Tristimulus Values (X, Y, Z):

When projecting color space onto the plane X+Y+Z=1X + Y + Z = 1X+Y+Z=1, the XXX, YYY, and ZZZ coordinates represent the **tristimulus values** in the CIE 1931 color space, which is based on human visual perception rather than specific wavelengths of visible light. Here's how it works and what each component means:

1. **Tristimulus Values (X, Y, Z)**:
    - In the CIE XYZ color space, XXX, YYY, and ZZZ values represent a color as a combination of three imaginary primary colors, chosen to encompass all visible colors.
    - XXX, YYY, and ZZZ values are not directly tied to specific wavelengths but are instead based on a mathematical model of human color perception.

2. **Normalization to X+Y+Z=1X + Y + Z = 1X+Y+Z=1**:
    - To simplify color calculations, colors are often normalized so that X+Y+Z=1
    - This makes the tristimulus values a form of **chromaticity coordinates** and removes intensity information, leaving only color hue and saturation.

3. **Relation to Wavelengths**:
    - Although XXX, YYY, and ZZZ aren't specific wavelengths, the CIE model is designed to approximate the entire range of visible colors.
    - Each visible wavelength maps to a unique point in the CIE 1931 chromaticity diagram, with pure spectral colors (monochromatic light) forming the boundary of the chromaticity diagram.

So, xxx, yyy, and zzz in the X+Y+Z=1X + Y + Z = 1X+Y+Z=1 plane represent **normalized tristimulus values**, capturing color information without intensity. They're not directly related to specific wavelengths but rather a perceptual model of how we see colors.

HSV (or HSB) color model

The **HSV (or HSB) color model**—standing for Hue, Saturation, and Value (or Brightness)—is a color representation often used in digital graphics and design because it closely aligns with human color perception. Unlike models like RGB or CIE XYZ, HSV separates color into three intuitive components:

1. **Hue (H)**:
    - Represents the color type and is usually measured in degrees from 0° to 360° around a color wheel.
    - Common hues at key points include:
        - **0°** (or 360°): Red
        - **120°**: Green

        - **240°**: Blue
    - Hue is independent of brightness or intensity, representing the "pure" color component.
2. **Saturation (S)**:
    - Measures the intensity or purity of the color and ranges from 0% (no color, making it grayscale) to 100% (full color saturation, no white or gray mixed in).
    - High saturation means vivid, intense colors, while low saturation means a washed-out or pastel color.
3. **Value (V) or Brightness (B)**:
    - Represents the brightness of the color, ranging from 0% (black) to 100% (full brightness).
    - In HSV, adjusting the value or brightness changes how light or dark the color appears without affecting hue or saturation.

How HSV Differs from RGB and Why It's Useful

- **Intuitive Color Manipulation**: HSV separates color into hue, saturation, and brightness, making it easier to adjust colors intuitively (e.g., making a color lighter or darker without changing its actual "color").
- **Widely Used in Art and Design**: Many image-editing programs, like Photoshop, use HSV sliders because artists can easily adjust tones, shades, and tints without complex color mixing.

The HSV Color Wheel

In this model:

- **Hue** forms the wheel's circumference, where colors shift gradually from one to another.
- **Saturation** affects the radial distance from the center (higher toward the edges), with the center typically desaturated (white or gray).
- **Value/Brightness** is commonly visualized as height or an additional dimension, where increasing it makes the color lighter or darker.