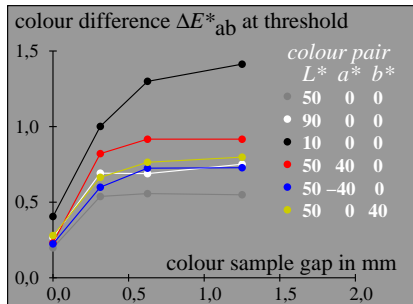


sensation scaling functions
lightness L^* and luminous value Y
adaptation on surround white:
 $L^* = 100 (Y / 100)^{1/2,0}$
adaptation on surround gray:
 $L^* = 100 (Y / 100)^{1/2,4}$
description with CIELAB 1976:
 $L^* = 116 (Y / 100)^{1/3,0} - 16$
adaptation on surround black:
 $L^* = 100 (Y / 100)^{1/3,0}$

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BEA40-2N

line element of Stiles (1946) with „color values“ L_P, M_D, S_T
three separate color signal functions
 $F(L_P) = i \ln(1 + 9 L_P)$
 $F(M_D) = j \ln(1 + 9 M_D)$
 $F(S_T) = k \ln(1 + 9 S_T)$
Taylor-derivations:
 $\Delta F(L_P, M_D, S_T) = \frac{dF}{dL_P} \Delta L_P + \frac{dF}{dM_D} \Delta M_D + \frac{dF}{dS_T} \Delta S_T$
 $= \frac{9i}{1+9L_P} \Delta L_P + \frac{9j}{1+9M_D} \Delta M_D + \frac{9k}{1+9S_T} \Delta S_T$

BEA41-1N

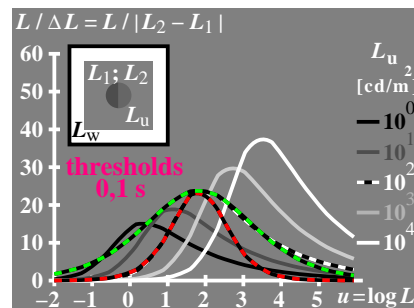
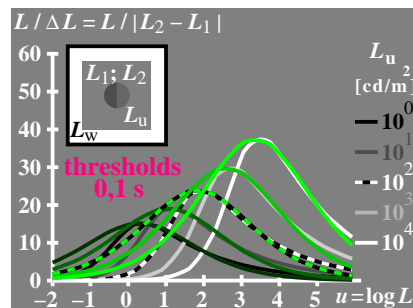
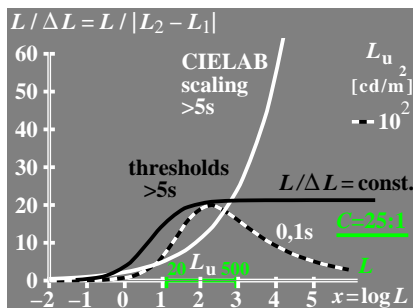
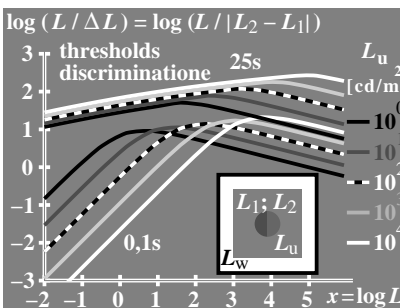
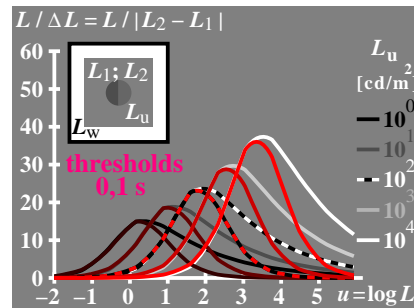
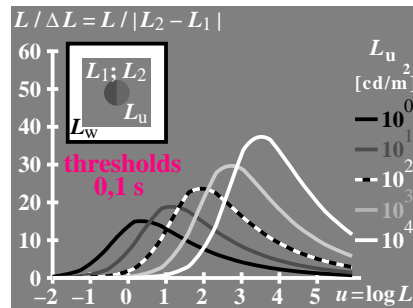
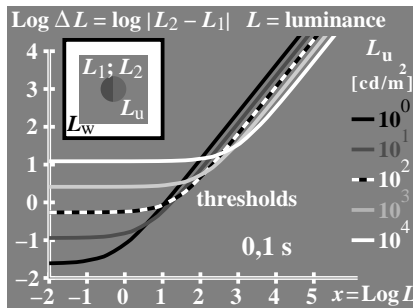
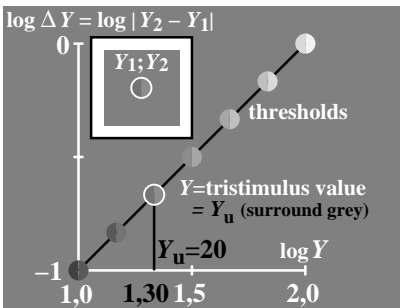
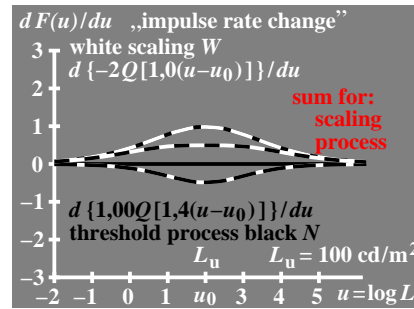
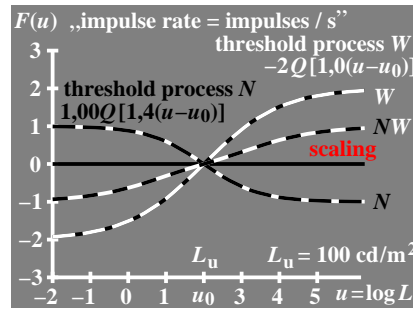
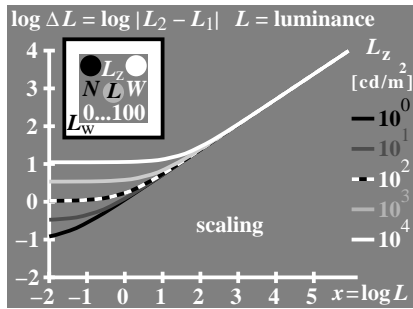
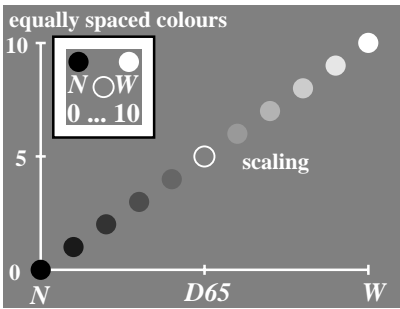
Weber-Fechner law in CIE 230:2019 for threshold colour differences of surface colours and two ranges $0.2 \leq L_u \leq 1$ and $1 \leq L_u \leq 5$
 The Weber-Fechner law describes the lightness L^* as logarithmic function of L_u .
 The Stevens law describes the lightness L^* as potential function of $L_u = 1/5$.
 IEC 61966-2-1 uses a similar potential function $L^*_{IEC} = m L_u^{1/2,4}$.
 The Weber-Fechner law is equivalent to the linear equation: $\Delta L_u = c L_u^{(n-0.1)}$ [1]
 Integration leads to the logarithmic equation: $L^* = k_1 \log(L_u) + c_0$ [2]
 Derivation leads for $\Delta L_u = 1$ to the linear equation: $L_u \Delta L_u = k_1$ ($k_0=46, k_1=63$) [3]
 For colours in offices the standard contrast range is 25:1-90:3,6

Table 1: CIE tristimulus value Y , luminance L , and lightness L^*

Colour (matte)	Tristimulus value Y	office luminance L [cd/m ²]	relative luminance $L_r = L/L_u$	CIE lightness L^*_{CIELAB} $L^* = k \log(L_u)$	relative lightness $L^*_r = k_0 \log(L_u)$
White W (paper)	90	142	5	94	44
White W (25:1=90:3,6)	18*5	-28,2*5	-	50+44	=44 log(5)
Grey Z (paper)	18	28,2	1	50	0
Black N	3,6	5,6	0,2	18	=32
Black N (paper)	=18:5	28,2:5	-	50-32	=44 log(0,2)

For the two lightness ranges it is $k_0 = -32/\log(0,2) = 46$ and $k_1 = 44/\log(5) = 63$.

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see similar files: http://farbe.li.tu-berlin.de/BEA4/BEA4LONP.PDF /.PS; only vector graphic VG; start output N: no 3D-linearization (OL) in file (F) or PS-startup (S), page 1/1
 technical information: http://farbe.li.tu-berlin.de or http://color.li.tu-berlin.de

TUB registration: 20220301-BEA4/BEA4LONP.PDF /.PS
 application for evaluation and measurement of display or print output
 TUB material: code=rh4ta