

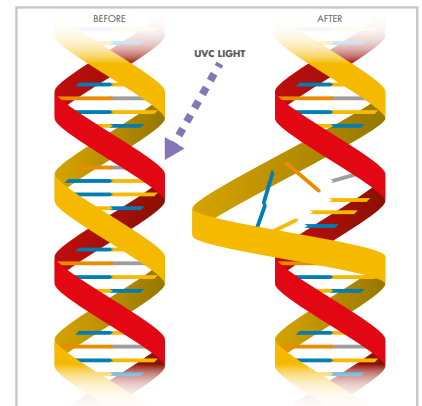
## Case Study

### How UVC Radiation Battles Viruses

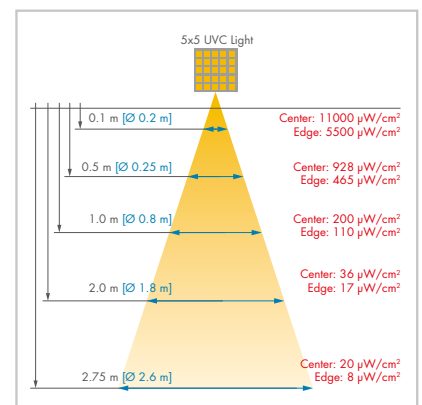
Like all viruses, the corona pathogen SARS-CoV-2 can only reproduce with the help of a host. Cells infected by the virus are “reprogrammed” by its ribonucleic acid (RNA) to produce new viruses. These are then released in the body and infect other cells. The host cells are destroyed by the reproduction process, which causes disease in the host body. Since each virus only attacks certain cell types, different disease patterns are triggered; in the current epidemic, for example, the respiratory organs are affected.<sup>1</sup>

UVC is high-energy, short-wave radiation in the wavelength range between 100nm and 300nm. In the range of from approximately 250nm to 290nm, it is absorbed by the RNA strands of the virus. This ensures that in the pyrimidine bases – thymine and cytosine – neighboring molecules “clump” together<sup>2</sup>. This prevents the cells from reproducing or even kills them. In either case, the virus is no longer dangerous because it only causes damage when it multiplies.

The natural UVC radiation of sunlight is absorbed by the ozone layer of our atmosphere. Therefore, neither organisms nor viruses have developed protective mechanisms against it. Irradiation with artificially produced UVC is, therefore, a particularly effective method of sterilization and disinfection. The intensity of UV radiation is inversely proportionate to the square of the distance. Thus, it quickly loses its effect as the distance from the source increases<sup>3</sup>. The irradiated object should, therefore, be as close as possible to the emitter.



UVC radiation destroys the nucleic acids, thus rendering the virus harmless.



The intensity of UVC radiation is decreasing rapidly with its distance from the source.

- [https://de.wikipedia.org/wiki/Viren#Vermehrung\\_und\\_Verbreitung](https://de.wikipedia.org/wiki/Viren#Vermehrung_und_Verbreitung)
- [https://en.wikipedia.org/wiki/Pyrimidine\\_dimer](https://en.wikipedia.org/wiki/Pyrimidine_dimer)  
<https://de.wikipedia.org/wiki/Thymin#Thymin-dimer>
- [https://en.wikipedia.org/wiki/Ultraviolet\\_germicidal\\_irradiation](https://en.wikipedia.org/wiki/Ultraviolet_germicidal_irradiation)

## UVC Disinfection Tent – Application in Wuhan

In the Huoshenshan Clinic in Wuhan, a disinfection tent equipped with UVC LEDs was used to disinfect the protective clothing of hospital staff for the first time this year as part of the effort to get the corona pandemic under control. The aim was to contain the spread of the SARS-CoV-2 pathogen as far as possible outside the isolation ward. Germicidal UVC LEDs from the US manufacturer Bolb, Inc. were used in the facility. Peter Gordon, development director at Bolb, Inc., answers some of the frequently asked questions (FAQs) about this application.

### Question: What exactly does the disinfection facility look like?

Peter Gordon: It is a room measuring 1.5m x 0.75m x 2m (l/w/h) with softshell walls. Flat, high-performance UVC LED arrays are mounted on the reflective surfaces of the ceiling and walls. There is also a floor plate with the same emitters on which the person stands during decontamination. With a simple and safe DC power source, the tents are also suitable for fast, mobile use.

### Question: How much power do the LEDs require?

Peter Gordon: A continuous intensity of 200  $\mu\text{W}/\text{cm}^2$  was generated in the tent used. During an irradiation time of 30 seconds, a dose of 6 mJ/cm<sup>2</sup> is thus emitted. Since each germ reacts differently to UVC radiation, the intensity and irradiation time must be adjusted accordingly to achieve the desired reduction rate. The most effective method is of course a combined application as a supplement to other disinfection methods.

### Question: Have your germicidal LEDs been developed specifically for applications in connection with corona?

Peter Gordon: No. They were originally intended for use against multi-resistant bacteria such as methicillin-resistant *Staphylococcus aureus* (MRSA). In this area, US laboratories have proven how effective germicidal LEDs are. The corresponding reports are available to us. Their effectiveness against viruses is currently being tested in China in connection with corona. At the same time, identical tests are being carried out in the USA. We are aware that the results from China and the USA will have to be reassessed in other regions according to their standards. To our knowledge, similar tests are currently being carried out in Germany (e.g., by the Technical University of Munich at Rechts der Isar Hospital).



One 5x5 LED Array from Bolb provides powers up to 2.5 W.



Light shower in the Huoshenshan Clinic, Wuhan, China.

**Question: Which wavelengths are used?**

Peter Gordon: Bolb's germicidal UVC LEDs emit UV light with wavelengths from 265 nm to 280 nm. This range of the electromagnetic spectrum is very close to the absorption maximum of RNA, thus effectively destroying its genetic information. The virus is unable to spread and infect cells, thus rendering it harmless.

**Question: Is UVC radiation also dangerous for humans?**

Peter Gordon: Yes. UVC radiation can cause burns on unprotected skin. In the case of corona disinfection, the primary concern is to treat the protective suits worn by medical staff. While they are exposed to the radiation, doctors and nurses are protected by the suit. For safety reasons, a reflective strip is attached to the protective visor which starts to glow under UV light. This makes the invisible radiation visible, and the operating personnel can ensure that the decontamination chamber is activated long enough to achieve the desired effect.

The information presented here is based on the experience of Bolb, Inc.'s customers and was provided to us by the manufacturer.

For more information, visit: <http://www.iuva.org/COVID-19>

**Please contact LASER COMPONENTS if you have any other questions.**