HunterLab

Agera L2
Dark Performance Mode

Performance Results & Technical Explanation

Agera L2 Dark Performance Mode

Performance Results & Technical Explanation

Ultra-dark and low-reflectance materials present unique color measurement challenges. As reflectance drops below ~15%, measurement uncertainty increases rapidly due to noise, stray light, and signal-to-noise limitations—often leading to unstable readings, false rejects, and poor process control.

Dark Performance Mode is a dedicated, dark-optimized measurement mode in Agera L2. It is not post-processing or software smoothing. Instead, it is a system-level optical and detection optimization designed specifically to reduce noise floor and improve repeatability on dark and low-reflectance samples.

This training reviews measured performance results across multiple instruments and modes to show how Dark Performance Mode delivers dramatically improved repeatability, stability, and confidence—on ultra-dark materials and beyond.

Agera L2 Dark Performance Mode

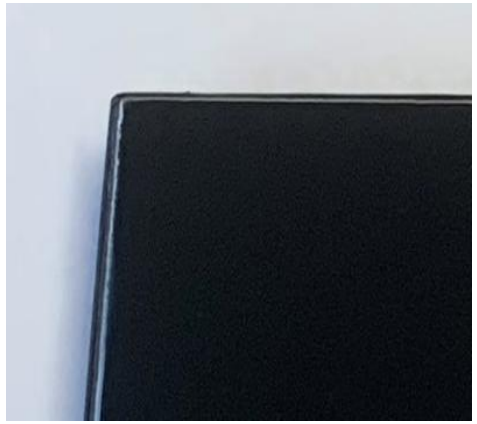
Technical Overview of Dark Performance Mode Operation

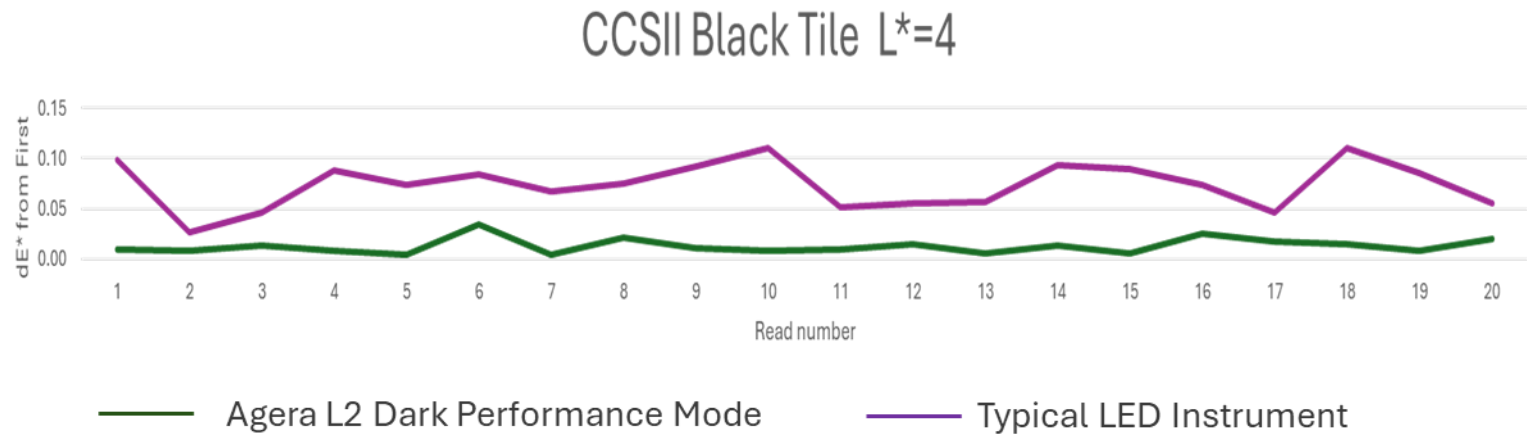
Dark Performance Mode integrates several hardware and software-level optimizations within the Agera L2 platform:

- **Dynamic Illumination Control** – The LED illumination system is adjusted to deliver higher stable, uniform light intensity at low reflectance levels without saturating the detector
- **Enhanced Detector Gain & Filtering** – The optical detector operates in a high-sensitivity range with digital noise filtering, preserving accurate signal response in the near-zero reflectance domain
- **Normalized Wavelengths** -all wavelengths are normalized to a 15% "virtual top-of-scale" reference. This expands the resolution, sensitivity, and usable dynamic range for very low-reflectance materials.
- **Stray Light Reduction Optics** – Internal baffling and coated optical surfaces minimize stray reflections that can skew readings on black or textured samples
- **Visual Correlation Assurance** – 0° illumination / 45° circumferential viewing geometry ensures the data aligns with human visual perception, even for textured, matte, or semi-gloss dark surfaces.

Agera L2 Dark Performance Mode

This graph highlights repeatability and noise-floor limitations when measuring an ultra-dark standard (CCSII black tile, L* ≈ 4) using a typical LED instrument versus Agera L2 with Dark Performance Mode).



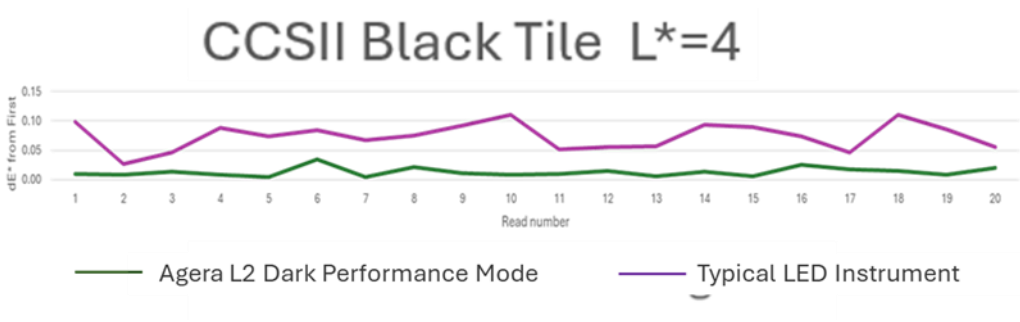


Agera L2 Dark Performance Mode

What the Data Shows

Purple line (Typical LED Instrument)

- ΔE* from first measurement fluctuates significantly across repeated reads
- Variability approaches 0.10–0.11 ΔE, even on a stable reference tile



Green line (Agera L2 Dark Performance)

- ΔE* remains tightly clustered
- Typical variation stays near 0.01–0.02 ΔE

This is a 5–10× improvement in repeatability on ultra-dark materials.

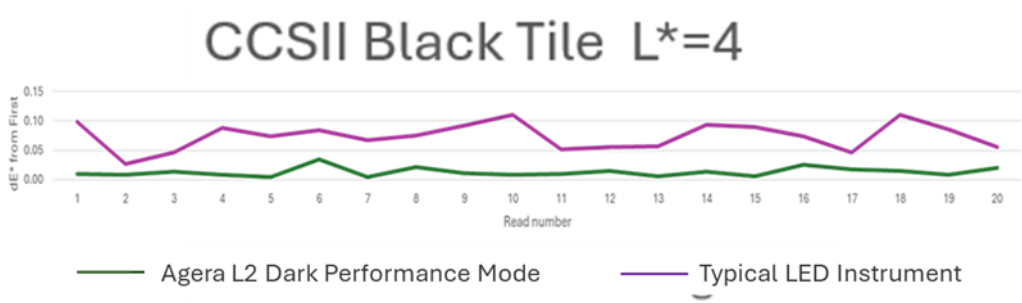
Agera L2 Dark Performance Mode

Why Most Instruments Struggle on Ultra-Dark Samples

1. Higher Effective Noise Floor

At L* ≈ 4, reflectance is extremely low:

- Stray light and detector noise become a significant fraction of the signal
- Small electronic or optical fluctuations translate directly into ΔE variation



Dark Performance Mode on Agera L2 lowers the instrument noise floor, allowing the true signal to dominate.

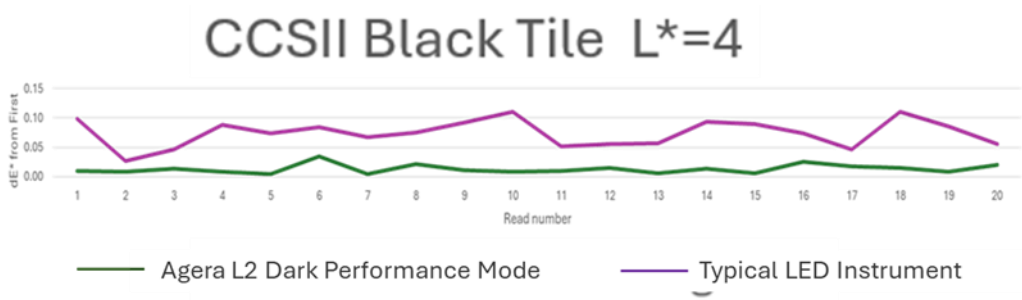
Agera L2 Dark Performance Mode

Why Most Instruments Struggle on Ultra-Dark Samples

2. Limited Dynamic Range Optimization

Not specifically optimized for ultra-dark materials:

- Detector gain and exposure are balanced for general-purpose samples
- Very low reflectance pushes the system toward its sensitivity limits



Dark Performance Mode dynamically optimizes the optical and detector response specifically for low-reflectance conditions.

Agera L2 Dark Performance Mode

Why Most Instruments Struggle on Ultra-Dark Samples

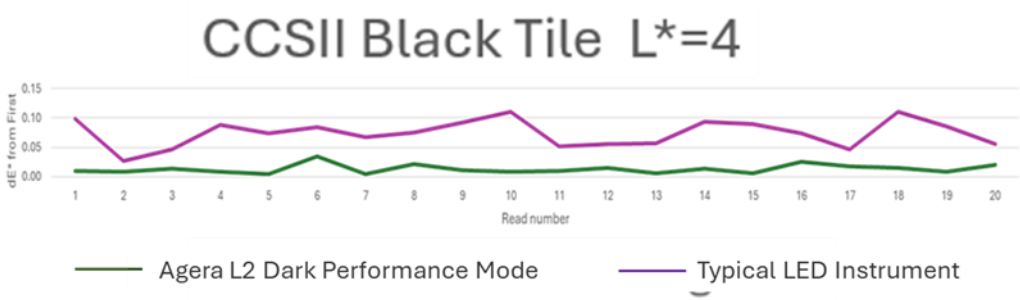
3. Increased Read-to-Read Instability

The rising and falling pattern in the Agera 1 trace indicates:

- Poor signal-to-noise ratio (SNR)
- Measurement variability that appears as false color change

This makes it difficult to distinguish:

- Real material variation
- Instrument-induced noise



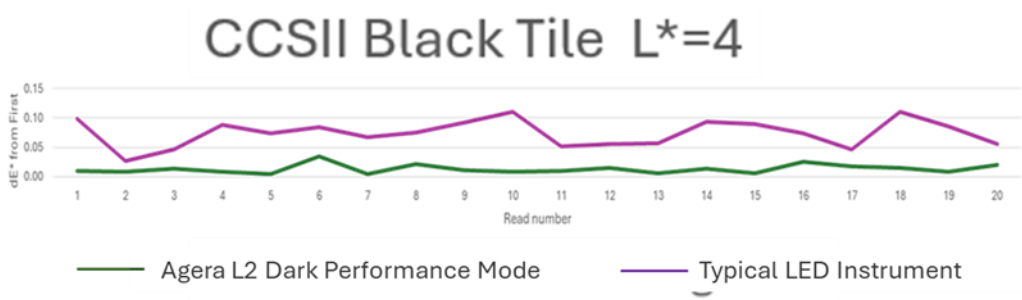
Dark Performance Mode produces flat, stable repeatability, enabling meaningful color decisions.

Agera L2 Dark Performance Mode

Why Most Instruments Struggle on Ultra-Dark Samples

4. Higher Risk of False Rejects

- A perfectly stable black reference can appear to "move" by up to 0.1 ΔE
- This consumes a large portion of typical dark-color tolerances

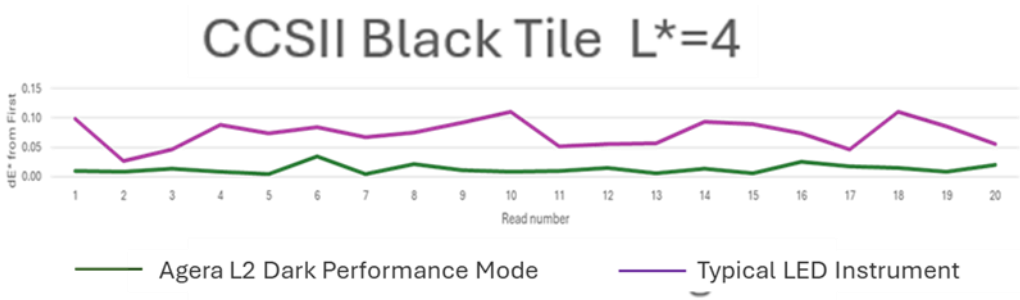


Dark Performance Mode dramatically reduces this risk, supporting tighter tolerances, more reliable SPC, and fewer false out-of-spec calls

Agera L2 Dark Performance Mode

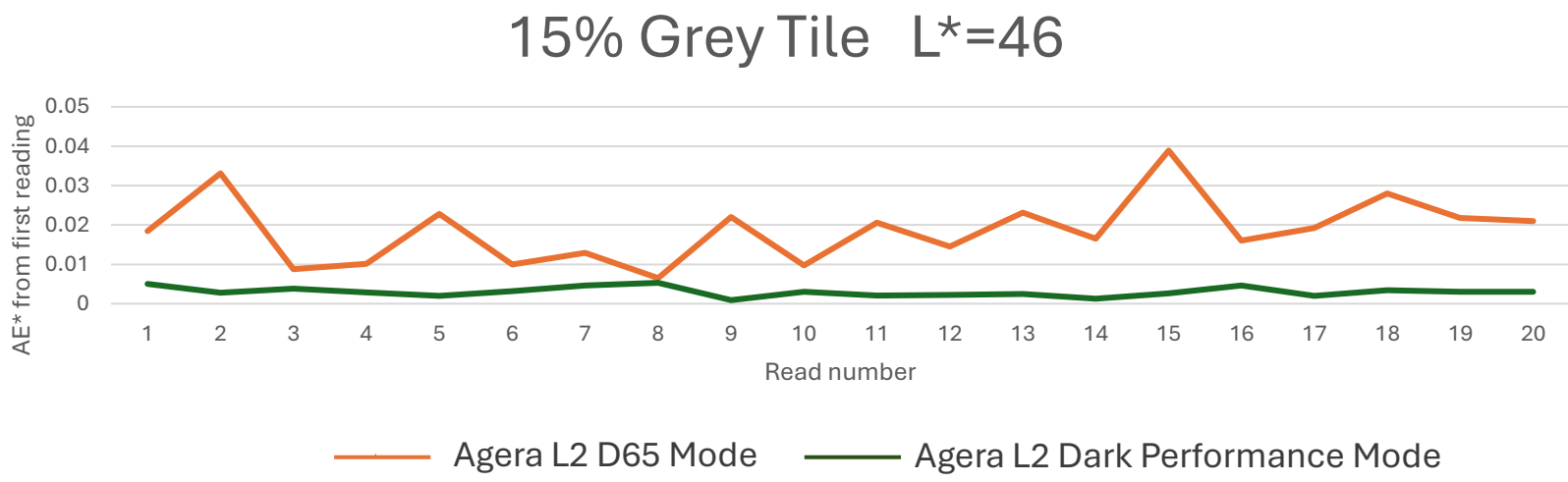
Key Performance Takeaway

On ultra-dark materials, most instruments are noise-limited, while Agera L2 with Dark Performance Mode is signal-limited – resulting in an order-of-magnitude improvement in repeatability.



Agera L2 Dark Performance Mode

This graph compares standard Agera L2 D65 Calibrated measurement mode to Agera L2 Dark Performance Mode on a mid-tone grey reference tile. While L* ≈ 46 is not an ultra-dark sample, it still reveals meaningful performance differences related to noise, stability, and repeatability.



Agera L2 Dark Performance Mode

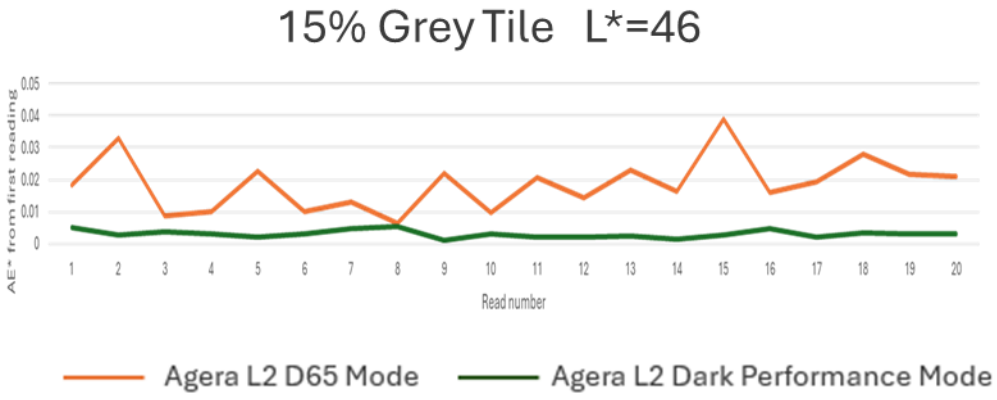
What the Data Shows

Orange line – D65 Calibrated (Standard Mode)

- ΔE* from first reading fluctuates between ~0.01 and ~0.04
- Read-to-read variability is clearly visible, even on a stable reference tile

Green line – UltraDark (Dark Performance Mode)

- ΔE* remains tightly clustered near ~0.002–0.006
- Significantly reduced scatter across all 20 reads



This represents a ~4–6× improvement in repeatability, even on a mid-lightness sample.

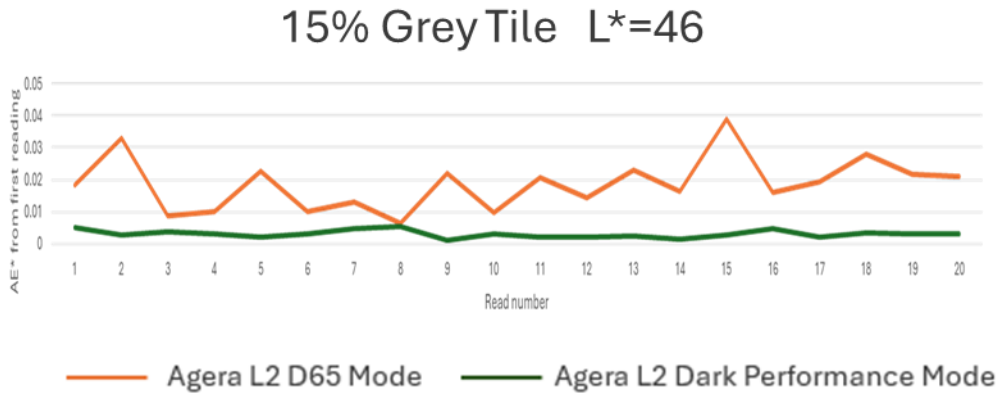
Agera L2 Dark Performance Mode

Why This Difference Exists (Even at L* ≈ 46)

1. Noise Floor Still Matters at Mid-Tones

Although reflectance is higher than the black tile:

- Detector noise, stray light, and optical flare still contribute to measurement variation
- These effects are simply *less obvious* without repeatability testing



Dark Performance Mode reduces the baseline noise floor, benefiting all reflectance levels.

Agera L2 Dark Performance Mode

Why This Difference Exists (Even at L* ≈ 46)

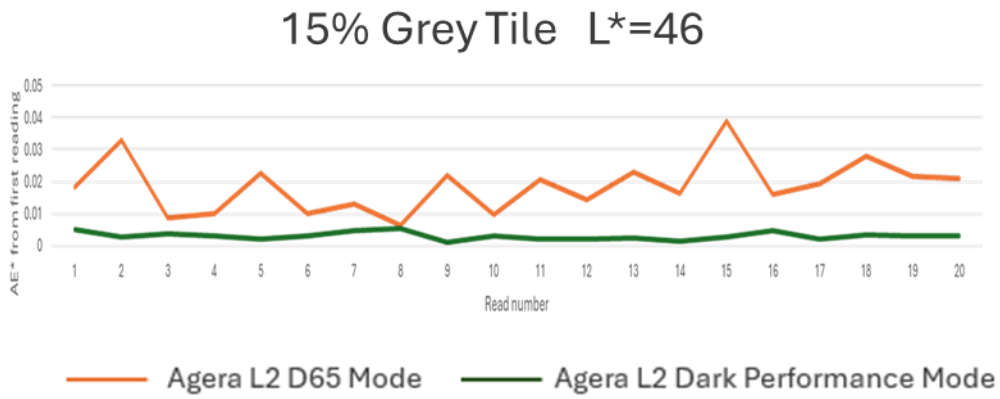
2. Standard Mode Is Optimized for Throughput, Not Ultimate Stability

D65 Calibrated mode balances:

- Instrument to visual correlation
- Broad application coverage

Dark Performance Mode prioritizes:

- Maximum signal stability
- Minimum measurement



This difference becomes visible in tight tolerance workflows.

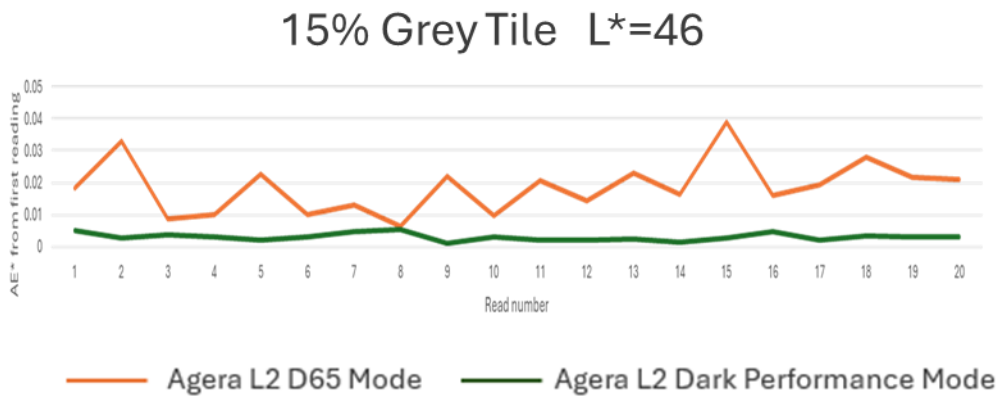
Agera L2 Dark Performance Mode

Why This Difference Exists (Even at L* ≈ 46)

3. Read-to-Read Scatter Consumes Tolerance Budget

With standard mode:

- Up to ~0.04 ΔE variation appears on a perfectly stable tile
- This consumes a meaningful portion of common production tolerances (e.g., ΔE ≤ 0.5)



Dark Performance Mode preserves tolerance budget for real process variation, not instrument noise.

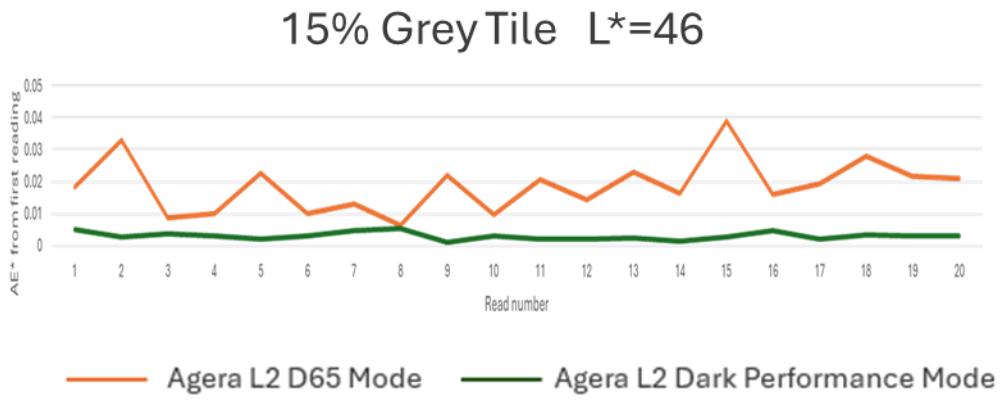
Agera L2 Dark Performance Mode

Why This Difference Exists (Even at L* ≈ 46)

4. UltraDark Mode Improves SPC and Trend Detection

The flatter UltraDark trace means:

- SPC charts tighten
- Small drifts become visible earlier
- Fewer false alarms triggered by measurement noise

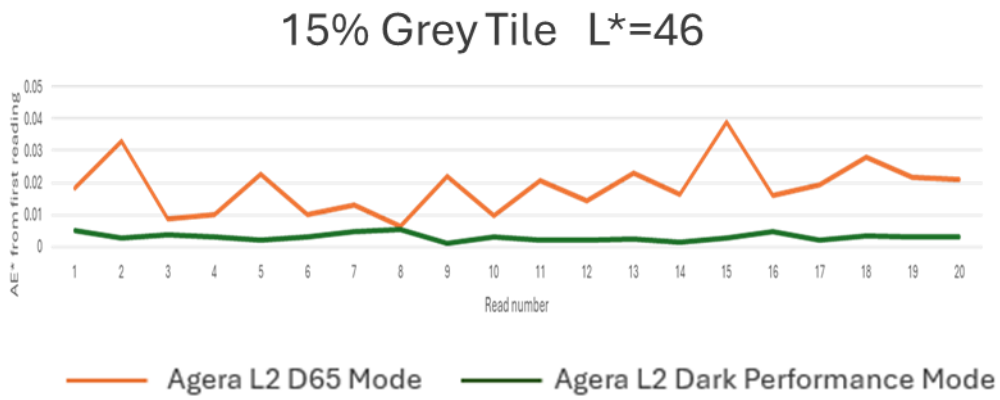


Dark Performance Mode preserves tolerance budget for real process variation, not instrument noise.

Agera L2 Dark Performance Mode

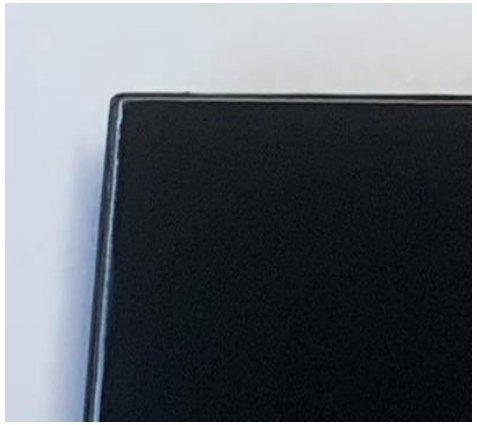
Key Performance Takeaway

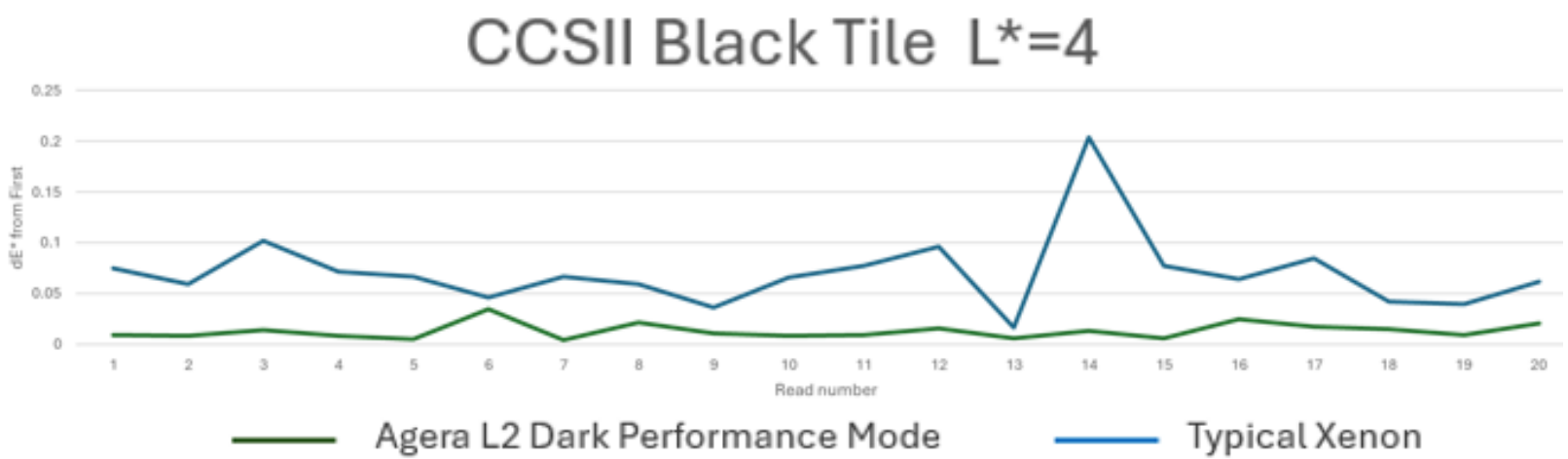
Even on mid-tone materials, Dark Performance Mode reduces measurement noise by a factor of four or more, delivering tighter repeatability and more reliable process control.



Agera L2 Dark Performance Mode

This graph compares repeatability on an ultra-dark reference tile of Agera L2 Dark Performance Mode and typical Xenon-lamp-based instruments.



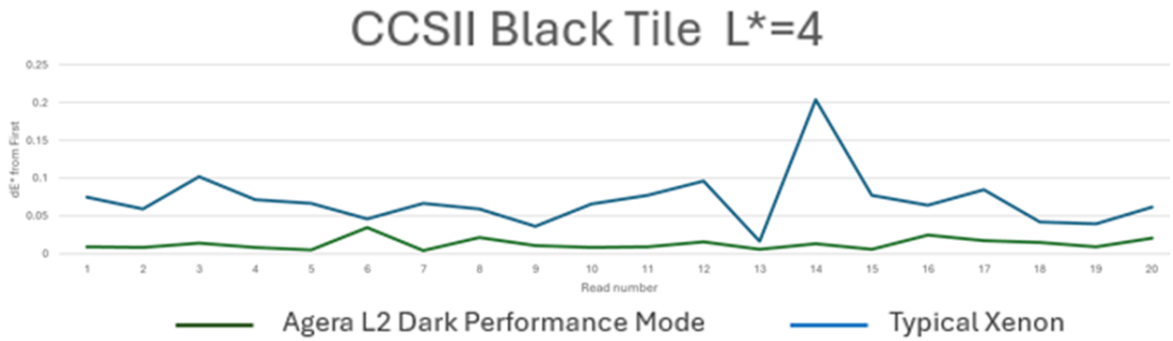


Agera L2 Dark Performance Mode

Typical Xenon vs Dark Performance Mode

What the Xenon Trace Reveals

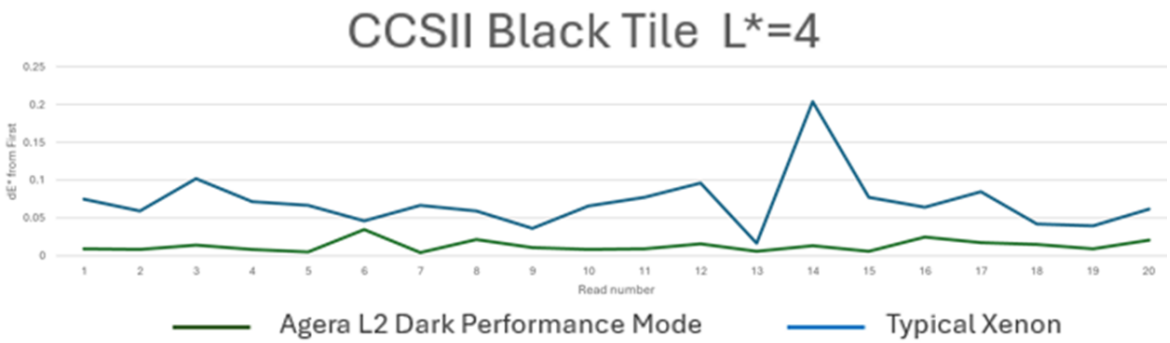
- Large spikes in ΔE, including excursions approaching ~0.20 ΔE
- Significant read-to-read instability
- Non-random noise pattern, indicating optical and detector limitations



Agera L2 Dark Performance Mode

Why Xenon Struggles on Ultra-Dark Samples

- Stray light becomes a dominant portion of the measured signal
- Small optical instabilities amplify into large ΔE swings



Agera L2 Dark Performance Mode

Why Dark Performance Mode Outperforms Xenon

Key Distinction: Dark Performance Mode is a system-level optimization, not just a lamp choice.

Dark Performance Mode combines:

- Optical configuration optimized for low reflectance
- Detector and gain handling designed for ultra-dark samples
- Noise floor suppression across the entire measurement chain

Typical Xenon

- Operate in **general-purpose measurement modes**

Agera L2 Dark Performance Mode

Key Performance Takeaway

Compared to xenon-based instruments, Agera L2 Dark Performance Mode delivers an order-of-magnitude improvement in repeatability on ultra-dark materials.

Ultra-Dark Measurement Performance Comparison

CCSII Black Tile (L ≈ 4)*

Instrument / Mode	Illumination Type	Typical ΔE Scatter	Repeatability on Ultra-Dark	Primary Limitation Observed	QC / SPC Suitability
Agera L2 – UltraDark Mode	LED, CIE-Calibrated D65 / Dark Performance Mode	~0.01–0.02	Excellent	Higher effective noise floor at low L*	Excellent
Typical LED	LED (non CIE-calibrated D65)	~0.05–0.12	Limited	No dedicated dark optimization	Limited
Typical Xenon	Xenon	~0.05–0.20	Poor	High stray light, older optical architecture	Poor

This comparison shows that even with CIE-calibrated D65 LED illumination, ultra-dark performance requires a dedicated dark-optimized measurement mode – which is exactly what Dark Performance Mode provides.

Agera L2 Dark Performance Mode

Key Takeaway (Very Important)

Illumination type alone does not determine ultra-dark performance – optical optimization, noise suppression, and measurement mode do.

Dark Performance Mode delivers superior ultra-dark repeatability regardless of illumination technology.