

## **Color measurement of digital cinemas**

The modern cinema becomes digital. Although it is a huge investment more and more theatres are fitted out with digital projectors and the peripheral equipment. These projectors are based on powerful discharge lamps and digital mirror devices. They create a brilliant image without any blurring and black point like errors moving through the viewing area, as it is known from the classical celluloid cinema.

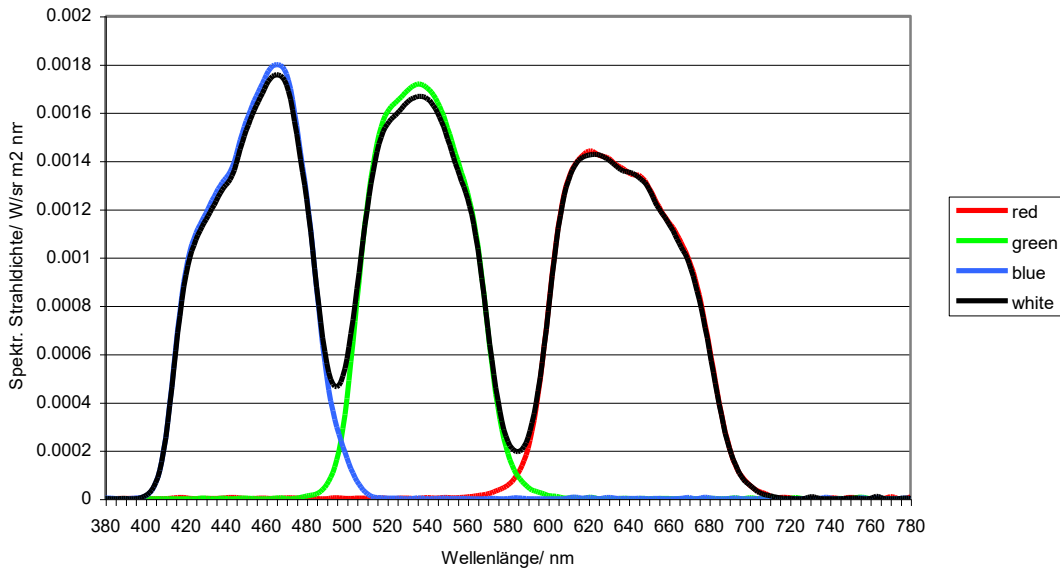
There is a main difference in both techniques concerning the storage of the color information. In case of film projection, it is permanently stored in the chemical layers of the film. In digital projection the color information is digitally stored, but the color impression is created by the interaction of this information with the settings of the optical system. Therefore, it is necessary to adjust the color channels of a digital projector to ensure a similar visual impression for the viewer in all cinemas. The parameters of the screen and the influence of the remaining additional room illumination play an important role for this adjustment.

The luminance and the chromaticity  $xy$  of the screen homogeneously illuminated with red, green, blue and white, have to be measured. The SMPTE requires a spot photometer with a precision of  $\pm 0.5 \text{ cd/m}^2$  for the luminance measurement and a spot spectroradiometer with a precision of 0.007 for the colorimetric measurement. Both measurements can be done with a spectroradiometer which fulfils both criteria.

The instrument has to be positioned in the middle of the auditorium in a height of 110 cm (distance from screen 1.5 ... 3.5 screen heights). The measured luminance in the corners and sides shall be at least 75 % of the center value. More details about the measurement can be found in the DCI Digital Cinema System Spec v. 1.0 (July 2005) and the SMPTE standard (draft) 431.1.

The practical measurement in a cinema is mostly limited on the measurement of the  $xy$  coordinates on some locations of the screen, followed by an projector adjustment and a new measurement, until the desired values are reached.

Specbos 1201 in combination with a laptop can be used for both kinds of measurement. The pilot laser circle can be seen clearly on the screen in the darkened audience. The following diagram shows the spectra of a white, blue, green and red illuminated screen. Furthermore, the appropriate measuring values are given in the table.



Blue, green, red and white spectrum of a Christies digital projector

Color	Red	Green	Blue	White
Luminance [cd/ m <sup>2</sup> ]	19	58	5	82
Chromaticity x	0.6732	0.2509	0.1444	0.3011
Chromaticity y	0.3237	0.7000	0.0429	0.3192

The measured colorimetric values can be sent to the projection room (e.g. via WLAN) and the projector color setting will be adjusted automatically. Afterwards the new values will be measured. This procedure is repeated until the demanded values are reached. So, it can be guaranteed that the color impression is the same in all cinemas.

The following figure shows the screen measurement with a specbos 1201 in a newly opened 3D digital cinema in Weimar (Germany). It is equipped with two similar Christies projectors. The red circle on the screen indicates the measuring area.

