified by IEC 62471 photobiological safety guidelines for lamps and lamp systems. The 365DisInFx™ LPU devices were configured to deliver germicidal UVC for the duration of the test at levels below the daily exposure limits specified by IEC 62471.

Safety: When used and installed as directed, continuous 24-hour exposure in occupied space is under the limits stated in IEC 62471 Photobiological Safety of Lamps and Lamp Systems.

Coverage: At a mounting height of 10', the LPU will achieve a coverage area of approximately 50 ft²

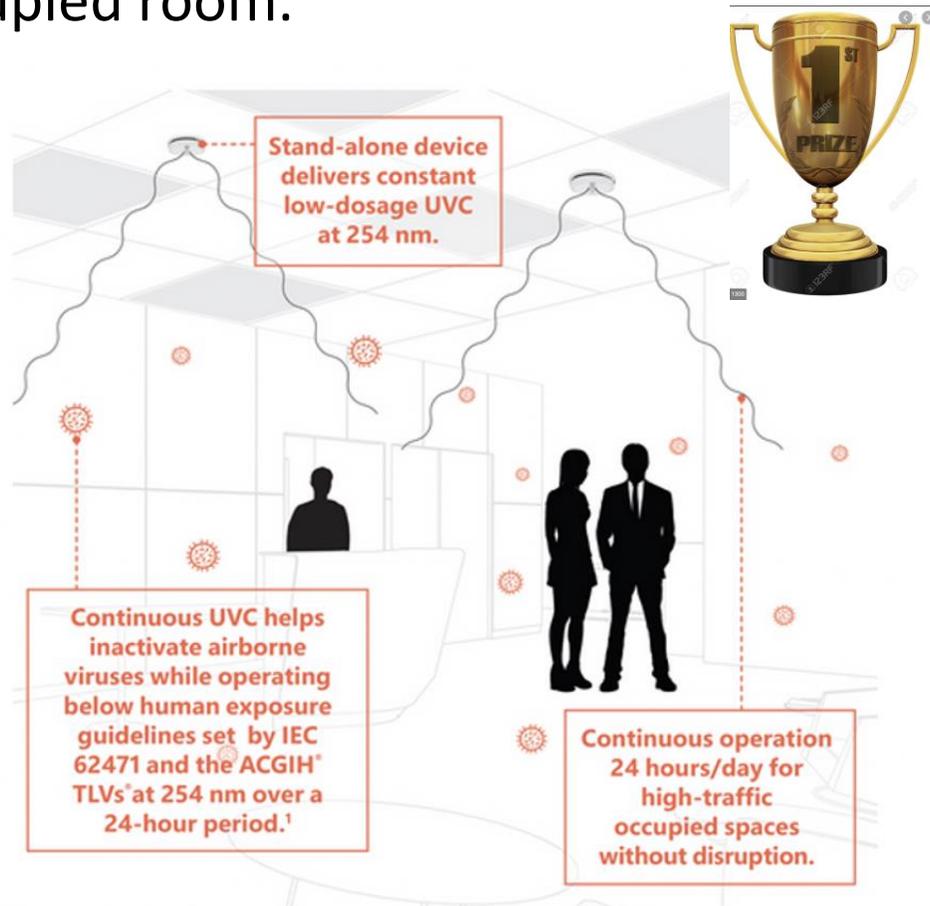


Source:

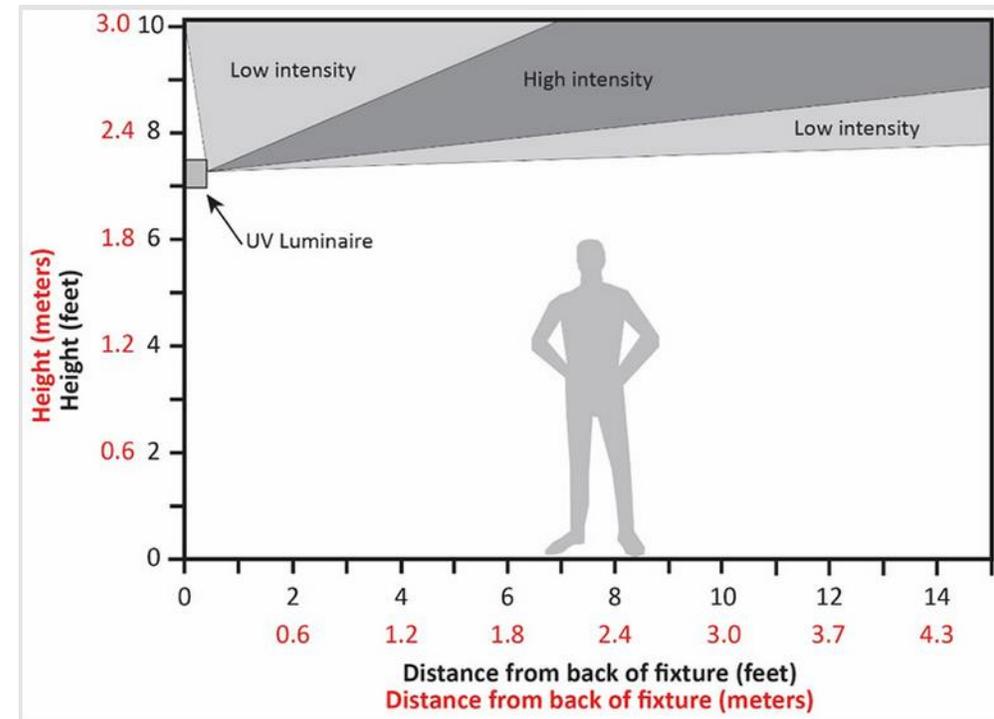
https://products.gecurrent.com/sites/products.currentbyge.com/files/documents/document_file/DSX101-365DisInFx-LPU-UVC-Technology-Specsheet.pdf

GE's Advancement for UV-C (254 nm)

GE ADVANCEMENT: UV-C puck advertised as continuous disinfection of whole occupied room.



OLDER TECH: UV-C disinfection previously limited to upper air for safety reasons (including air mixing with fans) to disinfect large volumes of air at once, but did not cover whole room:



GE Current: UV-C Safety

- Due to safety concerns, installation “should be performed by qualified professionals as detailed in Current’s installation guide” (not yet available).
- Mounting height important to ensure safety, “device is preprogrammed at our factory to provide the proper and intended irradiance levels for specific mounting heights.”
- Ensure safety and regulatory compliance with industry associations/agencies such as IEC 62471, ACGIH, UL (which follows IEC 62471), and EPA

GE Patents—UV-A/B

Issued patents (limited to UV-A/B) include:



Patented UVA technology can help reduce surface bacteria, including *Staphylococcus* (99%) and *Salmonella* (95%), over 24 hours.²

(12) United States Patent Clynné et al.

(10) Patent No.: US 9,937,274 B2

(45) Date of Patent: Apr. 10, 2018

(54) LIGHT DISINFECTION SYSTEM AND METHOD

(71) Applicant: GE Lighting Solutions, LLC, East Cleveland, OH (US)

(72) Inventors: Thomas Clynné, East Cleveland, OH (US); Gary Robert Allen, Euclid, OH (US); Kevin Jeffrey Benner, Solon, OH (US); Kevin James Vick, Cleveland Heights, OH (US); Erik Leeming Kvam, Niskayuna, NY (US)

(73) Assignee: GE LIGHTING SOLUTIONS, LLC, East Cleveland, OH (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 15/065,894

(22) Filed: Mar. 10, 2016

(65) Prior Publication Data
US 2016/0271281 A1 Sep. 22, 2016

(60) Related U.S. Application Data
Provisional application No. 62/134,954, filed on Mar. 18, 2015.

(57) ABSTRACT

A lighting system includes a light source configured to generate light toward one or more surfaces or materials to inactivate one or more pathogens on the one or more surfaces or materials. The light includes an inactivating portion having wavelengths in a range of 280 to 380 nanometers.

1. A system comprising:
a light source configured to generate light toward one or more surfaces or materials to inactivate one or more pathogens on the one or more surfaces or materials in an environment for human occupancy, the light including an inactivating portion having peak wavelength in a range of greater than 300 nanometers to below 380 nanometers.

GE Patents—UV-A/B

Issued patents (limited to UV-A/B) include:

(12) **United States Patent**
Clynne et al.

(10) **Patent No.:** **US 9,981,052 B2**
(45) **Date of Patent:** ***May 29, 2018**

(54) **LIGHT DISINFECTION SYSTEM AND METHOD**

(71) Applicant: **GE Lighting Solutions, LLC**, East Cleveland, OH (US)

(72) Inventors: **Thomas Clynne**, East Cleveland, OH (US); **Gary Robert Allen**, Euclid, OH (US); **Kevin Jeffrey Benner**, Solon, OH (US); **Kevin James Vick**, Cleveland Heights, OH (US); **Erik Leeming Kvam**, Niskayuna, NY (US)

(73) Assignee: **GE Lighting Solutions, LLC**, East Cleveland, OH (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days. days.
This patent is subject to a terminal disclaimer.

(21) Appl. No.: **15/429,773**

(22) Filed: **Feb. 10, 2017**

(65) **Prior Publication Data**
US 2017/0151359 A1 Jun. 1, 2017

Related U.S. Application Data
(63) Continuation of application No. 15/065,894, filed on Mar. 10, 2016.
(60) Provisional application No. 62/134,954, filed on Mar. 18, 2015.

(57) **ABSTRACT**

A lighting system includes a light source configured to generate light toward one or more surfaces or materials to inactivate one or more pathogens on the one or more surfaces or materials. The light includes an inactivating portion having wavelengths in a range of 280 to 380 nanometers.

1. A system comprising:
a light source configured to generate light toward one or more surfaces or materials to inactivate one or more pathogens on the one or more surfaces or materials, the light including an inactivating portion having wavelengths in a range of 280 to 380 nanometers, wherein the light source is configured to generate no more than 10000 watts of blue light per steradian per square meter.

GE Patents



Patented UVA technology can help reduce surface bacteria, including *Staphylococcus* (99%) and *Salmonella* (95%), over 24 hours.²

Patents/published applications to UV-A/B on surfaces (not air). But at least one published application indicates potential continuation or CIP for UV-C.

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2018/0339073 A1**
CLYNNE et al. (43) **Pub. Date: Nov. 29, 2018**

(54) **LIGHT DISINFECTION SYSTEM AND METHOD**

(71) Applicant: **General Electric Company**, Schenectady, NY (US)

(72) Inventors: **Thomas CLYNNE**, East Cleveland, OH (US); **Gary Robert ALLEN**, Euclid, OH (US); **Kevin Jeffrey BENNER**, Solon, OH (US); **Kevin James VICK**, Avon, OH (US); **Erik Leeming KVAM**, Niskayuna, NY (US); **Jonathan Alan MURRAY**, Dousman, WI (US)

(21) Appl. No.: **15/990,296**

(22) Filed: **May 25, 2018**

Related U.S. Application Data

(63) Continuation-in-part of application No. 15/429,773, filed on Feb. 10, 2017, now Pat. No. 9,981,052, which is a continuation of application No. 15/065,894, filed on Mar. 10, 2016, now Pat. No. 9,937,274.

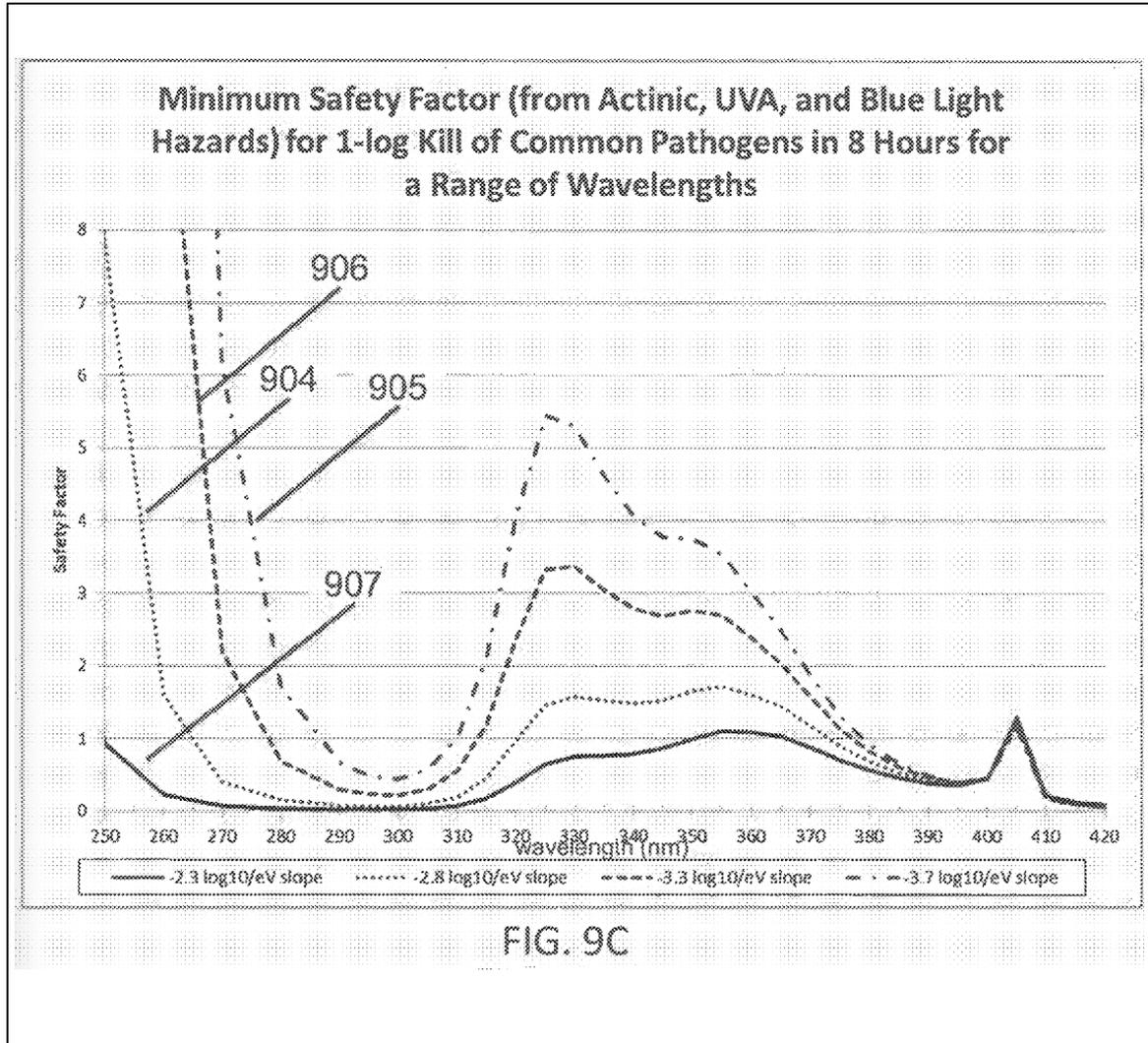
(60) Provisional application No. 62/134,954, filed on Mar. 18, 2015.

(57)

ABSTRACT

A general illumination lighting system and/or at least one targeted surface illumination lighting system. The general illumination lighting system including a general illuminating light source configured to generate light toward one or more surfaces or materials to inactivate one or more pathogens on the one or more surfaces or materials. The at least one targeted surface illumination lighting system including one or more targeted surface illuminating light sources that are integrated into or coupled to a plurality of devices, equipment, or fixtures. The one or more targeted surface illuminating light sources configured to generate targeted light toward one or more surfaces of the devices, equipment, or fixtures to inactivate one or more pathogens on the one or more surfaces. The light from the general illuminating light source and the one or more targeted surface illuminating light source including an inactivating portion having wavelengths in a range of 280 to 380 nanometers.

GE Patents—Disclosure of UV-C



[0050]

Lines **905**, **906**, and **907** in FIG. 9C show additional curves for minimum safety factor for different values of $-1/z(E)$ (-3.7 , -3.3 , and $-2.3 \log_{10}/eV$, respectively), along with Line **904** from FIG. 9B which represents $-1/z(E) = -2.8 \log_{10}/eV$. Line **905** shows a local maximum safety factor of 5.4 at 325 nm, with a safe range of 310-380 nm. Line **906** shows a local maximum safety factor of 3.4 at 330 nm, with a safe range of 315-375 nm. Line **904** shows a local maximum safety factor of 1.7 at 355 nm, with a safe range of 320-370 nm. Line **907** shows a local maximum safety factor of 1.1 at 355 nm, with a safe range of 350-365 nm. Additionally, lines **905**, **906**, and **904** show a safe area at low wavelengths (less than about 280, 270, or 260 nm respectively). This indicates that due to the increased pathogen inactivation ability shown by the kinetic model, these UVC wavelengths may be able to achieve 90% pathogen inactivation over 8 hours of exposure while being safe for humans.

Leviton Licenses GE's 365DisInFx UVA Tech



Leviton Lighting Brands First to License New 365DisInFx™ UVA Technology from GE Current, a Daintree company

📅 October 29, 2020

New patented technology can help to disinfect occupied healthcare, commercial and education facility spaces

Your humble editor had a zoom call with Santino Nemi and Tom Leonard of Leviton as well as Melissa Wesorick of GE Current, a Daintree Company. Santino explained that this was a licensing deal and Leviton would build the devices in North America. He went on to say that initially the 365DisInFx™ would be sold through the Viscor, Con Tech, Birchwood and Intense brands. He explained that Leviton has been discussing this with Current pre-pandemic and said, "We have been working on UV disinfection before it was cool." The product will be launched 1Q 2021.

Melville, N.Y. October 29, 2020 – Leviton Lighting brands announced they are the first lighting manufacturers to license 365DisInFx™ UVA technology, the new [disinfection lighting technology](#) by [GE Current, a Daintree company](#) ("Current"), for incorporation into their lighting portfolio. The patented technology can help to disinfect surfaces in occupied spaces, with immediate applications in healthcare, commercial, and educational facilities via Leviton Lighting & Controls luminaires.

"For more than 100 years, Leviton has focused on bringing technologies to market, and we're proud to announce this collaboration with Current as part of a multi-layered approach to disinfection technology that can encompass occupied spaces," said Richie Westfall, VP/general manager, Leviton Lighting & Controls. "As health and safety continue to be high priorities for healthcare and other facility environments, this solution fills a critical need by enabling continuous disinfection without requiring occupants to leave spaces."

Current's 365DisInFx™ UVA technology uses UV-A LEDs to reduce the potential spread of certain common infection-causing pathogens in virtually any space. This allows for spaces to be disinfected in real time while occupants are present. The UVA

Signify: UV-C

- Range of **non-LED (low-pressure mercury ~254 nm) GUV** products including luminaires (Alkco brand) for disinfecting air, surfaces, water, and chambers (BioShift) for disinfecting objects. Targeted for commercial installations (“schools, offices, industry, (food) retail and museums”).



- **New non-LED (low-pressure mercury ~254 nm) desk lamp** product. **Signify's 1st Consumer UV-C Product (Asia market only). For vacant space.**



Sources: <https://www.signify.com/en-us/products/indoor-luminaires/germicidal-uv-application/uv-c-2x2-grid-ceiling-mount#downloads>;
<https://www.lighting.philips.com.sg/consumer/uv-c-lighting>

Signify: UV-C Disinfection Desk Lamp

- **Signify's 1st Consumer UV-C Product**
- Because relatively high power (24 W @ 220/240 V, “disinfect surfaces and objects in any room in a matter of minutes”), room must be **vacant**.

Motion Sensor

Because exposure to UV-C can harm eyes and skin, Philips UV-C lights have an added layer of protection with built-in sensors that detect people and pets

- Similar competing products exist; Signify advertises difference in metal (vs. plastic) housing “which lasts longer when exposed to UV-C”



Signify: UV-C vs. SARS-COV-2



In laboratory testing, Signify's UV-C light sources inactivated 99% of SARS-CoV-2 virus on a surface with an exposure time of 6 seconds³

3. Data made available to us by the National Emerging Infectious Diseases Laboratories (NEIDL) at Boston University, which has been collected from a laboratory experiment conducted by Dr. Anthony Griffiths (Associate Professor of Microbiology at Boston University School of Medicine) and his team at the premises of the NEIDL (such data will be the subject of a forthcoming scientific publication by Boston University), shows that Signify's UV-C light sources irradiating the surface of a material inoculated with SARS-CoV-2 (the virus that causes the COVID-19 disease) at a UV-C dose of 5mJ/cm² (exposure time 6 seconds) resulted in a 99% reduction of the SARS-CoV-2 virus present on that surface. This study determined that a UV-C dose of 22mJ/cm² results in a reduction of 99.9999% of SARS-CoV-2 virus on that surface (exposure time 25 seconds). Research variables are available upon request.

Signify: UV-C Safety

Are there any certifications for the Philips UV-C Disinfection Desk Lamp?

This UV-C device is certified by the following standards

Items

Standard/guidelines

Safety

UV-C safety

GLA UV-C safety guideline including IEC 62471

This UV-C device is not approved and/or certified as a medical device, and it can't be used for the disinfection of the surfaces of medical devices (such as medical devices in a room, surgical masks and/or surgical respirators).

At this moment, none of our UV-C products are certified or approved under any applicable laws as a medical device and as such, Signify and/or any of its group companies do not currently intend for them to be used as medical devices anywhere in the world.

Signify Patents

- With respect to GUV, recently filed/published application on UV light source and prevention of emission when occupied:

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2020/0289686 A1**
Janik et al. (43) **Pub. Date: Sep. 17, 2020**

(54) **USING LIGHT FIXTURES FOR
DISINFECTION**

(71) Applicant: **Signify Holding B.V.**, Amsterdam (NL)

(72) Inventors: **Raymond George Janik**, Fayetteville,
GA (US); **Ethan Thomas Garrett**,
Newnan, GA (US)

(21) Appl. No.: **16/811,283**

(22) Filed: **Mar. 6, 2020**

Related U.S. Application Data

(60) Provisional application No. 62/816,673, filed on Mar.
11, 2019.

(57) **ABSTRACT**

An electrical device can include a sensor module that measures at least one parameter, where the at least one parameter is associated with determining the presence of a living being in a volume of space. The electrical device can also include a controller coupled to the sensor module, where the controller receives a measurement of the at least one parameter to determine whether the living being is in the volume of space. The electrical device can further include at least one ultraviolet (UV) light source coupled to the controller, which operates the at least one UV light source to emit UV light when the living being is not in the volume of space, and where the controller prevents the at least one UV light source from emitting the UV light when the living being is in the volume of space.

Signify Patents

[0015] Light fixtures (or other electrical devices that use one or more light sources) described herein can use one or more of a number of different types of light sources that emit visible light that is not ultraviolet (UV), including but not limited to light-emitting diode (LED) light sources, fluorescent light sources, organic LED light sources, incandescent light sources, and halogen light sources. Such light sources are called non-UV light sources herein. Additionally, example light fixtures or other electrical devices have at least one light source capable of emitting true ultraviolet (UV) rays (e.g., 250 nm-280 nm) and/or near UV rays (e.g., 380 nm-400 nm). Such light sources are called UV light sources herein and can use any of a number of lighting technologies that are capable of emitting UV rays.

1. An electrical device comprising:

- a sensor module that measures at least one parameter, wherein the at least one parameter is associated with determining the presence of a living being in a volume of space;
- a controller coupled to the sensor module, wherein the controller receives a measurement of the at least one parameter to determine whether the living being is in the volume of space; and
- at least one ultraviolet (UV) light source coupled to the controller, wherein the controller, upon determining that the living being is not in the volume of space, operates the at least one UV light source to emit UV light into the volume of space, and wherein the controller, upon determining that the living being is in the volume of space, prevents the at least one UV light source from emitting the UV light into the volume of space.

Acuity + Partners: Far-UVC (222 nm)

- **Acuity** recently announced “strategic agreements” with **1) Violet Defense + Puro Lighting** and **2) Ushio**
 - Pulsed Xenon apparently associated with Violet Defense + Puro; KrCl excimer associated with Ushio

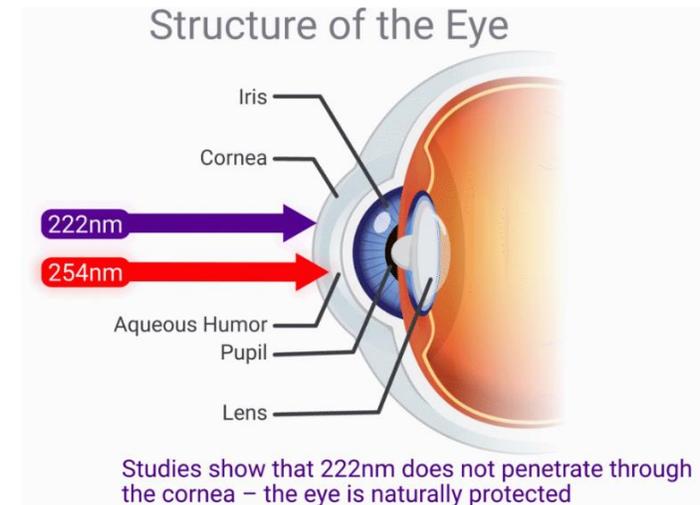
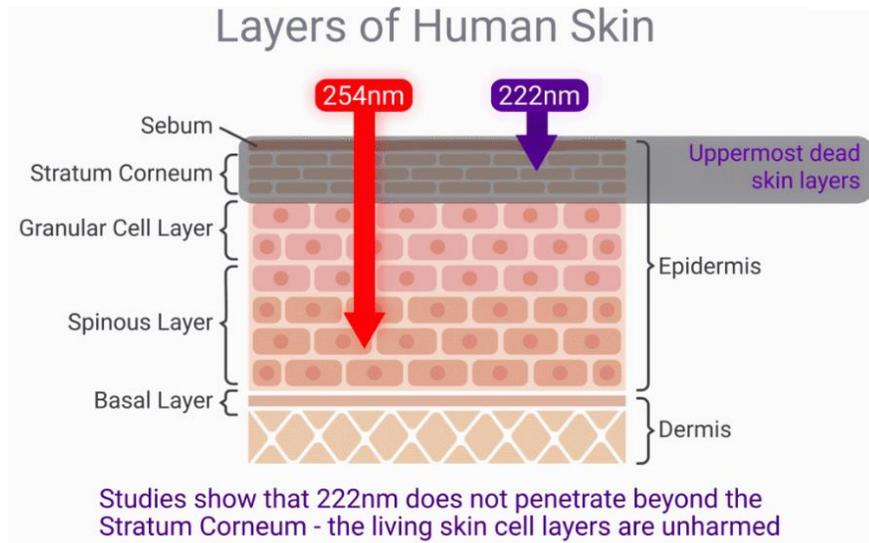
- **No Products yet**



- **Non-LED** emitting at **222 nm** for **occupied use**

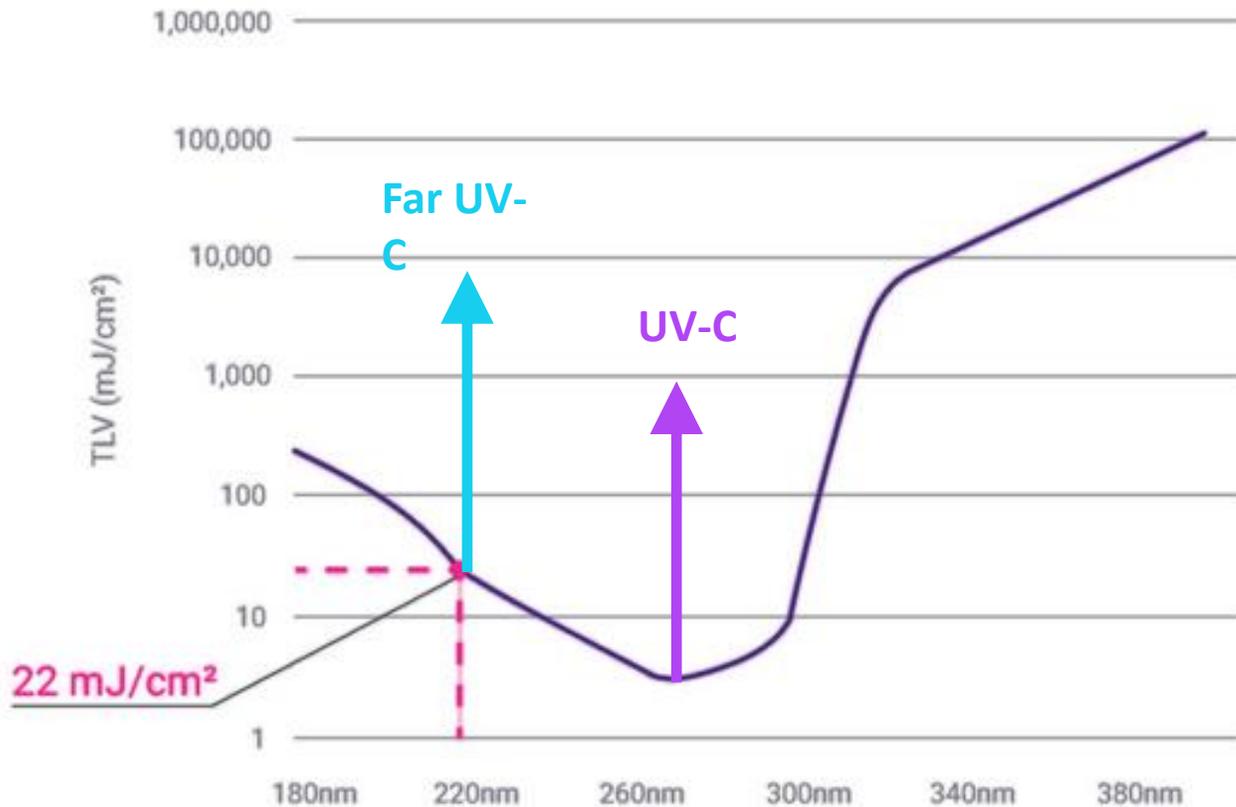
- Products **coming soon** from Acuity Brands’ portfolio of trusted brands such as Mark Architectural Lighting™, Lithonia Lighting®, and Healthcare Lighting®

USHIO



Acuity + Partners: Safety

UV Safety Levels as Established by ACGIH®



The ACGIH®, the American Conference of Governmental Industrial Hygienists, is a charitable scientific organization advancing occupational and environmental health.

ACGIH has published guidelines for the level of UV exposure that a typical worker can be exposed to without adverse health effects.

The level of exposure in the guidelines are quantified as Threshold Limit Values, or TLVs.

The ACGIH® 8-hour TLV at 222nm is currently set at 22mJ/cm². This translates to up to 66mJ/cm² of exposure allowed per 24-hour day.

Acuity + Partners: Patents

Advertises as “patented germicidal UV lighting technology” (Violet Defense - lenses) and “patented Care222 module” (Ushio – filtering, detecting sterilization with far-UVC). Relevant patents appear directed to filtering/lenses. For example:

Violet Defense: Issued USPs 8,993,988; 9,572,902; 10,046,075

Ushio: Issued USP 8,808,972; PCT Application WO2020203754

Acuity + Partners: Violet Defense Patents

First and second in family limited to lenses with UV light transmissive material, e.g.:

(12) **United States Patent**
Nathan et al.

(10) **Patent No.:** **US 9,572,902 B2**
(45) **Date of Patent:** ***Feb. 21, 2017**

(54) **DEVICE FOR ULTRAVIOLET AND COLOR LIGHT EMISSION**

(71) Applicant: **Violet Defense Technology, Inc.**,
Celebration, FL (US)

(72) Inventors: **Mark Nathan**, Celebration, FL (US);
Theresa Nathan, Celebration, FL (US)

(73) Assignee: **Violet Defense Technology, Inc.**,
Celebration, FL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 169 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **14/627,892**

(22) Filed: **Feb. 20, 2015**

(65) **Prior Publication Data**

US 2016/0151521 A1 Jun. 2, 2016

Related U.S. Application Data

(63) Continuation of application No. 14/078,288, filed on Nov. 12, 2013, now Pat. No. 8,993,988.

(57) **ABSTRACT**

Devices and uses of said devices for transmitting UV light over a broad area and for a long distance to inactivate microbes and non-microbial sources. The device is activated by a variable or dynamic logic process that controls activation of the device, such that activation is automatic and only when there is either a predetermined target or an absence of an action or activity within an effective range of the device. The device comprises at least one ultraviolet light emitting source emitting ultraviolet light in a range from about 10 to 400 nanometers and a lens formed of an ultraviolet light transmissive material. The at least one ultraviolet light emitting source is embedded within the lens. The lens may be formed into a functional or ornamental shape and does not filter or refract significantly the ultraviolet light emitted from the at least one ultraviolet light emitting source.

VIOLET DEFENSE™

Violet Defense Patents

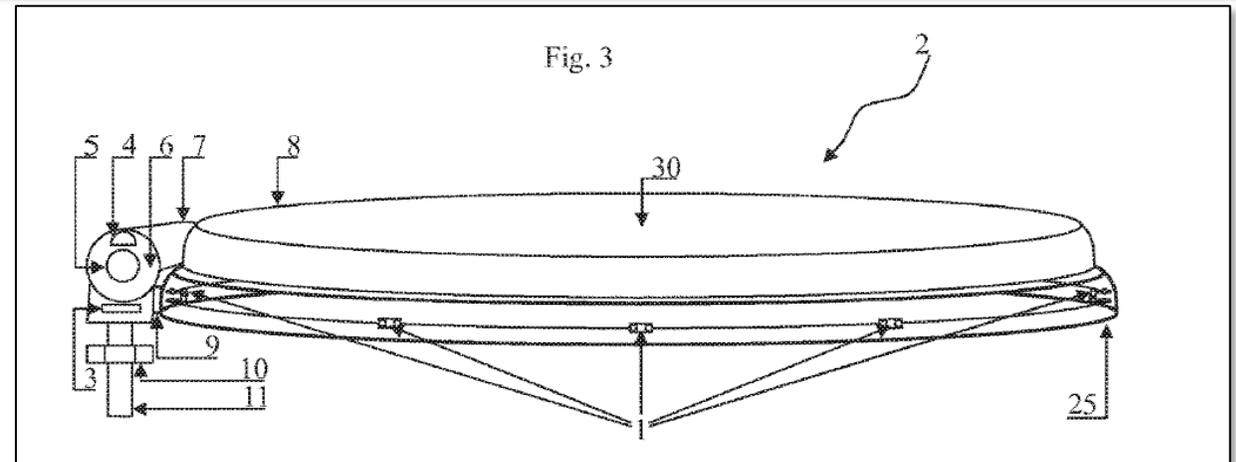
1. A device for projecting ultraviolet radiation and visible light, the device comprising:

at least one light emitting source for generating and emitting both ultraviolet light and at least one color, the light emitting source comprising at least one element for the generation of ultraviolet light and at least one element for the generation of the at least one color in the visible light spectrum;

a lens formed of an ultraviolet light transmissive material; wherein the at least one light emitting source is embedded and sealed permanently within an interior and underneath an outer surface of the ultraviolet light transmissive material so as to be fully surrounded by the ultraviolet light transmissive material, the at least one light emitting source protected from and impervious to external environmental factors, wherein the at least one light emitting source is in direct and immediate contact with the lens without a gap therebetween such that the ultraviolet light emitting outwardly from the at least one light emitting source passes through the ultraviolet light transmissive material, and



wherein the ultraviolet light transmissive material is permeable to the ultraviolet light emitted from the at least one light emitting source, the ultraviolet light transmissive material retaining and transmitting the photonic energy generated by the at least one light emitting source and projecting ultraviolet light from the lens to sanitize over a distance of up to 18 feet.



Applied UV (SteriLumen) + Axis

- Joint development agreement / exclusive license between SteriLumen (Applied UV subsidiary) and Axis Lighting (Canada) to develop and commercialize UV-C LED products for surface disinfection in hospitals in North America.
- Unclear if any products (commercial) currently available.
- SteriLumen has related “patented devices,” directed to drain disinfecting, vanity mirror disinfecting with UV-C (e.g., USPs 10,738,446; 10,639,394; 10,463,759).

Sources: <https://edisonreport.com/applied-uv-inc-announces-exclusive-licensing-and-joint-development-agreement-with-axis-lighting-to-commercialize-led-based-technologies-in-uv-c-devices-to-inactivate-pathogens-on-surfaces-in-the-hos/>; <https://sterilumen.com/>

Applied UV (SteriLumen)

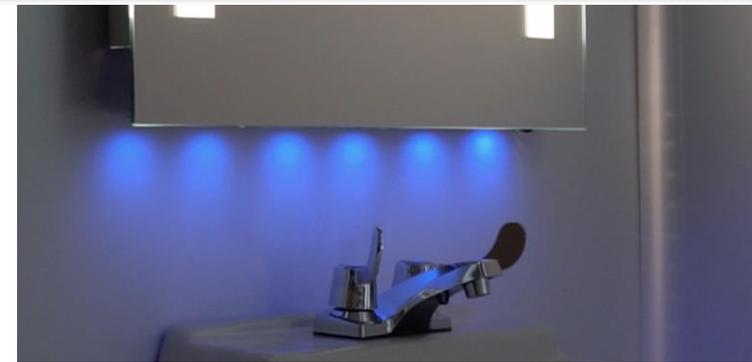
SteriLumen is patent protected technology that utilizes ultraviolet light for killing pathogens on surfaces in an easy and affordable manner.

SteriLumen UVC Technology Tested Against Human Coronavirus OC43

In accordance with CDC guidelines, a bio safety level 3 laboratory is required for testing SARS-CoV-2, the virus that causes COVID-19

There are a limited number of bio safety level ("BSL") 3 laboratories available due to the high demand for COVID-19 testing for vaccines and treatments

The SteriLumen disinfecting mirror and disinfecting drain were tested at ResInnova Laboratories, a BSL 2 laboratory, against OC43 human coronavirus, a strain of human coronavirus (beta group) that is genetically similar to SARS-CoV-2



SLR-2

Standalone and shelf disinfecting solution for sinks and other flat surfaces within 24". Available 2021.

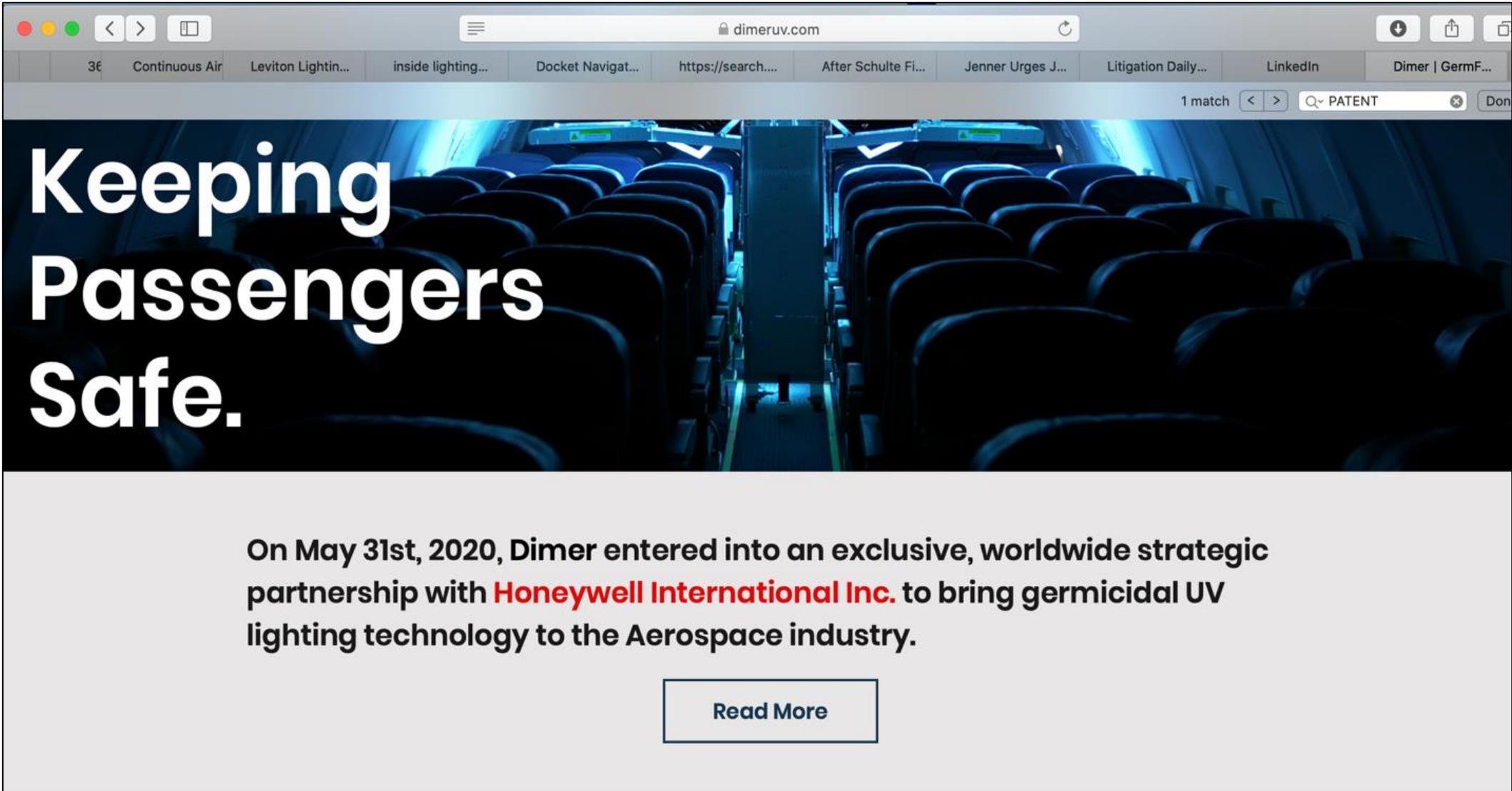


SLD-1

UVC disinfecting drain unit addressing a major pathogen area in restrooms



Dimer + Honeywell



3€ Continuous Air Leviton Lightin... inside lighting... Docket Navigat... https://search... After Schulte Fi... Jenner Urges J... Litigation Daily... LinkedIn Dimer | GermF...

1 match < > Q PATENT Don

Keeping Passengers Safe.

On May 31st, 2020, Dimer entered into an exclusive, worldwide strategic partnership with **Honeywell International Inc.** to bring germicidal UV lighting technology to the Aerospace industry.

[Read More](#)

Dimer Patents

(12) **United States Patent
Kreitenberg**

(10) **Patent No.:** US 8,907,304 B2
(45) **Date of Patent:** Dec. 9, 2014

(54) **ULTRAVIOLET AUTONOMOUS TROLLEY
FOR SANITIZING AIRCRAFT**

(71) Applicant: **Arthur Kreitenberg**, Los Angeles, CA
(US)

(72) Inventor: **Arthur Kreitenberg**, Los Angeles, CA
(US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/779,635**

(22) Filed: **Feb. 27, 2013**

(65) **Prior Publication Data**

US 2014/0241941 A1 Aug. 28, 2014

6,370,453	B2	4/2002	Sommer
6,389,639	B1	5/2002	Worsham
6,419,190	B1	7/2002	Nguegang
6,565,668	B1	5/2003	Sandberg et al.
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6,889,449	B2	5/2005	Silver
6,992,301	B2	1/2006	Fenc
7,204,208	B2	4/2007	Johnson et al.
7,459,695	B2*	12/2008	Hanley et al. 250/455.11
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7,523,692	B1	4/2009	Burns
8,029,739	B2	10/2011	Field et al.
8,105,532	B2*	1/2012	Harmon et al. 422/24
8,193,515	B2	6/2012	Kreitenberg
8,226,887	B2	7/2012	Harmon et al.
8,330,121	B2	12/2012	Douglas

(Continued)

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CN	2621044	Y	*	6/2004
CN	101756678			6/2010

Dimer's Issued Patents

US Patent No. 8,907,304

EU Patent No. 272272

Japanese Patent No. 6439253

US Patent No. 8,999,238

US Patent No. 9,144,618

US Patent No. 10,406,253

US Patent No. 9,149,549

US Patent No. 10,195,298

US Patent No. 10,500,296

US Patent No. 10,159,761

(57) **ABSTRACT**

A mobile body is configured to travel over a surface inside an aircraft cabin. A source of UV radiation is mounted to the mobile body and configured to direct UV radiation to the surface at a predetermined dosage. At least two articulated arms are mounted to the mobile body, and UV lamps mounted respectively on the arms. The mobile body is a trolley or cart for negotiating an aircraft aisle.

Puro Lighting



Broad Spectrum UV-C, UV-B and UV-A light to kill bacteria and viruses.



Broad Spectrum of Light Optimizes Effects

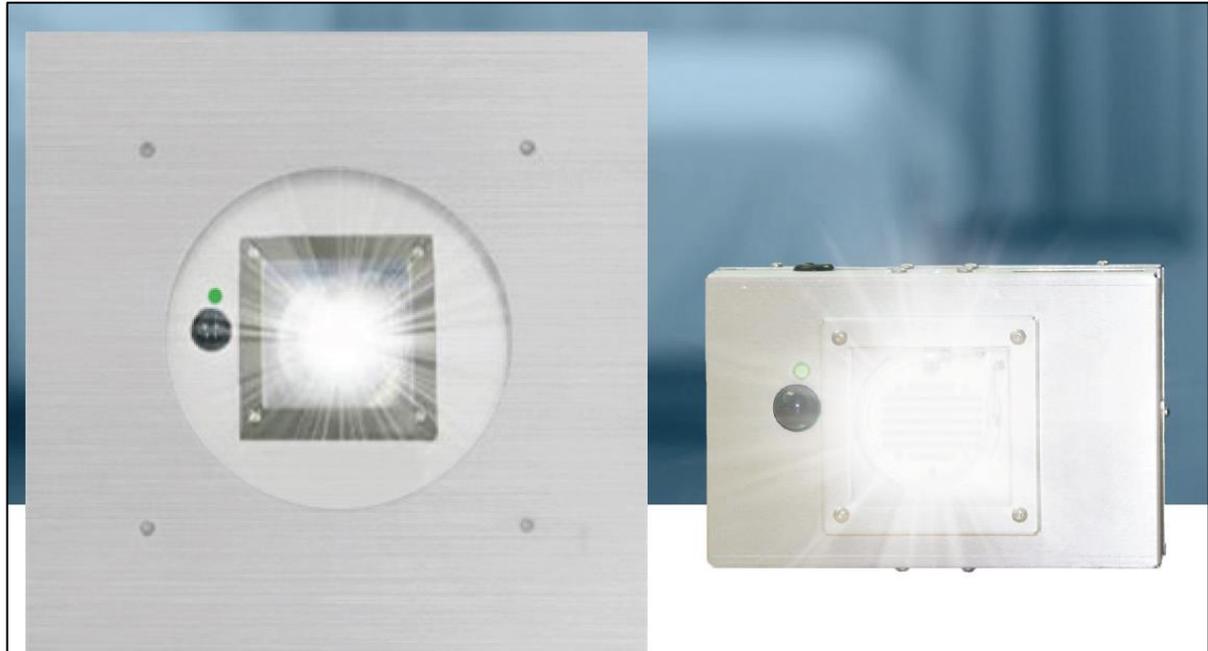
Puro's Helo and Sentry product lines, powered by Violet Defense technology, represent a significant breakthrough in germicidal protection for the world. The Puro™ solution uses a powerful, broad-spectrum light, including germicidal UV-C, UV-B and anti-bacterial UV-A to optimize their germ-killing efficiency.

UV-C is most traditionally referred to as germicidal UV with the ability to kill bacteria, viruses, mold, and fungus.

UV-A and UV-B light causes oxidation of proteins and lipids causing cell death.

Broad band UV lamps have also been shown to inhibit photo-reactivation, the process that can result in self-repair of damaged microbes.so

Puro Lighting



shown with 12"x12" flange

Helo F1

UV DISINFECTING FIXTURE



Ceiling or wall mounted installation to disinfect a whole room without staff requirements to relocate it.



Broad Spectrum UV-C, UV-B and UV-A light to kill bacteria and viruses.



Programmed manually or integrated into building automation systems through BACnet.



Single UV Light Engine with pulsed Xenon lamp for up to a 10' x 10' ft coverage area.

Puro Lighting

Portable UV Disinfection



Puro Lighting

P U R O TM
A P P R O A C H

We've packed an innovative, patented UV light technology into solutions to disinfect your spaces on demand — whether it's protection from above or protection that follows you around. We call this ***Disinfection On Demand. Any Room. Any Size. Any Time.***

At the heart of our products is the UV Light Engine, protected by patents from Violet Defense™. The lenses, made of a UV transmissive polymer, and are in direct and immediate contact with a Xenon lamp, the source of UV-C, UV-B and UV-A. This patented design allows significant UV energy transmission, without the fogging, cracking or discoloration that occurs over time with non-UV transmissive lens materials.

This powerful, groundbreaking design has enabled miniaturization of high intensity, broad-spectrum UV, enabling us to offer a fixture small and

University Patents: Univ. of Delaware

(12) **United States Patent** **Ufkes**

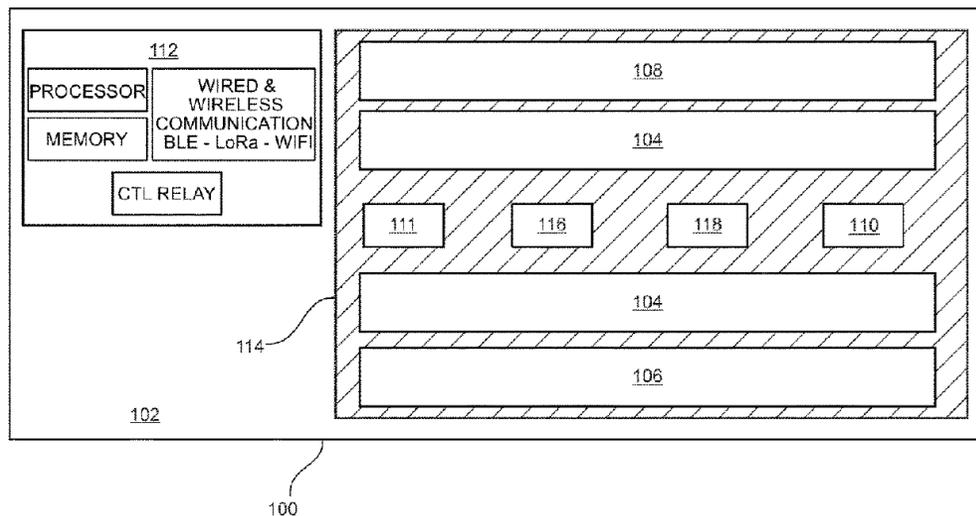
(10) **Patent No.:** **US 10,556,025 B2**
(45) **Date of Patent:** **Feb. 11, 2020**

(54) **FIXED POSITION HYBRID GERMICIDAL IRRADIATION APPARATUS, METHOD, AND SYSTEM**

(71) Applicant: **UD Innovations, LLC**, Sullivan's Island, SC (US)

(72) Inventor: **Philip J. Ufkes**, Sullivan's Island, SC (US)

(73) Assignee: **UD Innovations, LLC**, Sullivan's Island, SC (US)



(57) **ABSTRACT**

A fixed position hybrid germicidal irradiation apparatus, method, and system for ultraviolet germicidal irradiation. A plurality of emitters may be coupled to a substantially rectangular housing configured to be coupled to a standard commercial lighting fitting. A second plurality of emitters may be coupled to the substantially rectangular housing. The first plurality of emitters and the second plurality of emitters are operable to emit UV-C radiation at a wavelength of about 265 nanometers and near-UV radiation at a wavelength of about 405 nanometers respectively. UV-C sensors are configured to measure the amount of UV-C light or near UV-C light from a target surface. A controller may be configured to engage with the UV-C sensors to determine the amount of UV-C radiation collected by the UV-C sensors. The improved apparatus, method, and system reduces exposure time by varying the intensity and wavelength of the UV administered, while concurrently reducing UV overexposure.

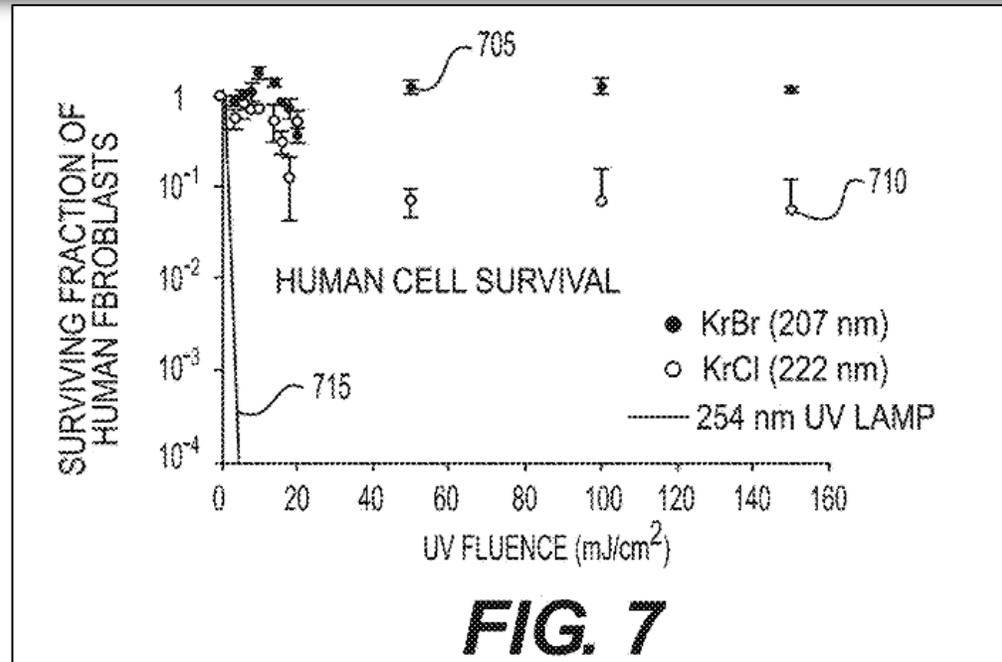
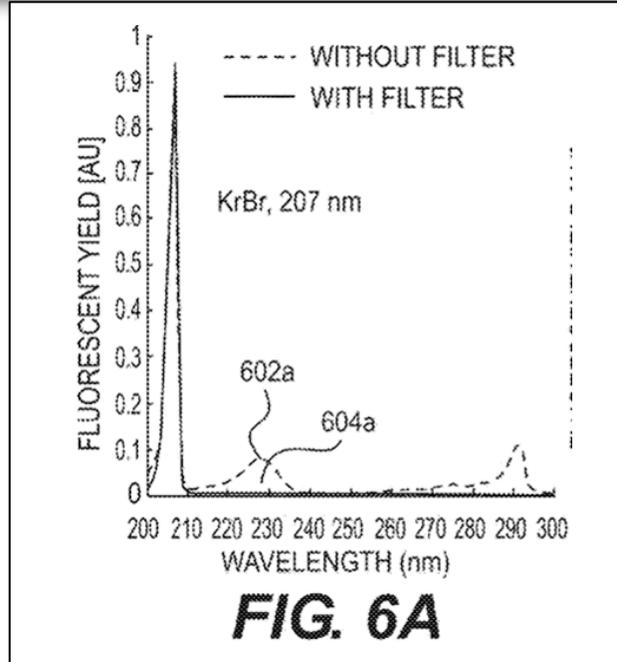
University Patent (App'n.): Columbia Univ.

Disclosed in Columbia Univ. Scientific Reports article (cited by FDA):

<p>(19) United States (12) Patent Application Publication RANDERS-PEHRSON et al.</p>		<p>(10) Pub. No.: US 2018/0169279 A1 (43) Pub. Date: Jun. 21, 2018</p>
<p>(54) APPARATUS, METHOD AND SYSTEM FOR SELECTIVELY AFFECTING AND/OR KILLING A VIRUS</p> <p>(71) Applicant: THE TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK, New York, NY (US)</p> <p>(72) Inventors: Gerhard RANDERS-PEHRSON, Ossining, NY (US); David Jonatha BRENNER, New York, NY (US); Alan BIGELOW, Hasting-on-Hudson, NY (US)</p> <p>(21) Appl. No.: 15/579,093</p> <p>(22) PCT Filed: Jun. 3, 2016</p> <p>(86) PCT No.: PCT/US16/35680 § 371 (c)(1), (2) Date: Dec. 1, 2017</p> <p>Related U.S. Application Data</p> <p>(60) Provisional application No. 62/170,203, filed on <u>Jun. 3, 2015.</u></p>	<p>(57) ABSTRACT</p> <p>Certain exemplary embodiments of the present disclosure can provide an apparatus and method for generating at least one radiation can be provided. The exemplary apparatus and/or method can <u>selectively kill and/or affect at least one virus.</u> For example, a radiation source first arrangement can be provided which is configured to generate at least one radiation having one or more wavelengths provided in a <u>range of about 200 nanometers (nm) to about 230 nm,</u> and at least one second arrangement can be provided which is <u>configured to prevent the at least one radiation from having any wavelength that is outside of the range can be provided</u> or which can be substantially harmful to cells of the body.</p>	

Sources: <https://www.fda.gov/medical-devices/coronavirus-covid-19-and-medical-devices/uv-lights-and-lamps-ultraviolet-c-radiation-disinfection-and-coronavirus>; <https://www.nature.com/articles/s41598-020-67211-2.pdf>

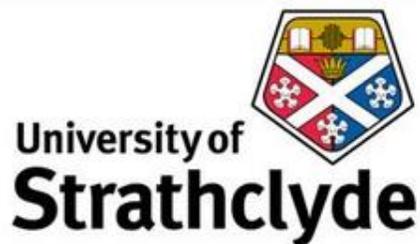
University Patent (App'n.): Columbia Univ.



1. An apparatus for generating at least one radiation, comprising:
a radiation source first arrangement configured to generate the at least one radiation having one or more wavelengths that are configured to selectively harm or damage at least one virus at least one of on a surface or in an aerosol; and
at least one filter second arrangement configured to substantially prevent the at least one radiation from having any wavelength that is substantially harmful to cells of the body range.

Patent and Class Action Lawsuits

Kenall/Univ. Strathclyde Lawsuits



Who: Kenall Manufacturing Co. and Univ. of Strathclyde (Scotland)

-versus-

**Vital Vio; New Star Lighting;
Clear-Vu Lighting; Visa Lighting**

What: 1-3 patents directed to lighting devices emitting **visible** light to inactivate **bacteria**; false advertising

Where: Dist. of Del; Eastern Dist. of NY; Eastern Dist. of Wisc

When: Sept. 2015 – Present

Status: Some settled, some ongoing

The logo for Vital Vio, featuring the words "vital vio" in a lowercase, teal, sans-serif font.



Kenall /Univ. Strathclyde Lawsuits: 3 Patents



US008398264B2

(12) **United States Patent**
Anderson et al. (10) Patent No.: **US 8,398,264 B2**
(45) Date of Patent: **Mar. 19, 2013**

- (54) **LIGHTING DEVICE** (56) **References Cited**
- (75) Inventors: **John Anderson**, Glasgow (GB); **Michelle Maclean**, Glasgow (GB); **Scott John MacGregor**, Glasgow (GB); **Gerald Alexander Woolsey**, Glasgow (GB)
- (73) Assignee: **University of Strathclyde**, Glasgow (GB)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 410 days.

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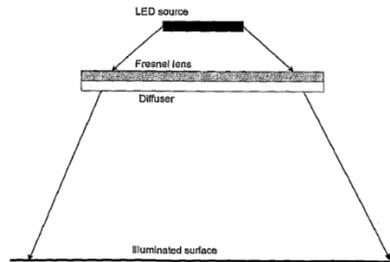
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Gutley et al., "In Vitro Bactericidal Effects of 405-nm and 470-nm Blue Light," *Photomedicine and Laser Surgery*, vol. 24, No. 6, 2006, pp. 684-688.
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- (21) Appl. No.: **12/739,802**
- (22) PCT Filed: **Oct. 31, 2008**
- (86) PCT No.: **PCT/GB2008/003679**
§ 371 (e)(1),
(2), (4) Date: **Apr. 26, 2010**
- (87) PCT Pub. No.: **WO2009/056838**
PCT Pub. Date: **May 7, 2009**
- (65) **Prior Publication Data**
US 2010/0246169 A1 Sep. 30, 2010
- (30) **Foreign Application Priority Data**
Oct. 31, 2007 (GB) 0721374.7

- (51) **Int. Cl.**
F21V 33/00 (2006.01)
F21V 9/00 (2006.01)
- (52) **U.S. Cl.** **362/234**; **362/231**; **362/253**; **362/276**
- (58) **Field of Classification Search** **362/230**, **362/231**, **800**, **234**, **253**, **276**, **802**, **804**, **572**-**575**
See application file for complete search history.

30 Claims, 7 Drawing Sheets



US09039966B2

(12) **United States Patent**
Anderson et al. (10) Patent No.: **US 9,039,966 B2**
(45) Date of Patent: **May 26, 2015**

- (54) **INACTIVATION OF GRAM-POSITIVE BACTERIA** (58) **Field of Classification Search**
- (75) Inventors: **John Galloway Anderson**, Glasgow (GB); **Michelle Maclean**, Glasgow (GB); **Gerald Alexander Woolsey**, Queensland (AU); **Scott John MacGregor**, Glasgow (GB)
- (73) Assignee: **University of Strathclyde**, Glasgow (GB)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.
- (21) Appl. No.: **11/997,227**
- (22) PCT Filed: **Jul. 28, 2006**
- (86) PCT No.: **PCT/GB2006/002841**
§ 371 (e)(1),
(2), (4) Date: **Jul. 3, 2008**
- (87) PCT Pub. No.: **WO2007/012875**
PCT Pub. Date: **Feb. 1, 2007**
- (65) **Prior Publication Data**
US 2008/0305004 A1 Dec. 11, 2008
- (30) **Foreign Application Priority Data**
Jul. 29, 2005 (GB) 0515550.2
- (51) **Int. Cl.**
A61N 9/00 (2006.01)
A62B 7/08 (2006.01)
A61N 5/06 (2006.01)
- (52) **U.S. Cl.**
CPC **A61N 5/06** (2013.01)
- 2 Claims, 16 Drawing Sheets**

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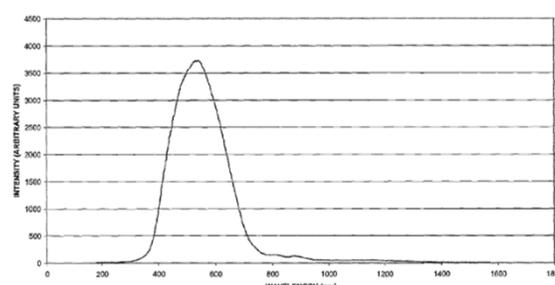
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- Bek-Thomsen, M., Lomholt, H.B., Killian, M., "Acne is Not Associated with Yet-Uncultured Bacteria" *J. Clin. Microbiol.*, 2008, 46(10), pp. 3355-3360.*
- (Continued)

Prior Publication Data
US 2008/0305004 A1 Dec. 11, 2008

- (57) **ABSTRACT**
A method for inactivating medically important Gram-positive bacteria including Methicillin-resistant *Staphylococcus aureus* (MRSA), Coagulase-Negative *Staphylococcus* (CONS), *Streptococcus*, *Enterococcus* and *Clostridium* species, comprising exposure to visible light, and in particular light within the wavelength range 400-500 nm.

Hamamatsu Xenon Lamp Spectrum (Entire Spectrum)



US09839706B2

(12) **United States Patent**
Anderson et al. (10) Patent No.: **US 9,839,706 B2**
(45) Date of Patent: ***Dec. 12, 2017**

- (54) **INACTIVATION OF GRAM-POSITIVE BACTERIA** (52) **U.S. Cl.**
- (71) Applicant: **University of Strathclyde**, Glasgow (GB)
- (72) Inventors: **John Galloway Anderson**, East Kilbride (GB); **Michelle Maclean**, Glasgow (GB); **Gerald Alexander Woolsey**, Queensland (AU); **Scott John MacGregor**, Glasgow (GB)
- (73) Assignee: **University of Strathclyde**, Glasgow (GB)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.
This patent is subject to a terminal disclaimer.
- (21) Appl. No.: **14/657,398**
- (22) Filed: **Mar. 13, 2015**
- (65) **Prior Publication Data**
US 2015/0182646 A1 Jul. 2, 2015
- Related U.S. Application Data**
- (63) Continuation of application No. 11/997,227, filed as application No. PCT/GB2006/002841 on Jul. 28, 2006, now Pat. No. 9,039,966.
- (30) **Foreign Application Priority Data**
Jul. 29, 2005 (GB) 0515550.2
- (51) **Int. Cl.**
A61N 9/00 (2006.01)
A62B 7/08 (2006.01)
- (52) **U.S. Cl.**
CPC **A61N 5/06** (2013.01)
- 4 Claims, 16 Drawing Sheets**

- AG1L 2/084 (2013.01); AG1L 9/18 (2013.01); AG1L 5/06 (2013.01); AG1L 2/0052 (2013.01)
- (58) **Field of Classification Search**
CPC A61L 2/084; A61N 5/06
See application file for complete search history.
- (56) **References Cited**
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- 3,926,556 A 12/1975 Boucher
4,910,942 A 3/1990 Dunn et al.
- (Continued)
- FOREIGN PATENT DOCUMENTS**
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- (Continued)

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- AU 2006273860 B2 4/2012
CA 2617205 A1 2/2007
- (Continued)

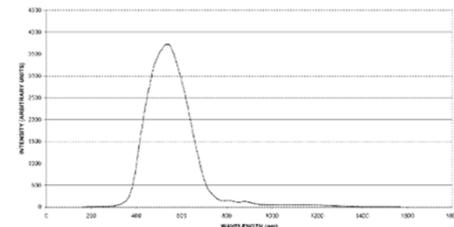
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- (Continued)

Prior Publication Data
US 2015/0182646 A1 Jul. 2, 2015

- (57) **ABSTRACT**
A method for inactivating medically important Gram-positive bacteria including Methicillin-resistant *Staphylococcus aureus* (MRSA), Coagulase-Negative *Staphylococcus* (CONS), *Streptococcus*, *Enterococcus* and *Clostridium* species, comprising exposure to visible light, and in particular light within the wavelength range 400-500 nm.

Hamamatsu Xenon Lamp Spectrum (Entire Spectrum)



Kenall /Univ. Strathclyde Lawsuits: 3 Patents

1. A lighting device with at least one first-element that emits visible light at a wavelength and irradiance sufficient to inactivate one or more pathogenic bacterial species, and at least one second element that emits light of one or more longer wavelengths to that of the first-element, wherein the at least one second element has a higher illuminance than that of the at least one first element.

1. A method for disinfecting air, contact surfaces, or materials by inactivating methicillin-resistant *Staphylococcus aureus* (MRSA) in the air, on the contact surfaces, or on the materials, said method comprising exposing the MRSA to visible light without using a photosensitiser, wherein the visible light for inactivating the MRSA consists of wavelengths in the range of 400-420 nm, and wherein the method is performed outside of a human body, the contact surfaces or the materials are non-living, and the air, contact surfaces or materials are not exposed to a disinfecting dose of light at a wavelength above 500 nm.

'706 Patent (Found Invalid):

1. A method for disinfecting air, contact surfaces or materials by inactivating one or more pathogenic Gram-positive bacteria in the air, on the contact surfaces or on the materials, said method comprising exposing the one or more pathogenic Gram-positive bacteria to visible light without using a photosensitizer, wherein the one or more pathogenic Gram-positive bacteria are selected from the group consisting of Methicillin-resistant *Staphylococcus aureus* (MRSA), Coagulase-Negative *Staphylococcus* (CONS), *Streptococcus*, *Enterococcus*, and *Clostridium* species, and wherein a portion of the visible light that inactivates the one or more pathogenic Gram-positive bacteria consists of wavelengths in the range 400-420 nm, and wherein the method is performed outside of the human body and the contact surfaces or the materials are non-living.

Kenall /Univ. Strathclyde: False Advertising

45. In the statements set forth in paragraphs 27-29 above in Vital Vio's advertising literature and website, Vital Vio falsely represented and advertised to customers and potential customers factual attributes of Vital Vio's infringing products. Among Vital Vio's misrepresentations were those claiming that its infringing products achieve a 99% reduction in harmful bacteria in real-world, commercial environments like hospitals and healthcare facilities (the "99% Claims"). These representations imply scientific substantiation.

47. On information and belief, Vital Vio's statements, as outlined in paragraphs 27-29 above, at best, rely on testing in highly controlled, laboratory environments and those results do not support the 99% Claims, including the effects of visible light on harmful bacteria in a hospital or healthcare facility settings.

48. Vital Vio, through the 99% Claims, as outlined in paragraphs 27-29 above, gives the false and misleading impression that Vital Vio's infringing products achieve a 99% reduction in harmful bacteria in a hospital or healthcare facility setting, similar to the capabilities of the episodic method of using an ultraviolet robot to disinfect.

Kenall /Univ. Strathclyde Lawsuits: Status

- Voluntarily dismissed against Vital Vio (2016), New Star (2018)
- Settled with Visa Lighting (May 2020) with agreement to discontinue use of Vital Vio tech.

Kenosha, Wisconsin (May 13, 2020) – Kenall Manufacturing and Visa Lighting mutually agreed to settle their pending litigation concerning visible light disinfection technology.

Visa Lighting has ceased its relationship with Vital Vio, Inc., will cease selling its current disinfecting products and will discontinue the use of technology from Vital Vio, Inc.

Patrick Marry, President of Kenall stated, " Kenall is pleased to resolve this disagreement with Visa Lighting. We look forward to a cooperative future with Visa Lighting."

- Clear-Vu continues:
 - 2018: IPRs on all three patents, only instituted as to '706 patent (newest, method). Institution denied for other two on procedural grounds
 - June 2020: PTAB held all four claims of '706 patent unpatentable
 - Sept. 8, 2020: Univ. of Strathclyde appealed PTAB's decision to Federal Circuit, currently pending

Class Action Lawsuit: UV Sanitizer USA



#1 Premium UV Sanitizer Wand

(100,000 Units Sold in the USA)

Protect Yourself Wherever You Go!



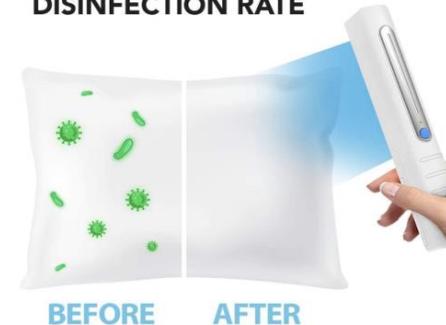
Who: Garbus (individual class representative)
-versus-
UV Sanitizer USA LLC

What: Various claims including deceptive business practices & false advertising (NY), breach of express warranty (every state), negligent misrepresentation (common law), Magnuson-Moss Warranty Act (15 USC § 2301), unjust enrichment (common law)

Where: Eastern Dist. of NY

When: Nov. 4, 2020 – Present

99.9% LAB-TESTED
DISINFECTION RATE



Class Action Lawsuit: UV Sanitizer USA

- Complaint includes the following claims from UV Sanitizer's marketing materials:

**Our UV Light Sanitizer™ is
Laboratory Tested to Eliminate Up to
99.99% Viruses, Germs, and Bacteria**

- ✔ Kills **99.99%** of bacteria, germs, viruses using ultraviolet light.
- ✔ **Reduces you and your loved ones** chances of getting sick.
- ✔ **Small and Portable.** Bring it wherever you go.
- ✔ Join the **1,000,000 members** who also use our UV Light Sanitizer.
- ✔ Save **cleaning wipes** and disinfecting chemicals.

**KILLS UP TO 99.9% OF HARMFUL BACTERIA, VIRUS,
GERMS, ALLERGENS AND MOLDS**

Eliminate Any Harmful Bacteria and Virus !

– **Is UV Light Sanitizer™ Safe?**

UV Light devices are widely used in hospitals and are 100% safe.

Rest assured that our UV Light Sanitizer Wands are completely safe to use: they have the approval of the SGS and they have been thoroughly lab-tested. They have been developed and produced in an FDA approved facility to ensure your well-being is taken care of.

Class Action Lawsuit: UV Sanitizer USA

Allegations include:

- “[T]he Product does not eliminate any harmful bacteria and viruses, nor does it kill 99.99% of viruses, bacteria, germs and molds,” relying upon FDA guidance for surface disinfection warning of blocking from dust and other contaminants and states “FDA has made it clear that UV disinfecting devices are intended to augment disinfection of surfaces *after manual cleaning has been performed...*” Complaint at 7 (emphasis in original) (citing <https://www.fda.gov/media/136533/download>, discussed earlier).
- Safety representations “are deceptive and misleading because the Product exposes consumers to potentially harmful UV radiation...”, noting the Product uses UV-C at ~254 nm. Cites UL, NEMA, American Lighting Association and journal articles regarding safety risks. Complaint at 8-9.

UV-C Lighting Products Are Here

59S®

The Pioneer of LED Sterilization

Just change your light

Prevent contamination to ensure the safety
of family members and employees



99.9%

kills up to 99.9%*
of all germs

59S® | SunClean™ Lighting

**The World's First Lighting
That Disinfects**



Source: <https://www.59s.com/products.html>

UV-C Lighting Products Are Here

59S®
The Pioneer of LED Sterilization



sales@59s.com

info@59s.com

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SunClean Downlight (American)



Item Specifics:

Light-Power: 11W/14W

Color Temperature: Warm white, cool white, and natural white

UV-Energy: 180mW

Disinfection Modes: 20-min Automatic mode, 2-hrs Intensive mode

Operation Modes: Manual switch mode / radar sensor automatic mode

Body Color: White

Dimension: 4"Φ130 x 82mm (5.12 x 3.23in), 6" (Φ7.4 x 3.54in)

Weight: 215(7.58oz), 280g(9.87oz)

Certifications: FCC CE

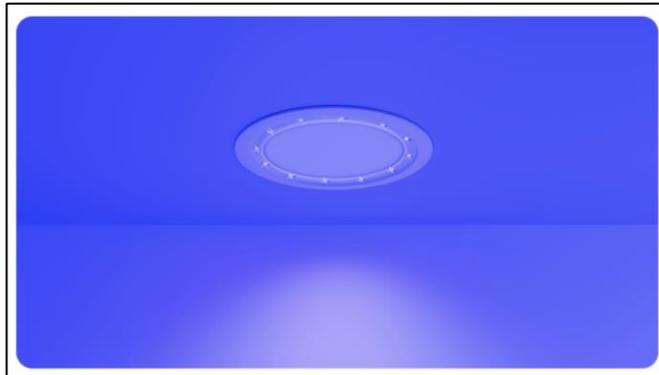
Warranty: 2 Years

Control Mode

Toggle the switch ON and OFF to control.



Exhibition Inform



Disinfection Mode

2-hour Disinfection Mode: Flip the switch ON-OFF-ON within 3 seconds to turn on. Disinfection stops automatically after 2 hours.

20-min Auto-Disinfection Mode: Flip the switch ON-OFF-ON-OFF-ON within 3 seconds to turn on. Illuminates while you are there, disinfects automatically when you leave.



David Radulescu, Ph.D.

David@radip.com

646-502-5951



Radulescu LLP

Patent
Litigators