Euroopa Liit
Euroopa Sotsiaalfond

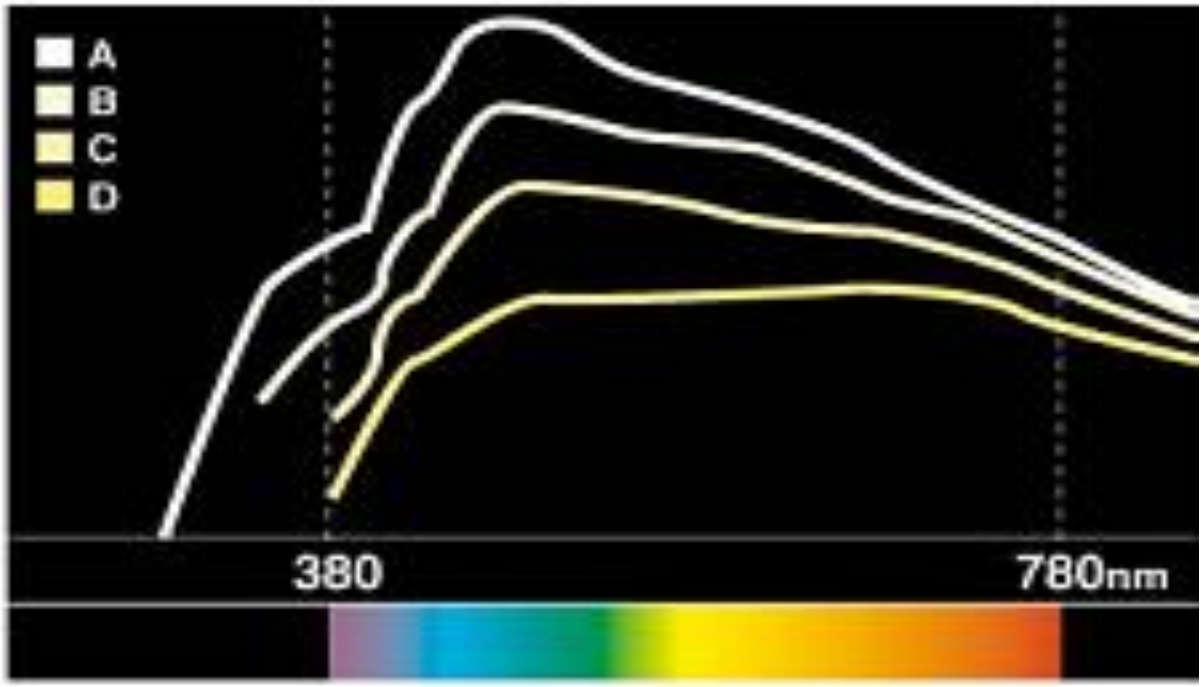
Eesti tuleviku heaks

Mis valgustab paremini – kas luksid või spekter? Ohud valesti valitud valguse korral

Tiiu Tamm
Elektrotehnika Instituudi lektor

Tartu 15.mai 2014

Valguse spektraaljaotus sõltuvalt mõõtekohast

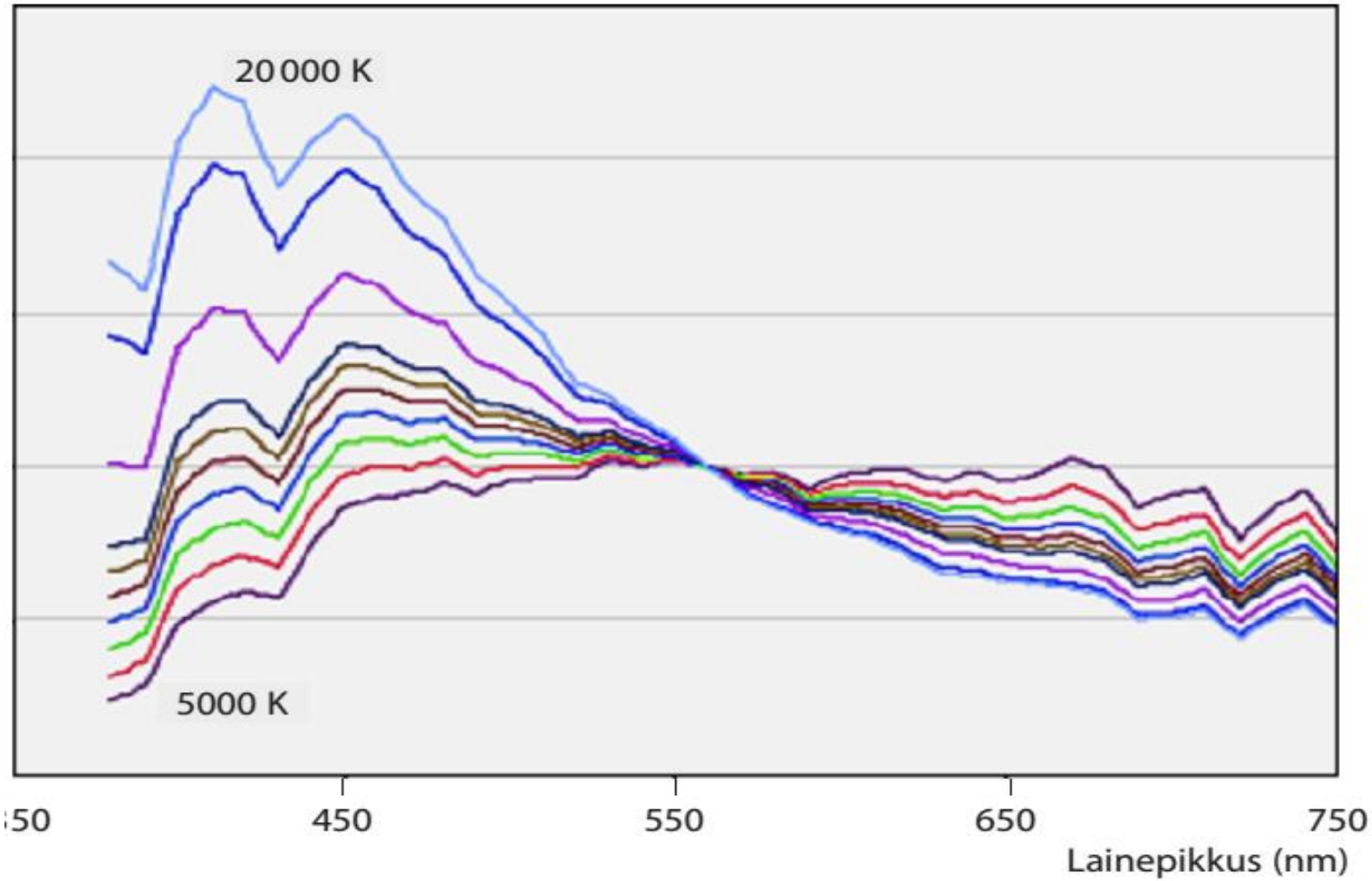


A - atmosfäärist ülal pool

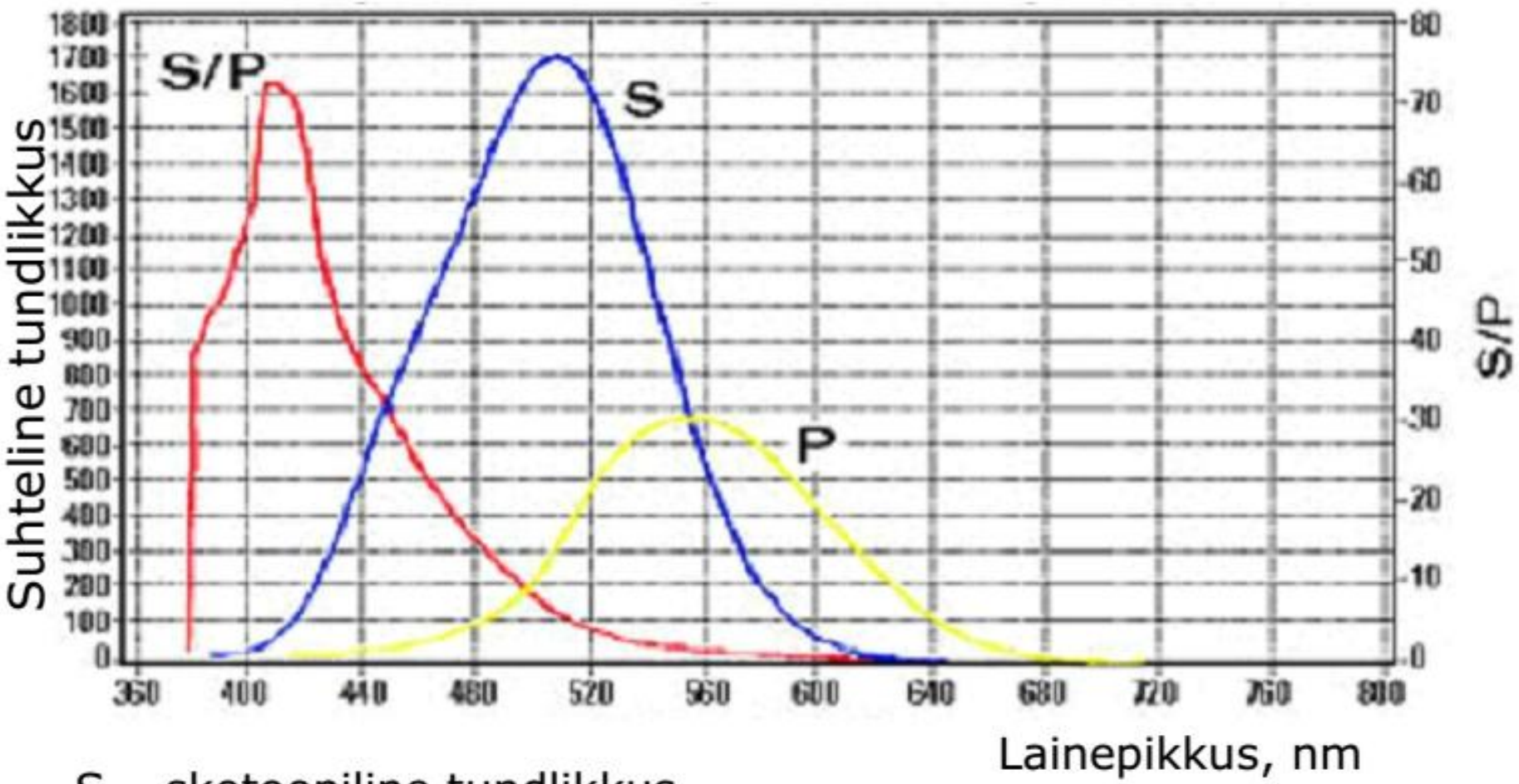
B - 5 km kõrgusel merepinnast (Päike on seniidis)

C - merepinnal (Päike seniidis)

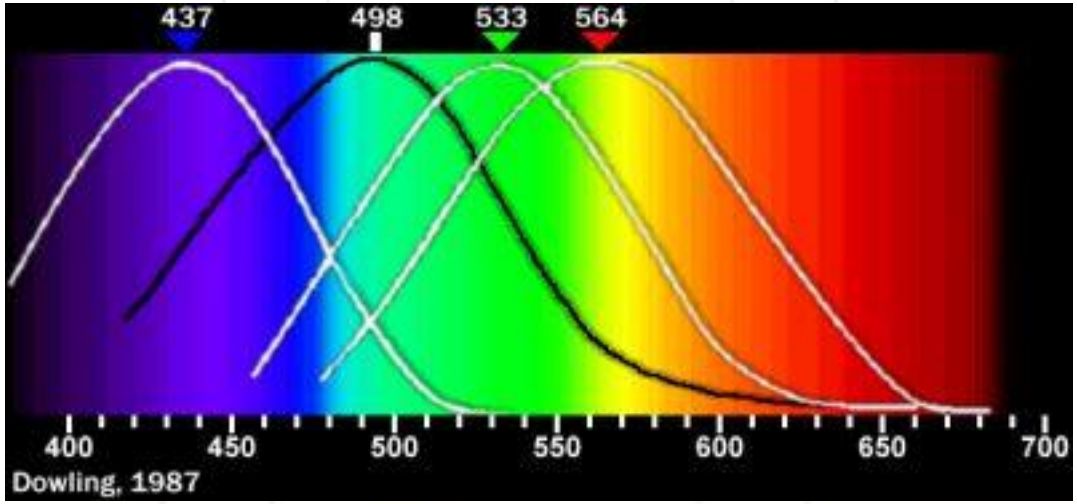
D - merepinnal (Päike on 60^0 seniidist)

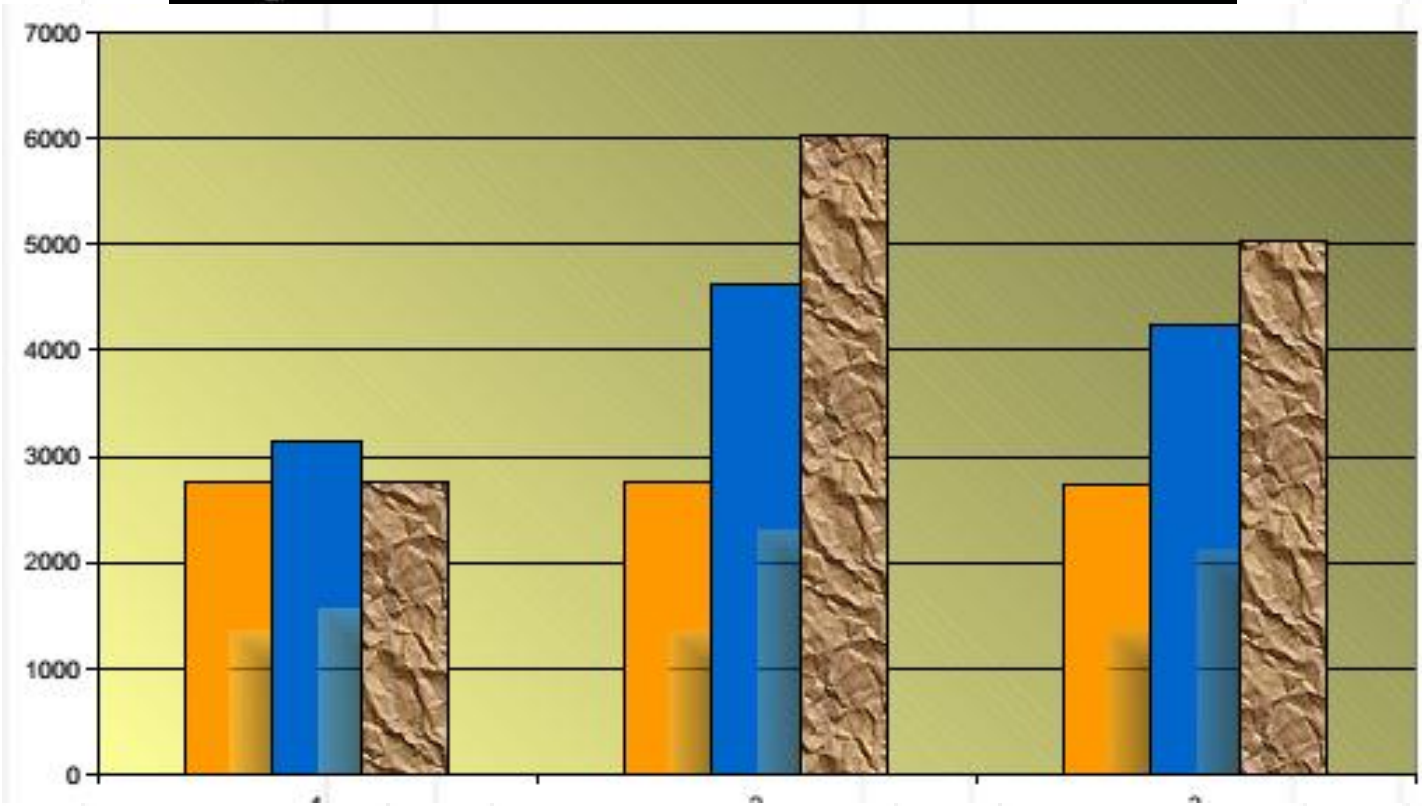

20 000 K
5000 K
450
550
650
750
Lainepikkus (nm)

Valguse skotoopiline ja fotoopiline nägemiskõver



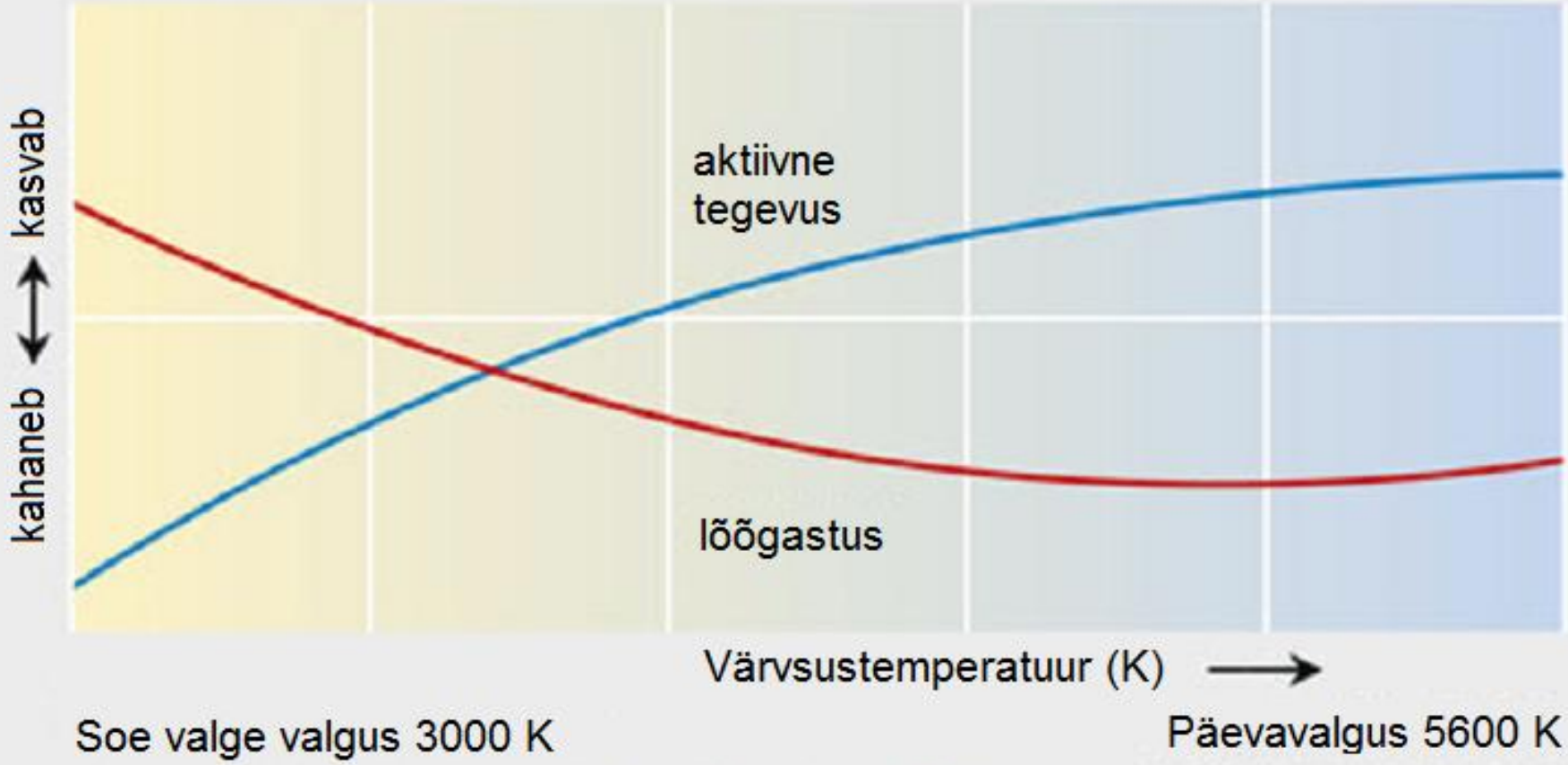
S – skotoopiline tundlikkus
P – fotoopiline tundlikkus
S/P – skotoopilise ja fotoopilise tundlikkuse suhe





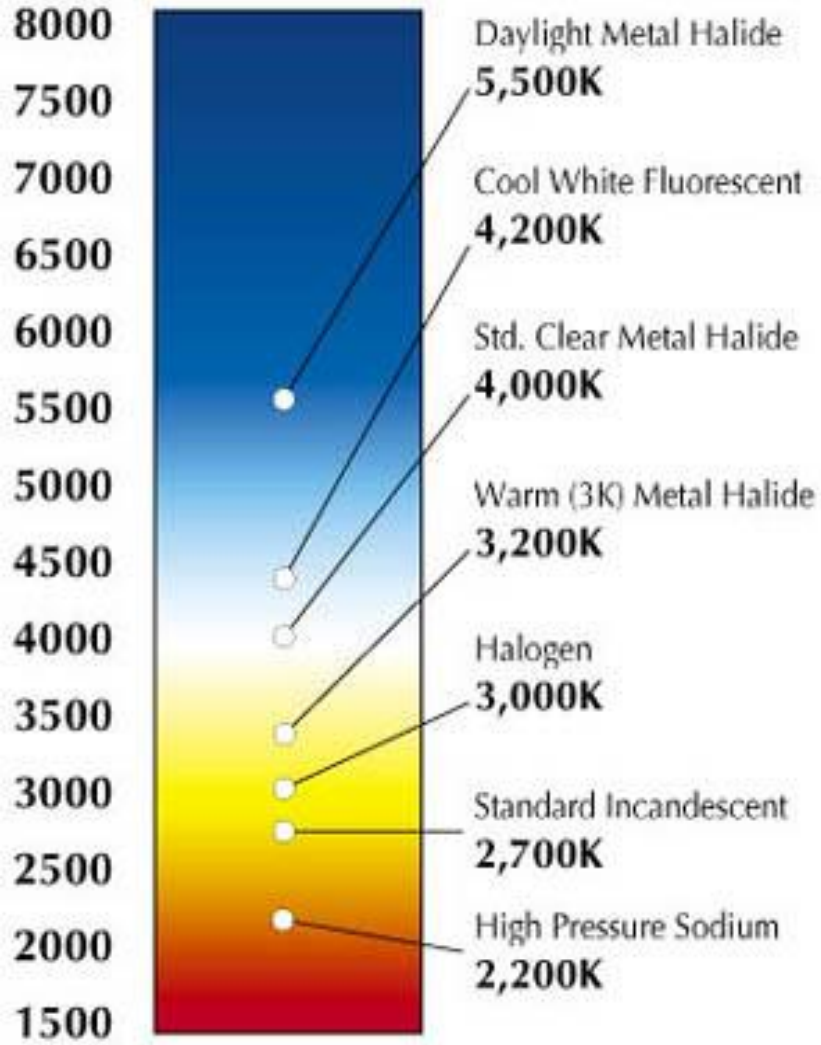
Fotoopiline valgusvoog

Skotoopiline valgusvoog



Dr. Susanne Fleischer, ETH, Institute für Hygiene und Arbeitsphysiologie, Zürich

Testi värvid			
R_1	Vanaroosa	R_5	Türkiis
R_2	Sinepikollane	R_6	Taevasinine
R_3	Kollakas-roheline	R_7	Violetne
R_4	Heleroheline	R_8	Lilla
Lisatesti värvid			
R_9	Punane	R_{12}	Sinine
R_{10}	Kollane	R_{13}	Nahavärv
R_{11}	Roheline	R_{14}	Leheroheline



Värvitoon	**Lähim värvsustemperatuur T_{CP}** K
Soe (soevalge)	alla 3300
Vahepealne (neutraalvalge)	3300 kuni 5300
Külm (päevavalgusvalge)	üle 5300

Luminofoorlampide tähised:

... 18W/827

... 18W/830 ... 18W/930

... 18W/835

... 18W/840 ... 18W/940

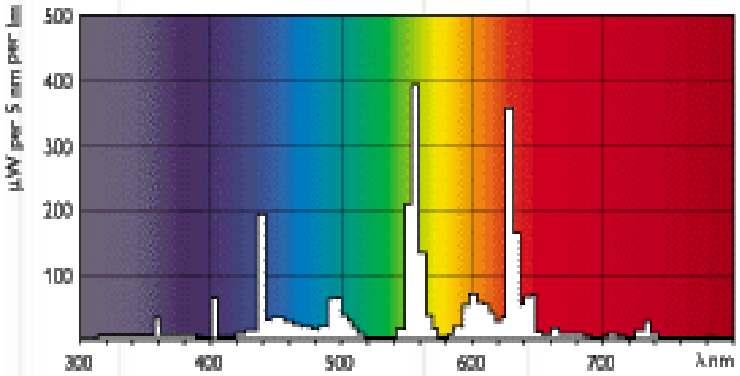
... 18W/954

... 18W/860 ... 18W/965

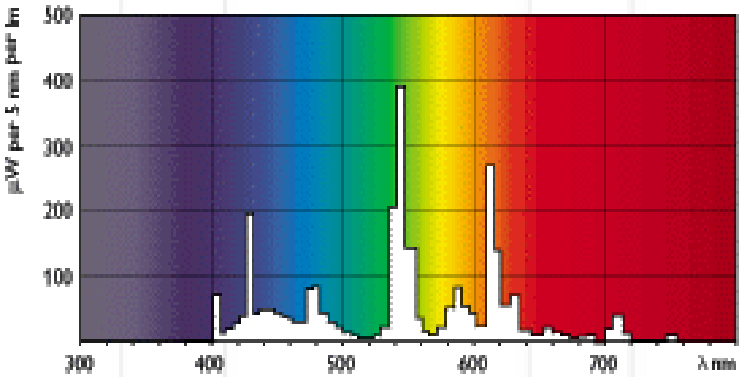
Ra-indeksi
1. number

Värvsustemperatuuri
2 esimest numbrit

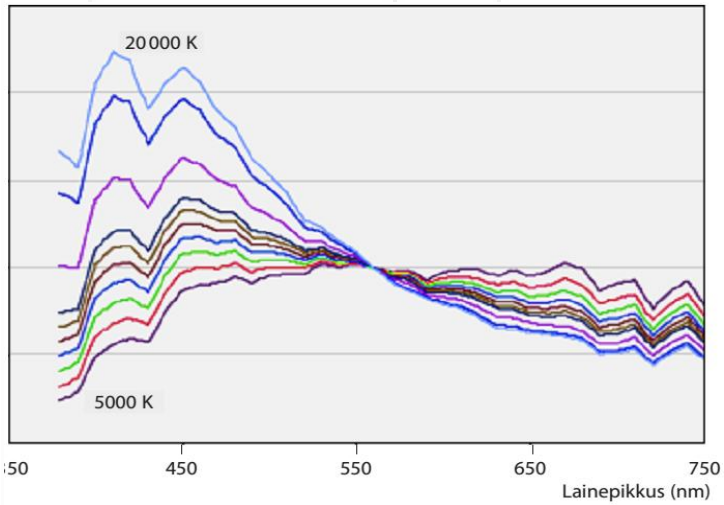
Lampide spektrid enamikel töökohtadel - madalrõhuluminofoorlambid

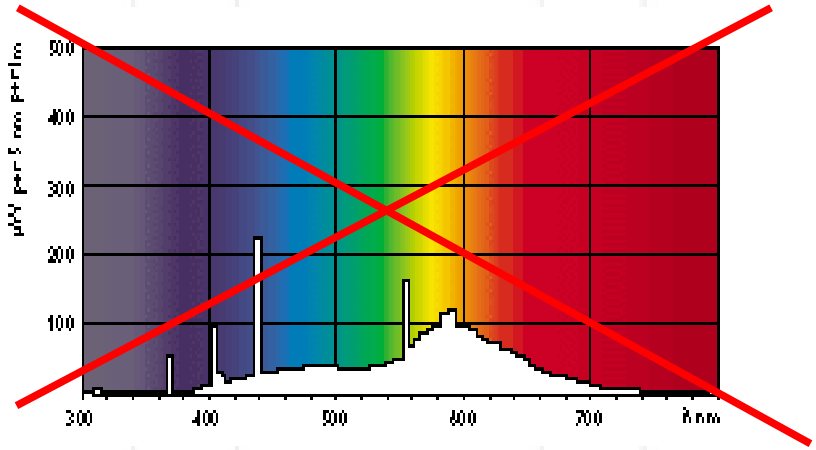


/830, Ra=80...89, 3000 K



/840, Ra=80...89, 4000 K



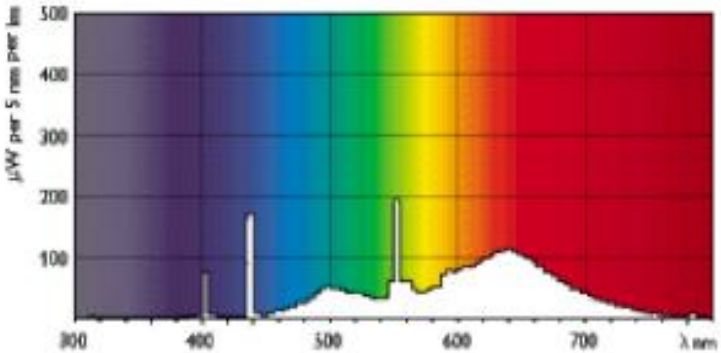


/33-640, Ra=60...69, 4000 K

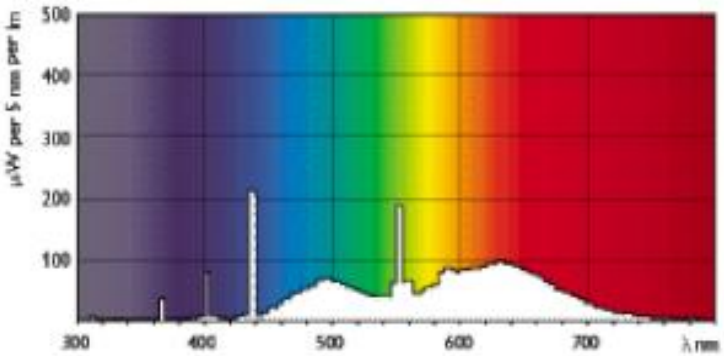
/830

/840

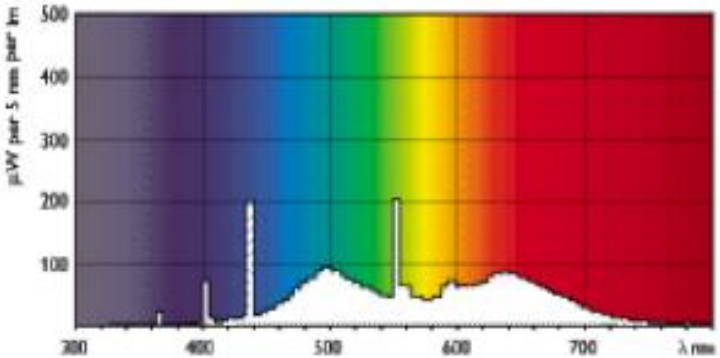
päevavalguses



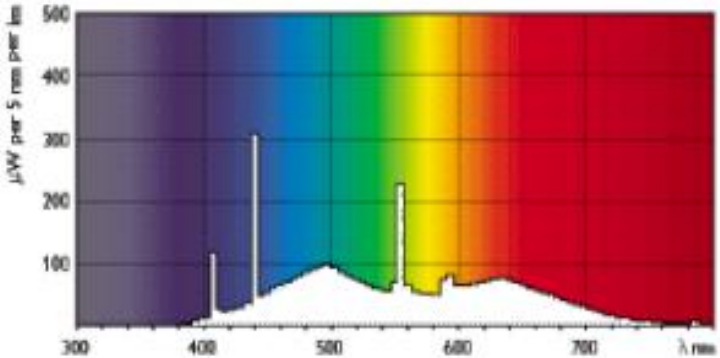
…/930, 3000 K



…/940, 4000 K

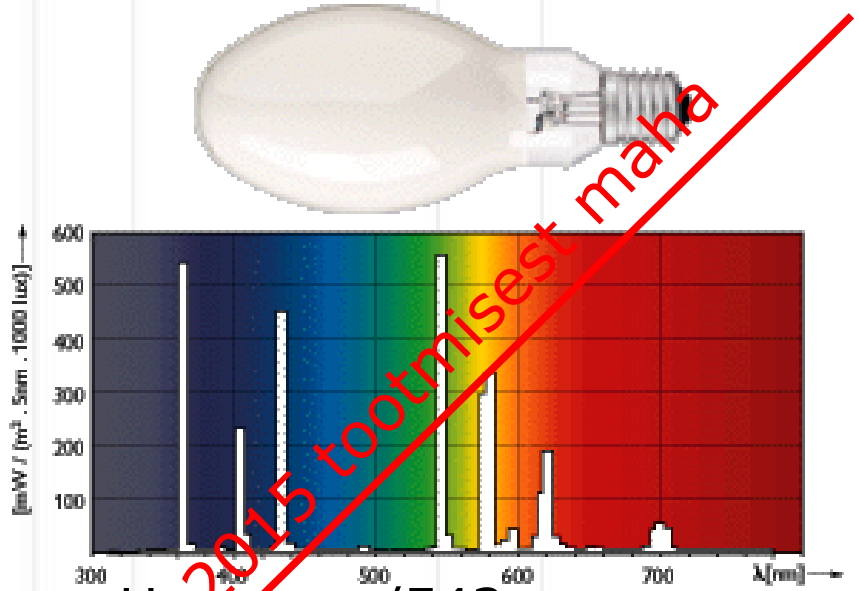


…/950, 5000 K



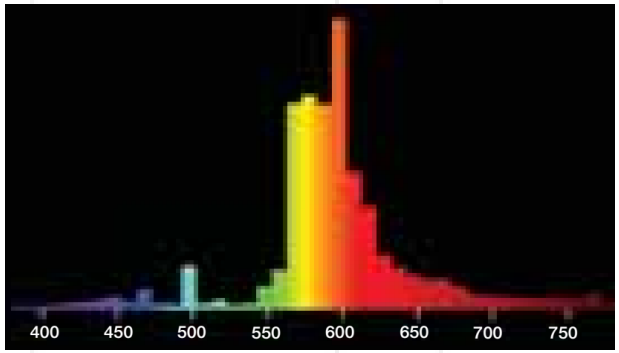
…/965, 6500 K

Lampide spektrid töökohtadel - kõrgrõhuluminofoorlambid

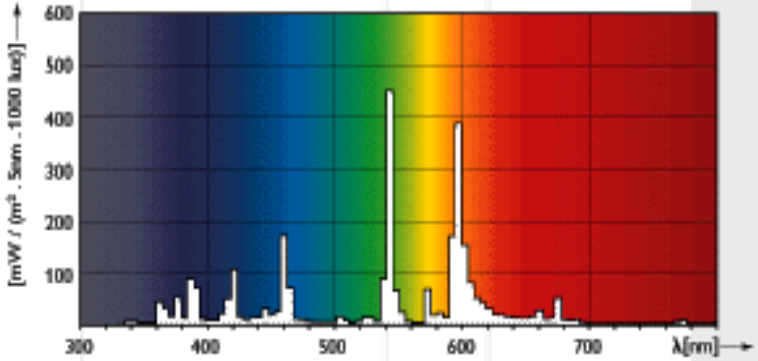


2015 tootmisest maha

Hg /542

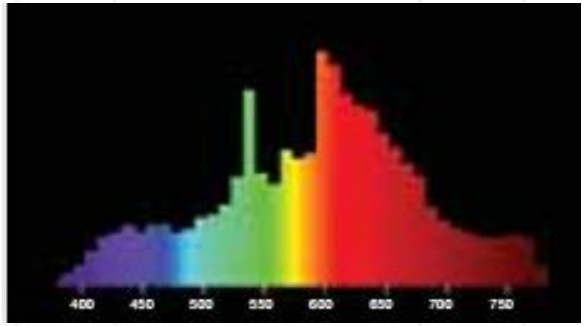


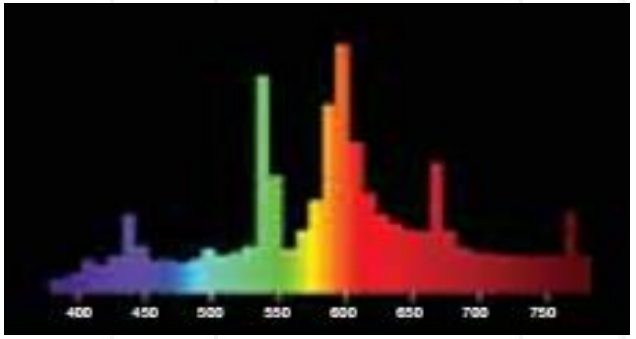
Na lamp, Ra 23, 2300 K

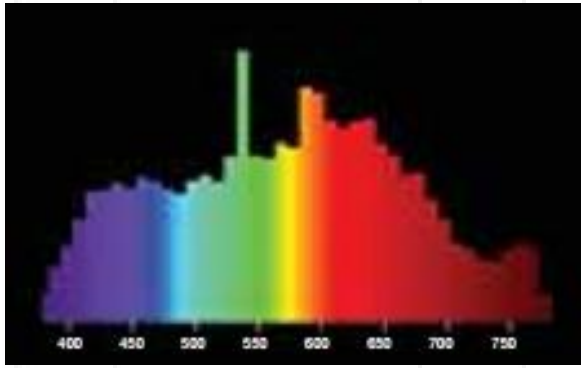


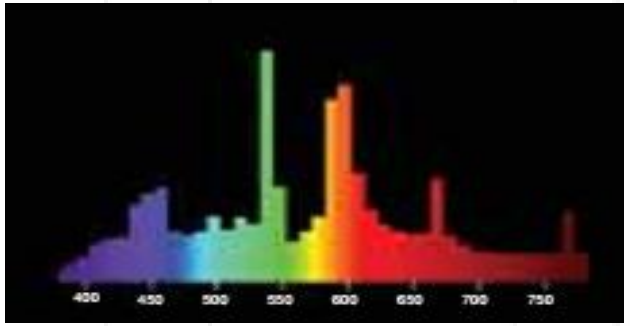
MH lamp, Ra 60...95, 3000...65

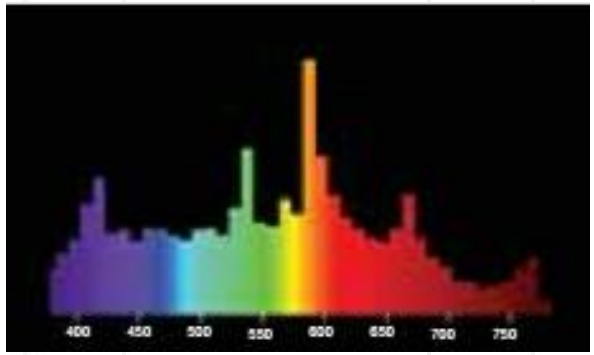
Lampide spektrid töökohtadel – kõrgrõhuluminofoorlambid, MH

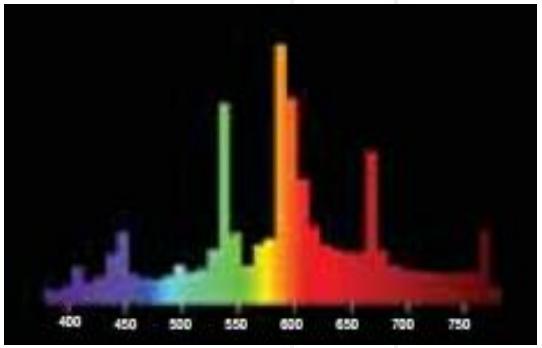


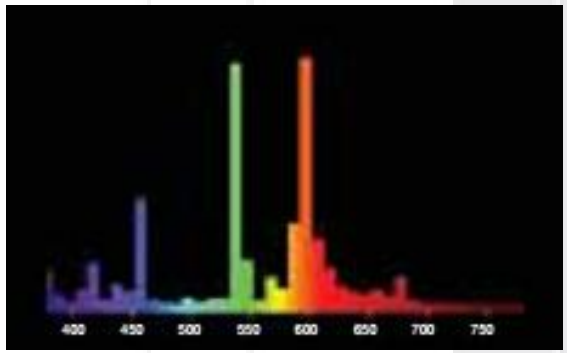




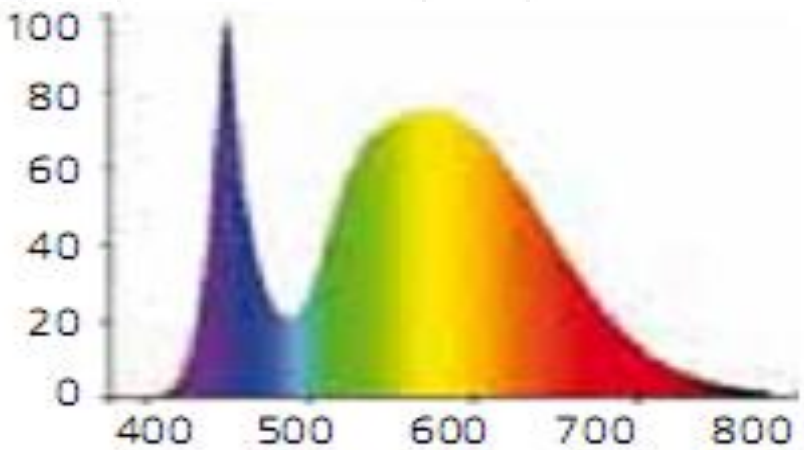


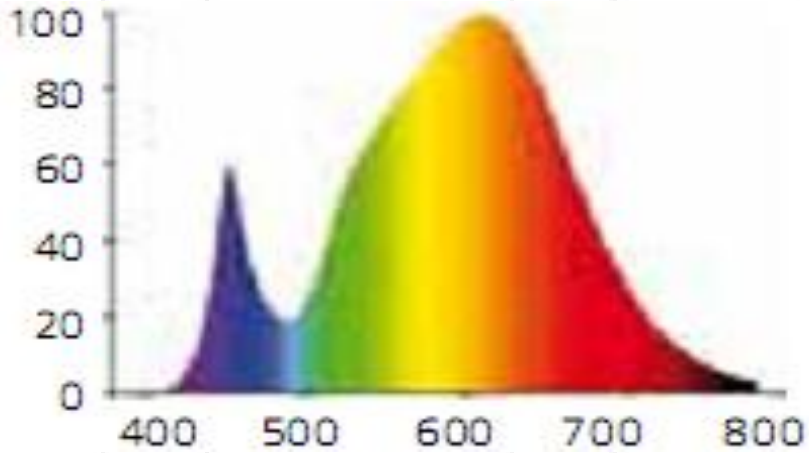




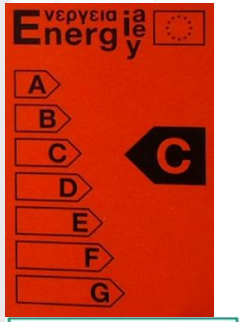


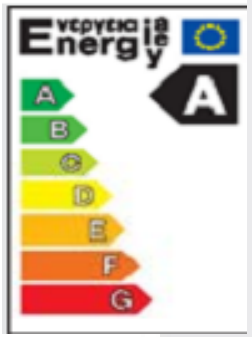
Lampide spektrid töökohtadel – leedlambid, LED

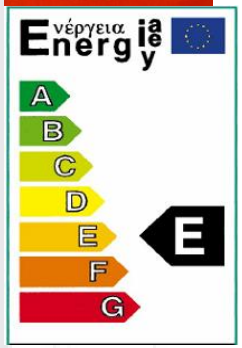


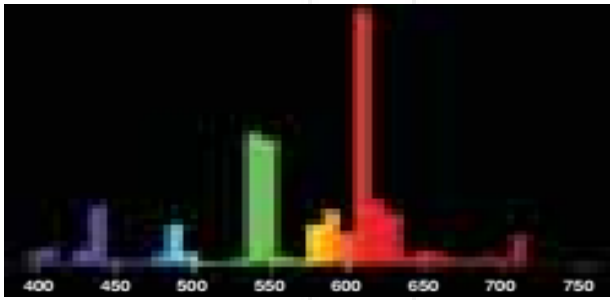


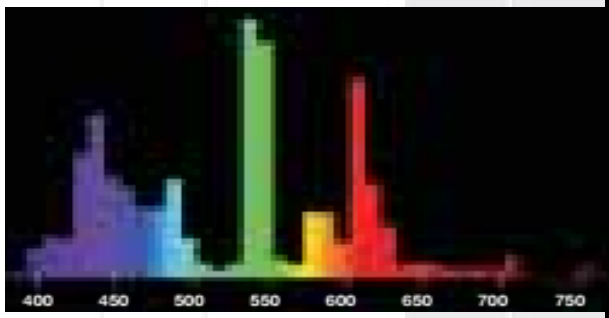
Lampide spektrid hõõglambi asemele

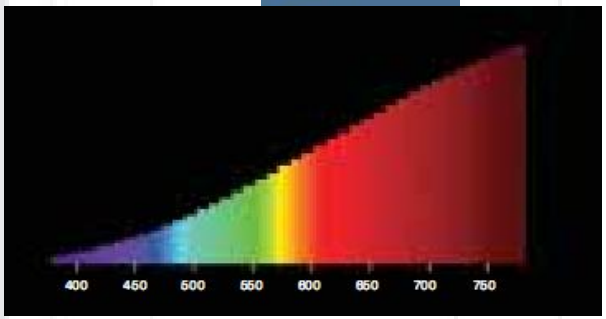


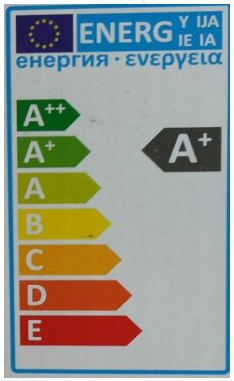


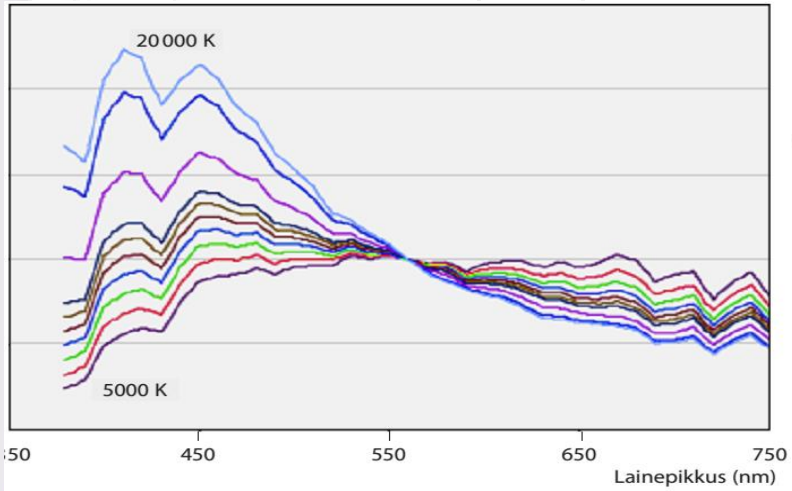


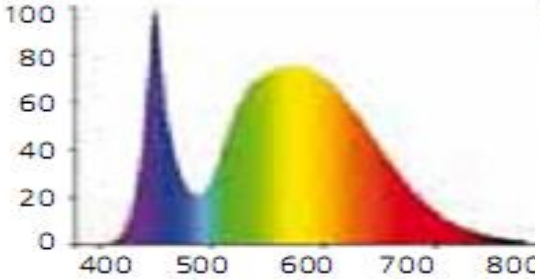


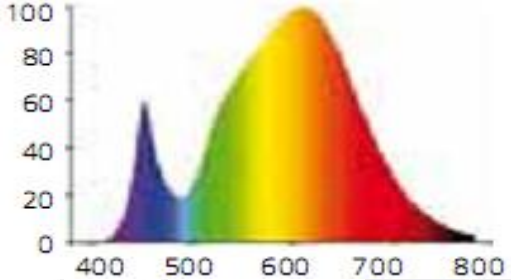












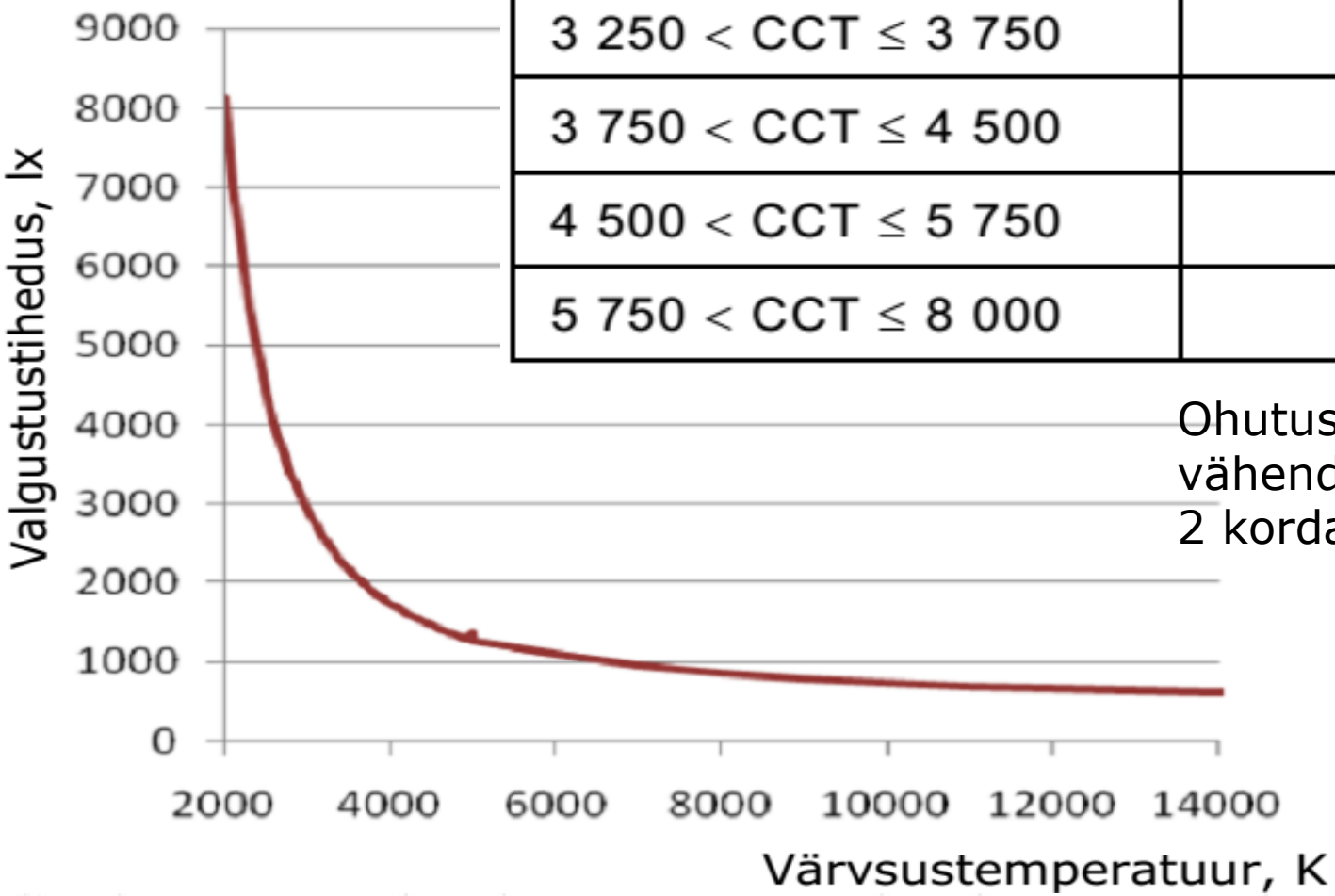
Fotobioloogiline ohutus

Sinise spektriosa risk (blue light hazard risk) – IEC/TR 62778

Sinise spektriosa fotobioloogilise riski deklareerib tootja.
R1 kuni R2:
Tootja peab andma soovituslikud ettepanekud:
- fikseeritud paigaldusega valgusti korral vähim kaugus silmadest, kuhu valgusti on lubatud paigaldada, sh ka juhuks, kui valgusti hoolduse käigus jääb valgusallikas otseselt nähtavaks.
- kantavate valgustite puhul on sümbol „ära vaata valgusallikasse" kohustuslik

Iga üksikut leedi ja -valgustit siiski mõõtma ei Pea. IEC 62471 kohaselt peaks seda tegema, kui heledus on üle 10000 cd/m^2. (ei kehti värviliste ja UV- leedide kohta)

värvsustemperatuur CCT (K)	**valgustustihedus *E*** (lx)
CCT ≤ 2 350	4 000
2 350 < CCT ≤ 2 850	1 850
2 850 < CCT ≤ 3 250	1 450
3 250 < CCT ≤ 3 750	1 100
3 750 < CCT ≤ 4 500	850
4 500 < CCT ≤ 5 750	650
5 750 < CCT ≤ 8 000	500



Ohutuse mõttes on vähendatud väärtust 2 korda

Värelus ja stroboskoopnähtus

Töötervishoiu ja tööohutuse seadus

2. peatükk

TÖÖKESKKOND

§ 3. Üldnõuded

(2) **Töökeskkonnas toimivad füüsikalised, keemilised, bioloogilised, füsioloogilised ja psühholoogilised tegurid ei või ohustada töötaja ega muu töökeskkonnas viibiva isiku elu ega tervist.**

§ 6. Füüsikalised ohutegurid

(1) **Füüsikalised ohutegurid on:**

...

3) masinate ja seadmete liikuvad või teravad osad, **valgustuse puudused**, kukkumis- ja elektrilöögioht ning muud samalaadsed tegurid.

Töökohtade paigutamine projekteerimise käigus

Tänan kuulamast!

Küsimuste aeg