



Advanced Grant *FilmColors*

Multispektrales Scannen von historischem Filmmaterial Konzepte für eine neue Generation von Filmabtastern

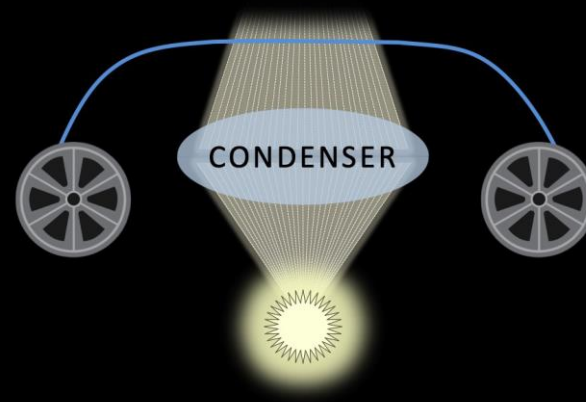
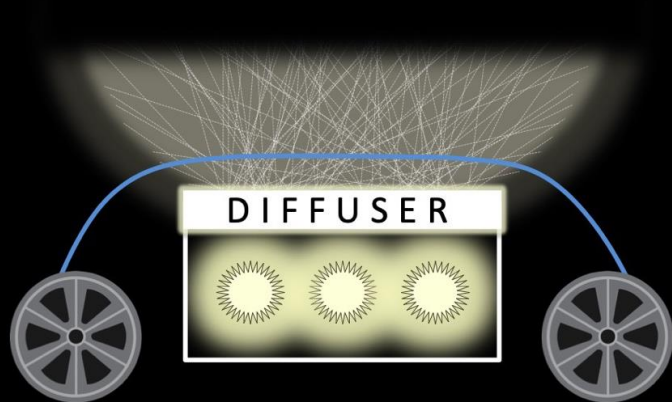
Memoriav Kolloquium

23.-24.10.2019

Giorgio Trumpy

David Pfluger



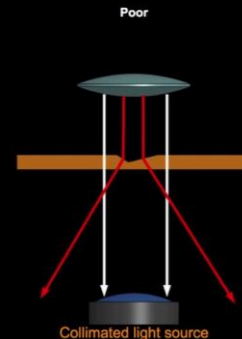
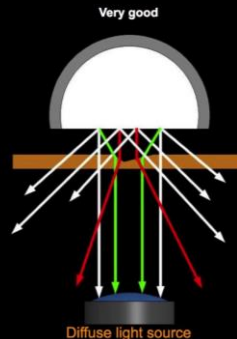


All film scanners use diffuse illumination

Illumination

- High power LEDs (R, G, B, IR), temperature controlled
- Integration sphere providing diffuse and indirect lighting for scratch reduction and uniform illumination of the gate aperture
- Infrared for dust & scratch removal through IR-Cleaner license

LED illumination system with dedicated spectral response,
Automatically adjusted according to film stock and manually adjustable (overwrite)
Integration sphere for diffuse light film illumination for dirt and scratch compression



Special light diffuser works as a powerful, effective scratch-remover, masking a great number of physical defects onto the film base, just as a wet print system would do, so making the digital post-production cleaning easier and cheaper.

- Powerful flashing RGB LED light-source providing a diffuse illumination to mask scratches

Extraction from scanned image.

Dirt and Scratch Reduction
Diffuse light source. Cleaning rollers.

Mounting Options
Desk Mount. Wall Mount.

- » 8 perf VistaVision and 3 perf gate options
- » Stable 700W metal halide diffuse illumination system
- » Up to 8K 35mm or 4K 16mm

Illumination

The LED light source ensures high image quality. It consists of a cluster of LEDs that are colour balanced to obtain a strong light tuned for different film stock.

A crucial part of the lighting system is the hybrid intergrating cylinder. The cylinder creates a highly diffused light source giving rise to smoother illumination.

Lamp life: several years of normal operation.

Extremely diffuse light output for scratch reduction.

DIFFUSE ILLUMINATION





FILM EMULSION SECTIONS – early & modern colors

from 1890s to 1930s

TINTED



TONED



STENCILED



DUFAY



from mid-1930s

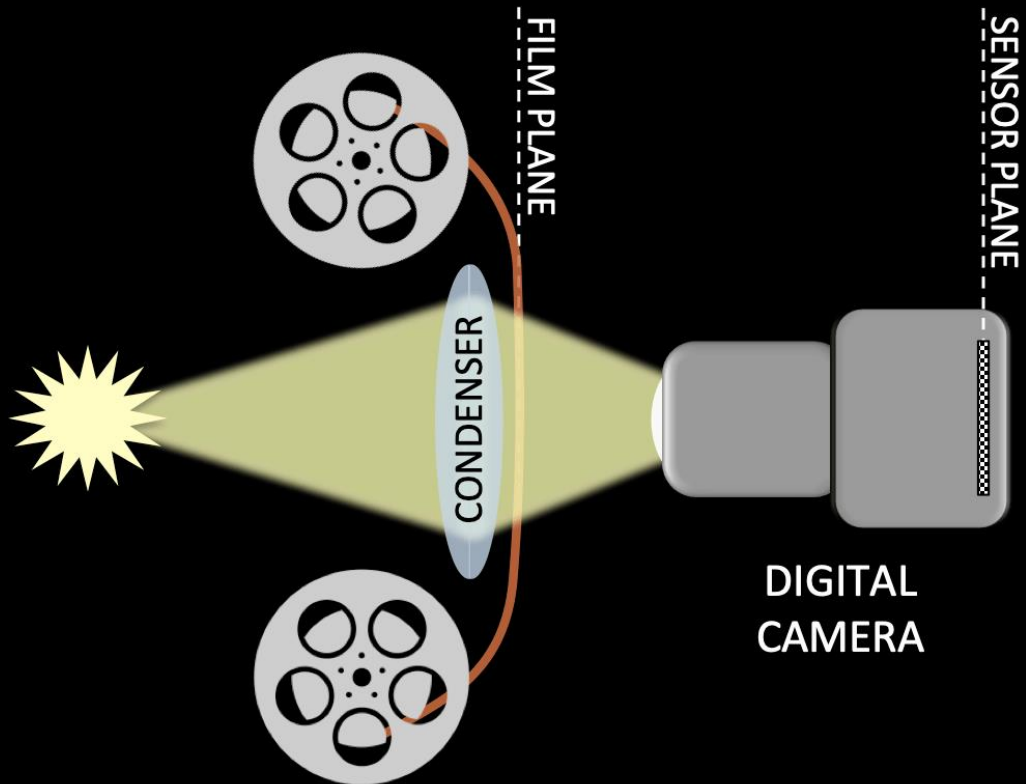
CHROMOGENIC

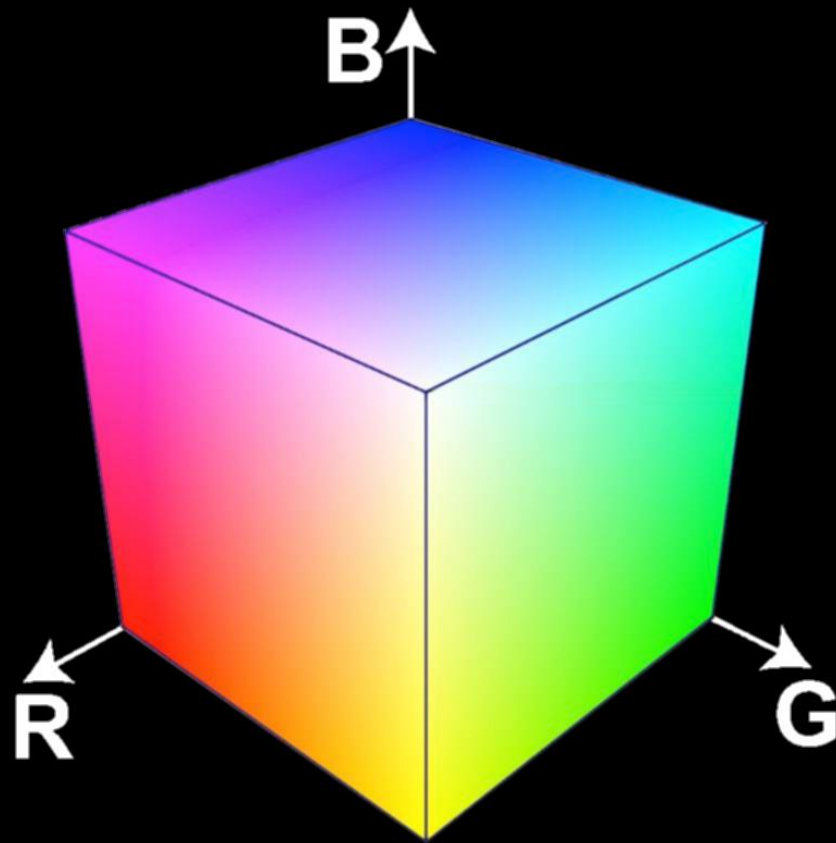


TECHNICOLOR







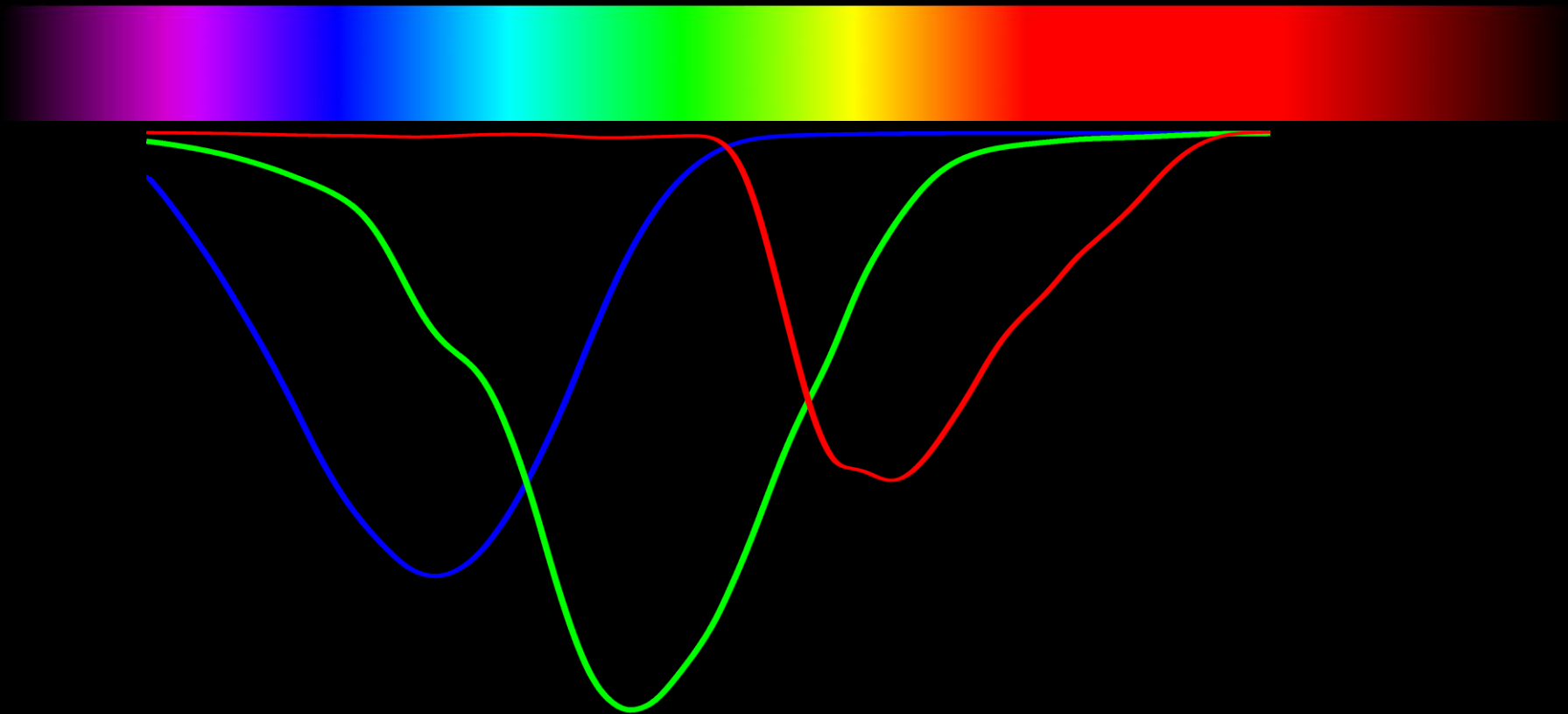


400 nm

500 nm

600 nm

700 nm

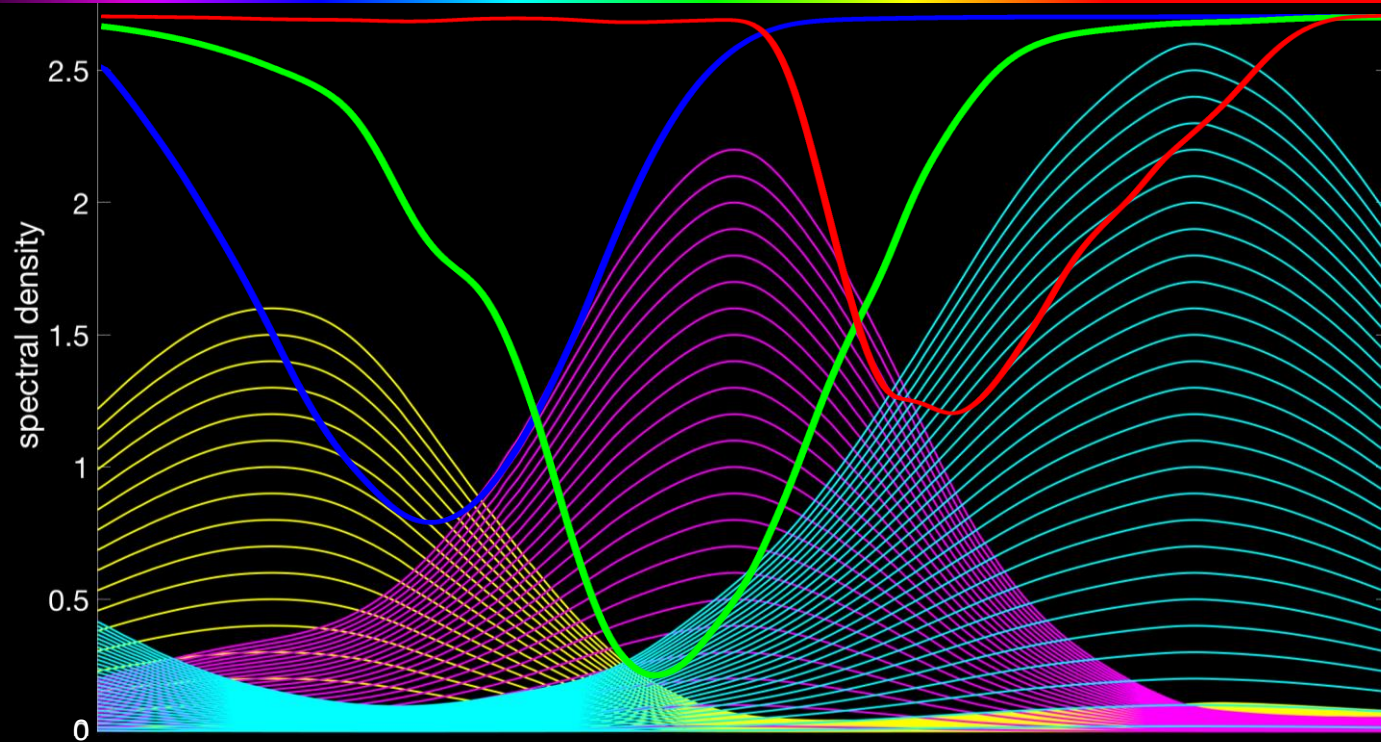


400 nm

500 nm

600 nm

700 nm

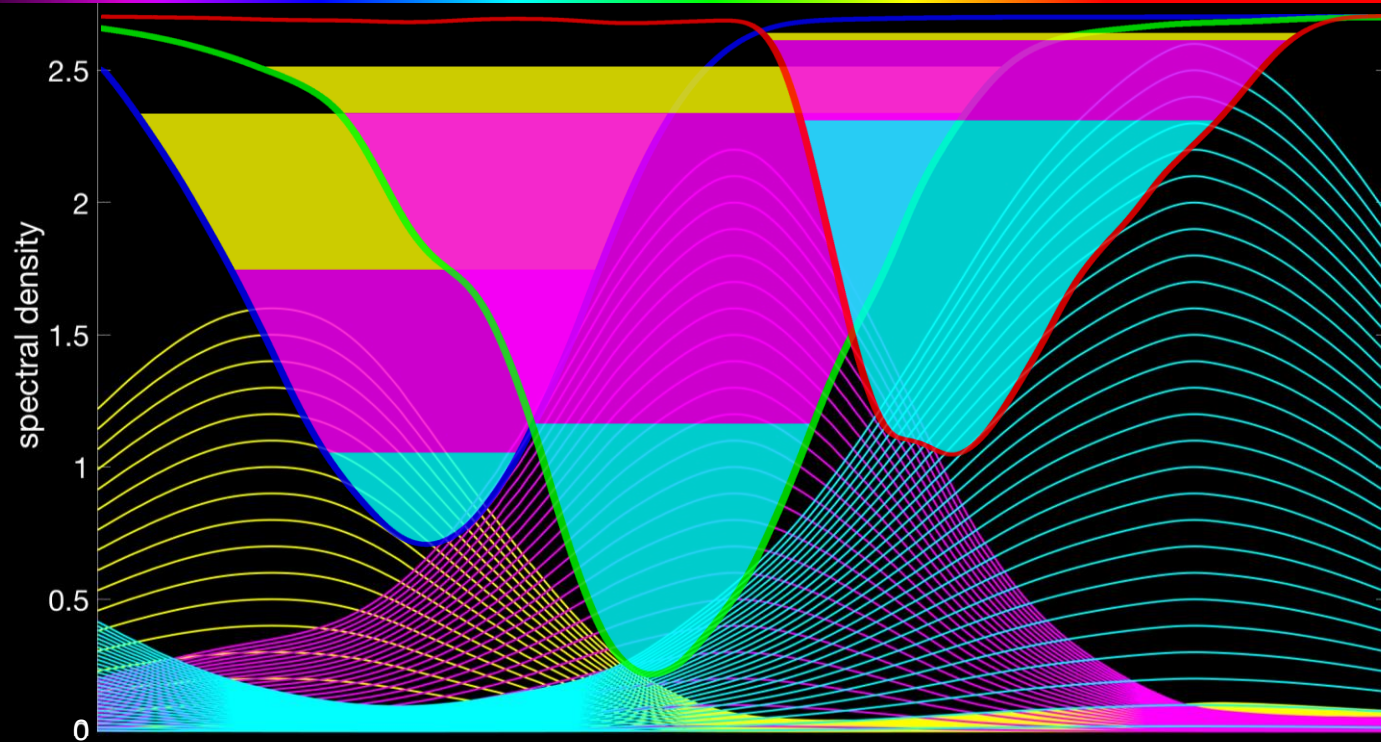


400 nm

500 nm

600 nm

700 nm

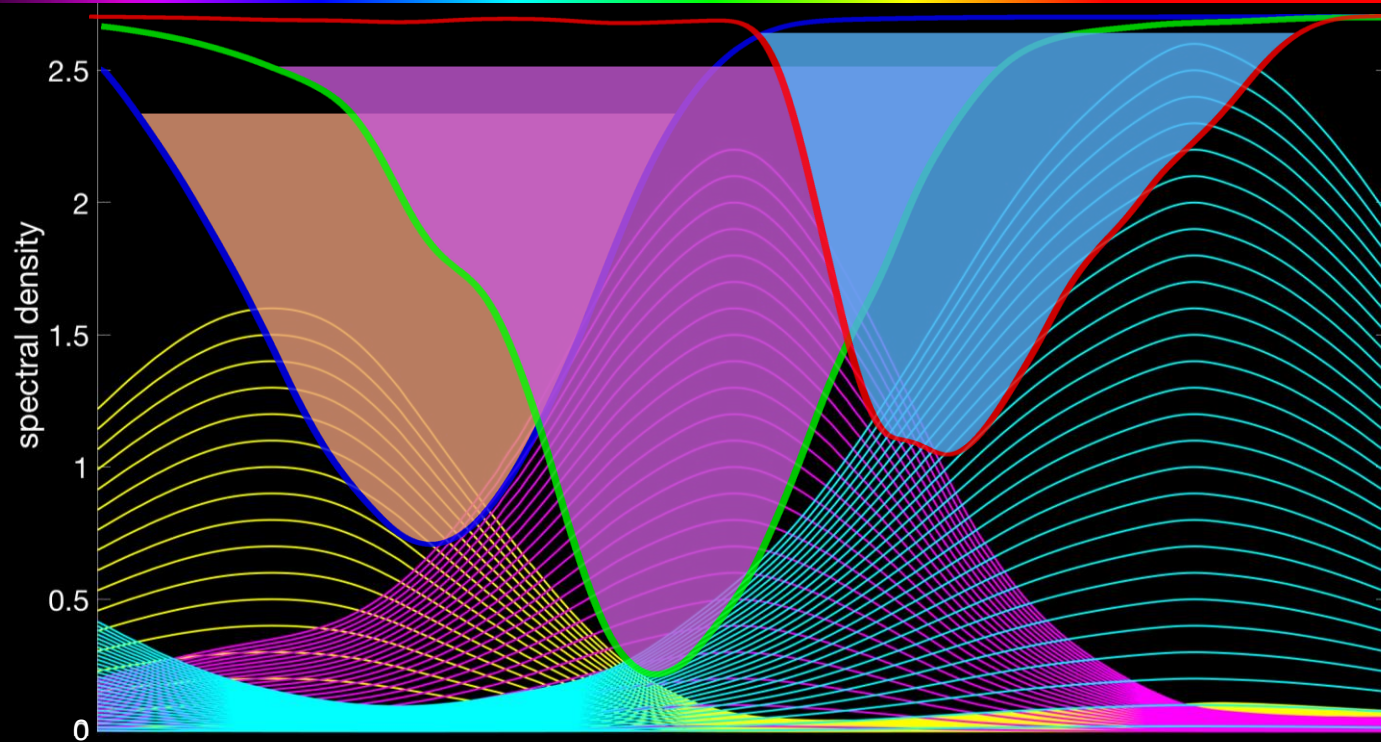


400 nm

500 nm

600 nm

700 nm

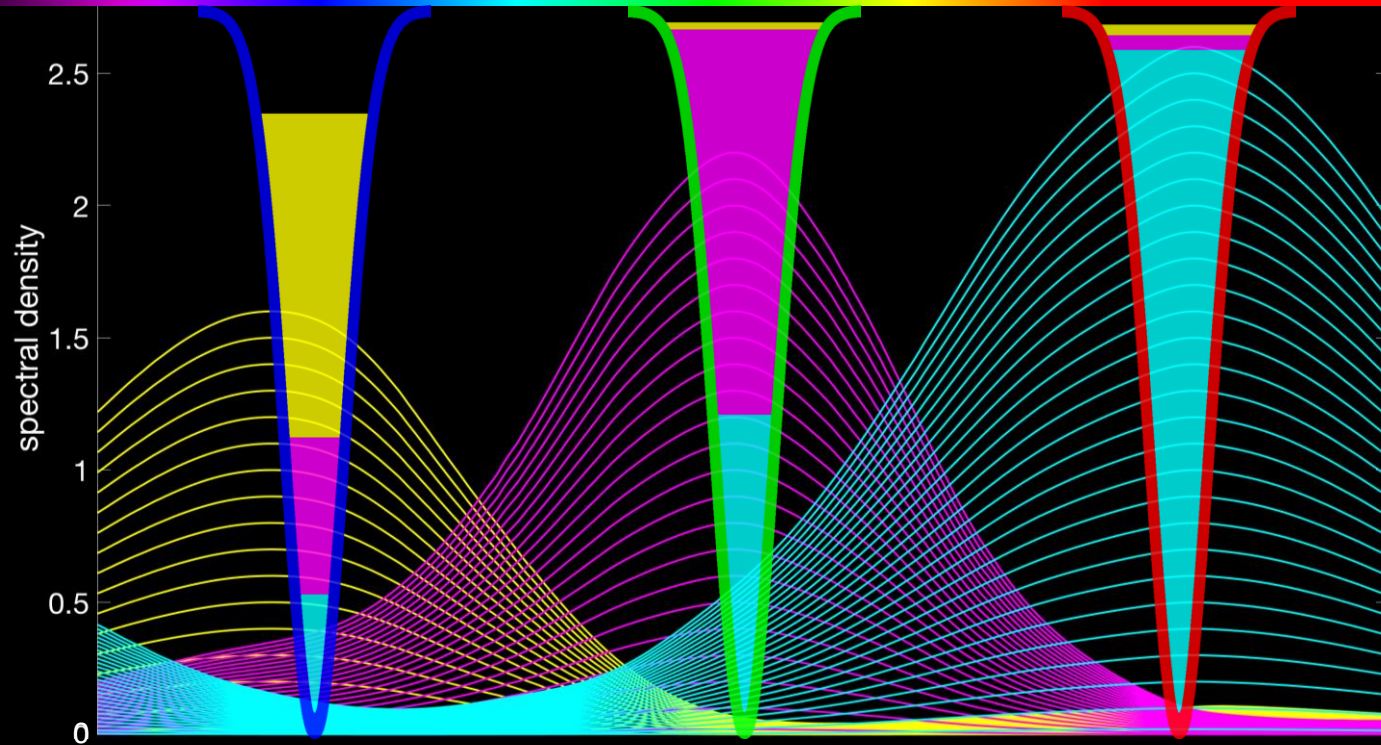


400 nm

500 nm

600 nm

700 nm

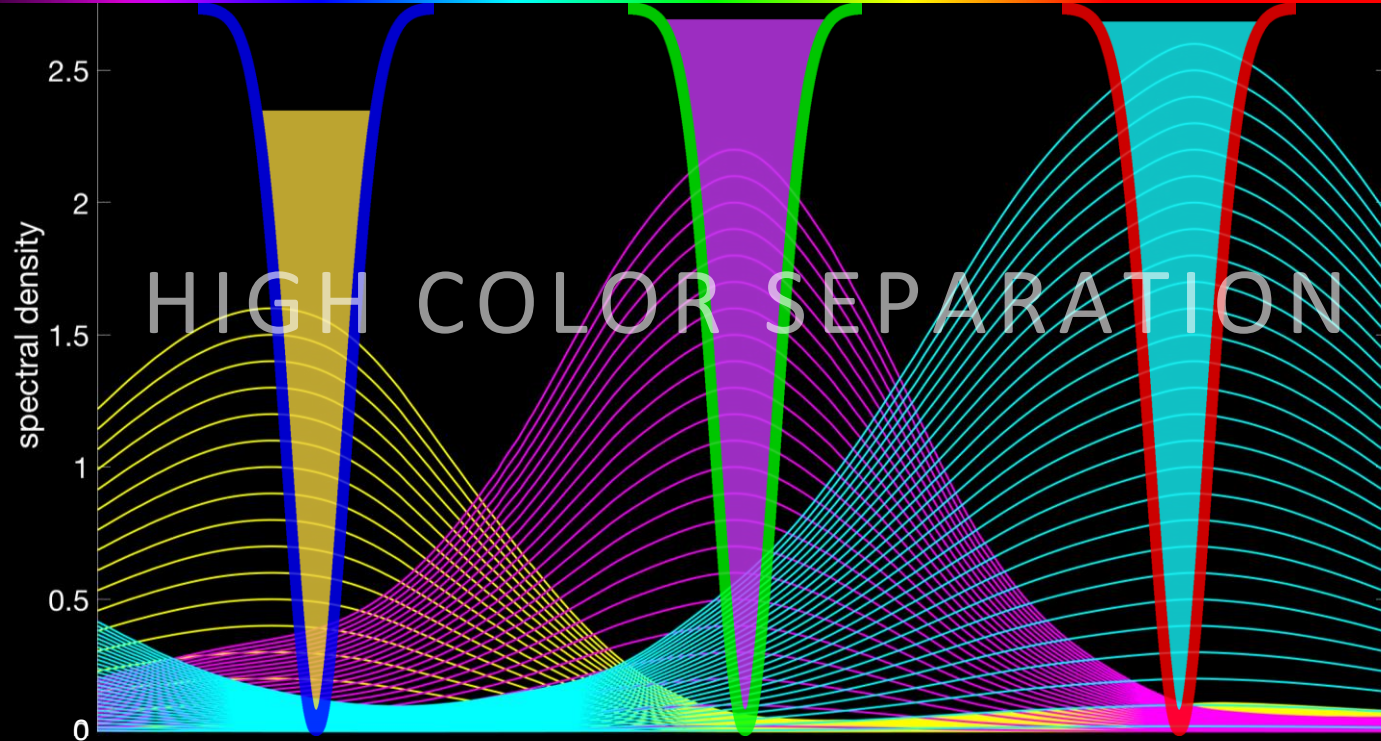


400 nm

500 nm

600 nm

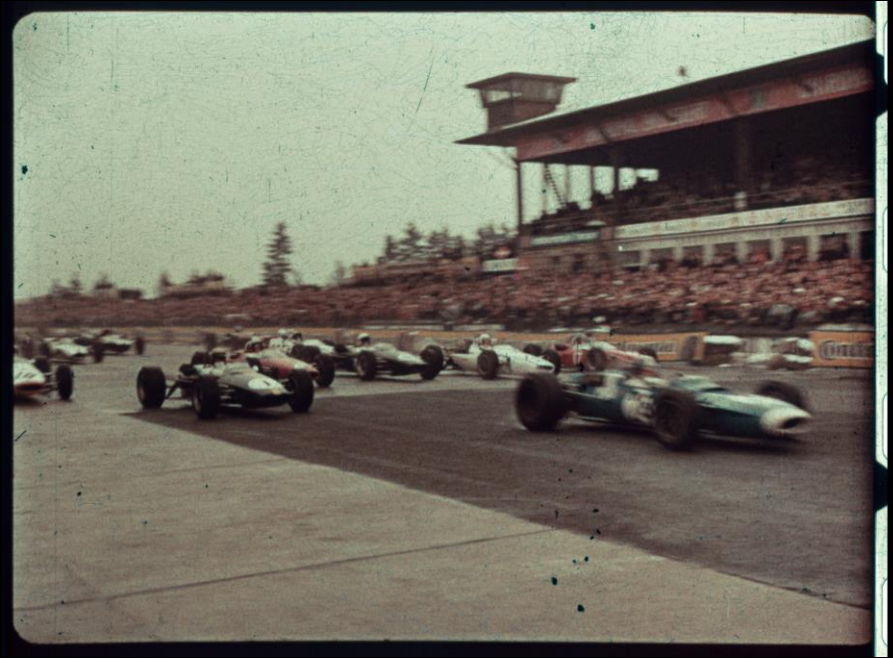
700 nm



faded print



result of digital unfading



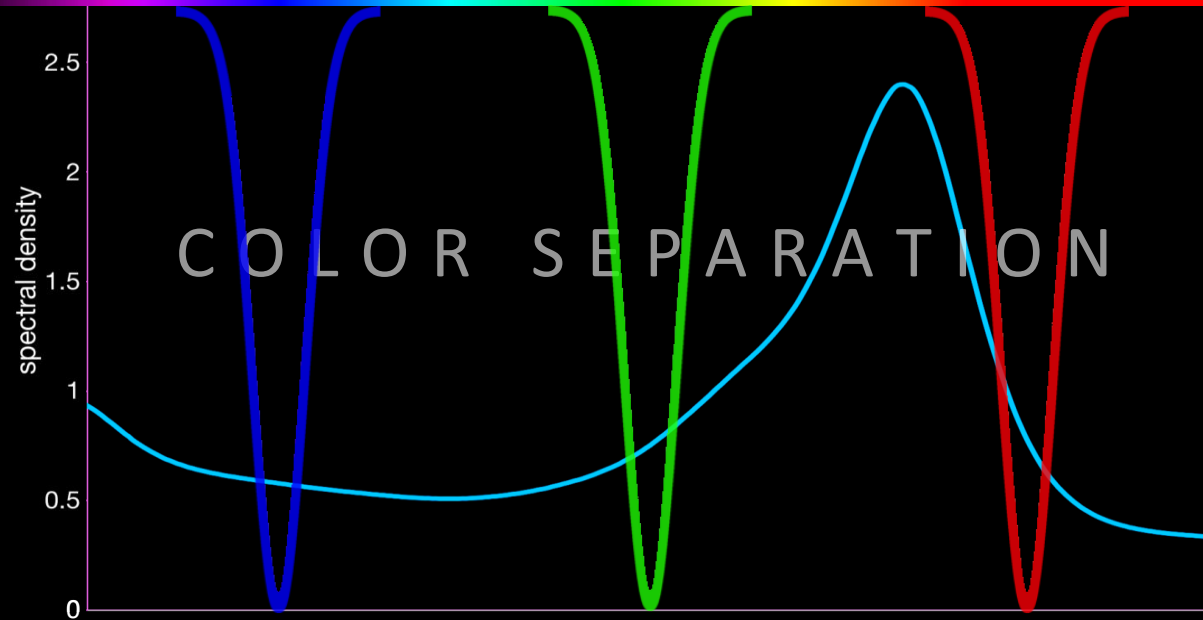
LOW COLOR SEPARATION

400 nm

500 nm

600 nm

700 nm

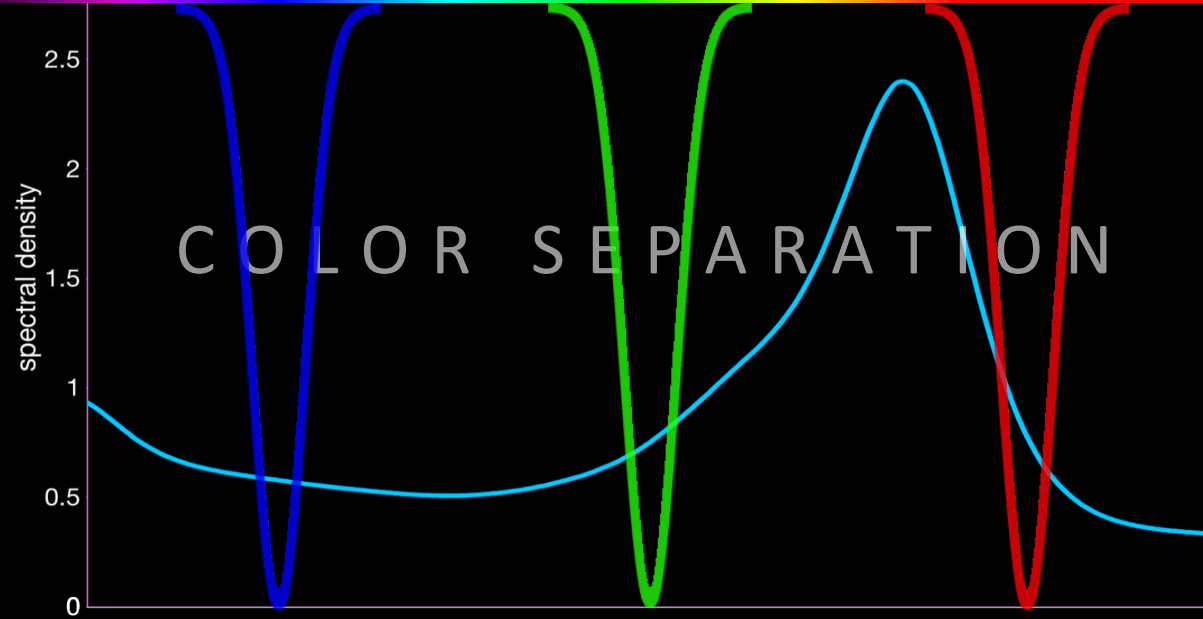


400 nm

500 nm

600 nm

700 nm



FUTURE GENERATION OF FILM SCANNERS

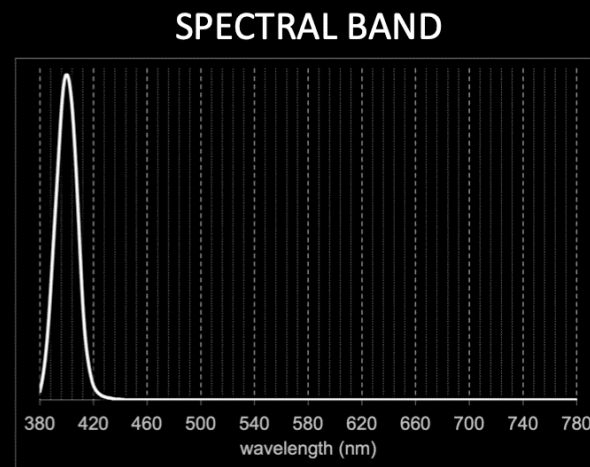
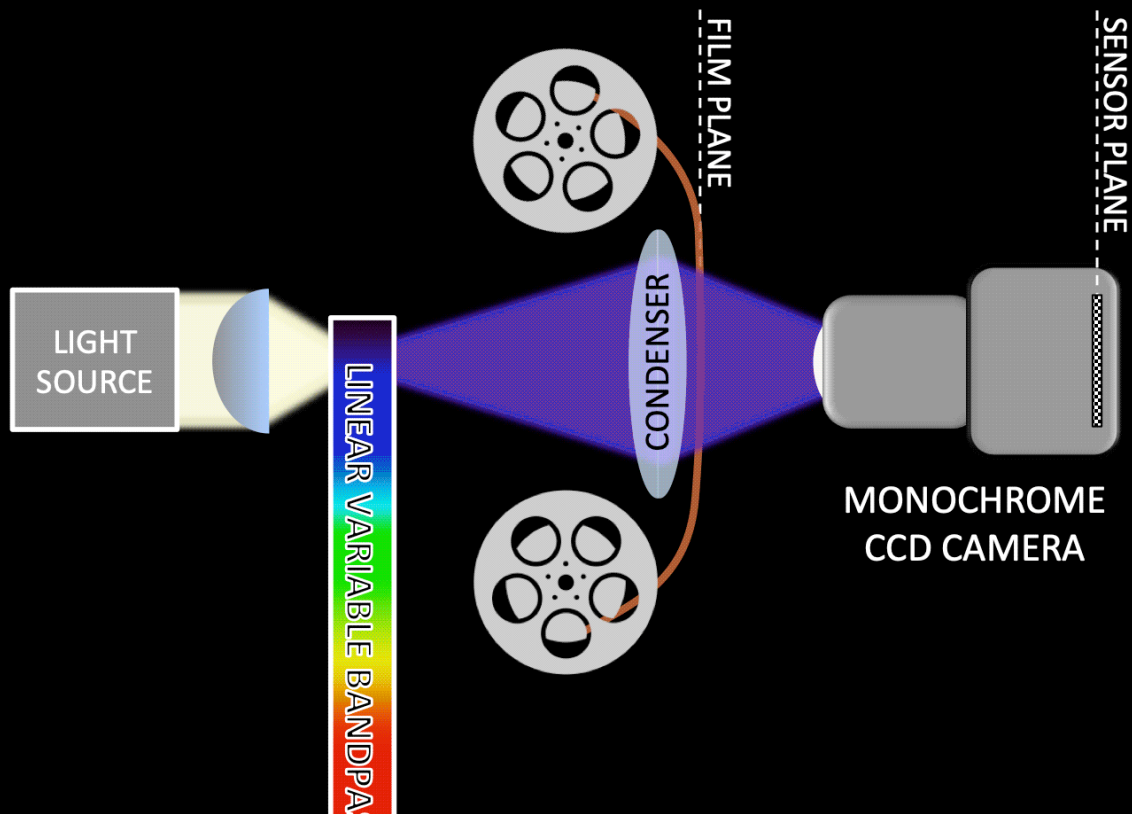
How many spectral bands?

What wavelengths?

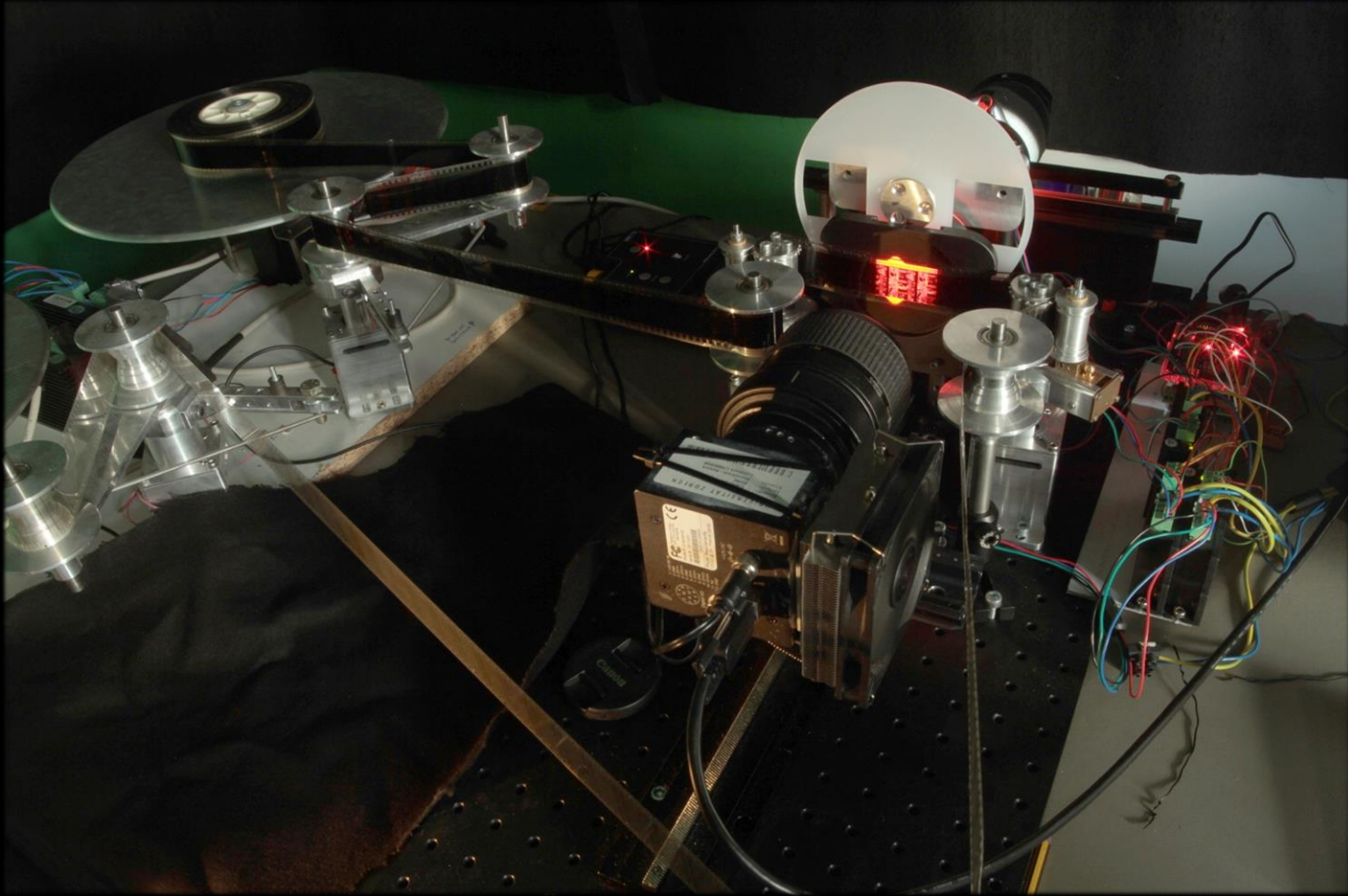
Evenly or unevenly distributed?

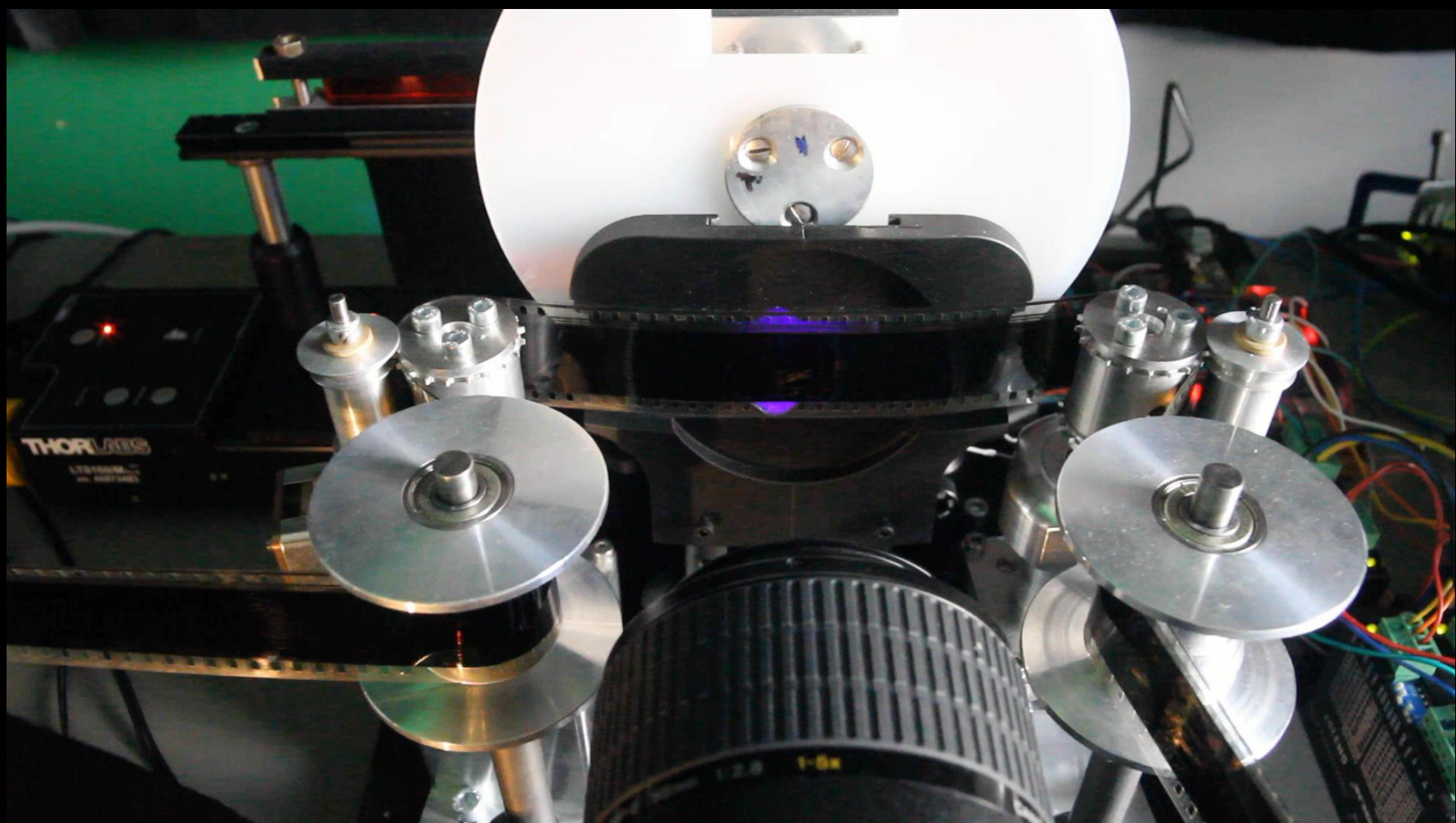
What bandwidths?

Same or differentiated?

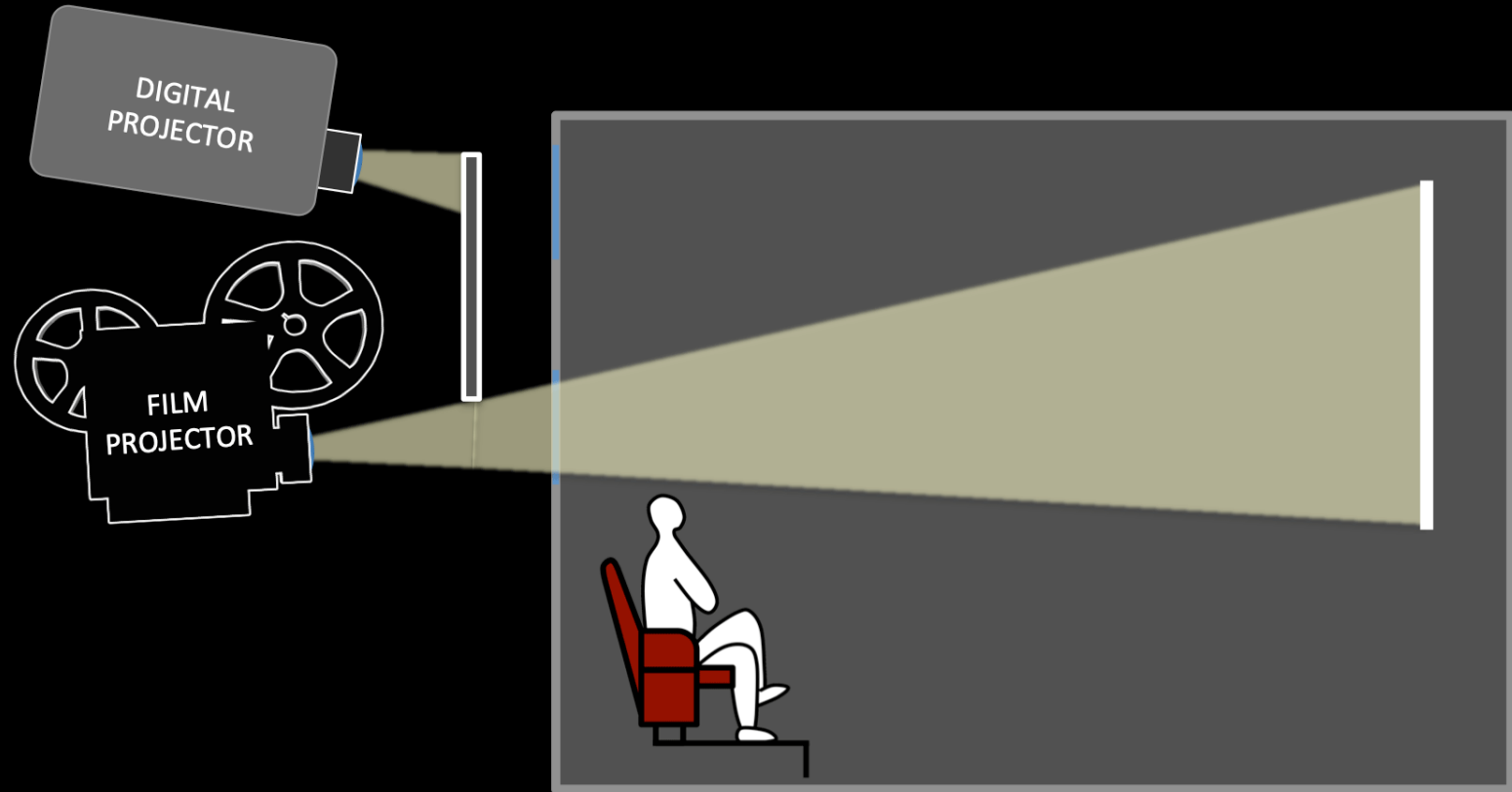


Plasma light source - 25 spectral bands from 400 to 730 nm (FWHM ~14 nm) - 65 mm f/2.8 macro lens - monochrome CCD 16 Mpixels





PARALLEL A/D PROJECTIONS



Tinting on safety film from 30s



Technicolor IV



Chromogenic film





Amber Tint - Acid Orange G



Pink Tint - Amaranth



Yellow Tint - Tartrazine



Blue Tone - Pathé



Yellow Tint - Acid Orange 6



Blue Tint - Acid Blue 22



Cine Blue/Green - Alphazurine A



Pink Tint & Blue Tone



Cine Blue - Direct Blue



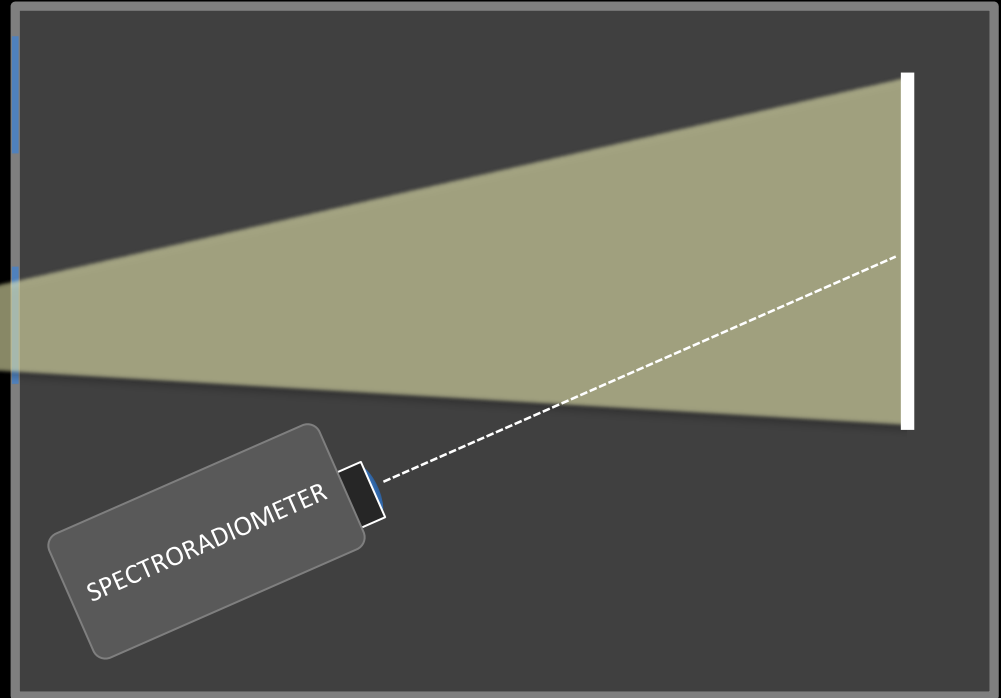
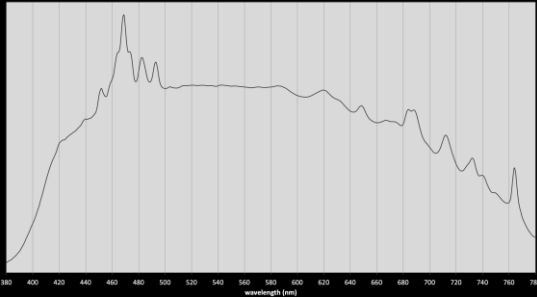
Cine Orange/Red - Acid Red 26



Violet - Basic Violet 1



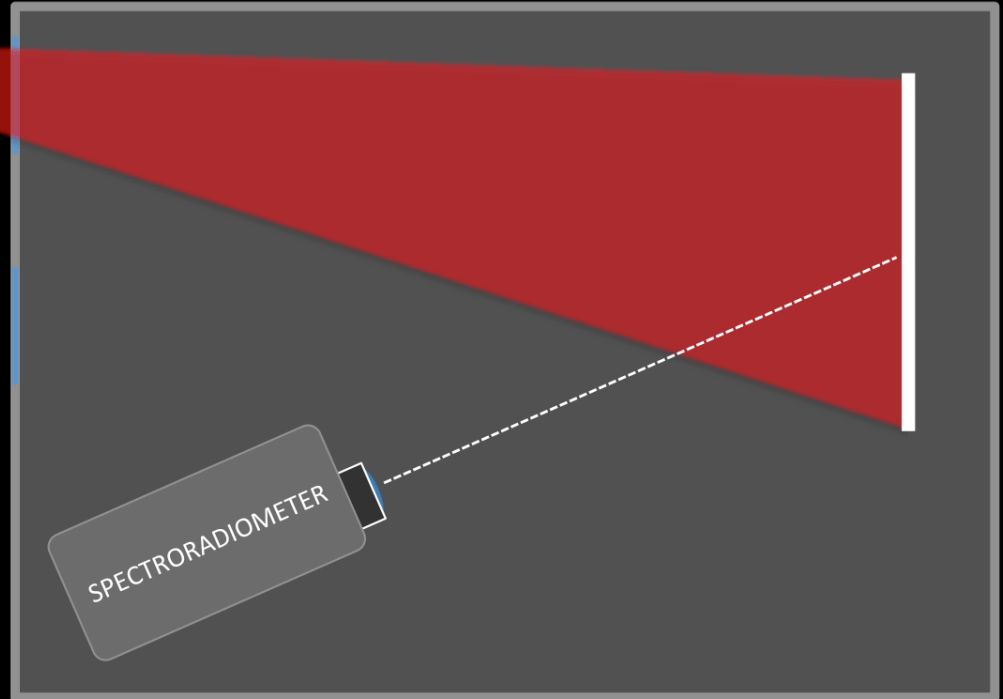
MEASURE THE FILM PROJECTOR LIGHT (Xenon arc lamp)



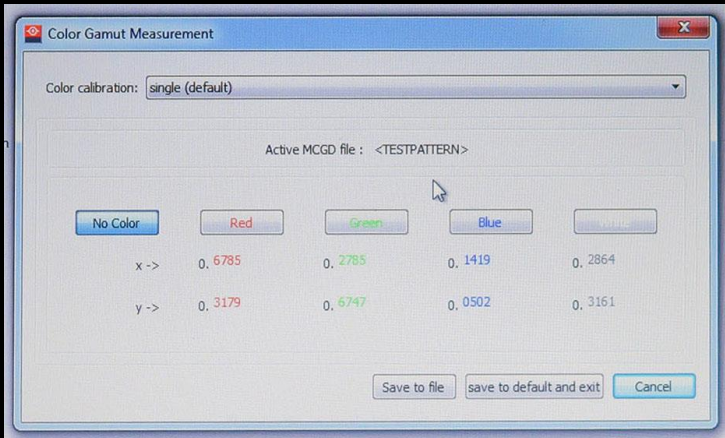
CALIBRATE THE DIGITAL PROJECTOR



DIGITAL
PROJECTOR



SPECTRORADIOMETER



COLORIMETRIC SUMMATIONS

$$\Sigma \left(\text{RESAMPLED ILLUMINANT} \times \text{MULTISPECTRAL IMAGE} \times \text{RESAMPLED CMFs} \right) = XYZ$$

The diagram illustrates the process of colorimetric summation for multispectral imaging. It shows the summation of the product of three components: a Resampled Illuminant, a Multispectral Image, and Resampled CMFs, resulting in the XYZ color space representation.

RESAMPLED ILLUMINANT: A graph showing the spectral power distribution of the illuminant across wavelengths (nm) from 380 to 780. The curve is a smooth, broad peak centered around 550 nm.

MULTISPECTRAL IMAGE: A stack of grayscale images showing the same scene (a still life with various objects) captured at different wavelengths.

RESAMPLED CMFs: A graph showing the color matching functions (CMFs) across wavelengths (nm) from 380 to 780. The curves are sharp and distinct, representing the human visual system's response to different wavelengths.

XYZ: The resulting color space representation, shown as a single grayscale image of the same scene, which is the sum of the weighted multispectral images.

LINEAR TRANSFORMATION BETWEEN VECTOR SPACES



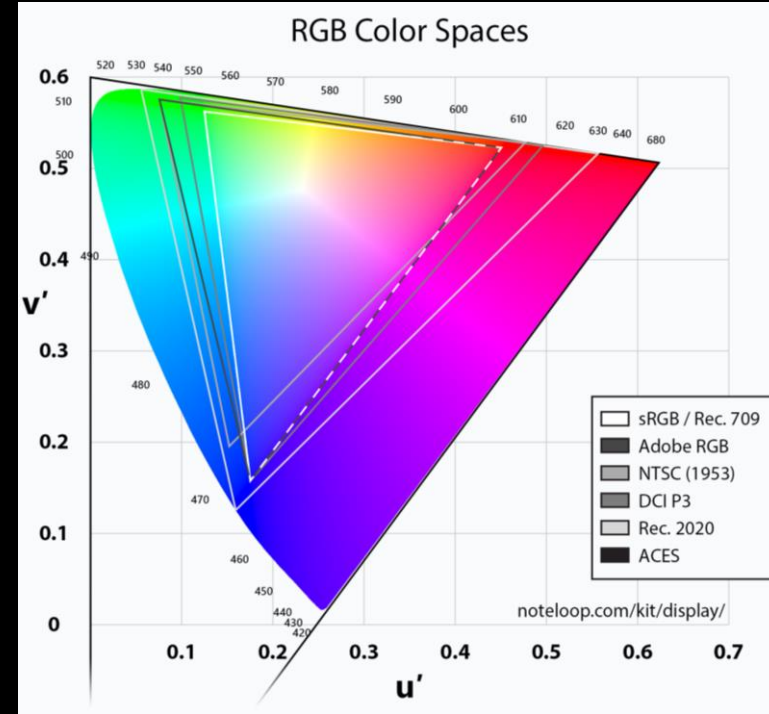
$$\times \begin{bmatrix} M_{RX} & M_{RY} & M_{RZ} \\ M_{GX} & M_{GY} & M_{GZ} \\ M_{BX} & M_{BY} & M_{BZ} \end{bmatrix} =$$

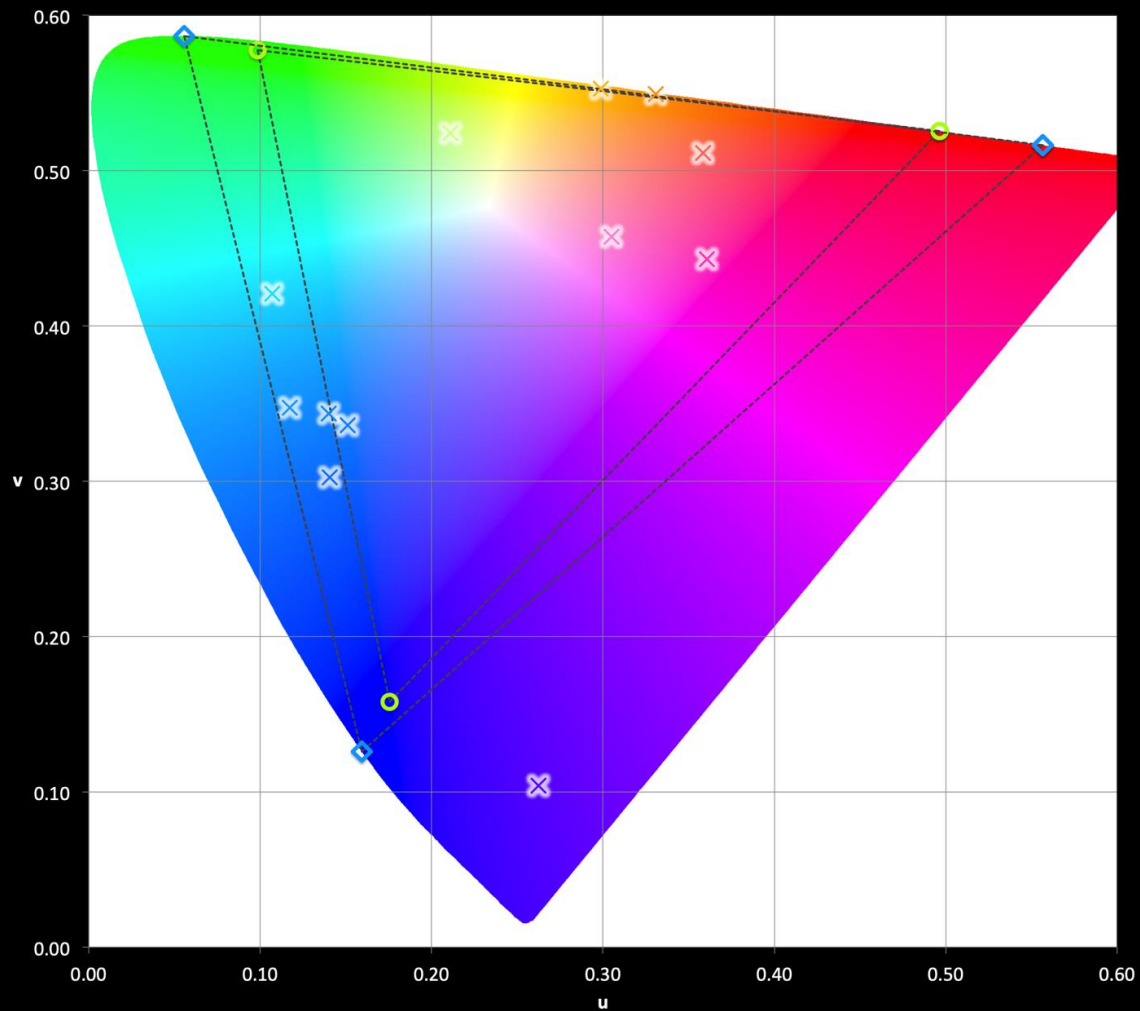

XYZ LINEAR RGB



$$\stackrel{1/\gamma}{=}$$


LINEAR RGB RGB



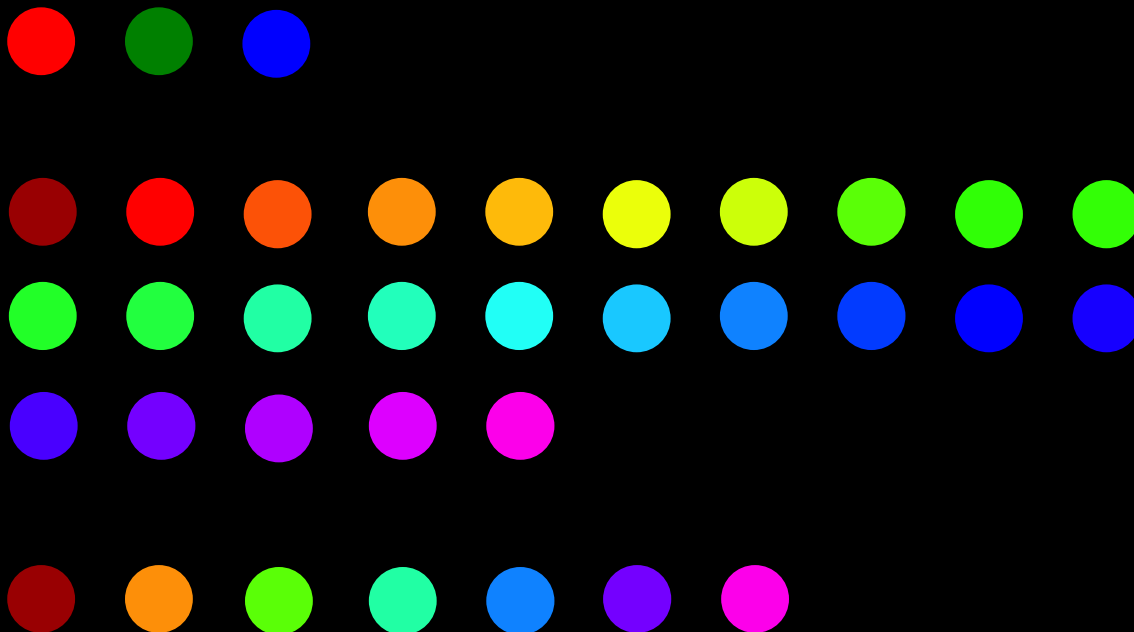


- DCI-P3
- × Acid Orange G
- × Amaranth
- × Tartrazine
- × Acid Orange 6
- × Acid Blue 22
- × Pathé tone
- × Composition - pink tint
- × Composition - blue tone
- × Alphazurine A
- × Direct Blue 15
- × Acid Red 26
- × Basic Violet 1
- ◇ Rec2020

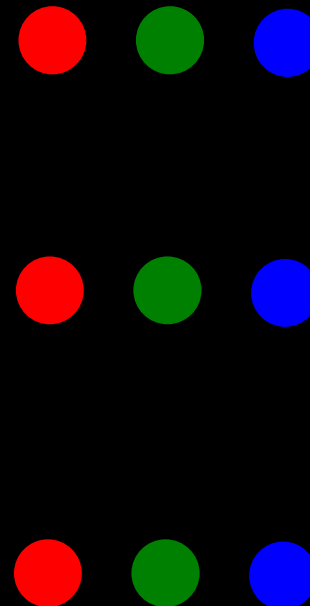
Was kommt da auf uns zu?

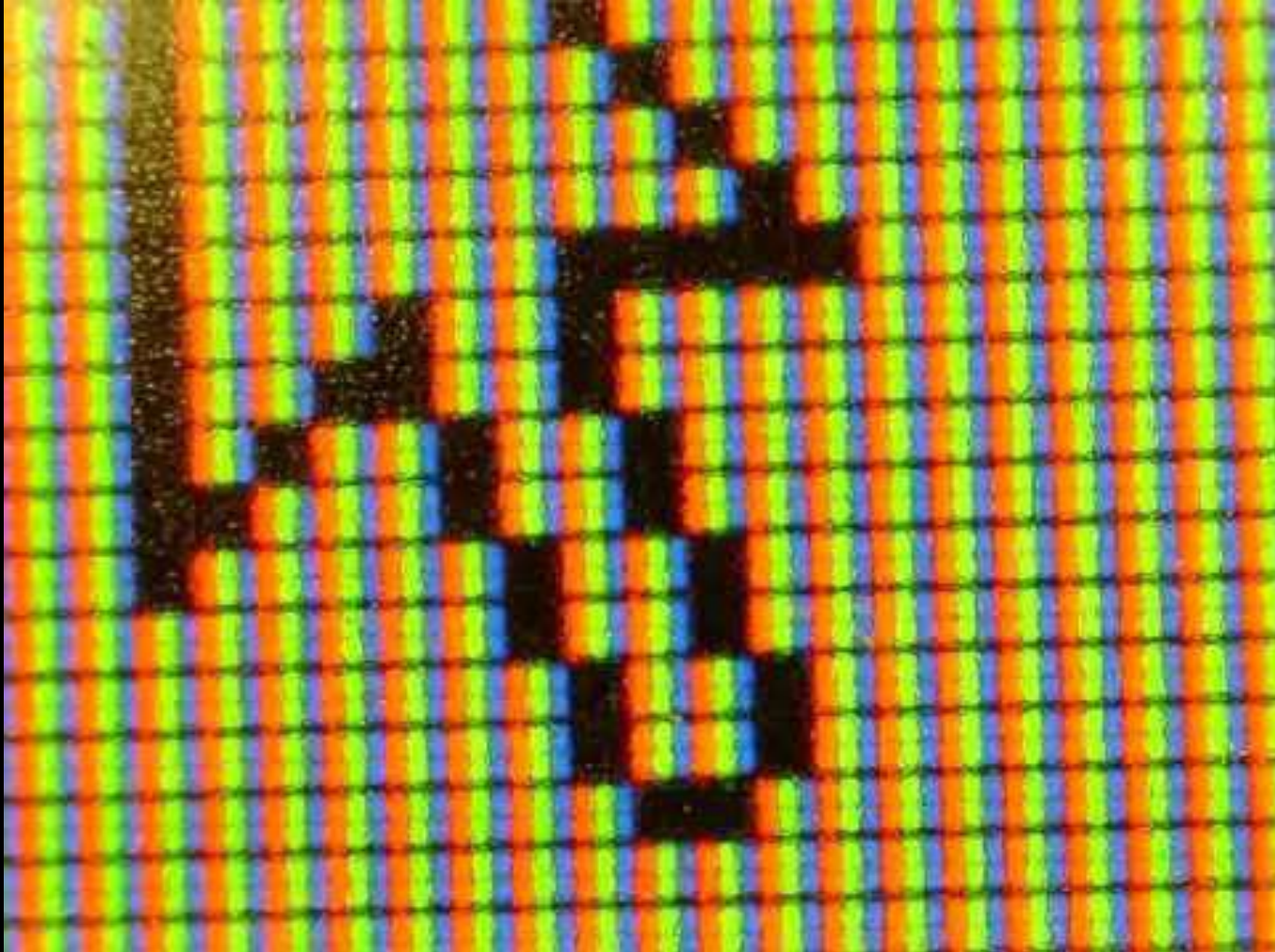


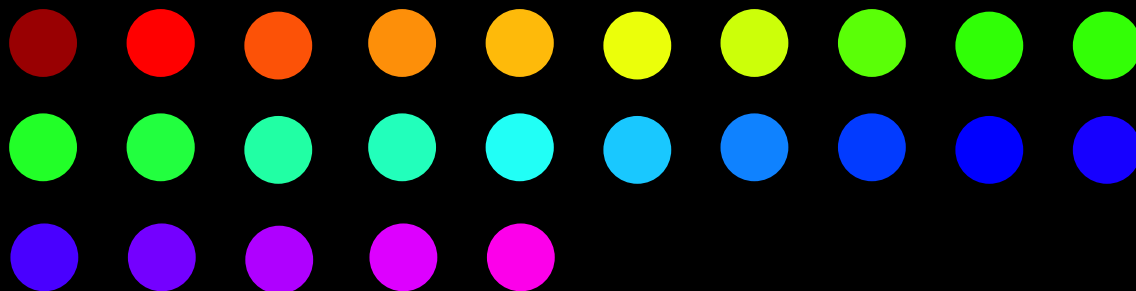
Aufnahme / Scan



Darstellung



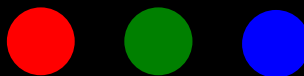




“Reduce to the Max”



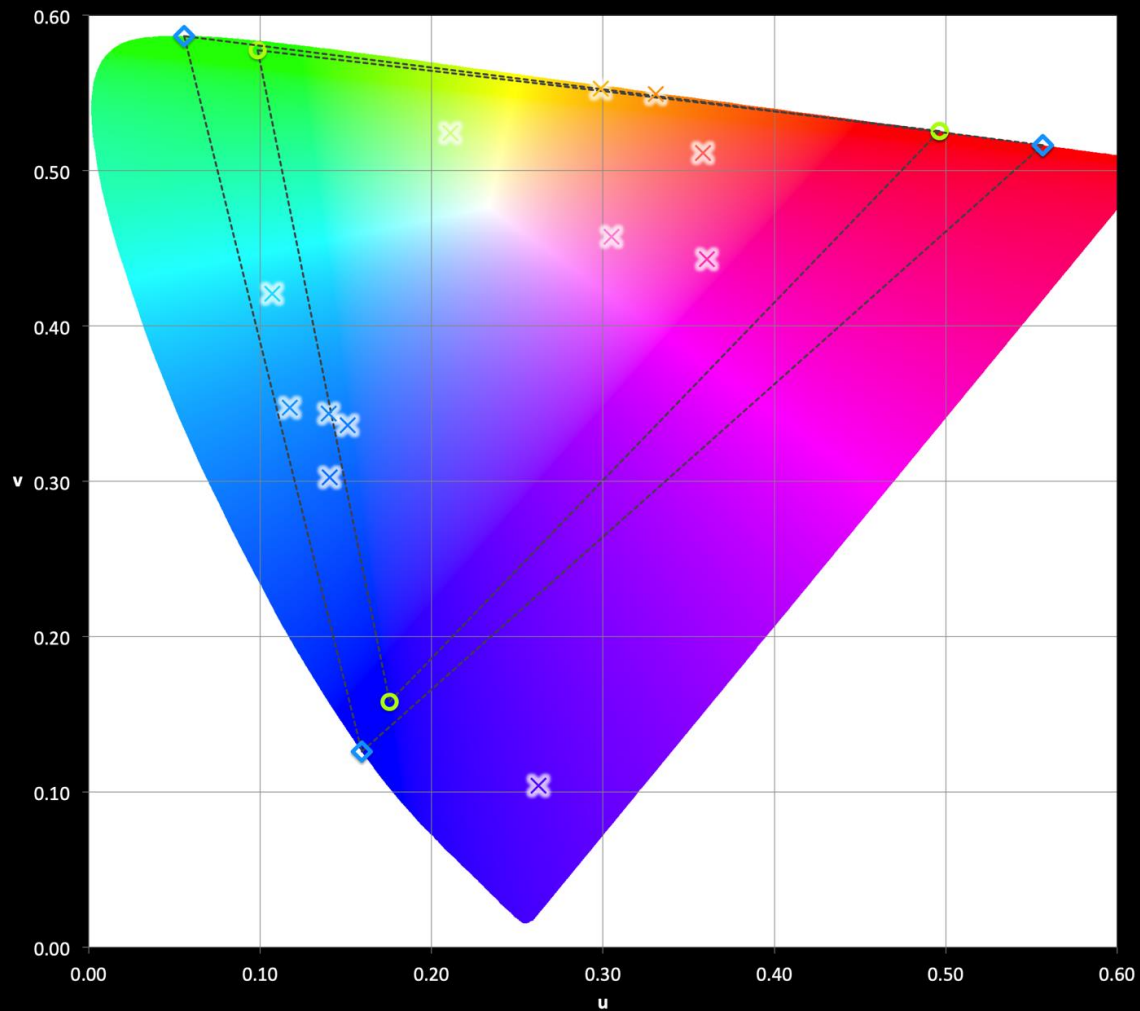
Äussere Umstände



Warum der Aufwand?

- 1) In der Digitalisierung von Kulturgut ist das Ziel das Artefakt in seinem vollen Informationsumfang zu konservieren.
 - > Das geht über die 'sichtbaren' Eigenschaften hinaus.
 - > Was dargestellt wird ist ein reduzierter Ausschnitt der vollen Information.

- 2) In naher Zukunft werden Mittel zur Abbildung von Bewegtbildern zur Verfügung stehen, die die heutigen bei weitem übertreffen.



- DCI-P3
- × Acid Orange G
- × Amaranth
- × Tartrazine
- × Acid Orange 6
- × Acid Blue 22
- × Pathé tone
- × Composition - pink tint
- × Composition - blue tone
- × Alphazurine A
- × Direct Blue 15
- × Acid Red 26
- × Basic Violet 1
- ◇ Rec2020

Datenvolumen

Aufnahme

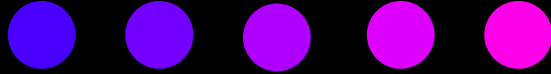
Datenvolumen bei 4K 16bit



79 MB/Bild, 6.79 TB/h

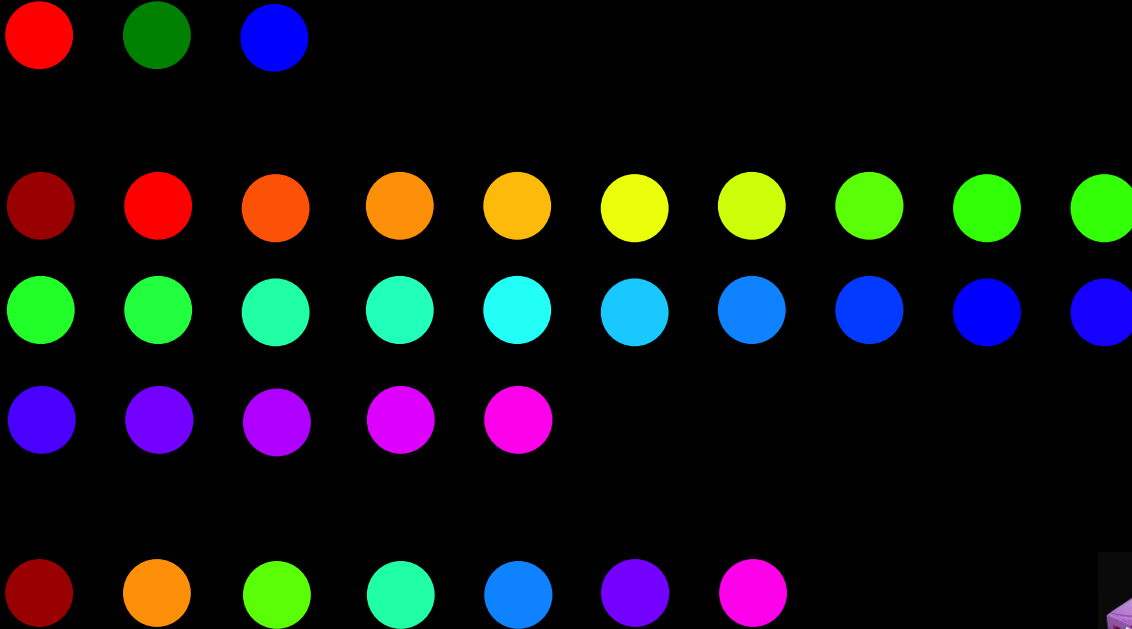


655 MB/Bild, 56.6 TB/h



183 MB/Bild, 15.8 GB/h

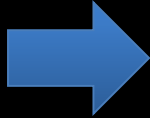
Aufnahme



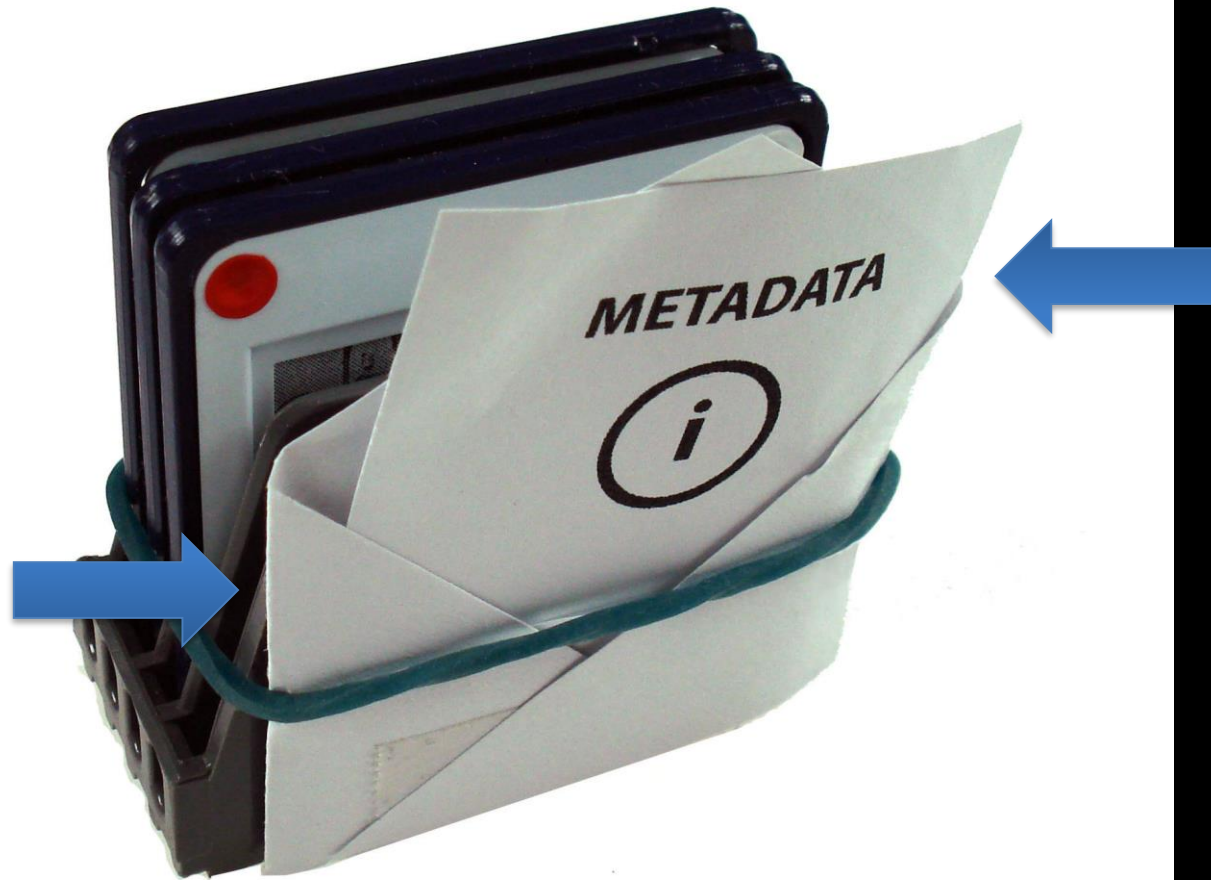
LTO 7 Tapes (6TB Kapazität)



Dateiformat











Neue Dateiformate werden nötig um die
grössere Zahl Farbauszüge unterzubringen.

ENVI Format

MovIm Video Codec (reto.ch)

STAY TUNED!