SPECTRA OF THE MONTH

SPECTROSCOPY REVEALS: THE TRUTH ABOUT BLUE-LIGHT BLOCKING

CONDUCTED BY: KURT AMEKU

INTRO

BACKGROUND OF APPLICATION

Studies have shown that exposure to blue light can suppress melatonin production—the hormone that regulates our sleep cycle. While this boost in alertness can sometimes improve focus and reaction time, too much blue light late in the day can make it harder to fall asleep and reduce sleep quality.

With the rise of digital devices, we're now exposed to blue light more than ever through our phones, computers, and other screens. In response, solutions like blue-light blocking glasses and "Night Mode" settings on smartphones have become popular ways to reduce exposure. Blue-light glasses filter out part of the blue region of the visible spectrum without affecting vision, while "Night Mode" adjusts the color output of a device's RGB LEDs to emit less blue light.

This raises an important question: Are blue-light glasses still necessary if our devices already have built-in light filtering? Or does one method outperform the other?

Using spectroscopic techniques, this experiment compares the blue-light attenuation of a pair of blue-light glasses with that of a smartphone's "Night Mode" setting. The test samples (Figure 1) include a phone without a screen protector and a pair of blue-light glasses

FIGURE # 1: Samples used in this experiment included a cell phone (without a screen protector, set to full brightness) and a pair of blue-light glasses.

DESCRIPTION OF SPECTROSCOPY SETUP

The setup for this experiment (Figure 2) was based around our AvaSpec-NXS2048CL compact spectrometer, commonly known as the Nexos. This compact instrument is our next-generation photonics backbone spectrometer, designed to empower a wide range of applications in various industries. This device is built using our new semi-automated manufacturing technique that ensures higher levels of consistency and reproducibility unit-to-unit. The Nexos offers USB2.0 communication as well as RS232 and SPI communication protocols, a CMOS linear array detector, ultra-low stray light as low as 0.1%, and a signal/noise ratio of 375:1. Furthermore, this spectrometer can be customized with a wide range of gratings (13 total available) and the replaceable slit option is now standard for non-OEM units, which provides even more flexibility for a variety of application needs. The unit used in this experiment was selected to include the full visible spectrum to fully capture the light emitted from the cell phone. For this, the selected unit had a wavelength range of 320-850nm wavelength range, with the range narrowed to 420nm-700nm to focus on the region of interest. A 50-micron slit was installed for a balance of high throughput and resolution.

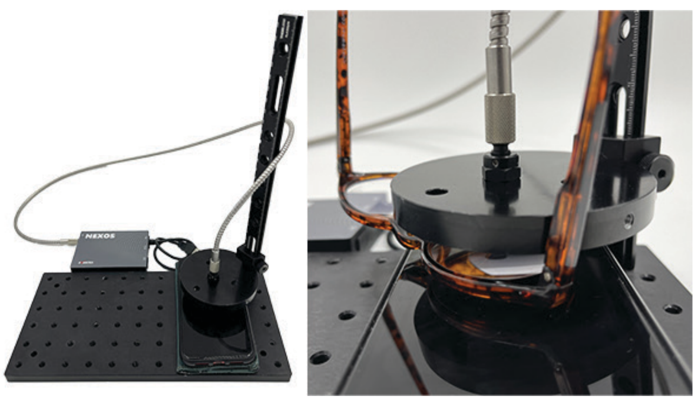

FIGURE #2 Experimental setup for transmission measurements: spectrometer pointed at the phone screen (Left) and blue-light glasses placed in-line to test blue-light blocking (Right).

The light source used for this experiment was the light emitted from a cell phone screen at full brightness. A white background for the phone was used in order to activate the full RGB range of the phone screen. Other accessories used for this experiment included a 600-micron core fiber, collimating lens, and our U.S. Transmission-Reflection (TR) Stage to hold the fiber in position and align it with the phone screen. A sufficient gap was left between the collimating lens and phone screen so the blue-light blocking glasses could be easily placed in-line to determine their performance.

DESCRIPTION OF METHODOLOGY

The cell phone used for this experiment was the personal cell phone of one of our engineers. This phone was chosen since it had no screen protector, which allowed the full light emission to be measured from the phone. The blue-light glasses were purchased from a local store to minimize potential increased efficacy from more expensive and specialized glasses. All phone measurements were taken at full brightness setting to again capture the full light emission. Measurements were taken with the "Night Mode" disabled, with it at the minimum setting, at approximately 25% shift, 50% shift, 75% shift, and full shift. For the blue-light glasses measurement, the "Night Mode" setting was disabled in order to compare the blue-light glasses light blocking to the "Night Mode" setting. Besides cleaning both the phone screen and blue-light glasses of any smudges or debris, no further preparation was done.

For data analysis, we used Transmittance mode in AvaSoft, our custom software package. While this is not a typical measurement method used for radiometric applications, such as measuring LED output, it is well suited for measuring the light-blocking capabilities of the blue-light glasses and provides a simple comparison of light transmission between the different "Night Mode" settings on the cell phone. In this measurement mode, the reference measurement will report 100% transmittance and the dark measurement will report 0% transmittance. For this experiment, the cell phone with the screen disabled was used as the dark measurement, and the cell phone screen with a white background at full brightness was used as the reference. We used an integration time of approximately 60 ms, which can be adjusted to increase or decrease the amount of light being measured at one time and affects the overall magnitude of the reported spectrum. We set averaging to 20, meaning 20 values were averaged together to provide more consistent spectra results.

TEST DATA AND RESULTS

Displayed below are the transmission spectra for each phone measurement:

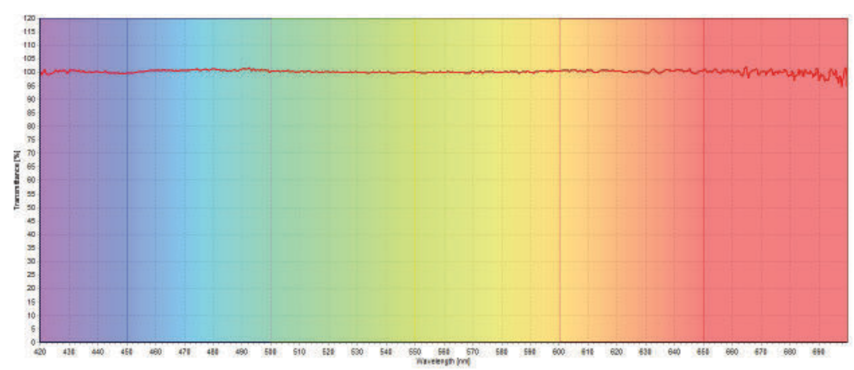

FIGURE #3: Transmission spectrum of cell phone at full brightness.

TEST DATA AND RESULTS

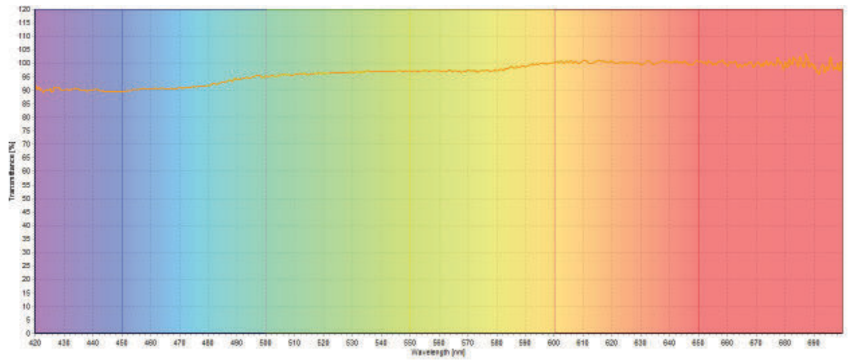

FIGURE #4: Transmission spectrum of cell phone at minimum “Night Mode”.

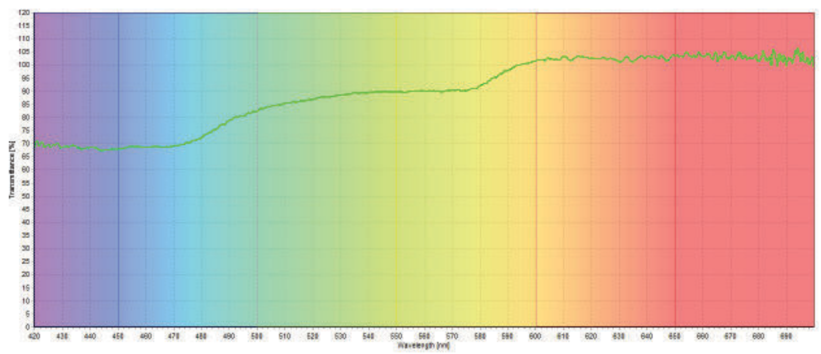

FIGURE #5: Transmission spectrum of cell phone at approximately 25% “Night Mode”.

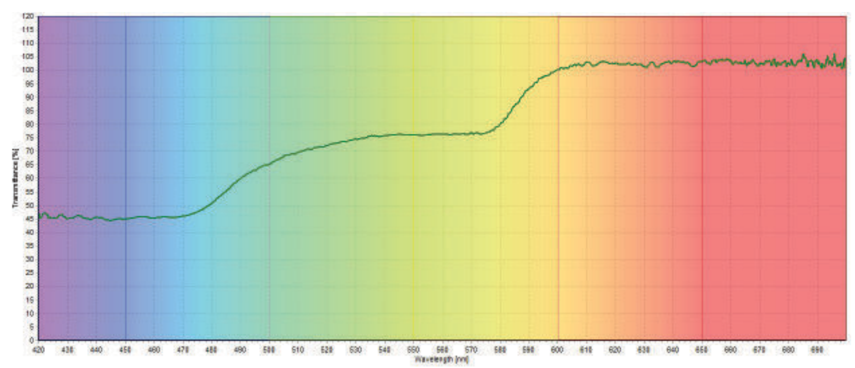

FIGURE #6: Transmission spectrum of cell phone at 50% “Night Mode”.

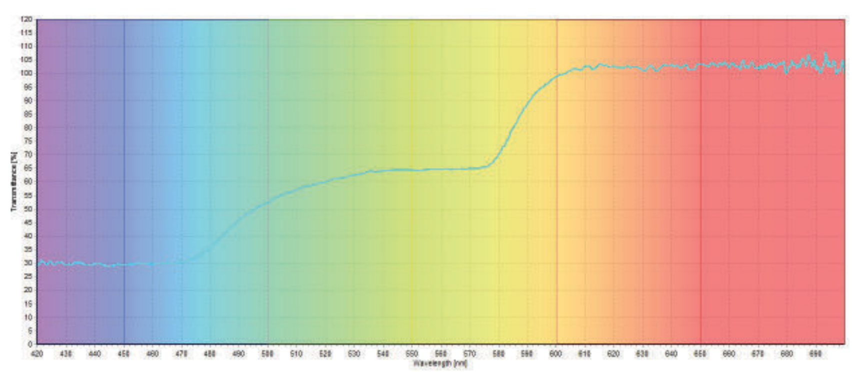

FIGURE #7: Transmission spectrum of cell phone at approximately 75%

TEST DATA AND RESULTS

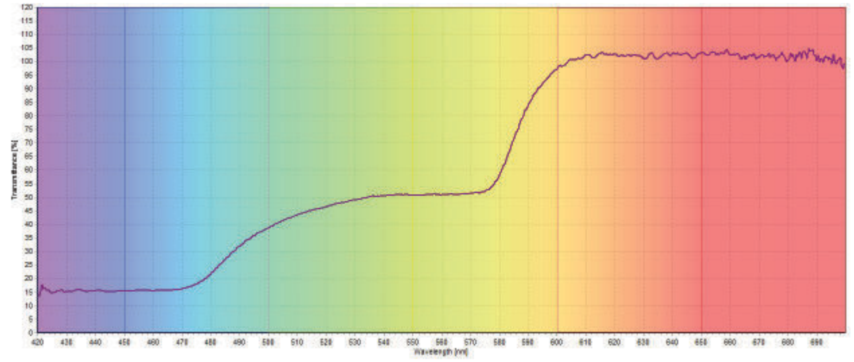

FIGURE #8: Transmission spectrum of cell phone at 100% "Night Mode".

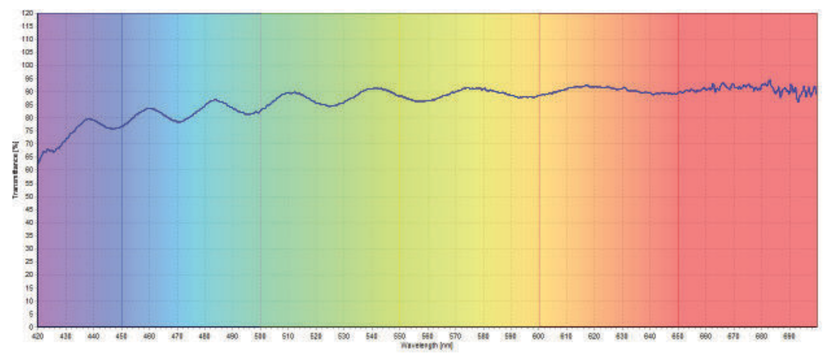

FIGURE #9: Transmission spectrum of cell phone at full brightness with blue-light glasses in-line.

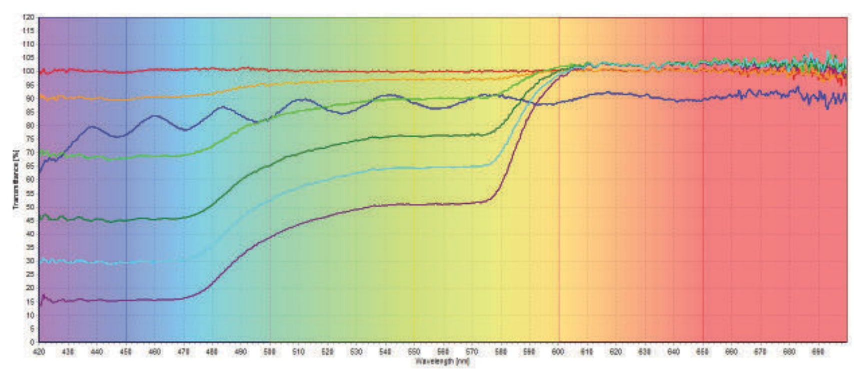

FIGURE #10: Transmission spectra of cell phone at full brightness (red), minimum "Night Mode" (orange), 25% "Night Mode" (light green), 50% "Night Mode" (dark green), 75% "Night Mode" (light blue), 100% "Night Mode" (purple), and full brightness with blue-light glasses in-line (blue), shown together for comparison.

ANALYSIS

The cell phone at full brightness served as the reference, showing ~100% transmission across the spectrum (Figure 3). Enabling "Night Mode" caused measurable attenuation: at the minimum setting, transmission dropped to ~90% in the 420–470 nm range and ~95% in 470–575 nm (Figure 4). As the setting increased, transmission decreased progressively: ~70% (420–470 nm) at 25%, ~45% at 50%, ~30% at 75%, and ~15% at 100% "Night Mode," with corresponding decreases in the 470–575 nm range (Figures 5–8).

In comparison, the blue-light glasses exhibited broader attenuation: ~80% transmission in 420–470 nm, ~85% in 470–575 nm, and ~90% in 575–700 nm (Figure 9). A combined plot of all spectra is shown in Figure 10.

Analysis reveals that while "Night Mode" primarily targets blue light, it also slightly attenuates green light—likely to maintain visual consistency on screens. The blue-light glasses, by contrast, provide broad-spectrum attenuation and display a distinct sinusoidal pattern, characteristic of thin-film interference coatings. This suggests a specialized coating designed to reduce blue light, similar to methods used in semiconductor thin-film measurements. Comparing integrals across 420–610 nm, the glasses' attenuation roughly matches a 25% "Night Mode" setting, with higher-quality glasses potentially offering stronger and more selective blue-light blocking without affecting higher-wavelength light.

CONCLUSION

In conclusion, the present experiment highlights the use of our spectrometers to measure the light transmission of blue-light glasses and directly compare them to the blue-light attenuating capabilities of a cell phone's "Night Mode" setting. Overall, the blue-light glasses had similar blue-light attenuation as the cell phone's "Night Mode" setting at approximately 25%. Interestingly, the blue-light glasses displayed a sinusoidal pattern in the transmission spectrum that can be attributed to an interference pattern of a thin film coating. Further quantification could be implemented to accurately measure the thickness of this coating and correlate how different coating thicknesses can attenuate light to different degrees. The AvaSpec-NXS2048CL is an ideal instrument for a broad range of applications and industries, including radiometric or transmission measurements. Our U.S. TR stage highlights the capabilities of our engineering team to provide custom assemblies and solutions for customer needs. Please contact Avantes for more information on the configuration that is best suited for your data collection.

CONTACT

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Avantes Headquarters
Phone: +31 (0) 313 670 170
Email: info@avantes.com
Website: www.avantes.com

Avantes Inc.
Phone: +1 (303) 410 866 8
Email: infousa@avantes.com
Website: www.avantesUSA.com

Avantes China
Phone: +86 (0) 108 457 404 5
Email: info@avantes.com.cn
Website: www.avantes.cn

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