6. PRINCIPIOS DE COLORIMETRÍA

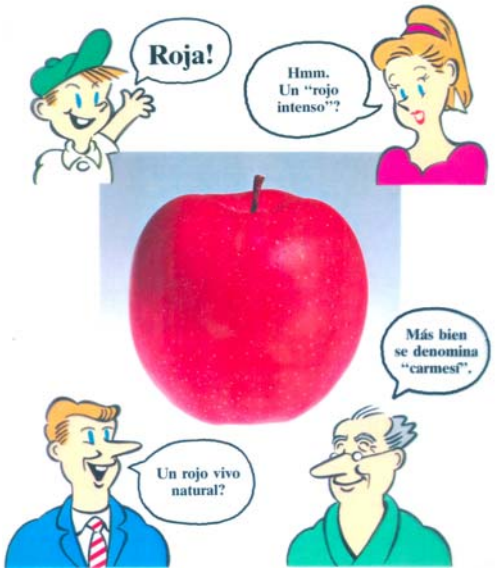
COLOR = LUZ + OBJETO + OBSERVADOR

LUZ: T_C, R_C

OBJETO: τ, ρ

COLORIMETRÍA: Ciencia generada para la medida y cuantificación del color

¿De qué color es esta manzana?



6.1. Trivariancia visual

¿Nº parámetros necesarios para definir un color?

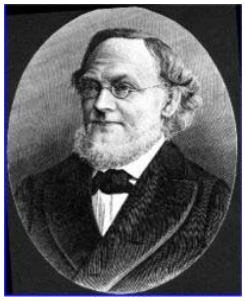
Atributos psicofísicos:

TONO
CLARIDAD
SATURACIÓN

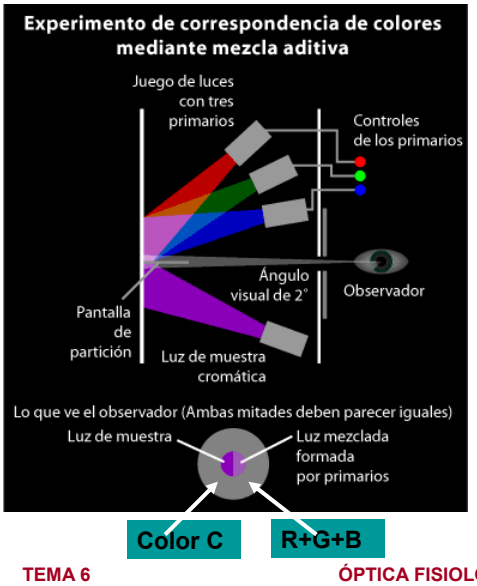
6.1. Trivariancia visual

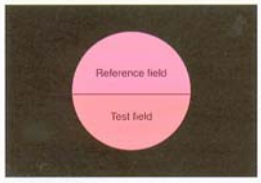
Leyes de Grassmann

1. **Simetría**: $A \equiv B \Rightarrow B \equiv A$
2. **Transitividad**: $A \equiv B$ y $B \equiv C \Rightarrow A \equiv C$
3. **Proporcionalidad**: $A \equiv B \Rightarrow kA \equiv kB$
4. **Aditividad**: $A \equiv B \Rightarrow A + C \equiv B + C$



6.2. Síntesis tricromática. Mezclas aditiva y sustractiva





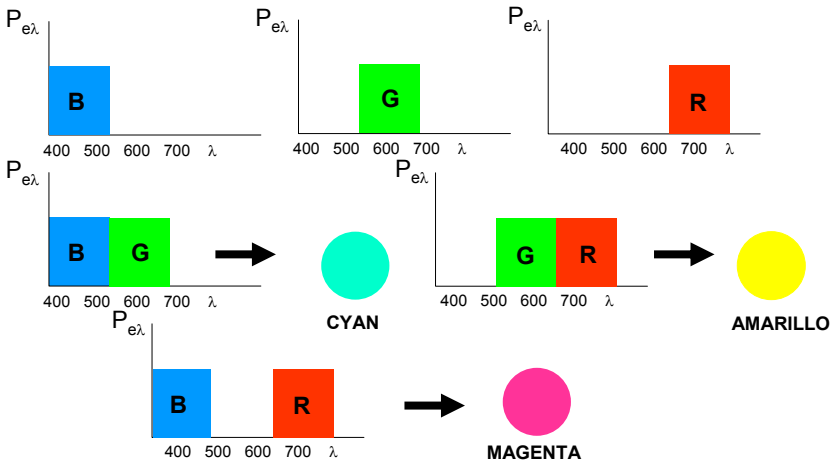
Cuando se produce la igualación:

$$c[C] = r[R] + g[G] + b[B]$$

r, g, b: VALORES TRIESTÍMULOS

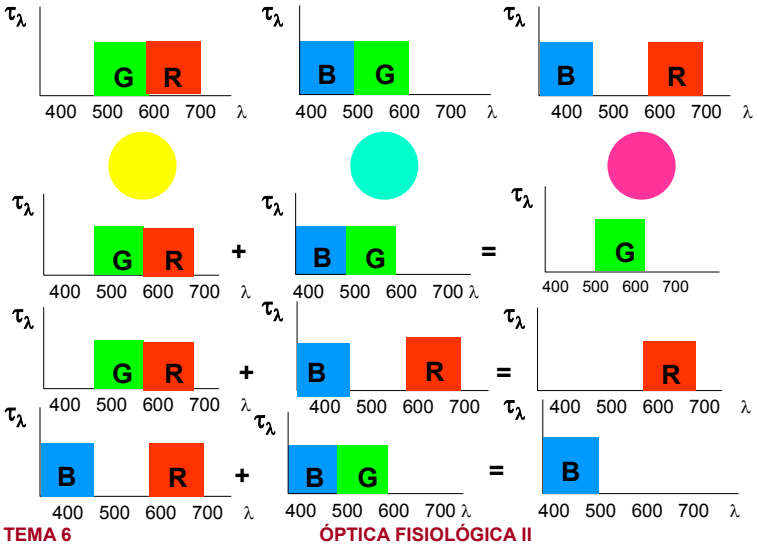
6.2. Síntesis tricromática. Mezclas aditiva y sustractiva

MEZCLA ADITIVA: R, G, B

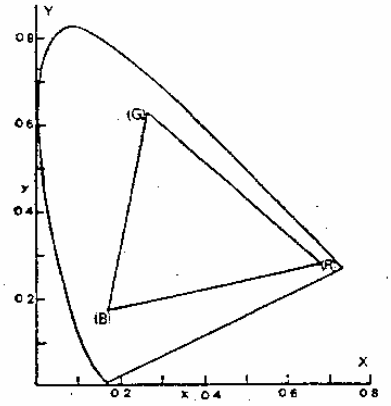


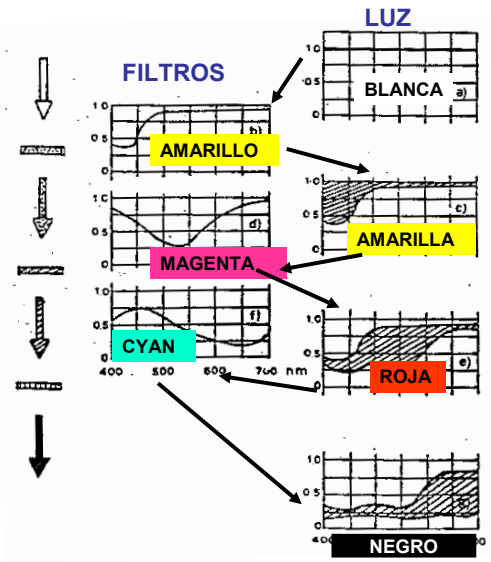
6.2. Síntesis tricromática. Mezclas aditiva y sustractiva

MEZCLA SUSTRACTIVA: AMARILLO, CYAN, MAGENTA



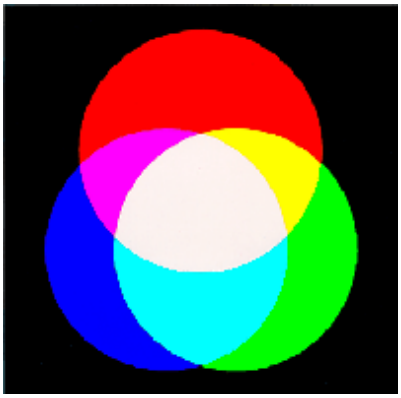
6.2. Síntesis tricromática. Mezclas aditiva y sustractiva





6.2. Síntesis tricromática. Mezclas aditiva y sustractiva

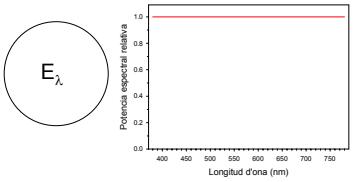
Mezclas aditiva y sustractiva

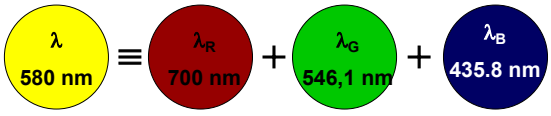


6.3. Sistema RGB. Sistema XYZ

SISTEMA RGB

BLANCO EQUIENERGÉTICO

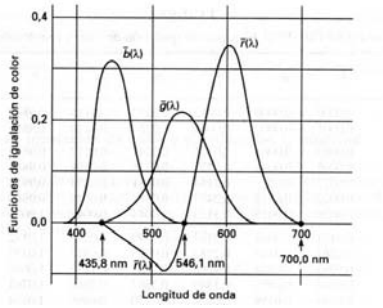




λ	$\bar{r}_\lambda$	$\bar{g}_\lambda$	$\bar{b}_\lambda$
380	2	5	10
390	2	7	14
400	4	8	18
410	6	11	24
780	28	10	0

6.3. Sistema RGB. Sistema XYZ

Funciones de igualación del color



Defectos:

- ☐ No da información sobre luminancia
- ☐ Valores triestímulos negativos!!

6.3. Sistema RGB. Sistema XYZ

SISTEMA XYZ

- Da información sobre la claridad
- No hay valores triestímulos negativos
- Los primarios son irreales

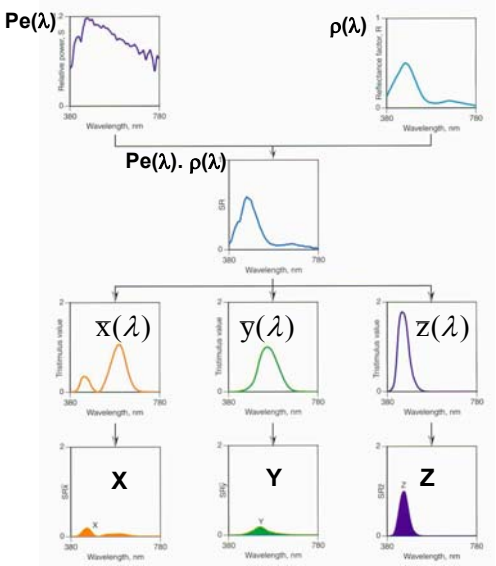
$$X = k \sum_{380}^{780} P_{0\lambda}.\rho_{\lambda}.\bar{x}_{\lambda}.\Delta\lambda$$

$$Y = k \sum_{380}^{780} P_{0\lambda}.\rho_{\lambda}.\bar{y}_{\lambda}.\Delta\lambda$$

$$Z = k \sum_{380}^{780} P_{0\lambda}.\rho_{\lambda}.\bar{z}_{\lambda}.\Delta\lambda$$

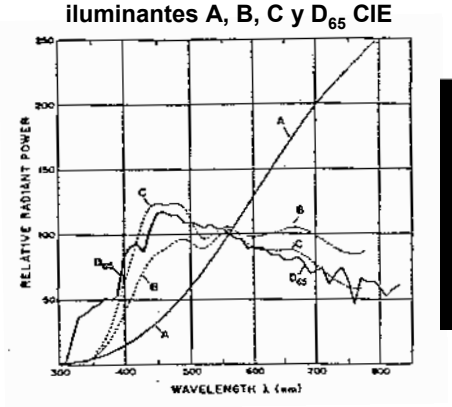
$$k = \frac{100}{\sum_{380}^{780} P_{0\lambda}.\bar{y}_{\lambda}.\Delta\lambda}$$

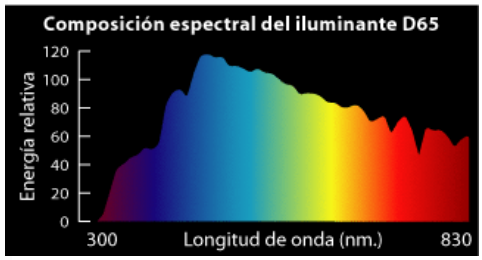
6.3. Sistema RGB. Sistema XYZ



6.3. Sistema RGB. Sistema XYZ

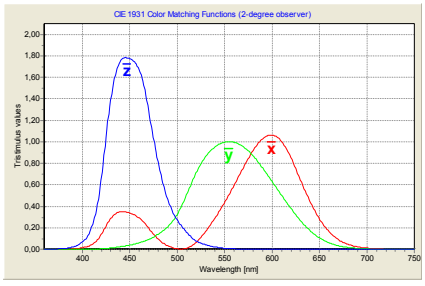
Espectros de emisión de los iluminantes A, B, C y D_{65} CIE



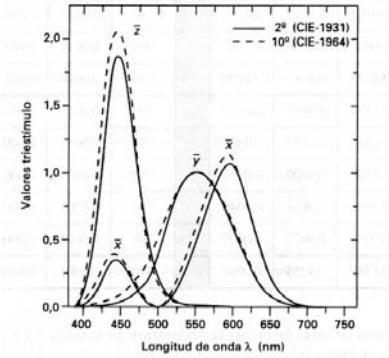


6.3. Sistema RGB. Sistema XYZ

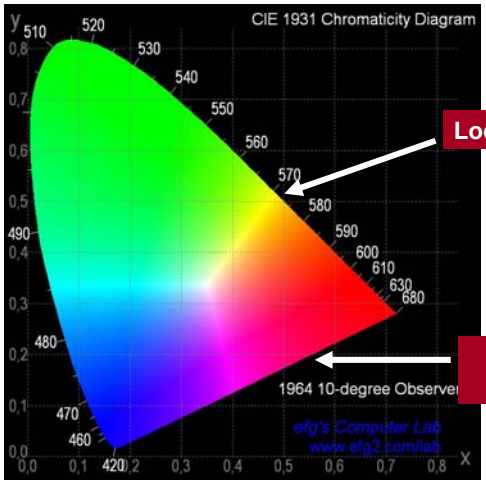
Observador patrón 2º (1931)



Observador patrón 2º y 10º (1931 y 1964 respectivamente)

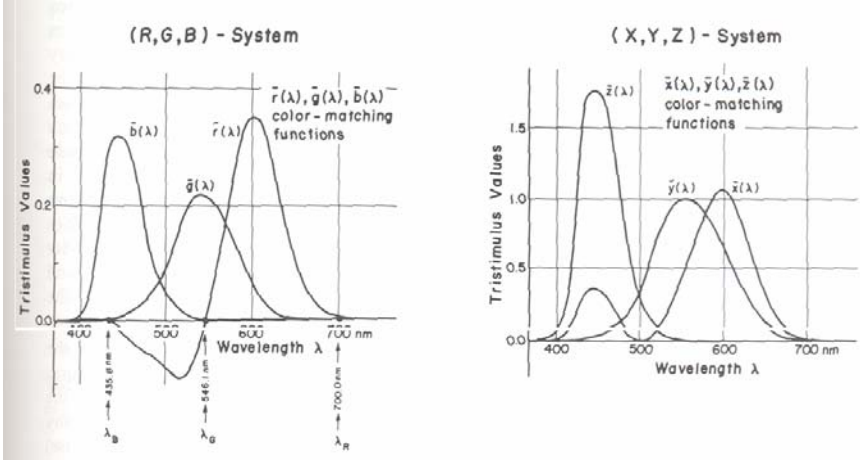


6.3. Sistema RGB. Sistema XYZ



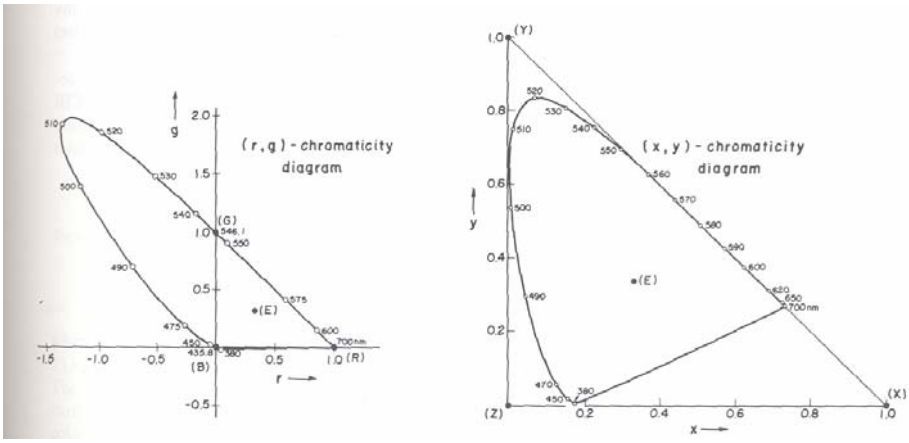
6.3. Sistema RGB. Sistema XYZ

Comparación funciones igualación color RGB - XYZ



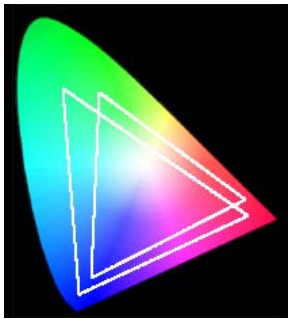
6.3. Sistema RGB. Sistema XYZ

Comparación diagrama cromático RGB - XYZ

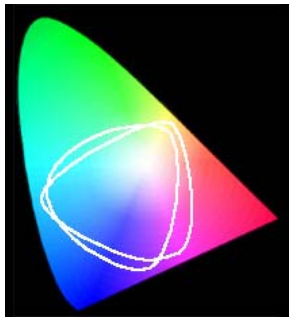


6.3. Sistema RGB. Sistema XYZ

Gamuts

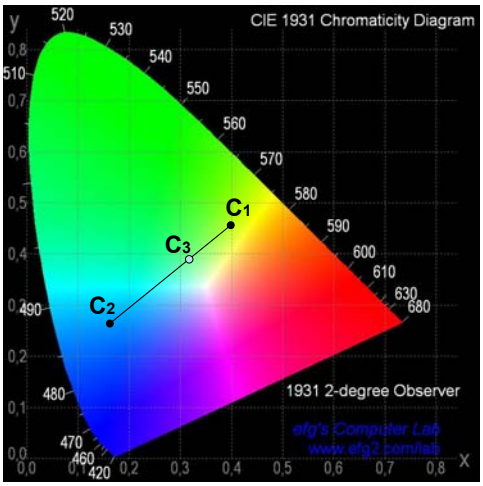


Gamut de dos monitores CRT



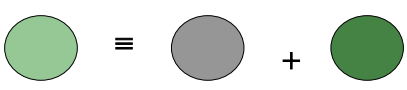
Gamut de dos impresoras

6.4. Diagrama cromático

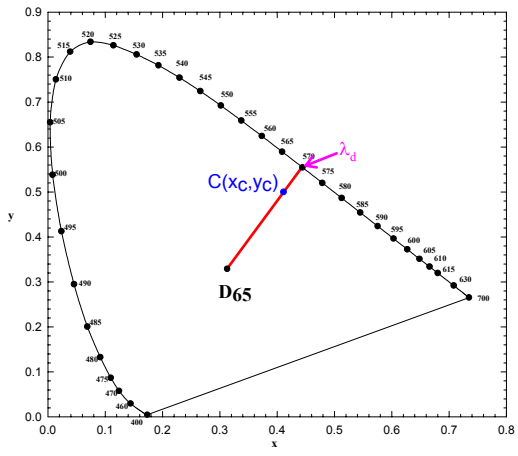


6.4. Diagrama cromático

Longitud de onda dominante

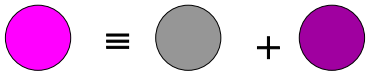


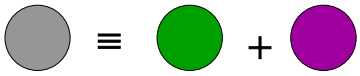
Unir el punto del iluminante (D65) con el del color (C) y buscar la intersección con el locus espectral



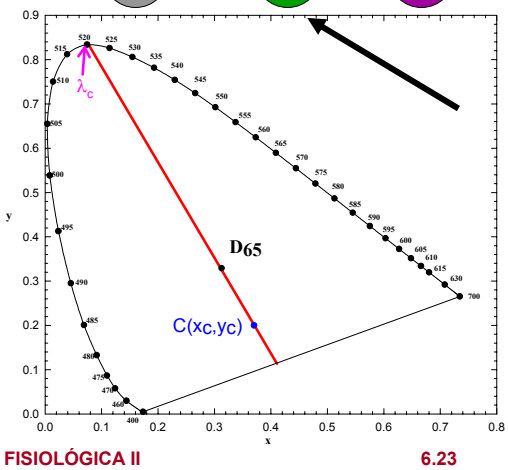
6.4. Diagrama cromático

Longitud de onda complementaria





Unir el punto del iluminante (D65) con el del color (C) y la línea de púrpuras. Continuar la recta hasta encontrar la intersección con el locus espectral

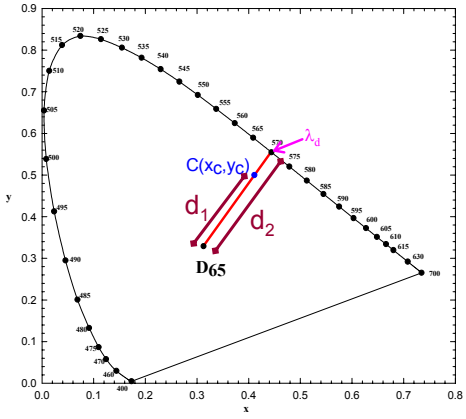


6.4. Diagrama cromático

Pureza espectral

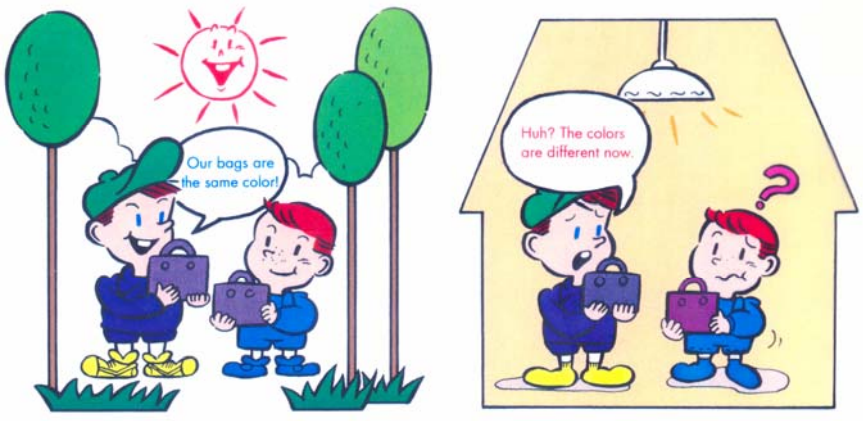
Distancia entre el punto del iluminante (D_{65}) y el del color (C) dividido por la distancia entre el punto del iluminante (D_{65}) y el de la longitud de onda dominante (l_d)

$$p_e = \frac{d_1}{d_2}$$

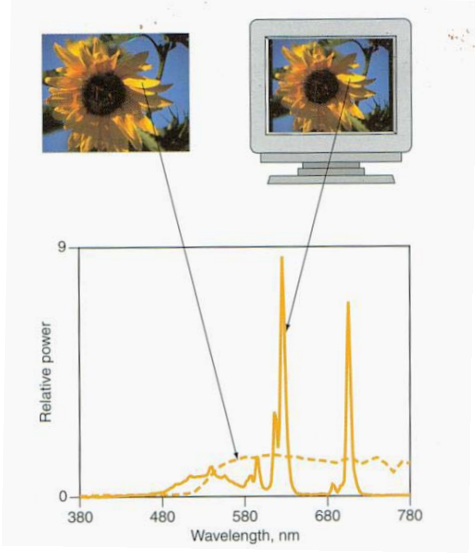


$$p_e = \frac{|x_c - x_{D65}|}{|x_{\lambda_d} - x_{D65}|} = \frac{|y_c - y_{D65}|}{|y_{\lambda_d} - y_{D65}|}$$

6.5. Metamerismo

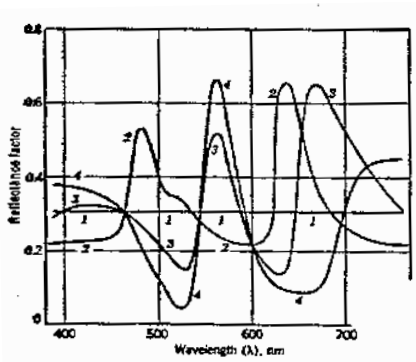


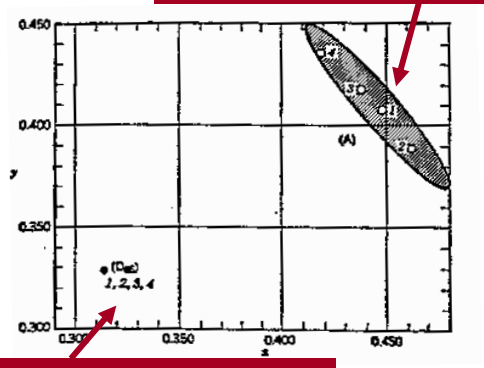
6.5. Metamerismo



6.5. Metamerismo

4 objetos iluminados con iluminante A y D65 (observador patrón de 1931):





Iluminante A: no metámeros

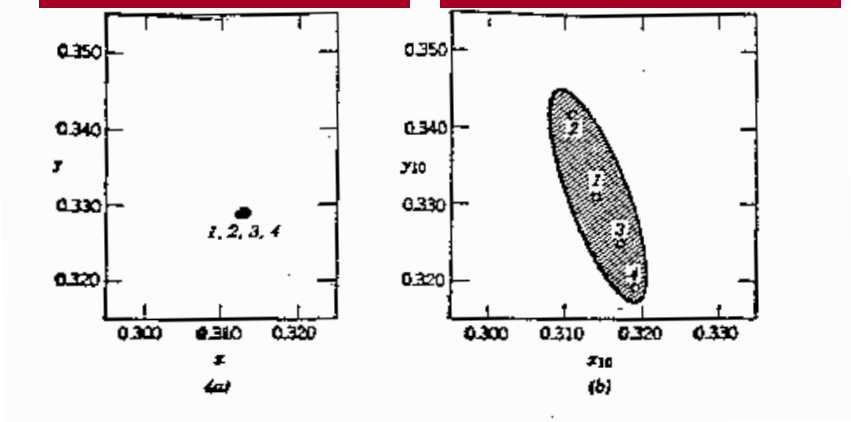
Iluminante D65: metámeros

6.5. Metamerismo

Los mismos 4 objetos iluminados bajo D65 pero para los dos observadores patrones (1931 y 1964):

Observador 1931: metámeros

Observador 1964: no metámeros



Tablas para cálculos de XYZ

Table I(3.3.8) CIE 1931 Color-Matching Functions $\bar{x}(\lambda), \bar{y}(\lambda), \bar{z}(\lambda)$ Weighted by the Relative Spectral Radiant Power Distributions of CIE Standard Illuminants A, B, C, from $\lambda = 380$ to 770 nm at Wavelength Intervals $\Delta\lambda = 10$ nm

Wavelength, λ(nm)	Illuminant A			Illuminant B			Illuminant C		
	$S(\lambda)\bar{x}(\lambda)$	$S(\lambda)\bar{y}(\lambda)$	$S(\lambda)\bar{z}(\lambda)$	$S(\lambda)\bar{x}(\lambda)$	$S(\lambda)\bar{y}(\lambda)$	$S(\lambda)\bar{z}(\lambda)$	$S(\lambda)\bar{x}(\lambda)$	$S(\lambda)\bar{y}(\lambda)$	$S(\lambda)\bar{z}(\lambda)$
380	0.001	0.000	0.006	0.003	0.000	0.014	0.004	0.000	0.020
90	0.005	0.000	0.023	0.013	0.000	0.060	0.019	0.000	0.089
400	0.019	0.001	0.093	0.056	0.002	0.268	0.085	0.002	0.404
10	0.071	0.002	0.340	0.217	0.006	1.033	0.329	0.009	1.570
20	0.262	0.008	1.256	0.812	0.024	3.899	1.238	0.037	5.949
30	0.649	0.027	3.167	1.983	0.081	9.678	2.997	0.122	14.628
40	0.926	0.061	4.647	2.689	0.178	13.489	3.975	0.262	19.938
450	1.031	0.117	5.435	2.744	0.310	14.462	3.915	0.443	20.638
60	1.019	0.210	5.851	2.454	0.506	14.085	3.362	0.694	19.299
70	0.776	0.362	5.116	1.718	0.800	11.319	2.272	1.058	14.972
80	0.428	0.622	3.636	0.870	1.265	7.396	1.112	1.618	9.461
90	0.160	1.039	2.324	0.295	1.918	4.290	0.363	2.358	5.274

Tablas para cálculos de XYZ

Wavelength, λ(nm)	Illuminant A			Illuminant B			Illuminant C		
	$S(\lambda)\bar{x}(\lambda)$	$S(\lambda)\bar{y}(\lambda)$	$S(\lambda)\bar{z}(\lambda)$	$S(\lambda)\bar{x}(\lambda)$	$S(\lambda)\bar{y}(\lambda)$	$S(\lambda)\bar{z}(\lambda)$	$S(\lambda)\bar{x}(\lambda)$	$S(\lambda)\bar{y}(\lambda)$	$S(\lambda)\bar{z}(\lambda)$
500	0.027	1.792	1.509	0.044	2.908	2.449	0.052	3.401	2.864
10	0.057	3.080	0.969	0.081	4.360	1.371	0.089	4.833	1.520
20	0.425	4.771	0.525	0.541	6.072	0.669	0.576	6.462	0.712
30	1.214	6.322	0.309	1.458	7.594	0.372	1.523	7.934	0.388
40	2.313	7.600	0.162	2.689	8.834	0.188	2.785	9.149	0.195
550	3.732	8.568	0.075	4.183	9.603	0.084	4.282	9.832	0.086
60	5.510	9.222	0.036	5.840	9.774	0.038	5.880	9.841	0.039
70	7.571	9.457	0.021	7.472	9.334	0.021	7.322	9.147	0.020
80	9.719	9.228	0.018	8.843	8.396	0.016	8.417	7.992	0.016
90	11.579	8.540	0.012	9.728	7.176	0.010	8.984	6.627	0.010
600	12.704	7.547	0.010	9.948	5.909	0.007	8.949	5.316	0.007
10	12.669	6.356	0.004	9.436	4.734	0.003	8.325	4.176	0.002
20	11.373	5.071	0.003	8.140	3.630	0.002	7.070	3.153	0.002
30	8.980	3.704	0.000	6.200	2.558	0.000	5.309	2.190	0.000
40	6.558	2.562	0.000	4.374	1.709	0.000	3.693	1.443	0.000

Tablas para cálculos de XYZ

Wavelength, λ(nm)	Illuminant A			Illuminant B			Illuminant C		
	$S(\lambda)\bar{x}(\lambda)$	$S(\lambda)\bar{y}(\lambda)$	$S(\lambda)\bar{z}(\lambda)$	$S(\lambda)\bar{x}(\lambda)$	$S(\lambda)\bar{y}(\lambda)$	$S(\lambda)\bar{z}(\lambda)$	$S(\lambda)\bar{x}(\lambda)$	$S(\lambda)\bar{y}(\lambda)$	$S(\lambda)\bar{z}(\lambda)$
650	4.336	1.637	0.000	2.815	1.062	0.000	2.349	0.886	0.000
60	2.628	0.972	0.000	1.655	0.612	0.000	1.361	0.504	0.000
70	1.448	0.530	0.000	0.876	0.321	0.000	0.708	0.259	0.000
80	0.804	0.292	0.000	0.465	0.169	0.000	0.369	0.134	0.000
90	0.404	0.146	0.000	0.220	0.080	0.000	0.171	0.062	0.000
700	0.209	0.075	0.000	0.108	0.039	0.000	0.082	0.029	0.000
10	0.110	0.040	0.000	0.053	0.019	0.000	0.039	0.014	0.000
20	0.057	0.019	0.000	0.026	0.009	0.000	0.019	0.006	0.000
30	0.028	0.010	0.000	0.012	0.004	0.000	0.008	0.003	0.000
40	0.014	0.006	0.000	0.006	0.002	0.000	0.004	0.002	0.000
750	0.006	0.002	0.000	0.002	0.001	0.000	0.002	0.001	0.000
60	0.004	0.002	0.000	0.002	0.001	0.000	0.001	0.001	0.000
70	0.002	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.000
Sums (X, Y, Z)	109.828	100.000	35.547	99.072	100.000	85.223	98.041	100.000	118.103
(x, y, z)	0.4476	0.4075	0.1449	0.3485	0.3517	0.2998	0.3101	0.3163	0.3736

Tablas para cálculos de XYZ

Table II(3.3.8) CIE 1931 Color-Matching Functions $\bar{x}(\lambda), \bar{y}(\lambda), \bar{z}(\lambda)$ Weighted by the Relative Spectral Radiant Power Distributions of CIE D-Illuminants D_{55}, D_{65}, D_{75}, from $\lambda = 380$ to 770 nm at Wavelength Intervals $\Delta\lambda = 10$ nm

Wavelength, λ(nm)	Illuminant D_{55}			Illuminant D_{65}			Illuminant D_{75}		
	$S(\lambda)\bar{x}(\lambda)$	$S(\lambda)\bar{y}(\lambda)$	$S(\lambda)\bar{z}(\lambda)$	$S(\lambda)\bar{x}(\lambda)$	$S(\lambda)\bar{y}(\lambda)$	$S(\lambda)\bar{z}(\lambda)$	$S(\lambda)\bar{x}(\lambda)$	$S(\lambda)\bar{y}(\lambda)$	$S(\lambda)\bar{z}(\lambda)$
380	0.004	0.000	0.020	0.006	0.000	0.031	0.009	0.000	0.040
90	0.015	0.000	0.073	0.022	0.001	0.104	0.028	0.001	0.132
400	0.083	0.002	0.394	0.112	0.003	0.531	0.137	0.004	0.649
10	0.284	0.008	1.354	0.377	0.010	1.795	0.457	0.013	2.180
20	0.915	0.027	4.398	1.188	0.035	5.708	1.424	0.042	6.840
30	1.834	0.075	8.951	2.329	0.095	11.365	2.749	0.112	13.419
40	2.836	0.187	14.228	3.456	0.228	17.336	3.965	0.262	19.889
450	3.135	0.354	16.523	3.722	0.421	19.621	4.200	0.475	22.139
60	2.781	0.574	15.960	3.242	0.669	18.608	3.617	0.746	20.759
70	1.857	0.865	12.239	2.123	0.989	13.995	2.336	1.088	15.397
80	0.935	1.358	7.943	1.049	1.525	8.917	1.139	1.656	9.683
90	0.299	1.942	4.342	0.330	2.142	4.790	0.354	2.302	5.147

Tablas para cálculos de XYZ

Wavelength, λ(nm)	Illuminant D_{55}			Illuminant D_{65}			Illuminant D_{75}		
	$S(\lambda)\bar{x}(\lambda)$	$S(\lambda)\bar{y}(\lambda)$	$S(\lambda)\bar{z}(\lambda)$	$S(\lambda)\bar{x}(\lambda)$	$S(\lambda)\bar{y}(\lambda)$	$S(\lambda)\bar{z}(\lambda)$	$S(\lambda)\bar{x}(\lambda)$	$S(\lambda)\bar{y}(\lambda)$	$S(\lambda)\bar{z}(\lambda)$
500	0.047	3.095	2.606	0.051	3.342	2.815	0.054	3.538	2.979
10	0.089	4.819	1.516	0.095	5.131	1.614	0.099	5.372	1.690
20	0.602	6.755	0.744	0.627	7.040	0.776	0.646	7.249	0.799
30	1.641	8.546	0.418	1.686	8.784	0.430	1.716	8.939	0.437
40	2.821	9.267	0.197	2.869	9.425	0.201	2.900	9.526	0.203
550	4.248	9.750	0.086	4.267	9.796	0.086	4.271	9.804	0.086
60	5.656	9.467	0.037	5.625	9.415	0.037	5.584	9.346	0.037
70	7.048	8.804	0.019	6.947	8.678	0.019	6.843	8.549	0.019
80	8.517	8.087	0.015	8.305	7.886	0.015	8.108	7.698	0.015
90	8.925	6.583	0.010	8.613	6.353	0.009	8.387	6.186	0.009
600	9.540	5.667	0.007	9.047	5.374	0.007	8.700	5.168	0.007
10	9.071	4.551	0.003	8.500	4.265	0.003	8.108	4.068	0.003
20	7.658	3.415	0.002	7.091	3.162	0.002	6.710	2.992	0.001
30	5.525	2.279	0.000	5.063	2.089	0.000	4.749	1.959	0.000
40	3.933	1.537	0.000	3.547	1.386	0.000	3.298	1.289	0.000

Tablas para cálculos de XYZ

Wavelength, λ(nm)	Illuminant D_{55}			Illuminant D_{65}			Illuminant D_{75}		
	$S(\lambda)\bar{x}(\lambda)$	$S(\lambda)\bar{y}(\lambda)$	$S(\lambda)\bar{z}(\lambda)$	$S(\lambda)\bar{x}(\lambda)$	$S(\lambda)\bar{y}(\lambda)$	$S(\lambda)\bar{z}(\lambda)$	$S(\lambda)\bar{x}(\lambda)$	$S(\lambda)\bar{y}(\lambda)$	$S(\lambda)\bar{z}(\lambda)$
650	2.398	0.905	0.000	2.147	0.810	0.000	1.992	0.752	0.000
60	1.417	0.524	0.000	1.252	0.463	0.000	1.151	0.426	0.000
70	0.781	0.286	0.000	0.680	0.249	0.000	0.619	0.227	0.000
80	0.400	0.146	0.000	0.346	0.126	0.000	0.315	0.114	0.000
90	0.172	0.062	0.000	0.150	0.054	0.000	0.136	0.049	0.000
700	0.089	0.032	0.000	0.077	0.028	0.000	0.069	0.025	0.000
10	0.047	0.017	0.000	0.041	0.015	0.000	0.037	0.013	0.000
20	0.019	0.007	0.000	0.017	0.006	0.000	0.015	0.006	0.000
30	0.011	0.004	0.000	0.010	0.003	0.000	0.009	0.003	0.000
40	0.006	0.002	0.000	0.005	0.002	0.000	0.004	0.002	0.000
750	0.002	0.001	0.000	0.002	0.001	0.000	0.002	0.001	0.000
60	0.001	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.000
70	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000
Sums (X, Y, Z)	95.642	100.000	92.085	95.017	100.000	108.813	94.939	100.000	122.558
Chromaticities (x, y, z)	0.3324	0.3476	0.3200	0.3127	0.3291	0.3581	0.2990	0.3150	0.3860

Tablas para cálculos de XYZ

Table III(3.3.8) CIE 1964 Color-Matching Functions $\bar{x}_{10}(\lambda)$, $\bar{y}_{10}(\lambda)$, $\bar{z}_{10}(\lambda)$ Weighted by the Relative Spectral Radiant Power Distributions of CIE Standard Illuminants A, B, C, from $\lambda = 380$ to 770 nm at Wavelength Intervals $\Delta\lambda = 10$ nm

Wavelength, λ(nm)	Illuminant A			Illuminant B			Illuminant C		
	$S(\lambda)\bar{x}_{10}(\lambda)$	$S(\lambda)\bar{y}_{10}(\lambda)$	$S(\lambda)\bar{z}_{10}(\lambda)$	$S(\lambda)\bar{x}_{10}(\lambda)$	$S(\lambda)\bar{y}_{10}(\lambda)$	$S(\lambda)\bar{z}_{10}(\lambda)$	$S(\lambda)\bar{x}_{10}(\lambda)$	$S(\lambda)\bar{y}_{10}(\lambda)$	λ
380	0.000	0.000	0.001	0.000	0.000	0.002	0.001	0.000	.002
90	0.003	0.000	0.011	0.007	0.001	0.029	0.009	0.001	0.043
400	0.025	0.003	0.111	0.070	0.007	0.313	0.103	0.011	63
10	0.132	0.014	0.605	0.388	0.040	1.786	0.581	0.060	2.672
20	0.377	0.040	1.795	1.137	0.119	5.411	1.708	0.179	8.122
30	0.682	0.083	3.368	2.025	0.249	9.997	3.011	0.370	14.865
40	0.968	0.156	4.962	2.729	0.442	13.994	3.969	0.643	20.349
450	1.078	0.260	5.802	2.787	0.673	14.997	3.914	0.945	21.058
60	1.005	0.426	5.802	2.350	0.997	13.568	3.168	1.343	18.292
70	0.737	0.698	4.965	1.585	1.500	10.671	2.062	1.952	13.887
80	0.341	1.076	3.274	0.674	2.125	6.470	0.849	2.675	8.144
90	0.076	1.607	1.968	0.137	2.880	3.528	0.167	3.484	4.268

Tablas para cálculos de XYZ

Wavelength, λ(nm)	Illuminant A			Illuminant B			Illuminant C		
	$S(\lambda)\bar{x}_{10}(\lambda)$	$S(\lambda)\bar{y}_{10}(\lambda)$	$S(\lambda)\bar{z}_{10}(\lambda)$	$S(\lambda)\bar{x}_{10}(\lambda)$	$S(\lambda)\bar{y}_{10}(\lambda)$	$S(\lambda)\bar{z}_{10}(\lambda)$	$S(\lambda)\bar{x}_{10}(\lambda)$	$S(\lambda)\bar{y}_{10}(\lambda)$	λ
500	0.020	2.424	1.150	0.032	3.822	1.812	0.037	4.398	2.085
10	0.218	3.523	0.650	0.299	4.845	0.894	0.327	5.284	0.976
20	0.750	4.854	0.387	0.927	6.002	0.478	0.971	6.285	0.501
30	1.644	6.086	0.212	1.920	7.103	0.247	1.973	7.302	0.255
40	2.847	7.267	0.104	3.214	8.207	0.117	3.275	8.362	0.119
550	4.326	8.099	0.033	4.711	8.818	0.035	4.744	8.882	0.036
60	6.198	8.766	0.000	6.382	9.025	0.000	6.322	8.941	0.000
70	8.277	9.002	0.000	7.936	8.630	0.000	7.653	8.322	0.000
80	10.201	8.740	0.000	9.017	7.726	0.000	8.444	7.235	0.000
90	11.967	8.317	0.000	9.768	6.789	0.000	8.874	6.168	0.000
600	12.748	7.466	0.000	9.697	5.679	0.000	8.583	5.027	0.000
10	12.349	6.327	0.000	8.935	4.579	0.000	7.756	3.974	0.000
20	10.809	5.026	0.000	7.515	3.494	0.000	6.422	2.986	0.000
30	8.583	3.758	0.000	5.757	2.520	0.000	4.851	2.124	0.000
40	5.992	2.496	0.000	3.883	1.618	0.000	3.226	1.344	0.000

Tablas para cálculos de XYZ

Wavelength, λ(nm)	Illuminant A			Illuminant B			Illuminant C		
	$S(\lambda)\bar{x}_{10}(\lambda)$	$S(\lambda)\bar{y}_{10}(\lambda)$	$S(\lambda)\bar{z}_{10}(\lambda)$	$S(\lambda)\bar{x}_{10}(\lambda)$	$S(\lambda)\bar{y}_{10}(\lambda)$	$S(\lambda)\bar{z}_{10}(\lambda)$	$S(\lambda)\bar{x}_{10}(\lambda)$	$S(\lambda)\bar{y}_{10}(\lambda)$	$S(\lambda)\bar{z}_{10}(\lambda)$
650	3.892	1.561	0.000	2.454	0.984	0.000	2.014	0.808	0.000
60	2.306	0.911	0.000	1.410	0.557	0.000	1.142	0.451	0.000
70	1.277	0.499	0.000	0.751	0.294	0.000	0.598	0.233	0.000
80	0.666	0.259	0.000	0.374	0.145	0.000	0.293	0.114	0.000
90	0.336	0.130	0.000	0.178	0.069	0.000	0.136	0.053	0.000
700	0.167	0.064	0.000	0.084	0.033	0.000	0.062	0.024	0.000
10	0.083	0.033	0.000	0.039	0.015	0.000	0.028	0.011	0.000
20	0.040	0.015	0.000	0.018	0.006	0.000	0.013	0.004	0.000
30	0.019	0.008	0.000	0.008	0.004	0.000	0.005	0.003	0.000
40	0.010	0.004	0.000	0.004	0.002	0.000	0.003	0.001	0.000
750	0.006	0.002	0.000	0.003	0.001	0.000	0.002	0.001	0.000
60	0.002	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.000
70	0.002	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.000
Sums (X, Y, Z)	111.159	100.000	35.200	99.207	100.000	84.349	97.298	100.000	116.137
Chromaticities (x, y, z)	0.4512	0.4059	0.1429	0.3499	0.3526	0.2975	0.3104	0.3191	0.3705

Tablas para cálculos de XYZ

Table IV(3.3.8) CIE 1964 Color-Matching Functions $\bar{x}_{10}(\lambda), \bar{y}_{10}(\lambda), \bar{z}_{10}(\lambda)$ Weighted by the Relative Spectral Radiant Power Distributions of CIE D-Illuminants D_{55}, D_{65}, D_{75}, from $\lambda = 380$ to 770 nm at Wavelength Intervals $\Delta\lambda = 10$ nm

Wavelength, λ(nm)	Illuminant D_{55}			Illuminant D_{65}			Illuminant D_{75}		
	$S(\lambda)\bar{x}_{10}(\lambda)$	$S(\lambda)\bar{y}_{10}(\lambda)$	$S(\lambda)\bar{z}_{10}(\lambda)$	$S(\lambda)\bar{x}_{10}(\lambda)$	$S(\lambda)\bar{y}_{10}(\lambda)$	$S(\lambda)\bar{z}_{10}(\lambda)$	$S(\lambda)\bar{x}_{10}(\lambda)$	$S(\lambda)\bar{y}_{10}(\lambda)$	$S(\lambda)\bar{z}_{10}(\lambda)$
380	0.000	0.000	0.002	0.001	0.000	0.003	0.001	0.000	0.004
90	0.008	0.001	0.035	0.011	0.001	0.049	0.014	0.002	0.062
400	0.102	0.011	0.458	0.136	0.014	0.613	0.165	0.017	0.744
10	0.507	0.052	2.330	0.667	0.069	3.066	0.805	0.083	3.698
20	1.277	0.134	6.075	1.644	0.172	7.820	1.958	0.205	9.311
30	1.864	0.229	9.203	2.348	0.289	11.589	2.754	0.338	13.593
40	2.866	0.464	14.692	3.463	0.560	17.755	3.947	0.639	20.236
450	3.170	0.765	17.056	3.733	0.901	20.088	4.184	1.010	22.517
60	2.650	1.124	15.304	3.065	1.300	17.697	3.397	1.441	19.613
70	1.705	1.614	11.484	1.934	1.831	13.025	2.113	2.001	14.235
80	0.721	2.272	6.918	0.803	2.530	7.703	0.866	2.729	8.309
90	0.138	2.903	3.554	0.151	3.176	3.889	0.162	3.391	4.152

Tablas para cálculos de XYZ

Wavelength, λ(nm)	Illuminant D_{55}			Illuminant D_{65}			Illuminant D_{75}		
	$S(\lambda)\bar{x}_{10}(\lambda)$	$S(\lambda)\bar{y}_{10}(\lambda)$	$S(\lambda)\bar{z}_{10}(\lambda)$	$S(\lambda)\bar{x}_{10}(\lambda)$	$S(\lambda)\bar{y}_{10}(\lambda)$	$S(\lambda)\bar{z}_{10}(\lambda)$	$S(\lambda)\bar{x}_{10}(\lambda)$	$S(\lambda)\bar{y}_{10}(\lambda)$	$S(\lambda)\bar{z}_{10}(\lambda)$
500	0.034	4.048	1.920	0.036	4.337	2.056	0.038	4.560	2.162
10	0.329	5.331	0.984	0.348	5.629	1.040	0.362	5.855	1.081
20	1.027	6.646	0.530	1.062	6.870	0.548	1.086	7.028	0.560
30	2.150	7.957	0.277	2.192	8.112	0.282	2.216	8.201	0.285
40	3.356	8.569	0.122	3.385	8.644	0.123	3.399	8.679	0.123
550	4.761	8.912	0.036	4.744	8.881	0.036	4.717	8.830	0.036
60	6.153	8.701	0.000	6.069	8.583	0.000	5.985	8.465	0.000
70	7.451	8.103	0.000	7.285	7.922	0.000	7.129	7.753	0.000
80	8.645	7.407	0.000	8.361	7.163	0.000	8.108	6.947	0.000
90	8.919	6.199	0.000	8.537	5.934	0.000	8.259	5.740	0.000
600	9.257	5.422	0.000	8.707	5.100	0.000	8.318	4.872	0.000
10	8.550	4.381	0.000	7.946	4.071	0.000	7.530	3.858	0.000
20	7.038	3.271	0.000	6.463	3.004	0.000	6.076	2.824	0.000
30	5.107	2.236	0.000	4.641	2.032	0.000	4.325	1.894	0.000
40	3.475	1.448	0.000	3.169	1.295	0.000	2.872	1.197	0.000

Tablas para cálculos de XYZ

Wavelength, λ(nm)	Illuminant D_{55}			Illuminant D_{65}			Illuminant D_{75}		
	$S(\lambda)\bar{x}_{10}(\lambda)$	$S(\lambda)\bar{y}_{10}(\lambda)$	$S(\lambda)\bar{z}_{10}(\lambda)$	$S(\lambda)\bar{x}_{10}(\lambda)$	$S(\lambda)\bar{y}_{10}(\lambda)$	$S(\lambda)\bar{z}_{10}(\lambda)$	$S(\lambda)\bar{x}_{10}(\lambda)$	$S(\lambda)\bar{y}_{10}(\lambda)$	$S(\lambda)\bar{z}_{10}(\lambda)$
650	2.081	0.835	0.000	1.848	0.741	0.000	1.703	0.683	0.000
60	1.202	0.475	0.000	1.053	0.416	0.000	0.962	0.380	0.000
70	0.666	0.261	0.000	0.575	0.225	0.000	0.520	0.203	0.000
80	0.321	0.125	0.000	0.275	0.107	0.000	0.248	0.097	0.000
90	0.139	0.054	0.000	0.120	0.046	0.000	0.108	0.042	0.000
700	0.069	0.027	0.000	0.059	0.023	0.000	0.053	0.021	0.000
10	0.034	0.013	0.000	0.029	0.011	0.000	0.026	0.010	0.000
20	0.013	0.005	0.000	0.012	0.004	0.000	0.010	0.004	0.000
30	0.007	0.003	0.000	0.006	0.002	0.000	0.006	0.002	0.000
40	0.004	0.001	0.000	0.003	0.001	0.000	0.003	0.001	0.000
750	0.002	0.001	0.000	0.001	0.001	0.000	0.001	0.000	0.000
60	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000
70	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sums (X, Y, Z)	95.800	100.000	90.980	94.825	100.000	107.381	94.428	100.000	120.721
Chromaticities (x, y, z)	0.3341	0.3487	0.3172	0.3138	0.3309	0.3553	0.2996	0.3173	0.3831

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