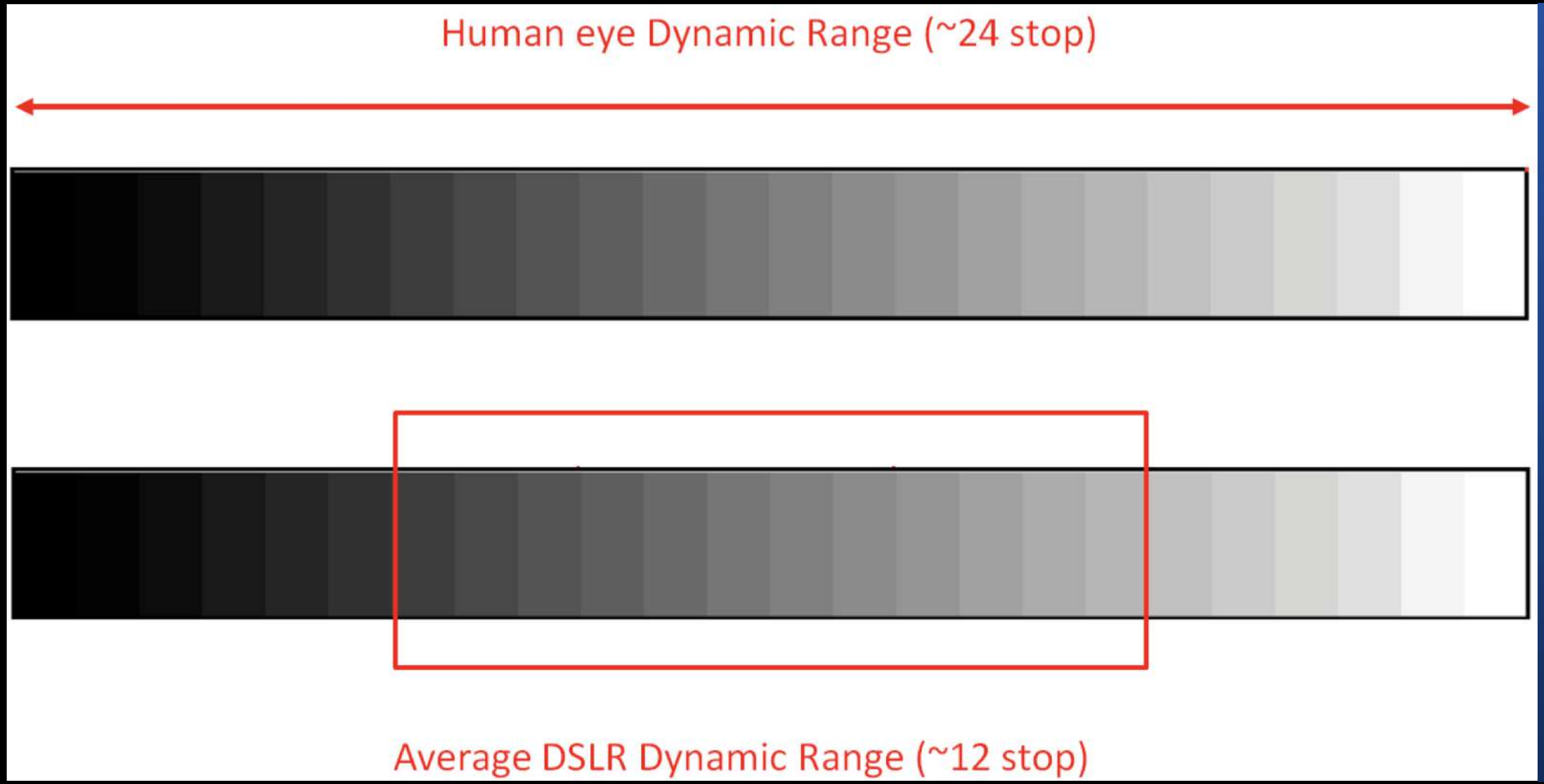
DOLBY
VISION
Perceptual Quantizer (PQ) EOTF
$Y = L\left(\frac{V^{1/m} - c_1}{c_2 - c_3 V^{1/m}}\right)^{1/n}$
$0 \le V \le 1$
$L = 10{,}000$
$m = 78.8438$
$n = 0.1593$
$c_1 = 0.8359$
$c_2 = 18.8516$
$c_3 = 18.6875$
10000
1000
100
10
1
0
1023
948
847
769
668
519
0
100 nits
400 nits
1000 nits
2000 nits
5000 nits
10000 nits

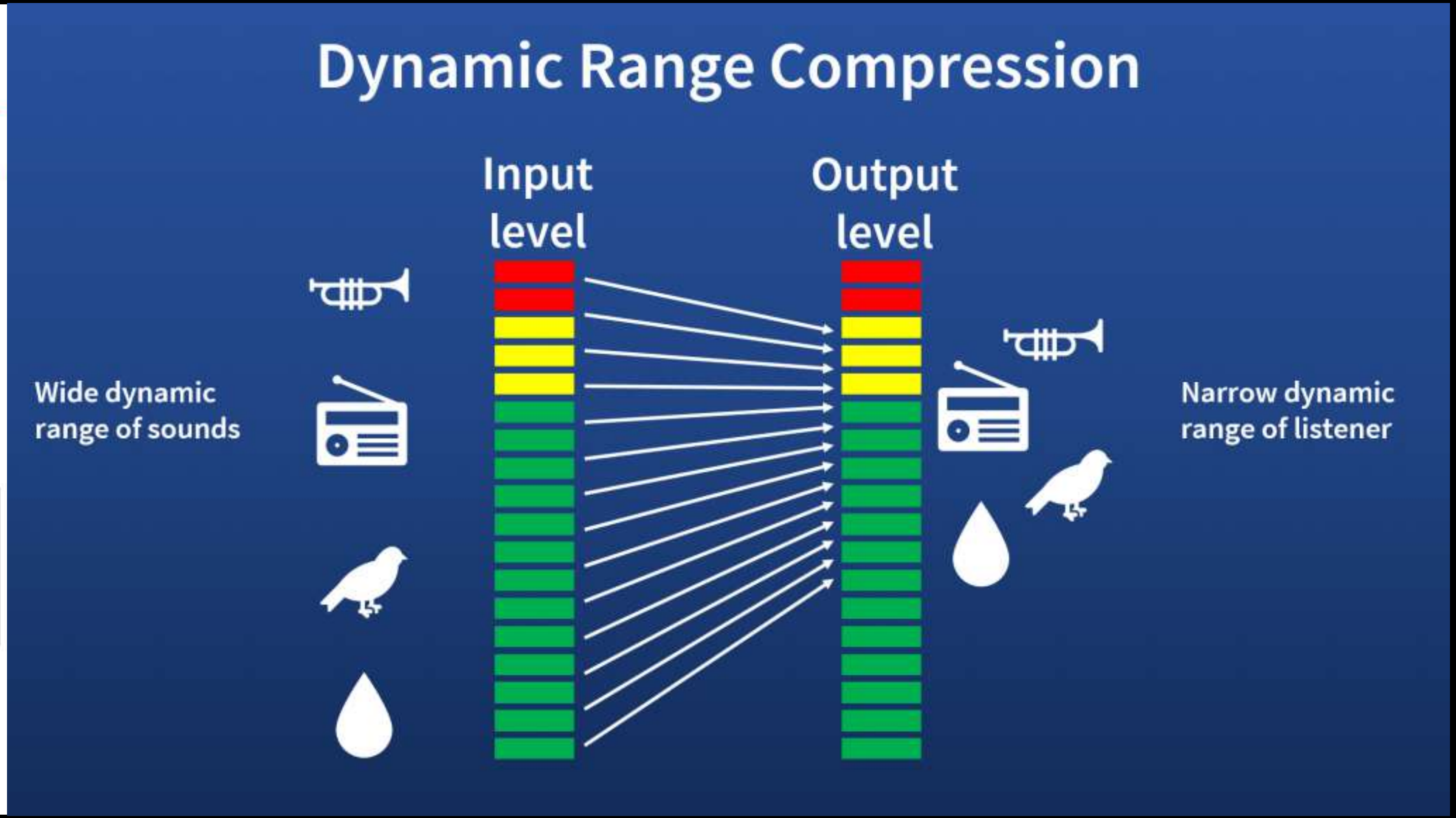
DYNAMIC RANGE

-DYNAMIC RANGE (ABBREVIATED DR, DNR,[1] OR DYR[2]) IS THE RATIO BETWEEN THE LARGEST AND SMALLEST VALUES THAT A CERTAIN QUANTITY CAN ASSUME. IT IS OFTEN USED IN THE CONTEXT OF SIGNALS, LIKE SOUND AND LIGHT. IT IS MEASURED EITHER AS A RATIO OR AS A BASE-10 (DECIBEL) OR BASE-2 (DOUBLINGS, BITS OR STOPS) LOGARITHMIC VALUE OF THE RATIO BETWEEN THE LARGEST AND SMALLEST SIGNAL VALUES

-DYNAMIC RANGE, IN THE CONTEXT OF ELECTRICAL ENGINEERING, SPECIFIES THE RANGE OF POSSIBLE OR ACCEPTABLE VALUES THAT A DYNAMIC SIGNAL CAN ASSUME WHEN DELIVERED TO OR PRODUCED BY A GIVEN SYSTEM.

-IS THE RATIO OF THE LARGEST TO THE SMALLEST INTENSITY OF BRIGHTNESS THAT CAN BE RELIABLY TRANSMITTED OR REPRODUCED BY A PARTICULAR IMAGING SYSTEM.





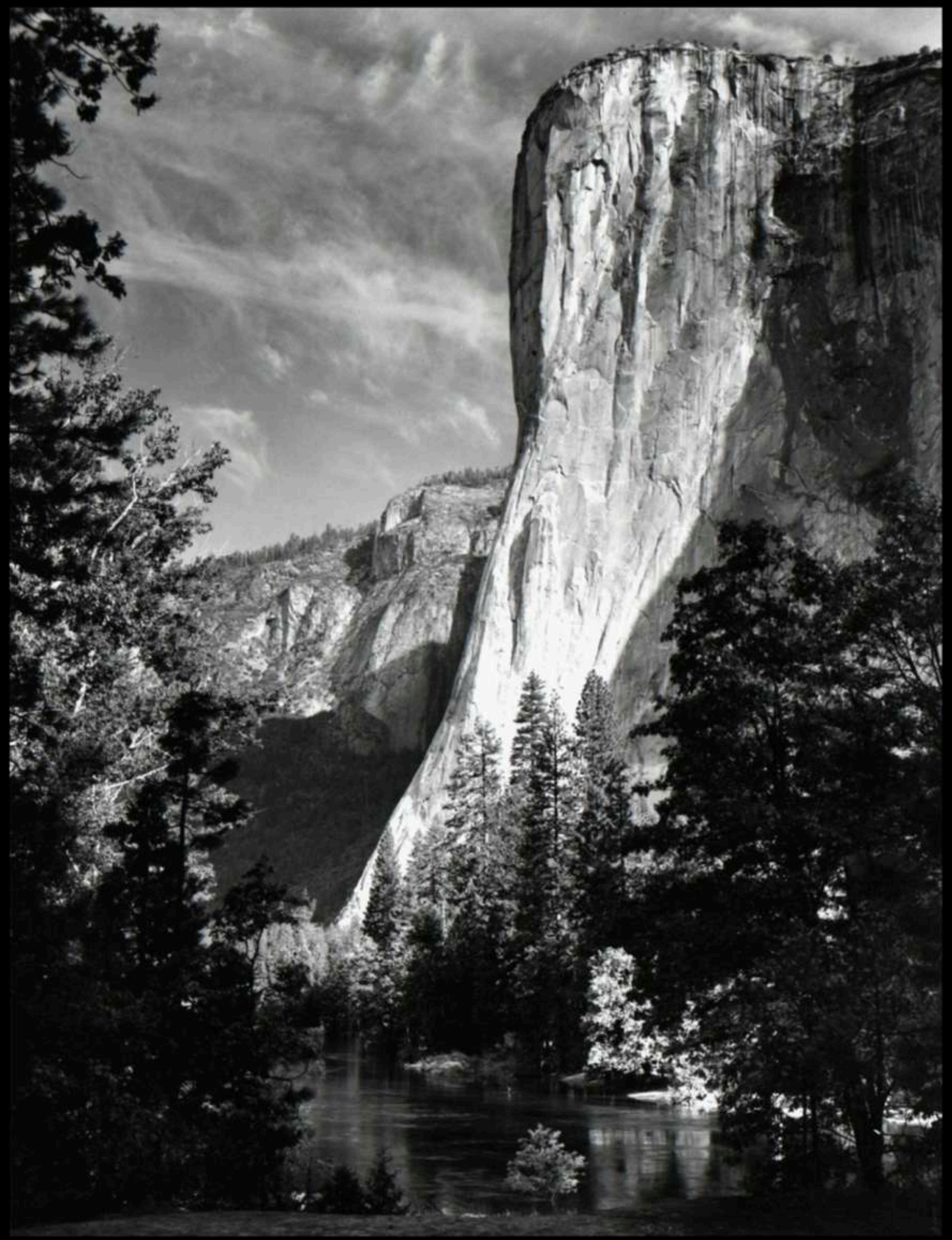
43.500 BC

YEAR 1656

YEAR 1860

→ WEBER-FECHNER LAW

YEAR 1956



YEAR 1990

→ FIRST EDITION REC 709

YEAR 2023

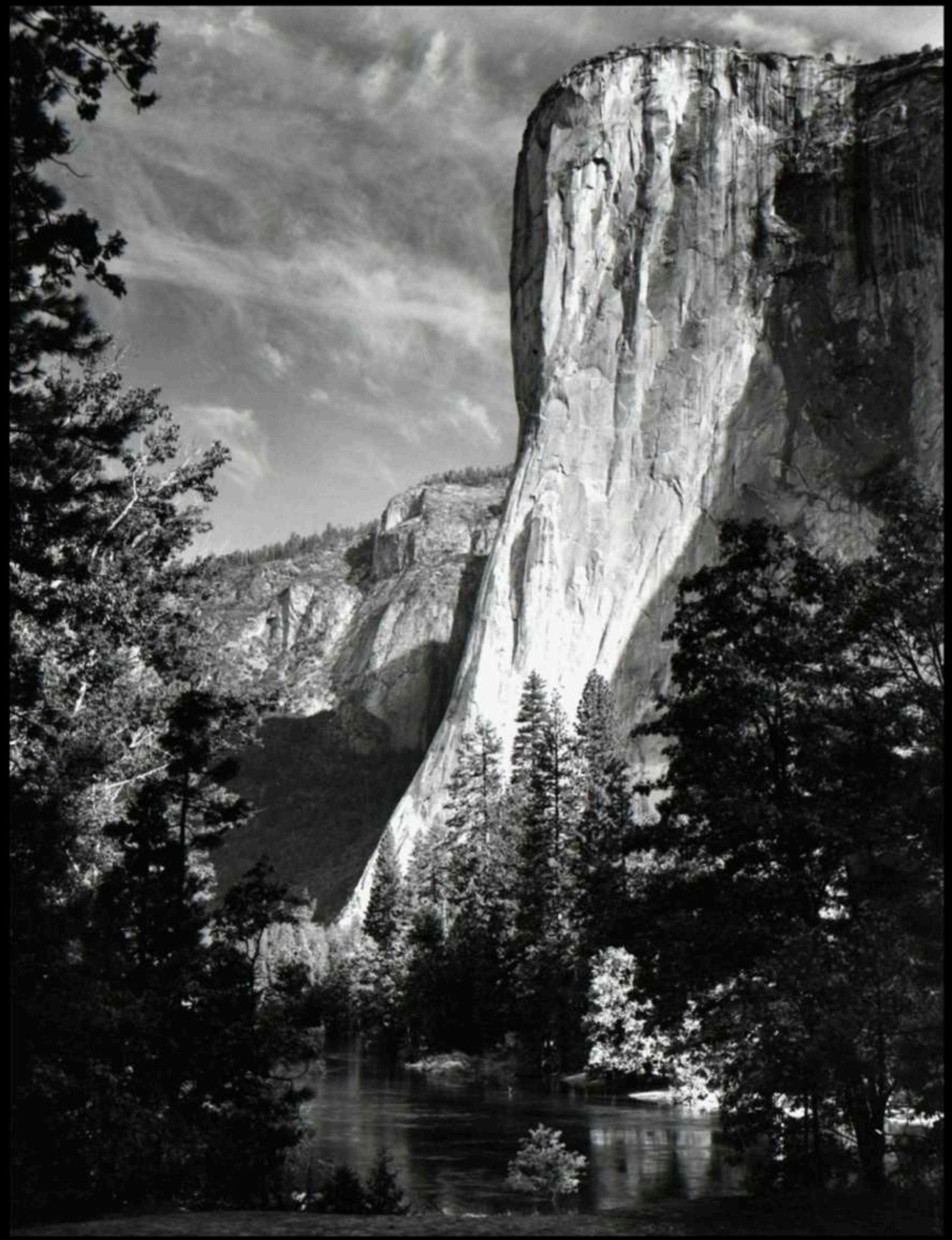
“LAS MENINAS” (YEAR 1656)

Diego Velázquez

43.500 BC

YEAR 1656

YEAR 1956



YEAR 2023

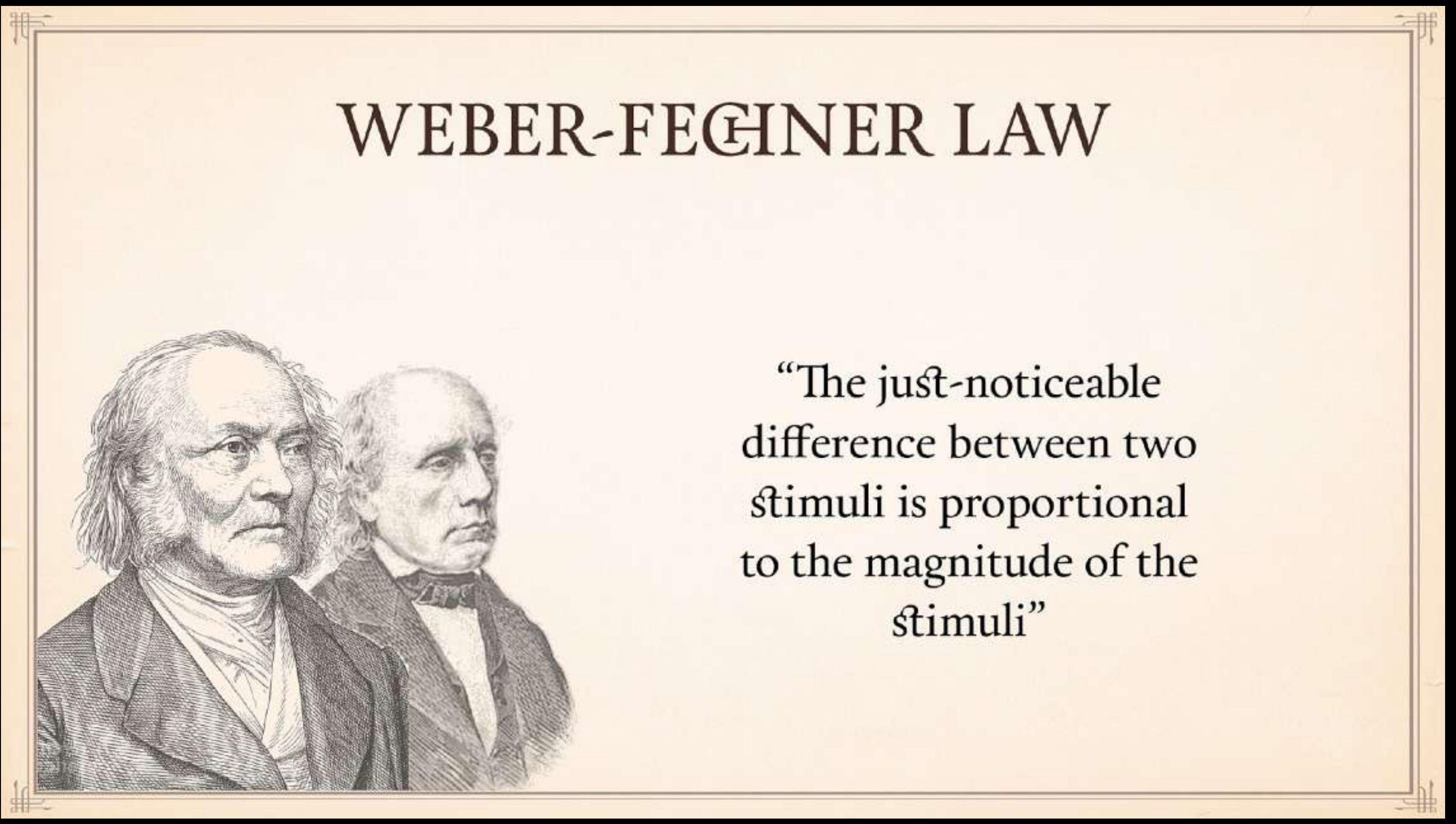
YEAR 1860

→ WEBER-FECHNER LAW

YEAR 1990

→ FIRST EDITION REC 709

PSYCHOPHYSICS QUANTITATIVELY INVESTIGATES THE RELATIONSHIP BETWEEN PHYSICAL STIMULI AND THE SENSATIONS AND PERCEPTIONS THEY PRODUCE. PSYCHOPHYSICS HAS BEEN DESCRIBED AS "THE SCIENTIFIC STUDY OF THE RELATION BETWEEN STIMULUS AND SENSATION.



Ernst Heinrich Weber

Gustav Theodor Fechner

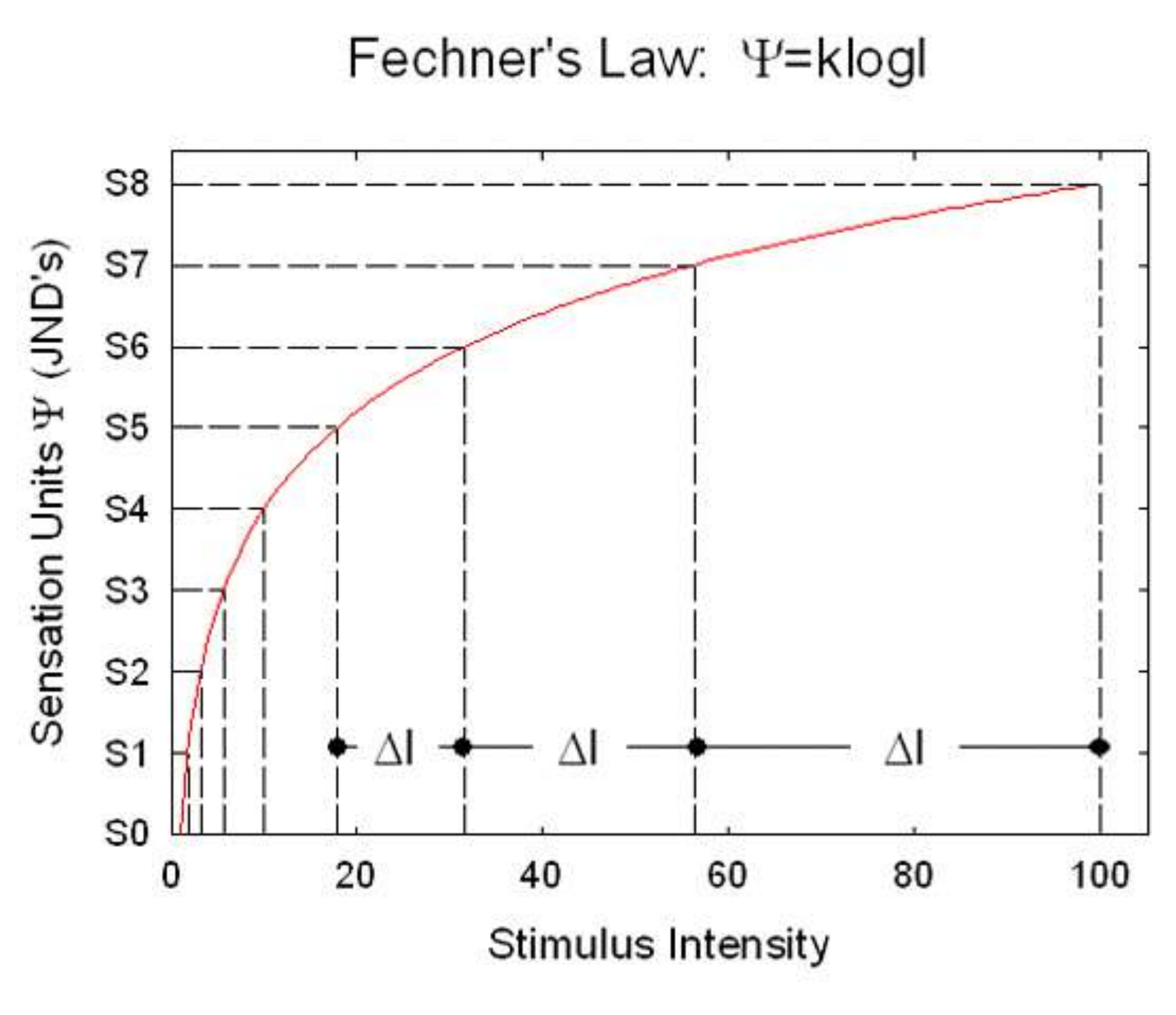
Fechner's Law

$$S = k * \log I$$

S = Sensation, the psychological experience, the JND

k = Weber fraction for that task (ΔI/I)

I = Physical intensity



PSYCHOPHYSICS

Stevens Power Law

$S = kI^n$

where, S = sensory magnitude

K = constant, dependent upon unit of measurement of stimulus

I = intensity of physical stimulus

n = exponent that is experimentally determined for each sensory continuum.

4

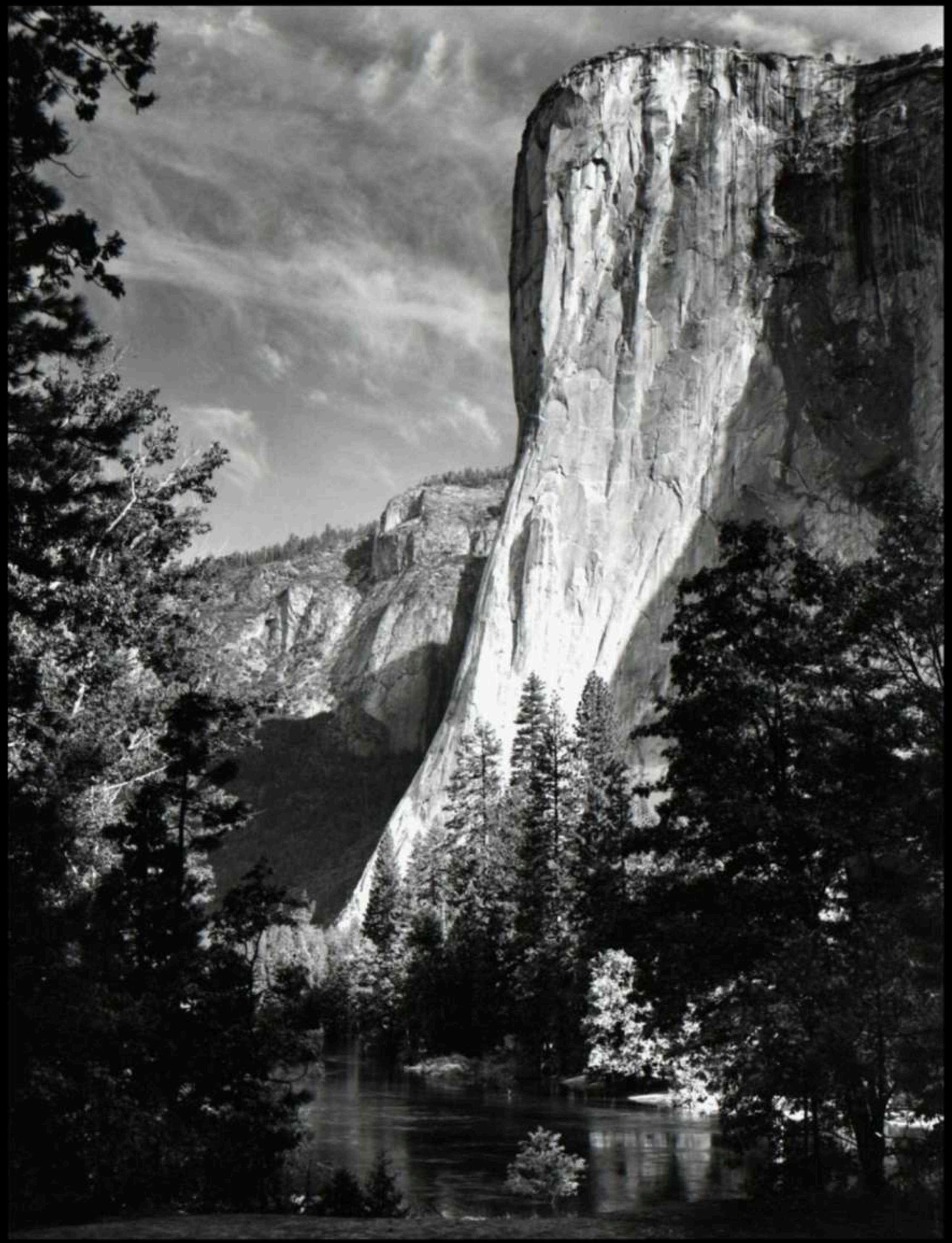
43.500 BC

YEAR 1656

YEAR 1860

→ WEBER-FECHNER LAW

YEAR 1956



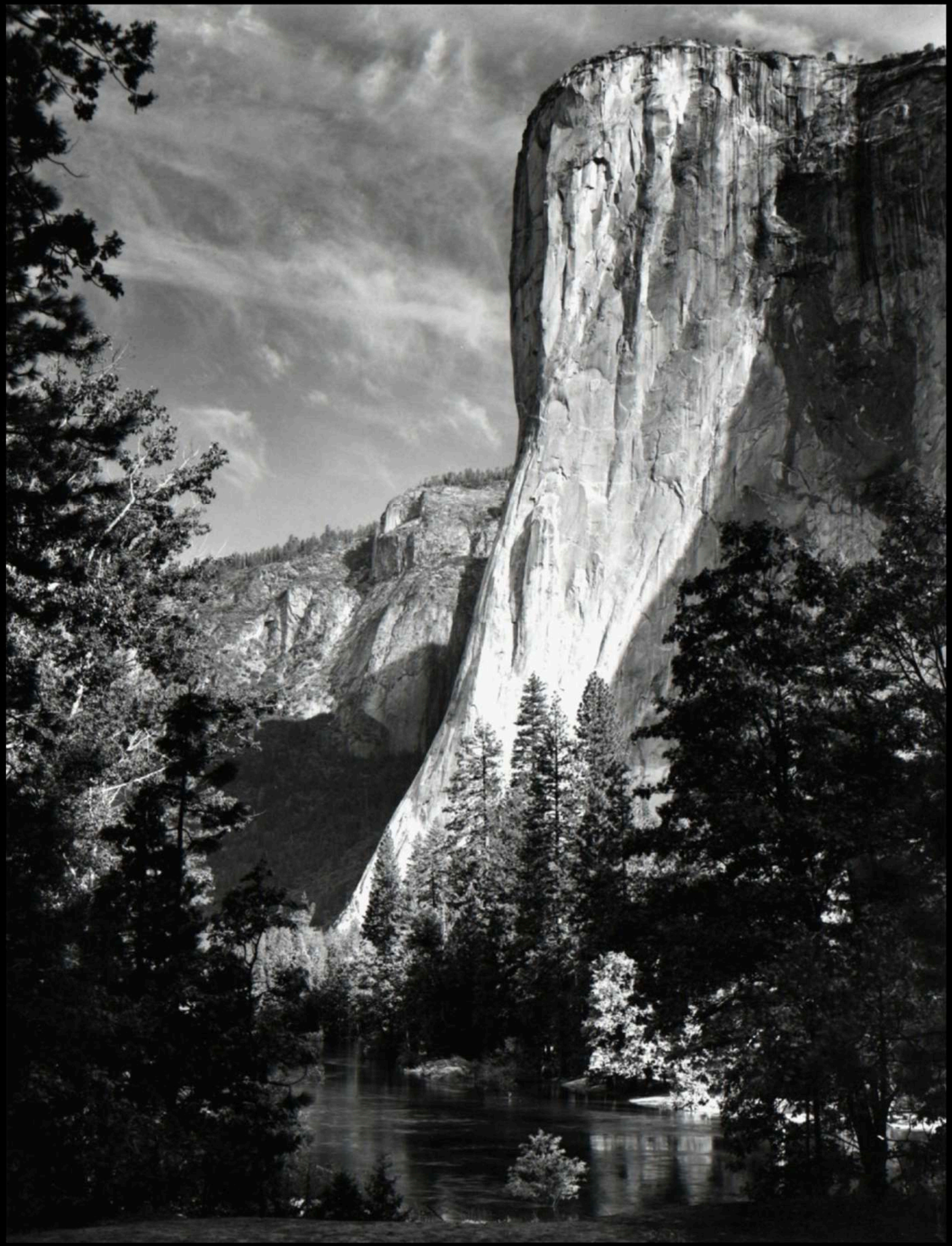
YEAR 1990

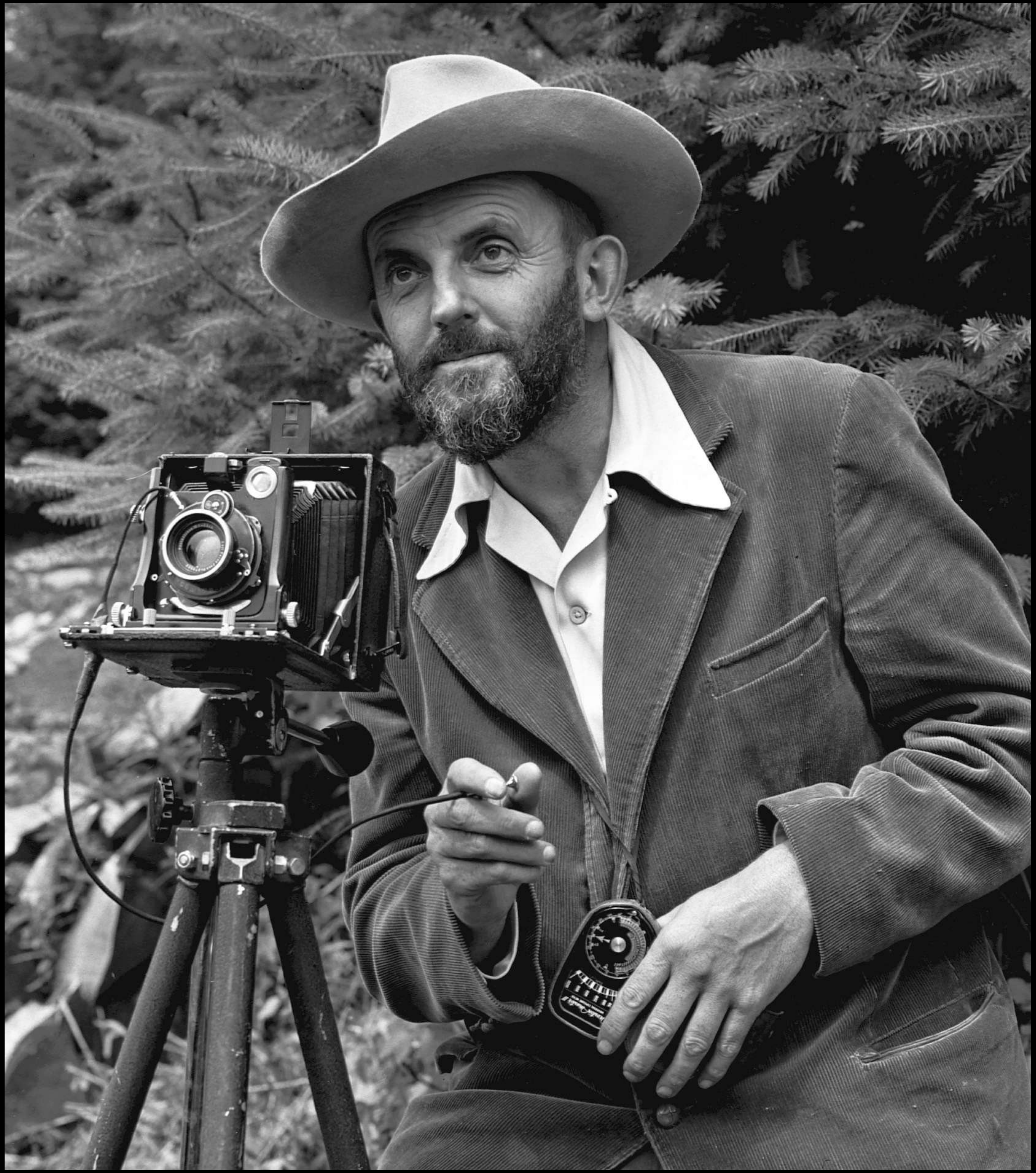
→ FIRST EDITION REC 709

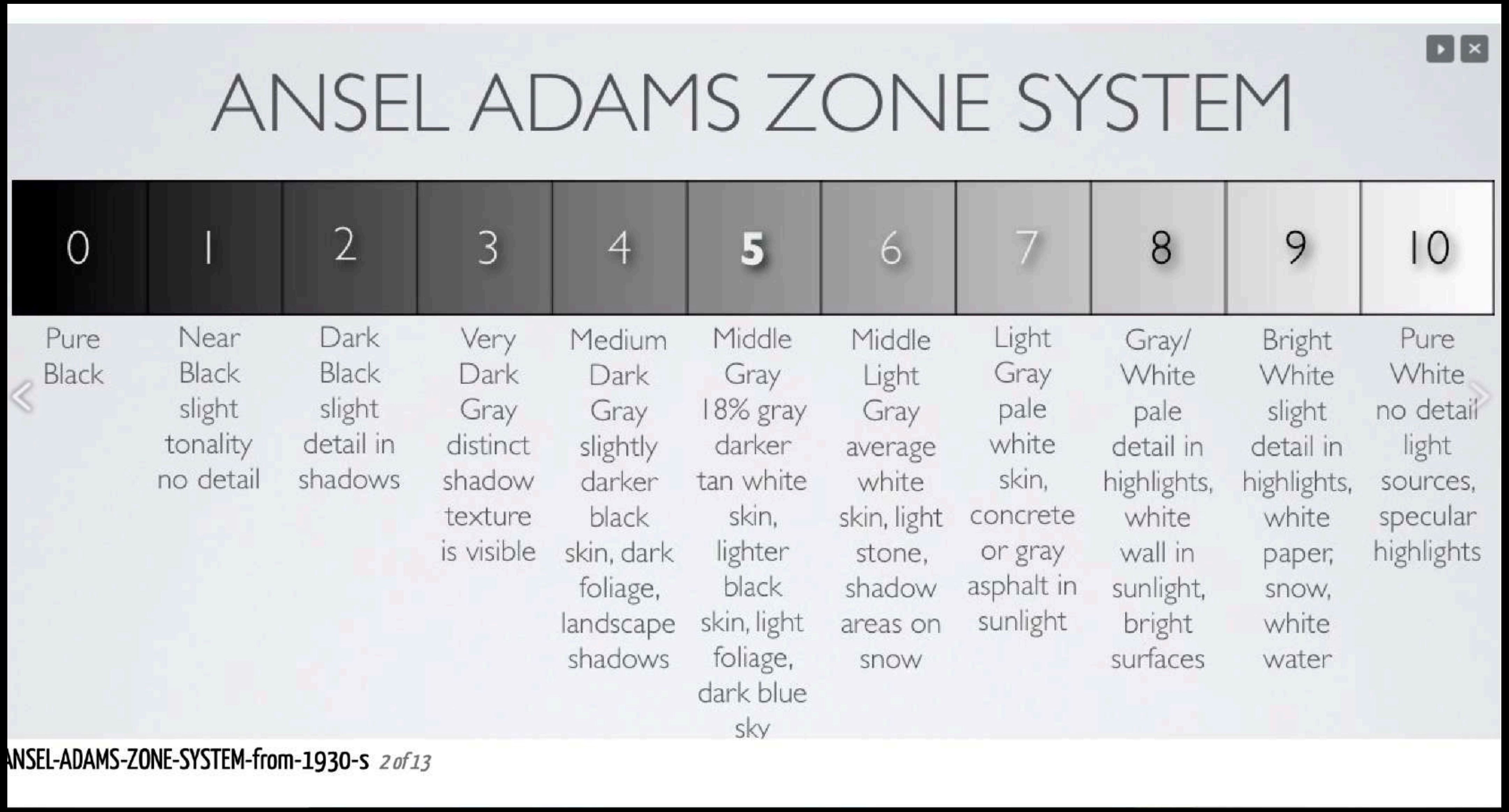
YEAR 2023

“THE CAPITAN, SUNRISE” (YEAR 1956)

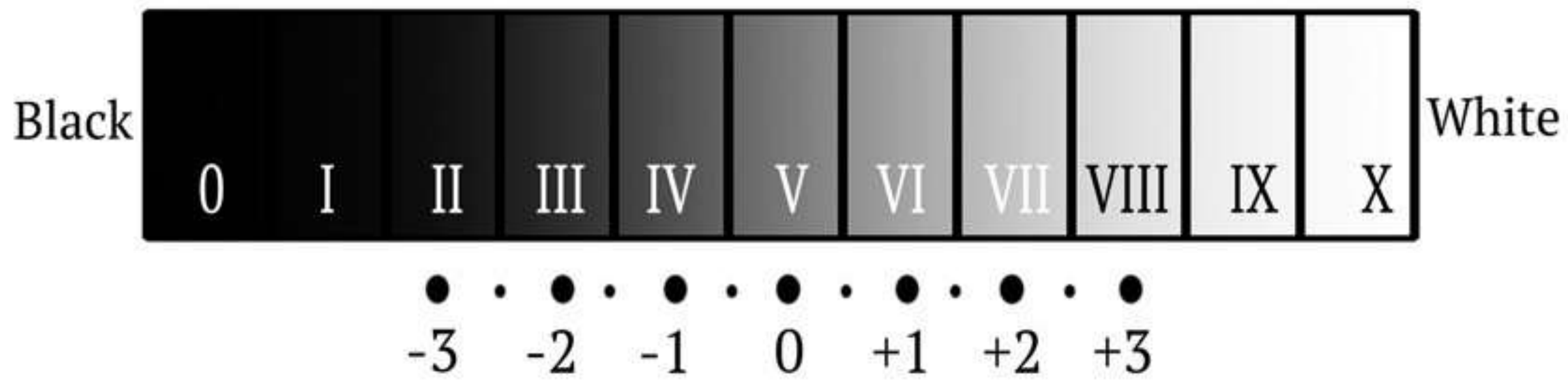
Ansel Adams



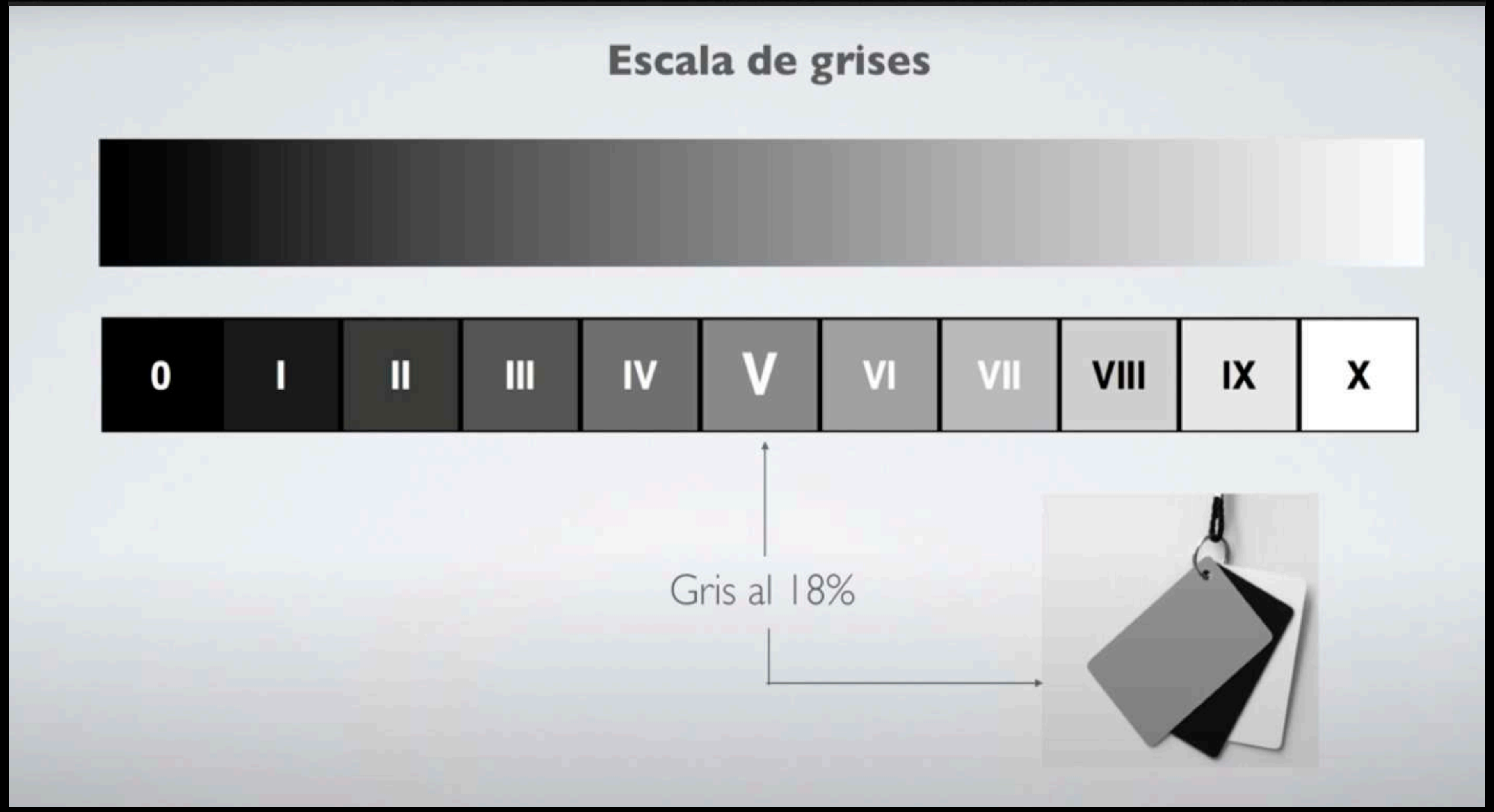



ANSEL ADAMS ZONE SYSTEM
0
1
2
3
4
5
6
7
8
9
10
Pure Black
Near Black slight tonality no detail
Dark Black slight detail in shadows
Very Dark Gray distinct shadow texture is visible
Medium Dark Gray slightly darker black skin, dark foliage, landscape shadows
Middle Gray 18% gray darker tan white skin, lighter black skin, light foliage, dark blue sky
Middle Light Gray average white skin, light stone, shadow areas on snow
Light Gray pale white skin, concrete or gray asphalt in sunlight
Gray/White pale detail in highlights, white wall in sunlight, bright surfaces
Bright White slight detail in highlights, white paper, snow, white water
Pure White no detail light sources, specular highlights
ANSEL-ADAMS-ZONE-SYSTEM-from-1930-s 2 of 13

The Zone System



Zone 0	Complete lack of density in the negative image. Total black in print
Zone I	First step above black, slight tonality, but no texture
Zone II	First suggestion of texture. Deep tonalities, representing the darkest part of the image in which some detail is required
Zone III	Average dark materials. Low values showing adequate texture
Zone IV	Average dark foliage. Dark stone. Landscape shadow
Zone V	Dark skin, gray stone, weathered wood. Middle gray
Zone VI	Average caucasian skin value in sunlight. Shadows on snow in sunlit snowscapes. Light stone, clear north sky
Zone VII	Very light skin, light gray objects
Zone VIII	White with textures and delicate values
Zone IX	Glaring white surfaces. Snow in flat sunlight White without texture
Zone X	Light sources, actual or reflected. Printed at maximum white value



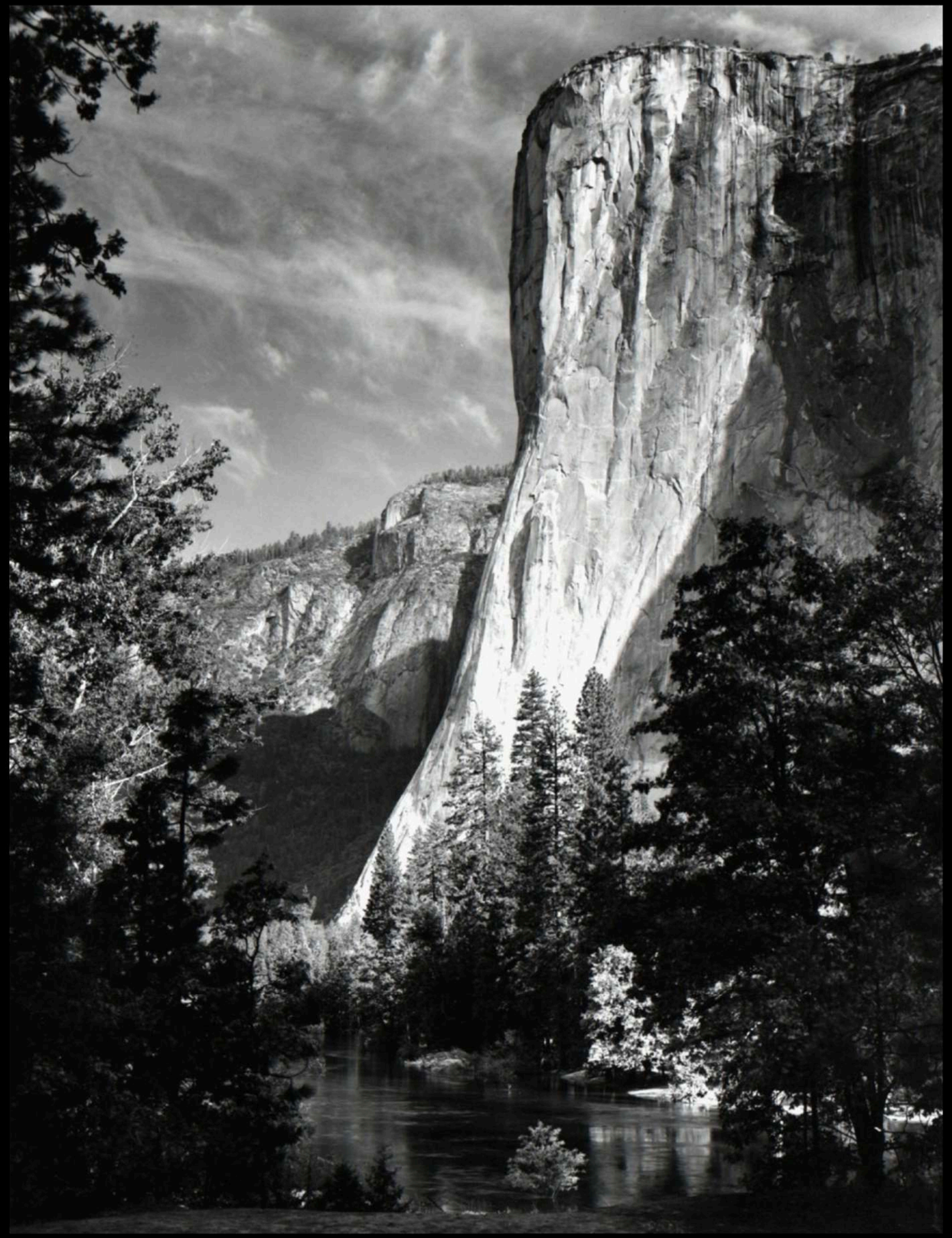
43.500 BC

YEAR 1656

YEAR 1860

→ WEBER-FECHNER LAW

YEAR 1956

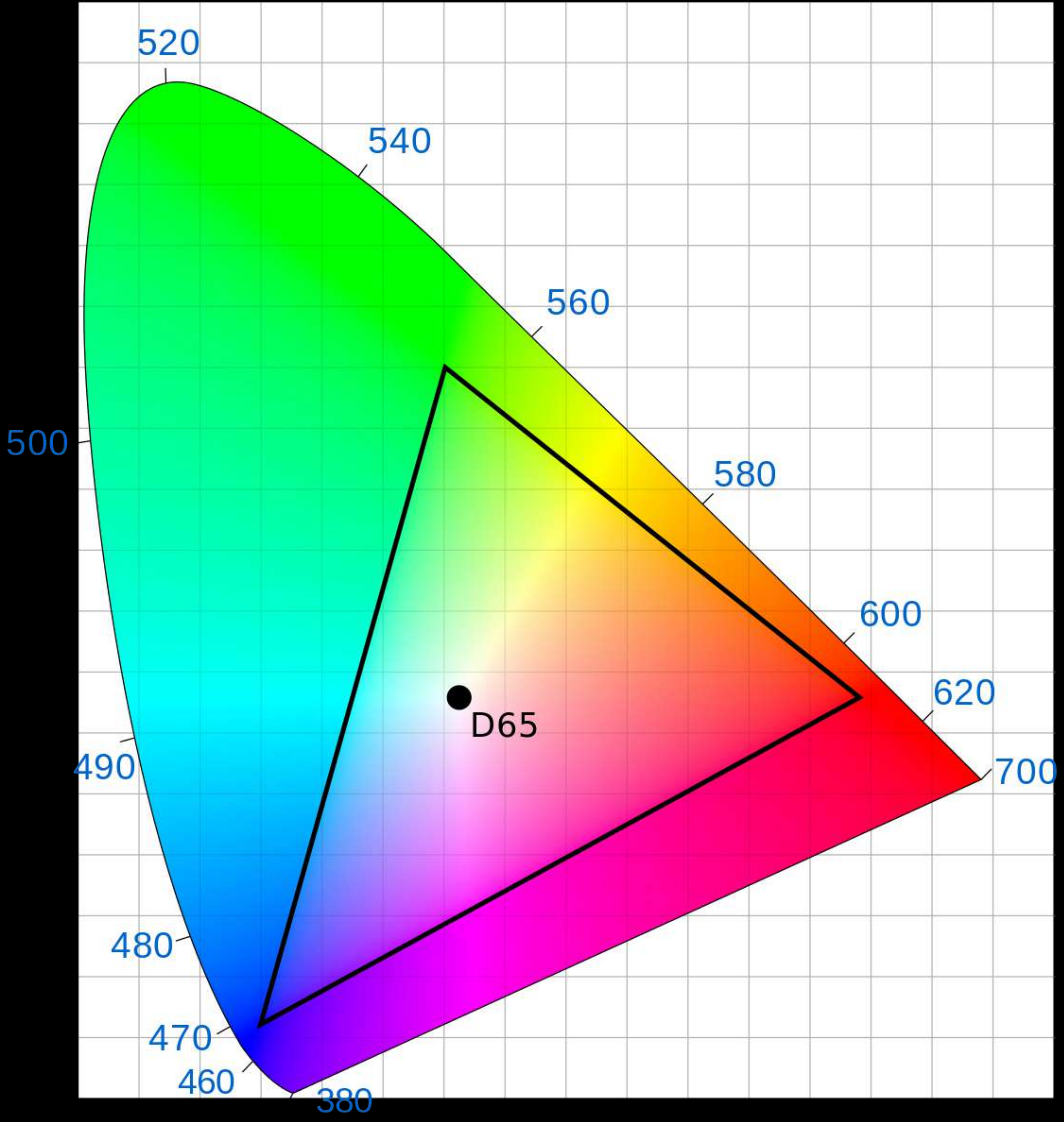


YEAR 1990

→ FIRST EDITION REC 709

YEAR 2023

REC 709, BT 709 OR ITU 709



Primary chromaticities [edit]

RGB color space parameters[7]

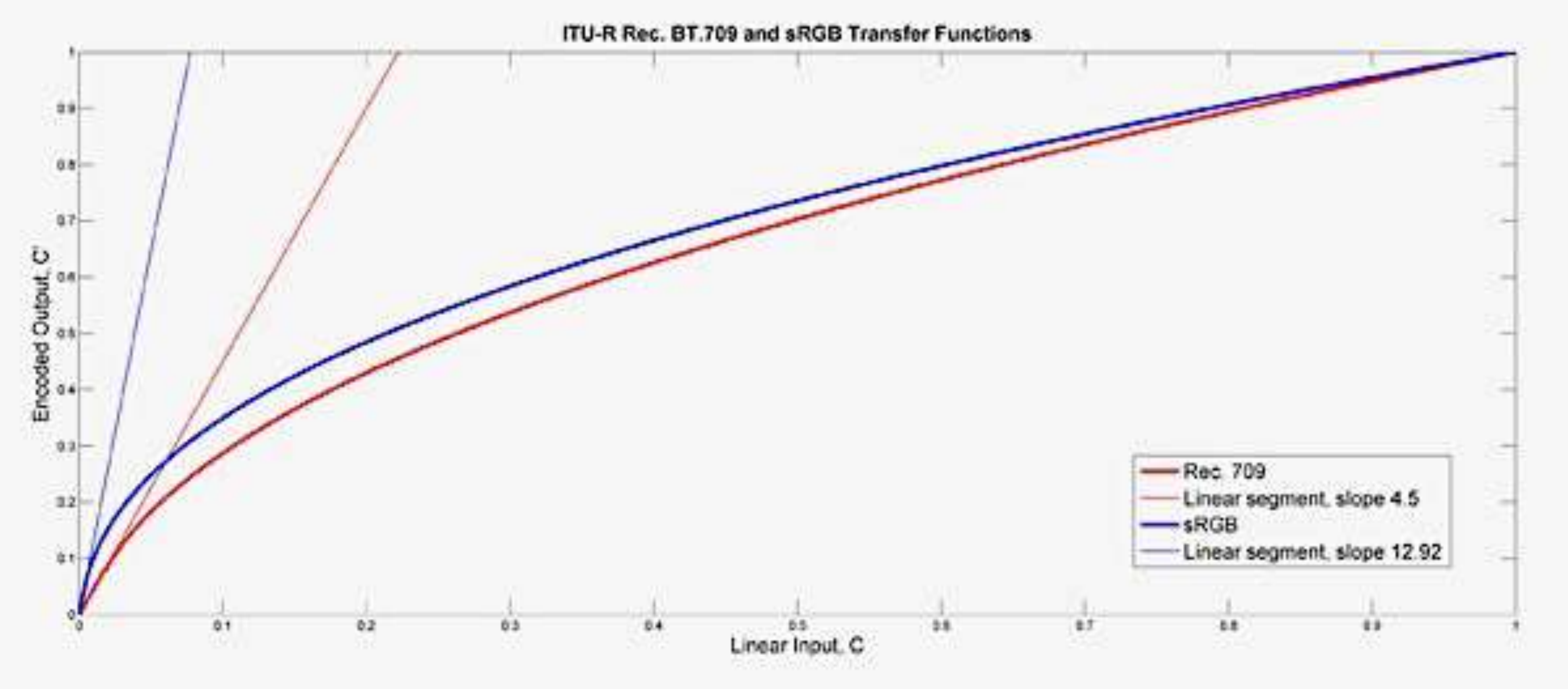
Color space	White point		Primaries					
	x_W	y_W	x_R	y_R	x_G	y_G	x_B	y_B
ITU-R BT.709	0.3127	0.3290	0.64	0.33	0.30	0.60	0.15	0.06

Note that red and blue and y_G are the same as the EBU Tech 3213 (PAL) primaries while the x_G is halfway between EBU Tech 3213's x_G and SMPTE C's x_G (PAL and NTSC are two types of BT.601-6). In coverage of the CIE 1931 color space the Rec. 709 color space (and the derivative sRGB color space) is almost identical to Rec. 601 and covers 35.9%.[8] It also covers 33.24% of CIE 1976 u'v'[9][10] and 33.5% of CIE 1931 xy.[10] White point is D_{65} as specified in 2° standard observer.

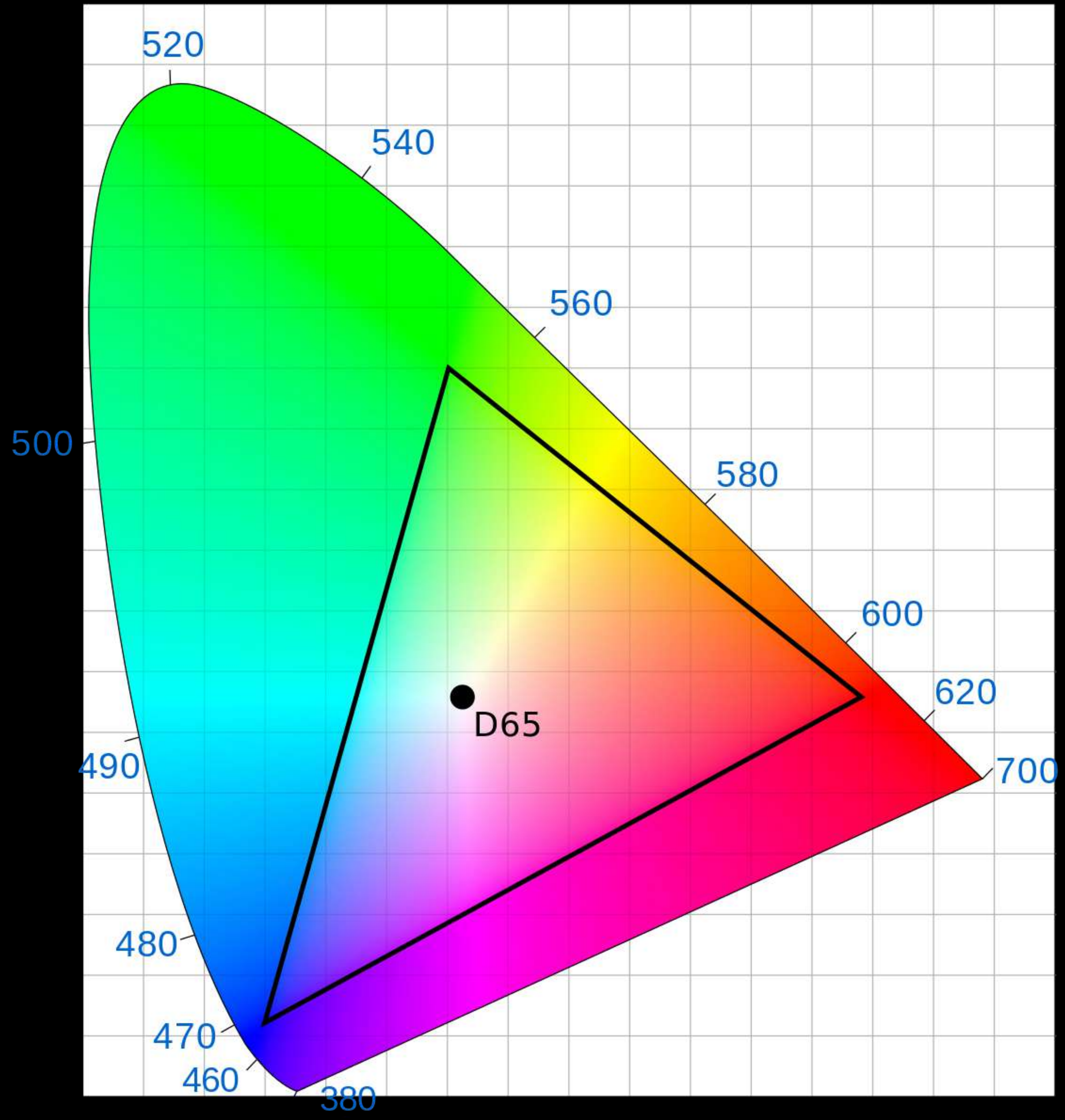
BT.709 RGB color cube (image encoded with an ICC profile)

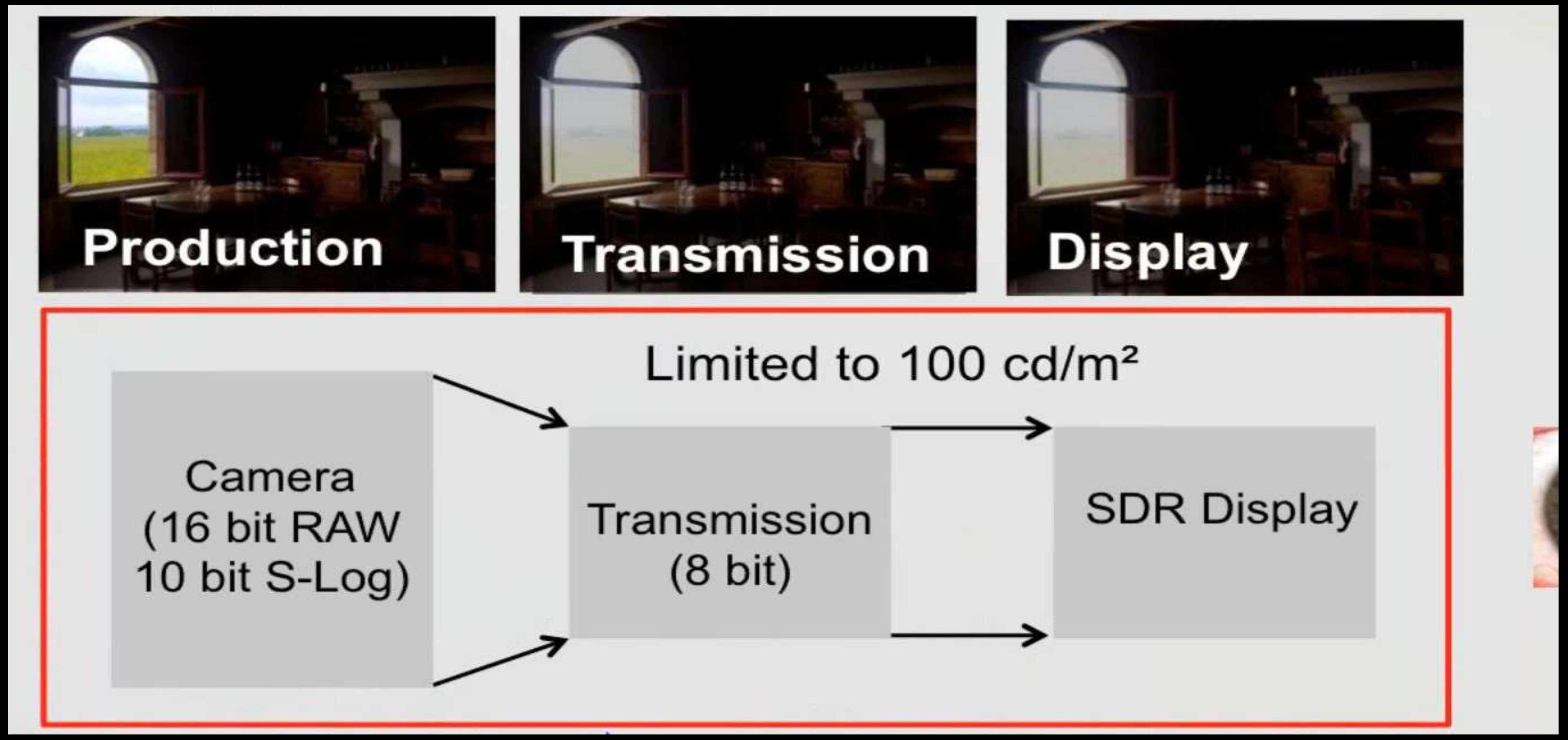
Transfer characteristics [edit]

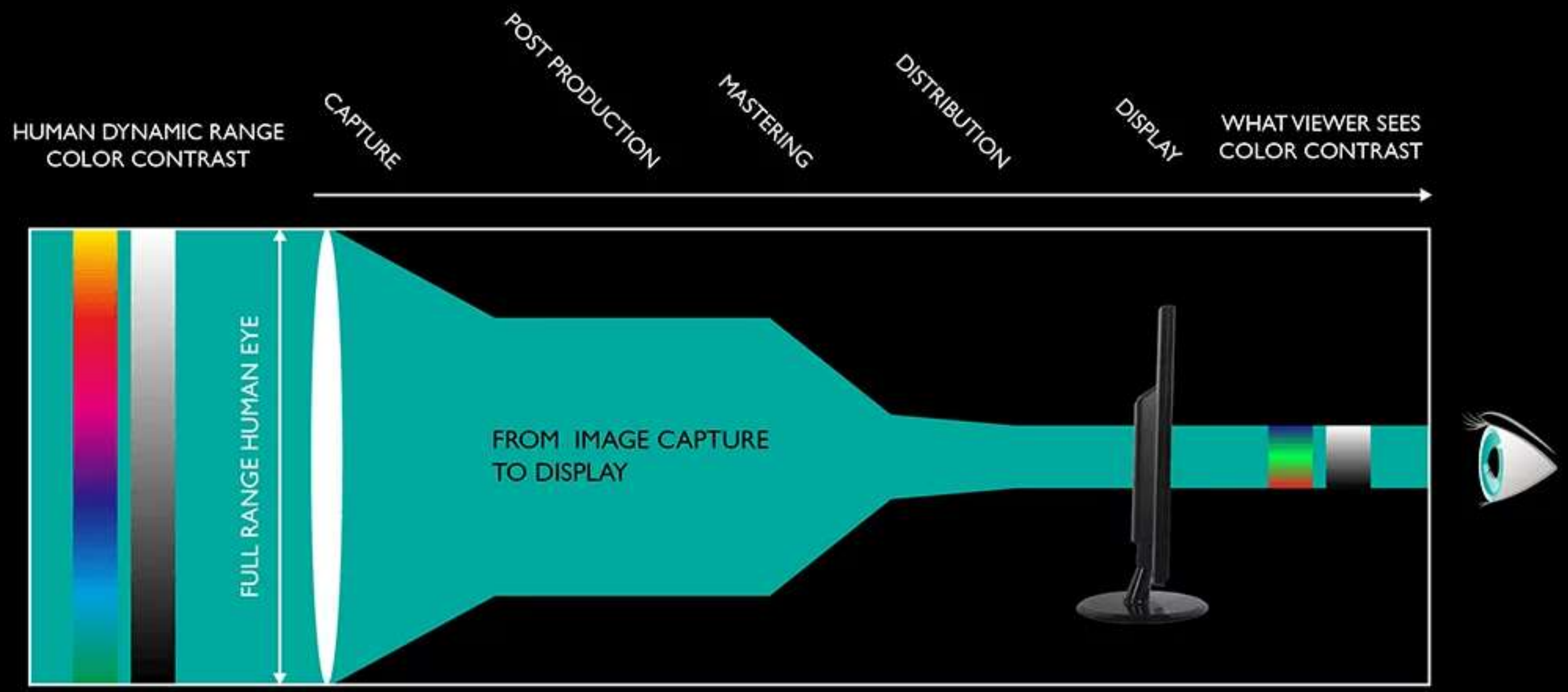
Rec. 709 specifies a non-linear OETF (opto-electrical transfer function) which is known as the "camera gamma" and which describes how HDTV camera encodes the linear scene light into a non-linear electrical signal value. Rec. 709 doesn't specify the display EOTF (electro-optical transfer function) which describes how HDTV displays should convert the non-linear electrical signal into linear displayed light, that was done in ITU-R BT.1886. See ITU-R BT.2087 for a detailed description of the options for color conversion from Rec. 709 to Rec. 2020.



REC 709, BT 709 OR ITU 709







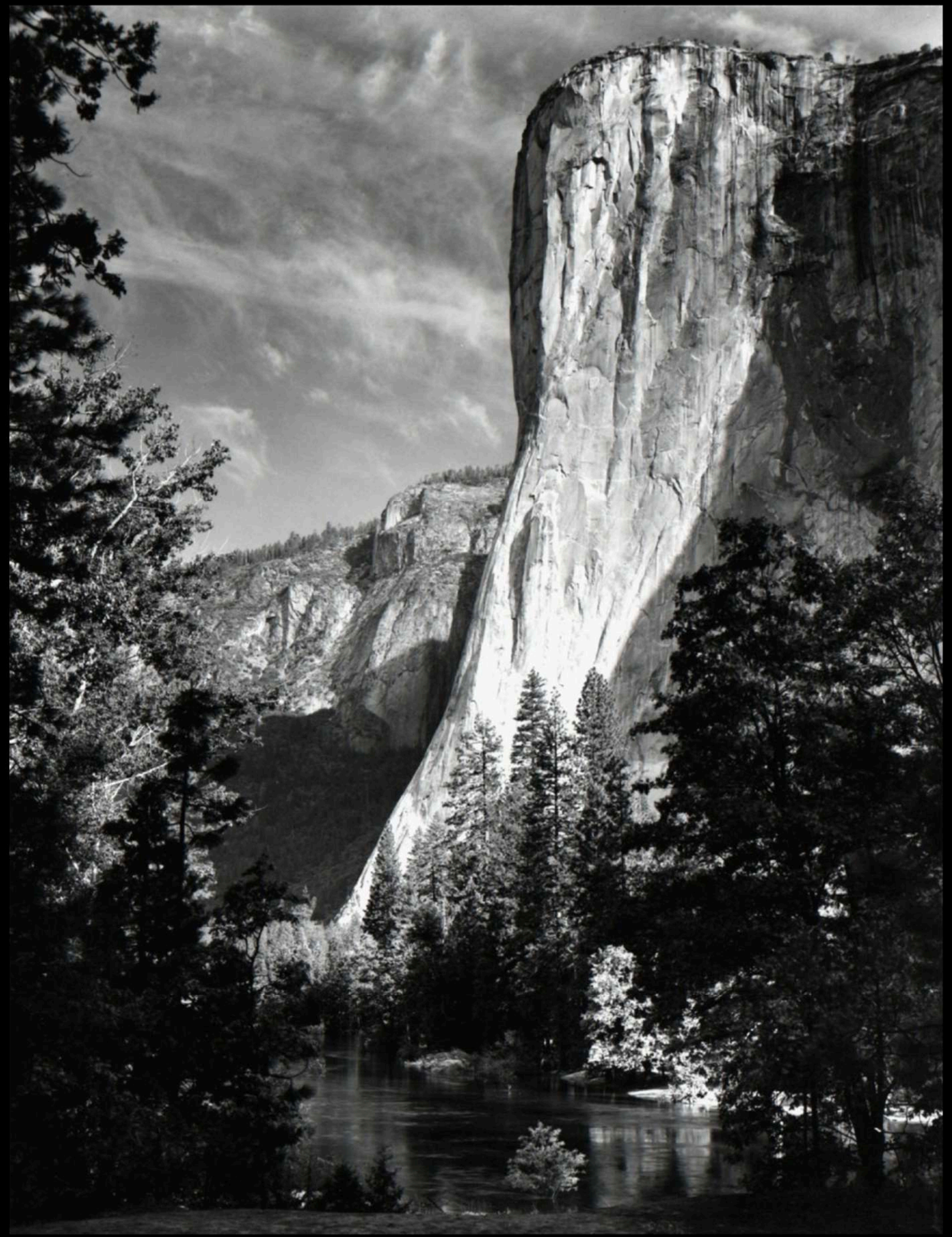
43.500 BC

YEAR 1656

YEAR 1860

→ WEBER-FECHNER LAW

YEAR 1956



YEAR 1990

→ FIRST EDITION REC 709

YEAR 2023

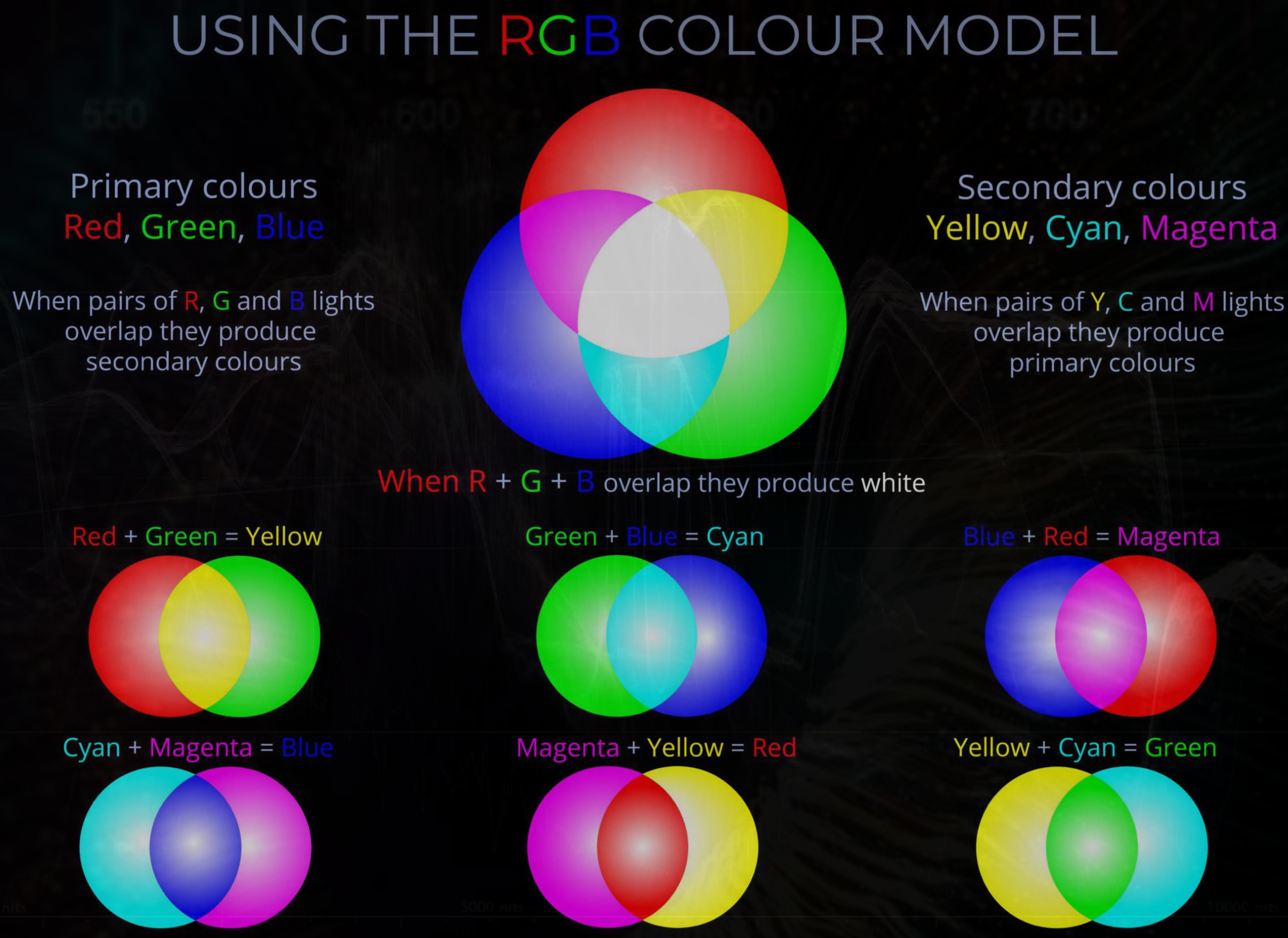
PART II

SOME THEORY TO REFRESH WHEN TALKING ABOUT HDR:

- BIT DEPTH AND CROMA SAMPLING
- CAMERA SENSOR AND HUMAN PERCEPTION
- COLOR SPACES
- STOPS, NITS AND SCOPES
- LCD, MINI LCD, OLED BASICS
- CONTRAST RATIO

COLOR SPACES

-WE USE THE RGB COLOR MODEL, THE ADDITIVE SYNTHESIS OF LIGHT, WHERE ALL COLORS TOGETHER GIVE YOU WHITE. THE COLOR SPACES FOR DISPLAYS,CAMERAS, AND POSTPRODUCTION, ALL USE THE RGB MODEL.

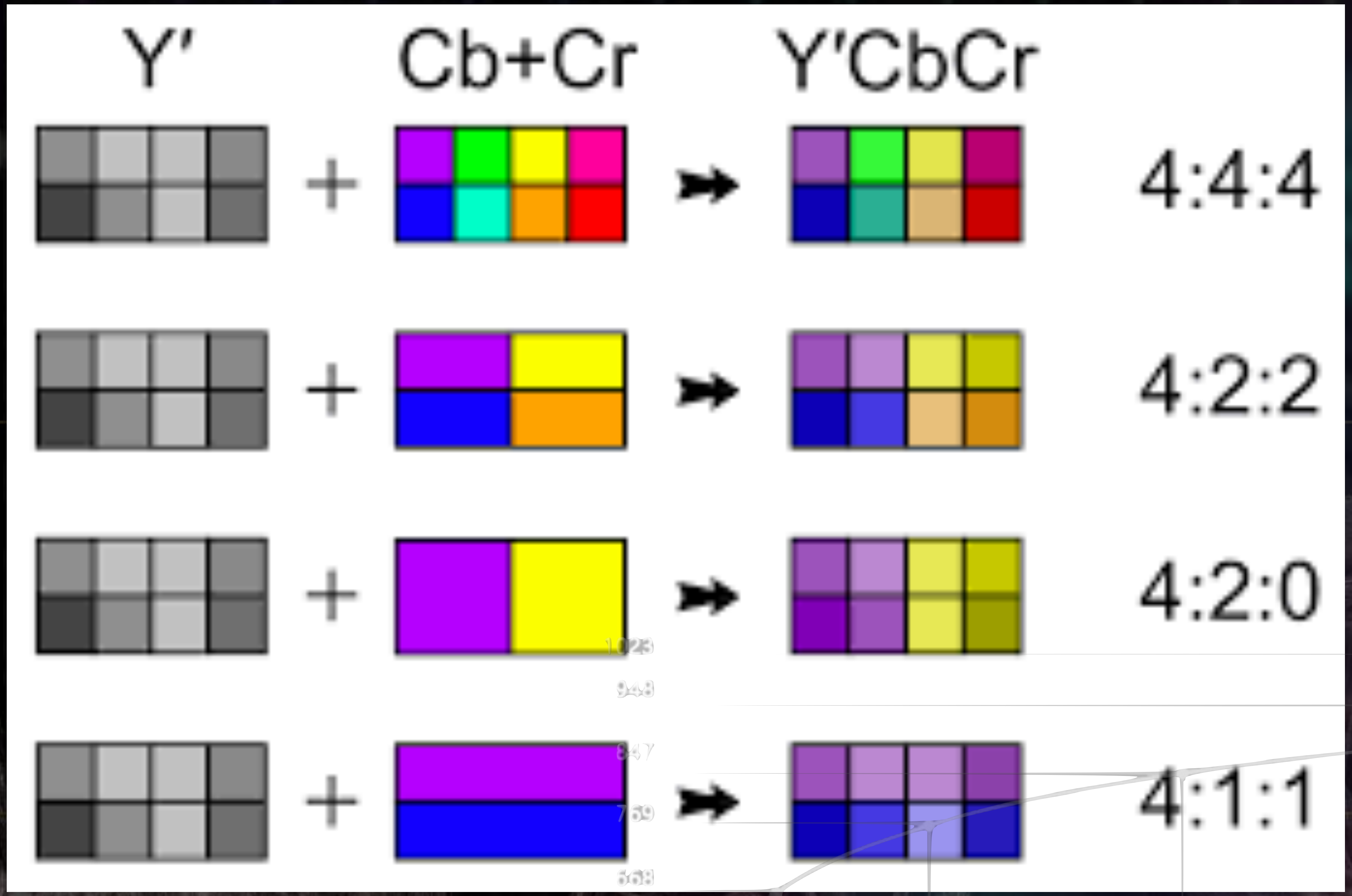


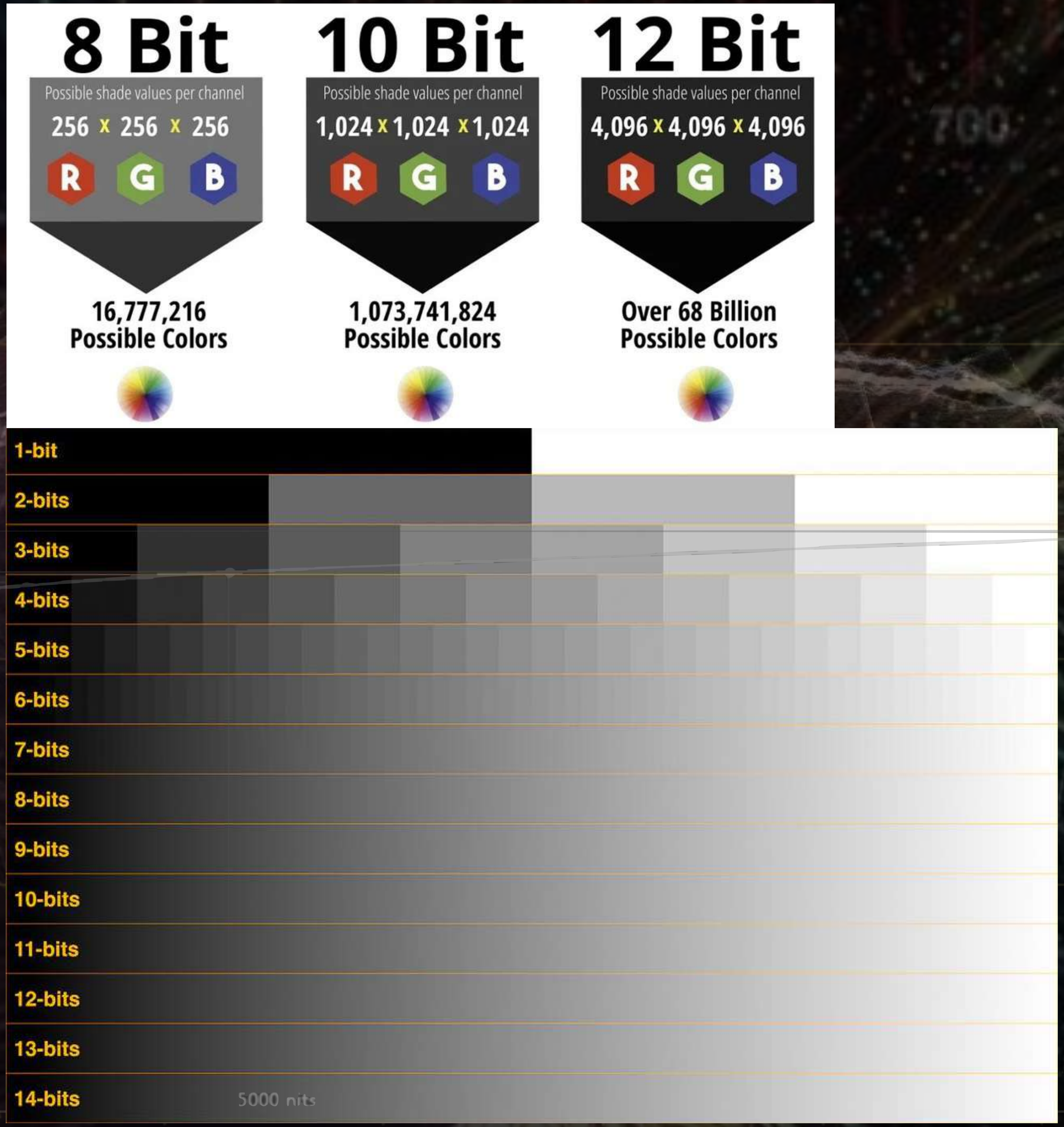
BIT DEPTH AND CROMA SAMPLING

-CHROMA SUBSAMPLING IS THE PRACTICE OF ENCODING IMAGES BY IMPLEMENTING LESS RESOLUTION FOR CHROMA INFORMATION THAN FOR LUMA INFORMATION, TAKING ADVANTAGE OF THE HUMAN VISUAL SYSTEM'S LOWER ACUITY FOR COLOR DIFFERENCES THAN FOR LUMINANCE.[1]

-MORE SCHADE VALUES PER CHANNEL EQUAL TO MORE POSSIBLES COLORS

-EVEN WHEN HDR IST MAINLY A DISPLAY MEDIUM, HDR NEEDS AT LEAST 10 BIT UND 422 TO WORK PROPERTLY AND PRESERVE DYNAMIC RANGE TROUGH THE PRODUCTION PIPELINE.



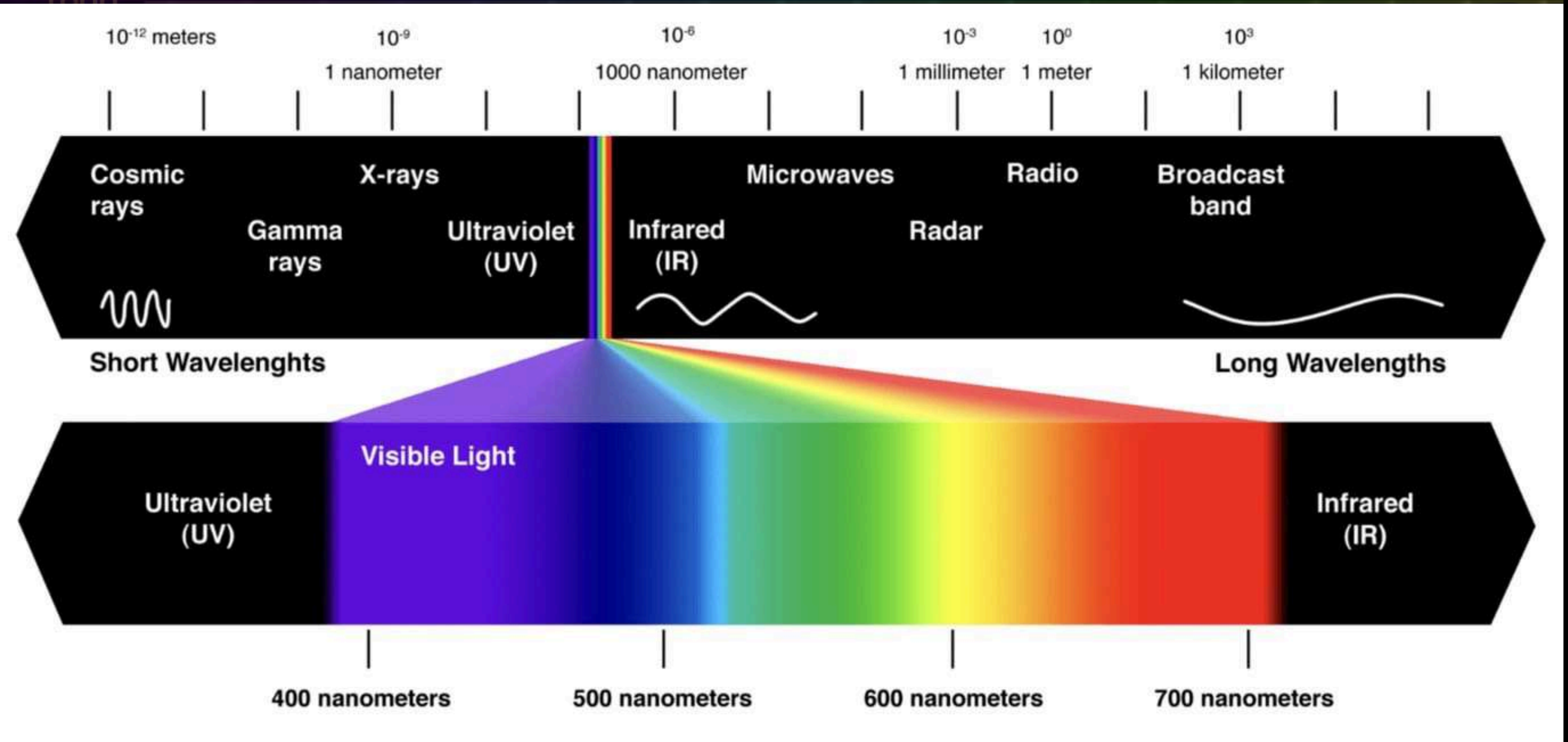


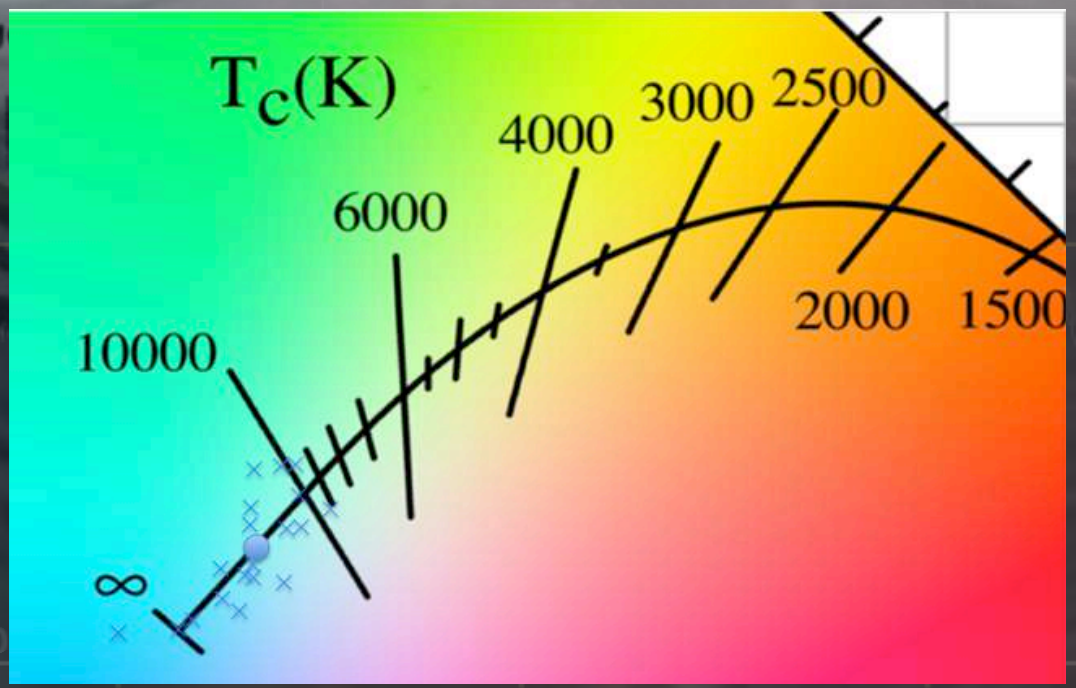
COLOR SPACES

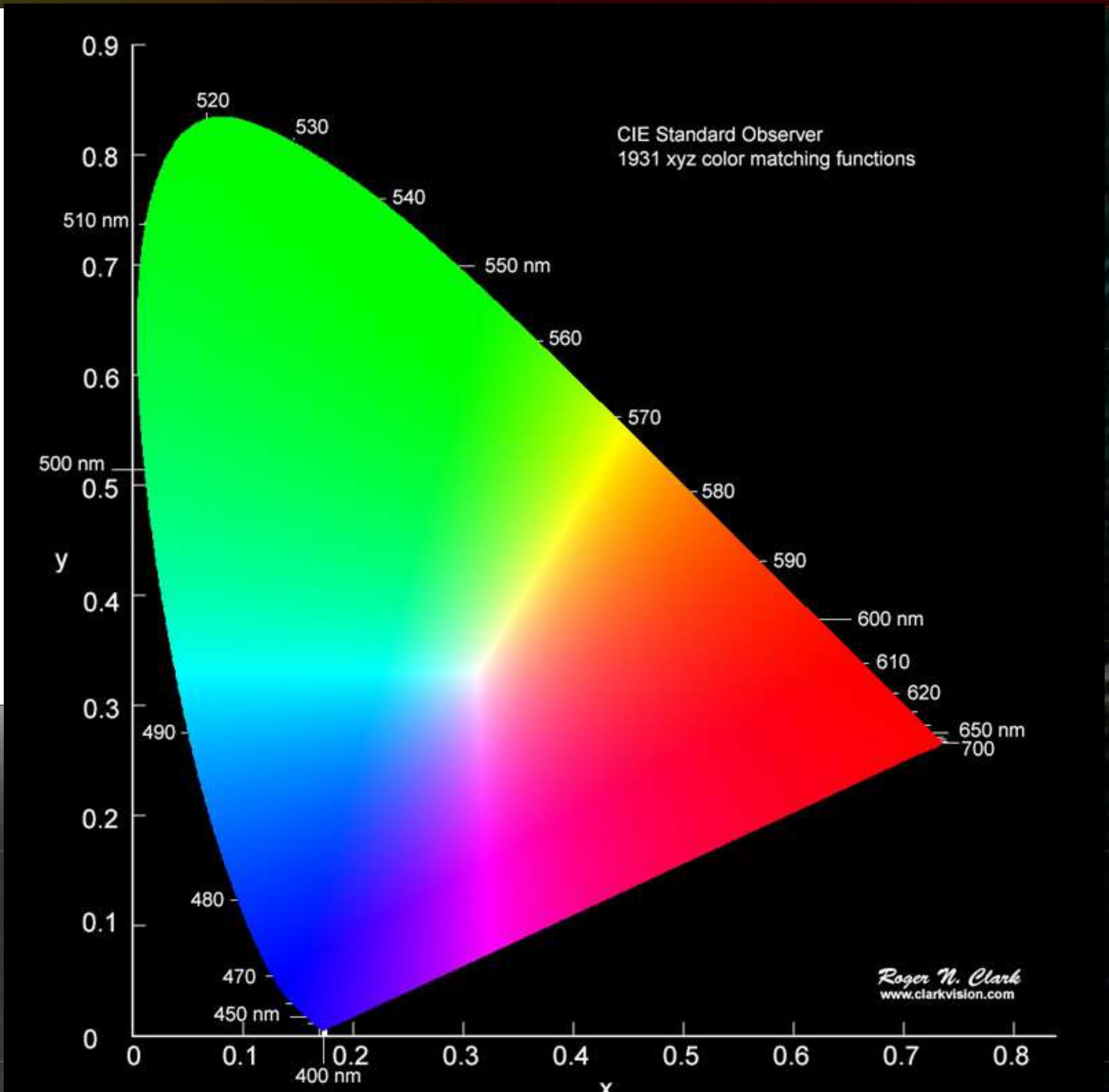
-THE CROMATICYTY DIAGRAM: THIS DIAGRAM WAS THE RESULT OF RESEARCH DONE IN 1931 BY THE INTERNATIONAL COMMISSION ON ILLUMINATION (CIE).

THE HORSESHOE-SHAPED LINE, THAT JOINS THE POSITION OF ALL VISIBLE WAVELENGTHS IS KNOWN AS THE SPECTRAL LOCUS

AT THE CENTER OF THE COLOR SPACE, IS THE POINT OF LESS SATURATION, IT WILL DEFINE THE ASPECT OF WHITE, THE PLACKIAN LOCUS





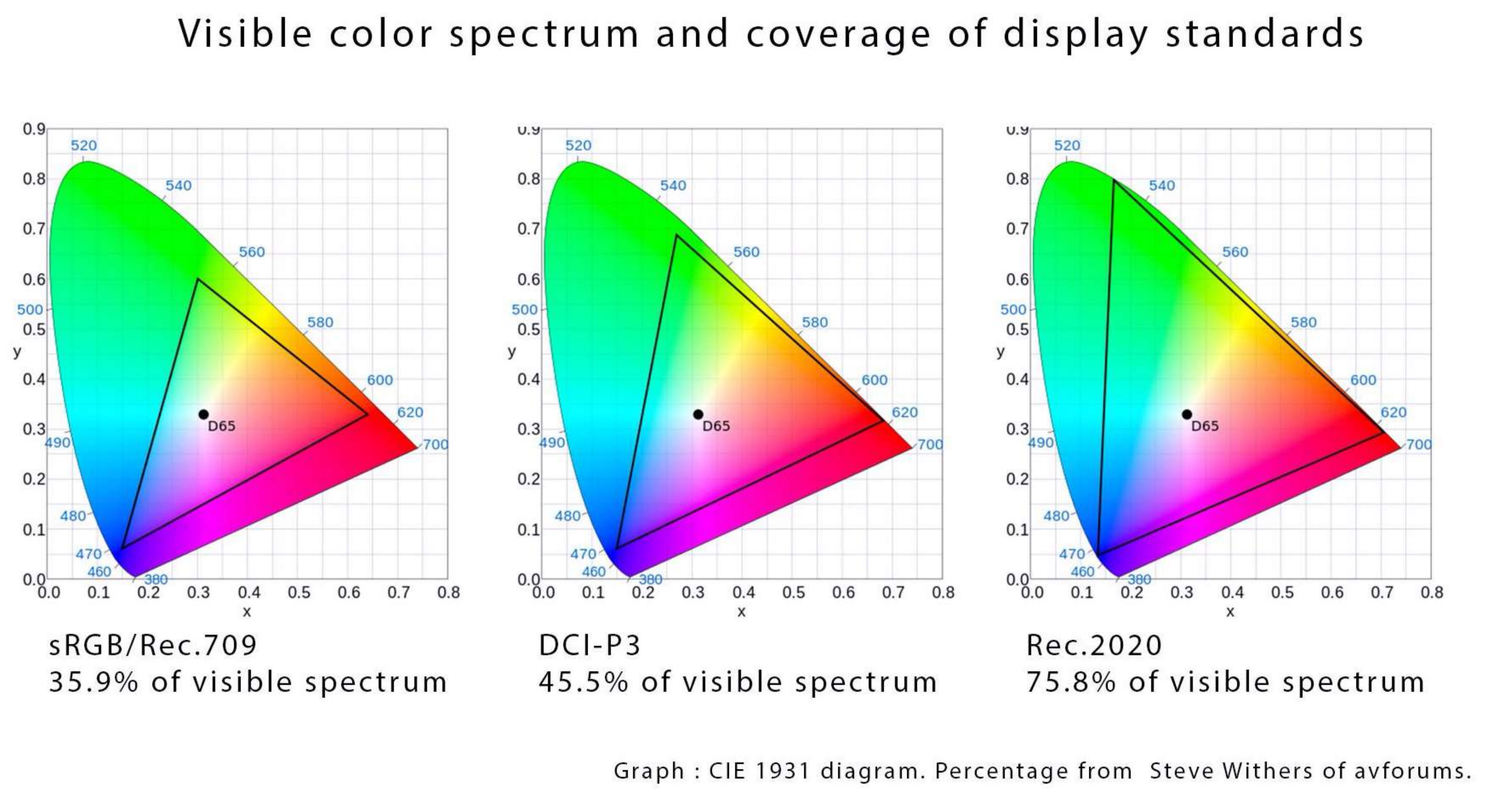


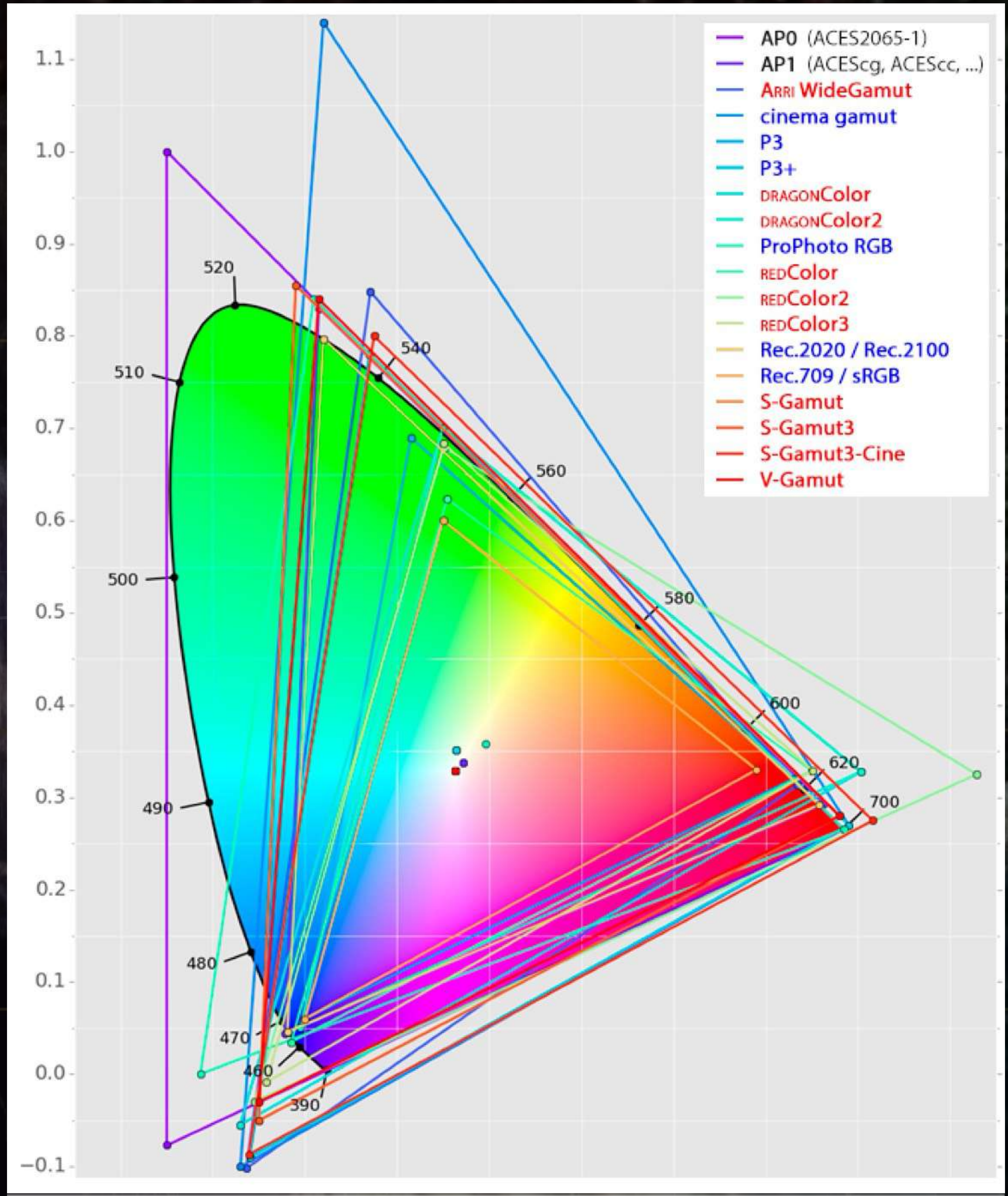
COLOR SPACES

-DISPLAY REFERRED COLORIMETRY: SRGB,REC 709,DCI-P3,REC2020 (RELATED TO DISPLAYS)

-SCENE REFERRED COLORIMETRY: ARRI WIDE GAMUT, RED WIDE GAMUT, PANASONIC V-GAMUT (RELATED TO CAMERAS)

-SCENE REFERRED COLORIMETRY: ACES AP0, ACES AP1, DAVINCI WIDE GAMUT (NON RELATED TO CAMERAS)



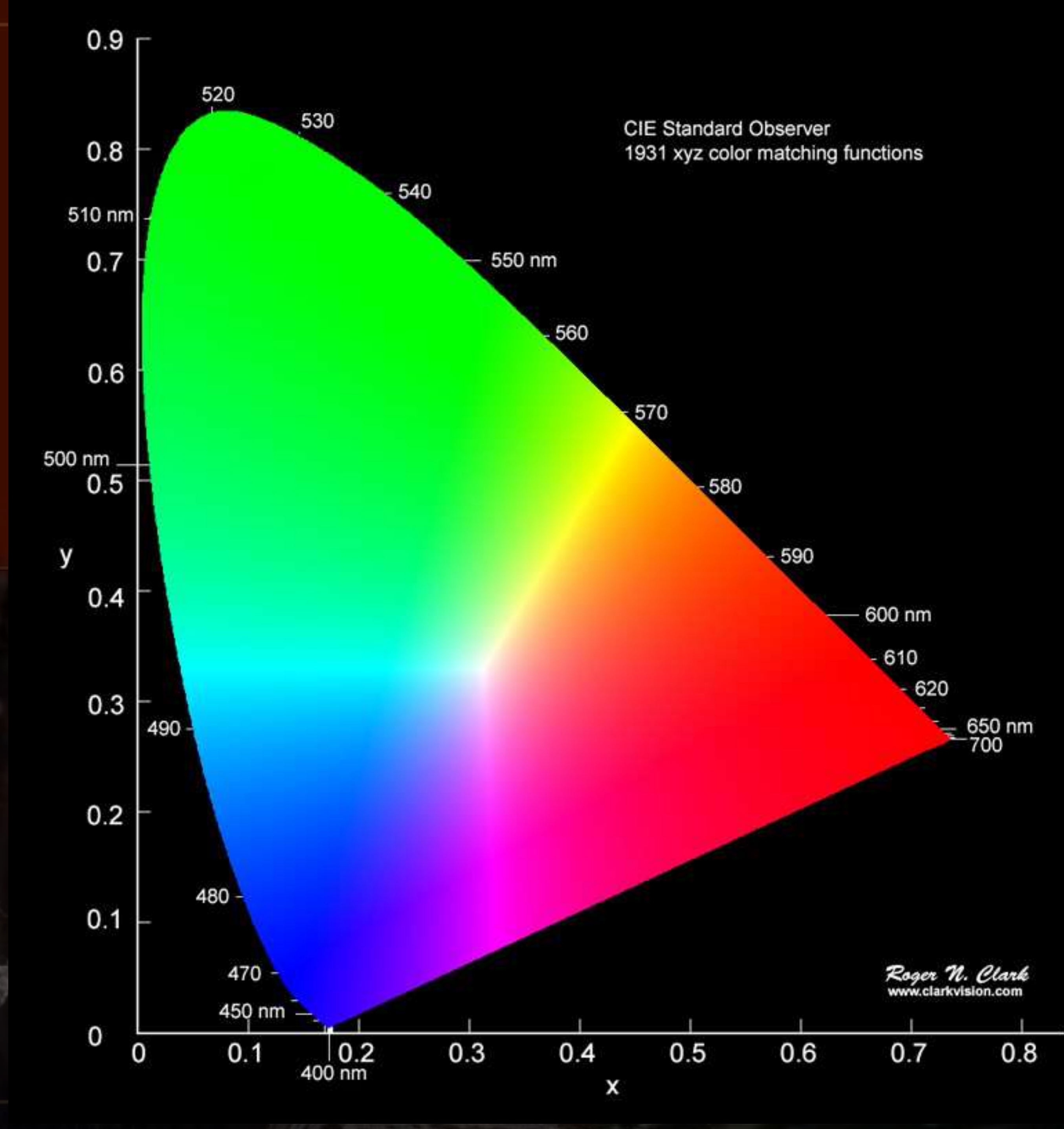


COLOR SPACES

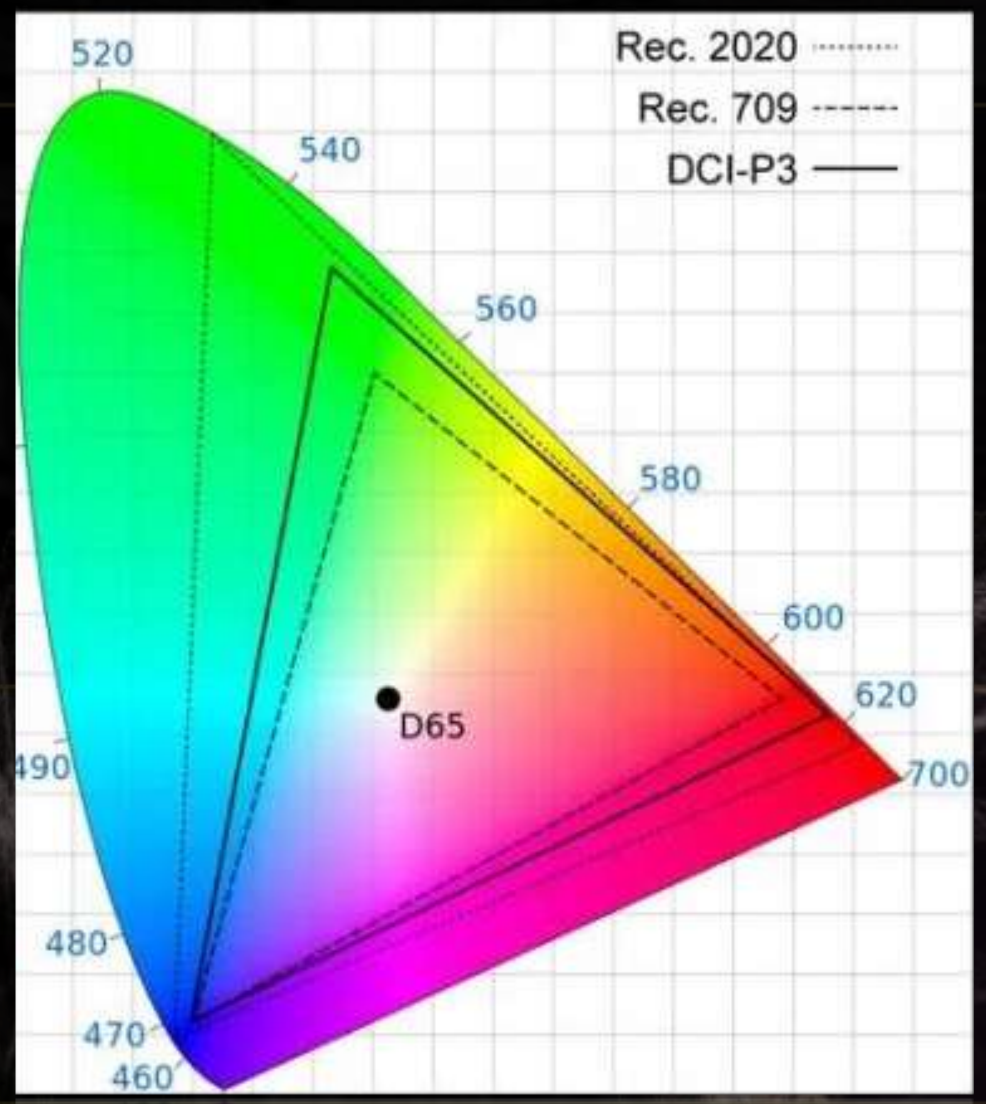
-PRIMARIES: DEFINE THE GAMUT BY ESTABLISH X AND Y COORDINATES FOR EACH COLOR PRIMARY (RGB)

-WHITEPOINT: DEFINE THE COORDINATES OF THE LOWEST CHROMATIC INTENSITY (D65 FOR SDR AND HDR)

-TRANSFER FUNCTION: DEFINE THE MAPPING BETWEEN LINEAR TRISTIMULUS VALUES AND NON-LINEAR ELECTRONIC SIGNAL VALUE



REC. 2020 PRIMARY COLORS IS 630 NM FOR THE RED PRIMARY COLOR, 532 NM FOR THE GREEN PRIMARY COLOR, AND 467 NM FOR THE BLUE PRIMARY COLOR.

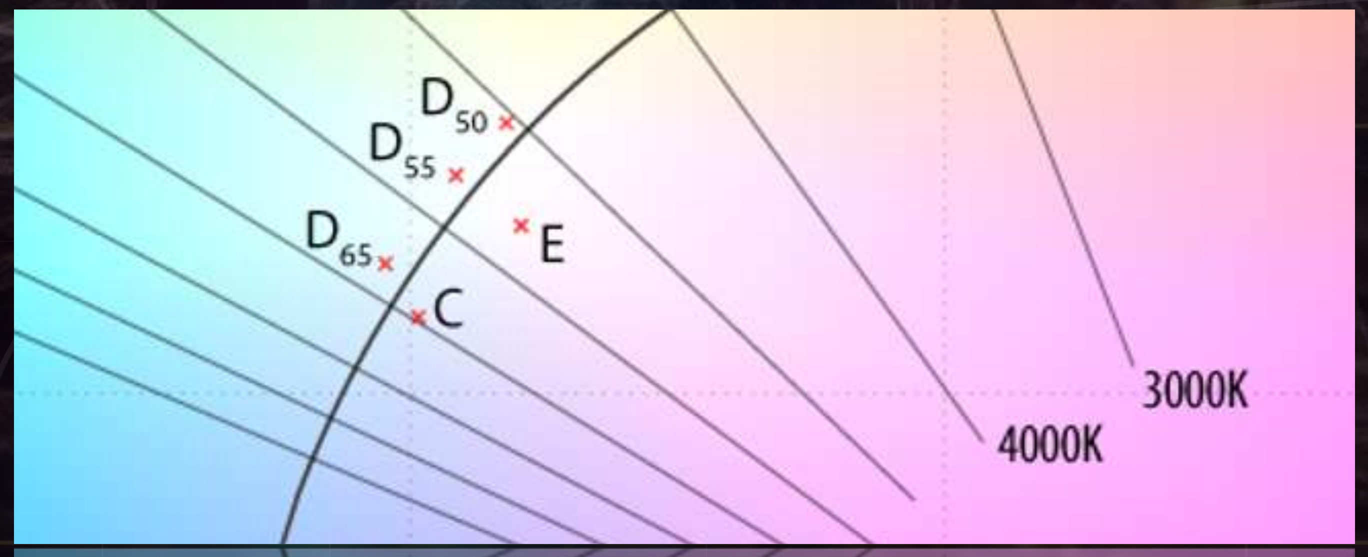


-PRIMARIES

CIE STANDART ILUMINANT D65: CORRESPOND TO THE DIRECT SUN LIGHT AT NOON, INCLUDING THE REFLECTED LIGHT OF THE SKY IN WESTERN EUROPE-NORTHERN EUROPE.

IN COLOR TEMPERATURE IT SITS AT AROUND 6504 K, SLIGHTLY ABOVE THE PLANCKIAN LOKUS.

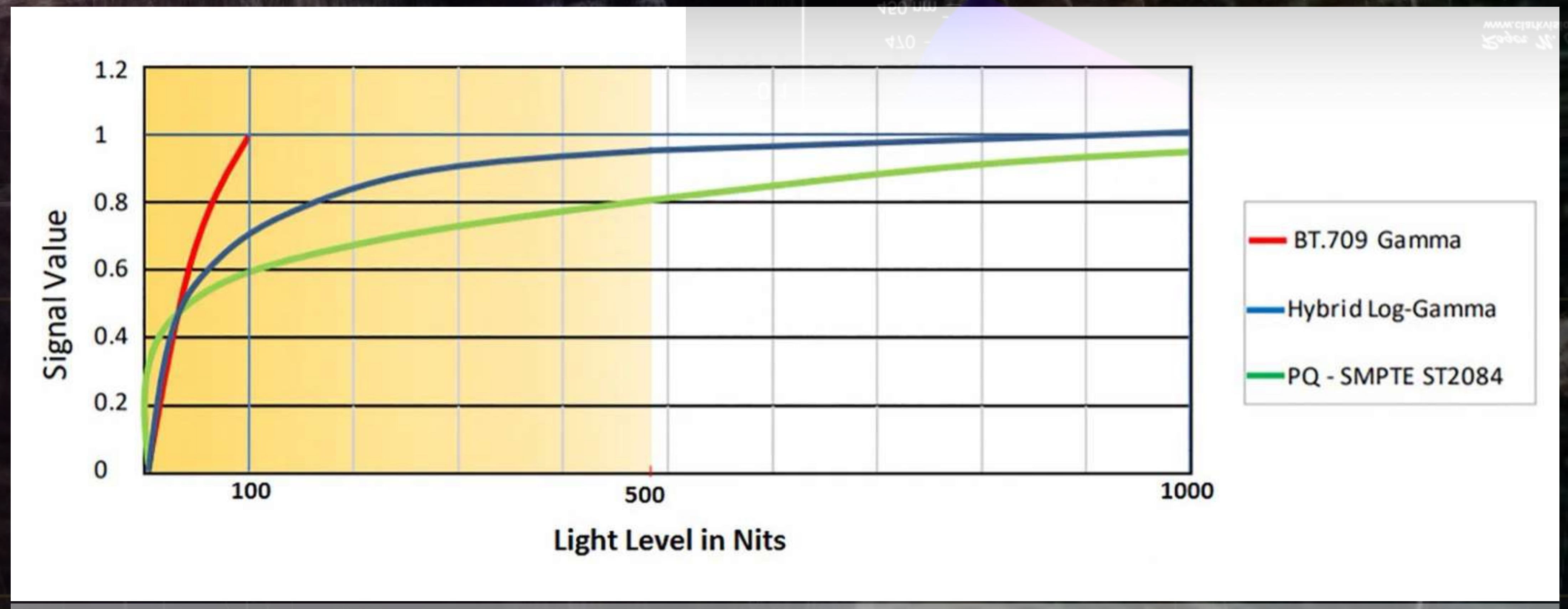
USED IN SDR UND HDR.



-WHITEPOINT

SDR TRANSFER FUNCTIONS:
LINEAR, LOG, GAMMA

HDR TRANSFER FUNCTIONS:
HLG, PQ



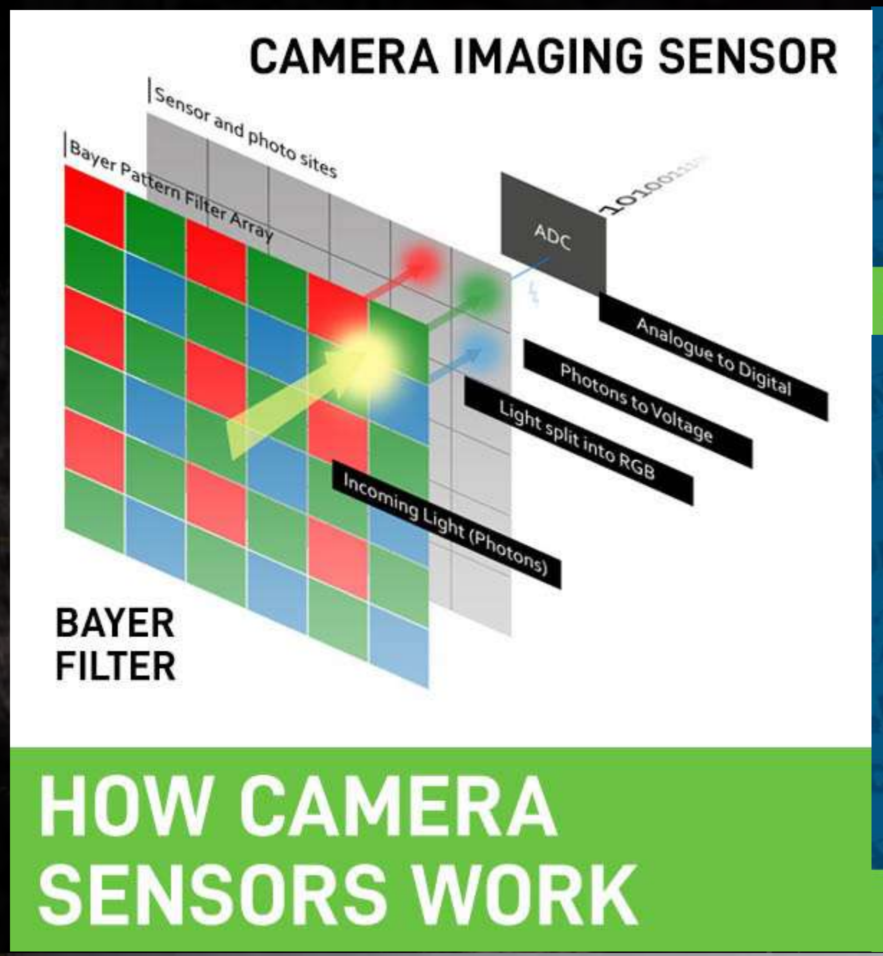
-TRANSFER FUNCTION

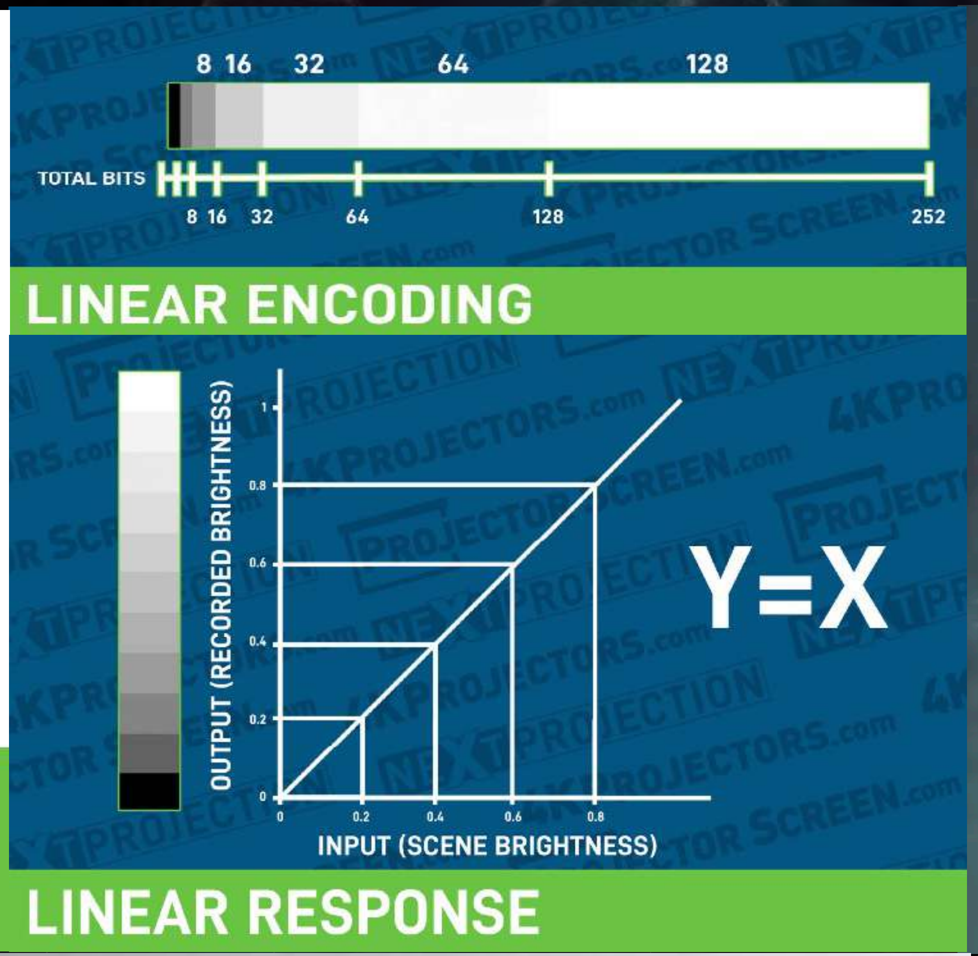
CAMERA SENSOR AND HUMAN PERCEPTION

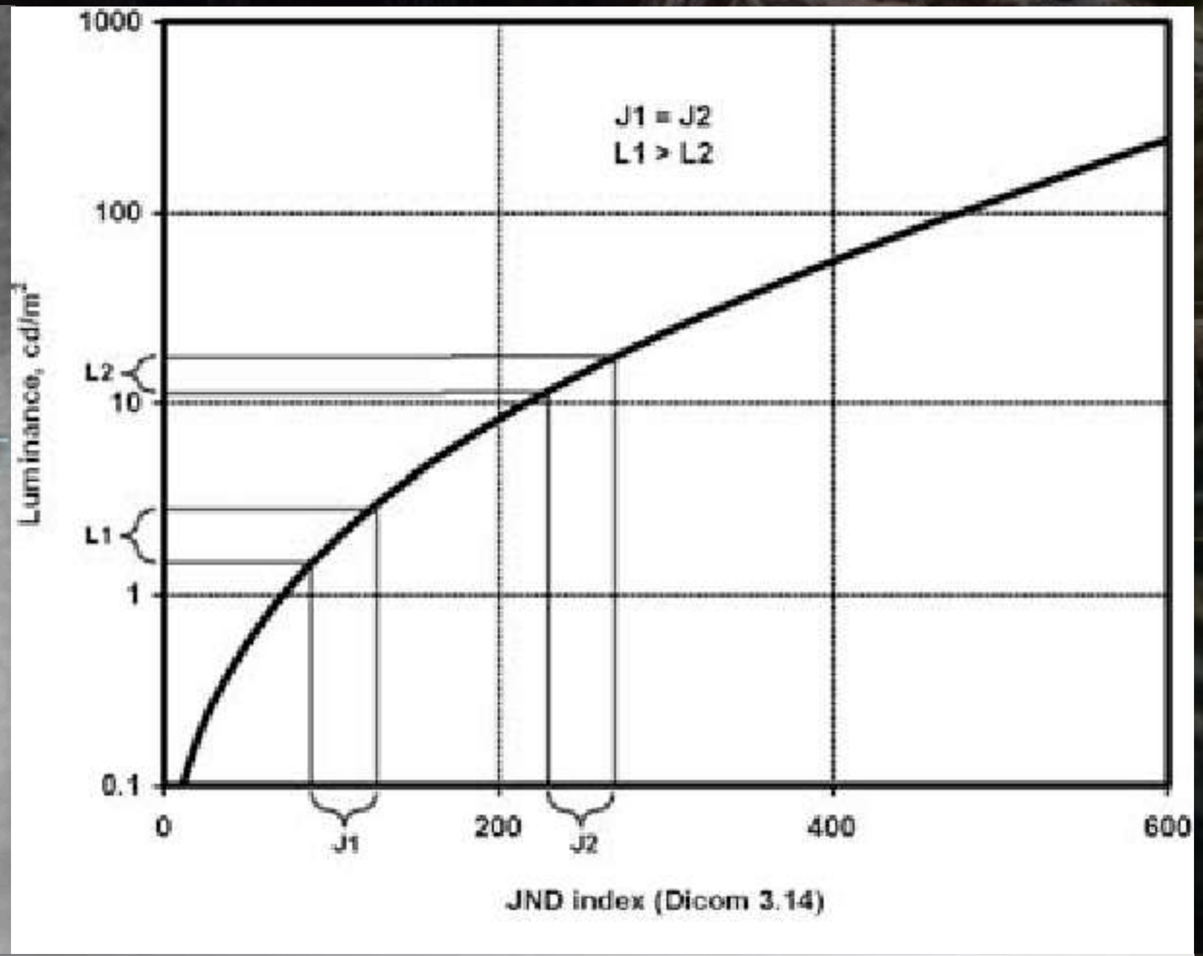
-THE SENSOR RESPONSE TO LIGHT IS LINEAL.

-THE HUMAN VISUAL SYSTEM RESPONSE IS LOGARITHMIC, NOT LINEAR.

OUR EYES DON'T RESPOND LINEARLY TO THE CHANGE OF LIGHTS. BY LINEARLY, IT MEANS PROPORTIONALLY. WHEN PHOTONS HIT THE RETINAS IN OUR EYES, THE RESPONSE IS A CURVE INSTEAD OF THE LINEAR LINE. WE ARE MORE SENSITIVE TO THE CHANGES IN THE DARK TONES THAN THAT OF THE BRIGHT TONES. CONTRARILY, A CAMERA RESPONDS LINEARLY TO THE PHOTONS HITTING ITS SENSOR. FOR INSTANCE, WHEN THERE IS TWICE THE LUMINANCE, THE SENSOR RECORDS TWICE THE BRIGHTNESS LEVEL.



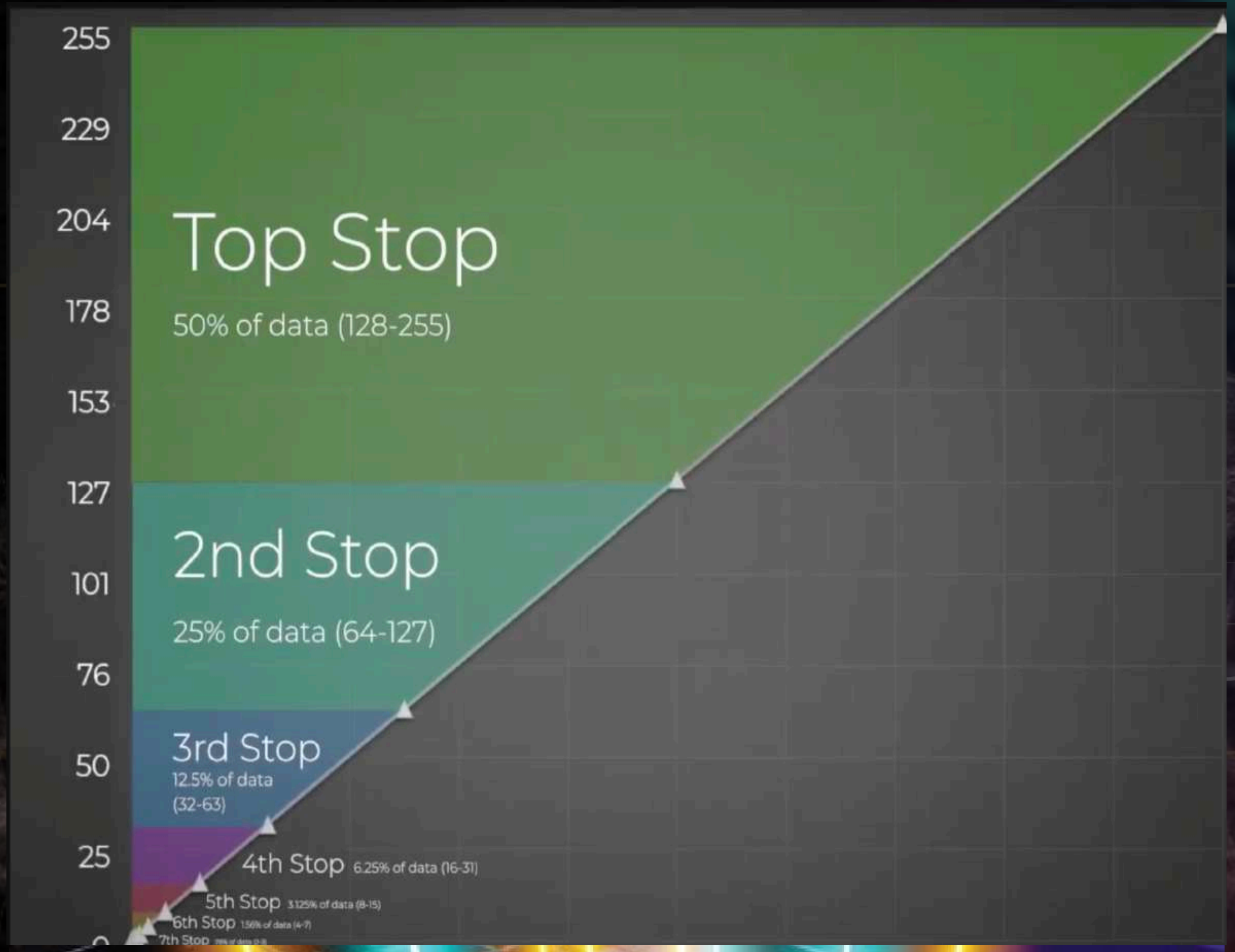


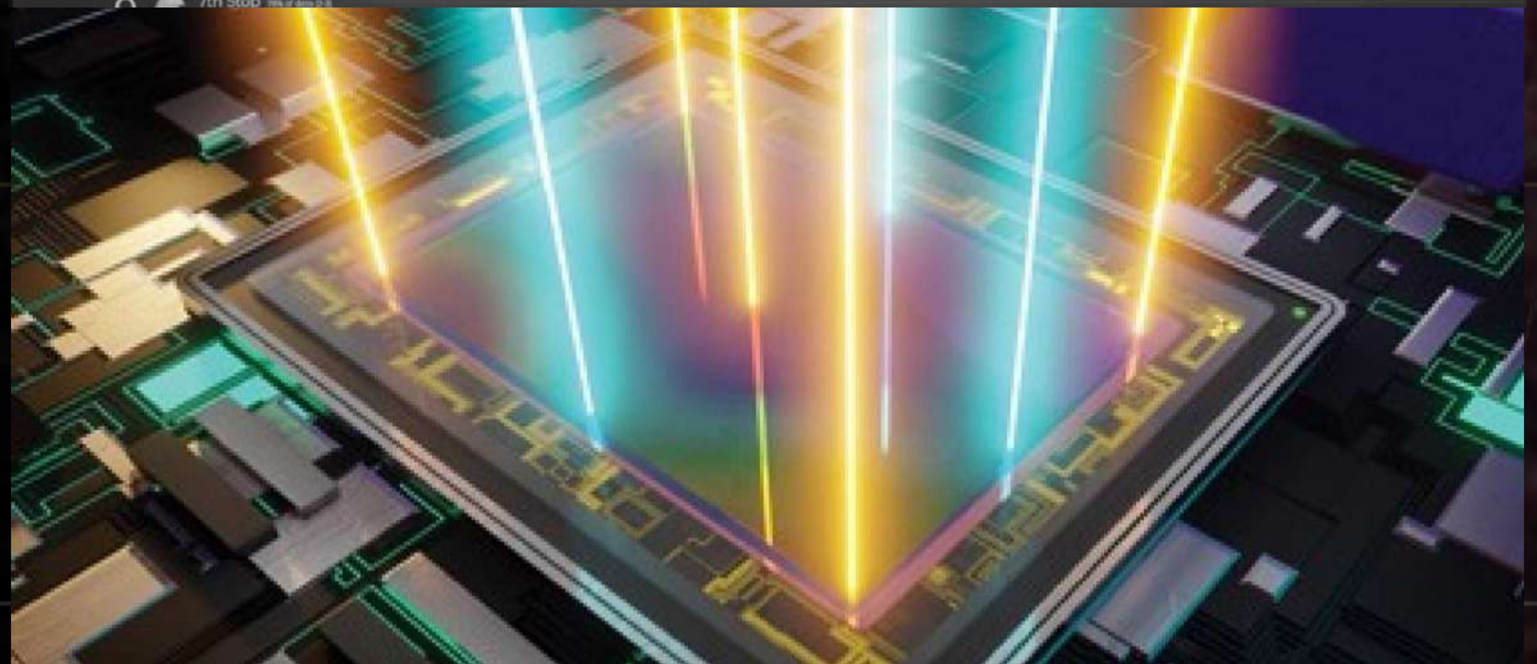


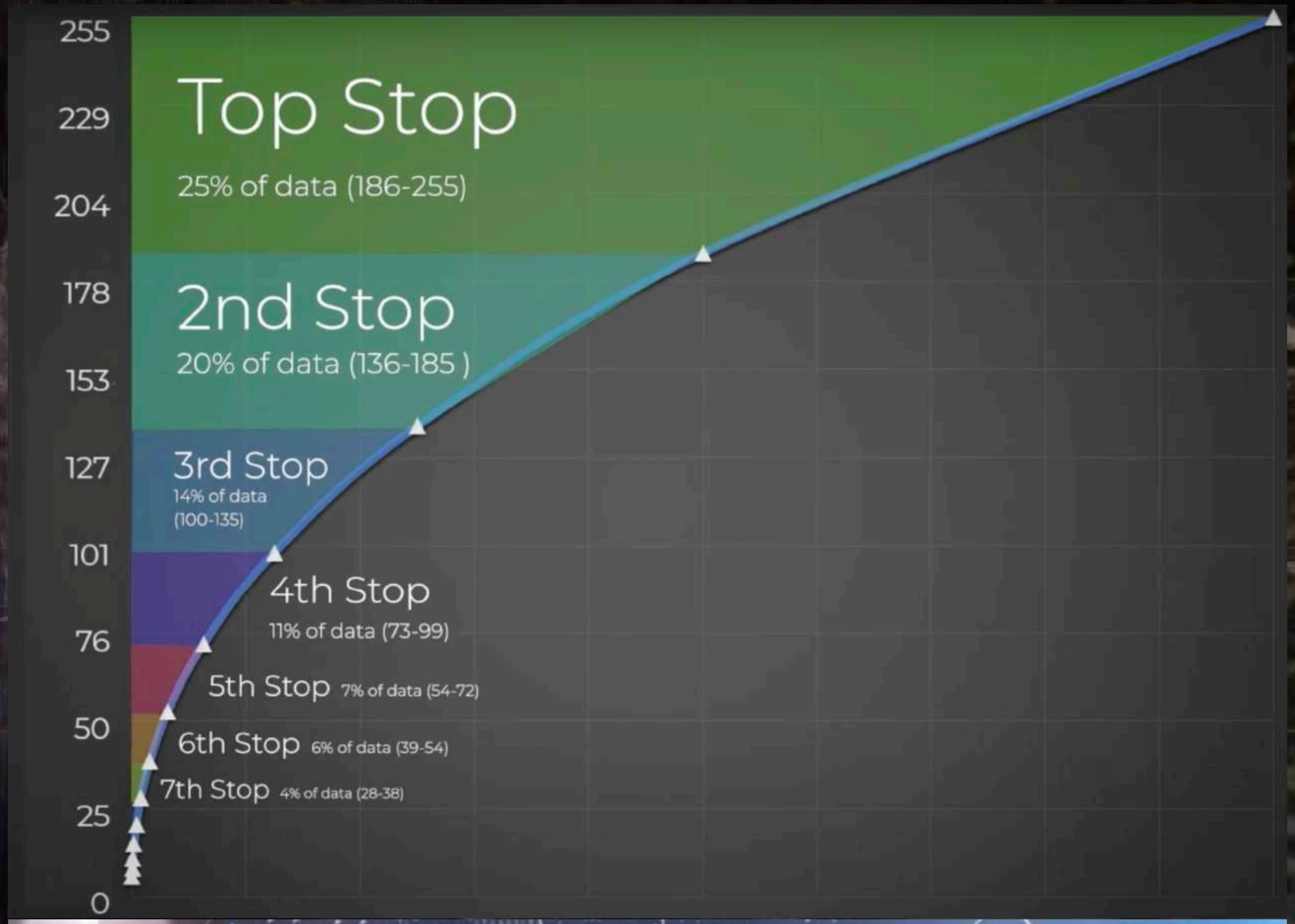
CAMERA SENSOR AND HUMAN PERCEPTION

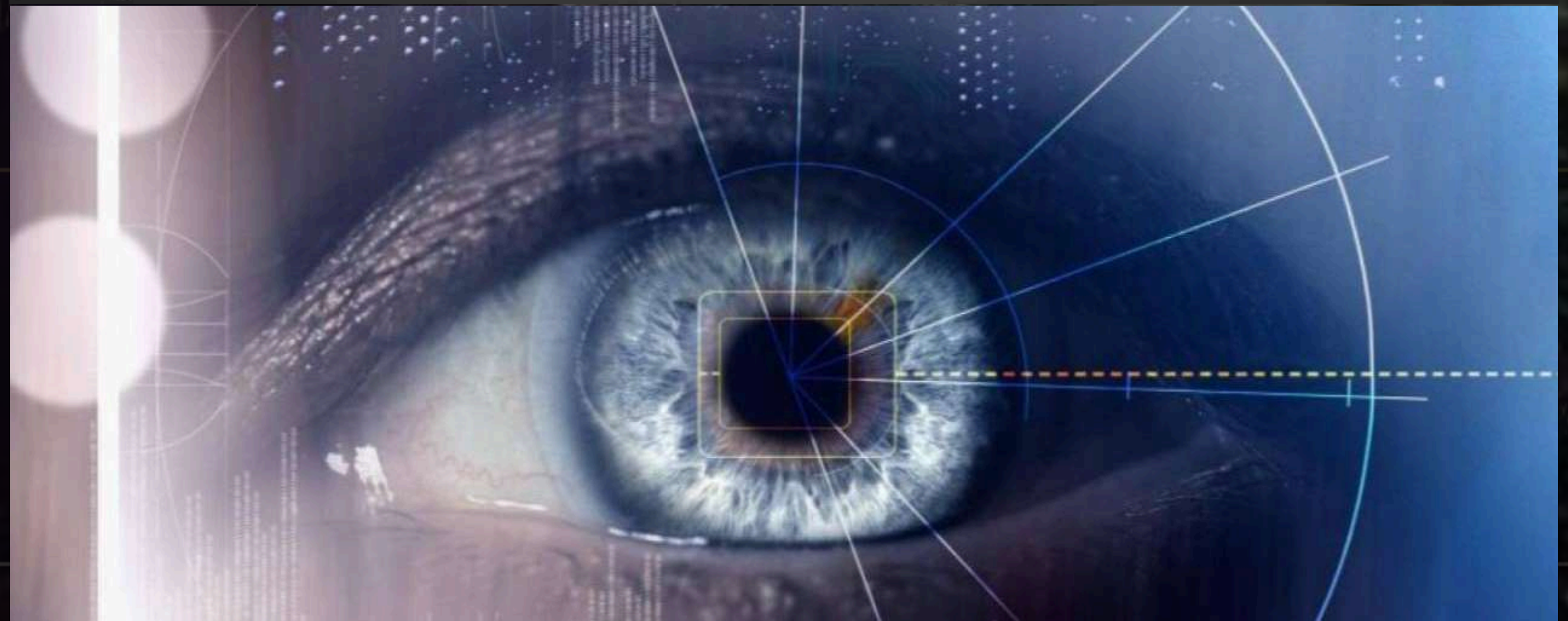
- -THE SENSOR RESPONSE TO LIGHT IS LINEAL.
- -THE HUMAN VISUAL SYSTEM RESPONSE IS LOGARITHMIC, NOT LINEAR.

ENCODING THE LIGHT IN A NON-LINEAR WAY, RESULTS IN A MUCH EVEN DISTRIBUTION VON SLIGHT IN RELATION TO SIGNAL VALUES.









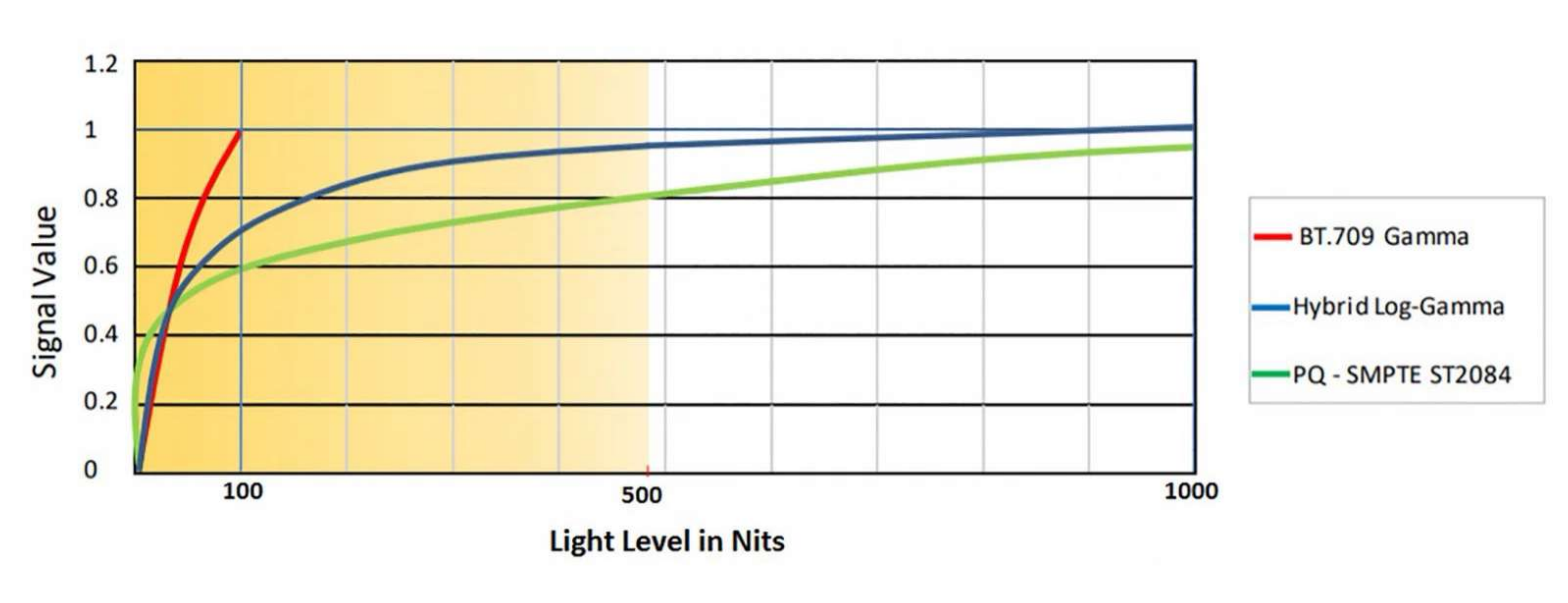
TRANSFER FUNCTIONS

-OPTO-ELECTRONIC TRANSFER FUNCTIONS (OETF): INGEST THE SCENE LIGHT AS INPUT, AND CONVERT INTO THE PICTURE OR VIDEO SIGNAL. THIS IS TYPICALLY DONE WITHIN THE CAMERA.

-ELECTRO-OPTICAL TRANSFER FUNCTIONS (EOTF): TAKES THE VIDEO SIGNAL AND CONVERT IT INTO THE LINEAR LIGHT OUTPUT OF THE DISPLAY. TYPICALLY DONE WITHIN THE DISPLAY.

-OPTO-OPTICAL TRANSFER FUNCTIONS (OOTF): TAKES THE SCENE LIGHT AS INPUT, AND THE DISPLAY LIGHT AS OUTPUT. TYPICALLY DONE WITHIN THE DISPLAY.

TO DISPLAY THE DIGITAL IMAGES ON THE SCREEN, DISPLAY DEVICES NEED TO CONVERT THE PIXEL VALUES TO CORRESPONDING LIGHT VALUES. THIS PROCESS IS USUALLY NON-LINEAR AND IS CALLED EOTF (ELECTRO-OPTICAL TRANSFER FUNCTION). DIFFERENT TYPES OF "TRANSFER FUNCTIONS" ARE SUPPORTED IN DIFFERENT DISPLAY DEVICES.



MEASURING:

-STOPS: A STOP OF LIGHT IS NOT A FUNDAMENTAL UNIT, BUT A METHOD OF MEASURING THE INCREASE OR DECREASE OF LIGHT IN A PHOTOGRAPHIC EXPOSURE. INCREASING IT BY 1-STOP MEANS TWICE AS MUCH LIGHT, AND DECREASING IT BY 1-STOP MEANS HALF THE AMOUNT OF LIGHT. STOPS ARE THE MEASURE OF LIGHT IN THE SCENE, IS THE TRADITIONAL UNIT THAT CINEMATOGRAPHERS USE ON SET. SCENE UND CAMERA DYNAMIC RANGE ITS USUALLY MEASURED IN STOPS.

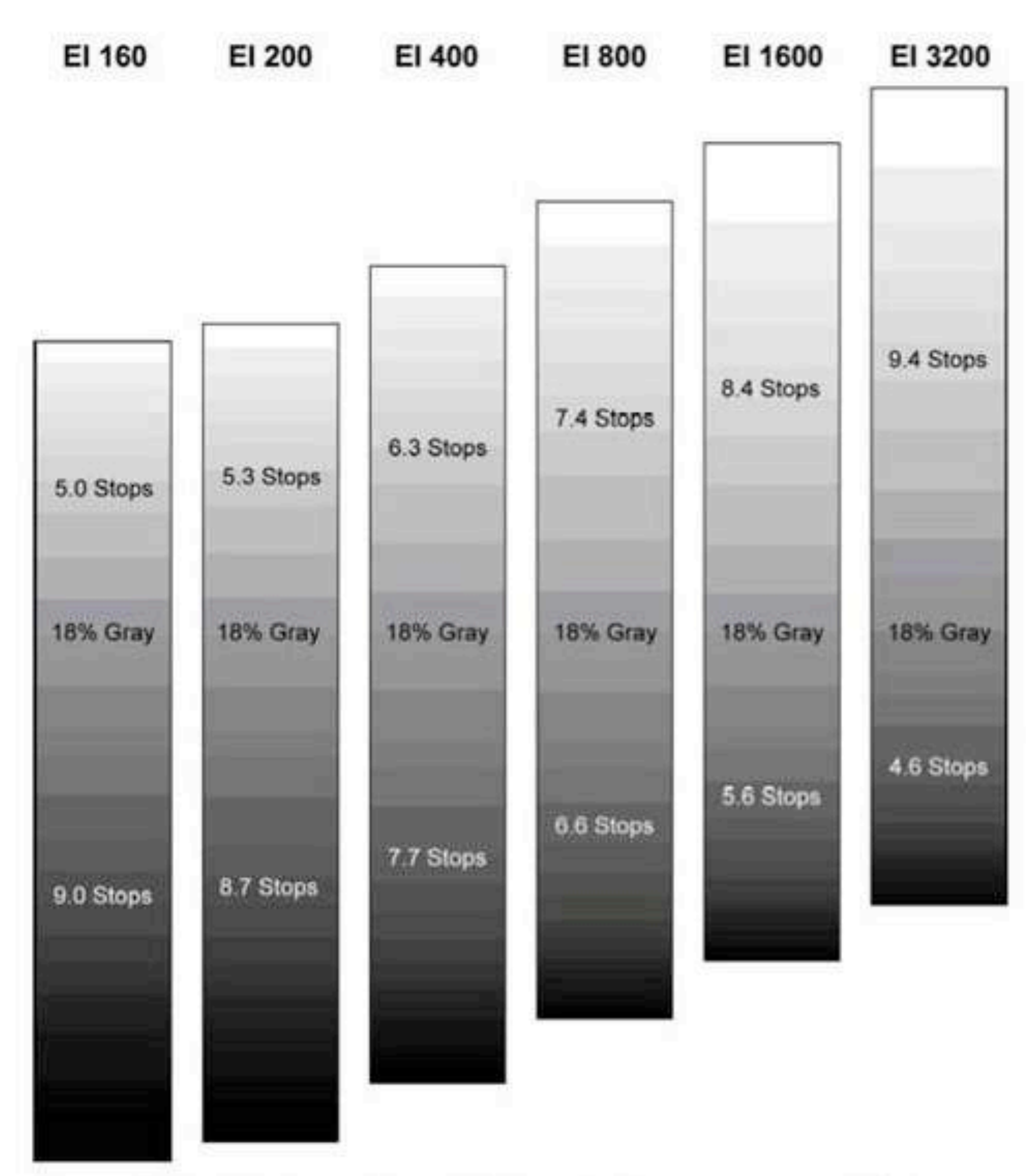
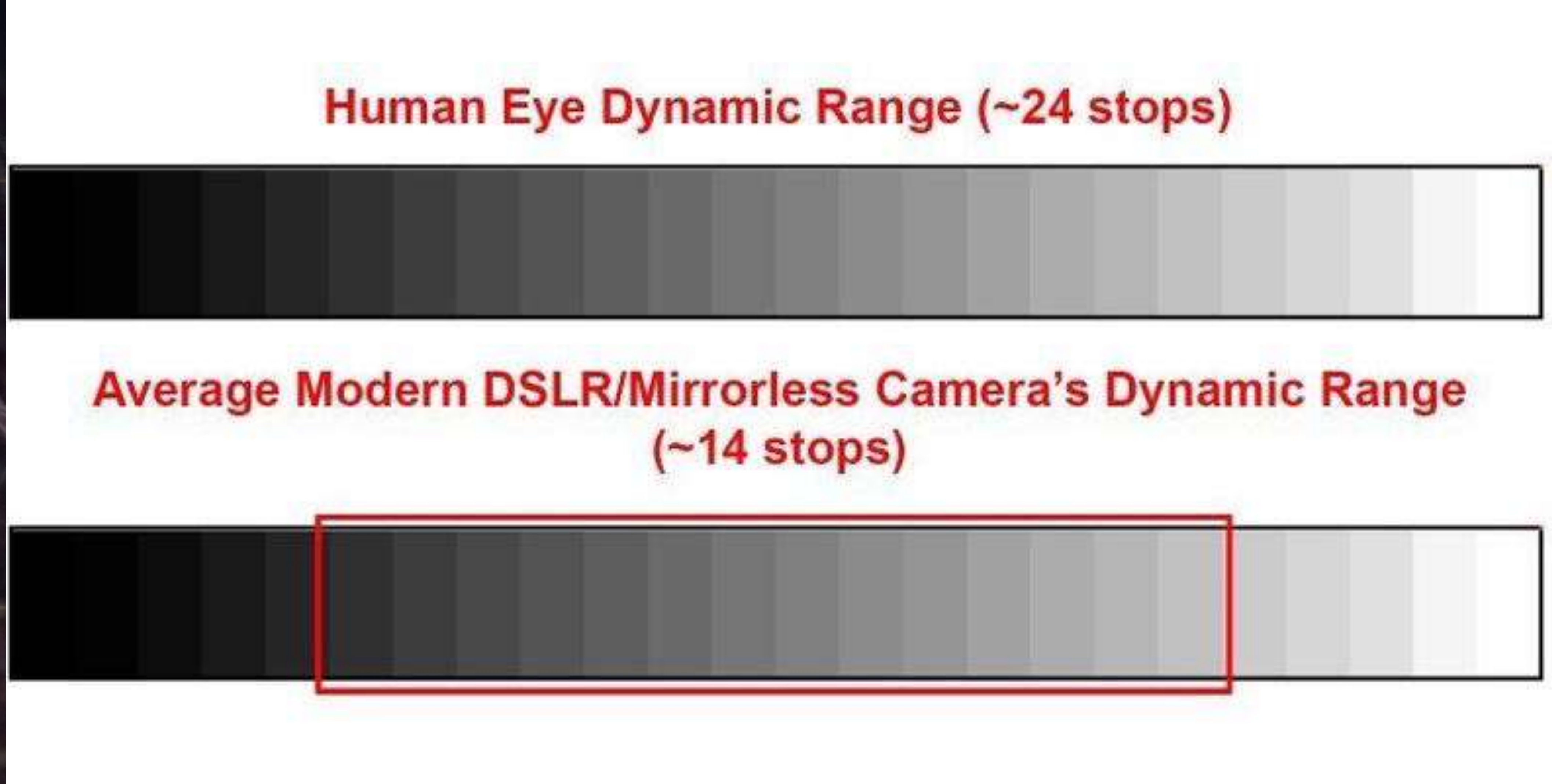
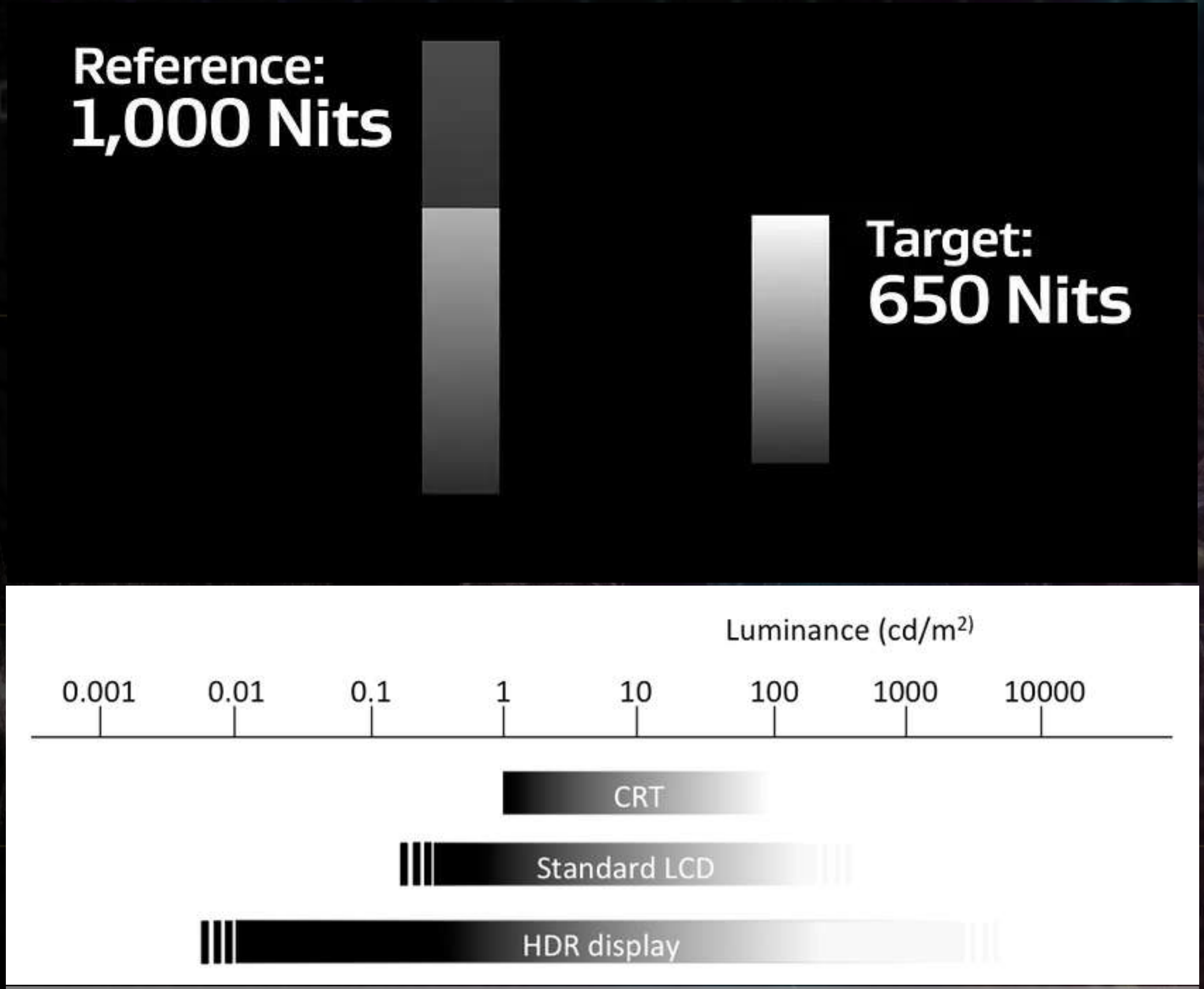


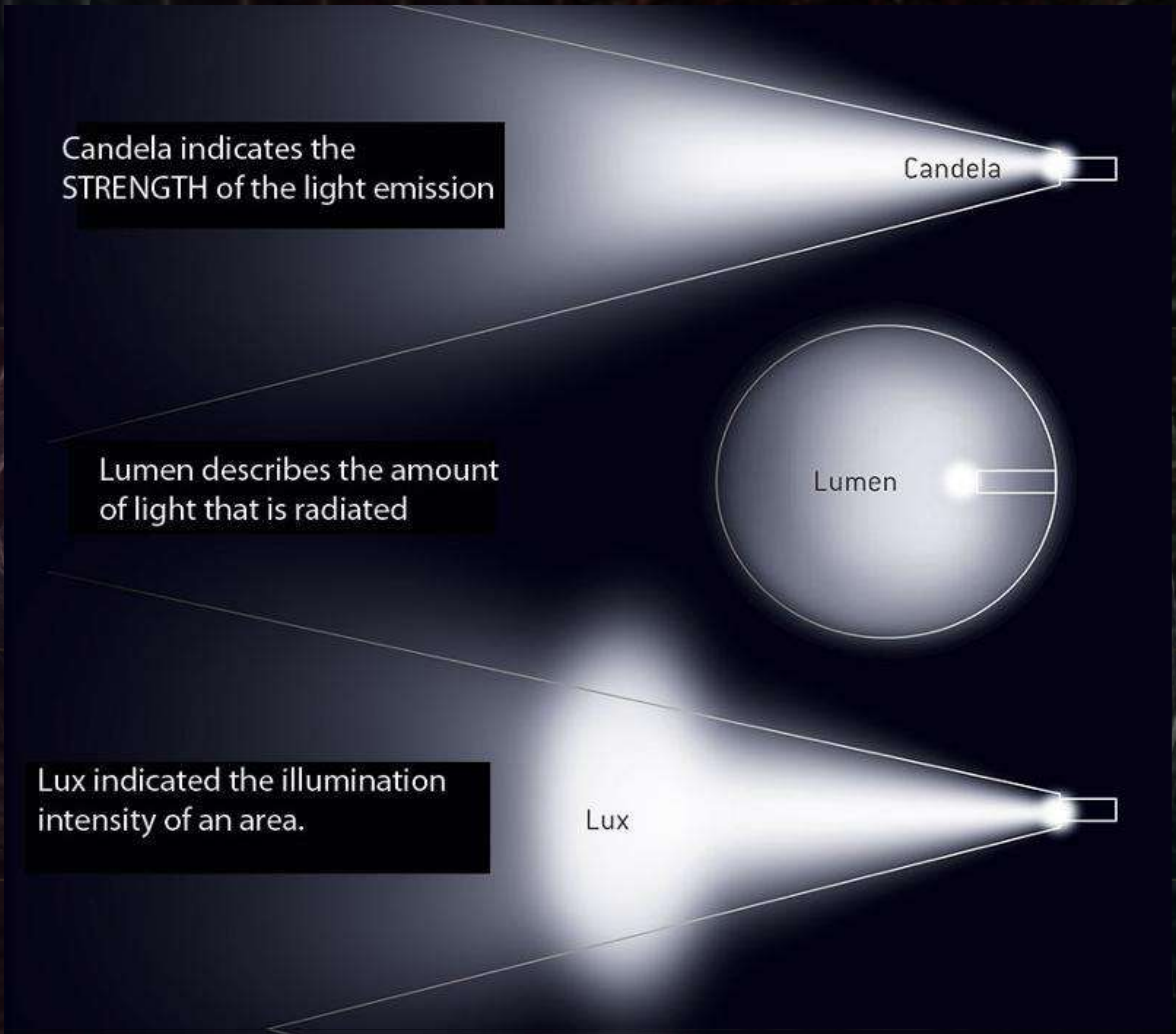
Figure 42: Graphical comparison of latitude at different exposure indexes



MEASURING:

-NITS: NITS ARE A UNIT OF MEASUREMENT USED TO QUANTIFY THE BRIGHTNESS OF ELECTRONIC DISPLAYS. ONE NIT IS EQUIVALENT TO ONE CANDELA PER SQUARE METER (CD/M^2), WHERE CANDELA REPRESENTS THE STANDARD UNIT FOR MEASURING LUMINOUS INTENSITY. THEREFORE, NITS MEASURE THE AMOUNT OF LIGHT EMITTED OR REFLECTED BY A DISPLAY PER SQUARE METER.





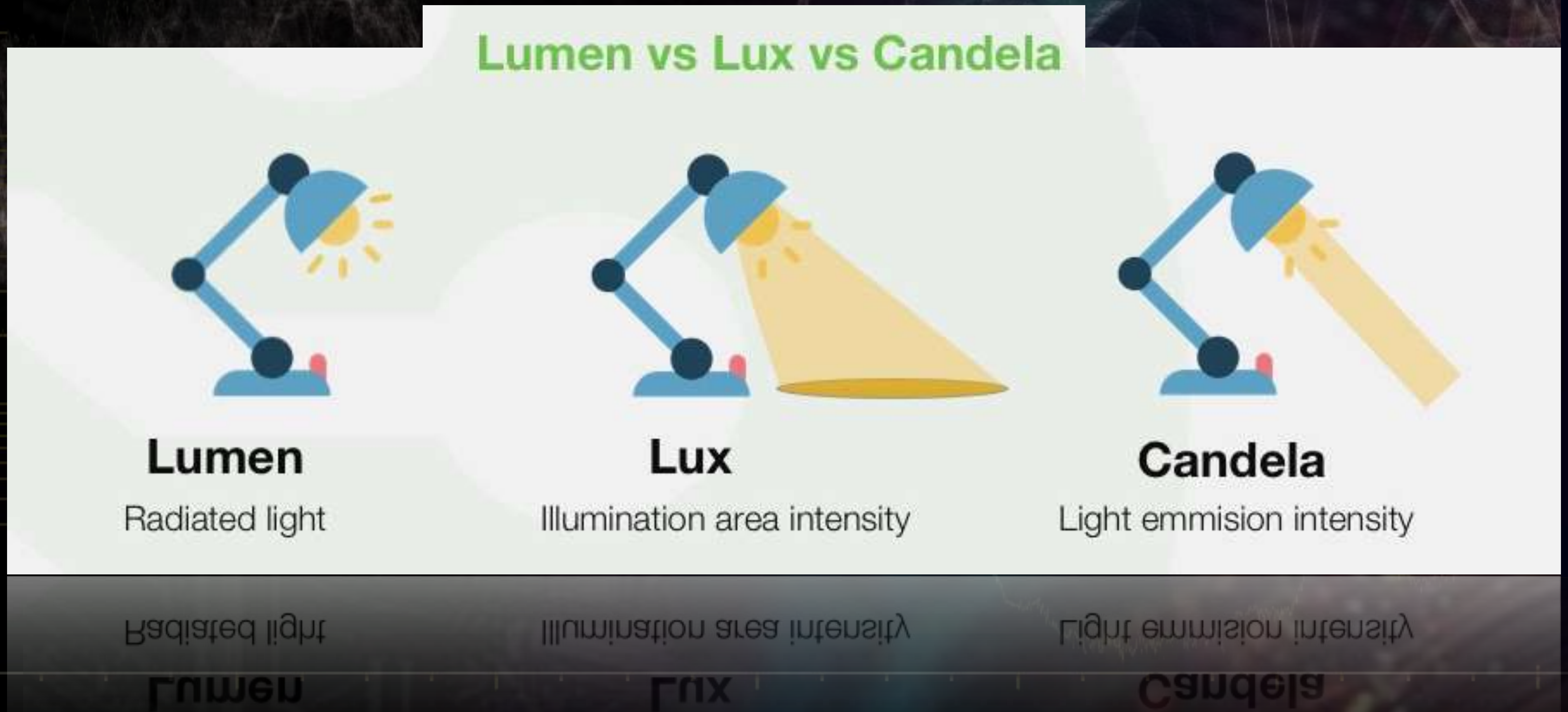
MEASURING:

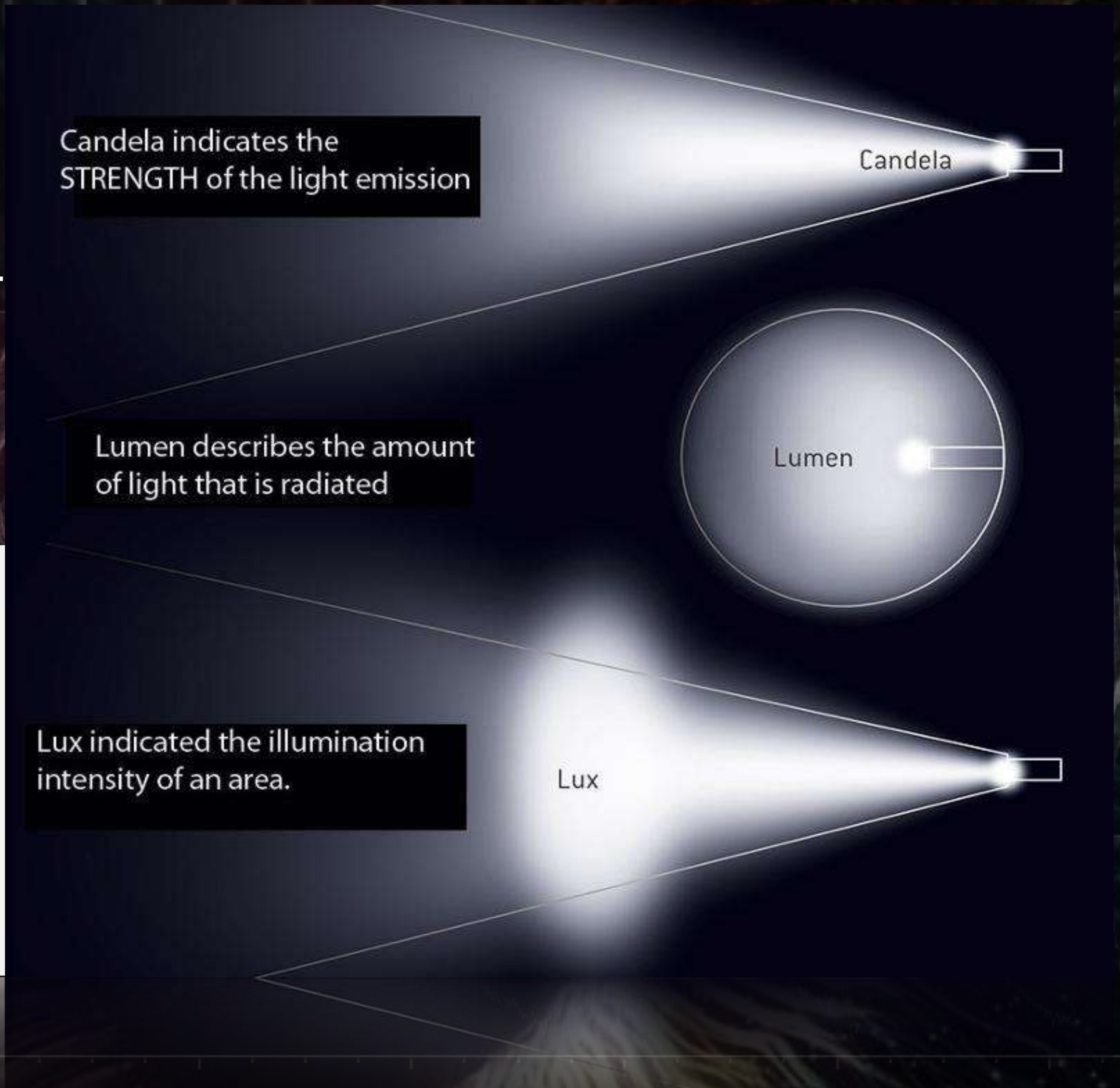
-NITS: NITS ARE A UNIT OF MEASUREMENT USED TO QUANTIFY THE BRIGHTNESS OF ELECTRONIC DISPLAYS. ONE NIT IS EQUIVALENT TO ONE CANDELA PER SQUARE METER (CD/M²), WHERE CANDELA REPRESENTS THE STANDARD UNIT FOR MEASURING LUMINOUS INTENSITY. THEREFORE, NITS MEASURE THE AMOUNT OF LIGHT EMITTED OR REFLECTED BY A DISPLAY PER SQUARE METER.

-CANDELA, LUX AND LUMENS

CANDELA (CD), LUX (LX), AND LUMENS ARE THE THREE MAIN WAYS THAT LIGHT MAY BE MEASURED. THE LUMEN MEASURES THE AVERAGE BRIGHTNESS OVER A LARGER AREA THAN THE CANDELA, WHICH IS WHY THE TWO UNITS ARE OFTEN CONFUSED.

LIGHT INTENSITY IS MEASURED IN CANDELAS, WHILE LIGHT OUTPUT IS MEASURED IN LUMENS. HOW BRIGHT SOMETHING IS MEASURED IN LUX. THEY ARE ALL MEASURING THE SAME THING BUT IN DIFFERENT WAYS. BECAUSE IT MEASURES LIGHT INTENSITY IN A SINGLE DIRECTION, THE CANDELA IS THE MOST EXACT UNIT OF MEASUREMENT.





MEASURING:

-CONTRAST RATIO: THE CONTRAST RATIO IS A PROPERTY OF A DISPLAY SYSTEM, DEFINED AS THE RATIO OF THE LUMINANCE OF THE BRIGHTEST SHADE (WHITE) TO THAT OF THE DARKEST SHADE (BLACK) THAT THE SYSTEM IS CAPABLE OF PRODUCING. A HIGH CONTRAST RATIO IS A DESIRED ASPECT OF ANY DISPLAY.

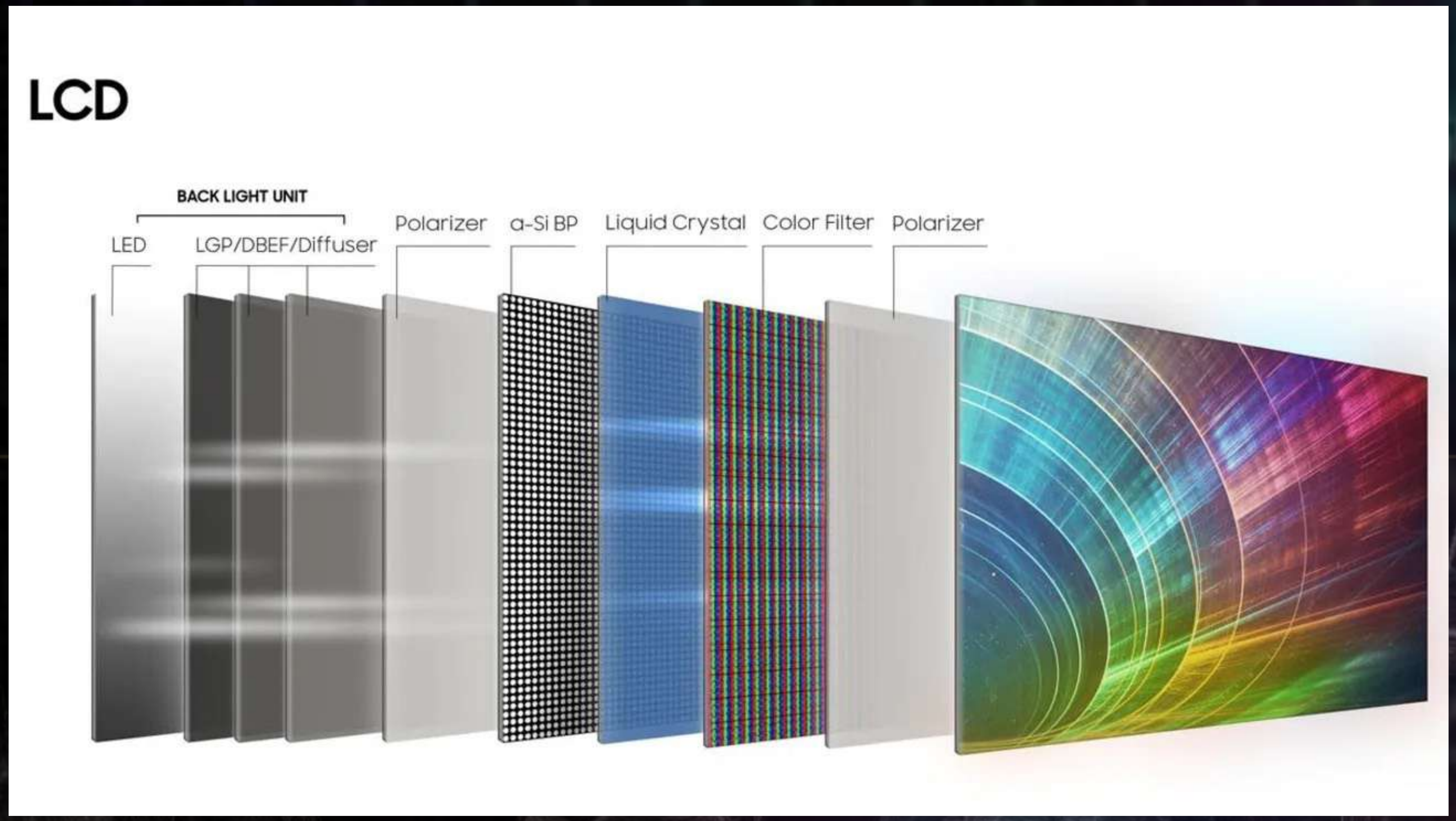
-ONE REASON CONTRAST RATIOS ARE IMPORTANT IS BECAUSE SEPARATION BETWEEN INTENSITY LEVELS IN AN IMAGE HELP US DIFFERENTIATE THINGS. THAT SEPARATION CAN ALSO BE A FACTOR IN HOW 3-DIMENSIONAL THE IMAGES LOOK

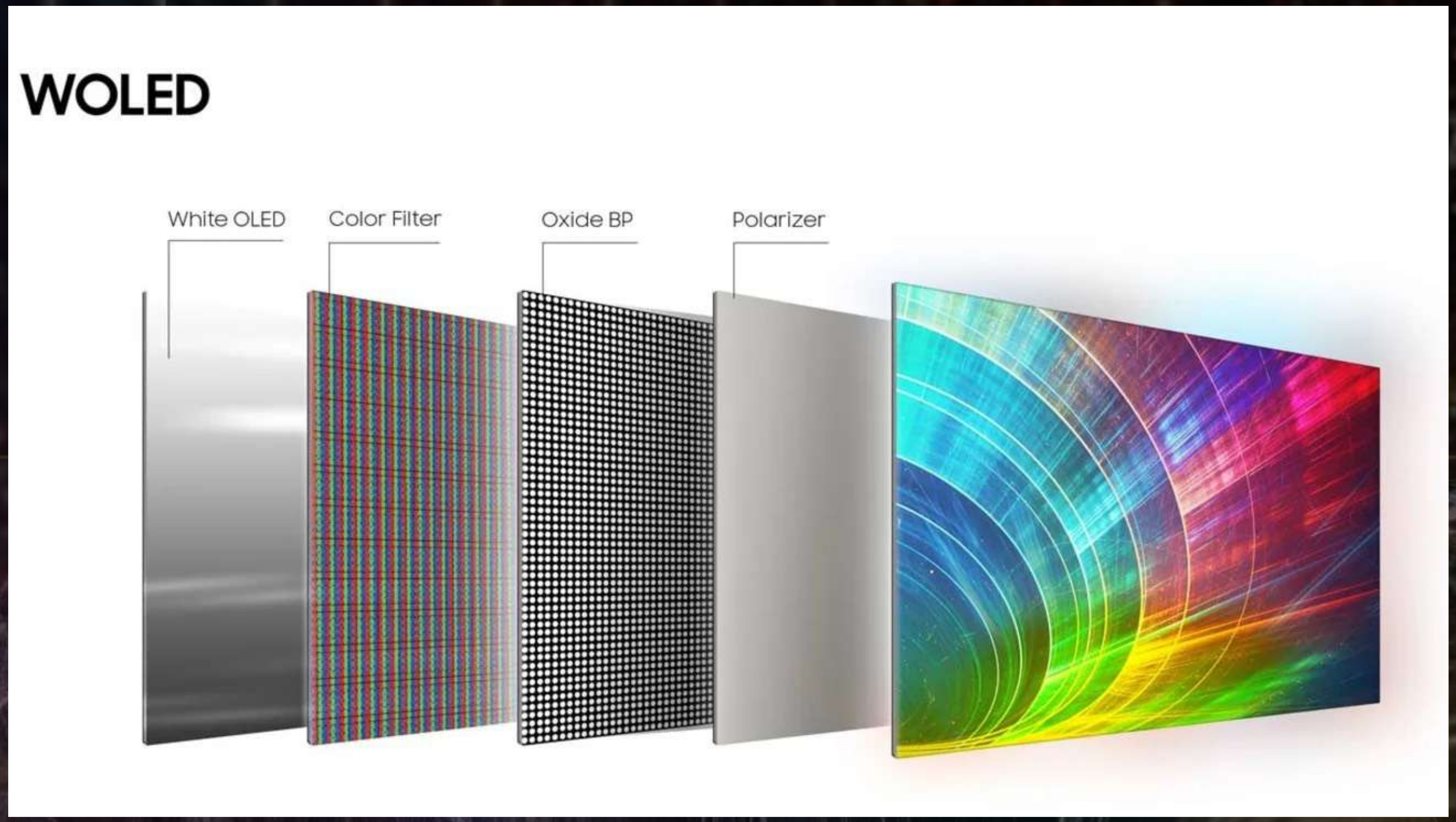
-FOR EXAMPLE, AN LED DISPLAY CONTRAST RATIO OF 1000:1 MEANS THAT THE WHITE IS 1000 TIMES BRIGHTER THAN THE BLACK. THE HIGHER THE CONTRAST RATIO, THE MORE CLEAR AND COLORFUL THE IMAGE IS. THE LOWER THE CONTRAST RATIO, THE MORE DULL AND BLURRY THE IMAGE IS.

TV DISPLAYS

-LCD: LIQUID CRYSTAL DISPLAYS (USE FLUORESCENT BACKLIGHTS) / -LED: ARE ALSO LCD BUT USE LED INSTEAD FLUORESCENT BACKLIGHTS / -QLED: THEY USE QUANTUM DOTS TO PRODUCE COLOURS

-OLED: ORGANIC LIGHT-EMITTING DIODE





PART III

HDR

High Dynamic Range

HDR HAS HAD SOMETHING OF A DIFFICULT BIRTH, WITH DIFFERENT DISPLAY MANUFACTURERS EFFECTIVELY DEFINING THEIR OWN HDR, SPECIFICATIONS, BASED ON HDR10, HDR10+, DOLBY VISION, AND HLG.

HIGH DYNAMIC RANGE (HDR):

MAIN DIFERENCES BETWENN SDR UND HDR

SDR:

- LIMITED COLOR GAMUT
- LIMITED DYNAMIC RANGE (6 BIS 8 STOPS)
- TIPICALLY 8 BIT COLOR DEPTH
- NO METADATA

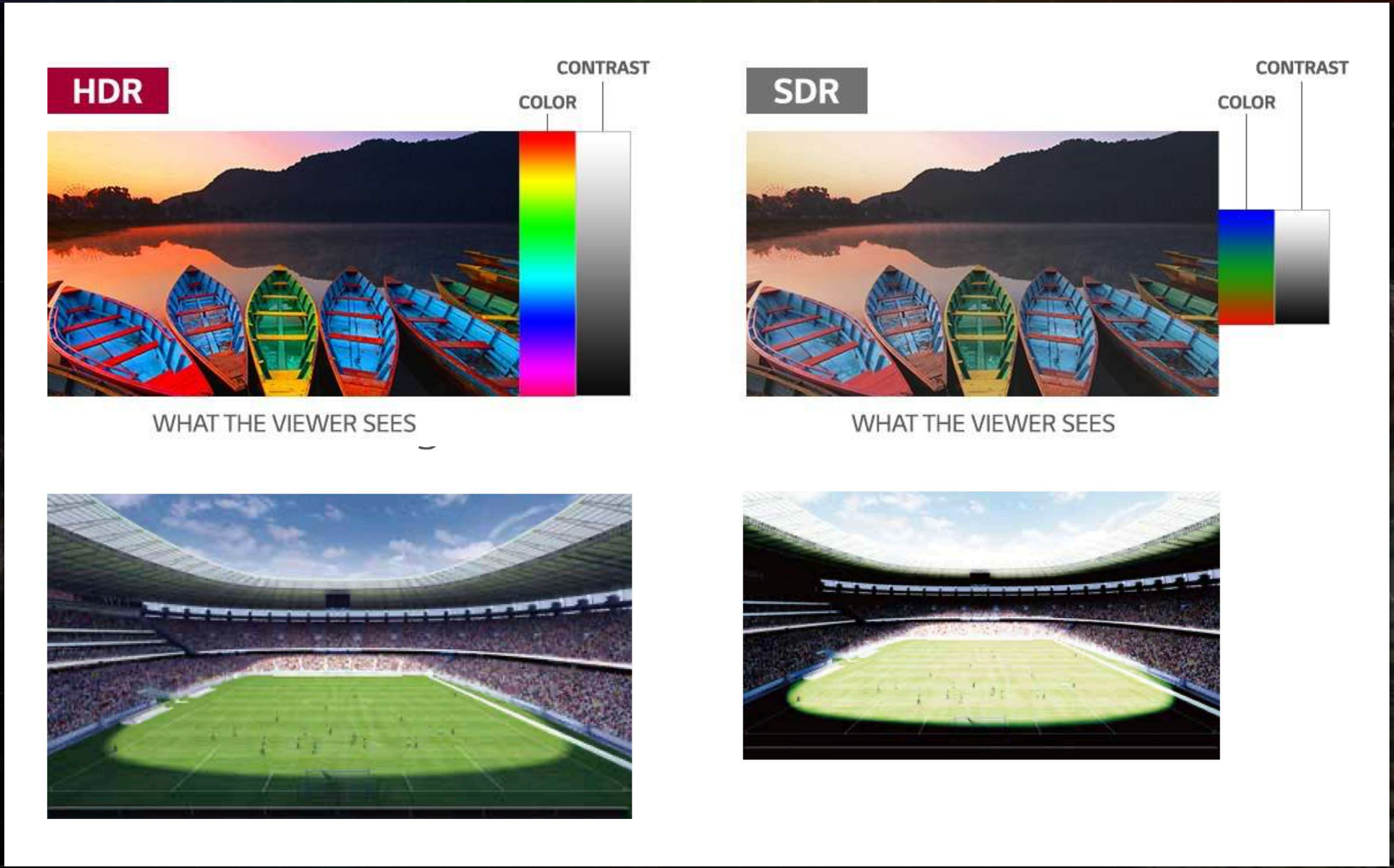
HDR:

- WIDE COLOR GAMUT
- HIGH DYNAMIC RANGE (12 BIS 16 STOPS)
- GREATER PRECISION 10 OR 12 BIT COLOR DEPTH
- STATIC UND DYNAMIC METADATA POSIBLE.

HIGH DYNAMIC RANGE (HDR):

-HDR IS A NEXT-GENERATION DISPLAY SIGNAL TECHNOLOGY THAT PRODUCES HIGH LEVELS OF COLOR CLARITY AND CONTRAST THAT BETTER MATCH IMAGES WE SEE IN THE REAL WORLD.

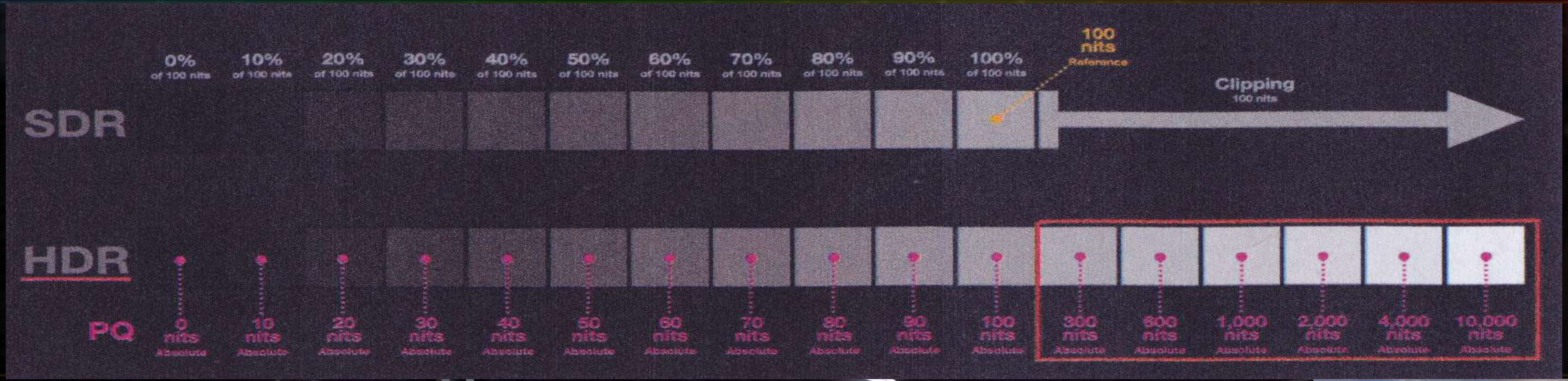
-HIGH DYNAMIC RANGE IS THE CAPABILITY TO REPRESENT A LARGE LUMINANCE VARIATION IN THE VIDEO SIGNAL, FROM VERY DARK VALUES (0.00005 CD/M2) TO VERY BRIGHT VALUES (GREATER THAN 1000 CD/M2).



HIGH DYNAMIC RANGE (HDR):

-PROVIDE ADDITIONAL BRIGHTNESS HEADROOM FOR SPECTRAL HIGHLIGHT DETAIL, SUCH AS CHROME REFLECTIONS, SUN ILLUMINATED CLOUDS, FIRE, EXPLOSIONS, LAMP BULB FILAMENTS, ETC.

-THE ADVANTAGES OF HAVING MORE ACCURATE SPECULAR REFLECTIONS ENABLED BY HDR INCLUDE BETTER SURFACE MATERIAL IDENTIFICATION AS WELL AS IN DEPTH PERCEPTION.



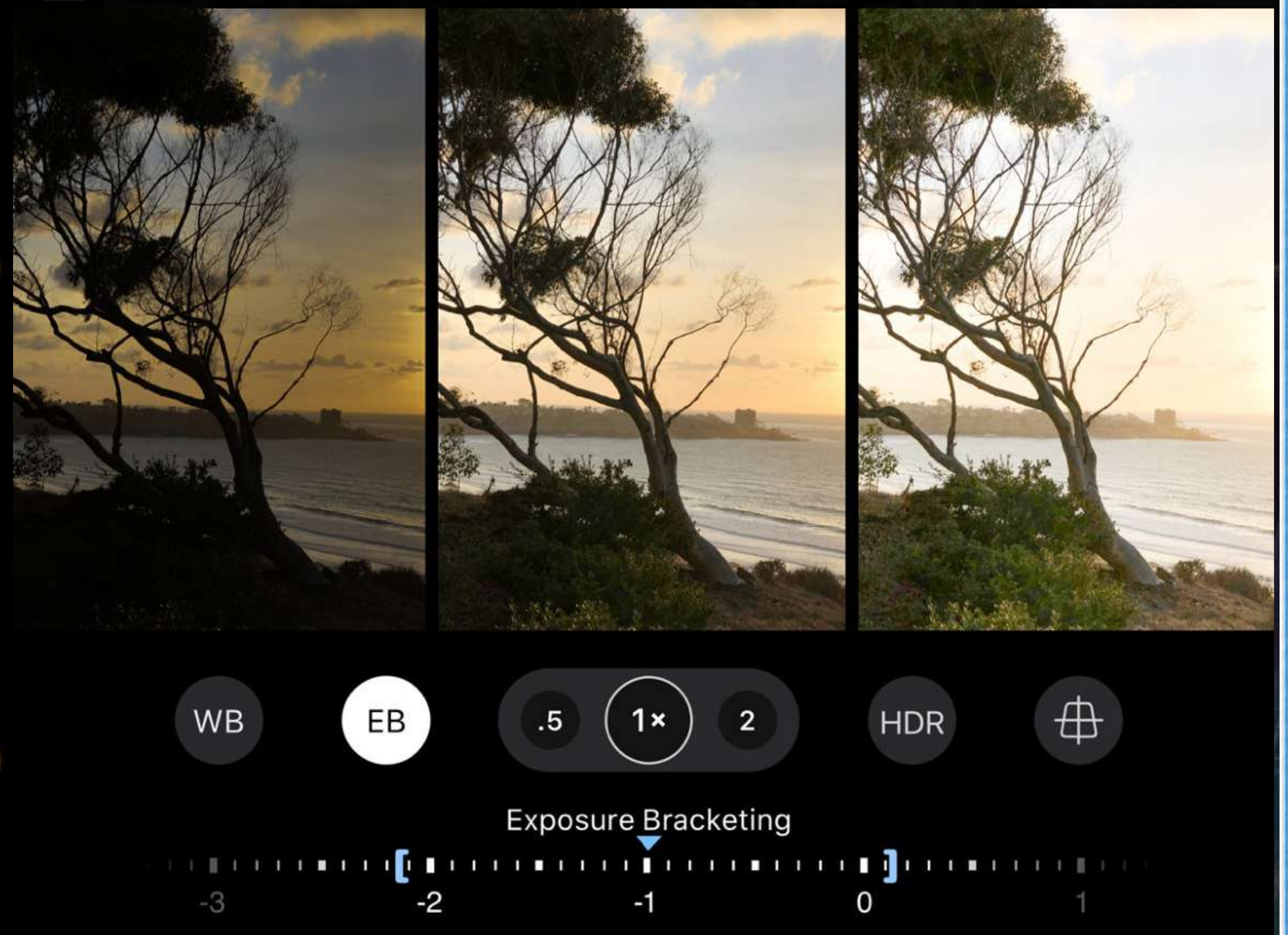
KEY CONCEPTS WHEN TALKING ABOUT HDR:

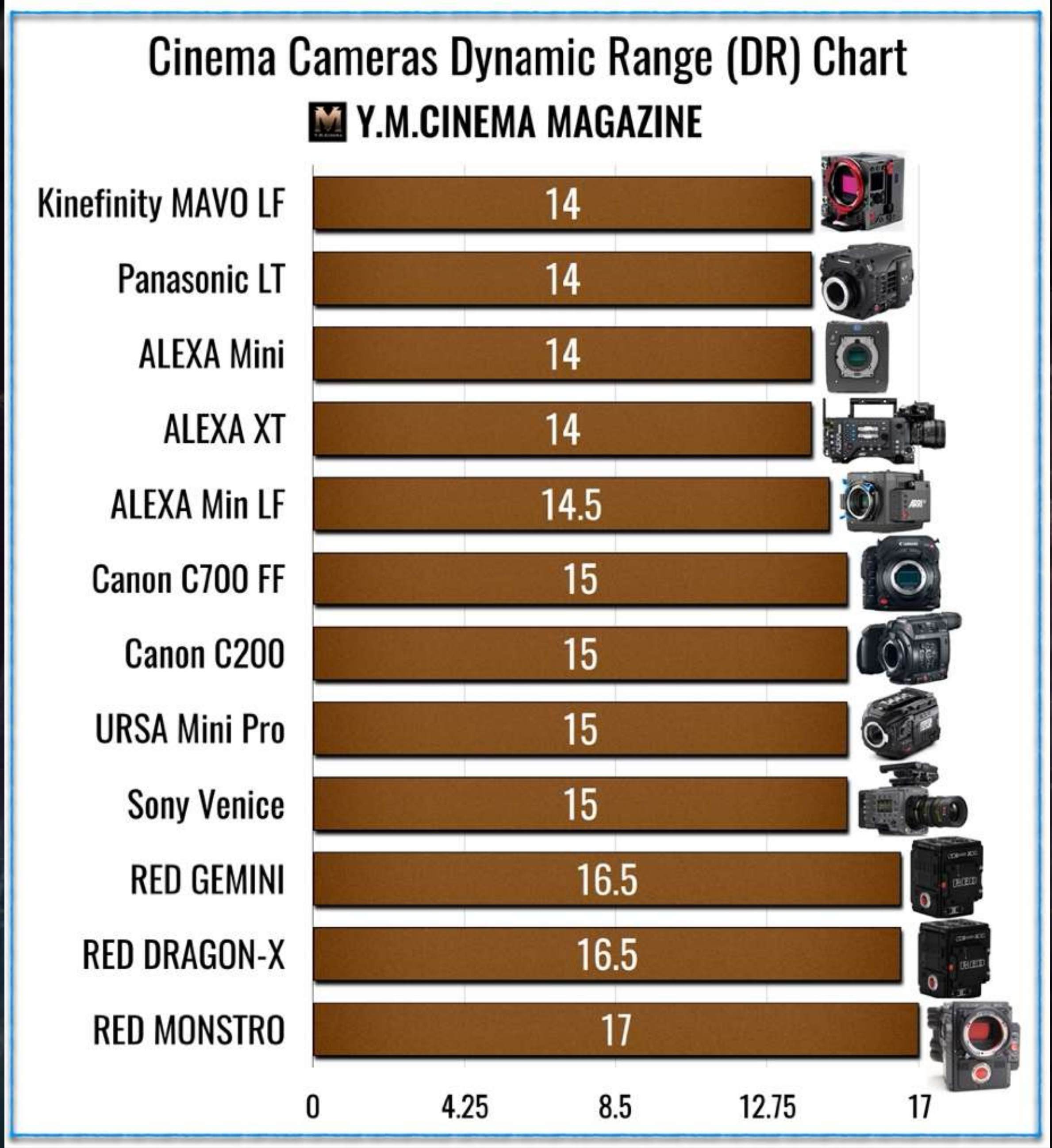
- -SINGLE EXPOSURE
- -WIDER COLOR GAMUT AND VOLUMEN
- -COLOR SPACES
- -TRANSFER FUNCTIONS
- -METADATA AND TONE MAPPING
- -GRADING AND MASTERING HDR

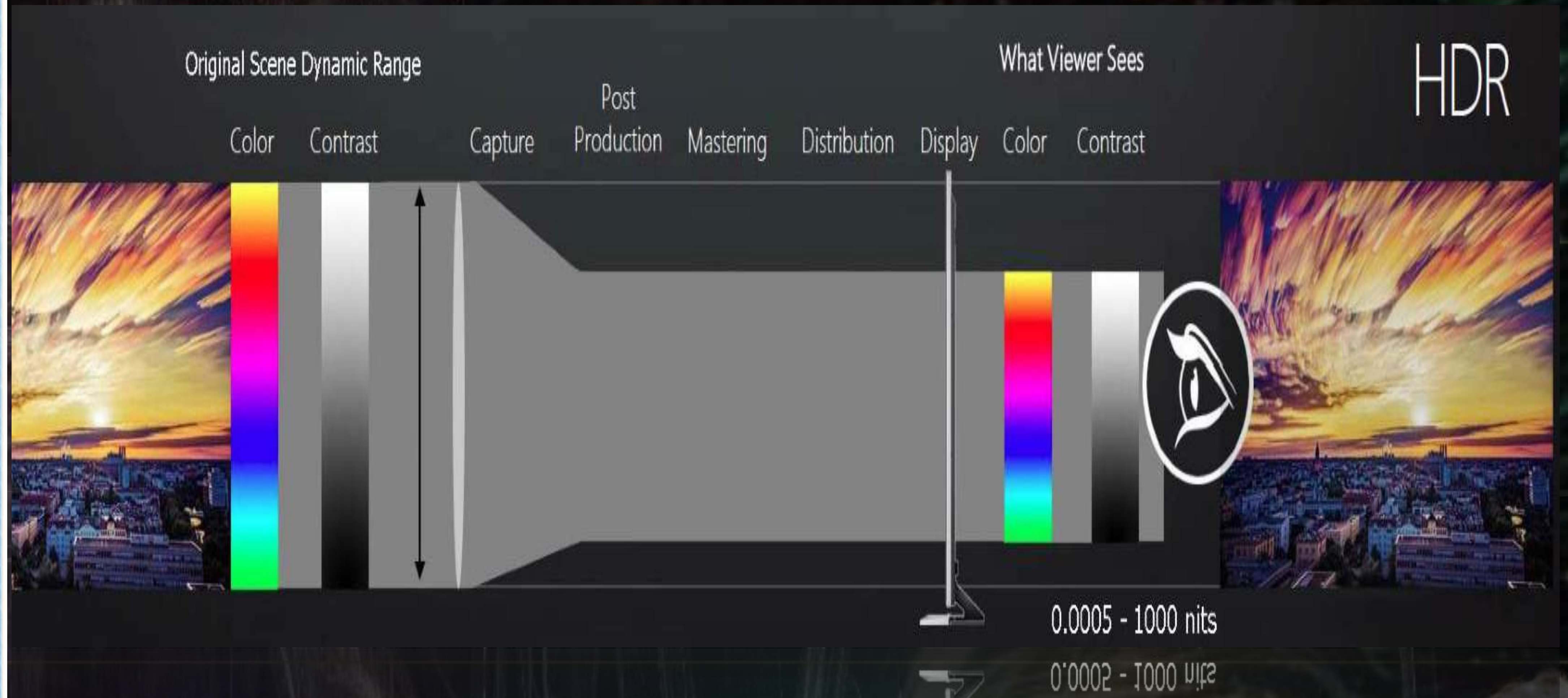
SINGLE EXPOSURE

-SINGLE EXPOSURE: HDR IS NOT BRACKETING, OR HDR PHOTOGRAPHY, WHICH TONE MAP AN HDR IMAGE INTO AN SDR CONTAINER WITHOUT INCREASING DYNAMIC RANGE.

-MOST DIGITAL CINEMA CAMERAS TODAY CAN CAPTURE AT LEAST 14 STOPS OF EXPOSURE RANGE, HDR ITS ABOUT PRESERVING THIS DYNAMIC RANGE FROM CAPTURE, TROUGH PRODUCTION, TILL DISTRIBUTION AND DISPLAY.



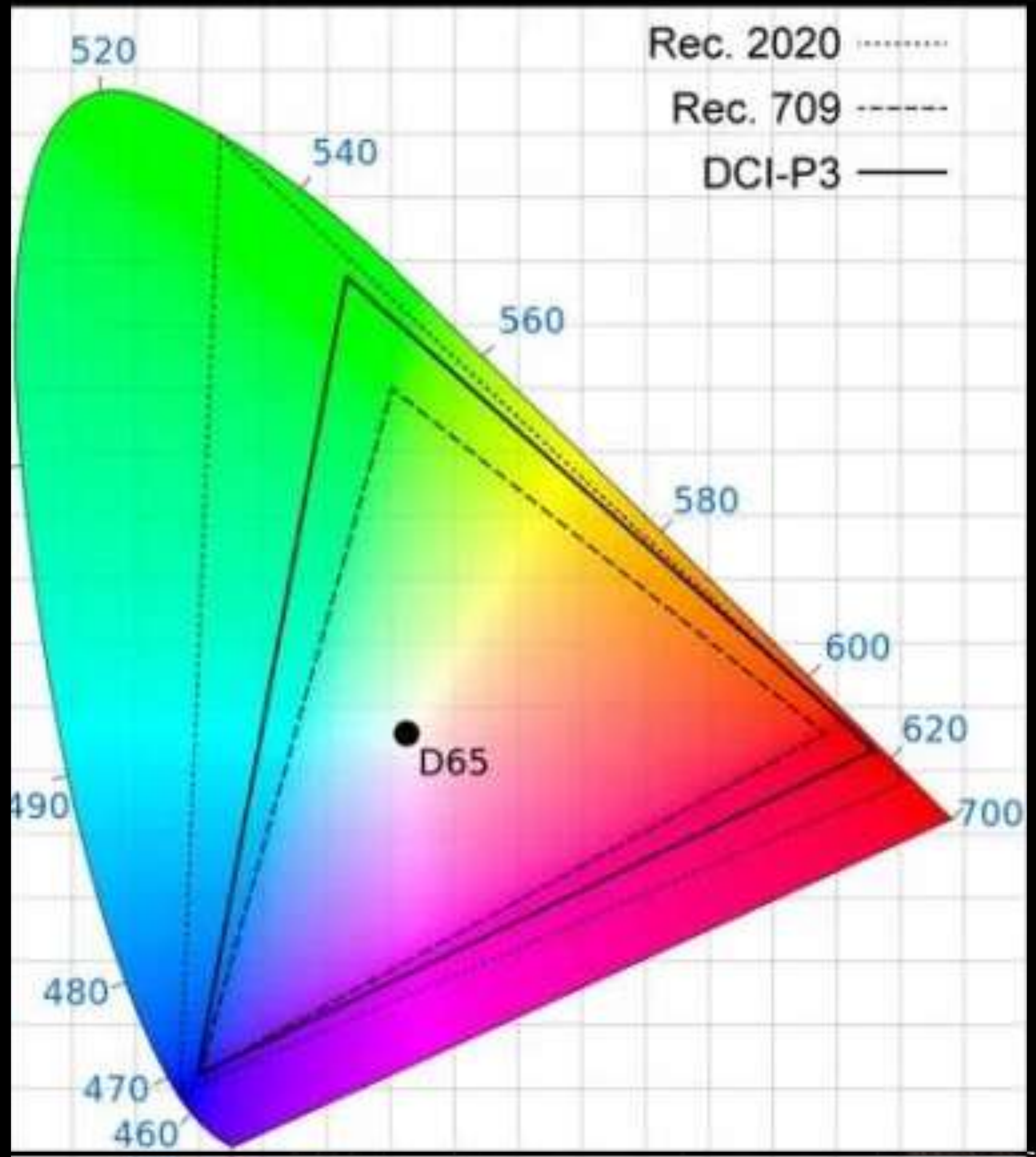


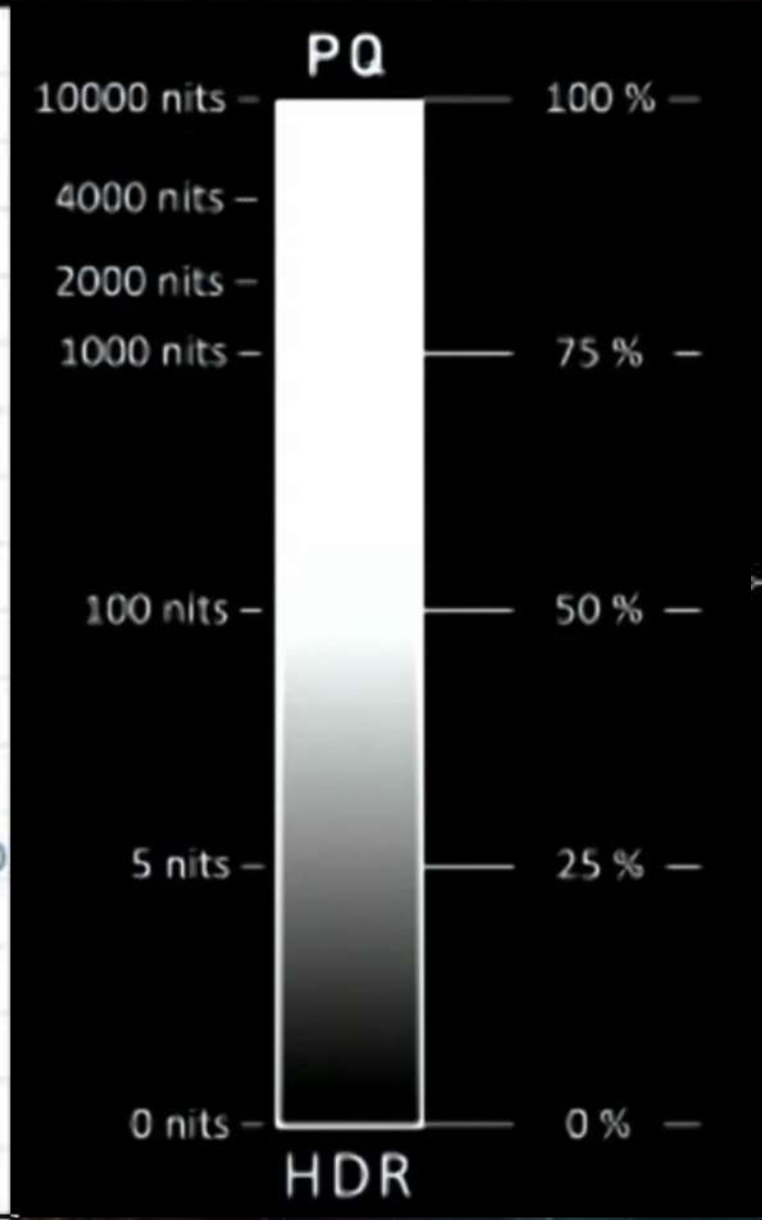


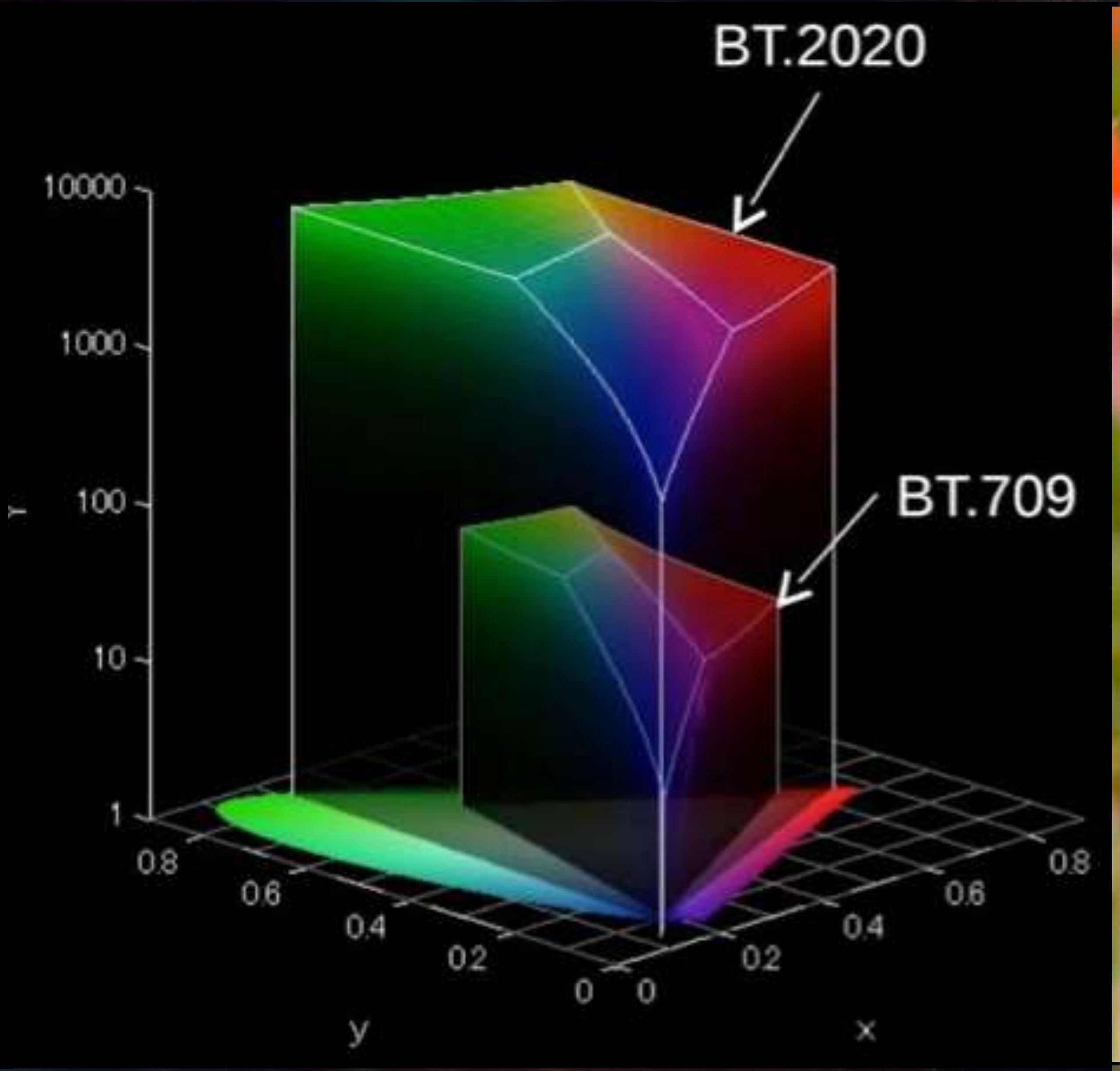
COLOR GAMUT AND COLOR VOLUME

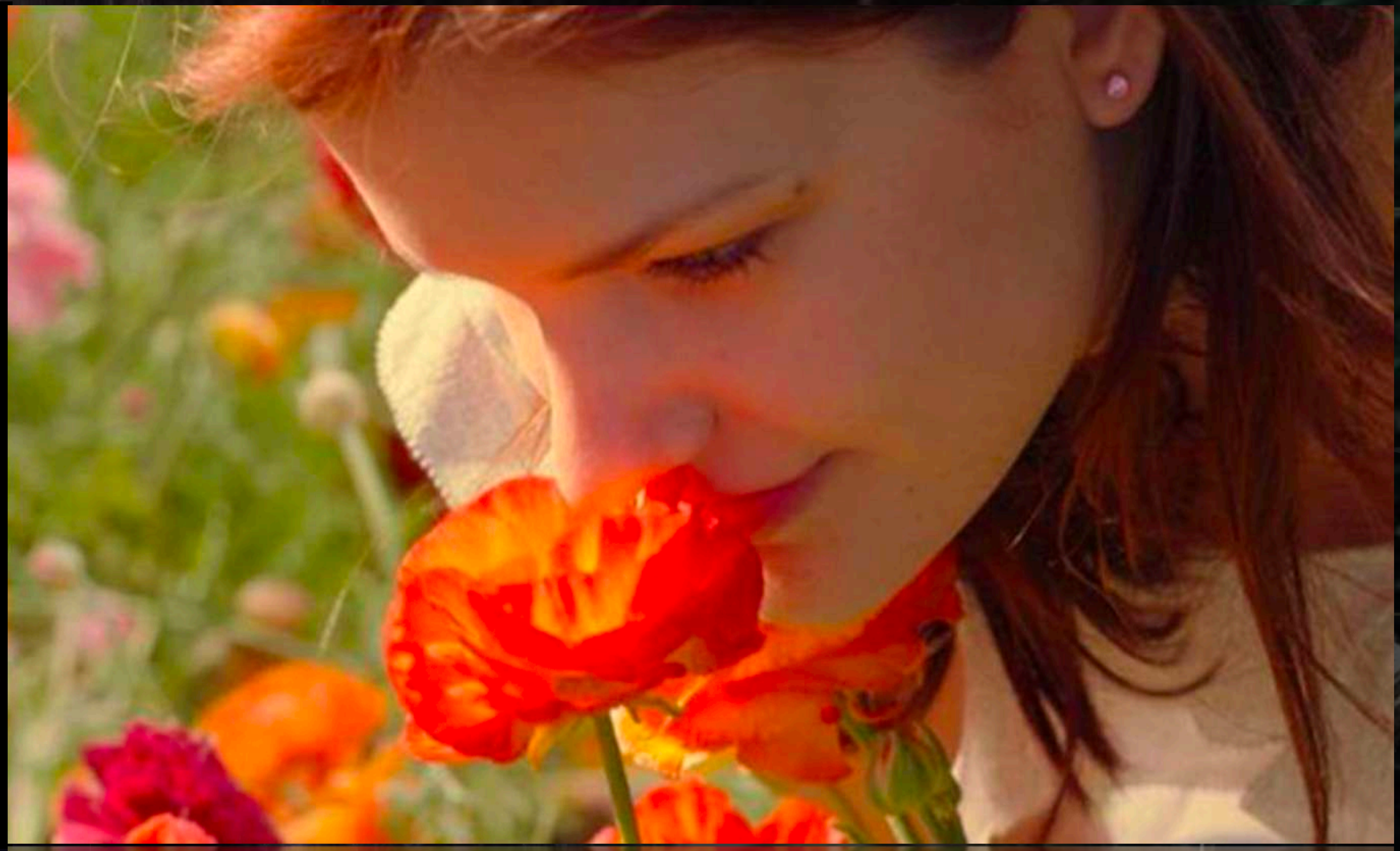
-HIGH DYNAMIC RANGE AND WIDER COLOR SPACES ARE BECOMING LINKED BY STANDARDS BODIES INTO WHAT IS OFTEN REFERRED TO AS COLOR VOLUME. THE HIGHER THE LUMINANCE RANGE AND THE WIDER THE COLOR SPACE, THE LARGER THE OVERALL COLOR VOLUME.

-WIDE COLOR GAMUT ENABLES MORE TRUE-TO-LIFE HUES AND SATURATION LEVELS, ESPECIALLY IN VERY BRIGHT AND VERY DARK IMAGE AREAS. IT ALLOWS YOU TO SEE MORE LIFELIKE COLOR REPRESENTATIONS OF VIVIDLY COLORED OBJECTS LIKE FLOWERS AND EGGPLANTS, SPORTS JERSEYS, OR STAINED GLASS.









COLOR SPACES

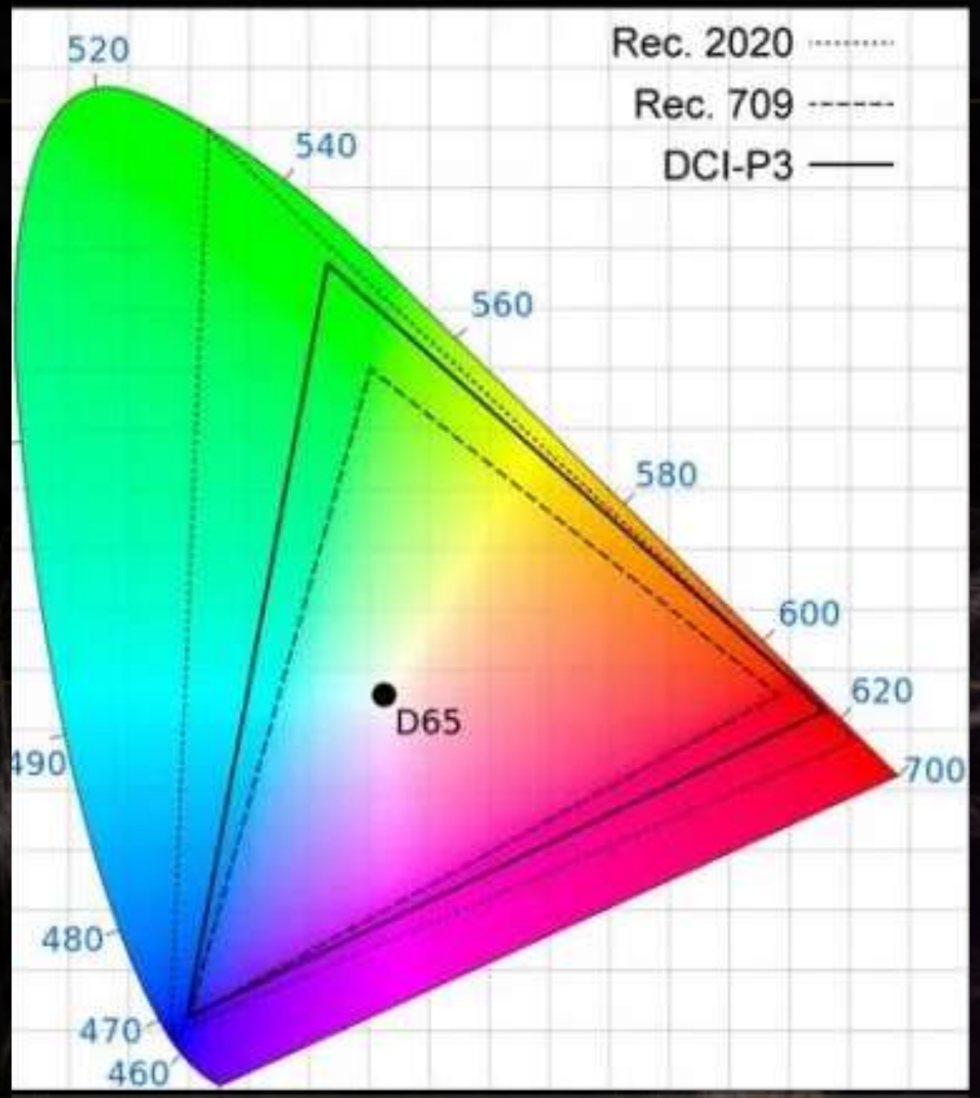
-THE BT.2020 COLOR SPACE IS A LARGE CONTAINER FOR COLOR GAMUT INFORMATION, BUT THE SIZE OF THE CONTAINER DOES NOT DEFINE THE COLOR GAMUT OF ANY PARTICULAR CONTENT. THE COLOR GAMUT VOLUME WITHIN THE BT.2020 CONTAINER, AS SPECIFIED BY HDR METADATA, CAN BE ANY GAMUT CONTENT THAT IS NO LARGER THAN THE BT.2020 COLOR SPACE CONTAINER (WRAPPER).

-D65 STAYS AS WHITEPOINT ON ALL STANDARDS

-PQ IS THE UNIVERSAL MASTERING CURVE.

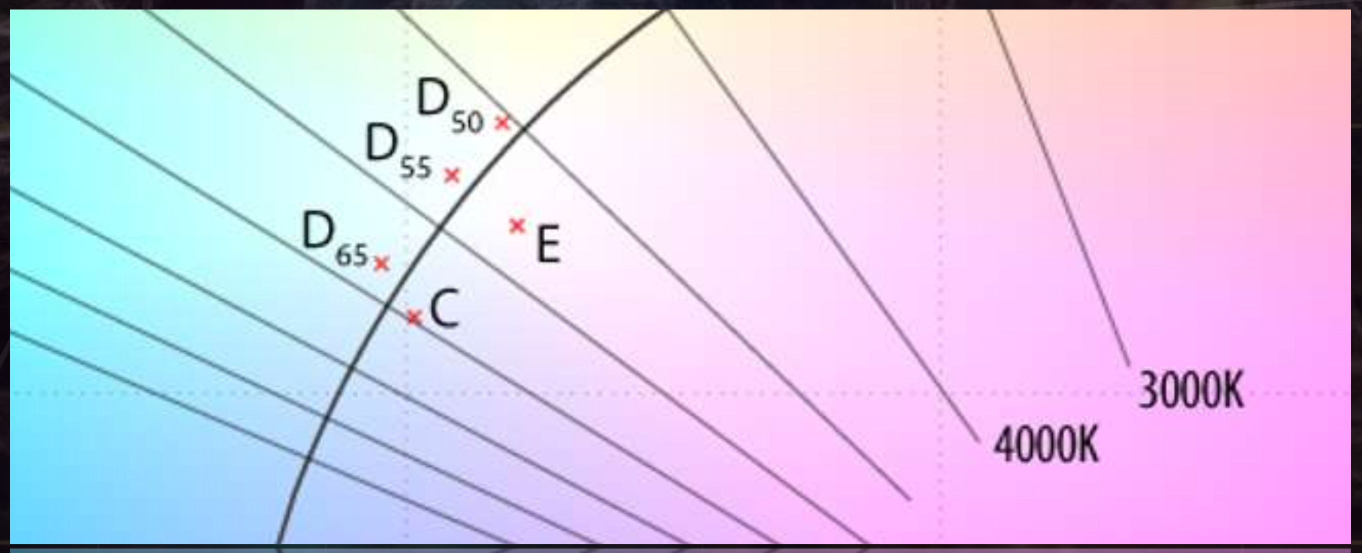
REC. 2020 (WRAPPER)

P3 (ENCLOSED GAMMUT)



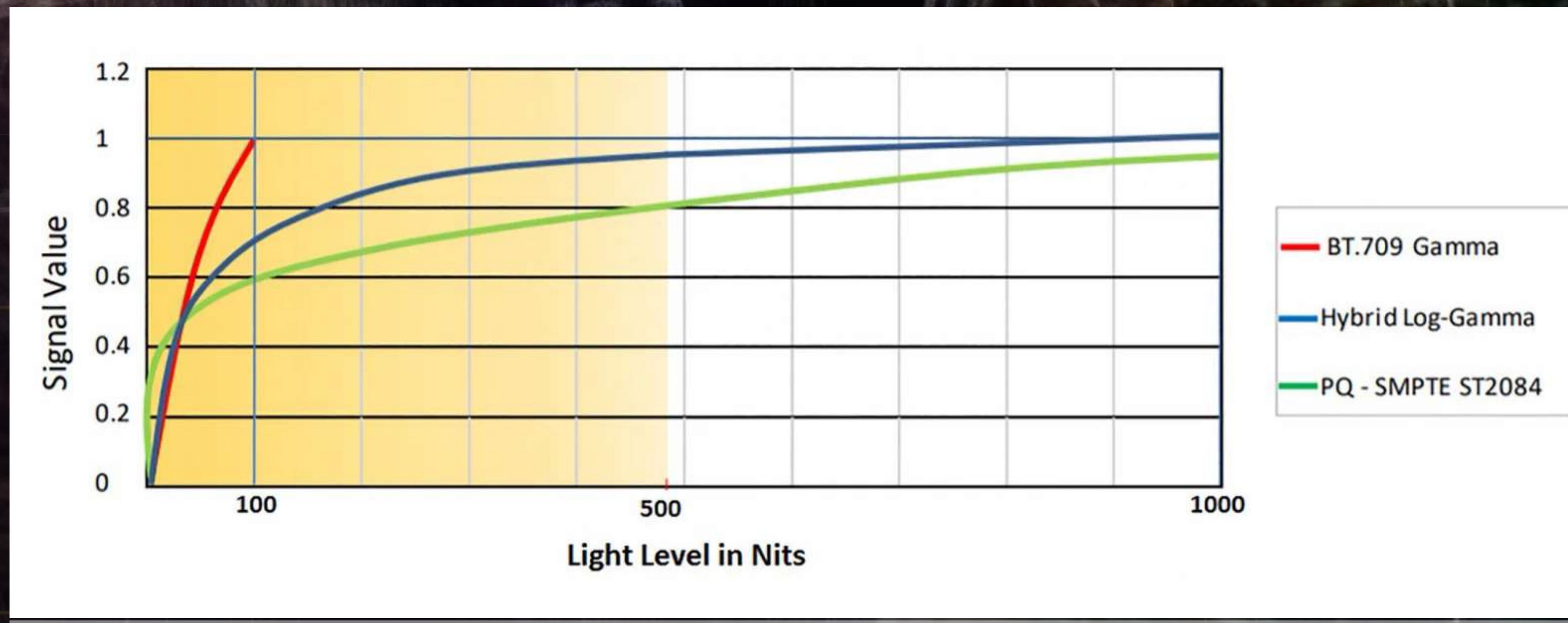
-PRIMARIES

CIE STANDART ILUMINANT D65:



-WHITEPOINT

HLG, PQ



-TRANSFER FUNCTION

TRANSFER FUNCTIONS IN HDR

- PQ (PERCEPTUAL QUANTIZER)

- HLG

THE SMPTE ST2084 EOTF CURVE IS A 10 OR 12-BIT QUANTIZATION OF ABSOLUTE BRIGHTNESS. IT IS AN ABSOLUTE LUMINANCE FUNCTION, REQUIRING THE EOTF OF THE PLAYBACK DISPLAY TO EXACTLY MATCH THE EOTF OF THE MASTERING REFERENCE DISPLAY. THE ST2084 EOTF WAS DESIGNED WITH HEADROOM FOR FUTURE EXPANSION AND COVERS A RANGE OF LUMINANCE FROM 0.00005 NITS UP TO 10,000 NITS. ST2084 MAPS EACH VIDEO SIGNAL CODE WORD TO THE SAME ABSOLUTE LUMINANCE AND CHROMATICITY IN EVERY DISPLAY (I.E. 10-BIT CODE WORD 691 ALWAYS MAPS TO 500 NITS).

THIS ALLOWS EACH PLAYBACK DISPLAY TO EXACTLY MATCH THE LUMINANCE AND CHROMATICITY OF THE MASTERING REFERENCE DISPLAY. THIS HDR EOTF, STANDARDIZED AS ST2084, IS BASED ON THE CONTRAST SENSITIVITY FUNCTION OF THE HUMAN EYE, AS MEASURED BY BARTEN AND REFERENCED IN ITU-R REPORT BT.2246-5.
IT IS CALLED A PERCEPTUAL QUANTIZER (PQ) CURVE.

Perceptual Quantizer (PQ) EOTF

$$Y = L\left(\frac{V^{1/m} - c_1}{c_2 - c_3 V^{1/m}}\right)^{1/n}$$

$0 \le V \le 1$
$L = 10{,}000$
$m = 78.8438$
$n = 0.1593$
$c_1 = 0.8359$
$c_2 = 18.8516$
$c_3 = 18.6875$

Barten Formula for Contrast Sensitivity Function

$$CSF = \frac{1}{m_t} = \frac{M_{opt}(u)/k}{\sqrt{\frac{2}{T}\left(\frac{1}{X_0^2}+\frac{1}{X_{max}^2}+\frac{u^2}{N_{max}^2}\right)\left(\frac{1}{\eta p E}+\frac{\Phi_0}{1-e^{-(u/u_0)^2}}\right)}}$$

$$M_{opt}(u) = e^{-2\pi^2\sigma^2 u^2}$$

$$\sigma = \sqrt{\sigma_0^2 + (C_{ab} d)^2}$$

$$d = 5 - 3\tanh\left(0.4\log\left(L X_0^2/40^2\right)\right)$$

$$E = \frac{\pi d^2}{4} L\left(1-(d/9.7)^2+(d/12.4)^4\right)$$

$k = 3.0$
$\sigma_0 = 0.5$ arcmin
$C_{ab} = 0.08$ arcmin/mm
$T = 0.1$ sec
$X_0 = 40°$
$X_{max} = 12°$
$N_{max} = 15$ cycles
$\eta = 0.03$
$\Phi_0 = 3 \times 10^{-8}$ sec deg^2
$u_0 = 7$ cycles/deg
$p = 1.25 \times 10^6$ photons/sec/deg^2/Td

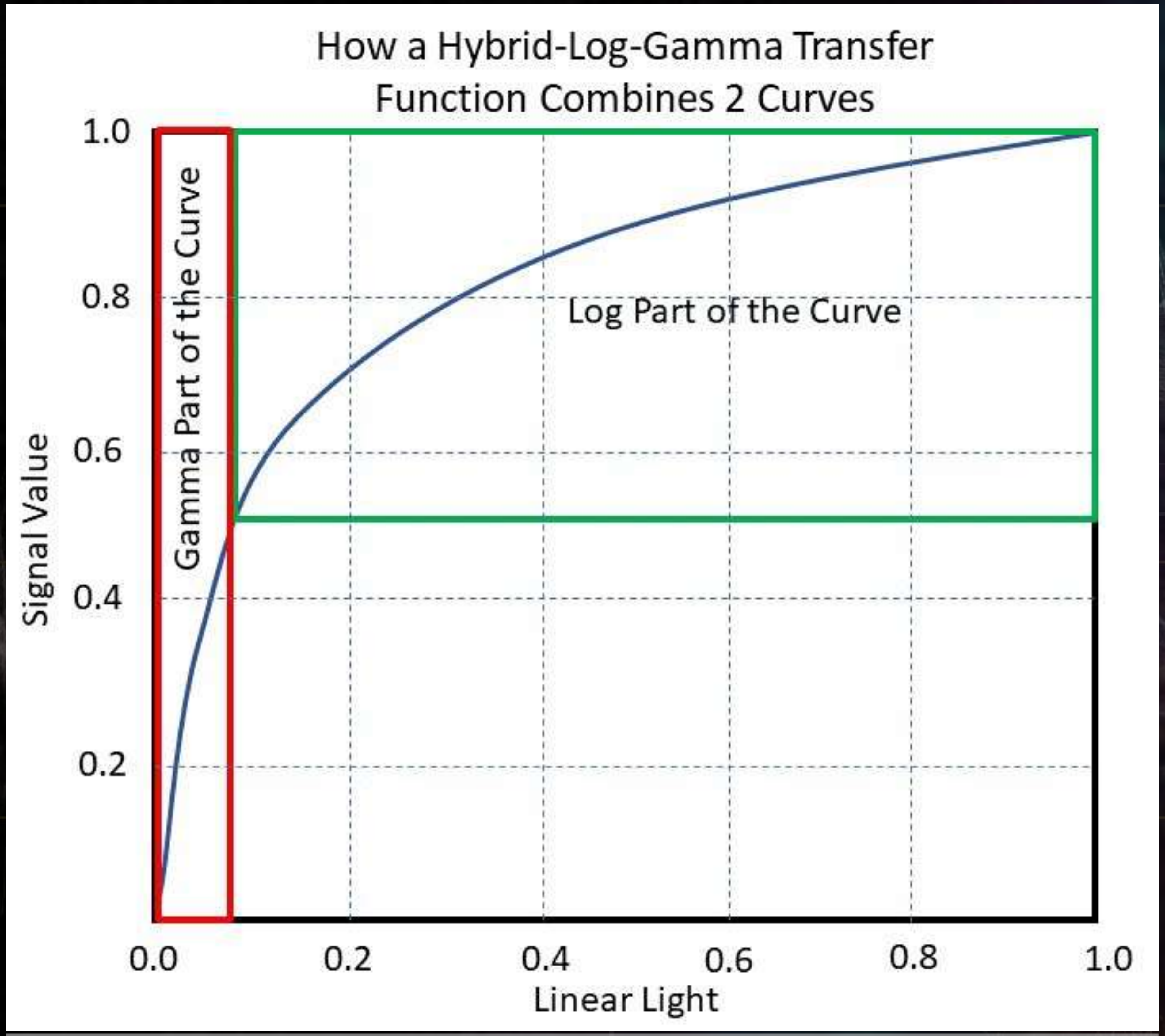
*Peter G. J. Barten, "Formula for the contrast sensitivity of the human eye"
Proc. SPIE-IS&T Vol. 5294:231-238, Jan 2004

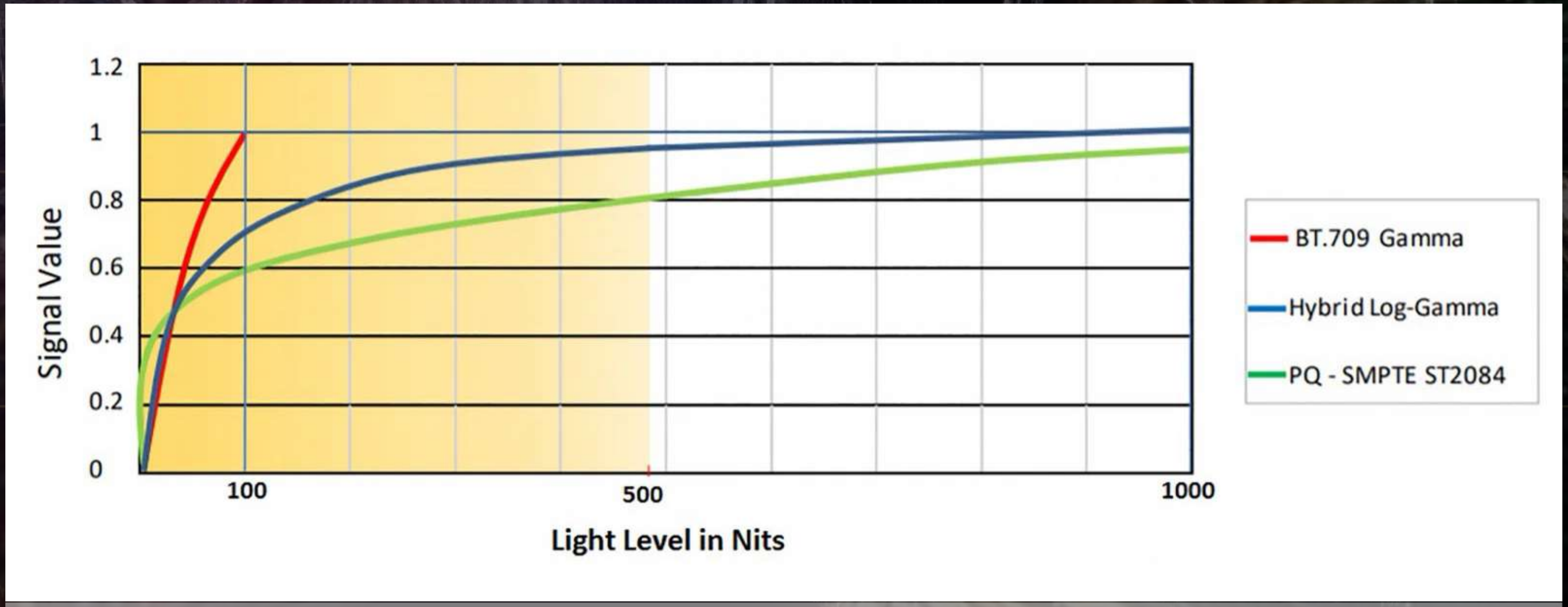
TRANSFER FUNCTIONS IN HDR

-PQ (PERCEPTUAL QUANTIZER)

-HLG

CONSIST IN A GAMMA CURVE FOR THE FIRST SECTION OF THE FUNCTION, AND A LOGARITHMIC CURVE FOR THE SECOND PART. IT IS RETRO-COMPATIBLE WITH SDR SYSTEMS. THIS EOTF IS USED IN THE HLG10 VIDEO FORMAT AND CAN BE TRANSLATED FROM THE PQ ONE. DON'T USE METADATA.





METADATA AND TONE MAPPING

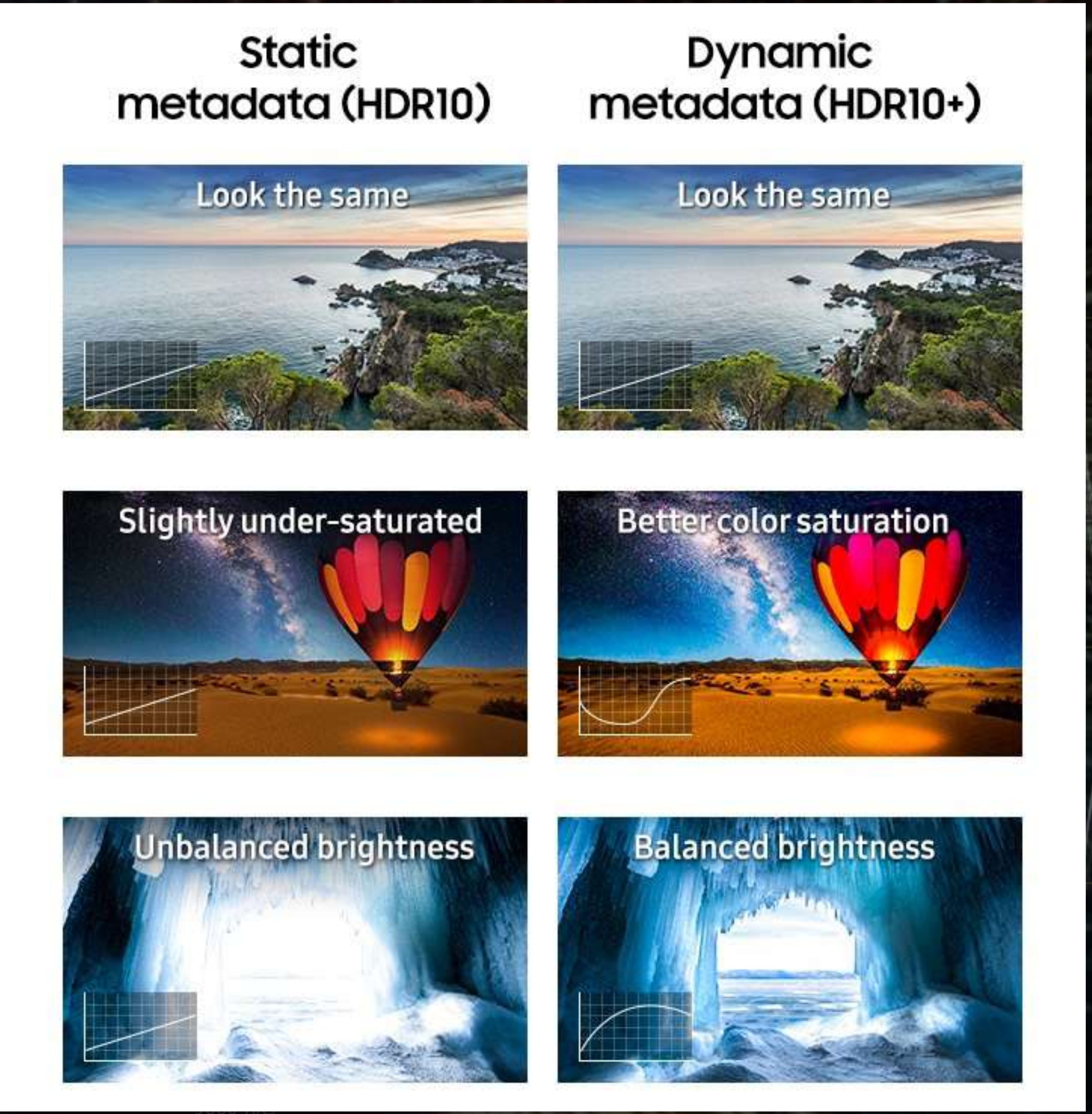
-THE PURPOSE OF HDR METADATA IS TO AID THE DISPLAY DEVICE TO SHOW THE CONTENT IN AN OPTIMAL MANNER.USING THE INFORMATION RELATED TO THE MASTERING DEVICE PROPERTIES, THE TARGET DEVICE CAN MAP THE CONTENT ACORDING TO ITS COLOR GAMUT AND PEAK BRIGHTNESS. TE IDEA IS TO HAVE THE SAME RENDER INTENT.

-WITHOUT THE METADATA, EACH TV WOULD STRETCH THE VALUES OF THE IMAGE ARBITRARILY, RESULTING IN A VERY DIFFERENT APPEARANCE OF BLACKS, WHITES, MIDTOWNS, COLORS, CONTRAST…WITHOUT MAINTAINING ANY LOGIC.

-THERE ARE TWO TYPES OF METADATA: STATIC UND DYNAMIC.

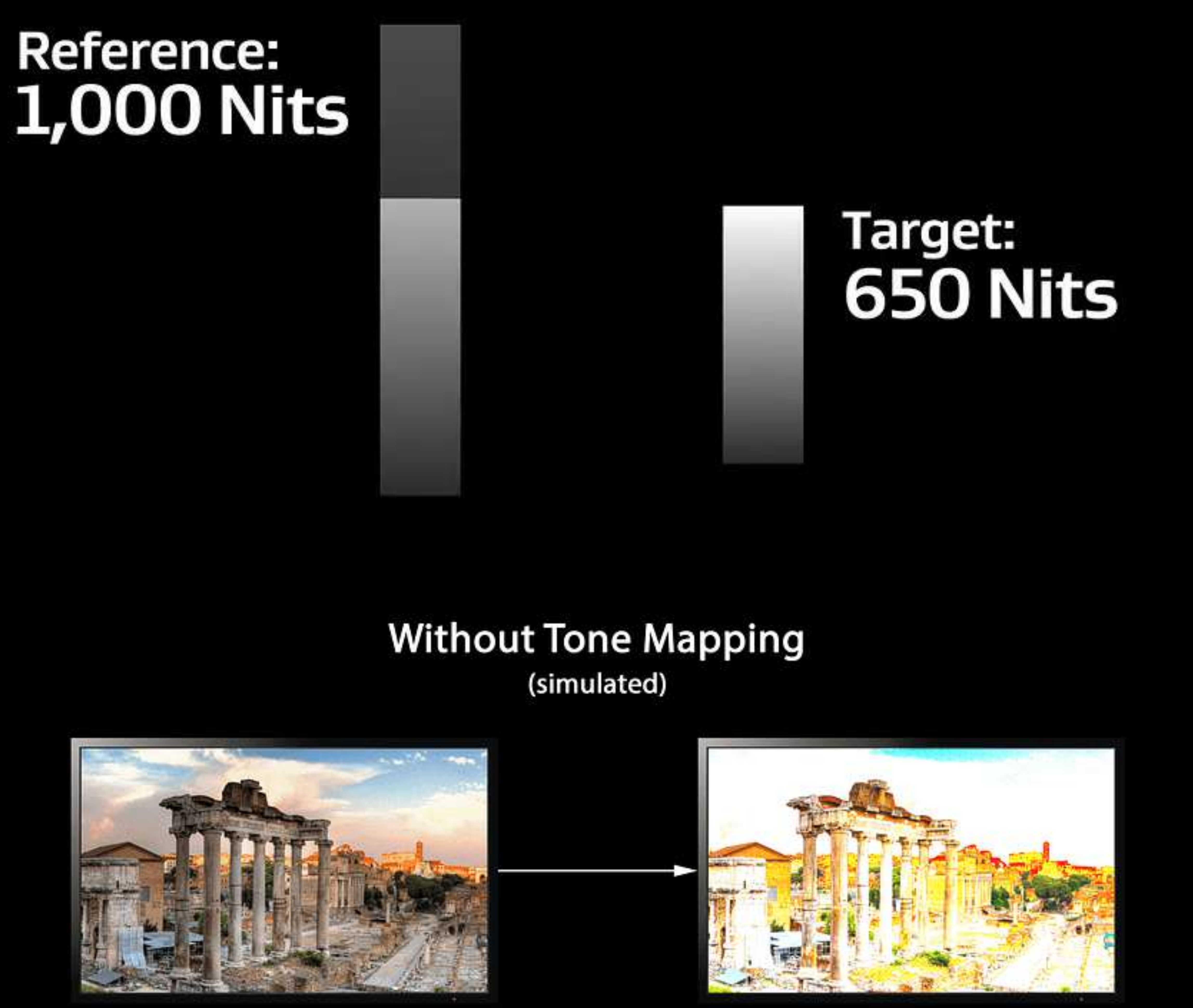
THE STATIC METADATA DESCRIBES A SETTING THAT MUST BE APPLIED TO THE WHOLE PROGRAMM OR MOVIE. IT WILL AVERAGE VALUES FROM DARK AND BRIGHT SCENES. OF COURSE THE AVERAGE WILL REQUIRE SACRIFICING CERTAIN PARTICULAR MOMENTS FOR THE GREATER GOOD OF THE WHOLE VIDEO.

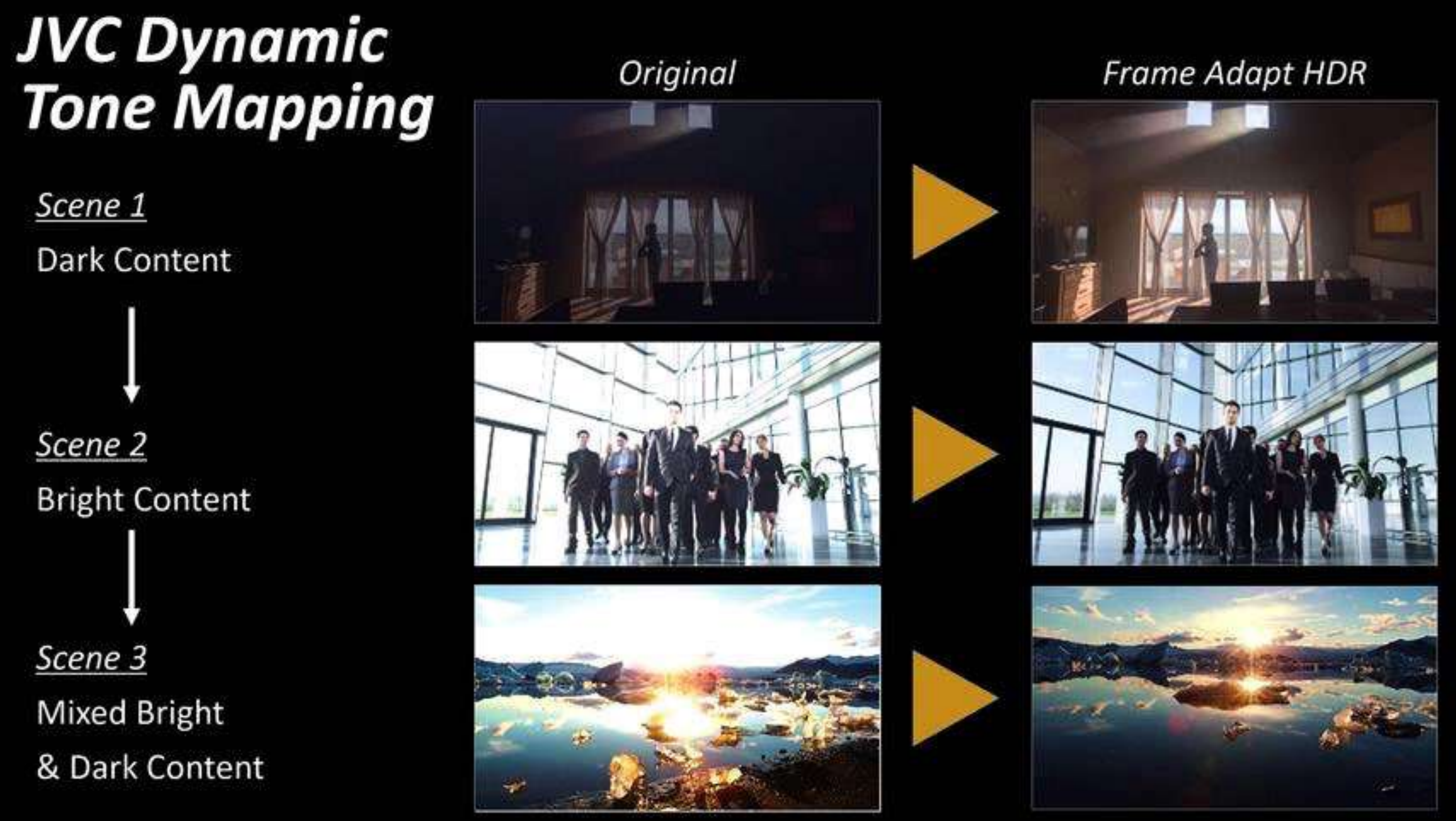
THE DYNAMIC METADATA ALLOWS A DIFFERENT SETTINGS FOR INTERVALS OF THE PROGRAMM, EVEN DOWN TO A FRAME-BY-FRAME DIFFERENT SET OF METADATA.



METADATA AND TONE MAPPING

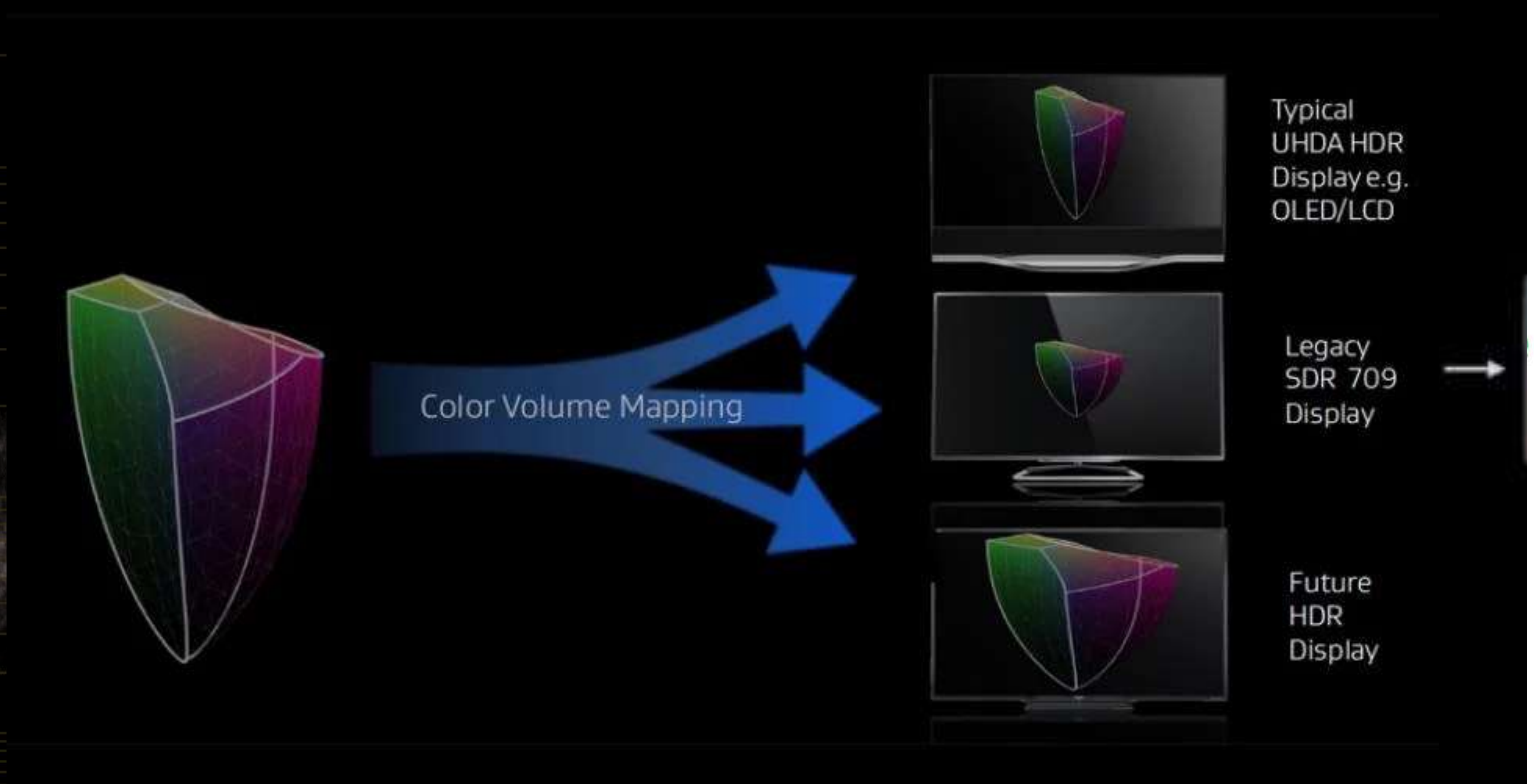
-TONE MAPPING IS THE PROCESS OF ADAPTING DIGITAL SIGNALS TO APPROPRIATE LIGHT LEVELS BASED ON HDR METADATA. THIS PROCESS IS NOT SIMPLY APPLYING THE EOTF ON THE IMAGE DATA, BUT IT IS RATHER TRYING TO MAP THE IMAGE DATA WITH THE DISPLAY DEVICE CAPABILITIES USING METADATA INFORMATION. TONE MAPPING WILL COMPRESS THE DISTRIBUTION OF LUMINANCE VALUES BY DISCARDING DISCRETELY CERTAIN VALUES AND POSITIONING THE REST ACCORDINGLY IN A WAY THAT PRESERVES THE SAME ARTISTIC INTENT WITHIN A LOWER DYNAMIC RANGE FRAMEWORK.

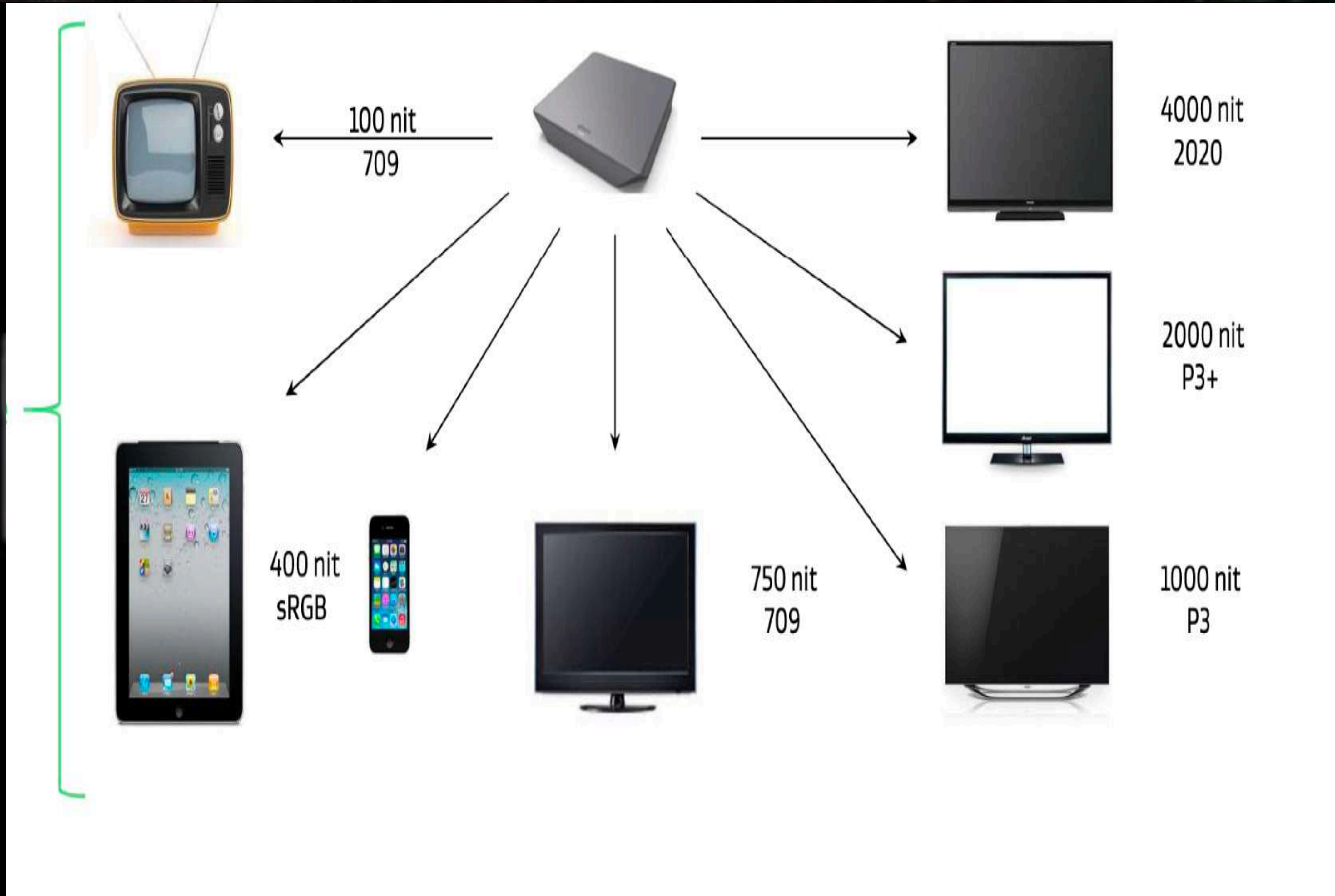




MASTERING AND GRADING

THE MAIN DIFFERENCE BETWEEN MASTERING SDR UND HDR ITS RELATED TO THE PEAK BRIGHTNESS AND DISPLAY COLOR VOLUMEN. MASTERING MONITORS FOR SDR HAVE THE SAME PEAK (100 NITS) AND SIMILAR COLOR VOLUMEN TO THE TARGET DISPLAYS (TV). IN THE OTHER HAND, MASTERING HDR IMPLIES ALWAYS A DIFFERENCE IN GAMUT, PEAK BRIGHTNESS AND COLOR VOLUMEN BETWEEN MASTERING MONITOR AND TARGET DISPLAYS DEVICES (DIFFERENT TV AS WELL AS TABLETS AND MOBILES).





MASTERING AND GRADING

-THE GENERAL IDEA IS THAT THE THE AVERAGE PICTURE LEVEL BETWEEN SDR UND HDR REMAIN ALMOST IDENTICAL, WITH THE SHADOWS AND MIDTONES BEING MOSTLY THE SAME BETWEEN TRADITIONALLY SDR AND HDR-GRADED IMAGES. THE DIFFERENCE IS THAT HDR PROVIDES ABUNDANT ADDITIONAL HEADROOM FOR VERY BRIGHT HIGHLIGHTS AND COLOR SATURATION THAT FAR EXCEED WHAT HAS BEEN PREVIOUSLY VISIBLE IN SDR TELEVISION AND CINEMA.

Figure 7.5 Standard dynamic range (SDR) vs high dynamic range (HDR) "Brightness Zones"

A KEY DIFFERENCE BETWEEN GRADING HDR UND SDR REFERS TO DYNAMIC RANGE. WHEN GRADING SDR, COLORIST STRUGGLE SQUEEZING HUGE CAMERA DYNAMIC RANGE ON A TINY SDR CONTAINER. THEY TEND TO USE ALL THE AVAILABLE RANGE, MAXIMISING THE CONTRAST OF THE SIGNAL TO FILL DIE 100 NITS CAPACITY.

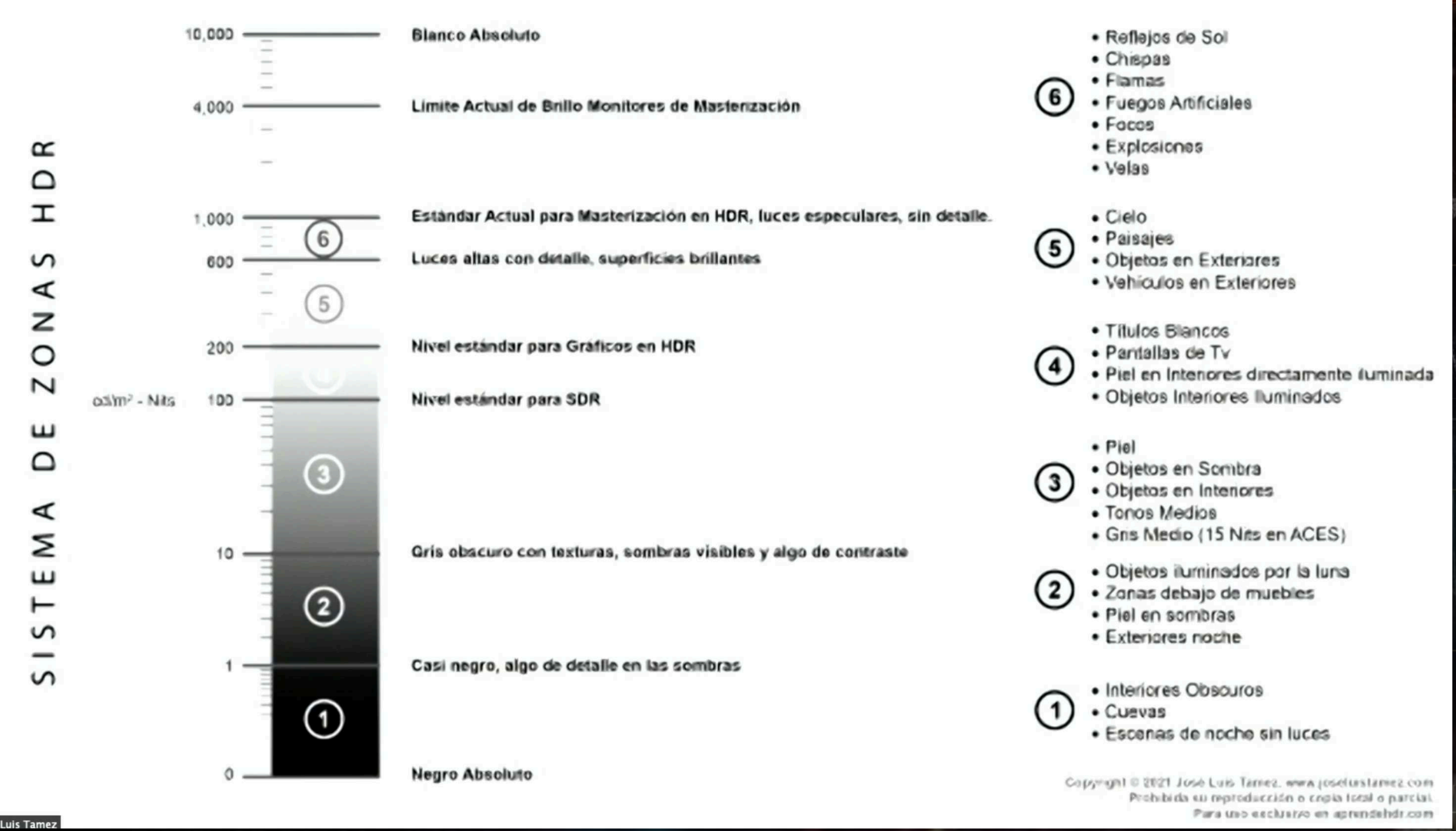
GRADING HDR IN THE OTHER HAND, OFFERS MUCH MORE HEADROOM ABOVE THE 100 NITS. THIS WAS THE MAIN DISCUSSION AS HDR CAME OUT. WHAT SHOULD WE DO WITH THIS HUGE AMOUNT OF DYNAMIC RANGE?, SHOULD WE COMPRESS THE SIGNAL UP LIKE WITH SDR?, WHERE SHOULD BE GRAPHICS, SKIN TONES AND SPECULAR HIGHLIGHTS LOCATED?, OR HOW WE APPROACH TO COMBINE SDR EXISTING FOOTAGE WITH HIGH DYNAMIC RANGE CONTENT?

Figure 7.4 Stretched luminance zones does not convert standard dynamic range (SDR) into high dynamic range (HDR)

GRADING AND MASTERING

GRADING HDR IN THE OTHER HAND, OFFERS MUCH MORE HEADROOM ABOVE THE 100 NITS. THIS WAS THE MAIN DISCUSSION AS HDR CAME OUT. WHAT SHOULD I DO WITH THIS HUGE AMOUNT OF DYNAMIC RANGE?, SHOULD WE COMPRESS THE SIGNAL UP LIKE WITH SDR?, WHERE SHOULD BE GRAPHICS, SKIN TONES AND SPECULAR HIGHLIGHTS LOCATED?

TO ILLUSTRATE THIS, WE ARE GOING TO USE AN HDR SYSTEM ZONES DEVELOP FROM JOSE LUIS TAMES (DOLBY LABORATORIES).



Luis Tamez

HDR STANDARTS:

-STANDARDS HAVE BEEN AND CONTINUE TO BE FORMULATED FOR EVERY ASPECT OF HDR CONTENT CREATION, TRANSPORT, DELIVERY, AND DISPLAY. THE INTERNATIONAL TELECOMMUNICATIONS UNION (ITU), SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS (SMPTE), CONSUMER ELECTRONICS ASSOCIATION (CEA), MOTION PICTURE EXPERTS GROUP (MPEG), AND THE BLU-RAY DISC ASSOCIATION (BDA) HAVE ALL DEVELOPED STANDARDS RELATING TO SOME ASPECT OF UHDTV AND HDR.

ITU-R RECOMMENDATION BT.2020 (REC2020):
DEFINES VARIOUS ASPECTS OF HDTV WITH SDR AND WIDE COLOR GAMUT (RESOLUTIONS, FRAME SRATES, BIT DEPHS,PRIMARIES, OETF ETC). REC 2020 DEFINES A COLOR SPACE WE USE AS A CONTAINER FOR HDR, WHAT WE CALL COLOR SPACE WRAPPER

SMPTE ST2084:

STANDARDIZES AN ELECTRO-OPTICAL TRANSFER FUNCTION (EOTF) FOR HDR THAT WAS DEVELOPED BY DOLBY LABS TO DEFINE THE PROCESS BY WHICH DIGITAL CODE WORDS ARE CONVERTED INTO VISIBLE LIGHT. THE PQ IS A NON LINEAR EOTF THAT ALLOWS FOR DISPLAY OF HDR VIDEO TO 10.000 NITS, AND CAN BE USE WITH THE REC 2020 COLOR SPACE

ITU-R RECOMMENDATION BT.2100:
INTRODUCE HDTV BY RECOMMENDING THE USE OF PQ OR HLG TRANSFER FUNCTIONS. HLG WAS DESIGNED FOR LIVE TV AT IT DOES NOT REQUIRE METADATA.

SMPTE – SMPTE STANDARD ST2086:
DEFINES STATIC METADATA; METADATA THAT DOES NOT CHANGE DURING PLAYBACK OF THE ASSOCIATED VIDEO CONTENT.

SMPTE – SMPTE STANDARD ST2094:
IT DEFINES CONTENT DEPEND METADATA FOR COLOR VOLUMEN TRANSFORMATION OF HIGH LUMINANCE AND WIDE COLOR GAMUT IMAGES. IT INCLUDES DYNAMIC METADATA THAT CAN CHANGE FROM SCENE TO SCENE. THIS INCLUDES THE DOLBY VISION FORMAT (FURTHER SPECIFIED ON THE STANDARD ST.2094-10), AND SAMSUNGS HDR10+ (DEFINED IN THE ST.2094-40)

HDR VIDEO FORMATS:

- HDR 10 MEDIA PROFILE (HDR10)
- HLG(10)
- DOLBY VISION
- HDR 10+ (HDR10 PLUS)

HDR Formats Comparison Chart

HDR Types	Image	Peak Brightness Maximum	Color Depth	Metadata	Licensing	Applications
HLG	HLG	1,000 nits	10 bits	None	Royalty-Free	Satellite TV and broadcast
HDR 10	HDR 10	1,000 nits	10 bits	Static Metadata	Royalty-Free	Almost all HDR-enabled TVs support HDR10
HDR 10+	HDR10+	4,000 nits	10 bits	Dynamic Metadata	Royalty-Free	Various TV brands support HDR,such as Samsung, SONY and Panasonic
Dolby Vision	DOLBY VISION	10,000 nits	12 bits	Dynamic Metadata	Proprietary and License	Fewer TV brands support it,such as LG and SONY but its support is slightly growing

HDR DELIVERY SYSTEMS:

A NUMBER OF SYSTEMS HAVE BEEN PROPOSED FOR DELIVERING HDR CONTENT TO CONSUMER DISPLAYS. THESE HDR SYSTEMS, WHICH COMBINE EXISTING AND PROPOSED STANDARDS, ARE OUTLINED HERE AND DISCUSSED INDIVIDUALLY IN THE FOLLOWING SECTIONS.

SYSTEM 1: HDR10; USES ST2084 EOTF, A SINGLE CONTENT LAYER WITH STATIC METADATA; NOT COMPATIBLE WITH SDR TVS; SPECIFIED BY CTA FOR HDR- COMPATIBLE TVS AND MANDATED FOR ULTRA HD BLU-RAY.

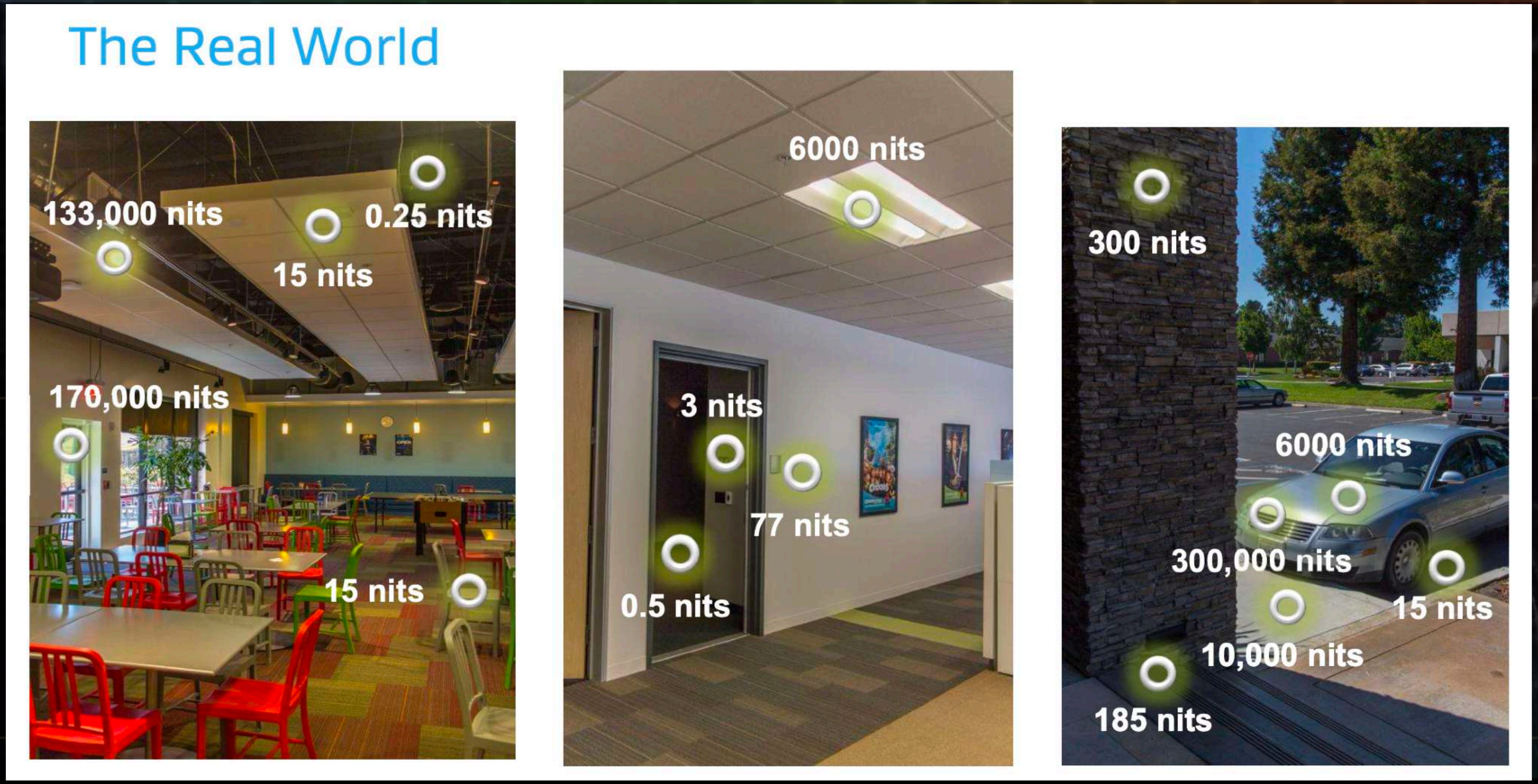
SYSTEM 2: DOLBY VISION; USES ST2084 EOTF, A BASE CONTENT LAYER WITH STATIC METADATA, AND AN ENHANCED CONTENT LAYER WITH DYNAMIC METADATA; OPTIONALLY COMPATIBLE WITH HDR10 TVS AND SDR TVS; OPTIONAL FOR ULTRA HD BLU-RAY.

SYSTEM 3: BBC/NHK; USES A HYBRID LOG-GAMMA (HLG) EOTF WITH NO METADATA; PLAYBACK ON HLG-COMPATIBLE HDR TVS OR SDR TVS.

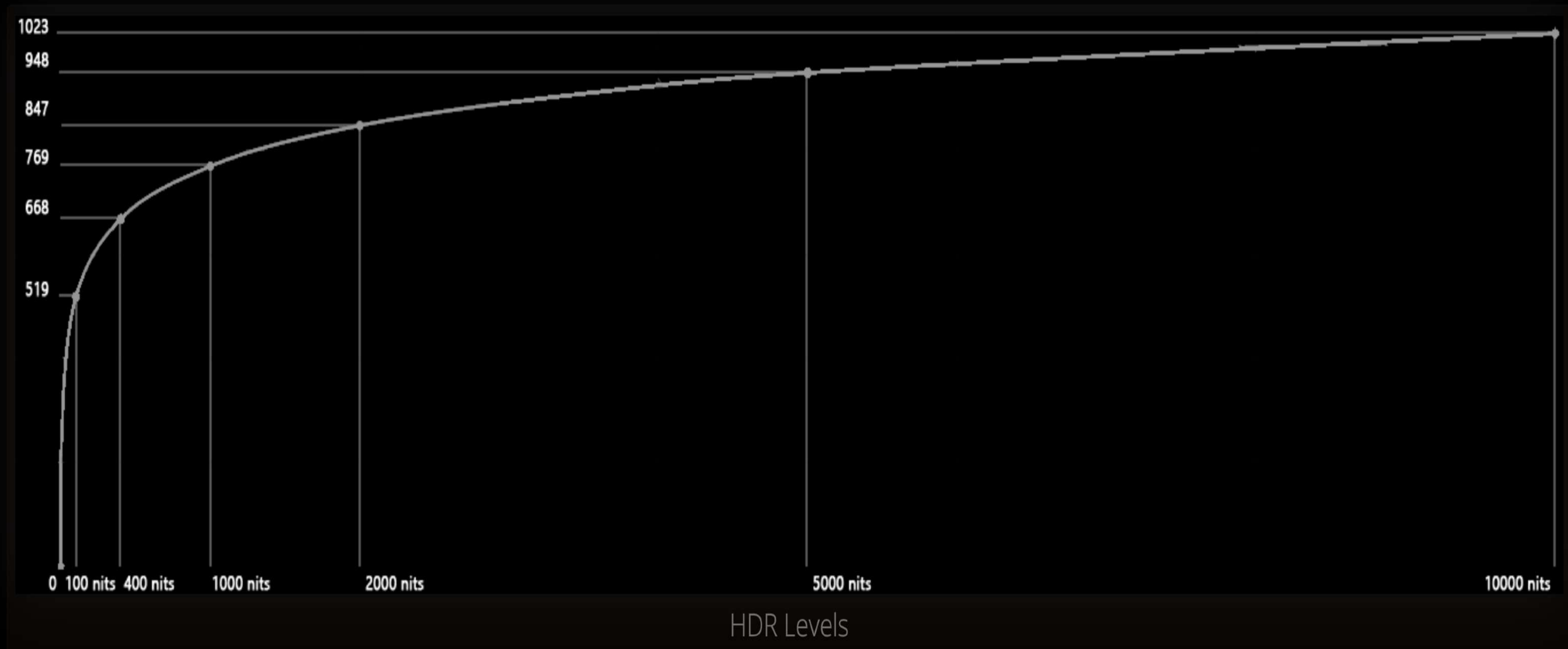
SYSTEM 4: TECHNICOLOR/PHILIPS; USES ST2084 EOTF, A SINGLE CONTENT LAYER WITH METADATA; OPTIONAL FOR ULTRA HD BLU-RAY; COMPATIBLE WITH SDR TVS THROUGH AN EXTERNAL DECODER DEVICE (E.G. STB OR BD PLAYER).

CONCLUSION ABOUT HIGH DYNAMIC RANGE TECHNOLOGY (HDR):

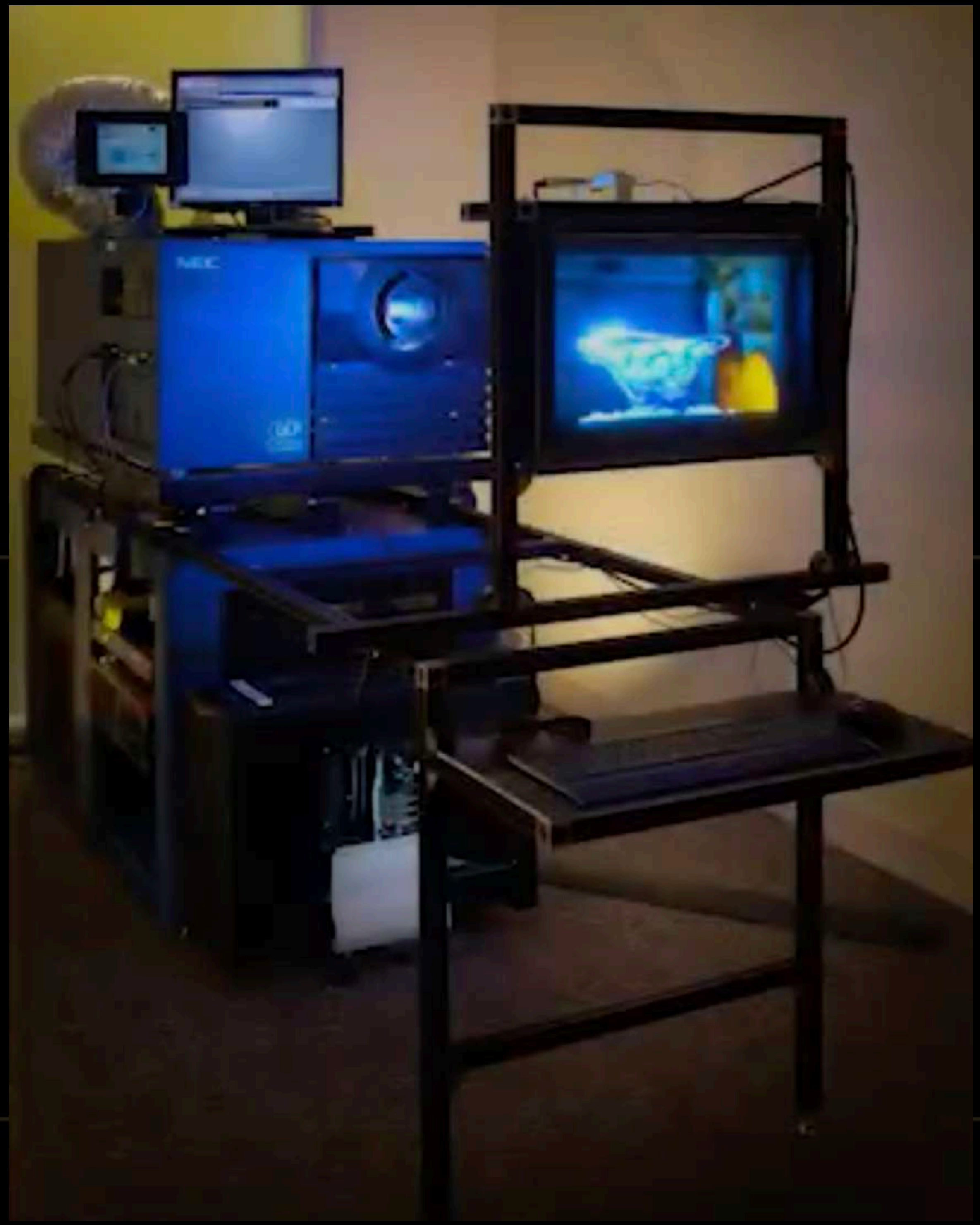
-WE ARE DEVELOPING TECHNOLOGY BASED ON OUR PREVIOUS EXPERIENCE WITH SDR. AT THIS MOMENT, NO DISPLAY IS CAPABLE OF REPRODUCING EITHER THE COMPLETE GAMUT OF REC2020, NEITHER THE LUMINANCE RANGE OF 10.000 NITS COVER BY THE EOTF PQ. HOWEVER, DEFINING HDR TECHNOLOGY BASED ON THE POTENTIALITY OF THIS TECHNOLOGY ENSURES FUTURE COMPATIBILITY.



HUMAN VISUAL DYNAMIC RANGE			BT.2020 Range	
Brightness	20,000+ NITS	→	Brightness	10,000 NITS
Darkness	0.001 NITS		Darkness	0.007 NITS
Stops	24+ Stops		Stops	19 Stops



PART IV



DOLBY VISION

Perceptual Quantizer (PQ) EOTF

$$Y = L\left(\frac{V^{1/m} - c_1}{c_2 - c_3 V^{1/m}}\right)^{1/n}$$

$0 \leq V \leq 1$
$L = 10{,}000$
$m = 78.8438$
$n = 0.1593$
$c_1 = 0.8359$
$c_2 = 18.8516$
$c_3 = 18.6875$

-DOLBY BUILT A PROTOTYPE HDR P3 DISPLAY WHICH COULD CREATE VERY DEEP BLACK LEVELS - 0.004 NITS UP TO 20.000 PEAK NITS WHILE MAINTAINING A CONTRAST OF 5 MILLION : 1

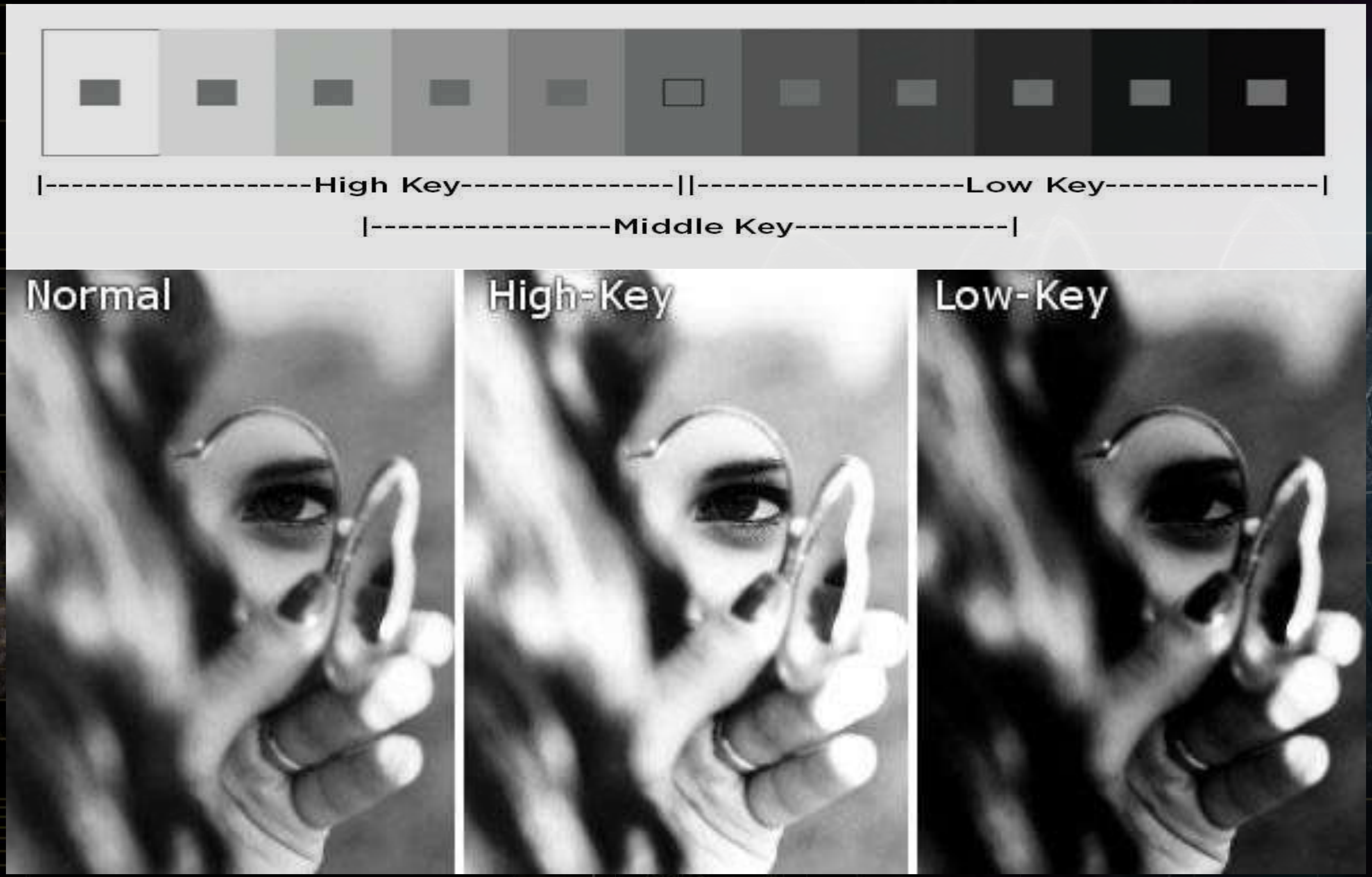
3 PREFERENCES STUDIES WERE CONDUCTED TO DETERMINE THE USER PREFERENCES FOR:

-THE BLACK LEVEL
-THE DIFFUSE WHITE MAXIMUM
-FOR THE HIGHLIGHTS

THE RESULTS OF THIS STUDIES INDICATE AS PREFERRED BLACK LEVEL 0.01 NITS, AND AS PREFERRED MAXIMUM WHITE LEVEL 10.000 NITS. AS RESULT, THE PQ CURVE (PERCEPTUAL QUANTIZER) IS BORN, THIS EOTF REPLACE THE OLD GAMMA EOTF VON SDR, AND IS TODAY THE MAIN CURVE USED IN HDR, COVERING A RANGE FROM 0.0001 0.0001 NITS UP TO 10.000 NITS. IT USES A NON-LINEAR DISTRIBUTION OF THE VALUES BASED ON WHAT IS CALLED JUST NOTICEABLE DIFFERENCES (JND).

THE CREATIVE INTENT

-TO PRESERVE THE CREATIVE INTENT IS PER SE THE GOAL OF EACH COLOR MANAGEMENT WORKFLOW.



MOVIE AND TELEVISION DIRECTORS TELL STORIES; GAME DESIGNERS CREATE IMMERSIVE, ENGAGING GAME EXPERIENCES. ONE OF THE REAL CHALLENGES FOR BOTH TYPES OF CONTENT CREATORS LIES IN THE LIMITATIONS OF THE MEDIUM.

DOLBY VISION GIVES THE DIRECTOR AND COLORIST (OR THE GAME PROGRAMMER AND THE LIGHTING AND EFFECTS DESIGNER) THE TOOLS THEY NEED TO ACCURATELY REPRESENT THE VIBRANT COLORS, BRIGHT HIGHLIGHTS, AND DETAILED SHADOWS THAT HELP DRAW THE VIEWER INTO THE SCENE.

BECAUSE ANY DOLBY VISION TELEVISION HAS BEEN CAREFULLY CALIBRATED BY THE MANUFACTURER AND DOLBY TECHNICIANS, THIS TECHNOLOGY CAN PRODUCE THE BEST AND MOST ACCURATE POSSIBLE REPRESENTATION OF WHAT THE CREATOR INTENDED. THIS IS WHY DOLBY VISION IS BEING ADOPTED BY ALL THE MAJOR STUDIOS FOR THE CINEMA AND HAS VAST SUPPORT FOR DELIVERING THE BEST HOLLYWOOD CONTENT TO THE HOME.

SOME BASICS ABOUT DOLBY VISION AND DV WORKFLOW:

-DOLBY BACKGROUND

-DOLBY CONTRIBUTIONS TO HDR

-SYSTEM REQUIREMENTS:

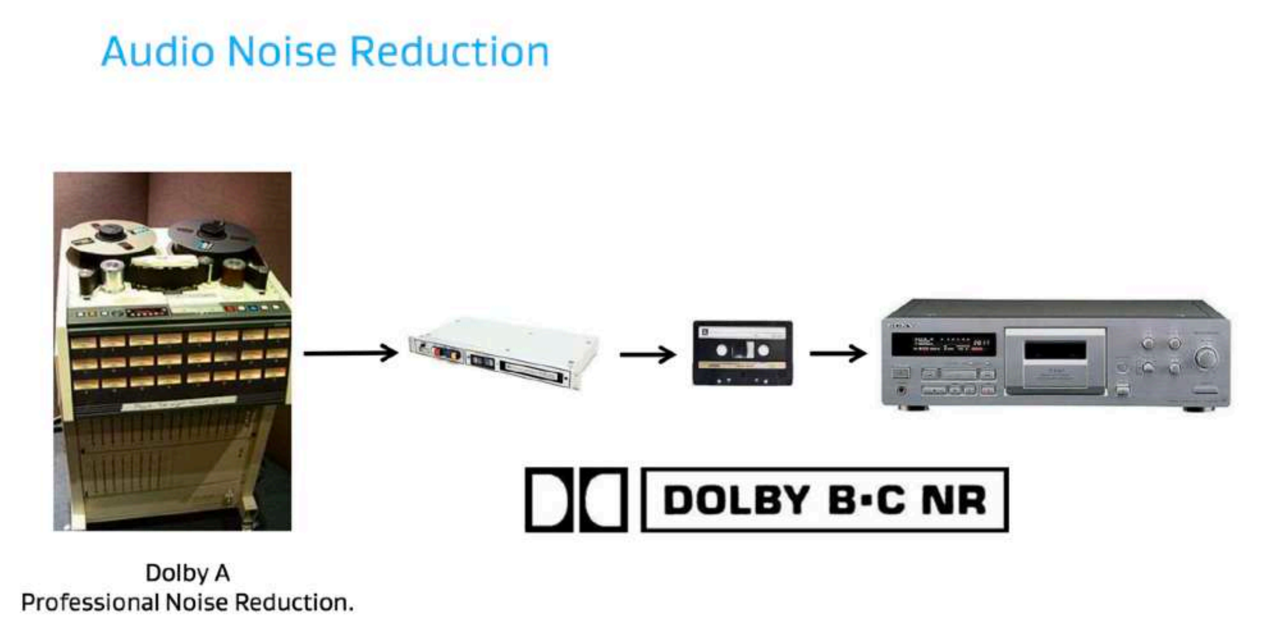
- -SOFTWARE
- -HARDWARE

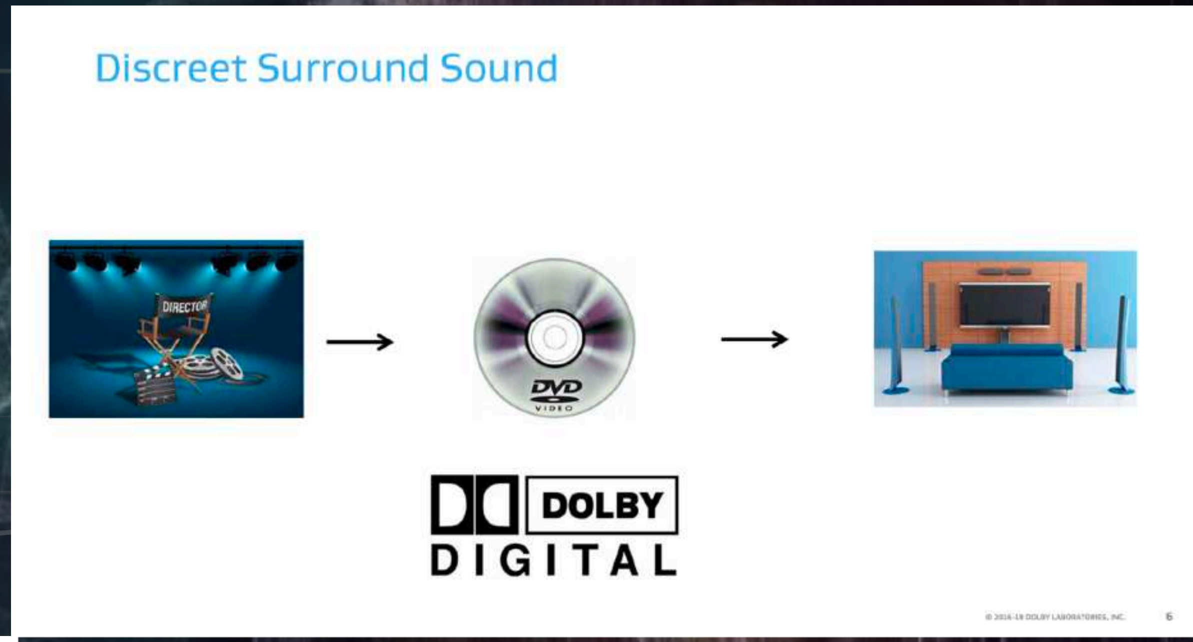
-DOLBY VISION WORKFLOW:

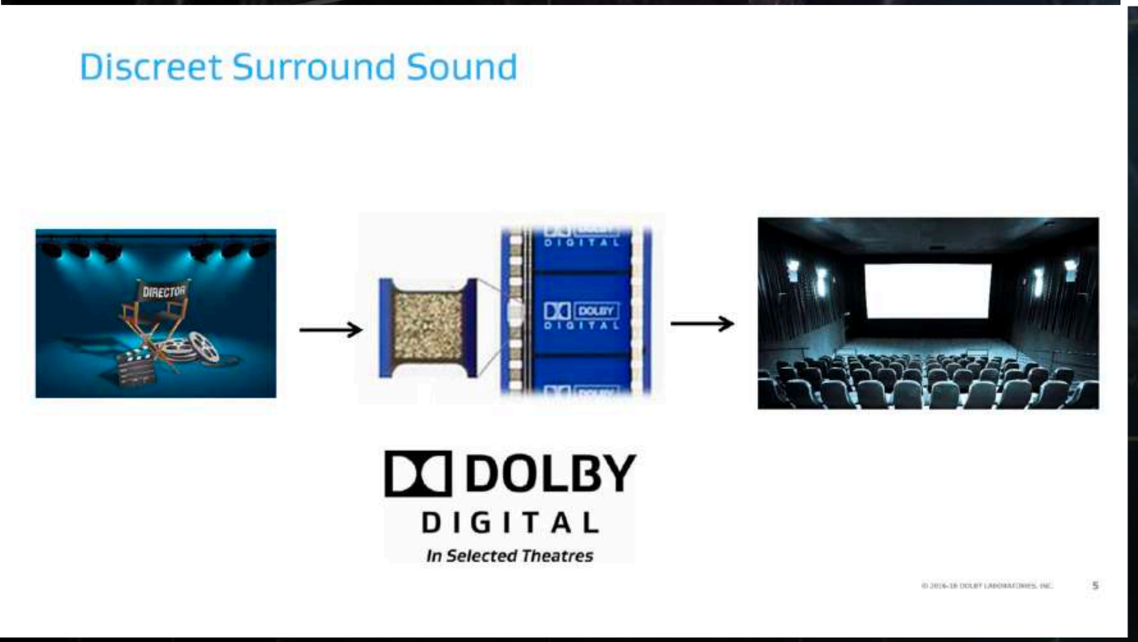
- -CREATE HDR MASTER
- -CREATE LEVEL1 (L1) ANALYSIS DOLBY VISION METADATA
- -OPTIONALLY APPLY CREATIVE LEVEL 2 (L2) TRIM METADATA.
- -CREATE DELIVERABLES

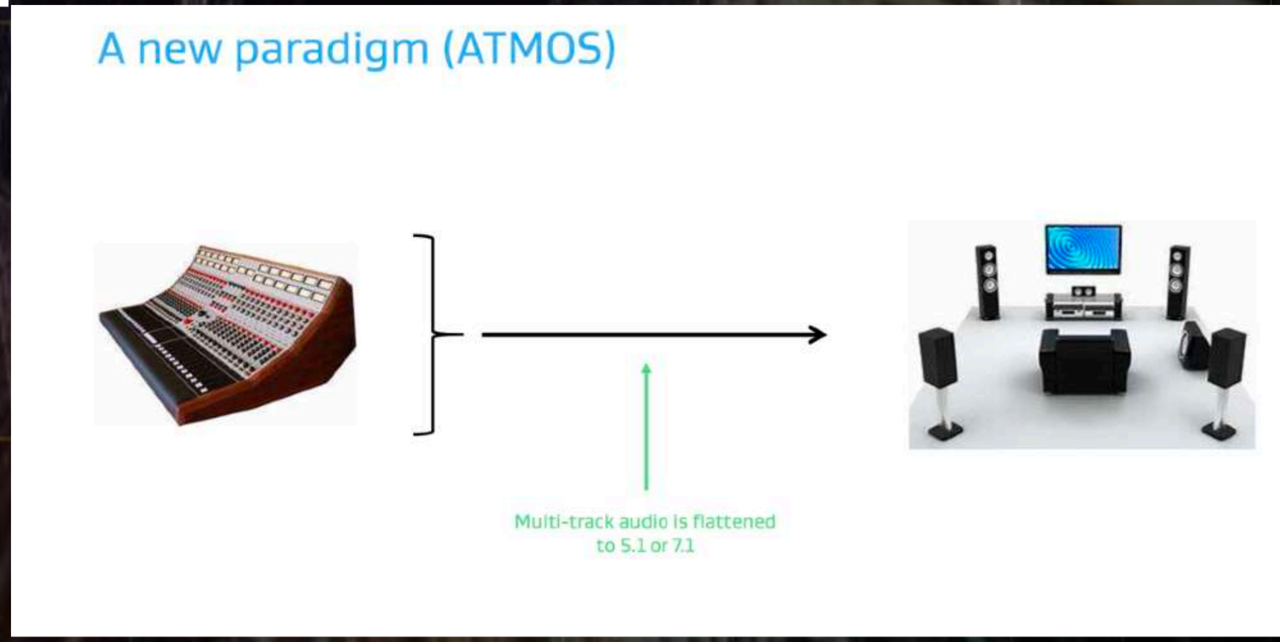
-DOLBY BACKGROUND

DOLBY HAS WORKED CLOSELY WITH HOLLYWOOD STUDIOS, CINEMAS, AND CONSUMER EQUIPMENT MAKERS OVER THE LAST 50 YEARS TO MAKE THE STORIES AND EXPERIENCES AS ENGAGING AS POSSIBLE—FIRST WITH NOISE REDUCTION, THEN 5.1 SURROUND AND 7.1 SURROUND, AND NOW WITH DOLBY VISION AND DOLBY ATMOS.







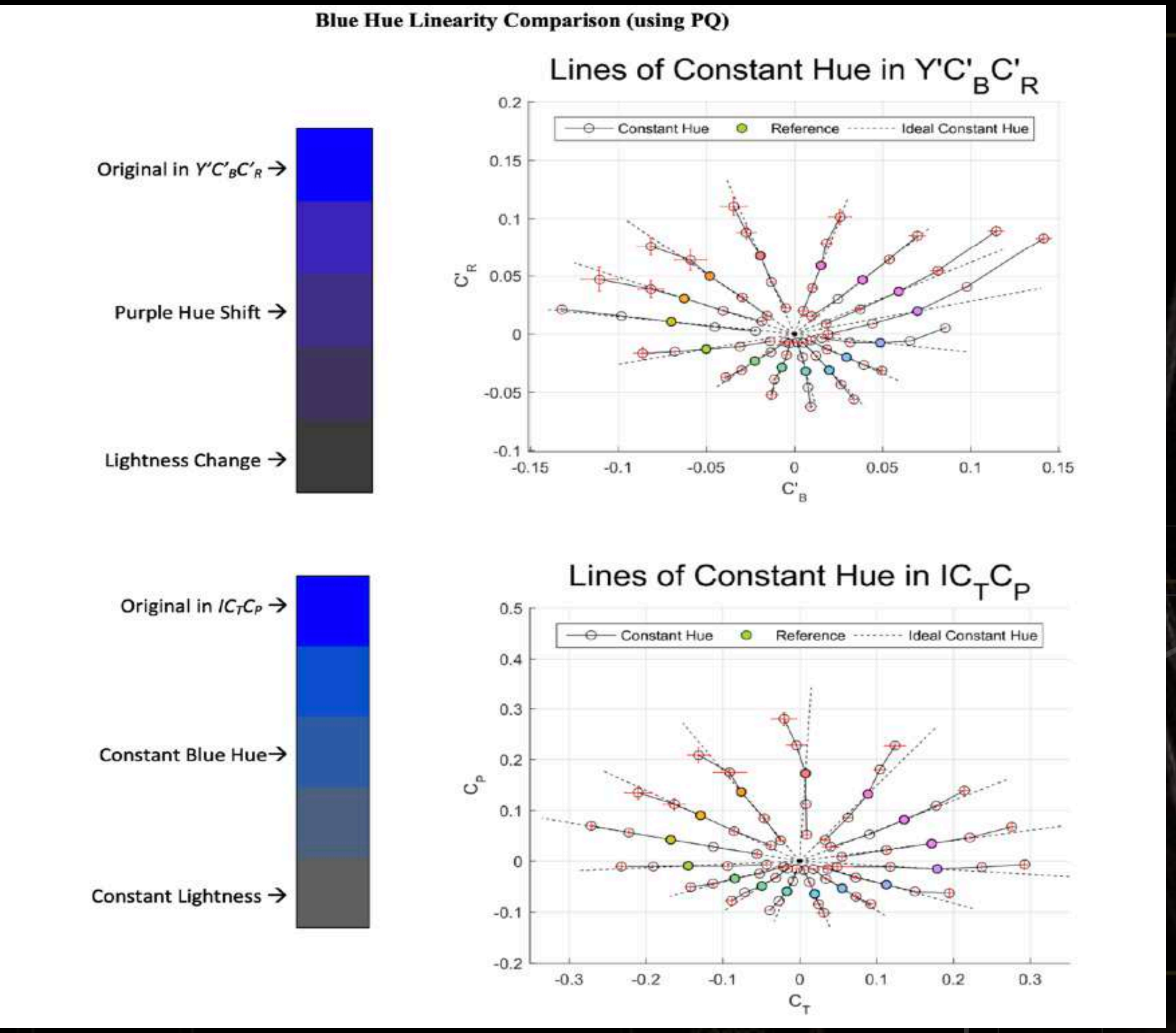


-DOLBY CONTRIBUTIONS TO HDR

-PQ: TRANSFER FUNCTION REQUIRES NO COMPROMISES: CAN REPRESENT DEEPEST BLACKS TO BRIGHTEST HIGHLIGHTS, WITH DETAIL VISIBLE (AND NO COUNTOURING) ACROSS THE ENTIRE RANGE FROM BLACK TO 10.000 NITS. STANDARDISED AS SMPTE 2084

-ICTCP: THE *YCbCr* LIMITATIONS BECOME APPARENT WITH HDR AND WCG.

ICtCp IS A COLOR REPRESENTATION WITH ATTRIBUTES CONSTANT LUMINANCE AND CONSTANT HUE



YCbCr IS SDR'S LEGACY COLOR-OPPONENT BASED ENCODING SCHEME THAT SEPARATES LUMA FROM CHROMA INFORMATION FOR THE PURPOSES OF CHROMA SUBSAMPLING. WITH THE LARGE COLOR VOLUME THAT RESULTS FROM HIGH DYNAMIC RANGE AND WIDER COLOR GAMUT, THE SHORTCOMINGS IN USING Y *YCbCr* TO MAP LUMINANCE, HUE, AND SATURATION DIFFERENCES FROM ONE COLOR VOLUME TO ANOTHER HAVE BECOME MAGNIFIED, ALSO YIELDING LARGER COLOR CROSSTALK ENCODING ERRORS AND AMPLIFICATION OF NOISE NEAR THE EDGES OF THE RGB COLOR SPACE

THE *ICtCp* COLOR REPRESENTATION RESULTS IN CONSTANT INTENSITY, HUE LINEARITY, AND PERCEPTUAL UNIFORMITY. THIS YIELDS EFFICIENT ENCODING OF HIGH DYNAMIC RANGE AND WIDE GAMUT COLOR DIFFERENCE SIGNALS WITH LOWER QUANTIZATION ERROR, AS WELL AS MORE ACCURATE COLOR VOLUME MAPPING.

-ST2094-10 TO ASSIST DISPLAY ADAPTATION: ALLOW RECEIVERS TO OPTIMISE IMAGE DISPLAY BASED ON A ACTUAL DISPLAY CAPABILITIES. METADATA CAN BE GENERATED LIVE ENCODE.

-SYSTEM REQUIREMENTS FOR DOLBY VISION WORKFLOW

SOFTWARE: YOU NEED A COLOR GRADING SYSTEM SUPPORTING DOLBY VISION:

BLACKMAGIC DAVINCI RESOLVE / FILMLIGHT BASELIGHT / DIGITAL VISION NUCODA / AUTODESK LUSTRE

DOLBY VISION IS ALSO SUPPORTED BY COMPOSITING AND FINISHING APPLICATIONS LIKE AUTODESK FLAME, OR 3D APPLICATIONS LIKE UNREAL (DOLBY VISION PLUG IN).

-SYSTEM REQUIREMENTS FOR DOLBY VISION WORKFLOW

HARDWARE: IF YOU WANT TO MASTER DOLBY VISION CONTENT AT A DOLBY CERTIFIED LEVEL YOU WILL NEED A MONITOR WITH:

- -MINIMUN 1000 NITS PEAK LUMINANCE
- -CONTRAST RATIO - 200.000: 1
- -COVER 100%. DCI-P3 COLOR GAMUT
- -SUPPORT REC 2020
- -SUPPORT SMPTE ST-2084 EOTF

FLANDERS SCIENTIFIC XM-311K SONY BVM-X300 CANON DP-V2420

-YOU ALSO NEED AN CONTROL MAPPING UNIT, WHICH CAN BE INTERNAL (BUILT IN WITHIN THE SOFTWARE) OR EXTERNAL (HARDWARE)

The Dolby Content Mapping Unit is a 1U workstation (Supermicro) and is available only from Dolby authorized system integrators.

-DOLBY VISION WORKFLOW. THE DOLBY VISION CONTENT CREATION PROCESS INVOLVES THE FOLLOWING STEPS:

CREATE THE HDR MASTER: CREATING THE HDR MASTER INVOLVES USING IMAGES IN THE HIGHEST QUALITY, COLORING ON AN APPROVED DOLBY VISION ENABLED COLOR CORRECTOR AND MONITORING ON A REFERENCE GRADE PROFESSIONAL HDR MONITOR. USE THE HIGHEST QUALITY IMAGES AS THE SOURCE AS THE STARTING POINT FOR THE DOLBY VISION HDR MASTER. IN GENERAL, STARTING A PROJECT WITH CAMERA RAW IS BEST, FOLLOWED BY UNCOMPRESSED 16 OR 12 BIT, RGB, 444 FILES SO THAT ALL THE DYNAMIC RANGE AND COLOR INFORMATION IS PRESERVED FROM THE ORIGINAL ACQUISITION.

USE AN APPROVED DOLBY VISION COMPATIBLE COLOR CORRECTOR FOR BOTH HDR AND DOLBY VISION MASTERING. THE PROJECT'S INTERNAL WORKING SPACE SHOULD BE SET TO ST.2084 (PQ) AND EITHER P3D65 OR REC.2020. BE CAREFUL TO NOT CLIP HIGHLIGHTS IN THE HDR MASTER AS THESE CANNOT BE RECOVERED IN THE REC.709 SDR TARGET. THE DOLBY VISION CONTENT MAPPING ALGORITHMS ARE DESIGNED TO MAINTAIN THE LOOK AND INTENT OF THE HDR MASTER.

USE A PROFESSIONAL, REFERENCE GRADE HDR MONITOR THAT MEETS THE MINIMUM REQUIREMENTS FOR DOLBY VISION. IS RECOMMENDED THAT THE HDR AND SDR MONITORS USE THE SAME DISPLAY TECHNOLOGY. FOR EXAMPLE, IF YOU USE THE SONY BVM-X300 OLED HDR MASTER MONITOR, DO NOT USE AN LCD-BASED OR CONSUMER TV FOR THE SDR TARGET DISPLAY. IN ADDITION TO PROFESSIONAL MONITORING, PROFESSIONAL SCOPES ARE ALSO STRONGLY RECOMMENDED. USE PROFESSIONAL SCOPES THAT CAN DISPLAY PQ SIGNAL VALUES.

-DOLBY VISION WORKFLOW. THE DOLBY VISION CONTENT CREATION PROCESS INVOLVES THE FOLLOWING STEPS:

CREATING GLOBAL DOLBY VISION METADATA: SETTING THE DOLBY VISION ALGORITHM VERSION, WITH THE INTRODUCTION OF DOLBY VISION CONTENT MAPPING VERSION 4 (CMV4) IN THE FALL OF 2018, THERE ARE NOW TWO VERSIONS OF ALGORITHMS SUPPORTING DOLBY VISION. THE PREVIOUS CM ALGORITHM IS VERSION 2.9 (CMV2.9). THIS IS THE VERSION THAT HAS BEEN USED SINCE THE INTRODUCTION OF DOLBY VISION.

WITH THE ROLLOUT OF DOLBY VISION CMV4, SYSTEMS SUPPORTING THE INTEGRATED CMU ARE ALSO STARTING TO BECOME AVAILABLE. TRADITIONALLY, A COLOR CORRECTOR WOULD NEED TO BE CONNECTED TO AN EXTERNAL CMU WHICH CONTAINED ALL THE MAPPING ALGORITHMS AND VIDEO I/O TO THE TARGET DISPLAY. WITH THE NEW CMV4 ROLLOUT, COLOR CORRECTORS HAVE THE OPTION TO INCLUDE THESE ALGORITHMS WITHIN THEIR PLATFORM AND ELIMINATES THE NEED FOR AN ECMU.

SELECT THE MASTERING MONITOR TO THE SPECIFICATION OF THE HDR MONITOR USED. THIS SETTING IS USED TO CREATE LEVEL 0 (L0) METADATA THAT IS ESSENTIAL TO DOLBY VISION. ALL THE MAPPING ALGORITHMS ARE BASED ON THE MASTERING DISPLAY –IT IS CRUCIAL TO SELECT THE PROPER MASTER DISPLAY NIT VALUE. (I.E. SONY BVM X300 IS 1000-NITS)

SET THE ASPECT RATIO FOR THE PROJECT. THE ASPECT RATIO SHOULD BE SET TO LIMIT THE ANALYSIS AREA TO THE ACTIVE PICTURE AREA (EXCLUDING LETTERBOXES). THIS STEP IS CRUCIAL TO GET THE PROPER L1 VALUES THAT ARE NOT ANALYZING THE BLACK LEVELS OF THE LETTERBOX REGION. IF THIS IS NOT SET CORRECTLY, THE 'L1MIN' VALUES WILL READ 0.000 FOR ALL SHOTS.

-DOLBY CONTRIBUTIONS TO HDR