Ultraviolet light vs. COVID19: from the Sun to artificial lamps the germicidal power of ultraviolet rays against the pandemic

Results of a study carried out by the Italian National Institutute for Astrophysics (Inaf) and the University of Milano, in collaboration with Istituto Nazionale Tumori and the Don Gnocchi Foundation of Milan, for the first time demonstrate the high germicidal power of short ultraviolet radiation (UV-C) on SARS-COV-2 coronavirus. This result has important public health implications on the strategies to be adopted to manage the pandemic and clearly explaIN how decontamination and sterilization protocols to prevent SARS-Cov-2 infection must be designed. Notably, taking off from these results a second study explains the role of Sun-derived UV-B/A in conditioning the epidemiology and the wordwide evolution of the COVID-19 pandemic.

Results show that short wavelength ultraviolet light (254 nm, the so-called UV-C rays), typically produced by low cost Mercury lamps (used for example in aquariums to keep water sanitized) has excellent efficacy in neutralizing the SARS-COV-2 coronavirus. This is confirmed by a multidisciplinary experimental study that involved a group of researchers with different skills and diverse backgrounds from the Italian National Institute of Astrophysics (INAF), the University of Milan, the National Cancer Institute and the Don Gnocchi Foundation in Milan. Italy. The germicidal power of UV-C light on bacteria and viruses is well known as UV-C light inactivates pathogens as a consequence of its ability to induce the breakage of the molecular bonds of DNA and RNA chains inside microbes .

UV-C light-based systems are broadely used for the disinfection of environments and surfaces in hospitals. However a direct measure of the dose necessary to inactivate SARS-CoV-2 had not yet been calculated "*We exposed to UV light different concentrations of viruses that were resuspended into acqueous solutions*" says Mara Biasin, Professor of Applied Biology of the University of Milan "*and we found that a realatively small dose - 3.7 mJ / cm^2, equivalent to that delivered for just a few seconds by an UV-C lamp placed at a few centimeters from the target – is sufficient to inactivate and inhibit the reproduction of the virus by a factor of 1000, regardless of its concentration*". Andrea Bianco, Technologist at INAF / Brera Astronomical Observatory in Milan / Merate concludes: "*With such small doses it is possible to implement an effective disinfection strategy preventing SARS-CoV-2 infection. These data will be extremely useful to to develop systems and protocols to contain the COVID-19 pandemic*".

These result were also instrumental in validating a parallel study, coordinated by INAF and the University of Milano, that showed how the ultraviolet rays produced by the Sun modulate the epidemiology of the COVID-19 pandemic by inactivating SARS-CoV-2 contained in the droplets produced by people when they speak, cough, or sneeze. In this case, the short wavelenght UV-C ultraviolet rays (produced by the Sun but absorbed by the ozone layer of our atmosphere) do not act directly, but viral inactivation is driven by UV-B and UV-A rays with a wavelength between about 290 and 400 nanometers.

Thus, in summer just a few minutes are sufficient for Sun-derived UV-B and UV-A rays to inactivate the virus, Fabrizio Nicastro, INAF researcher at the Astronomical Observatory of Rome comments: "*Our study quite well explains how the COVID19 pandemic developed with a maximal virulence in the northern Earth hemisphere during the first months of the year while it is now moving its peak towards the countries of the southern hemisphere, where the winter has begun*". Although other factors, and in particular social distancing have likely played a role in the reduction of the infection that has been observed in Italy in the last period, it will be important to analyze whether a second wave of SARS-CoV-2 infection will be seen in autumn, when the amount of Sun-derived UV-B and UV-A rays will naturally diminish. Notably, these results are in good agreement

with the model originally proposed in 2005 by Lytle and Sagripanti in order to explain the seasonal trend of certain viruses, such as e.g. the influenza viruses.

"*These studies are of great importance in the context of combating the COVID19 pandemic and demonstrate how the integration of apparently compeletly different competences can lead to excellent results*" says Mario Clerici, of the University of Milan and the Don Gnocchi Foundation. "*The activities undertaken by Inaf and targetting t the COVID19 pandemic began last March on the specific impulse by the Ministry of University and Research to all Universities and Research Bodies. The technologies and skills developed in the astrophysical field are now applied and highly useful for civil society and are useful for industrial developments*. "observes Giovanni Pareschi of INAF / Astronomical Observatory of Brera

"*Inaf's contribution to solving the COVID-19 pandemics goes beyond the specific technological skills in dealing with radiation*" says Inaf President Nichi D'Amico with satisfaction, and continues: "*there is another deeper aspect, connected to one of the main themes of modern astrophysics, namely the search for life forms in the Universe, which with Astrobiology sees precisely the development of advanced knowledge and technologies looking for primordial life forms (i.e. organic molecules, bacteria, viruses) in the Universe in the attempt to understand the role of radiations, and in general of environmental factors, in the development of life in other worlds* ".

Pending publication in international journals, these results have been published in two preprints of the international medrxiv archive at the following URLs:

- A. Bianco, M. Biasin, G. Pareschi, et al, "***UV-C irradiation is highly effective in inactivating and inhibiting SARS-CoV-2 replication"*** – https://www.medrxiv.org/content/10.1101/2020.06.05.20123463v1
- F. Nicastro, G. Sironi, E. Antonello, et al., ***"Modulation of COVID-19 Epidemiology by UV-B and -A Photons from the Sun"***, https://www.medrxiv.org/content/10.1101/2020.06.03.20121392v1

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