

Strategies in Light®

MARCH 1-3, 2016

SANTA CLARA CONVENTION CENTER | SANTA CLARA, CA

Workshop 2: Quality of Light Tunable Light Sources

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Outline

- Introduction
- Light quality
- Products
- Why go beyond RGB?
- Success
- Sky shots
- Summary



- Founded 2007 – Silicon Valley, CA
- Purpose – create any light for human consumption
 - Products/services to create/playback light
- Privately owned
- Current products:
 - Light Replicator (16 color light player)
 - Penta (5 color light player)
 - Light Recorder (spectrometer)
 - LumenScripts (content)
 - Recordings, created, composed digital data

Target Applications for Researchers

- Consumer/Home – daylight experience indoors, better circadian cycle
- Retail – make products more appealing
- Healthcare – faster healing, wake/sleep
- Workplace – increase productivity
- Sensors – time varying spectrum
- Movie, TV – outdoor scene or filter replication

Two ways of experiencing light

Illumination

- Look at people, objects
- Less saturated colors
- Changes slowly
- Low spatial density
- High spectral density
- CRI – important, RGBWA
- Collimated, Diffuse

- Electric lights, Daylight
 - RGB is NOT sufficient

Infotainment

- Look at the light
- Saturated colors
- Changes fast
- High spatial density
- Low spectral density
- CRI – don't care, RGB
- Collimated, Diffuse

- Computer Display, TV, Rock Concert
 - RGB is sufficient

The sky is a special case. It fits into both categories.

Light quality

- Right light, right time, right place
 - “Right” depends on application and business goals
- Right Light
 - Amount – including dim to zero
 - Spectrum – at a minimum: fire to actual daylight
 - Color rendering – accuracy and preference
 - Perfect collimation to completely diffuse as needed
 - Sharp shadows, no unwanted color breakup or mismatch

Light Quality

- Right light, right time, right place
 - “Right” depends on application and business goals
- Right Time
 - Of day
 - Month of year

Light Quality

- Right light, right time, right place
 - “Right” depends on application and business goals
- Right Place
 - Surfaces – layers, horizontal, vertical
 - Movement – daylight direction is not fixed
 - Room
 - Compass
 - Earth

Defining Success

- Technical milestones
- Energy savings
- Business goals – make money
 - **Deployment**
 - Price – race to the bottom
 - **Features** – light quality among them

Features

- The customer doesn't know what they desire
- Risk takers will need to lead the way
- Before smart phones, few realized they wanted to take and send pictures constantly
- For most of us the price of a phone is not the first consideration
- Most of us replace our phone before it fails

History of quantifying the color of objects

- Not enough different light sources or control to care
- CRI – Ra(1-8), R1-15, dumb down, accuracy
- CQS – better single metric
- TM-30 – better, dual metric (accuracy, preference)

- In general – any reference SPD, any set of object SPDs
 - Hawaiian sunset, plumeria blossoms
 - Golden hour (before sunset)
 - Blue hour (before/after sunrise/set)
 - Account for object fluorescence, whiteness

Products

Warm-white, Cool-white “white tunable”



Warm-white, Cool-white “white tunable”



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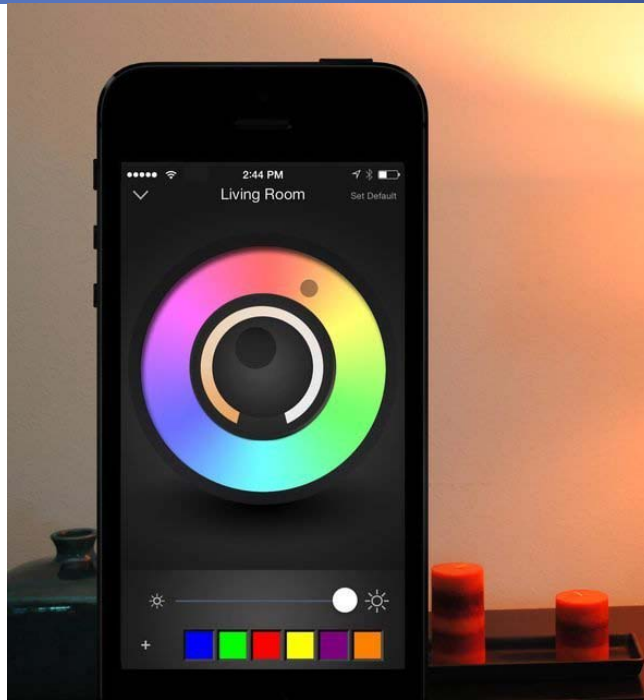
Beetle

Advanced
Tunable System

2700K–6500K CCT Control
Samjin Ultra System Compatible



RGB and beyond



RGB and beyond

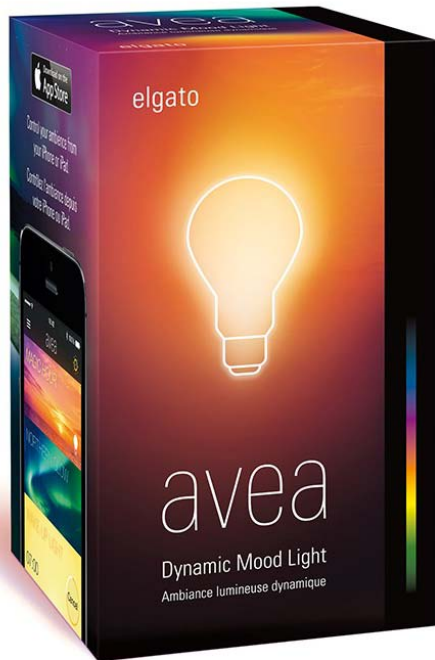
MarSwell® 450LM RGBW Bluetooth Smart LED



Flux Bluetooth Smart LED Light Bulb



RGB and beyond



RGB and beyond



RGB and beyond

 K E T R A™

lumenetix®

Home araya⁵ Products iOS App

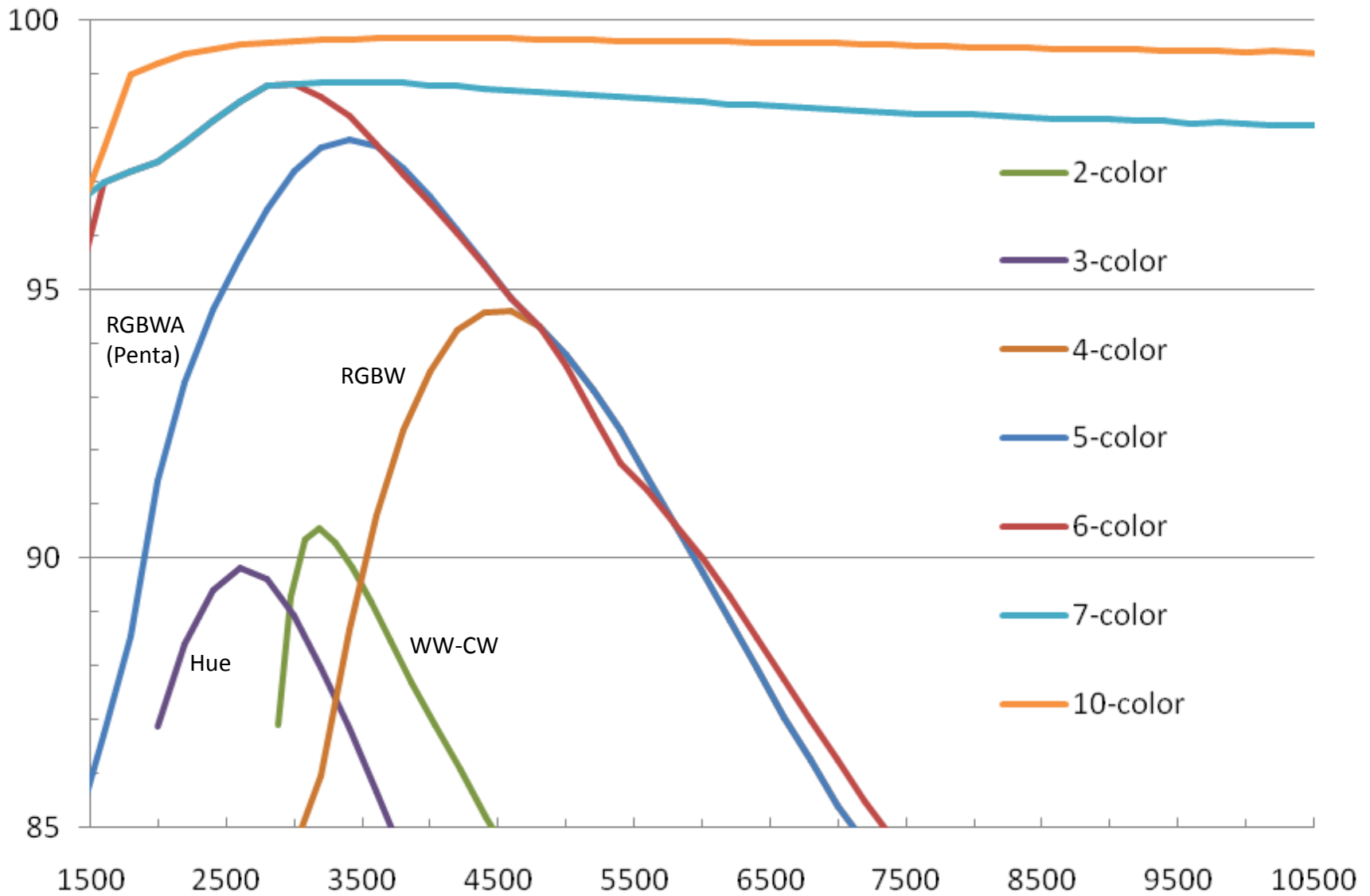


iOS  Bluetooth™ DMX  EcoSystem Enabled  Acuity Controls  Presto  CRESTRON

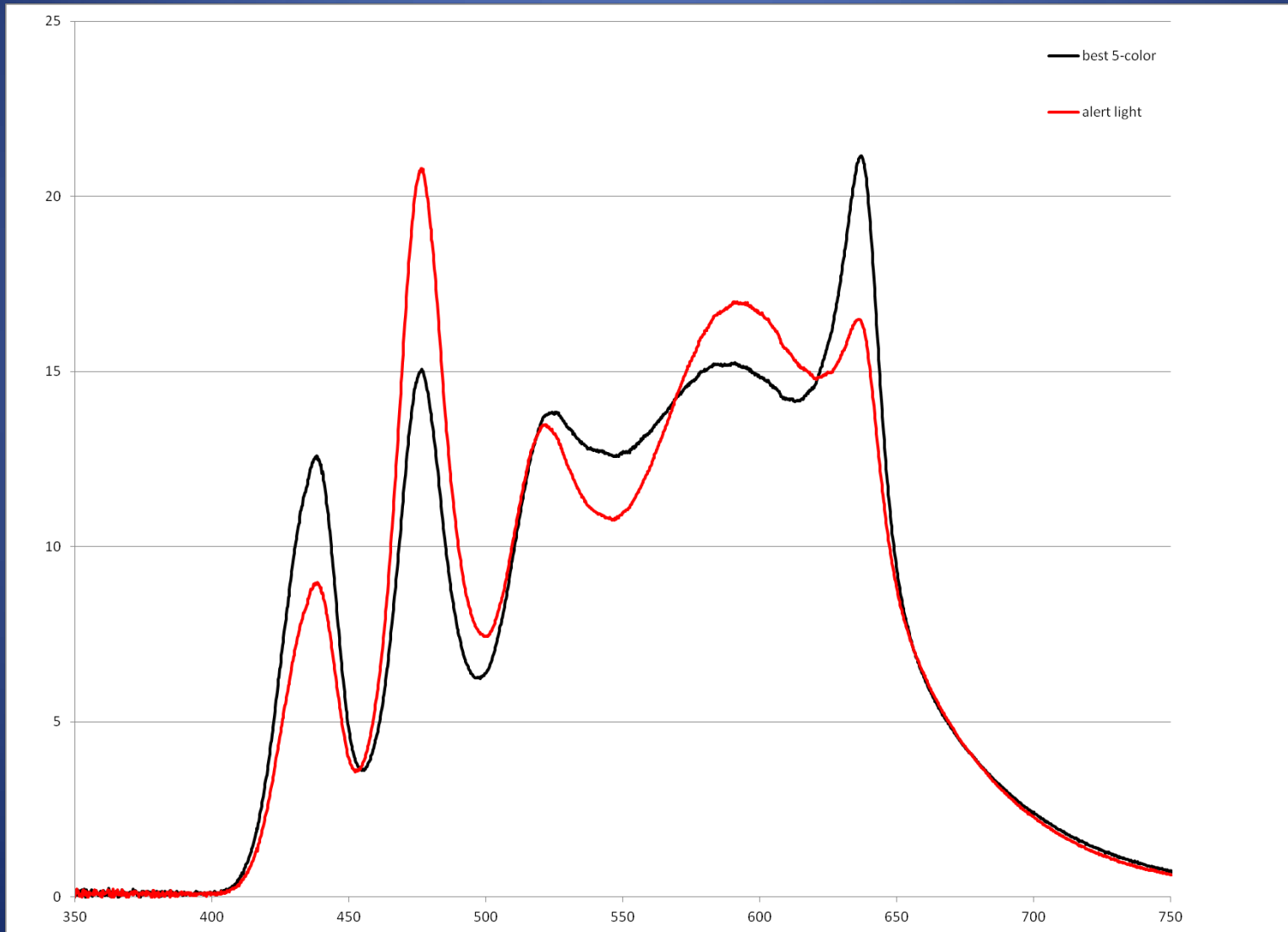
Why go beyond RGB

- Broader CCT range at higher color quality
- Multiple solutions for a given chromaticity
- Larger gamut area

Multi-color – CQS vs. CCT



Multiple 4000K, high CRI solutions – 5-color



Collecting Data

- Spectrometer
- Camera with fish-eye lens

Portable Spectrometer for Light Recording

Removable Aluminum case that secures Spectrometer

Bluetooth Technology for remote measurements

Diffuser light entry for easy measurements

WiFi
Lightweight handheld device with Wifi to transfer data

Free APP to analyse many types of data including Spectrum. Continuous measuring compatible

Calibrated with NIST traceable light source

Comes packaged with iPod touch 5

A SENSE

Pod 11:02 AM

Continuous

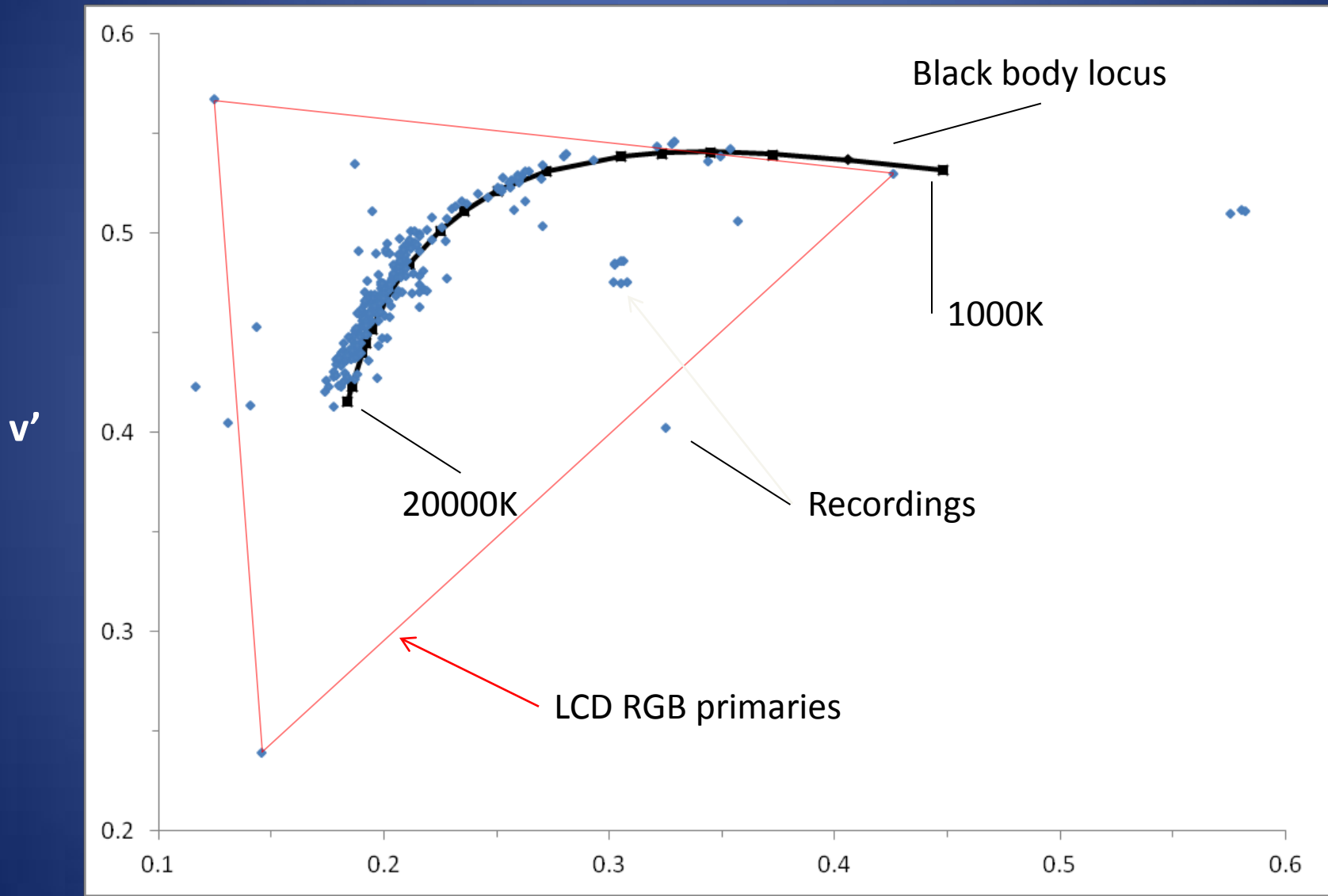
Measure delay 1 min

Total Times 5

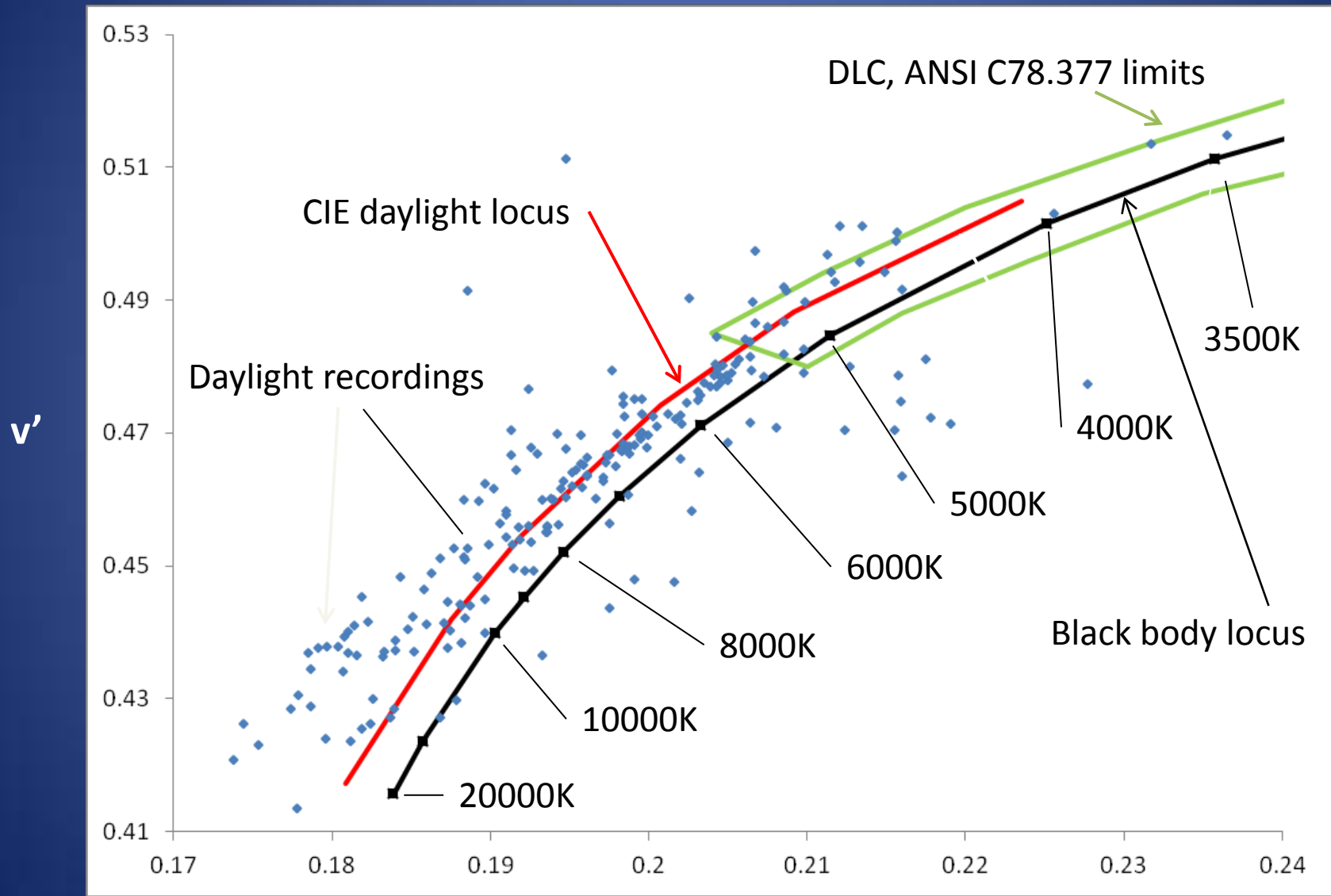
Select Parameter(s)

CCT	✓
CRI	✓
COS	✓
Illuminance	✓
CIE1931	✓
CIE1976	✓
No	✓

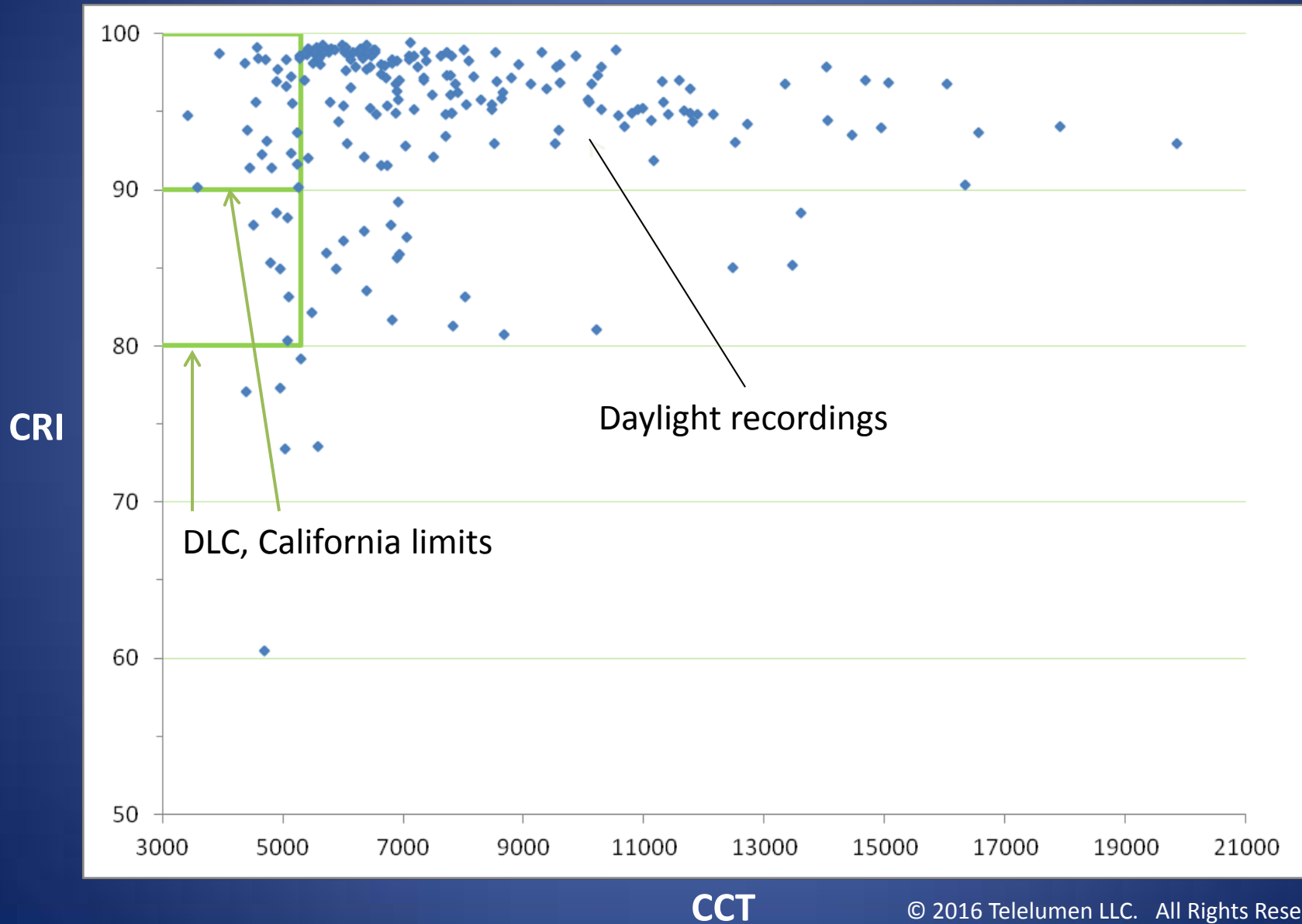
Spectrometer recordings and $u'v'$



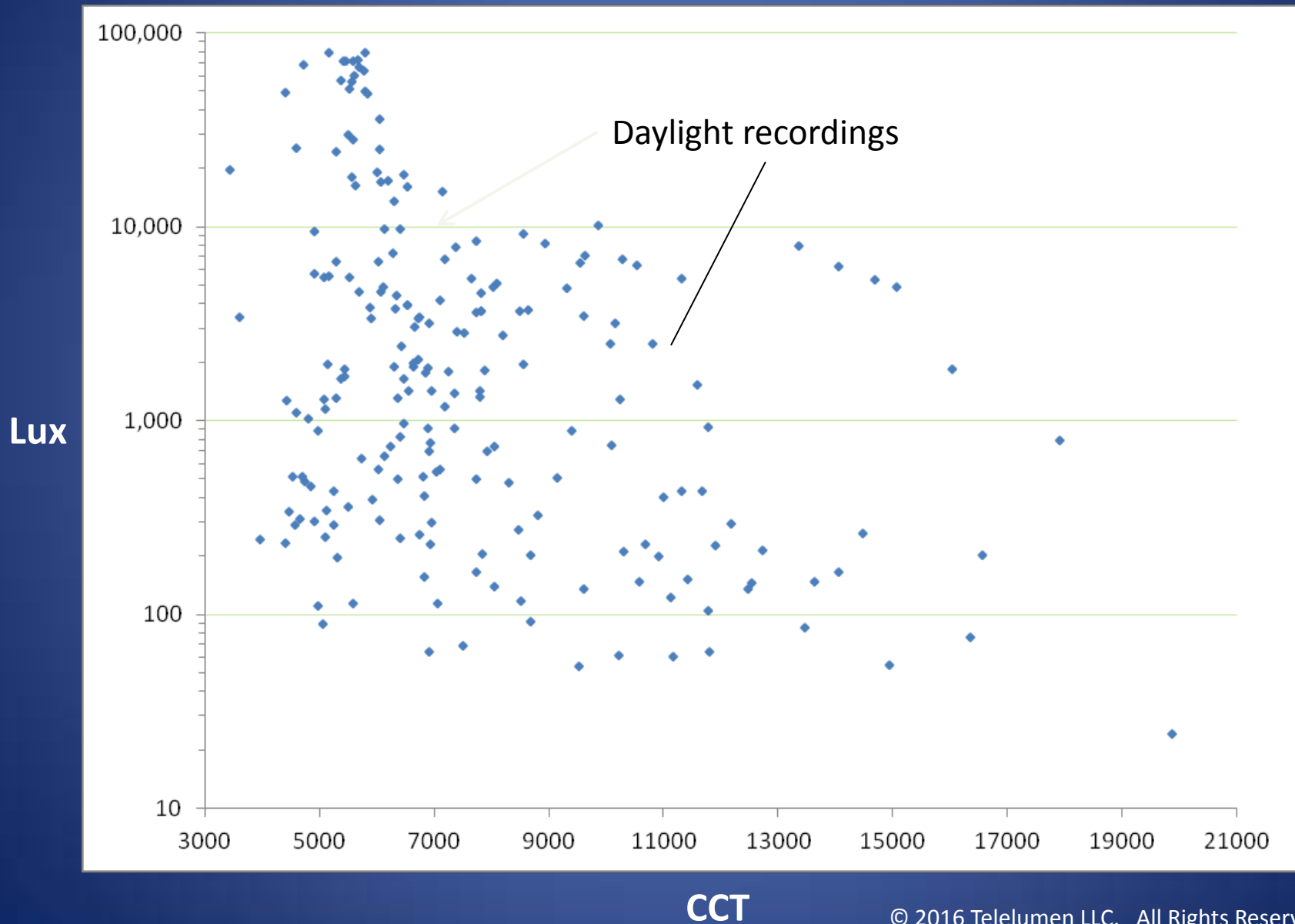
Daylight recordings and Convention



CRI vs. CCT



Illuminance vs. CCT































CCTANE









LUXURY BRAND SHOP
Japan-free Tax Shop

MEX
24h OPEN
24h OPEN
24h OPEN

BEER
OPEN
OPEN





















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Summary

- Products have moved beyond fixed CCT
- Control interfaces are often complex
- Light Players provide a simpler solution
 - Select professionally produced content from playlist
- Daylight model for electronic illumination
- The blackbody locus is a convenience
- Clock, calendar time are key elements
- Its up to us to invent the future



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Thank You