

W3C  
CSS Colors 4 workshop



I'm Chris or @svgeesus

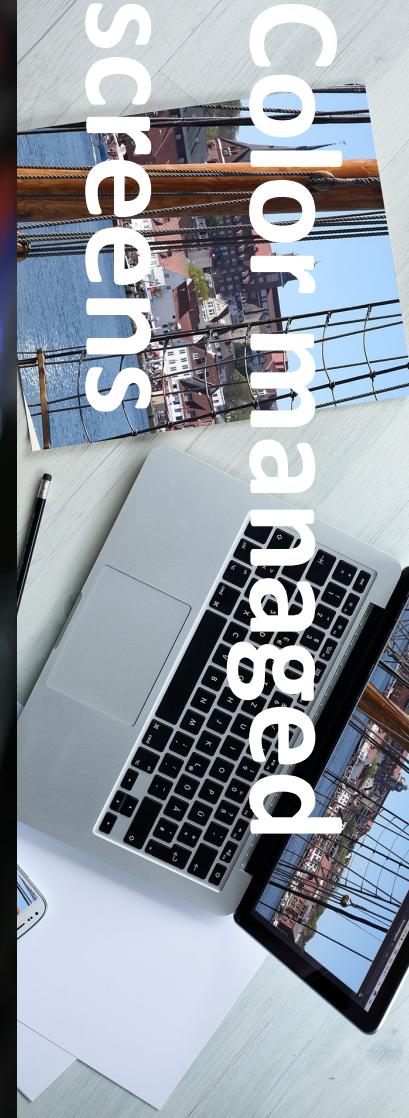
Hello!





# The Prehistoric Web

Color managed screens



Broadcast



CSS Color 4



High W3C CSS Color 4 hope

# The Prehistoric Web



# ITU Rec BT.709 (1990)

## part 2

1080i and 1080p High Definition TV

Defines chromaticities, D65 white

OETF with linear segment

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A CRT monitor is positioned on a red carpet. The monitor has a dark grey or black bezel. A power cord is visible on the left side. The screen is off, showing a dark grey or black display. The monitor is centered in the frame, with its base at the bottom and the screen extending upwards and to the right.

CRT monitor

# Indexed-color displays

16 color VGA displays. **256 colors common.**

*"Truecolor"* for the lucky few

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# Gamma mayhem

**Mac:**  $2.6/1.45 = 1.79$

**SGI:**  $2.4/1.7 = 1.4$

**PC, Unix:** 2.2 (ish)

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# W3C Workshop on High Quality Printing from the Web, April 25th '96

This workshop is sponsored by the [World Wide Web Consortium \(W3C\)](#).

Steve Raggett and Susan Hardy

• [Topics](#) • [Agenda](#) • [Minutes](#) • [Where](#) • [Registration](#)

Issues of the World Wide Web for online publishing, the time has now come to focus on improving the quality of printing from the Web. This raw together participants to identify technical issues that will enable improved quality of printing. It is intended that the workshop will W3C subgroup to address these issues with members drawn from W3C member companies and organizations.

Position papers submitted by Participants

It is strongly encouraged to provide position papers on these or closely related topics in advance of the workshop to be made publically available at the W3C's Web site.

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# SRGB proposal

many issues involved with printing documents available on the Web. This paper is intended to address two of the major issues: a) ergistic relationship possible between HTML and PDF is using PDF for graphical objects within HTML documents. The case for PDF graphics in HTML is presented in the second section of this paper.

b) Printing of Web Documents by Brad Chase, Bitstream Inc.

In the past year, Bitstream has been working closely with industry leaders to resolve the problems of formatting, displaying, and printing web pages. Combining with Bitstream's experience in the font and printing industries has led to a number of insights in the areas of fonts, style sheets, and print engines.

## Proposal to Make Web Printing More Satisfying by [John C. Thomas](#)

I find it easier to read long textual documents from a printed page than from my workstation screen, I find myself reaching for the "Print" button in my web browser any time a document must be scrolled more than a few times. This becomes inconvenient, however, if the document has many pages. Traversing the document tree must be manually traversed. The "[Next]" link which is beginning to appear on web pages from some of the more advanced web sites is only a partial solution. The tool I want is an interactive web crawler which retrieves, indexes and prints a document and prints it out to some predefined sphere of context.

[Sumner M. Saitz <\[sumner@harlequin.com\]\(mailto:sumner@harlequin.com\)>](#)

as a leader in high-quality electronic printing would like to collaborate with other members of the W3C to develop open standards and support growing demands of the Web community.

## Standard Color Space for the Internet by [Matthew Anderson/, Ricardo Motta/Hewlett-Packard](#), [Srinivasan Chandrasekar/Microsoft](#), [Microsoft](#)

[Packard](#)

Microsoft propose the addition of support for a standard color space within the Microsoft OS's, HP products and the Internet. The aim of this proposal is to complement the current color management strategies by enabling a third method of handling color in the OS's and the Internet that utilizes device independent color definition that will provide good quality transmission and system overhead. Based on a color space well suited to CRT monitors, television screens, film cameras, and printing systems such a space can be supported with minimal hardware overhead. One of the main benefits of this standard color space, the suitable implementation on the Web.

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Embedding on the WWW by Andrew Pennock  
Font Embedding on the WWW by Andrew Pennock  
Color Management on the Web by Leslie Cuff  
A proposal for embedding fonts in HTML documents on the world wide web. Clients interact with platform-specific services (called in this document) that provide much of the embedding functionality.

**SRGB**

Same chromaticities, D65 white as BT.709

“Inverse OETF” with linear segment

Display referred

Overall system gamma 1.0 (normal surround)

Assumes 5% viewing flare

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# Cascading Style Sheets

## Cascading Style Sheets, level 1

W3C Recommendation 17 Dec 1996

[www.w3.org/pub/WWW/TR/REC-CSS1](http://www.w3.org/pub/WWW/TR/REC-CSS1)

Wium Lie ([howcome@w3.org](mailto:howcome@w3.org))  
BERT  
([bert@w3.org](mailto:bert@w3.org))

### This document

This document is a W3C Recommendation. It has been reviewed by [W3C](http://www.w3.org/) (<http://www.w3.org/>) Members and general consensus that it is appropriate for use has been reached. It is a stable document and may be used as reference material or cited as a normative document in another document. W3C promotes widespread deployment of this Recommendation.

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This document specifies level 1 of the Cascading Style Sheet mechanism (CSS1). CSS1 is a simple style sheet mechanism that allows authors and readers to attach style (e.g. fonts, colors and spacing) to HTML documents. The CSS1 language

The format of an RGB value in decimal notation is a '#' immediately followed by either three or six hexadecimal digits. The three-digit RGB notation (#rgb) is converted into six-digit form (#rrggb) by replicating digits, not by adding zeros. For example, #fb0 expands to #ffbb00. This makes sure that white (#ffff) can be specified with the short notation (#fff) as well.

# CSS1 Uses sRGB

The format of an RGB value in the functional notation is `rgb( [value] [, value] [, value] )`, where each value is either three integer values in the range of 0-255, or three percentage values in the range of 0.0% to 100.0% followed by optional whitespace.

Values outside the numerical ranges should be clipped. The three rules below are therefore equivalent:

```
EM { color: rgb(255, 0, 0) }          /* integer range 0 - 255 */
EM { color: rgb(300, 0, 0) }          /* clipped to 255 */
EM { color: rgb(110%, 0%, 0%) }      /* clipped to 100% */
```

RGB colors are specified in the sRGB color space [9]. UAs may vary in the fidelity with which they represent these colors. The use of sRGB provides an unambiguous and objectively measurable definition of what the color should be, which can be used to international standards [10].

UAs may limit their efforts in displaying colors to performing a gamma-correction on them. sRGB specifies a display gamma of 2.2 under specified viewing conditions. UAs adjust the colors given in CSS such that, in combination with an output device's "natural" display gamma, an effective display gamma of 2.2 is produced. Appendix D gives further details of this. Note that colors specified in CSS are affected; e.g., images are expected to carry their own color information.

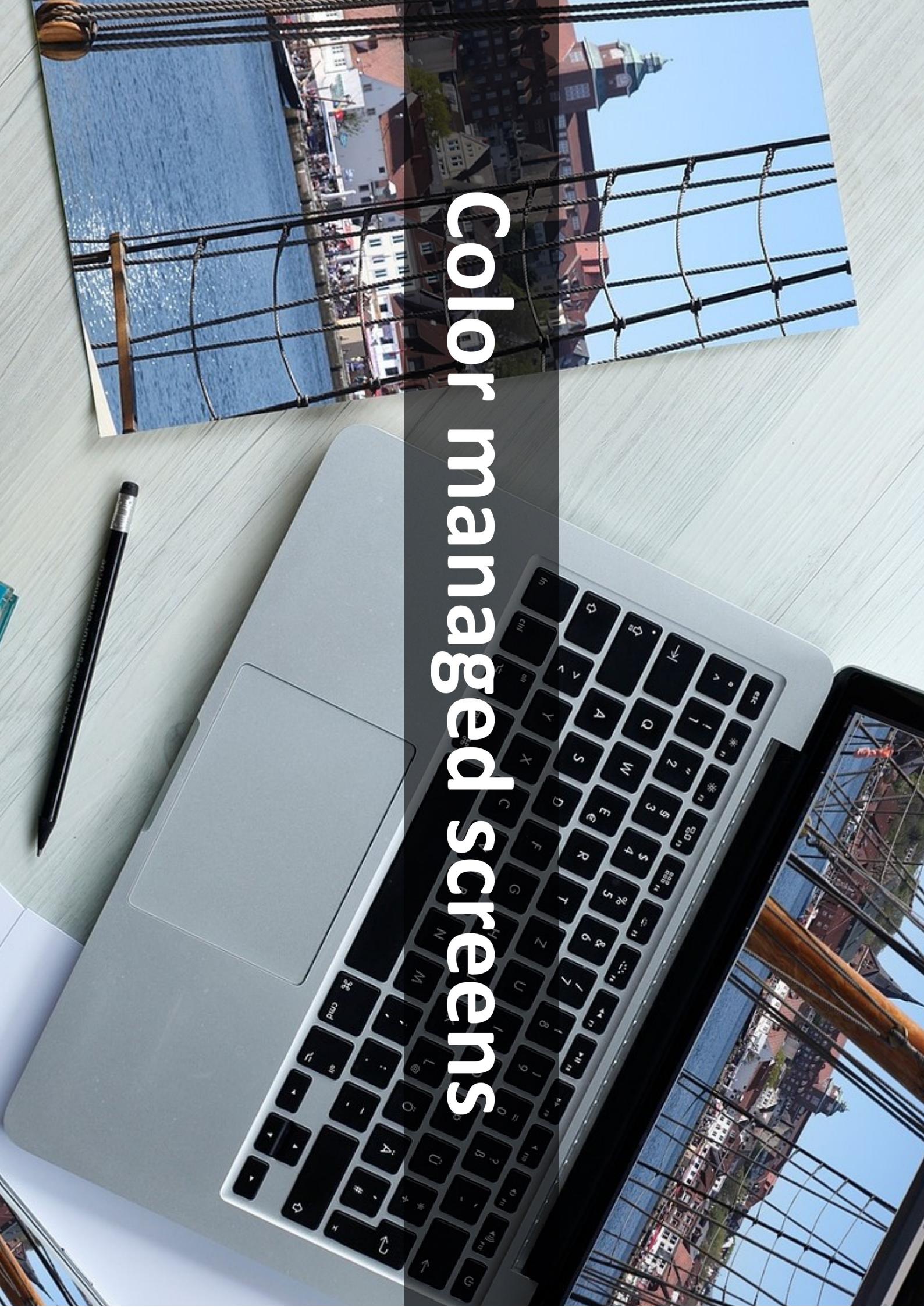
A Uniform Resource Locator (URL) is identified with a functional notation:

```
BODY { background-color: url('http://www.w3.org/Style/CSS/Colors/4Shop'); }
```

The format of a URL value is `url( [uri] [, [optional whitespace]] )`, where `[uri]` is defined in [4], followed by optional whitespace (single quote ('') or double quote ("')) and ending with optional closing quote ('') or double quote ("').

followed by optional whitespace followed by '}'. Quote characters that are not part of the URL itself must be balanced.

Color managed Screens



# Color Management

arrives

Mac: ColorSync

Win95/NT: Kodak CMS (aftermarket)

Win98/2000: ICM

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Linux/KDE: colord-kde

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Web vs. Everything Else

# Color Management in Industry

Commercial printing, production of paint, plastics, fabric, 3D print

- There is a **paying customer**
- Design is **finished before production**
- Production is **centralized**
- Reliable, calibrated instruments for color QA

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# Color Management on the Web

Even with color-managed screens:

- Content & browsers are **free**
- Design **customized** to end-user display
- Production is **distributed**
- End-user calibration **rare**

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# CSS Color 3 (2011)

sRGB only, 8 bits per component

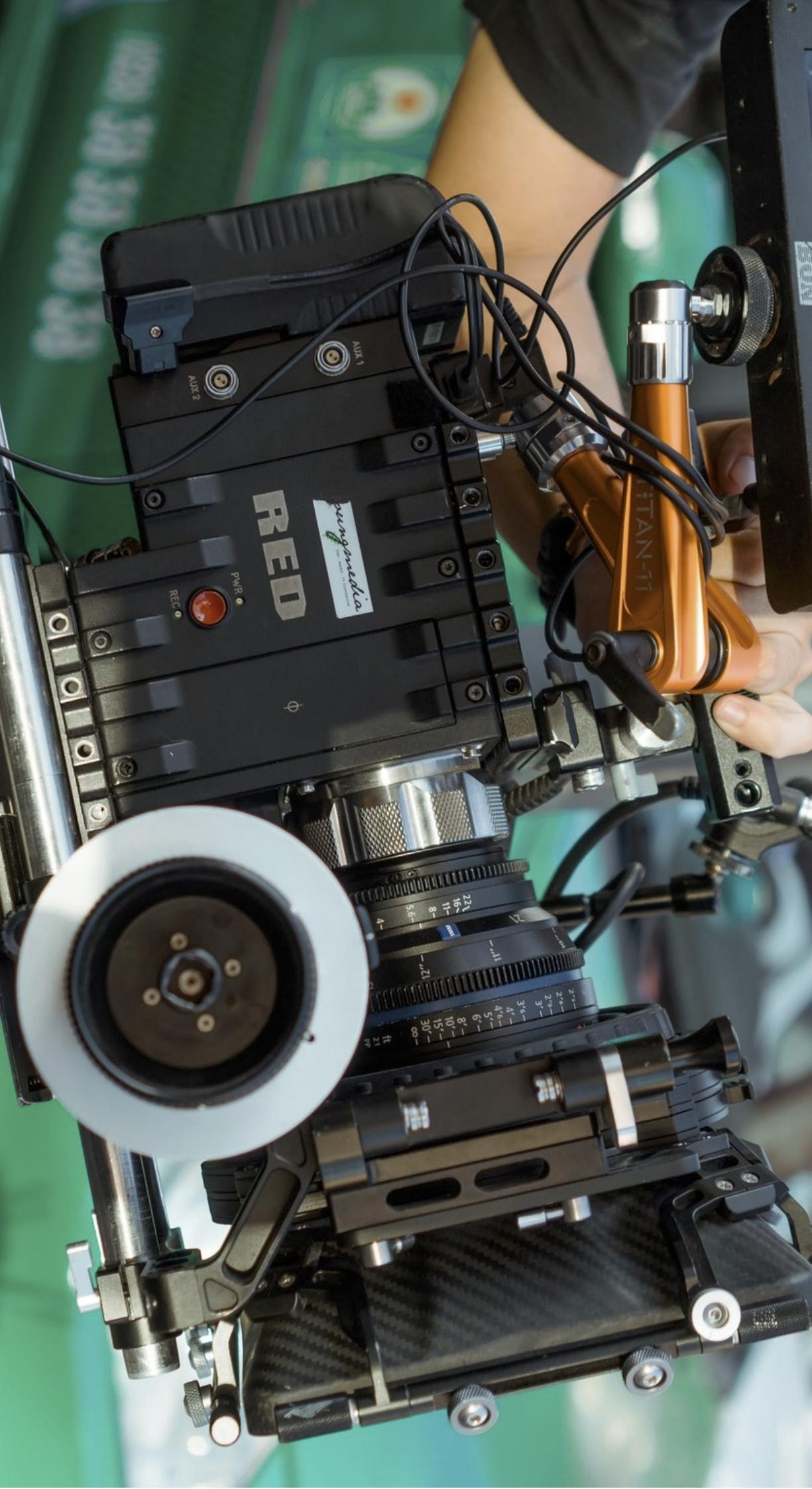
Chrome, Safari color managed; Firefox threw data at screen

```
fill: rgb(243, 214, 155);  
// looks fine on sRGB,  
// too saturated on P3 wide gamut
```



# Broadcast

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# DCI P3 - SMPTE EG 432

Digital Cinema Initiative

Projectors for digital cinema

Defines chromaticities, **weird** white

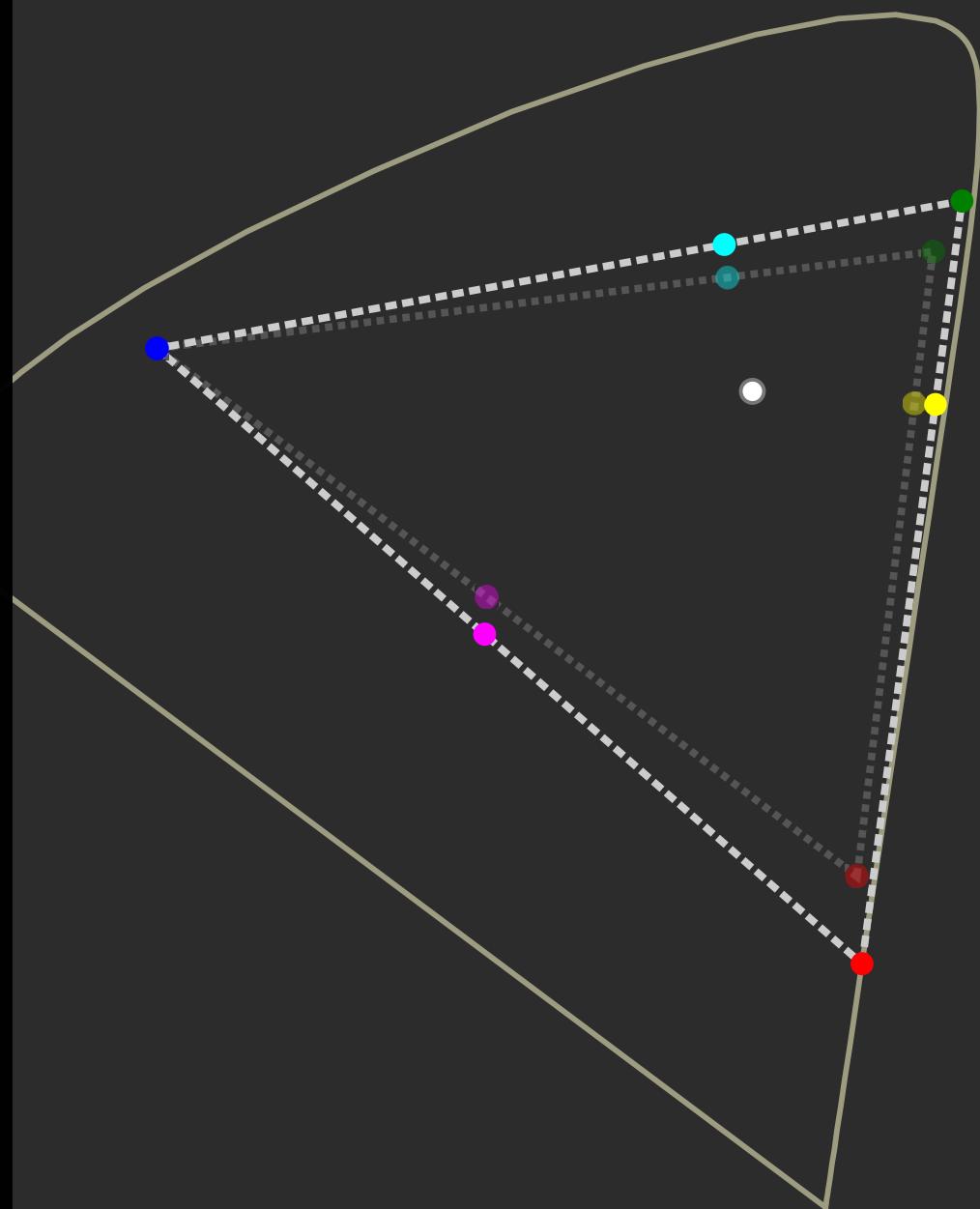
Monochromatic red, 615nm

White luminance 48 cd/m<sup>2</sup>

Dark surround

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# UltraHD Premium

Conforming devices required to display at least 90% of DCI P3



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# VESA DisplayHDR

(For tier 500 and greater)

Conforming devices required to display at least 90% of DCI P3



VESA CERTIFIED

DisplayHDR™

W3C CSS Color for 4k

# Apple Display P3

White, EOTF, viewing conditions same as sRGB

Primaries same as DCI-P3

Display-referred

Factory-calibrated phones, tablets, laptops, *watches*

All color managed

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# ITU Rec BT.2020 (2012)

Ultrawide gamut

Monochromatic primaries (630, 532, 467nm)

10 or 12 bits per component

OETF, and non-matching EOTF (gamma 2.4)

D65 white, dim surround

Display-referred

Ultrawide (4K, 8K) broadcast streaming

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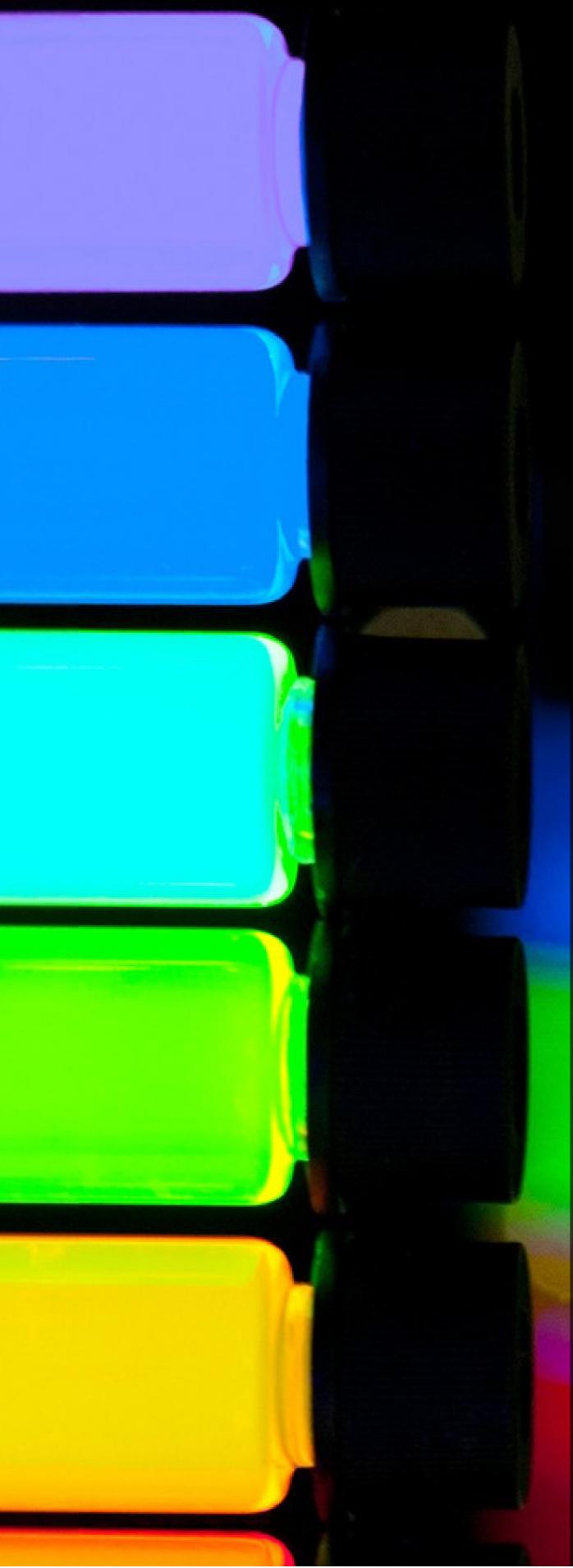
# BT.2020 in practice

Content mostly mastered in DCI-P3  
HDMI 2.0 supports BT.2020, 12bit  
Content thus delivered in BT.2020

For HDR, metadata declares the mastering gamut volume

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# CSS Color 4



# CSS Color Module Level 4

W3C First Public Working Draft, 05 July 2016

**This version:**

<http://www.w3.org/TR/2016/WD-css-color-4-20160705/>

**Latest version:**

<http://www.w3.org/TR/css-color-4/>

**Editor's Draft:**

<https://drafts.csswg.org/css-color/>

**Feedback:**

[www-style@w3.org](mailto:www-style@w3.org) with subject line “[css-color] ... message topic ...” ([archives](#))

**Issue Tracking:**

[Inline In Spec](#)

**Editors:**

[Tab Atkins Jr.](#) (Google)

[Chris Lilley](#) (W3C)

**Former Editors**  
L. David Baron (Mozilla Corporation)  
**W3C CSS Colors 4 shop**

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# What changed?

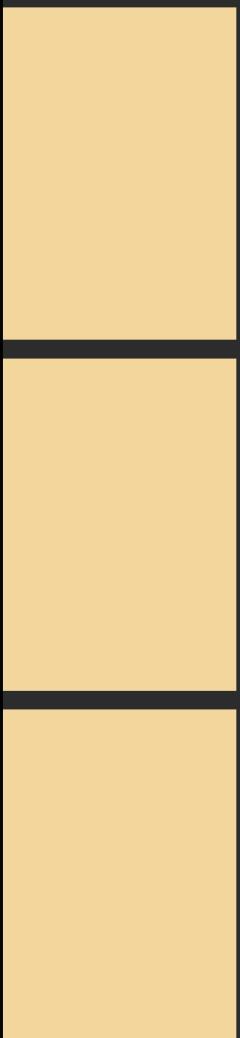
- ~~Wider color gamuts in digital SLR photography~~
- Apple Display P3 devices
- Dell, HP, Microsoft wide gamut laptop screens
- Samsung, Pixel, OnePlus wide gamut phones
- Wide gamut, HDR TV/movies/streaming
- Mobile CMS, *finally*
- Safari support for CSS Color 4 display-p3

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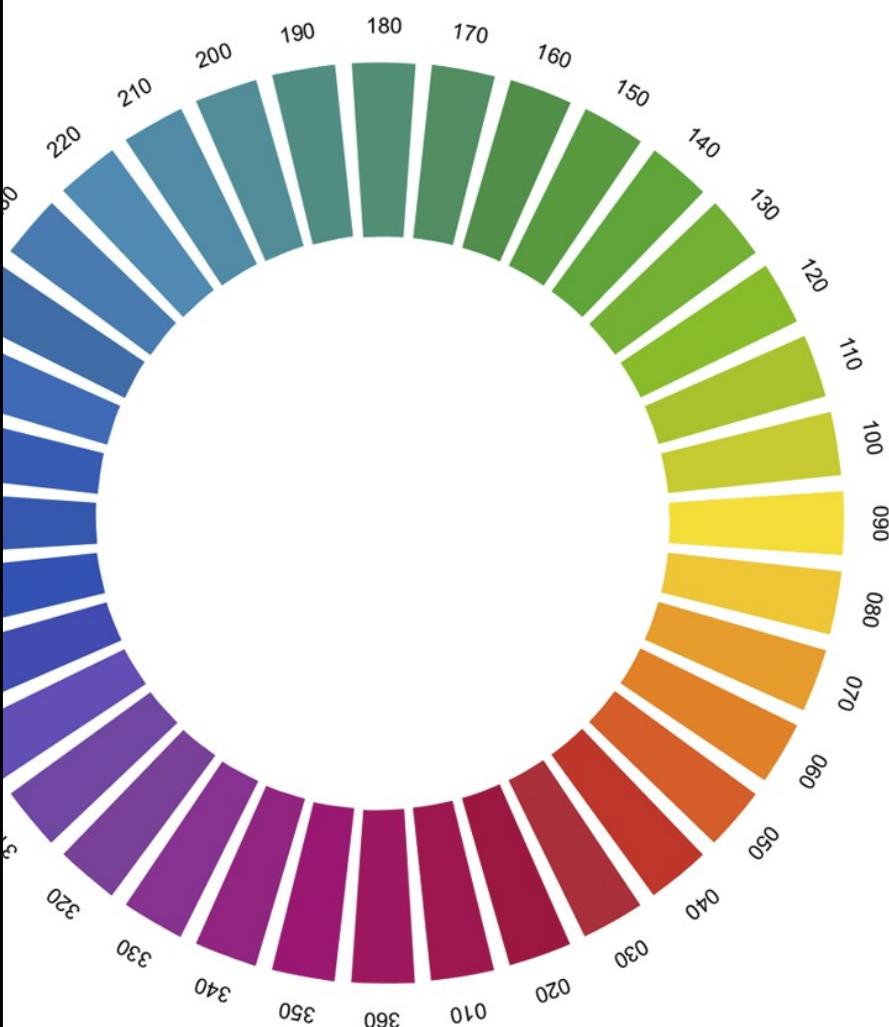
# Predefined Colorspaces

```
fill: color(display-p3 0.9341 0.8433 0.6361)
fill: color(photophoto-rgb 0.8474 0.8103 0.5824)
fill: color(rec2020 0.9151 0.8359 0.5960)

// these are the same color, L=87.16 C=38.25 T
```



# CIE Hue, Chroma (LCH)



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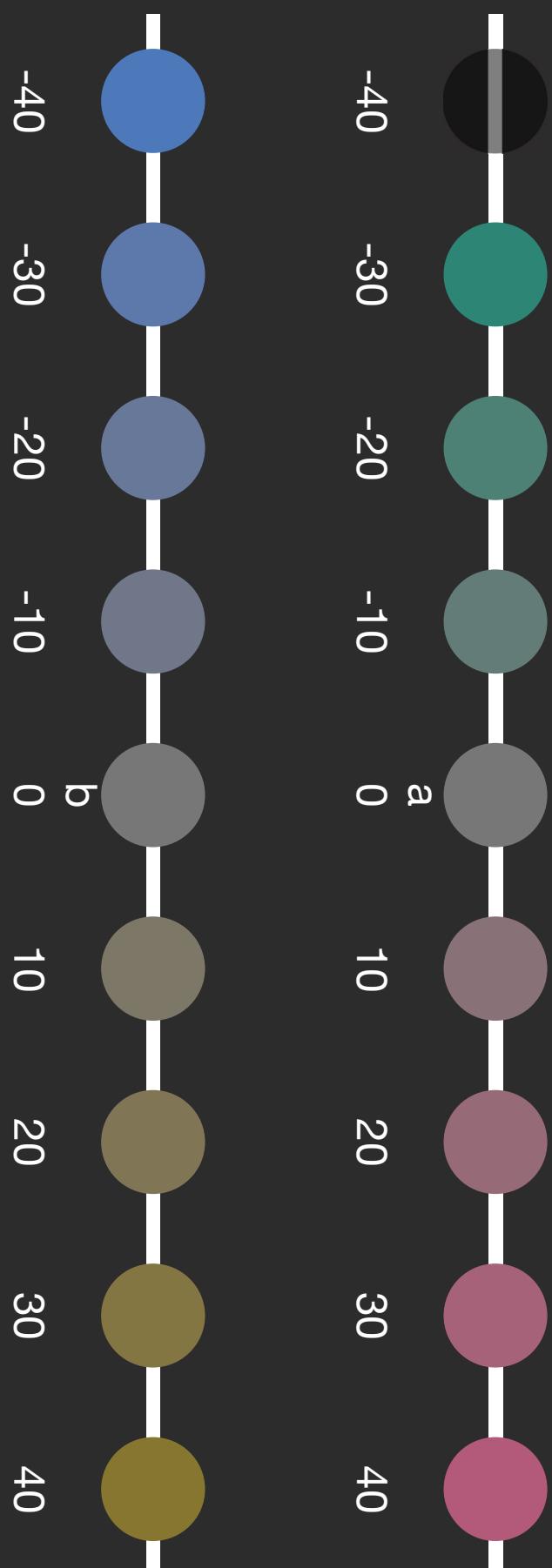
# LCH in CSS Color 4

```
background: lch(50% 0 0);  
border-color: lch(65% 30 180 / 50%);  
color: lch(55.3% 84.5 10.25, #F06);
```

Hue can be NaN for neutrals

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CIE a & b



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# Lab in CSS Color 4

```
background: lab(50% 0 0);  
border-color: lab(65% 46 -8 / 50%);  
color: lab(55.3% 83.1 15.0 / 75%, #F06);
```

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# CMYK: ICC Color in CSS Color 4

At-rule (like `@font-face`) points to ICC profile

```
@color-profile --fogra39 {  
    src: url('https://example.org/C_Fogra39L.ic  
}  
.header {  
    background-color: color(--fogra39 0% 70%  
}
```

# CMYKOGV: ICC Color in CSS Color 4

Not limited to 4 components

```
@color-profile --fogra5beta {  
    src: url('https://example.org/Fogra5beta_CL  
    color(0.03114666666666666, 0.10047, 0.223, 0.90000);  
}  
.  
.bluish_green {  
    background-color:  
        color(0.03114666666666666, 0.10047, 0.223, 0.90000);  
}
```

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0.03114666666666666, 0.10047, 0.223, 0.90000);

# Mixing & manipulating colors

# CSS Color Module Level 5

Editor's Draft, 13 November 2020



## ► Specification Metadata

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## Abstract

This module extends CSS Color [[css-color-4](#)] to add color modification functions.

**CSS** is a language for describing the rendering of structured documents (such as HTML and XML) on screen, on paper, etc.

## Status of this document

# CSS Color 5: manipulating color

In progress.

Please send feedback by filing issues in GitHub (preferred), including the spec code “css-color” in the title, like this: “[css-color] ...summary of comment...”. All issues and comments are [archived](#). Alternately, feedback can be sent to the ([archived](#)) public mailing list [www-style@w3.org](mailto:www-style@w3.org).

This document is governed by the [15 September 2020 W3C Process Document](#).

## Table of Contents

## 5 Modifying colors

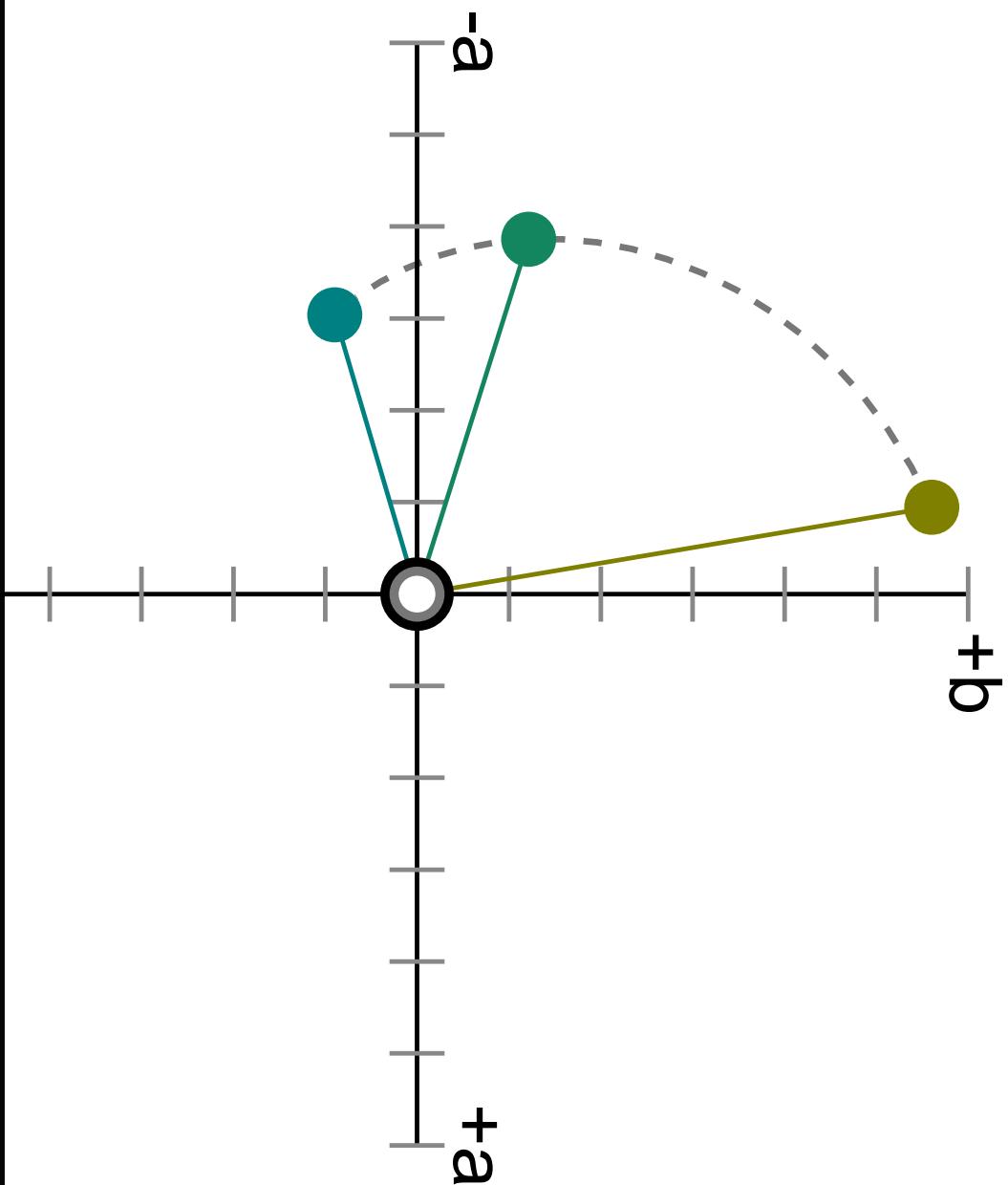
5.1  
Adjusting colors: the ‘color-adjust’ function

# Mixing colors in CSS Color 5

Two colors can be mixed in any colorspace; default is LCH

```
color-mix(teal 65%, olive);
```

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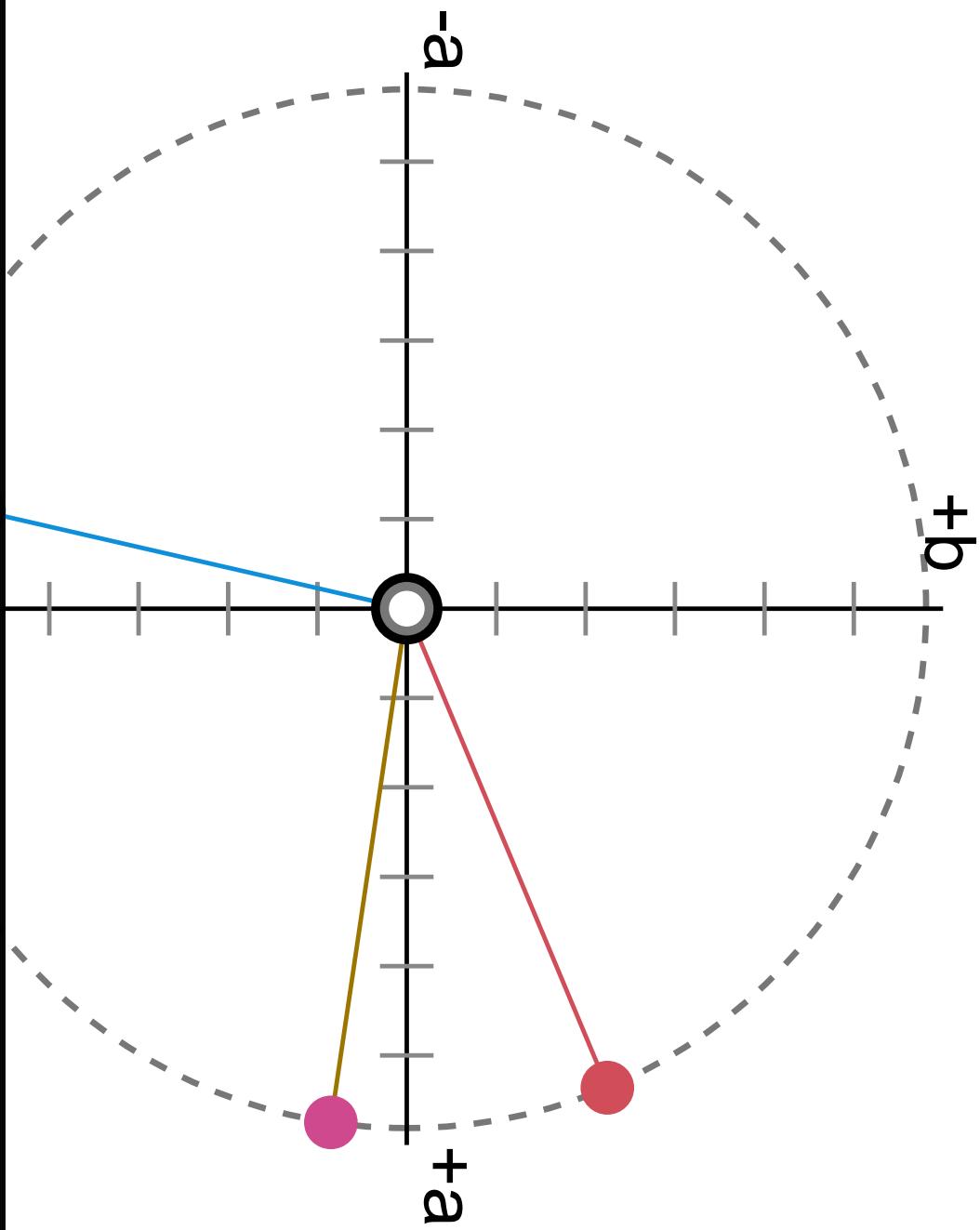
# Mixing colors in CSS Color 5

Individual components can be mixed

```
color-mix(lch(52% 58.1 22.7) hue 75.23%, lch(5
```

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W3C CSS Colors 4 draft



# Mix colors

Can be in different colorspaces

Space for mixing (LCH, Lab, XYZ)

Can specify long arc for hue mixing

Result can be out of gamut, needs gamut mapping

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# Most contrasting color in CSS Color 5

Base color, list of alternates

```
--myAccent: #b22222;
```

```
color-contrast(wheat vs tan, sienna, var(--myA
```

```
Contrast = (Yb + 0.05) / (Ya + 0.05)
```

Color Luminance Contrast

0.749

0.482

1.501

0.137

4.273

0.107

5.081

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0.305

2.249

2.649



# High Dynamic Range

# Need for HDR

Consumer WCG, HDR films, series, news, sports (BT.2100 PQ, HLG)

Consumer HDR gaming consoles

Consumer WCG, HDR-ready TVs commonplace

Consumer WCG (P3) laptops, tablets, phones; HDR coming

WCG, HDR  
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# ITU Rec BT.2100 (2016)

BT.2020 gamut

10 or 12 bits per component

D65 white, dim surround

PQ or HLG

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# Hybrid Log Gamma

Scene-referred, relative luminance

Diffuse white at 0.75

2.5 stops highlights

Range of viewing environments (dim to bright)

*"Brighter displays for brighter environments"*

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# Perceptual Quantizer

Reference display referred, absolute luminance

Diffuse white varies (0.54, 0.58, 0.66)?

5.5 stops highlights

Dim viewing environment

*"Brighter displays for more highlights"*

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# CSS Color HDR Module Level 1

Unofficial Proposal Draft, 23 September 2020



This version:

<https://drafts.csswg.org/css-color-hdr/>

Latest published version:

<https://www.w3.org/TR/css-color-hdr/>

Issue Tracking:

[CSSWG Issues Repository](#)

[Inline In Spec](#)

Editor:

[Chris Lilley \(W3C\)](#)

Suggest an Edit for this Spec:

[GitHub Editor](#)

Handling SDR and HDR content

Security Considerations

Conventions

# CSS Color HDR: high dynamic range

Abstract

Conventions

Color classes

Implementations

Definitions of Unstable and

Implementation Features

Implementations

Status of this document

Defined by this specification

Defined by reference

*This section describes the status of this document at the time of its publication. Other documents may supersede this document. A list of current W3C publications and the latest revision of this technical report can be found in the References section.*

References

References

References

References

References

This document is governed by the 15 September 2020 W3C Patent Policy. W3C maintains a [public list of any patent disclosures](#) made in connection with the deliverables of the group; that page also includes instructions for disclosing a patent. An individual who has actual knowledge of a patent which the individual believes contains

# Problems With CIE Lab

Hue non-linearity in blue area

Primarily designed for reflective, low-luminance ( $120\text{ cd/m}^2$ ),  
print gamuts

Hard to extend for specular whites brighter than paper white

Under-tested for wide-gamut colors, over-estimates  $\Delta E$

# CSS Color HDR (unofficial draft)

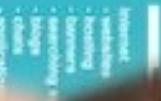
Adds BT.2100 (HLG & PQ)

Adds Jzazbz & JzCzhz (PQ-like, on LMS)

Adds I<sub>CT</sub>C<sub>P</sub> (PQ on LMS)

Defines SDR & HDR Compositing  
Defines BT.2408-0  
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# Future challenges



# CSS Compositing

Currently **gamma-encoded sRGB default**, for legacy

Web/Photoshop compatibility

**Porter-Duff compositing operators**

Ideal is compositing in linear-light, such as XYZ

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# CSS gradients

Currently interpolate in **alpha-premultiplied gamma-encoded**

**SRGB** space

Ideal is alpha-premultiplied, perceptually linear, chroma-preserving (LCH or JzCzhz)

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# Canvas (2D rendering

## context)

Currently **gamma-encoded sRGB default**, 8bits/component

Now adding other colorspaces from CSS Color 4

Adding 16-bit and half-float sRGB for WCG (and HDR?)

# CSS Object Model

Assumes colors are 8-bit sRGB

String (serialization) based

**Huge** legacy JS database

CSS Color 4 extends with serialization of color()

CSS Typed Object Model (in development)

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# Expert review

W3C Colorweb Community Group

W3C joined ICC

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# More Online

Slides: [github.com/svgeesus/css4-color-talk/20years.html](https://github.com/svgeesus/css4-color-talk/20years.html)

Specification: [drafts.csswg.org/css-color/conversions/](https://drafts.csswg.org/css-color/conversions/)

Code: [drafts.csswg.org/css-color/conversions.js](https://drafts.csswg.org/css-color/conversions.js)

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CSS Slideshow framework by Lea Verou

• @svgeesus

# W3C CSS Colors4 workshop

Thank you!

