

# Exponential response function of achromatic vision space $T^*_{EXP3X}$

| nonlinear color terms                                    | name and relationship with test field luminance $L$                                                                                                                                                                                                                                                                                                                                            | notes                                                                                                                      |
|----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| threshold sum<br>$T^*_{EXP3X}$                           | $T^*_{EXP3X} = A_1 \cdot \log(1 + A_2 \cdot 10^{X-X_u}); X = \log L$ $= A_1 \cdot \log(1 + A_2 \cdot 10^X / 10^{X_u}); L = 10^X$ $= A_1 \cdot \log(1 + A_4 \cdot L); dL/dX = \ln(10) \cdot 10^X$                                                                                                                                                                                               | $L/dL$<br>$= A_1 \cdot A_4 \cdot L / (1 + A_4 \cdot L)$<br>for large $L$ it is valid:<br>$1 \ll A_4 \cdot L$<br>therefore: |
| CIE luminance contrast sensitivity threshold<br>$L / dL$ | $dT^*_{EXP3X} / dL = A_1 \cdot A_4 / (1 + A_4 \cdot L)$ $= A_1 \cdot A_2 / [L_u \cdot (1 + A_2 \cdot (L/L_u))]$ <p>for <math>dT^*_{EXP3X} = 1</math>, and multiplication with <math>L</math>:</p> $L / dL = A_1 \cdot A_4 \cdot L / (1 + A_4 \cdot L)$ $= A_1 \cdot A_2 \cdot (L/L_u) \cdot [1 + A_2 \cdot (L/L_u)]$ <p>The ratio <math>L / dL</math> is constant for large <math>L</math></p> | $L/dL = A_1$<br>$= \text{constant}$<br>$= \text{Weber-Fechner law}$<br>$A_4 = A_2 / L_u$                                   |
| CIE luminance difference threshold $dL$                  | $dL = (1 + A_4 \cdot L) / (A_1 \cdot A_4)$ $= [1 + A_2 \cdot (L/L_u)] / (A_1 \cdot A_2 / L_u)$                                                                                                                                                                                                                                                                                                 |                                                                                                                            |