
# The Language Metadata Table (LMT)

V2.1 Release
NAB-NY, October 17, 2019

Yonah Levenson, LMT Chair

# LMT Committee Members & Contributors include: MESA

WARNER MEDIA

NBCUniversal

LIONSGATE

SHOWTIME

HBO

Paramount

movie labs

WARNER BROS. PICTURES

FOX

Hasbro

gracenote A NIELSEN COMPANY

turner

SONY

amazon

EIDR Entertainment Identifier Registry

Discovery CHANNEL

SMPTE

Disney

Haymillian

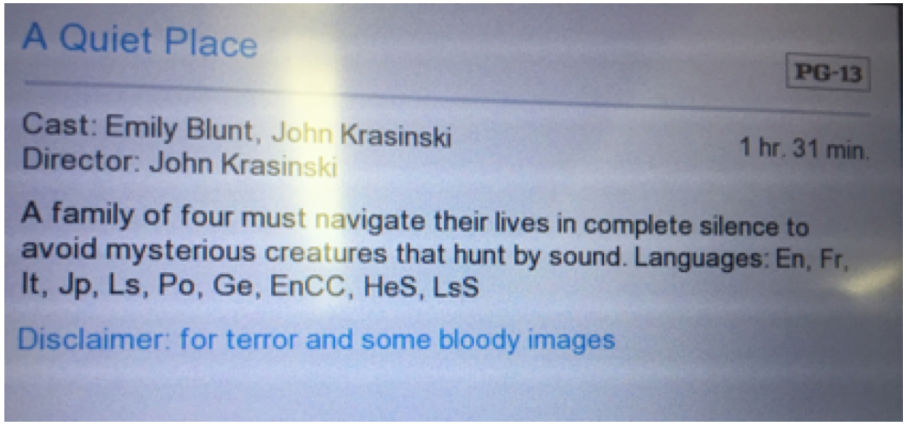
# Language Metadata:  Problem Statement

*The broadcast and media industry, as well as others, does not have a single unified standard of language terminology.*

***RESULT:***

*Each point of distribution/information exchange creates their own language code table, thus creating a kind of Tower of Babel.*

# Ex: Consumer Facing Language Display





# Why Create LMT?

- Language metadata is used by every aspect of media & entertainment, but is rarely standardized between systems or across supply chains.
- There was a need for a more flexible, granular, and modular language standard, applicable in both broad and narrow contexts.
- People are often confused or overwhelmed by all the options available.
- LMT includes values for several language applications in the media and entertainment industries, including codes for:
  - Audio and timed text for content
  - Visual or written languages for display on storefronts and packaging
  - Rights and Licensing localization
  - Distribution territories
  - Accessibility for the visually and hearing impaired

# LMT Scope

- Used to populate the language elements of an asset, e.g. text, audio
- Languages only; regions and territories are a separate discussion
- Notation of script/writing system where necessary
- Includes
  - Endonyms: Language name in the country's language.  Ex: Français
  - Exonyms: Language name as spoken in other countries.  Ex:  Französisch

# LMT Mission Statement

The Language Metadata Table (LMT) was created to provide a unified source of reference for language codes for use throughout the media and entertainment industries. LMT's mission is:

- To create a standardized table of language codes for implementation by entertainment and other industries using IETF BCP 47 (a.k.a., RFC 5646).
- To facilitate efficient and consistent LMT usage through best practices.
- To extend LMT code values through vetted field definitions and approved language code values with a community of thought leaders who focus on information and data from the business, professional associations and academic institutions through the exchange of knowledge and collaboration.

# LMT History

- The Language Metadata Table (LMT) initiative began at HBO in 2017 to normalize language codes and provide a unified source of reference throughout the enterprise.
- The initial table had 128 languages, each with a production use case.
- In July 2018, MESAlliance invited HBO to share their language tables as the basis of an industry standard. A working group was formed with representatives from studios, post houses, and other media affiliates and companies.
- In August 2018, LMT v1.0 was published with 128 languages.
- In September 2019, LMT v2.1 was published with over 200 languages, including best practices.

# Advantages to Adopting LMT

- Allows standard distinctions between spoken and written languages
- Provides flexibility for capturing language metadata for various departments
- Having a working group to manage the LMT can better account and coordinate the changing nature of languages
- Allows for better communication and the same labeling between service providers, clients, and content owners

# LMT Use Cases

- Licensing international content
  - As the industry seeks to scale new content development, more organizations are looking at international productions to expand inventory
- Distributing non-English content
  - As that international content gets distributed, platforms need metadata describing the language elements: audio tracks, subtitles, UI, etc.
  - Geographic information needs to be considered as part of the distribution metadata
- Accessibility requirements
  - How are closed-captions and other accessible elements described to the end-user?
- End-user localization preferences
  - Consumers want to view both content and settings in their desired languages wherever they are viewing, watching, and/or listening
  - UI/UX preferences

# LMT Implementation Examples

- Audio: Allows for standard description of the audio languages corresponding to content to a provider or client
- Closed Captions: LMT can distinguish between the audio language of the content and the caption or written language when sending materials to a vendor
- Burned In or Forced Narratives: Physical signs in the content often appear in different written language than subtitles for audio language
- Accessibility: Visual description or American Sign Language can be distinguished from other languages for the content
- Acquisition/Rights: The overall language can be used to show territorial or distribution for content that rolls up any audio or other languages
- Electronic Sell-Through Partners: Languages for viewing can be displayed on the screen in the correct dialect vs the subtitle or audio languages

# IETF BCP 47

- IETF:  Internet Engineering Task Force (a.k.a, the Internet people)
- BCP:  Best Current Practice
- BCP 47: Tags for Identifying Language
- IETF BCP 47 defines a standard application of:
  - ISO 639:  2- and 3-character Language codes
  - ISO 3166: 2-character Country codes
  - UN M. 49: 3-digit numeric Territory codes
  - ISO 15924: 4-character Script codes
- IETF BCP 47 works because
  - Language, dialect, script, and geographic codes can be combined in more than 40K ways
    - From the general: en for English
    - To the specific: fr-FR vs. fr-CA to distinguish Parisian French from Quebecoise
  - Codes under regular review to keep the lists current:
    - “Greenlandic” updated to “Kalaallisut” to reflect contemporary cultural norms
    - A WWW standard supported by W3C (a.k.a., the Web people) for HTML, XML, etc.

# Anatomy of a Language Code

- Full code syntax: `language-script-region-variant-extension-privateuse`
  - e.g., `mn-Cyrl-MN` for Mongolian written in Cyrillic as used in Mongolia
- Selecting from 9,000 subtags to create 40,000 combinations can be overwhelming.
- LMT provides commonly used codes supported by use cases in actual use, pre-constructed for easy reference.
- Within LMT, language groupings are explicitly defined – easy enough for Spanish, but hard for Chinese
- For each language, several fields are used to identify the standard:
  - Language Group Name, Tag, Code
  - Audio language tags and displays
  - Visual language tags and displays
  - Descriptions

# LMT Example

| Column Header Name | Example 1: English | Example 2: Spanish | Example 3: Serbian | Example 4: Mandarin | Example 5: Armenian (Eastern) | Example 6: Armenian (Western) | Example 7: American Sign Language |
|---|---|---|---|---|---|---|---|
| Language Group Name | English | Spanish | Serbo-Croation | Chinese | Armenian Family | Armenian Family | |
| Language Group Tag | en | es | sh | zh | hyx | hyx | |
| Audio Language Tag | en | es-419 | sr | cmn | hy | hyw | |
| Long Description 1 | English | Spanish as Spoken in Latin America | Serbian | Mandarin | Armenian | Armenian as spoken by the Armenian Diaspora | American Sign Language |
| Long Description 2 | | | | | | | |
| Audio Language Display Name 1 | English | Español como se habla en América Latina | Srpski | 普通话 | արեւմտահայերէն | հայերեն | |
| Audio Language Display Name 2 | | | cpncka | | | | |
| Visual Language Tag 1 | en | es-419 | sr-Latn-RS | zh-Hans | hy | hyw | ase |
| Visual Language Tag 2 | | | sr-Cyrl-RS | | | | |
| Visual Language Display Name 1 | | Español como se habla en América Latina | Srpski | 简体中文 | արեւմտահայերէն | հայերեն | American Sign Language |
| Visual Language Display Name 2 | | | cpncka | | | | |

# ISDCF and LMT: Differences & Discussions

| Audio Language Tag | Long Description 1 | Visual Language Tag 1 | Visual Language Display Name 1 |
|---|---|---|---|
| yue | Chinese – Cantonese - ISDCF only | yue | Chinese – Cantonese - ISDCF only |
| | Chinese – Mandarin Simplified - ISDCF Only | cmn-Hans | Chinese – Mandarin Simplified - ISDCF Only |
| | Chinese – Mandarin Traditional - ISDCF Only | cmn-Hant | Chinese – Mandarin Traditional - ISDCF Only |
| et | Estonian - ISDCF Only | et | Estonian - ISDCF Only |
| vls | Flemish - ISDCF only | vls | Flemish - ISDCF only |
| gsw | German – Swiss - ISDCF Only | gsw | German – Swiss - ISDCF Only |
| ky | Kyrgyz - ISDCF Only | ky | Kyrgyz - ISDCF Only |
| es -AR | Spanish – Argentina - ISDCF only | es -AR | Spanish – Argentina - ISDCF only |

- Source of truth? LMT or existing ISDCF
  - How hard is it for existing users to switch? Timeframe needed?
- LMT has more languages than ISDCF
  - Should all LMT languages be included in ISDCF?
- How should code differences/conflicts be resolved?

# Next Steps

- Expand coverage for Latin American countries.
  - Add Spanish for each Spanish-speaking country
  - Add Portuguese for each country as supported by use cases
- Explore language use cases for Asian countries.
  - Subject matter experts: please apply!
- Explore more languages and dialects use cases for India and Pakistan.
- Bear in mind what is needed from Unicode for the support of diacritics and non-Latin characters
- Next LMT Working Committee meeting: November 14 @1pm
  - Contact MESAlliance if interested in attending
- Please share your Language needs if not yet covered by LMT

# LMT Contact Information + Links

Email Addresses:

- LMT@mesalliance.org For General inquiries
- LMTWG@mesalliance.org For update and edition requests
- LMTChairs@mesalliance.org For direct contact with the Co-chairs

LMT Documentation Links

- https://www.mesalliance.org/language-metadata-table (scroll down for current docs)
- https://www.mesalliance.org/wp-content/uploads/2018/08/HBO-MESA-LMT-Press-Release-FINAL.pdf
- https://www.mesalliance.org/2018/08/07/mesa-publishes-hbo-developed-me-industry-language-metadata-table/
- https://www.mesalliance.org/2018/08/08/hbo-looks-to-demystify-language-metadata/
- https://www.mesalliance.org/2019/02/20/me-journal-the-language-metadata-table-lmt-an-industrywide-effort-to-collaborate/

# High-Throughput JPEG 2000 Overview and Demo

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Wavelet Consulting LLC

October 2019

Supported by
Kakadu Software
(JPEG2000 software SDK provider)

# High-Throughput JPEG 2000 Overview

- **International Standard published** in August 2019
  - Available free-of-charge https://www.itu.int/rec/T-REC-T.814/en
- **Enhances JPEG 2000 Part-1**
  - Replaces the slow block coder with a fast block coder.
  - Keeps everything else from JPEG 2000 Part-1.
- **Royalty-Free goal** like JPEG 2000 Part-1

# High-Throughput JPEG 2000 Overview

- Today's demo shows **decoding speedups in range 5x to 30x**
- Encoding also has similar speedups, but not part of today's demo.
- Demo content shows 5% file-size increase over regular Part-1
- Possible to perform lossless transcoding to/from both lossy and lossless Part-1 code streams, which enables easy adoption paradigms.

# High-Throughput JPEG 2000

## Example Use-cases and Standards

- **Designed for modern CPU architectures** with vectorized instructions like AVX and SSE.
- Also **well-suited to GPU implementation**.
- Initial hardware design shows significant improvement over JPEG2000 Part-1 hardware design, with similar logic elements and clock-frequency as JPEG-1 ("Original JPEG")
- **HTJ2K can be wrapped in MXF**, just like JPEG2000 Part-1
  - **SMPTE ST422 wrapping standard revision** that adds HTJ2K support in progress now, **should publish by end of 2019.**
  - Status of SMPTE project available here: https://kws.smpte.org/higherlogic/ws/public/projects/581/details

# High-Throughput JPEG 2000

## Example Use-cases and Standards

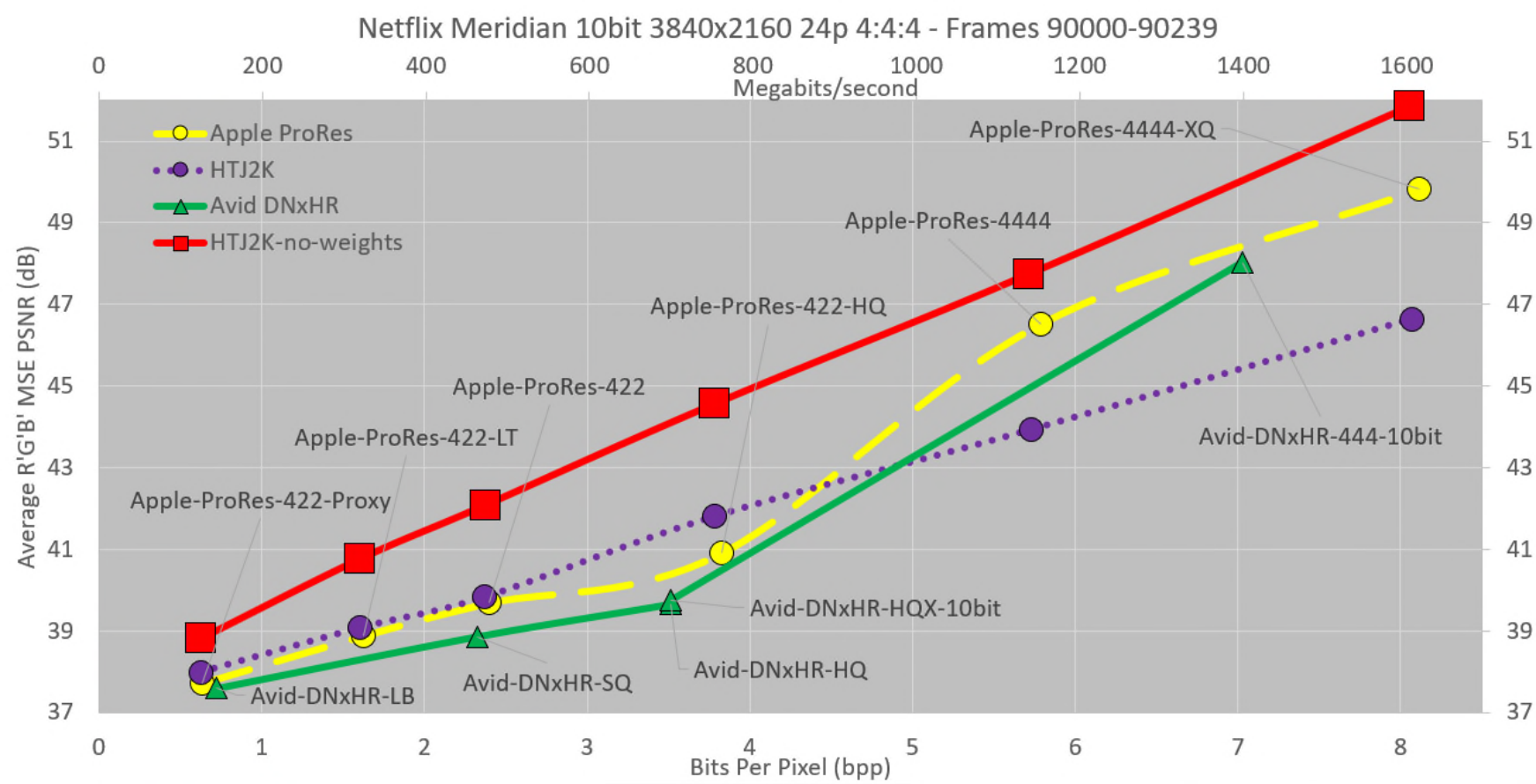
- **HTJ2K can** be used to **accelerate IMF workflows** and lower the bar to implementing IMF with lower-performance hardware.
  - Lossless transcoding to/from IMF's JPEG2000 Part-1 codestreams, can facilitate realtime playback or editing of existing JPEG2000 Part-1 IMF on laptop computers.
  - IMF could be updated to support HTJ2K directly, more discussion and standards work would be needed (contact me if interested)
- HTJ2K can be used a **ProRes alternative**.

# High-Throughput JPEG 2000

## Example Use-cases and Standards

- HTJ2K can be generally be used for **any image compression application**.
  - Leverages great flexibility of JPEG2000 Part-1 to support lossy and lossless compression of almost any sample data format (number of channels, resolutions, bitdepths, etc.)
- HTJ2K can be combined with other parts of JPEG2000 family (like Part-2) to support more exotic applications like true floating-point compression or flexible multi-component decorrelating transforms.

# High-Throughput JPEG 2000 compared to ProRes and DNxHR




- Apple ProRes compressed with Apple Compressor 4 and decompressed with BlackMagic DaVinci Resolve 15
- HTJ2K and HTJ2K-no-weights compressed and decompressed with Kakadu VXT7A.7B1 Beta demo applications kdu_compress and kdu_expand
- HTJ2K uses Kakadu's default human-visual-system CSF weightings, while HTJ2K-no-weights is optimized to maximize Average R'G'B' Mean Squared Error PSNR
- Avid DNxHR compressed and decompressed with BlackMagic DaVinci Resolve 15

# High-Throughput JPEG 2000 Demo

- **Meridian UHD SDR 3840x2160 24p 10bit 4:4:4 BT709 content**
  - 12-minute **Netflix mini-movie** created with modern Hollywood production practices.
  - **Publicly available** from various sources, including IMFUG.COM
- Decoding demo at 3 quality levels
  - J2K Part-1 400Mbs, and equivalent J2K Part-15 (415Mbs)
  - J2K Part-1 800Mbs, and equivalent J2K Part-15 (825Mbs)
  - J2K Part-1 Lossless (3.2Gbs), and J2K Part-15 Lossless (3.5Gbs)
- Demo platform
  - **CPU-only software decoding**
  - MacBook Pro 15-inch 2018 2.9GHz Intel Core i9 (6-core) 16GB RAM 1TB SSD
- 3 demo clip lengths:
  - **10-seconds**
  - 100-seconds
  - 723-seconds (full-clip)

# High-Throughput JPEG 2000 Decoding Demo Results

Results for 10-second clip of Meridian UHD SDR 10bit 24p

| Test code stream | decoding speed (fps) | native (Mbs) | decoding (Mbs) | HTJ2K speedup factor | HTJ2K bitrate increase | Compression Ratio (X:1) |
|---|---|---|---|---|---|---|
| J2K - Lossy 400Mbs | 24 | 394 | 393 | | | 15.2 |
| HTJ2K - Lossy 400Mbs | **111** | 414 | 1914 | **5x** | **5.2%** | 14.4 |
| J2K - Lossy 800Mbs | 11 | 785 | 366 | | | 7.6 |
| HTJ2K - Lossy 800Mbs | **91** | 824 | 3137 | **9x** | **4.9%** | 7.2 |
| J2K – Lossless | 2 | 3543 | 362 | | | 1.7 |
| HTJ2K – Lossless | **70** | 3726 | 10,932 | **30x** | **5.2%** | 1.6 |

# High-Throughput JPEG 2000 Implementations

- **Commercial Software**
  - Kakadu Software - v8 (Fall 2019) will include HTJ2K support www.kakadusoftware.com
- **Open Source**
  - OpenJPH https://github.com/aous72/OpenJPH
- **Reference Software**
  - In development as ISO/IEC 15444-5:2015/PDAM 1 Information technology — JPEG 2000 image coding system: Reference software — Part 5: — Amendment 1: Reference software for High-Throughput JPEG 2000 (HTJ2K)
- **GPU Implementation**
  - Described in: A. Naman and D. Taubman, "Decoding high-throughput JPEG2000 (HTJ2K) on a GPU," in IEEE International Conference on Image Processing, 2019.
- **Academic Implementation**
  - Described in: O. Watanabe and D. Taubman, "A MATLAB implementation of the emerging HTJ2K standard," in *IEEE Global Conference on Consumer Electronics (GCCE)*, 2019.

# ISDCF DCPL testing

Use of Imaging Colorimeter

And Imaging Photometer

For Cinema testing

**Pete Ludé**
CTO, Mission Rock Digital LLC
San Francisco, CA
**Pete @MissionRockDigital.com**

2 October 2019

# Thanks!!!

**Ben Bodner**

**LG Electronics**

**Thomas Boysen**

**RealD Inc**

# Modern Test Instruments

Used in NATO testing: Westboro Photonics P280 SU

**Imaging Photometer**

- Luminance Measurement only
- CMOS – up to 12 Megapixel
- Detection limit 1 millinit

Used in NATO testing: Westboro Photonics WP 6120 E

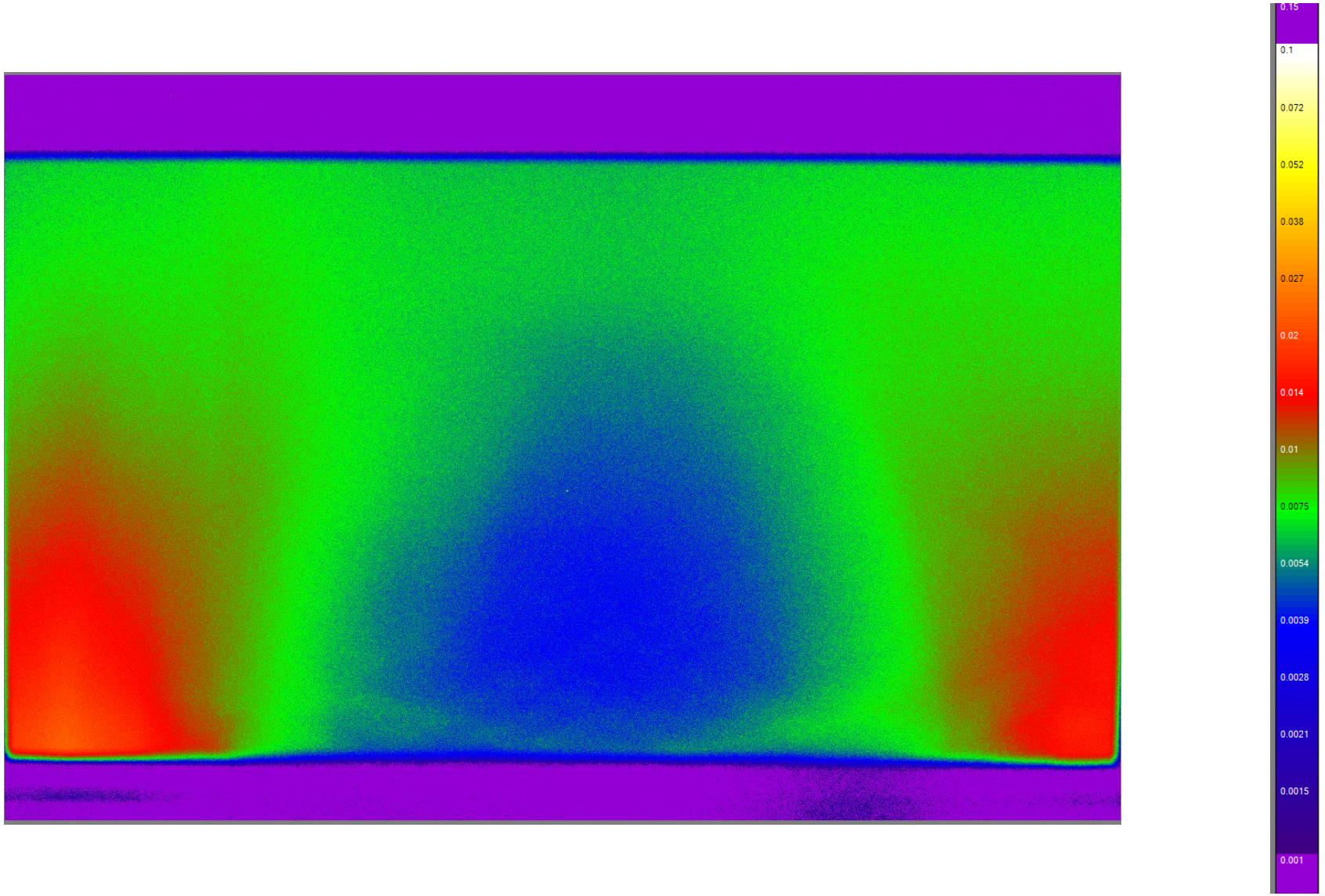
**Imaging Colorimeter**

- Luminance and Chromaticity
- Peltier-cooled CCD – up to 12 Megapixel
- Detection limit 0.02 millinit

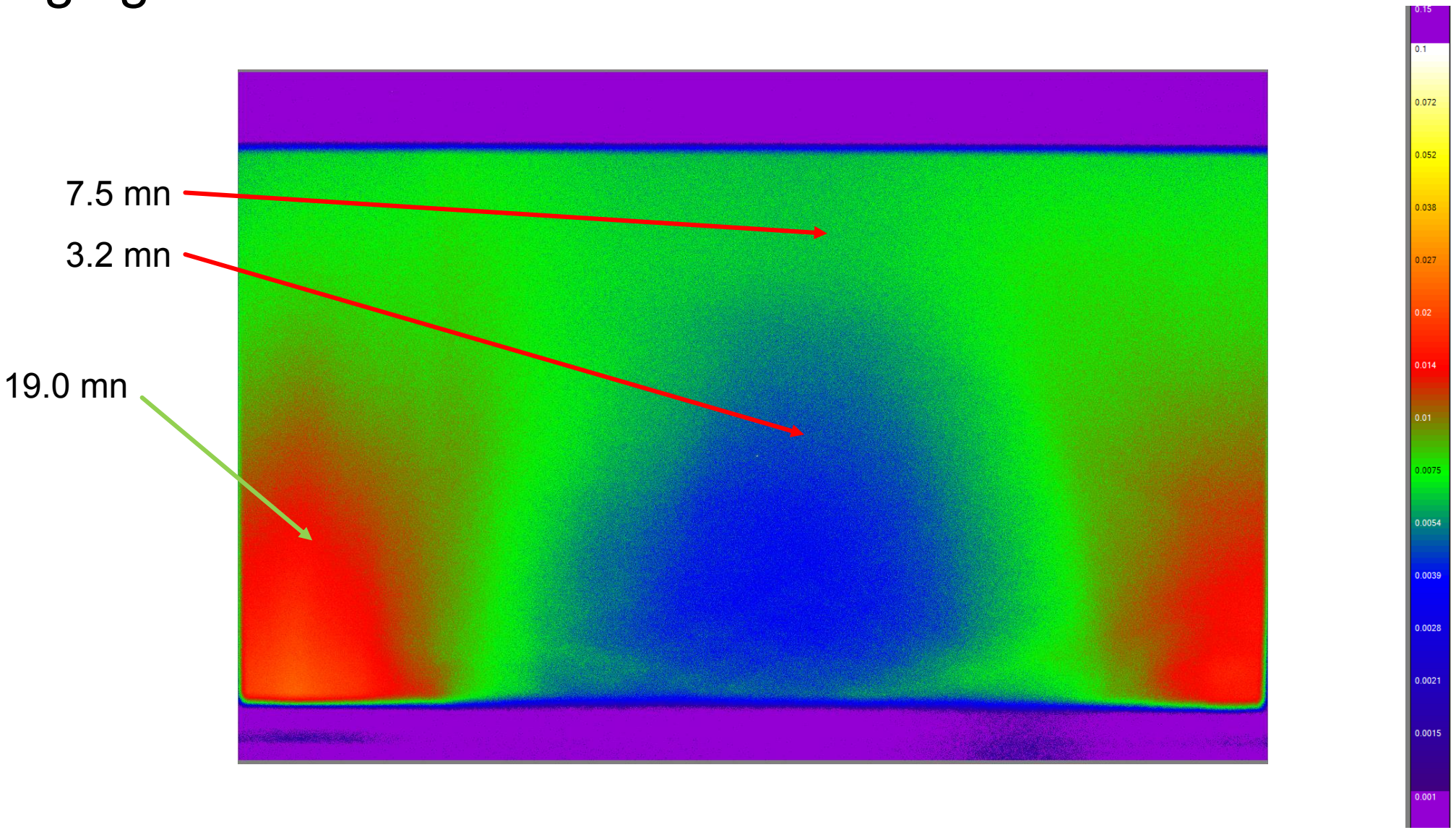
# Spot meter results

Example result: 3.1 millinits

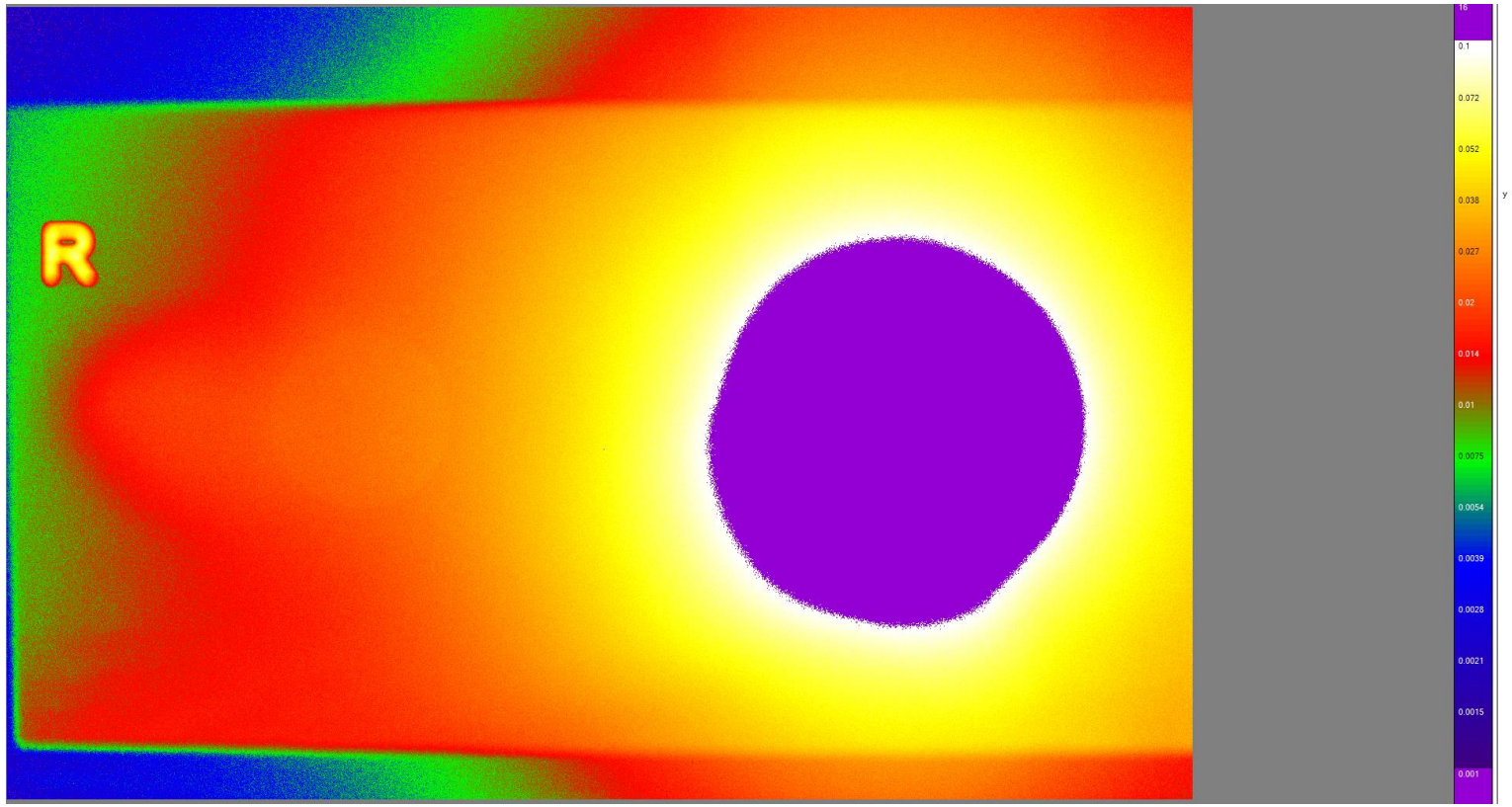
# Imaging Colorimeter results

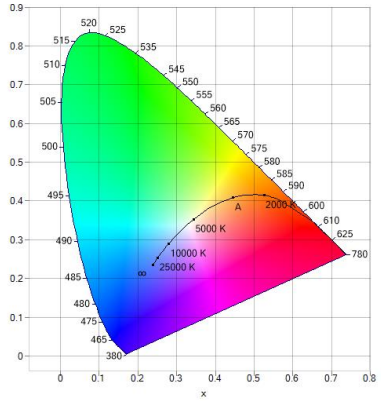


# Imaging Colorimeter results

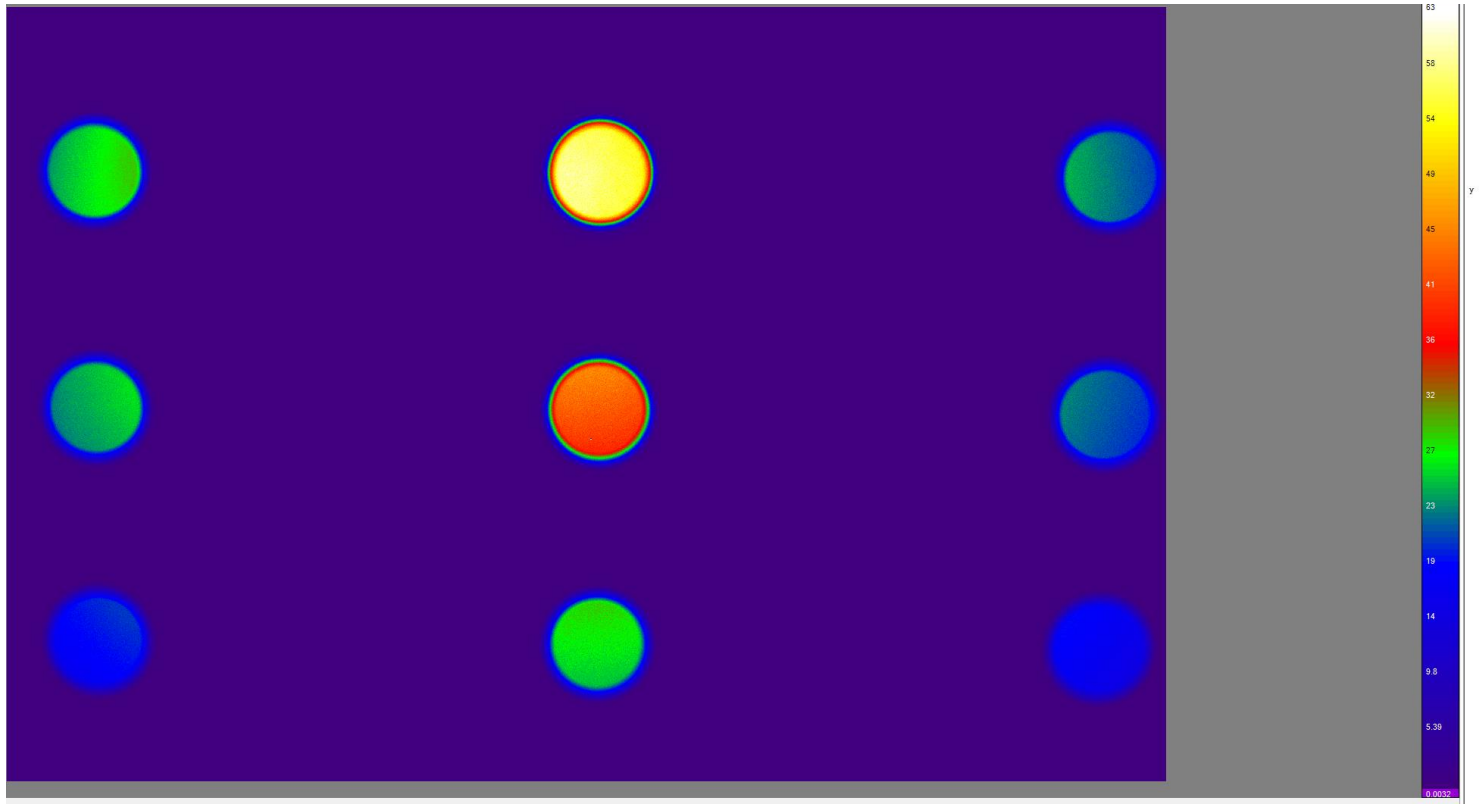


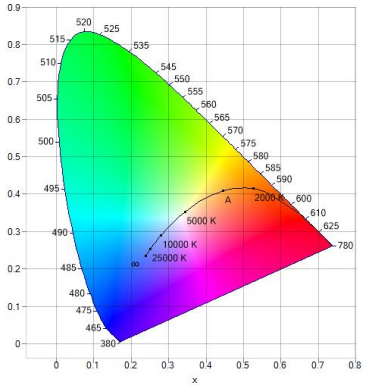
# Imaging Colorimeter results



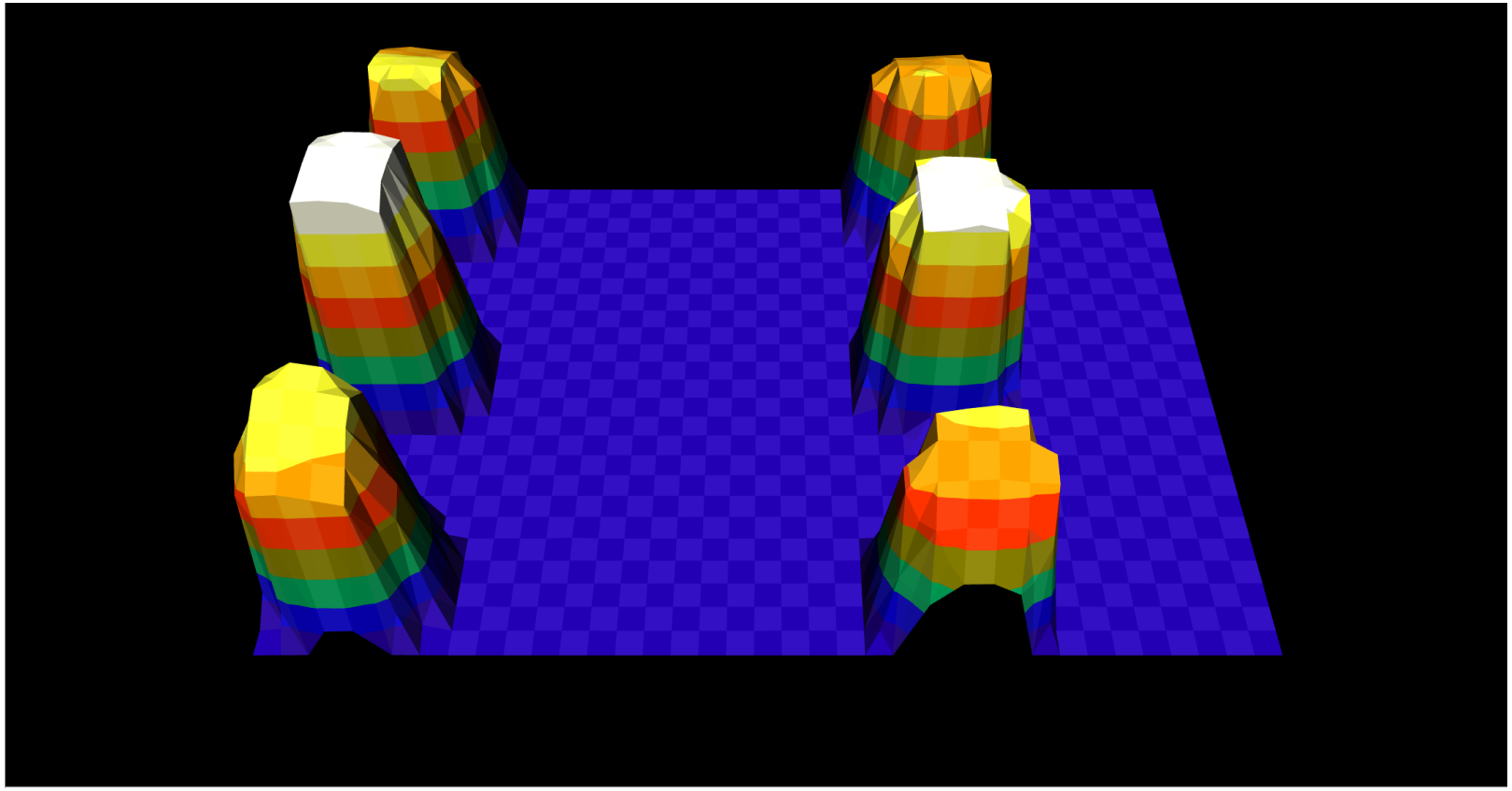



# Imaging Colorimeter results



# Imaging Colorimeter results



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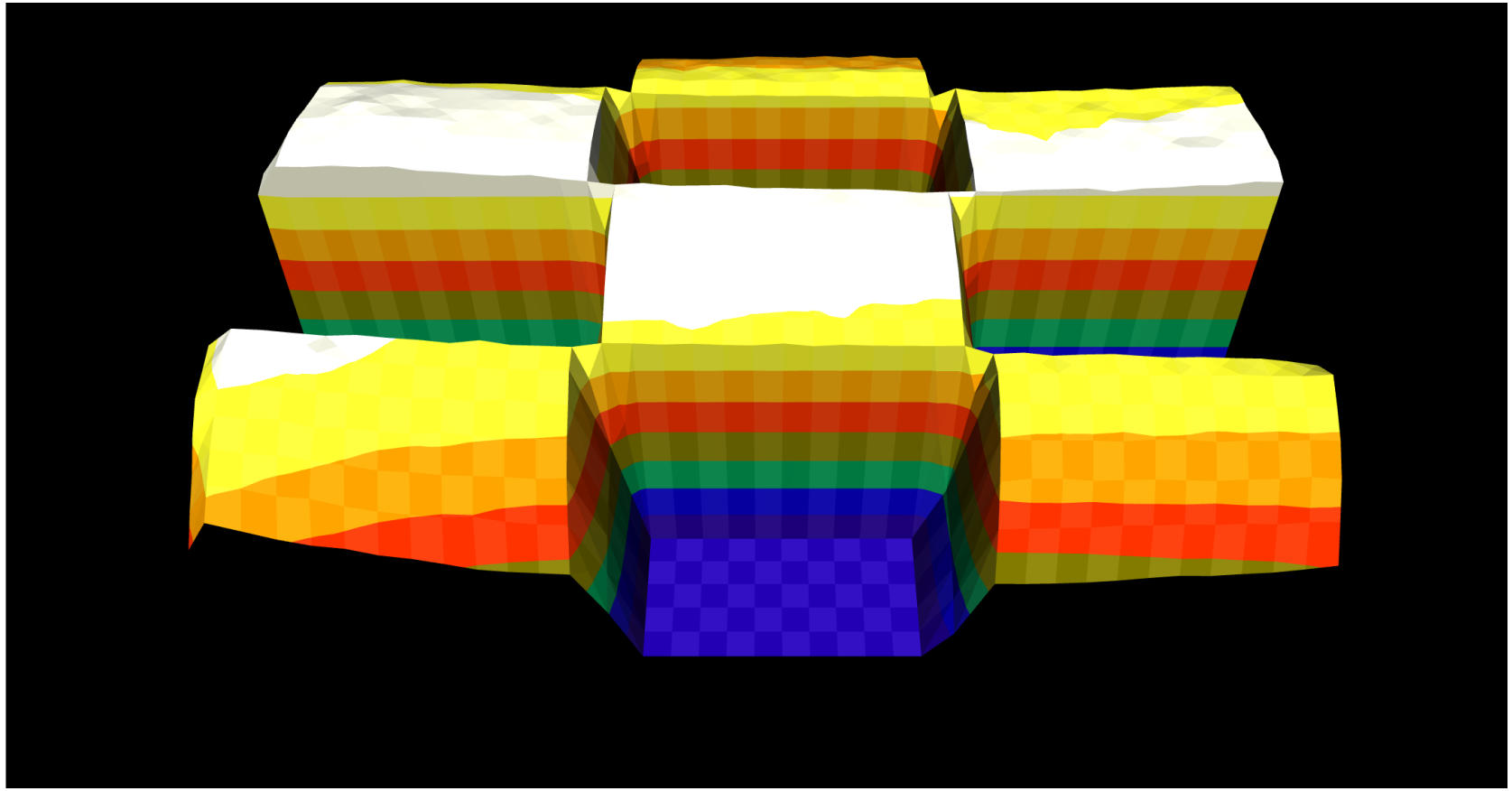

# Some conclusions

- Contemporary Imaging Photometry provides far more useful data!
- …but the instruments are a bit expensive.
- We should learn more about where this data can be most useful

THANKS to LG Electronics and RealD!