



# uvvmedico

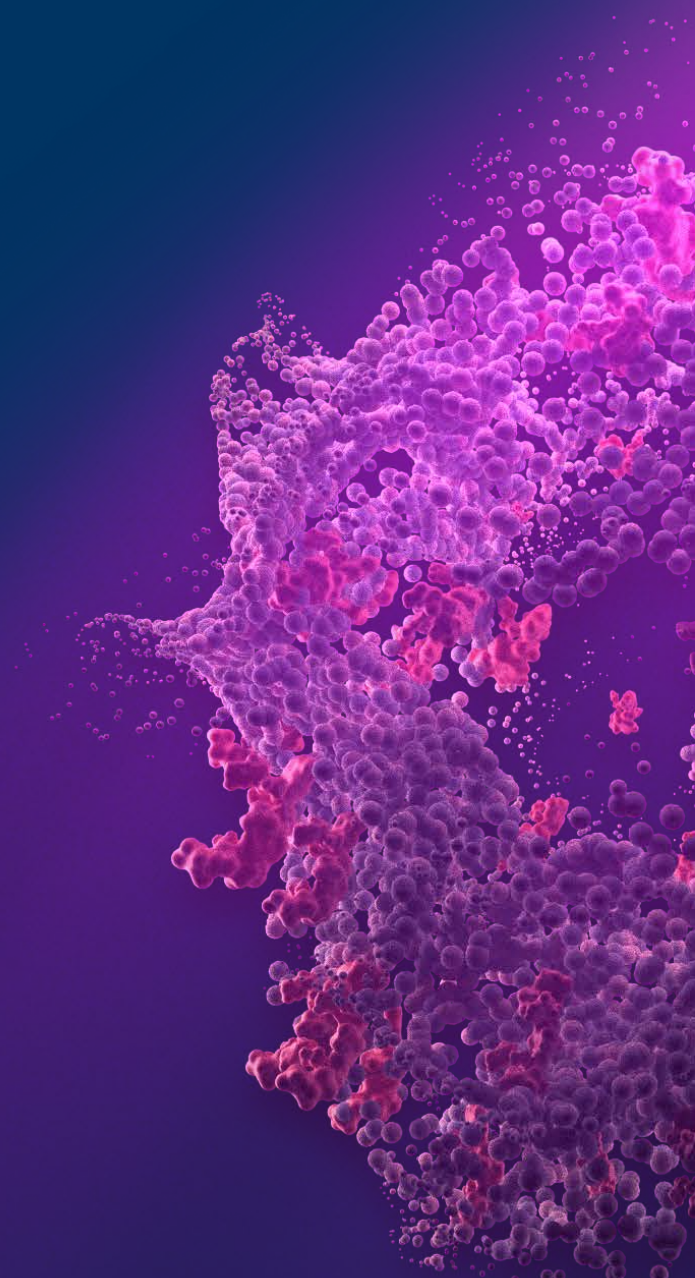
For a safer and healthier future



# Far UVC: safety, efficacy and availability

Nicolas Volet  
Co-founder, CTO

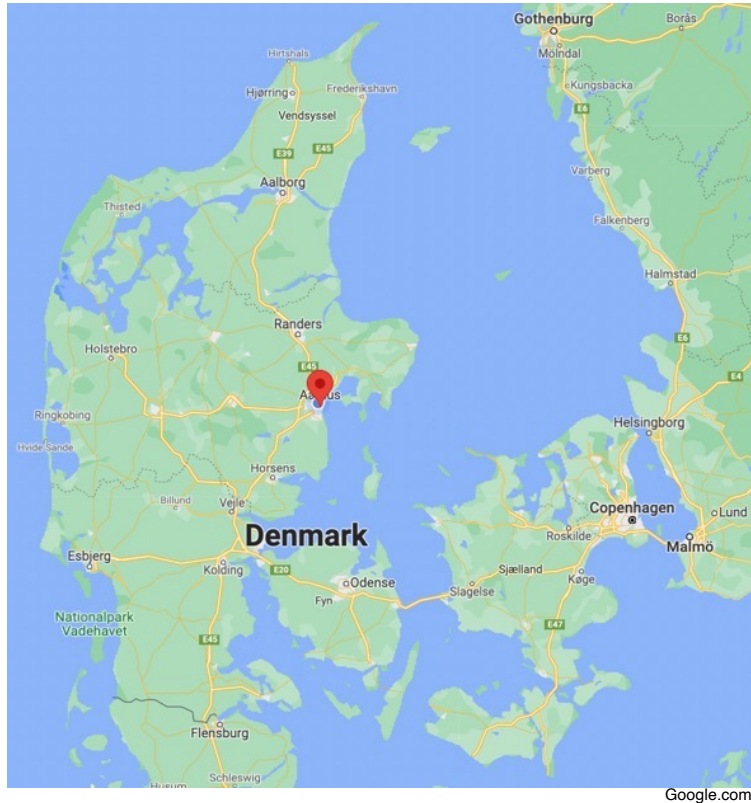
[www.uvmedico.com](http://www.uvmedico.com)





# Aarhus, Denmark

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- Aarhus University: 38'000 students  
Department of ECE: established in 2021

# Outline

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1) Present

2) Past

3) Future

Proud members of:



Partners with:



Funded by:



# Our mission

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**Fight the spread of infectious  
diseases with human-safe UV light**



UV MEDICO supporting sport teams

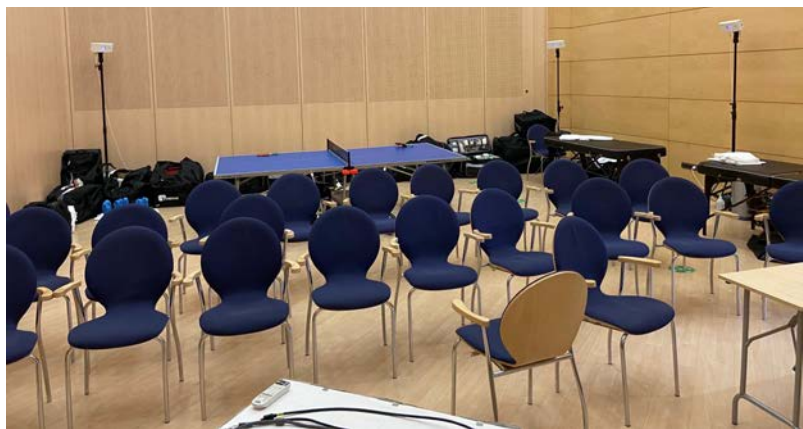
# 2022 European Handball Championship

Jan. 13–30, 2022



**In order to protect  
The Danish Team**

**10 x UV222 lamps have  
been installed in the  
dressing rooms of:  
- MVM Dome of Budapest**



# Danish national handball team



# 2022 European Handball Championship



Landsholdets corona-trick: Sådan snyder de smittekaos

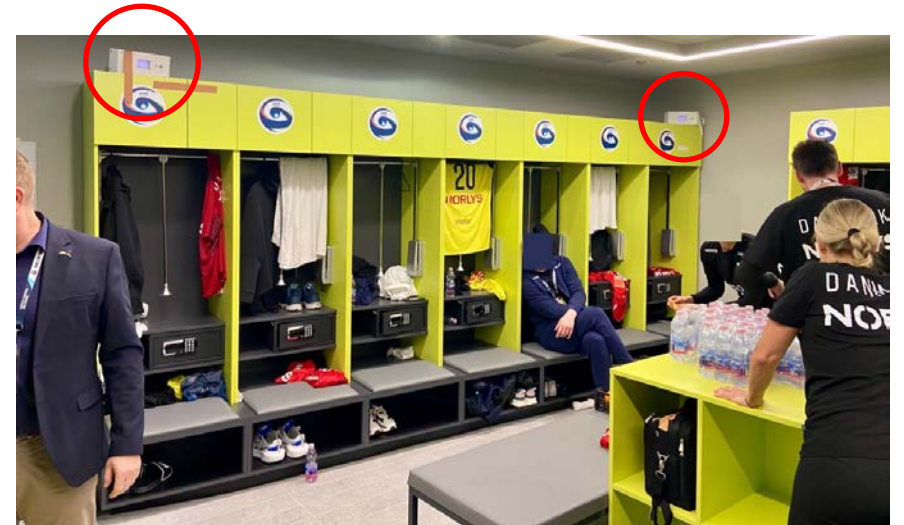
bt.dk • 3 min read

[www.bt.dk/haandbold/landsholdets-corona-trick-saadan-snyder-de-smittekaos?fbclid=IwAR1uwFNmKqxSyAVtxTytam50FJZXfWkorFZUxkjodmRiIRn1GFQOtHRAF1E](https://www.bt.dk/haandbold/landsholdets-corona-trick-saadan-snyder-de-smittekaos?fbclid=IwAR1uwFNmKqxSyAVtxTytam50FJZXfWkorFZUxkjodmRiIRn1GFQOtHRAF1E)

Jan. 25, 2022

*“Det danske landshold har været ét af de få lande ved EM, der stort set har været forskånet for coronasmitte.”*

“The Danish national team has been one of the few countries at the European Championships that has largely been spared corona infection.”

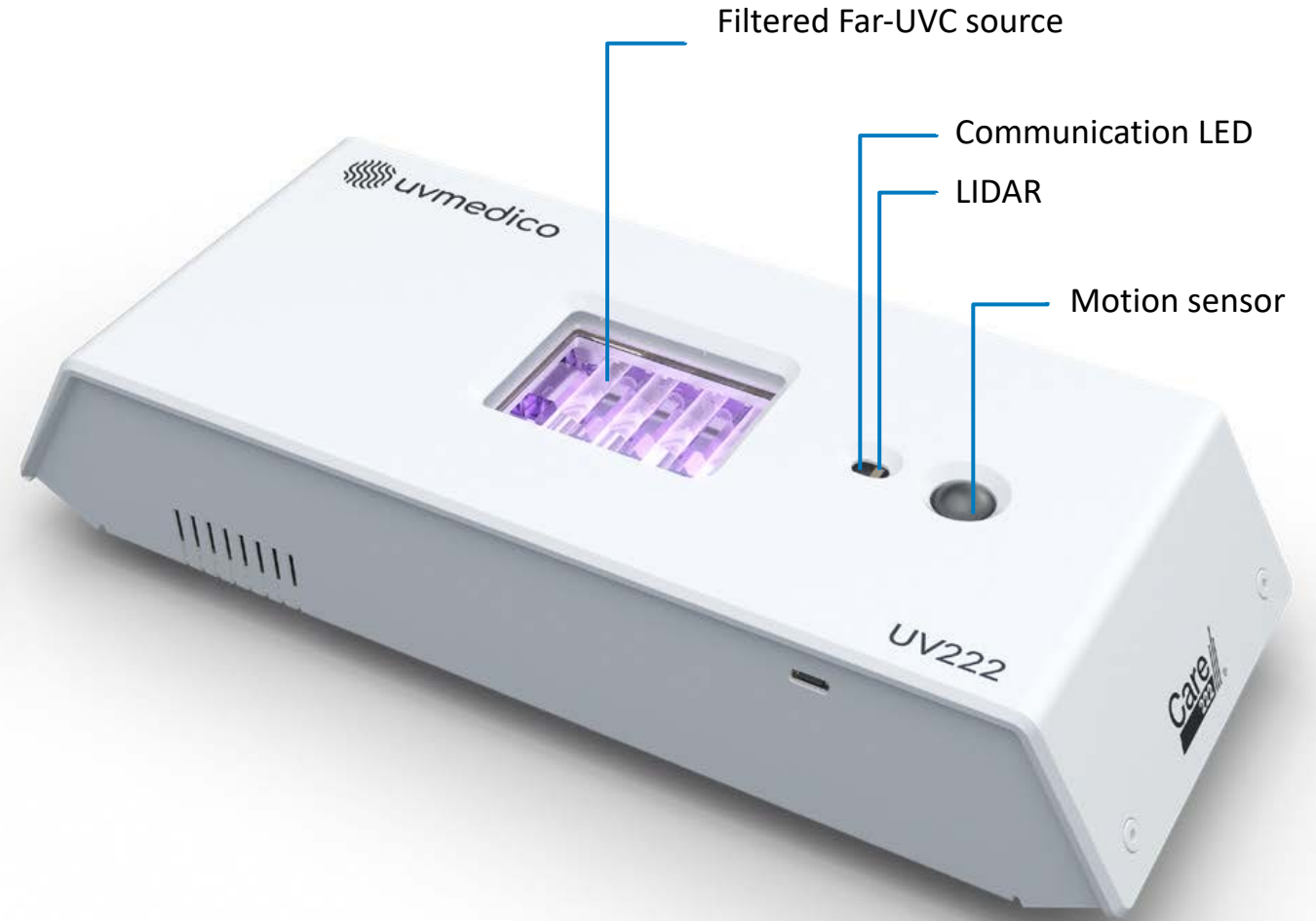




# UV222™

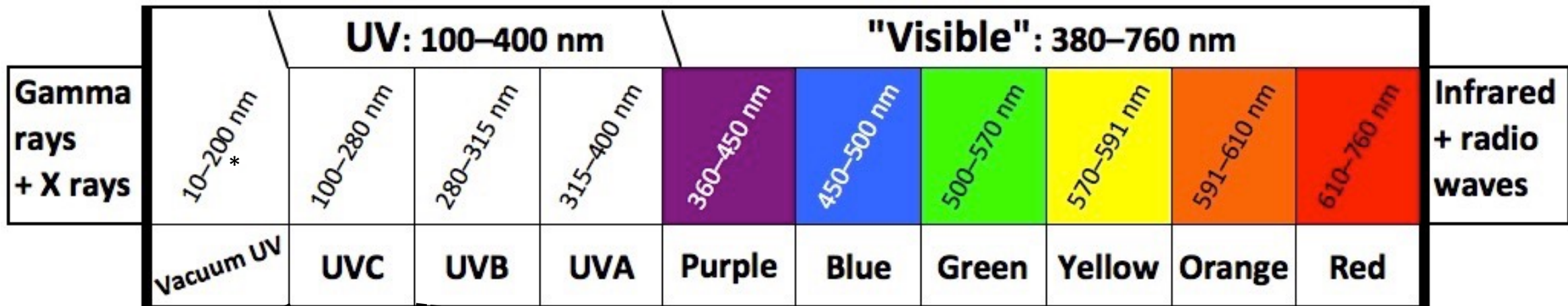
Each product is equipped with the following safety features :

- Motion sensor
- Lidar sensor – Distance to nearest object
- Intelligent software to optimize germicidal performance while continuously ensuring safety

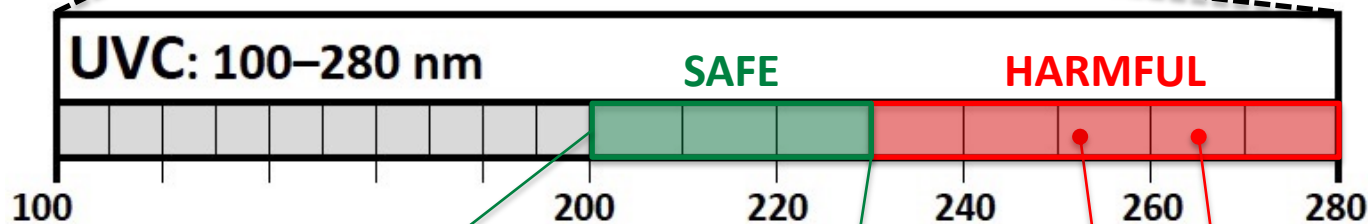


# What is “far UVC” ?

Electromagnetic spectrum



\*Wavelengths as defined by ISO 21348



Far UVC (200–230 nm):  
this spectral range is safe

UVC LEDs: 260–270 nm  
Mercury lamps: 254 nm

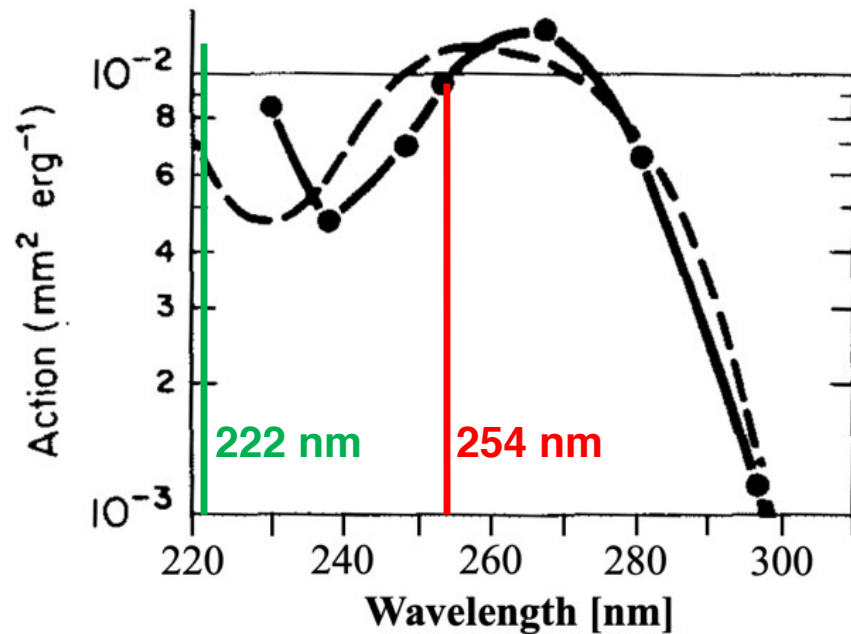
✓ UV Medico lamps  
emit at 222 nm



# UV absorption in DNA and in proteins

## ● Action spectra for killing *E. Coli*

F. L. Gates, "A study of the bactericidal action of ultra violet light" (1930).

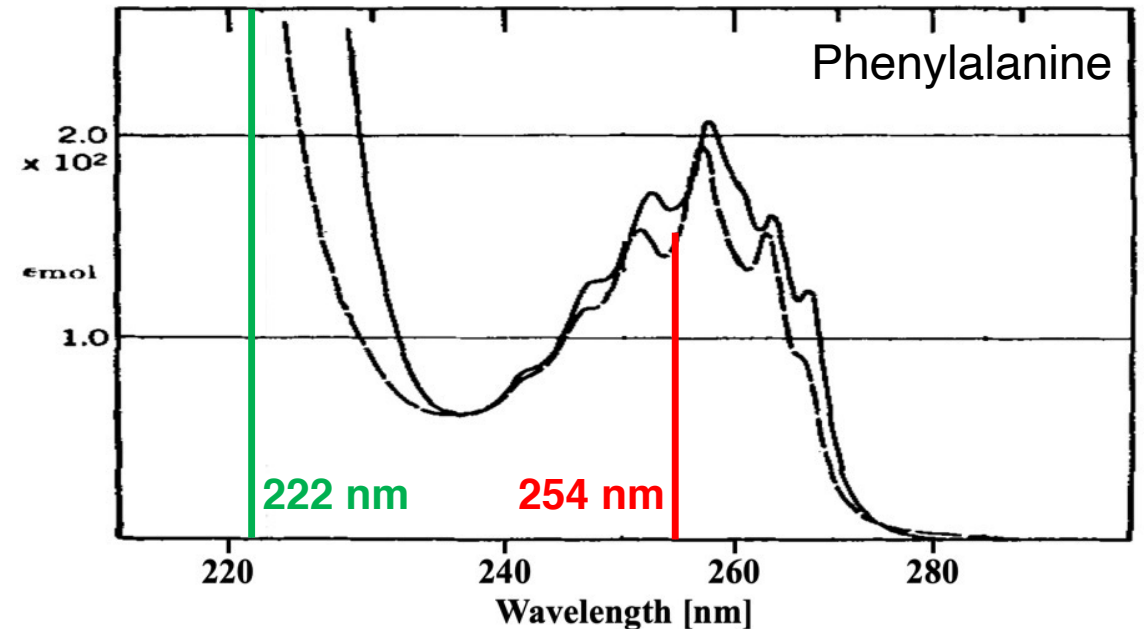


## — — — Relative absorption of DNA

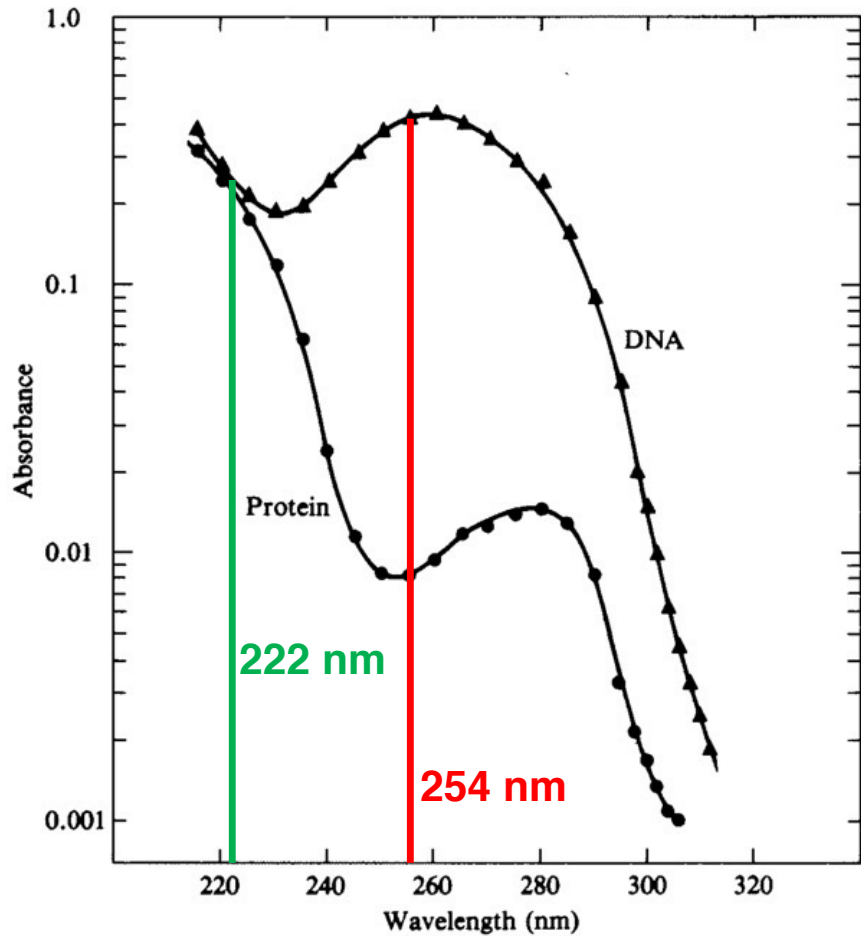
J. Jagger, "Introduction to Research in Ultra-Violet Photobiology" (1967).

## Typical absorption spectrum of amino acid

G. H. Beaven, *et al.*, "Ultraviolet Absorption Spectra of Proteins and Amino Acids" (1956).



# UV absorption in DNA and in proteins



W. Harm, "Biological effects of ultraviolet radiation" (1980).

The top layer of the eye (**cornea**) and the top layer of skin (**stratum corneum**) are dense in **proteins**.

- Proteins at **254 nm**: low absorption  
penetration through eyes and skin
- Proteins at **222 nm**: high absorption  
negligible penetration through eyes and skin

M. Clauss, *et al.*, "Higher effectiveness of photoinactivation of bacterial spores, UV resistant vegetative bacteria and mold spores with **222 nm** compared to **254 nm** wavelength" (2006).



# Tests on human cells

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M. Buonanno, *et al.*, “207-nm UV Light—A Promising Tool for Safe Low-Cost Reduction of Surgical Site Infections.”

• Columbia University

- 2013: *in-vitro* studies

“there exists a **narrow wavelength window in the far-UVC** region, around 200 nm, in which bacteria are efficiently killed, but which produces far less cytotoxic or mutagenic damage to human cells.”

- 2017: *in-vivo* safety studies

“*in-vivo* confirmation for earlier *in-vitro* based conclusions that 207 nm UV light at bactericidal fluences does not produce significant skin damage relative to controls”

# Some further studies

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N. Yamano, *et al.*, “[Long-term Effects](#) of 222-nm ultraviolet radiation C Sterilizing Lamps on Mice Susceptible to Ultraviolet Radiation” (2020).

“Our data suggest that 222-nm UVC lamps can be safely used for sterilizing human skin as far as the perspective of skin cancer development.”

- Kobe University
- Shimane University
- Ushio
- Nagasaki University

R. P. Hickerson, *et al.*, “Minimal, superficial DNA damage in [human skin](#) from filtered far-ultraviolet-C (UV-C)” (2021).

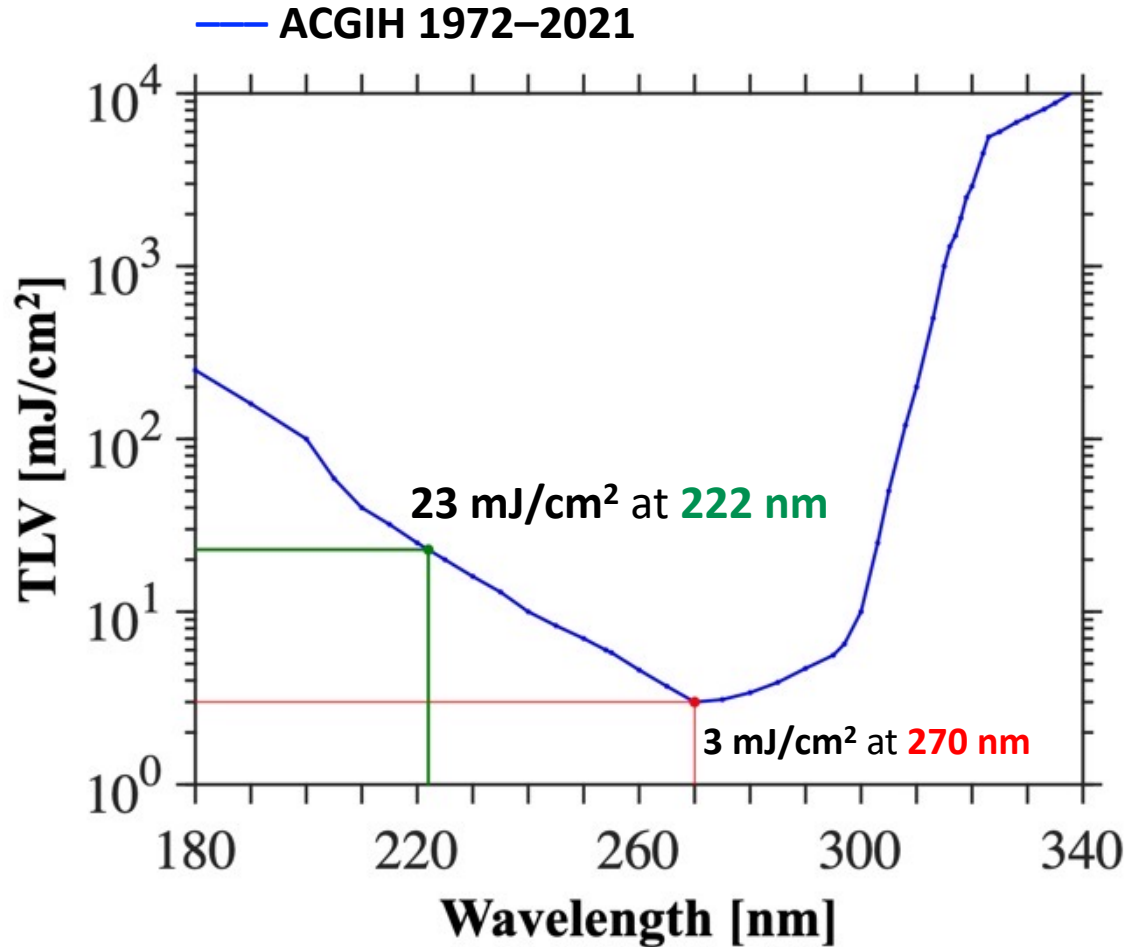
“This first-in-human demonstration of CPD location from filtered far-UV-C confirms [...] that the peak KrCl excimer emission wavelength of 222 nm does not penetrate beyond the most superficial epidermal layers.”

- University of St Andrews
- Ninewells Hospital and Medical School, Dundee



# UVC regulations

American Conference of  
Governmental Industrial Hygienists



These **threshold limit values** (TLVs) apply for a daily average exposure of 8 hours to the cornea.

- Minimum TLV of 3 mJ/cm<sup>2</sup> at **270 nm**
- **UV Medico lamps (222 nm)**: TLV of 23 mJ/cm<sup>2</sup>

If the lamp is turned on continuously for 8 hours, its irradiance should then be smaller than:

$$23 \text{ mJ/cm}^2 / (8 \cdot 60 \cdot 60 \text{ s}) \approx 0.80 \text{ } \mu\text{W/cm}^2 .$$

# What about coronavirus?

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From last slide:  
TLV at 222 nm: **23 mJ/cm<sup>2</sup>**

M. Buonanno, D. Welch, I. Shuryak, and D. J. Brenner,  
“Far-UVC light (222 nm) efficiently and **safely** inactivates airborne human coronaviruses” (2020).

- **99.9 % deactivation** of human coronaviruses was realized with doses **< 2 mJ/cm<sup>2</sup>**.

H. Kitagawa, *et al.*, “Effectiveness of 222-nm ultraviolet light on disinfecting SARS-CoV-2 surface contamination” (2021).

- **99.7 % deactivation** of SARS-CoV-2 was realized with doses of **3 mJ/cm<sup>2</sup>**.

# Need for change of regulation

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E. Eadie, *et al.*, “Extreme Exposure to Filtered Far-UVC: A Case Study” (Aug. 2020).

“These results [...] suggest that filtering longer ultraviolet wavelengths is critical for the human skin safety of far-UVC devices.”

D. H. Sliney, *et al.*, “A Need to Revise Human Exposure Limits for Ultraviolet UV-C Radiation” (Dec. 2020).

“the current TLV is clearly substantially overly conservative at wavelengths less than ~250 nm”



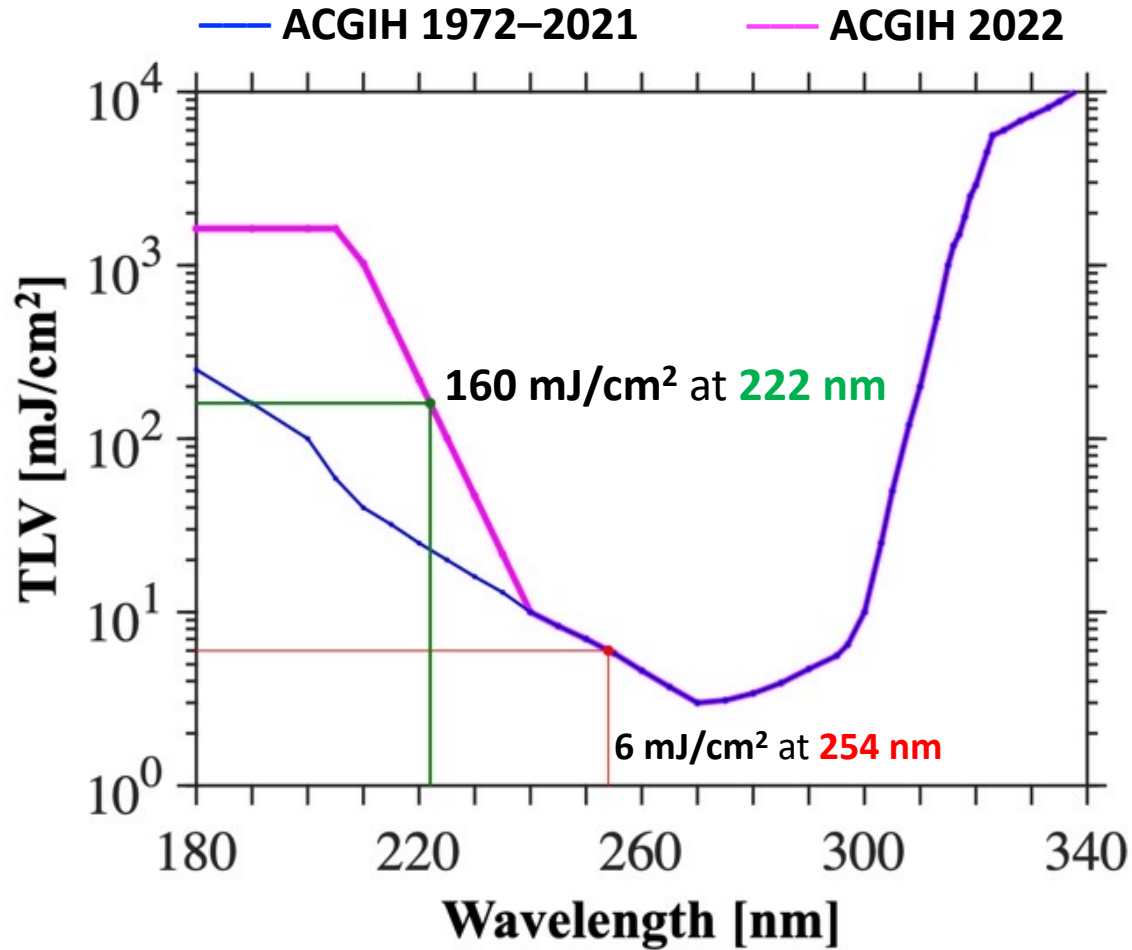
“Far UV-C Radiation: Current State-of Knowledge” (May 2021)

"there is sufficient evidence for immediate consideration of this technology during this world-wide health crisis [...] when it is properly designed, engineered, and applied."



# New UVC regulations

American Conference of  
Governmental Industrial Hygienists



These **threshold limit values** (TLVs) apply for a daily average exposure of 8 hours to the cornea.

- Low-P mercury lamps (**254 nm**): TLV of 6 mJ/cm<sup>2</sup>
- UV Medico lamps (**222 nm**): TLV of ~~23~~ mJ/cm<sup>2</sup>

According to ACGIH 2022,  
the TLV for 222 nm is now **160 mJ/cm<sup>2</sup>**

# UV Medico and Danish hospitals

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**Aarhus University Hospital**



**Kolding Hospital**



**Rigshospitalet**



# Waiting rooms of Aarhus University Hospital

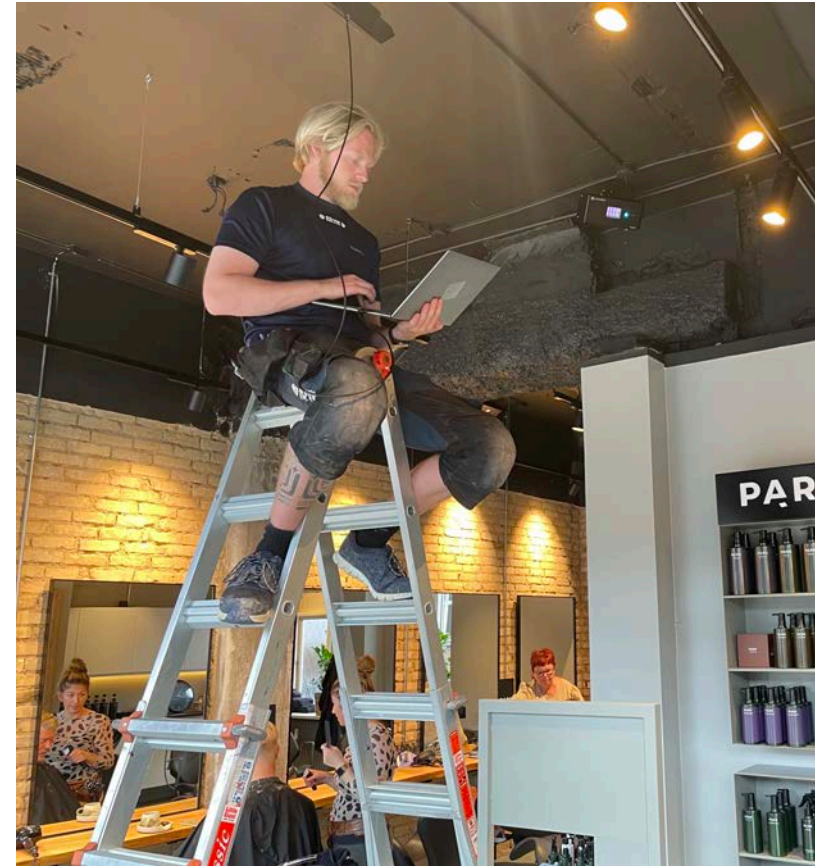
- Simulations to stay within the threshold limit value (TLV) and optimize light distribution.

- The number of colony-forming-unit (CFUs) is significantly reduced upon exposure of filtered far-UVC light.



NICOLAS VOLET  
CTO





## Installation at PARK hair salon in Horsens, Denmark



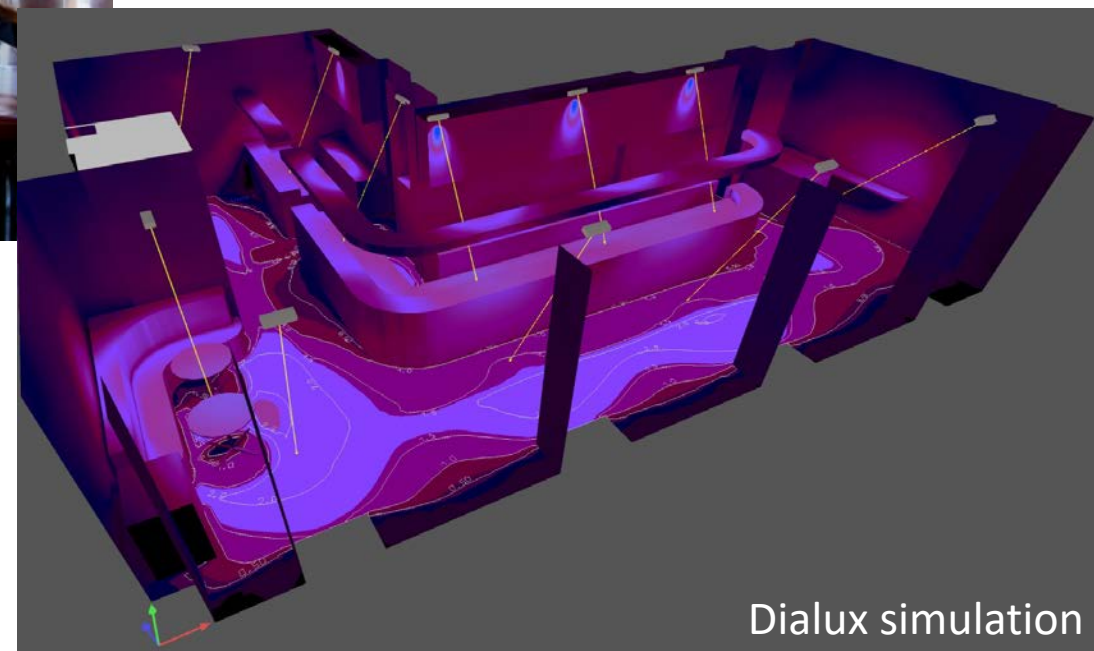




## Installation at Café Dan Turèll in Copenhagen



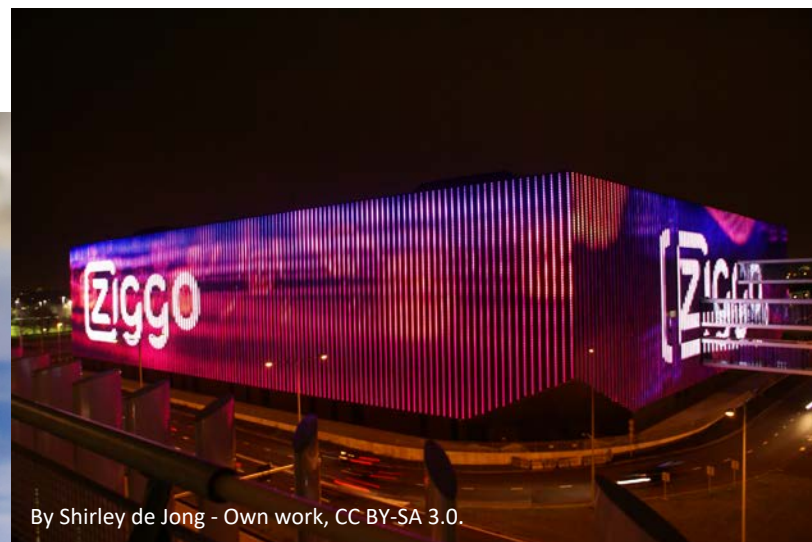
NICOLAS VOLET  
CTO



# UV MEDICO supporting sport teams

## UEFA Futsal Euro 2022 – The Netherlands

Jan. 19 – Feb. 6, 2022



**In order to protect  
16 teams**

**105 x UV222 lamps have  
been installed in the  
dressing rooms of:**

- **Ziggo Dome of  
Amsterdam**
- **MartiniPlaza in  
Groningen**



# UV MEDICO supporting sport teams

## Winter Olympic Games – Beijing

Feb. 4 – 20, 2022



In order to protect  
**Women's and  
Men's Ice Hockey  
Danish Teams**

**40 x UV222 lamps will be  
installed in the dressing  
rooms of:**

- Beijing National Indoor Stadium

