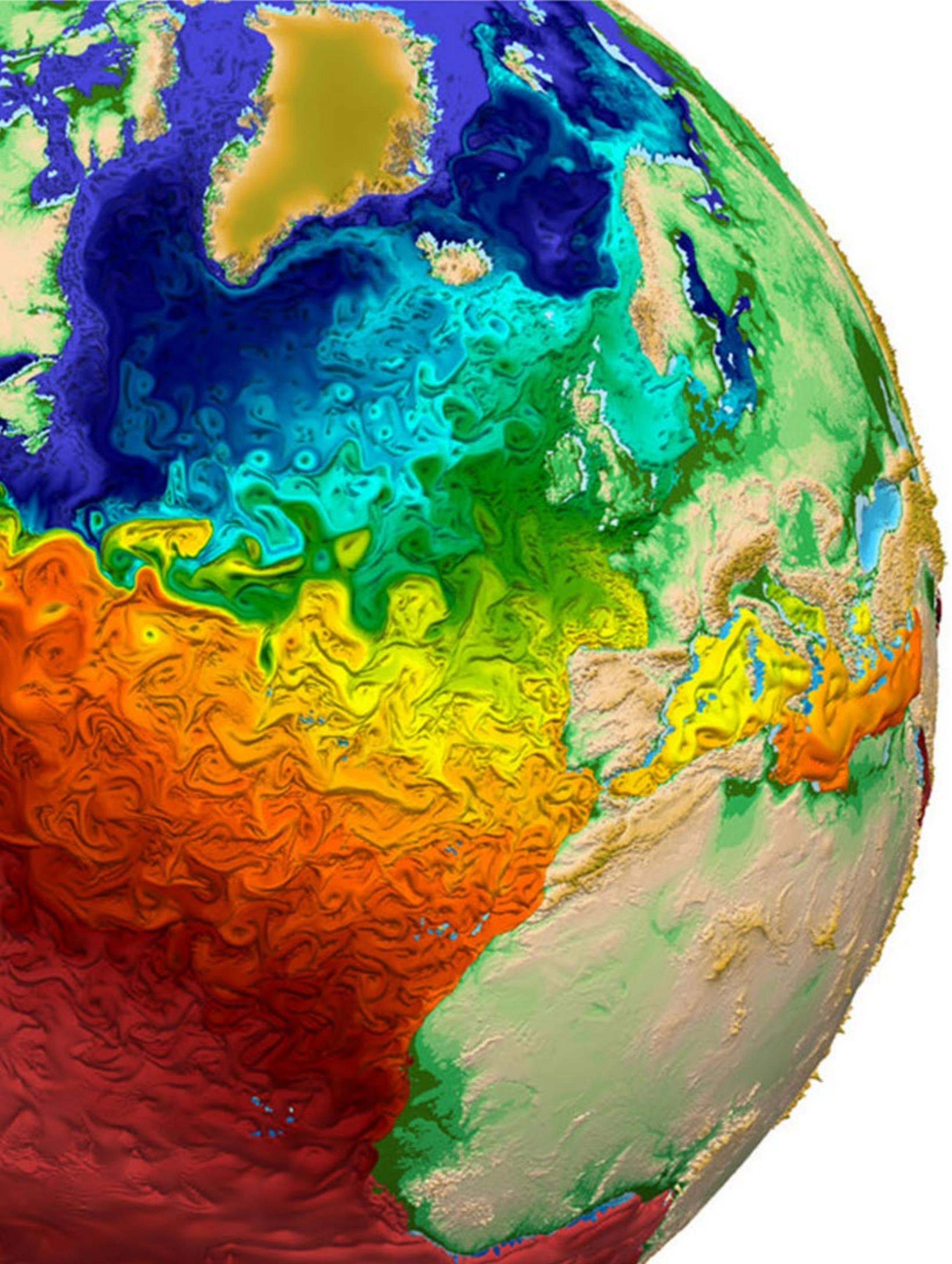

The sRGB Color Space

Scientific Visualization

Professor Eric Shaffer

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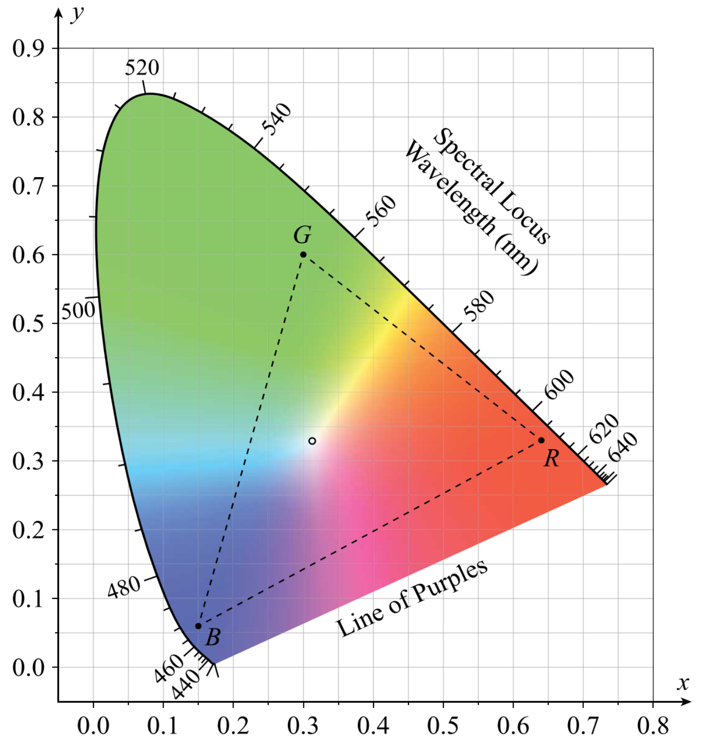
sRGB Color Space

- The standard RGB color space is defined in terms of the CIE XYZ space
- The primaries are

$$(x_R, y_R) = (0.64, 0.33)$$
$$(x_G, y_G) = (0.30, 0.60)$$
$$(x_B, y_B) = (0.15, 0.06)$$



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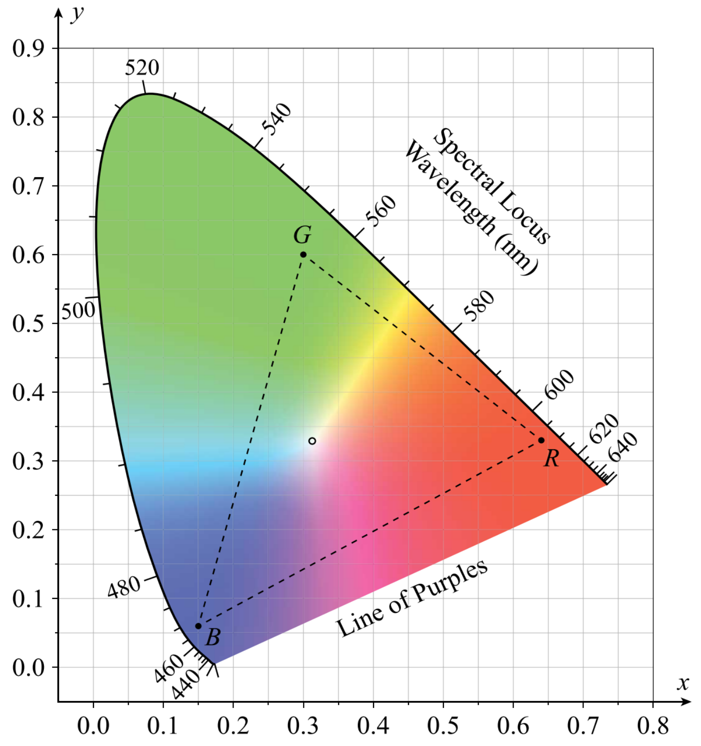

- You can compute the Y coordinates…..
  - Require that the primaries sum to D65 with $Y_{D65}=1$
  - Convert to XYZ space and solve for luminance there

$$Y_R = 0.212639$$
$$Y_G = 0.715169$$
$$Y_B = 0.072192.$$

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Conversion from XYZ to sRGB

We want to find a matrix M_{sRGB} that converts a XYZ color to sRGB

Each sRGB primary should convert to its defined XYZ coordinates

That gives us

$$\mathbf{M}_{\text{sRGB}} \begin{bmatrix} \frac{x_R}{y_R} Y_R & \frac{x_G}{y_G} Y_G & \frac{x_B}{y_B} Y_B \\ Y_R & Y_G & Y_B \\ \frac{z_R}{y_R} Y_R & \frac{z_G}{y_G} Y_G & \frac{z_B}{y_B} Y_B \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

The columns of the RHS matrix are the sRGB coordinates of the primaries

Conversion from XYZ to sRGB

We can substitute in the known xyY values for variables in middle matrix

e.g. $(x_g, y_g, Y_g) = (0.3, 0.6, 0.715169)$

$$\mathbf{M}_{\text{sRGB}} \begin{bmatrix} \frac{x_R}{y_R} Y_R & \frac{x_G}{y_G} Y_G & \frac{x_B}{y_B} Y_B \\ Y_R & Y_G & Y_B \\ \frac{z_R}{y_R} Y_R & \frac{z_G}{y_G} Y_G & \frac{z_B}{y_B} Y_B \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

We can then solve to get $\mathbf{M}_{\text{sRGB}} = \begin{bmatrix} 3.240970 & -1.537383 & -0.498611 \\ -0.969244 & 1.875968 & 0.041555 \\ 0.055630 & -0.203977 & 1.056972 \end{bmatrix}$

Conversion from sRGB to XYZ

To convert from sRGB to XYZ, we just need to use the inverse of M_{sRGB}

$$\mathbf{M}_{\text{sRGB}}^{-1} = \begin{bmatrix} 0.412391 & 0.357584 & 0.180481 \\ 0.212639 & 0.715169 & 0.072192 \\ 0.019331 & 0.119195 & 0.950532 \end{bmatrix}$$

sRGB: The Big Picture

sRGB is the standard color space used in modern computing

- Given an RGB triple to display, a web browser assumed it is an sRGB value
- Gives displays the opportunity to exhibit color uniformity
- In practice, this is still difficult to do
  - e.g. LCD-LED black isn’t the same as OLED black

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