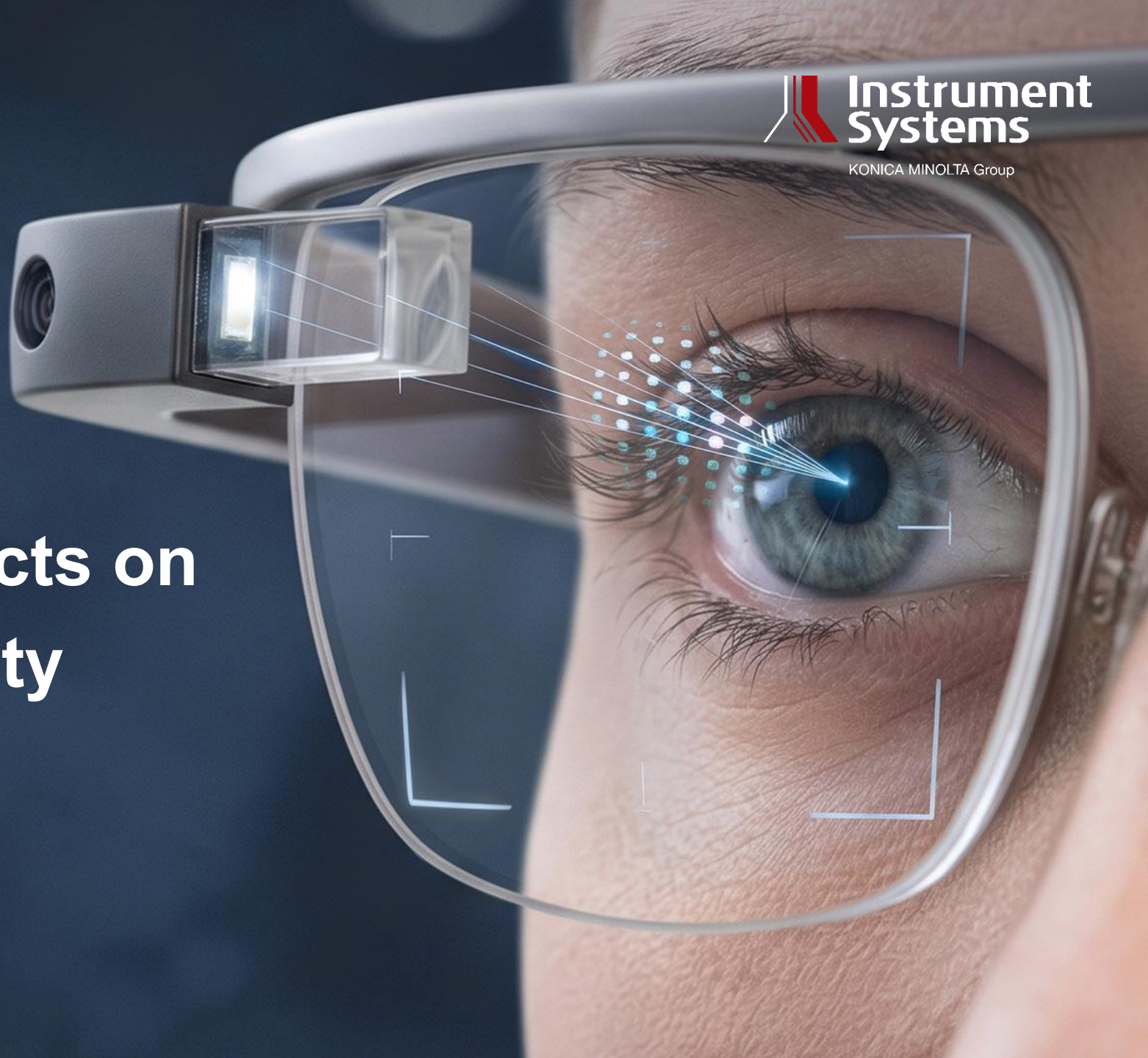


| EPIC TECHNOLOGY MEETING

Ambient Light Effects on Virtual Image Quality in AR Glasses

Sascha Reinhardt | October 2026



About Instrument Systems

- 💡 Expert in measuring light in radiometric and photometric quantities
- 📦 Member of the Konica Minolta Group since 2012
- 🏆 ISO/IEC 17025 accredited testing lab
- 🕶️ Measurement solutions for the AR/VR market

AR/VR MEASUREMENT SOLUTIONS FOR

🕶️ AR/VR devices

👁️ Near-eye displays

⚙️ Components

💻 Microdisplays

🔍 Wafer testing



Product portfolio

Theory: Additive Color Mixing in the CIE xy Diagram

Displays mix colors additively. For two colors:

Color 1: x_1, y_1 with luminance L_1

Color 2: x_2, y_2 with luminance L_2

lead to the mixed color

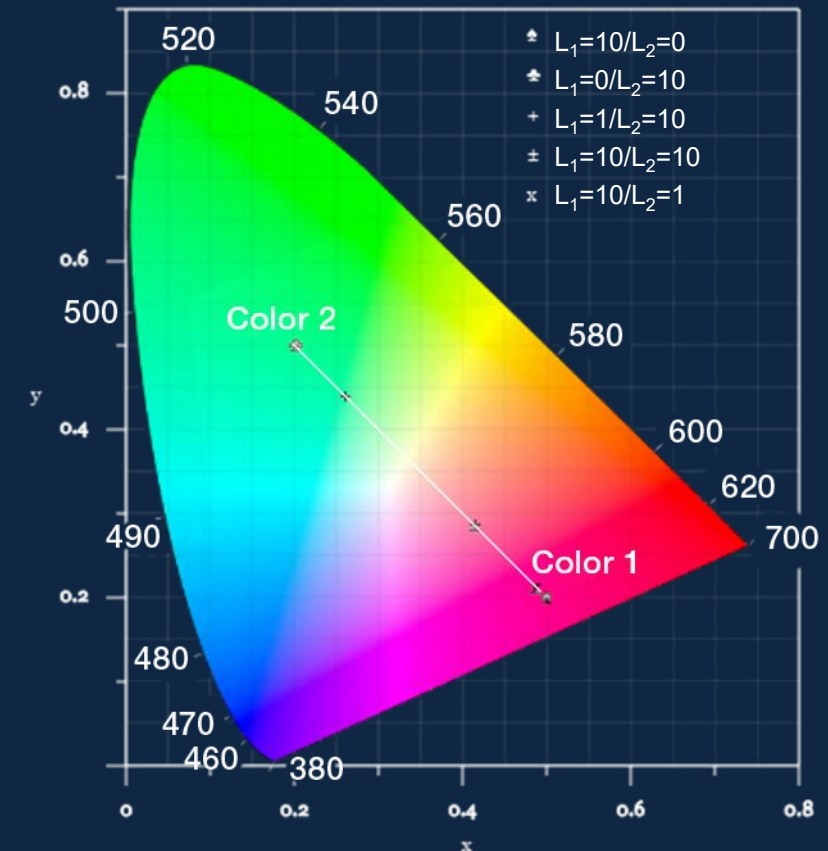
$$x_m = \alpha x_1 + (1 - \alpha) x_2$$

$$y_m = \alpha y_1 + (1 - \alpha) y_2$$

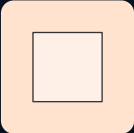
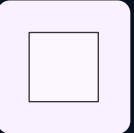
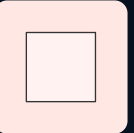
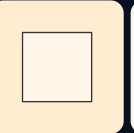
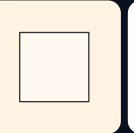
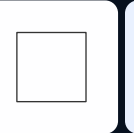
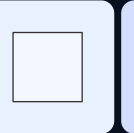
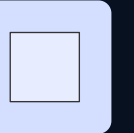
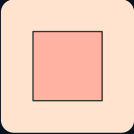
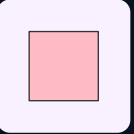
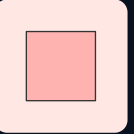
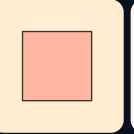
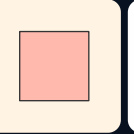
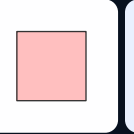
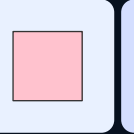
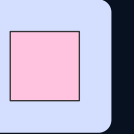
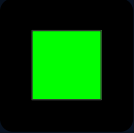
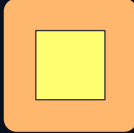
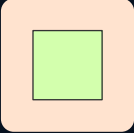
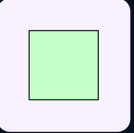
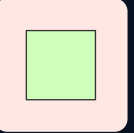
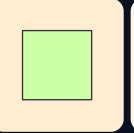
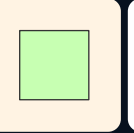
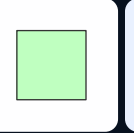
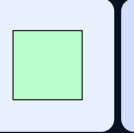
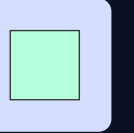
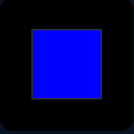
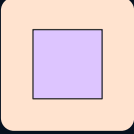
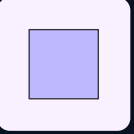
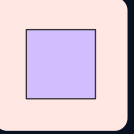
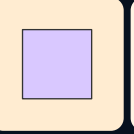
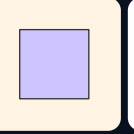
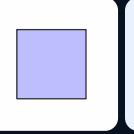
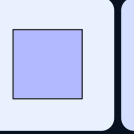
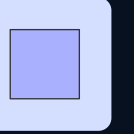
$$\alpha = (L_1/y_1) / (L_1/y_1 + L_2/y_2)$$



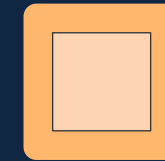
The mixed color lies on a straight line between the two colors



Color Shift Under Different Background Conditions

	Virtual image	A	B	C	E	D50	D55	D65	D75	D93
Black										
Red										
Green										
Blue										

How to read



Outer: Background illumination

Inner: Resulting virtual image color

The observed color results from the combination of virtual-image light and transmitted background light

TOP 300 AR/VR/MR Optical Probe



Production-ready

Robust, compact and lightweight



High accuracy

Luminance & color measurement with CAS spectrometer



Viewfinder camera

Integrated, 5 MP



Eye-like optics

Field of view of $\pm 1.2^\circ$



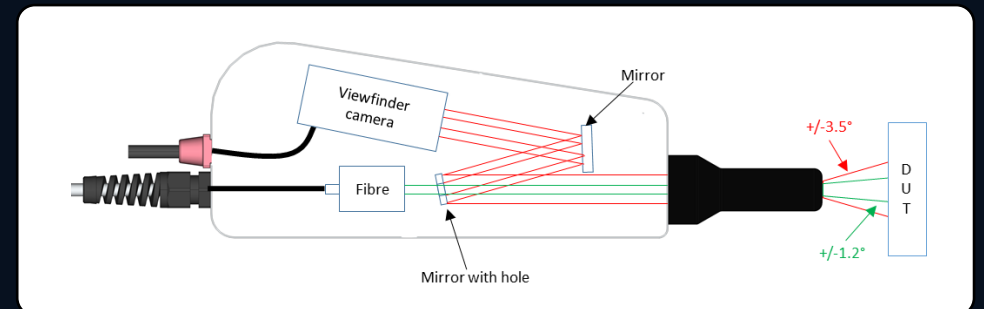
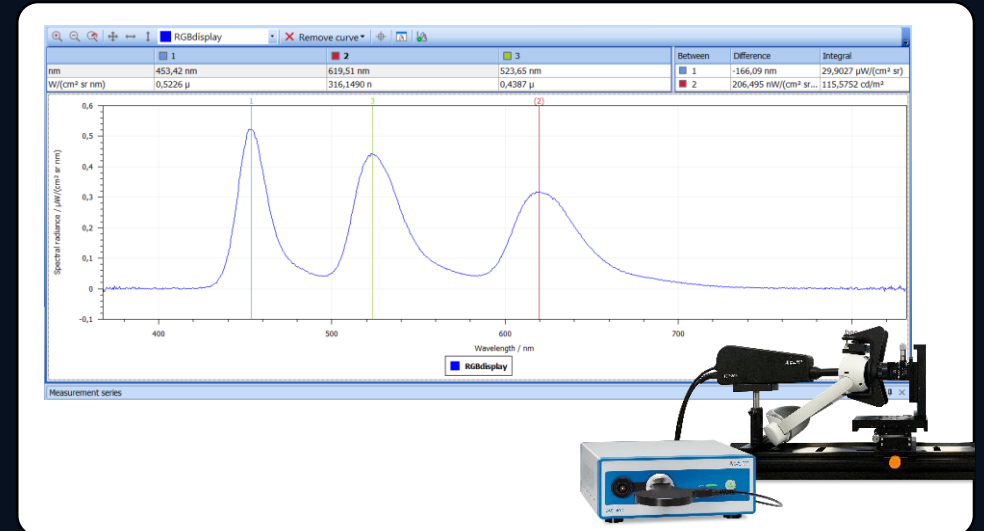
Adjustable optics

Configurable entrance pupil & focus distance



Binocular

Two-probe setup possible



Background Illumination Sources

► Sun-like spectrum

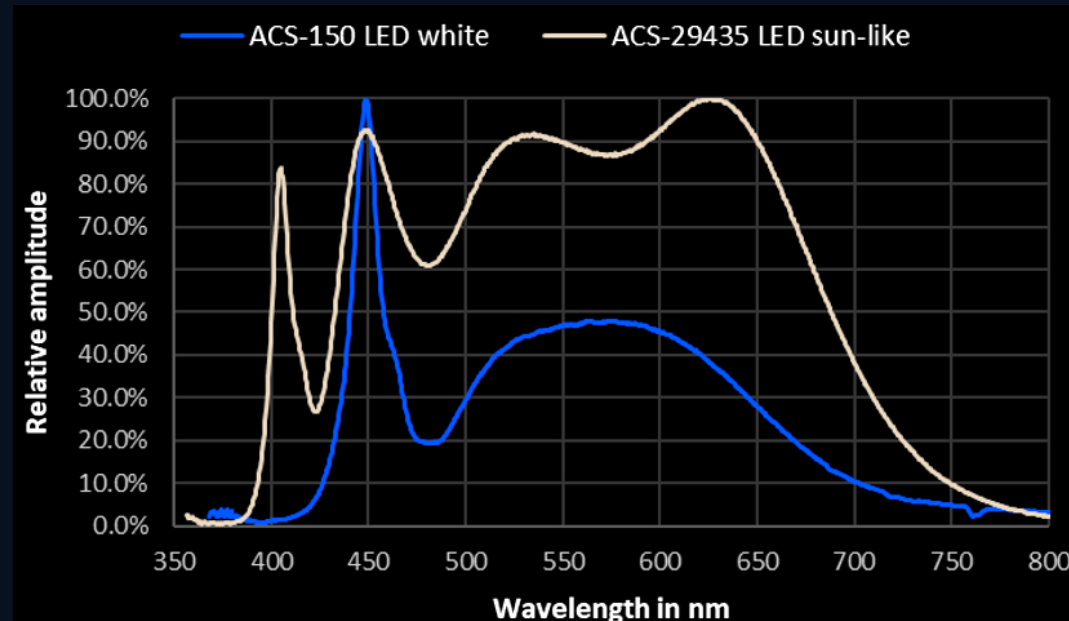
Various uniform light sources available, including sun-like spectrum

► Flexible aperture sizes

e.g. 50 or 75 mm

► 15,000 nits

maximum luminance



Relative spectra: white LED vs. sun-like LED source



Measurement Setup

1

Imaging colorimeter

TOP 300 optical probe measuring through the DUT

2

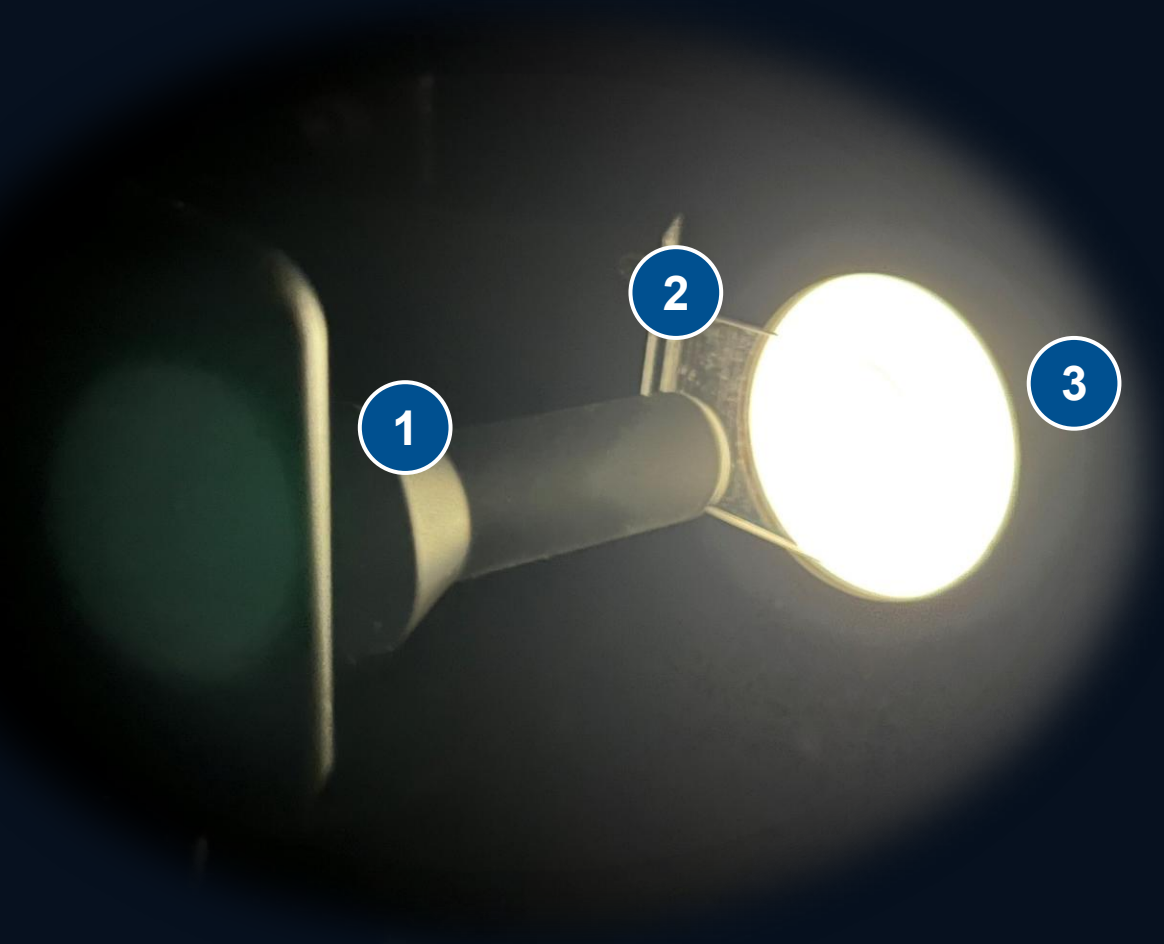
Device under test

LCOS-based waveguide, 300 cd/m²

3

Uniform light source

Background luminance:
0 to 1000 nits



Gamut Area Drops Rapidly with Background Light

**Background luminance
increased from 0 to 1000 nits**

Reference levels per IEC 63145-22-20

▶ **Indoor lighting**

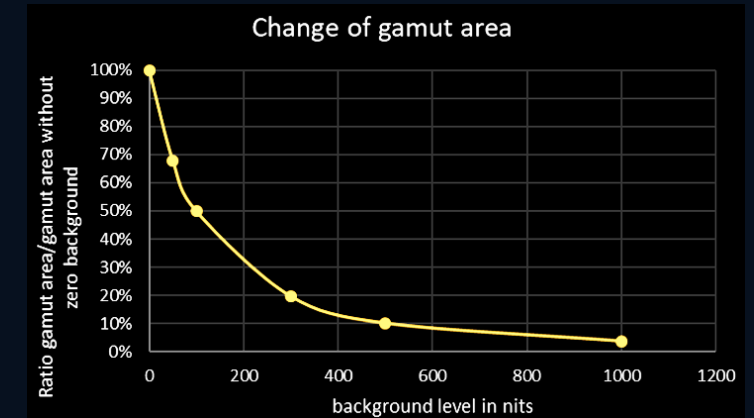
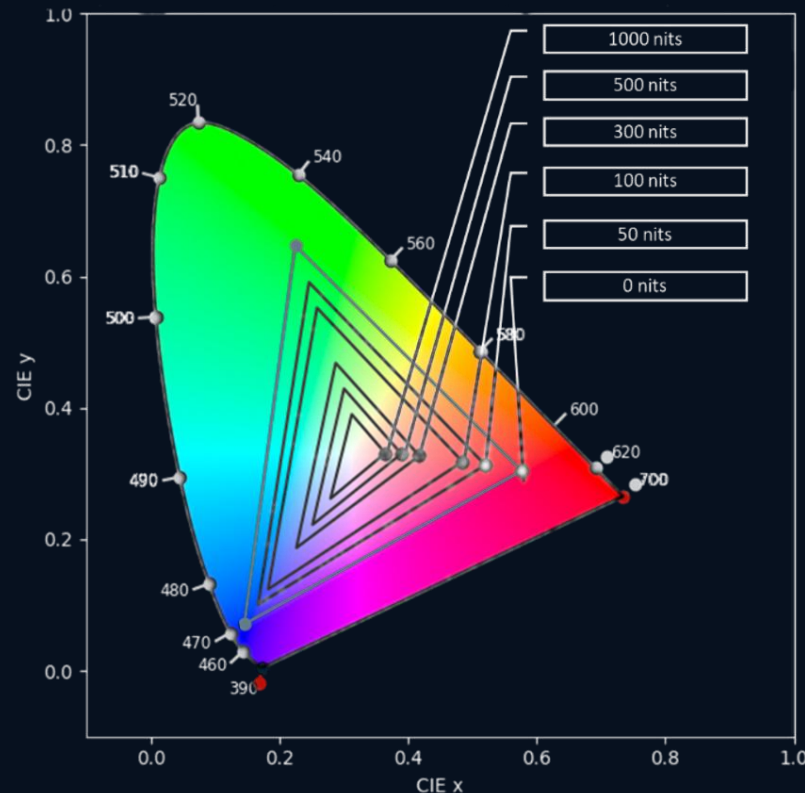
30 to 500 cd/m²

▶ **Overcast sky**

2 kcd/m²

▶ **Clear sky**

15 kcd/m²



**Quick drop even at lower
background levels.**

Summary

01

Ambient light matters

In optical see-through displays, the ambient background strongly influences how the virtual image is perceived

02

Content can disappear

Low-contrast or fine content in the virtual image may not be visible

03

Tinting / dimming help

Tinting or dimming acts as a black color and reduces the influence of ambient light

Thank you

for your attention

Questions and comments are welcome

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