Chromaticity Diagrams

Measuring Color III

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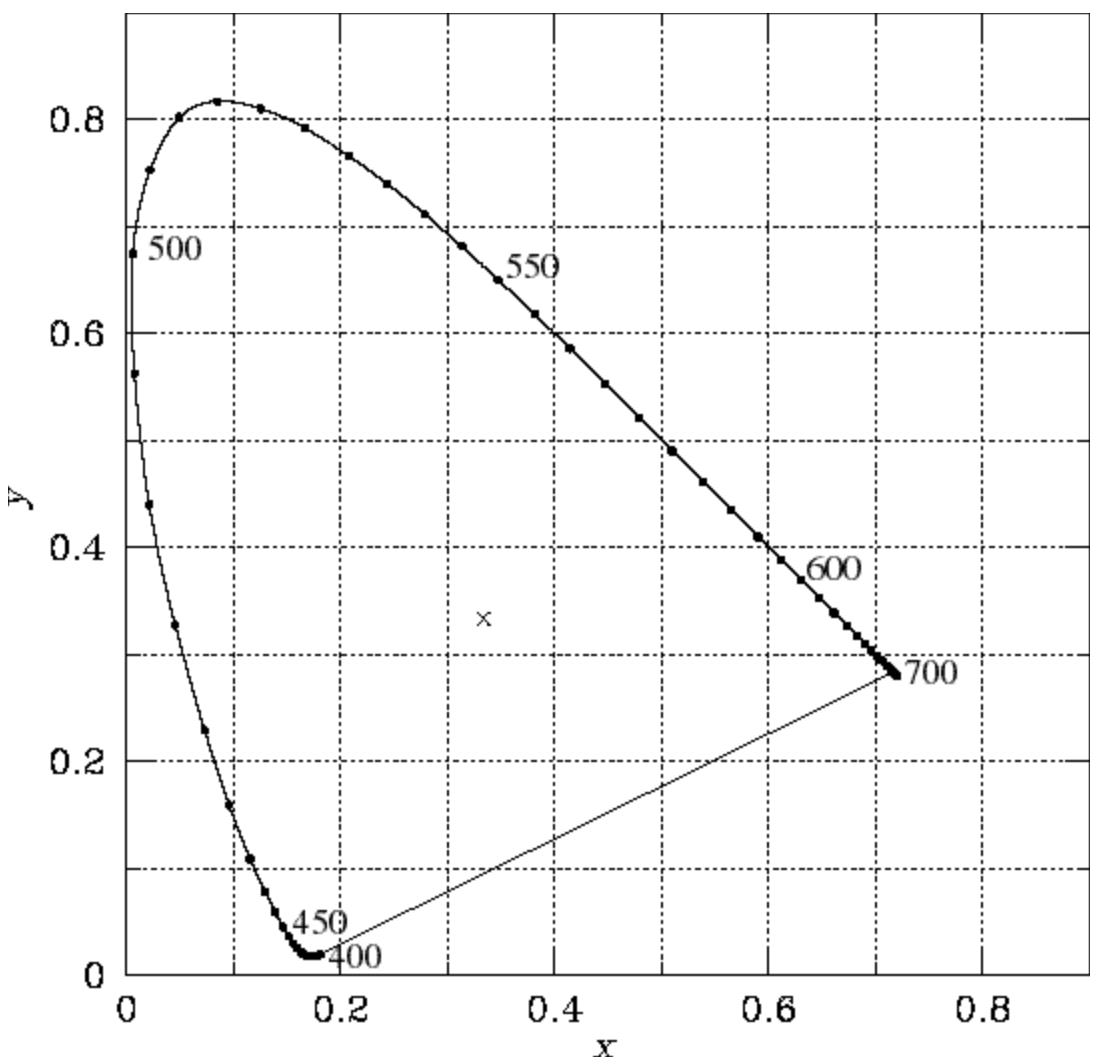
PHY 3400
Light, Color and Holography

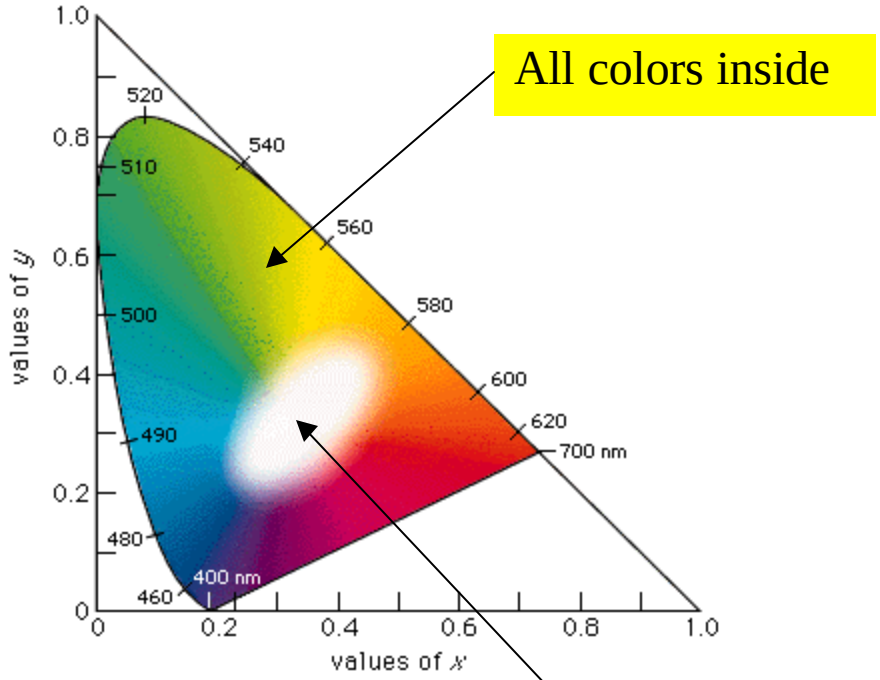
http://www.phys.ufl.edu/~avery/course/phy3400_f99/

Chromaticity diagram

- For every wavelength in the spectrum, calculate (XYZ) from the CIE color matching functions
- From XYZ, calculate (*xy*)
- Plot (*x*,*y*) for all wavelengths in spectrum
- Generates a horseshoe shaped diagram
  All physical colors lie *inside* the horseshoe



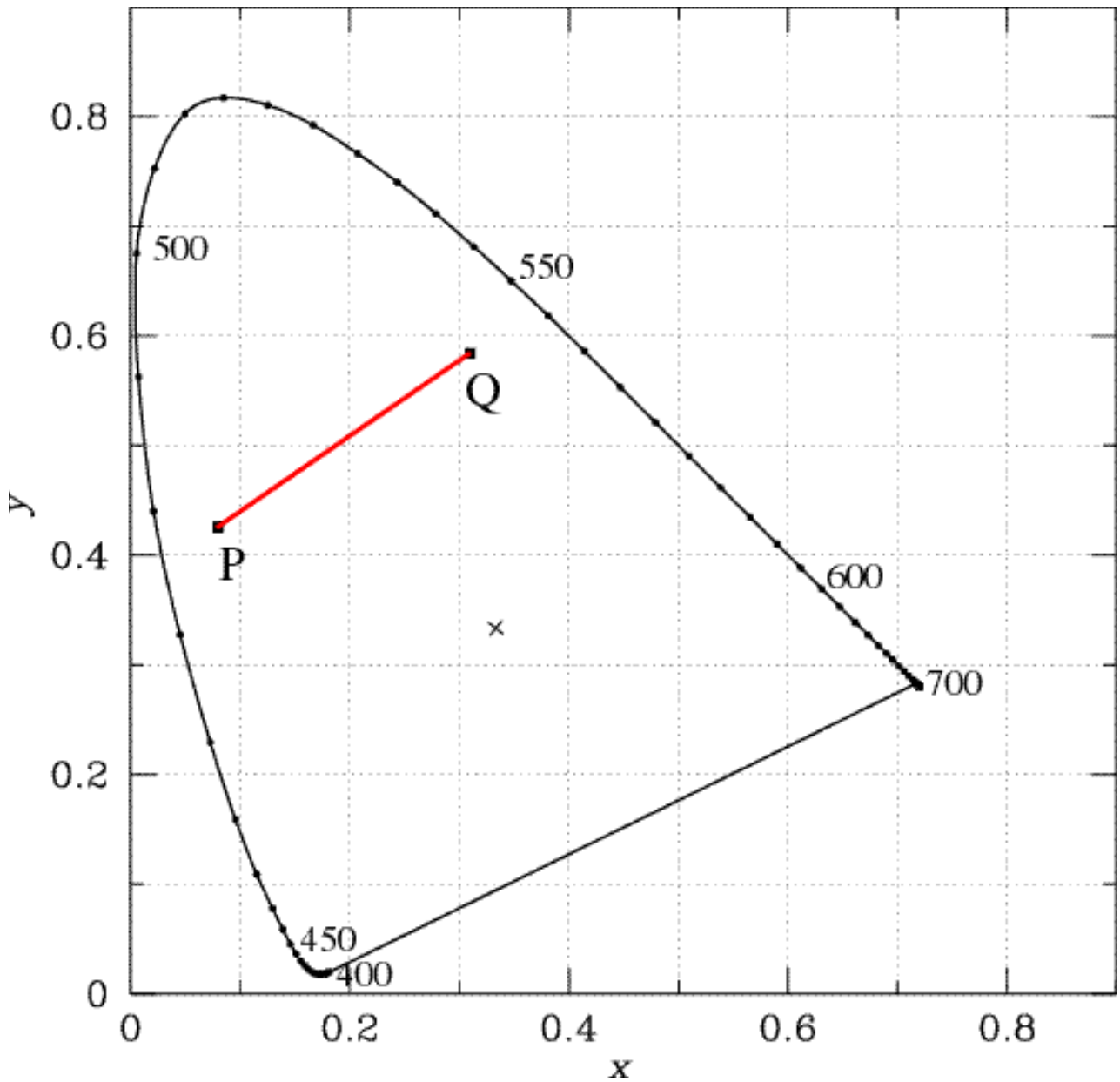
Artist's rendition of chromaticity diagram



- Monochromatic wavelengths on outside curve
- White light in the middle. Why?
  Flat spectrum: X=Y=Z $\Rightarrow$ $(xyz) = (0.33, 0.33, 0.33)$
- Other "white" sources lie close to this value

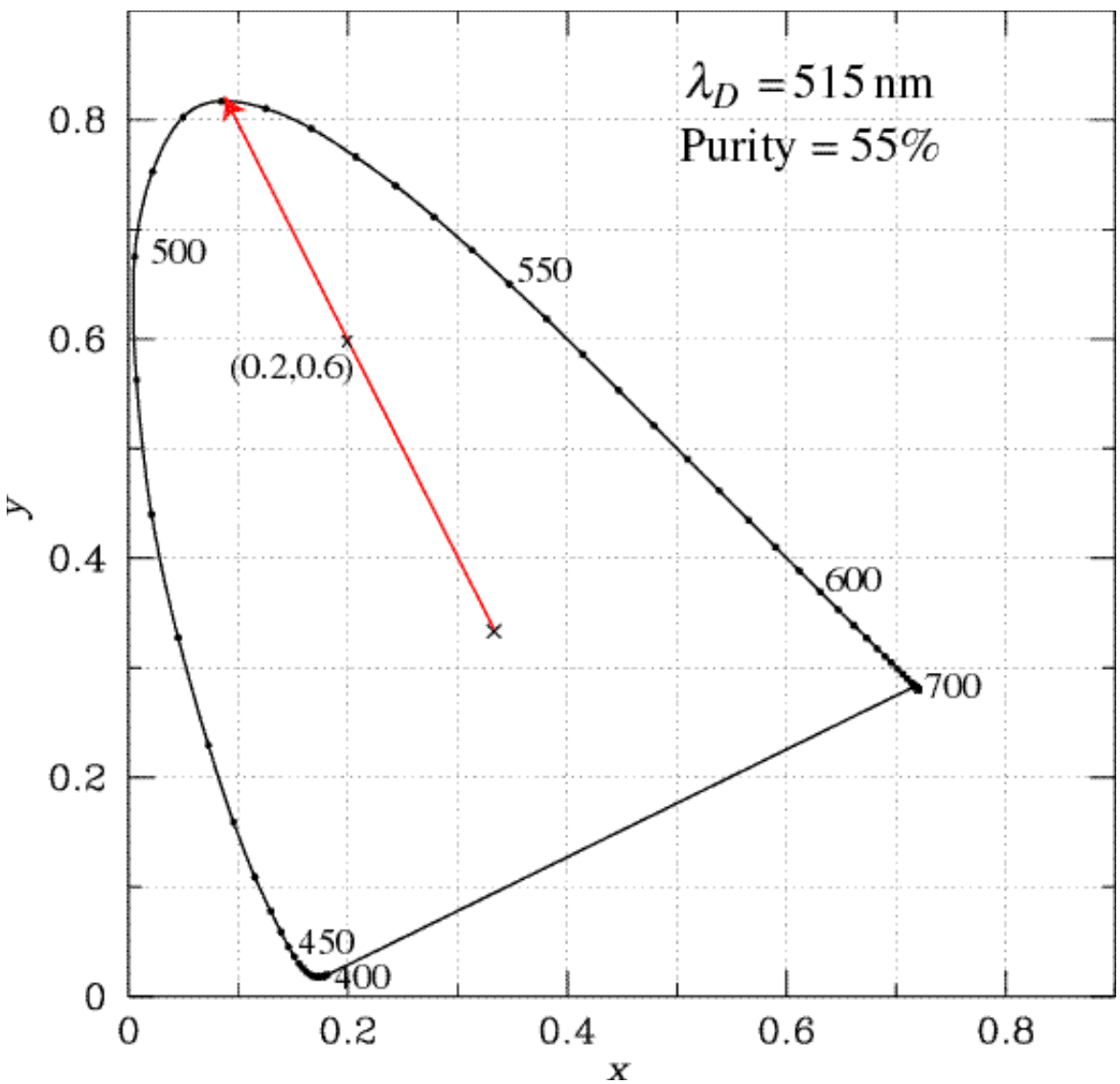
Two colors in diagram can produce any color lying between them

- Example of a *barocentric* system (center of gravity)
- Example: Different amounts of P,Q colors generate all points on red line. Similar to Newton color wheel.



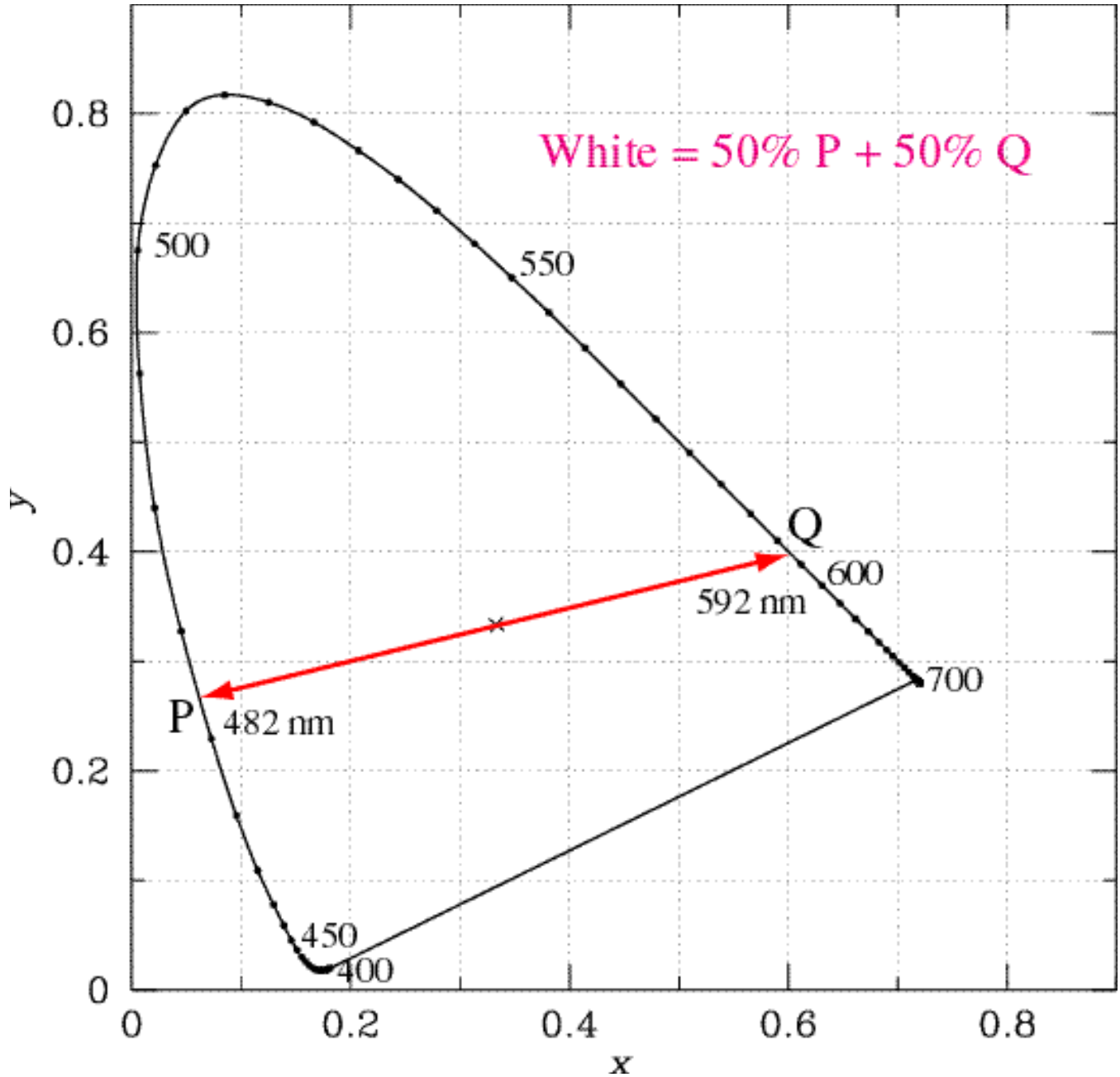
Dominant wavelength and purity

- Dominant wavelength: draw line from white point through the (xy) point of the color till it hits the curve $\Rightarrow l_D$
- Purity is the percentage of distance to the edge. At the edge, the purity is 100% and at the white point it is 0%
- Below: color can be reproduced by adding 45% white light and 55% monochromatic light at λ = 515 nm



Complementary wavelength

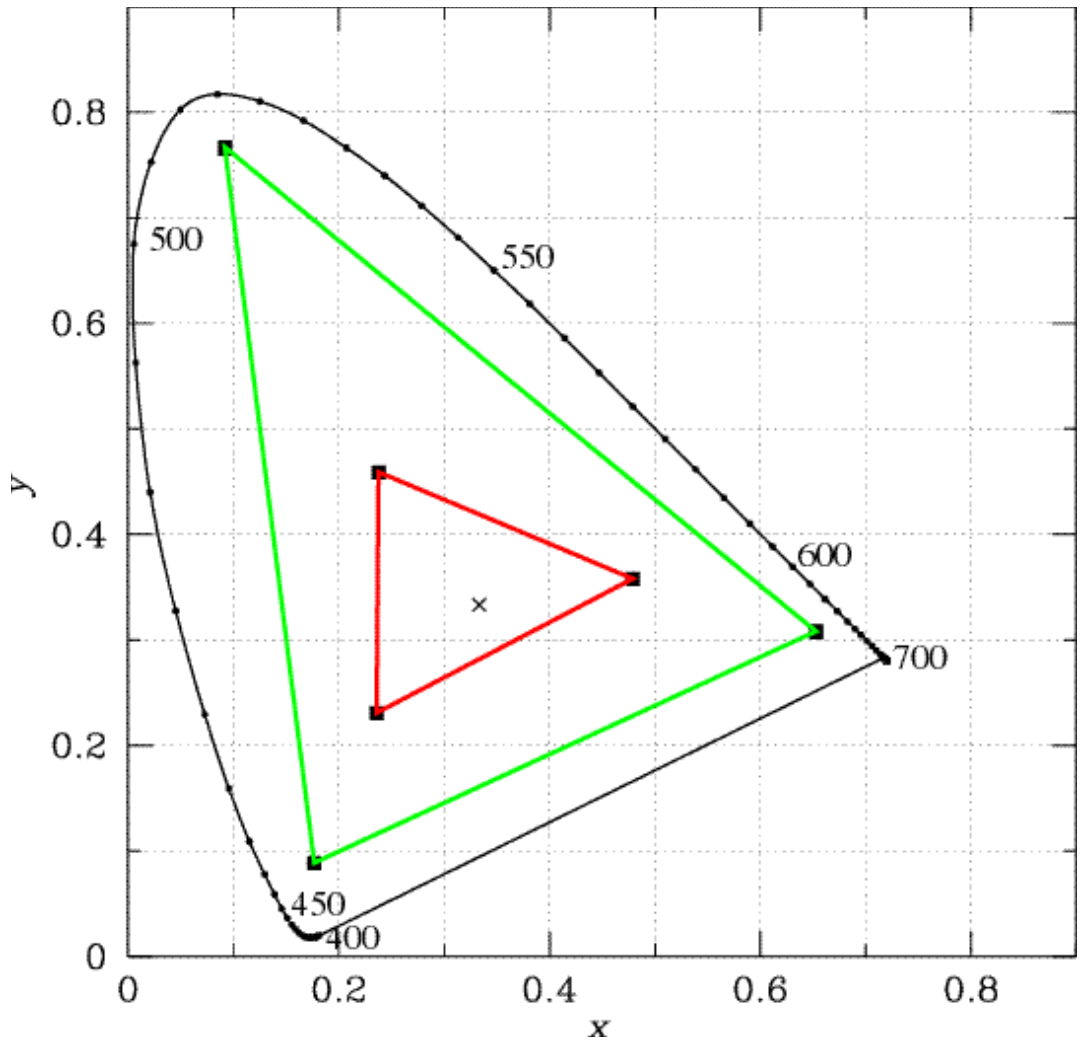
- Two points on opposite side of line passing through white point are called complementary
- Meaning: combination of light at *P* and *Q* can give white



Color Gamuts

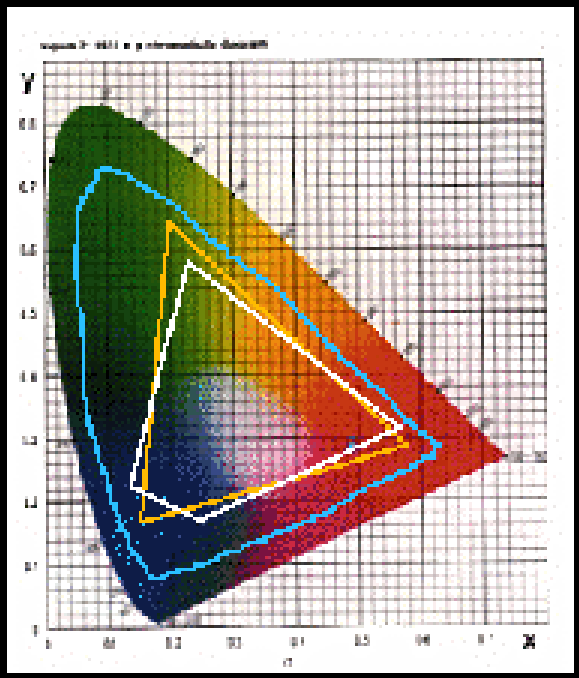
Any three colors form a triangle

- Combinations of colors must lie inside the triangle ⇒ gamut
- Best color reproduction ⇒ use biggest color gamut
- True for all media, print, monitor, film, slides
- No three primaries can reproduce human vision (see below)



CIE 1931 xy chromaticity diagram

Commission Internationale de l'Eclairage



Film

Monitor

Printing Press