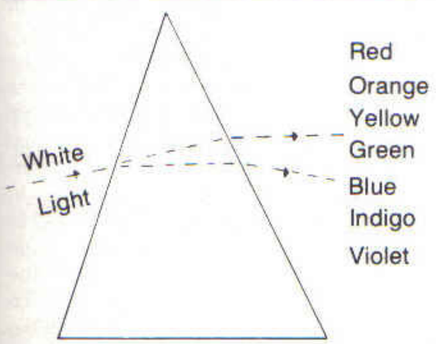
A Lens Primer for Lighting Directors: Part II

by Bentley Miller

Before we continue with our discussion on optics, I think that it is important to point out how every facet of optics is related to the tristimulus primaries as defined by the C.I.E. (Commission Internationale de l'Eclairage). The C.I.E. has produced a precise chart, the chromaticity diagram on which all colors are plotted. The colors which are used for the N.T.S.C. system are plotted as R (0.700 um), G (0.546 um) B (0.436 um) and lie within the triangle created by plotting the three colors on this chromaticity diagram. The use of this chart allows us to accurately plot any two colors that are mixed to produce a third color. Observing the points on the chromaticity diagram gives us precise parameters for color and saturation (see diagram).

In the last installment, we talked about optical path elongation as caused by a glass block and glass compensation was mentioned as well. These terms were used contextually to describe the optical effects caused by the prism block assembly which is at the heart of a contemporary color camera system. In television, we are concerned with basically three colors: red, blue and green. All colors in "white" are derived or synthesized from these three colors in a fashion that is too complex to discuss here. If we look at a prism, we can see that its optical properties make it possible for a prism to separate supposed "white light" into its composite spectrum of colors. This fact was briefly touched upon in the previous article, which showed a diagram of the electromagnetic spectrum. In a color camera, the function of separating light into the three colors, red, blue and green that we need for photoconductive tubes is performed by the prism block assembly.

Since not all camera formats have standardized values for glass compensation, it is imperative to match the correct camera with the correct lens to optimize performance of the lens and the camera.

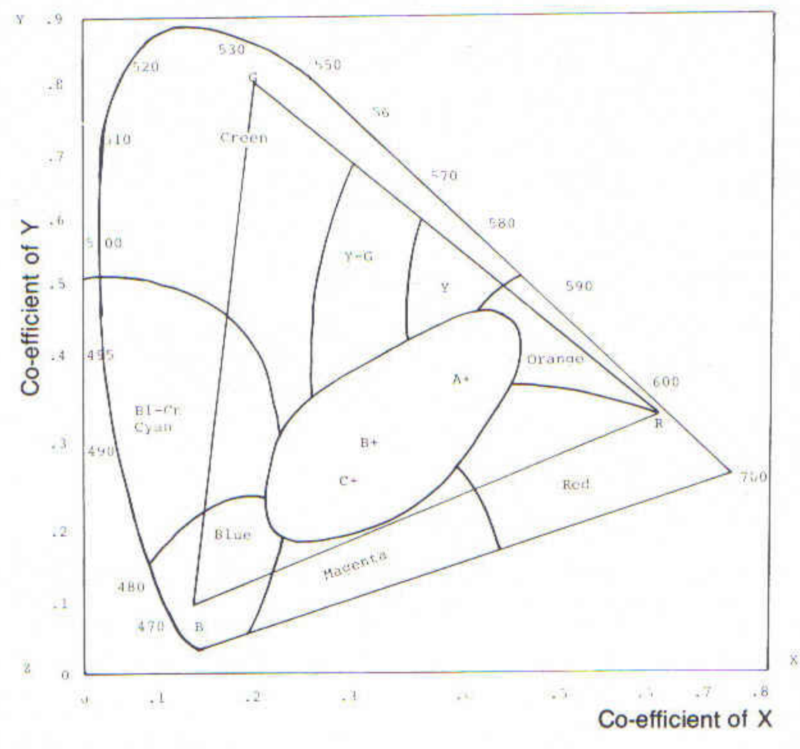


Prism

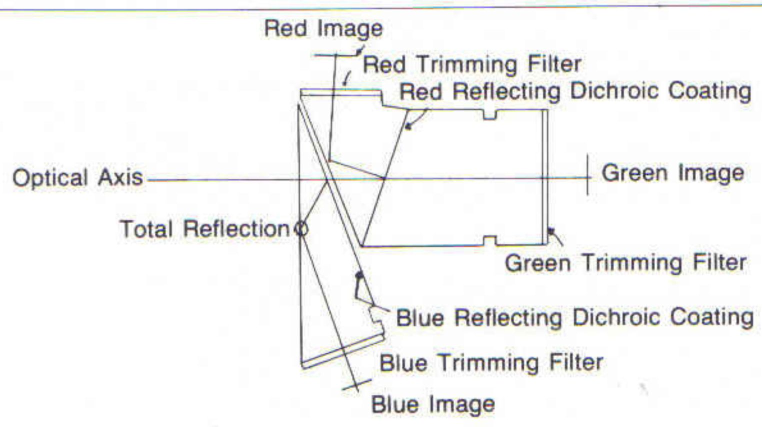
For example, if you had a prism beam assembly with a refractive index of say, 1.5, the optical path elongation would be 1/3 of the distance to the prism block assembly.[1]

As is to be expected, this element of optical physics would affect any aberration in the optical path. As we know from our previous discussion, when there is a mismatch of lens and camera, the result is increased spherical aberration and longitudinal chromatic aberration. This is due to the fact that a lens is designed to under-correct spherical aberration to nullify the over-correction caused by the glass block (the prism block assembly). If this balance of the two is thrown off the modulation transfer function "degrades significantly at higher frequencies".[2] If we recall from the chart on MTF a 2/3" camera is bandwidth limited by the 4.2 MHz of transmission system which produces a net result of contrast reproduced at 24 lines/mm. This value would be significantly reduced if there were a mismatch between the camera and lens.

Color Separation: the topic of optics involves the alteration and management of light through and through glass. The



C.I.E. Chromaticity Chart



Color Separation Optical System