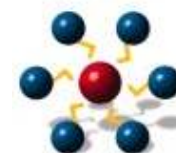


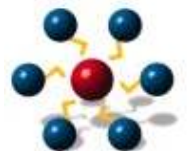
Optik

Matti Hotokka
Fysikalisk kemi



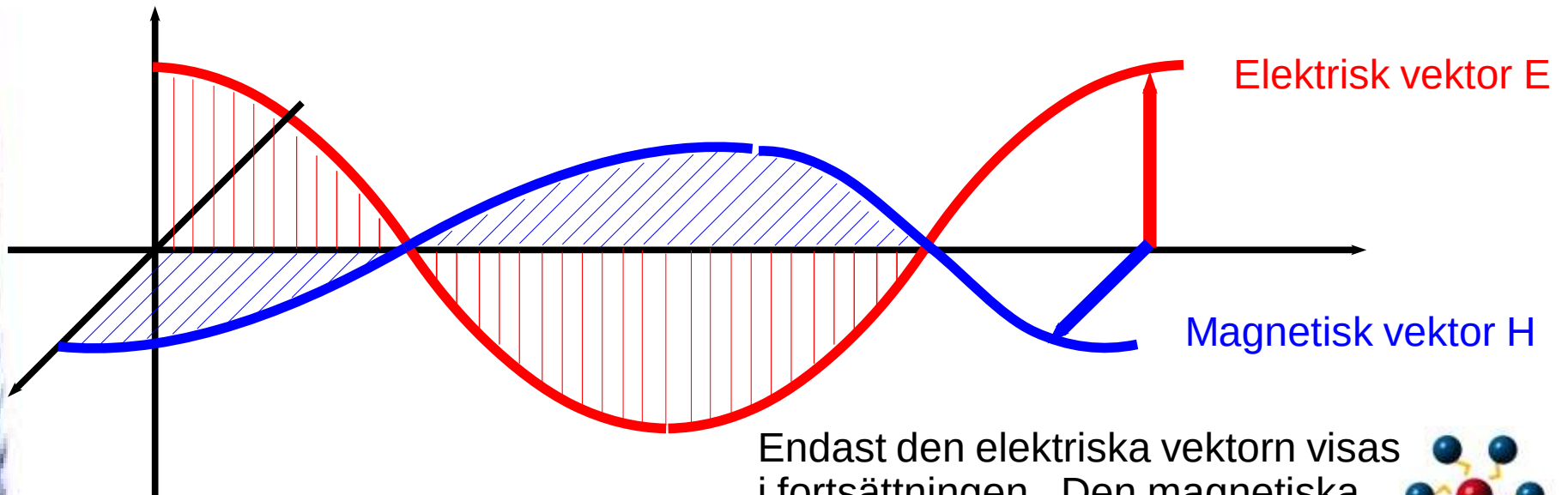
Ljus

- ⇒ Elektromagnetisk strålning
- ⇒ Dual karaktär
 - Fotoner
 - Vågrörelse
- ⇒ Karakteriseras av
 - Energi
 - Våglängd, frekvens

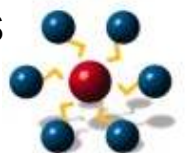


Elektromagnetisk strålning

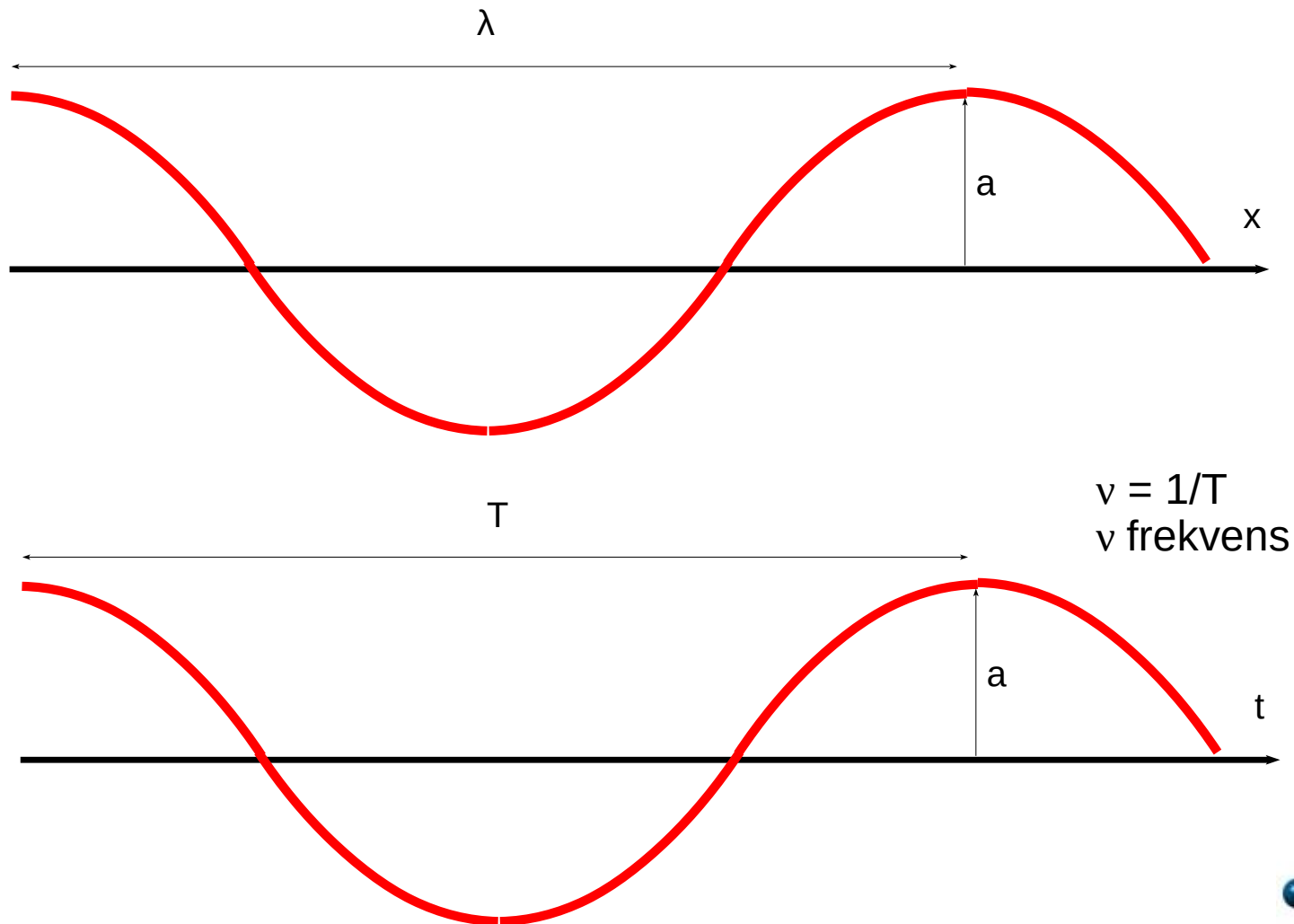
- ⇒ Består av
- Elektriska fältet E
 - Magnetfältet H



Endast den elektriska vektorn visas i fortsättningen. Den magnetiska vektorn är underförstådd.

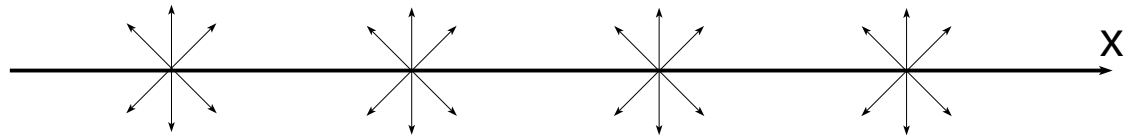


Våglängd och frekvens

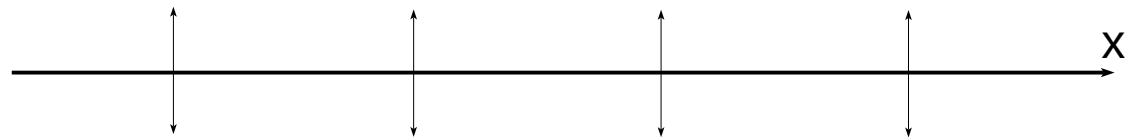


Polarisering

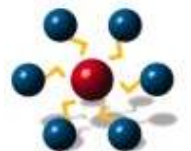
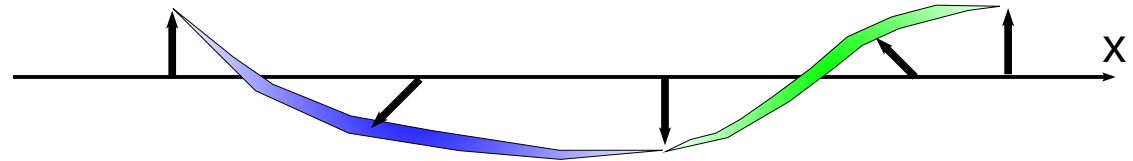
Opolariserat ljus



Planpolariserat ljus



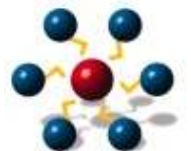
Cirkulärt polariserat ljus



Optisk täthet

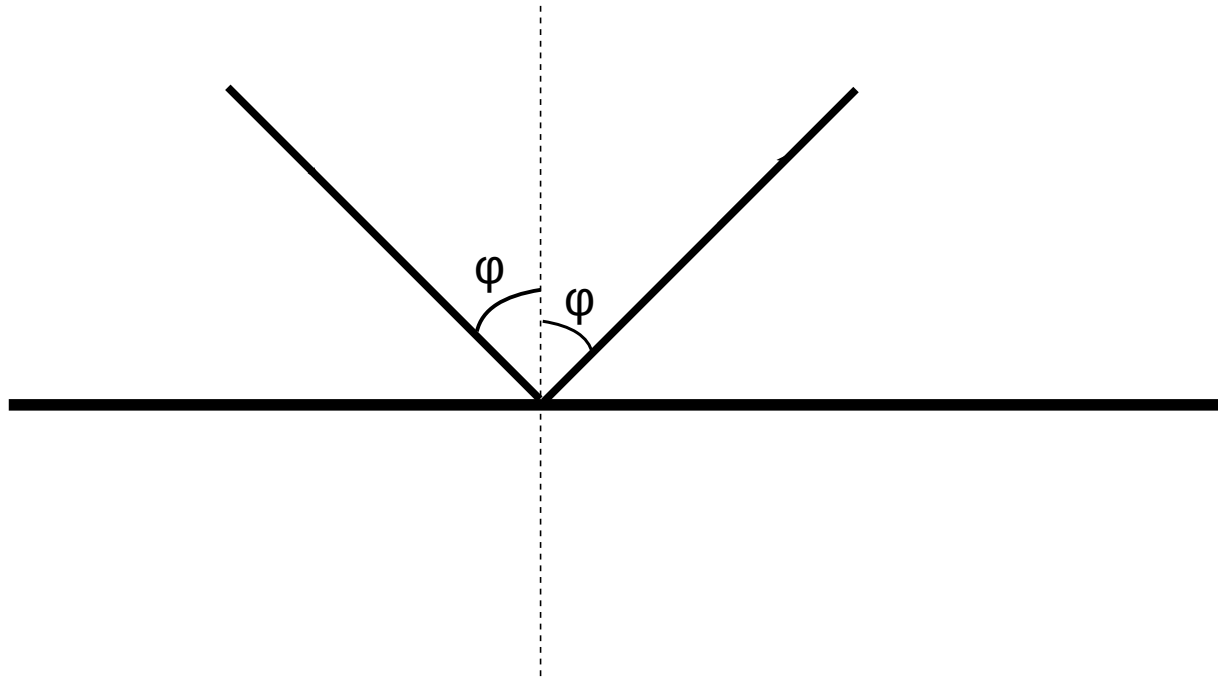
- ⇒ Ljusets hastighet i vakuum c
 - ▶ $299792458 \text{ ms}^{-1}$
- ⇒ Ljusets hastighet i mediet v
- ⇒ Brytningsindexet n (refractive index) ger den optiska tätheten
- ⇒ Brytningsindexet beror på våglängden

$$n = \frac{c}{v} = \frac{\lambda}{\lambda_m}$$



Reflexion

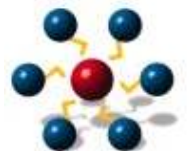
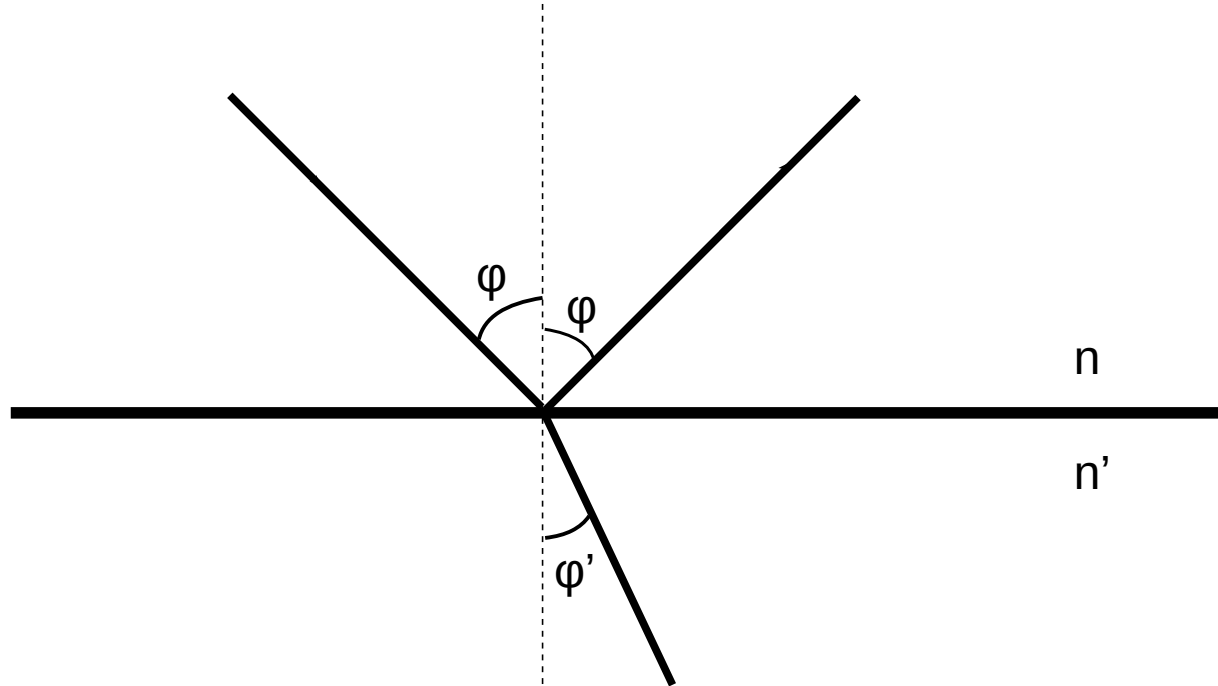
⇒ Vinklarna är lika



Brytning

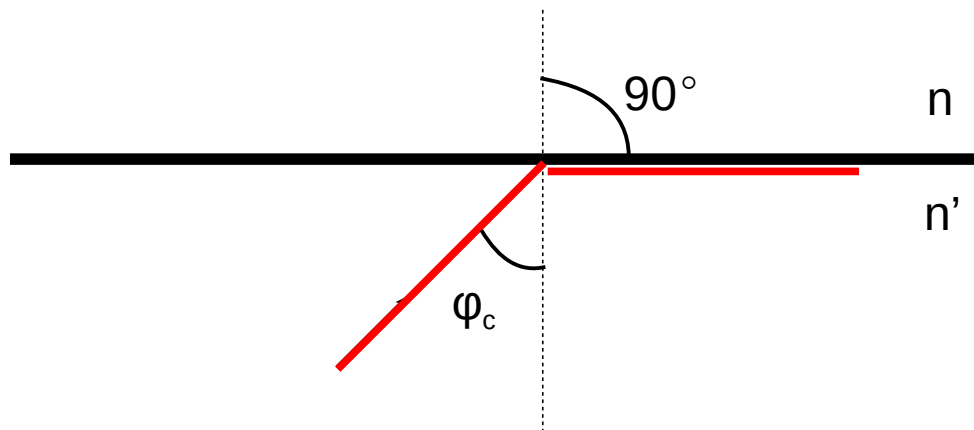
⇒ Snells lag

$$\frac{\sin \varphi}{\sin \varphi'} = \frac{n'}{n}$$

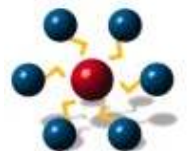


Total reflexion

- ⇒ Betyder att allt ljus reflekteras då ljuset kommer från optiskt tätare material till gränsytan
- ⇒ Kritisk vinkel: brytningsvinkeln är 90°

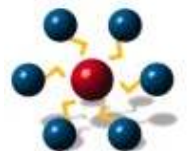
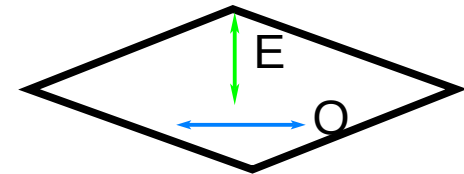
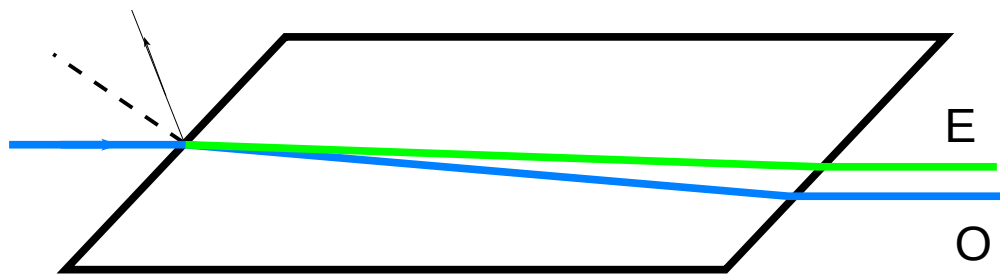


$$\sin \varphi_c = \frac{n}{n'}$$

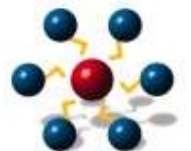
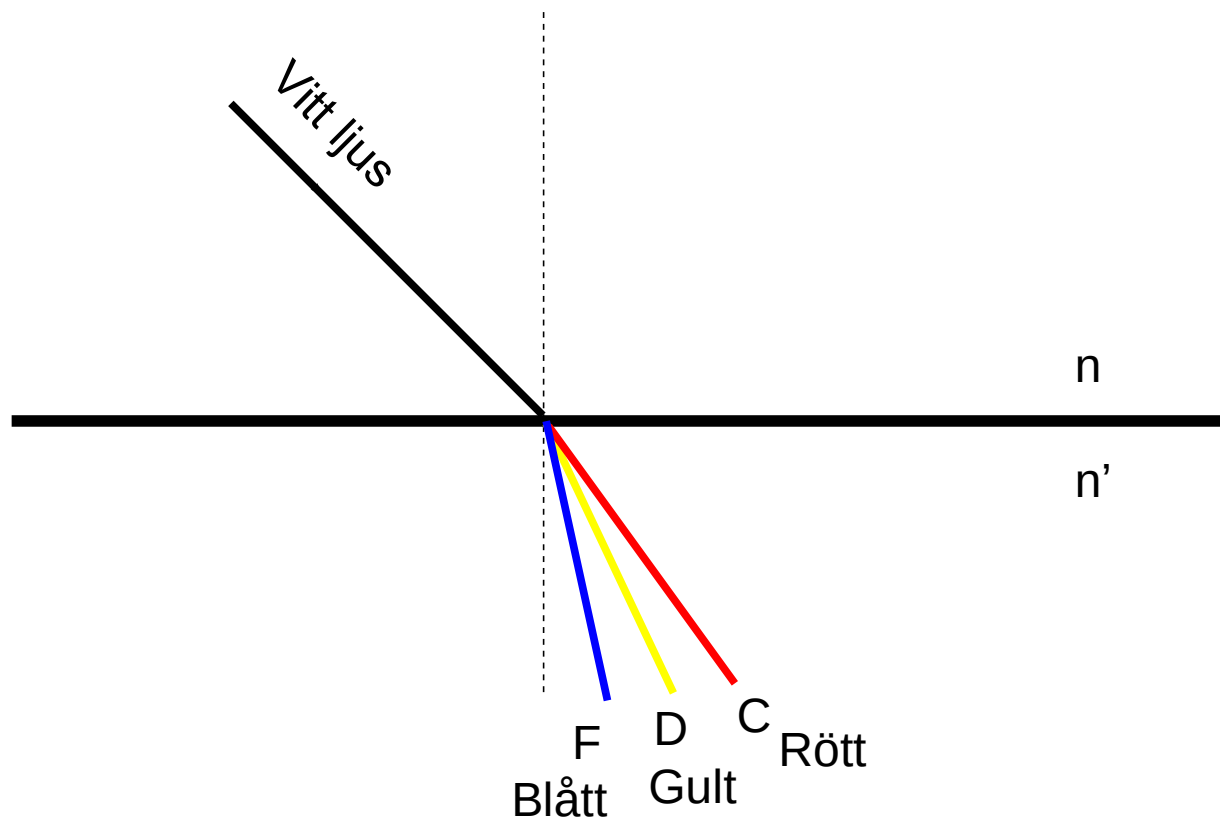


Dubbelbrytning

- ➡ Betyder, att i olika riktningar planpolariserat ljus beter sig på olika sätt
- ➡ Förekommer i många naturliga mineraler
 - T.ex. kalcit, kvarts

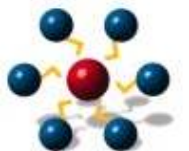


Dispersion



Fraunhofers notation

- ⇒ Fraunhofer hittade spektrallinjer i solens spektrum 1817 och döpte dem
 - ▶ Wollaston hade hittat dem redan 1802
 - ▶ Obs. Detta var före atomteorins tid.
 - ▶ Modern förklaring: Övergångar i atomer (och molekyler)
 - ▶ Se <http://www.harmsy.freeuk.com/fraunhofer.html>

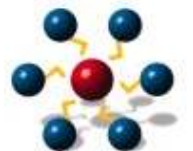


Fraunhofers notation

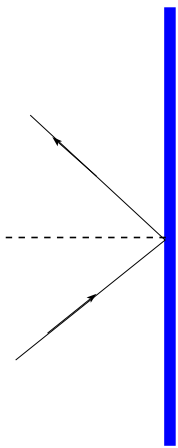
Exempel

Symbol	Atom	Våglängd [nm]
C	H	656.3
D	Na	589.6 & 589.0
F	H	486.1

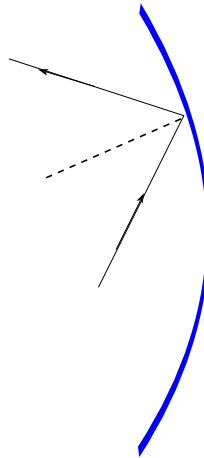
A (band)	O ₂	760
B (band)	O ₂	687
E	Fe	527.0
b	Mg	518.4 & 517.3
c	Fe	495.8
f	H	434.0
g	Ca	422.7
h	H	410.2
H	Ca	396.8



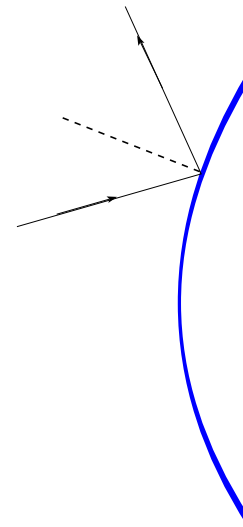
Spiegel



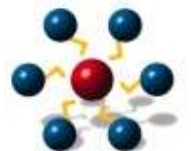
Plan



Konkav

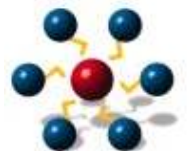
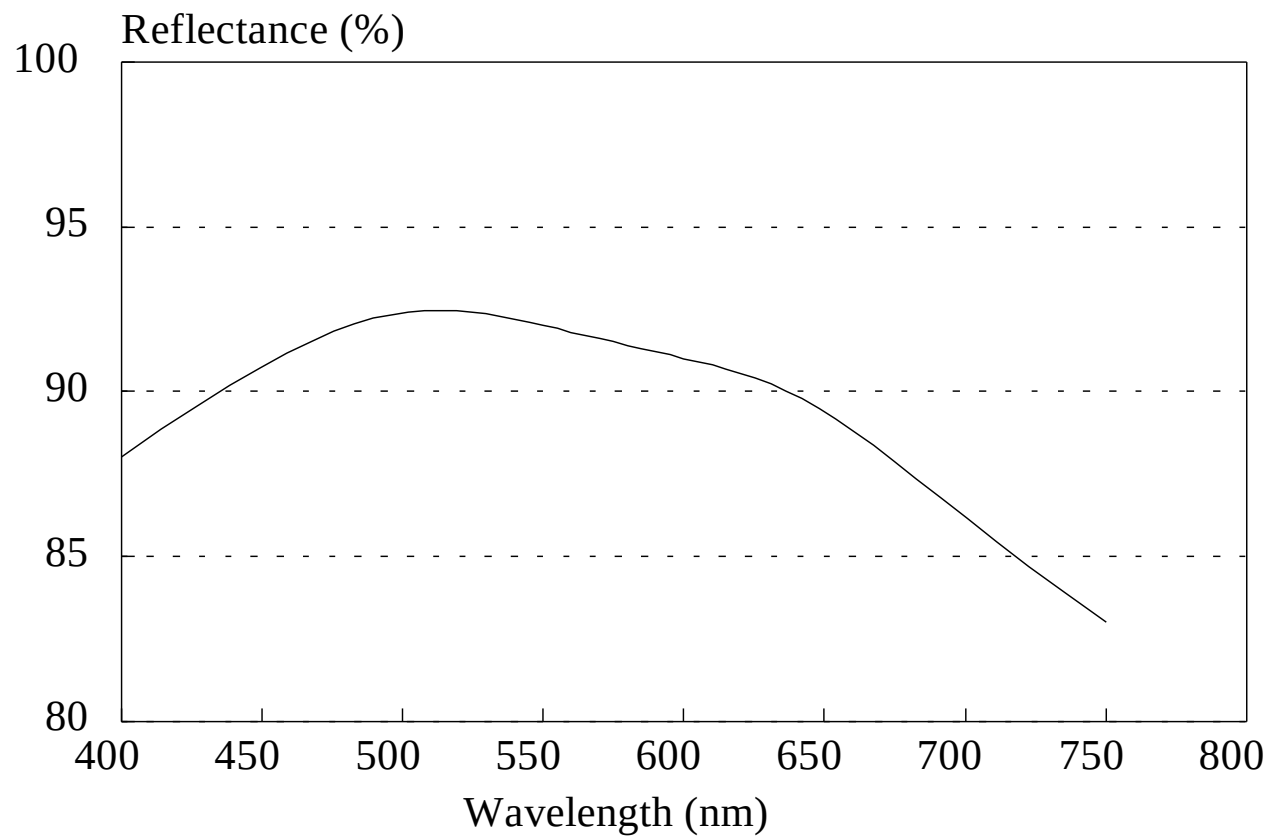


Konvex

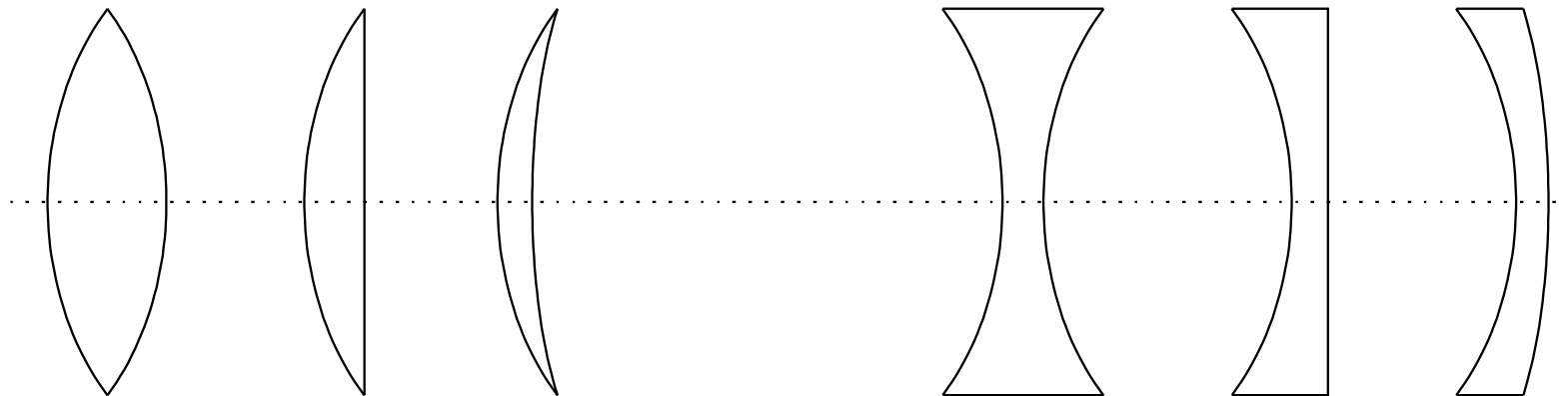


Reflektans

Aluminiumspegelns reflektans



Linser

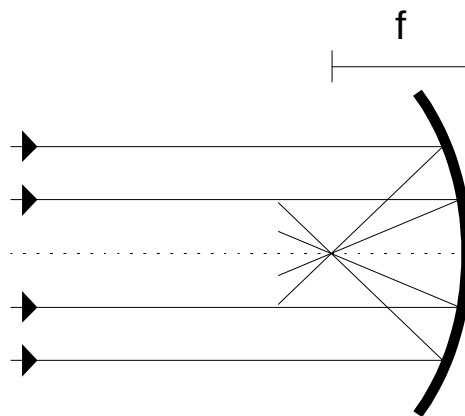
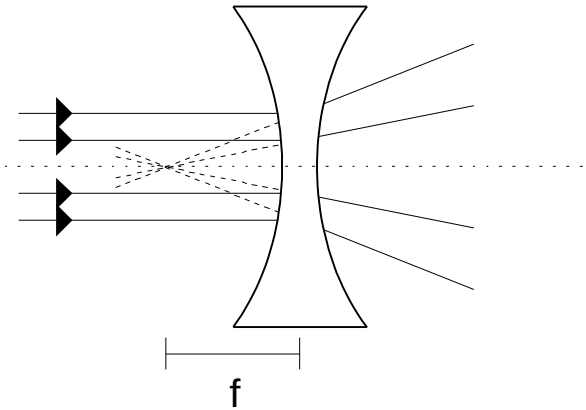
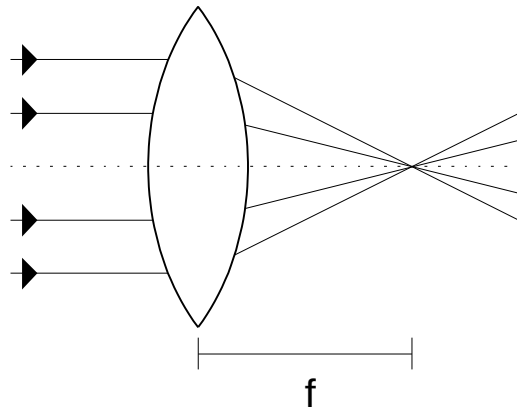


Konvexa

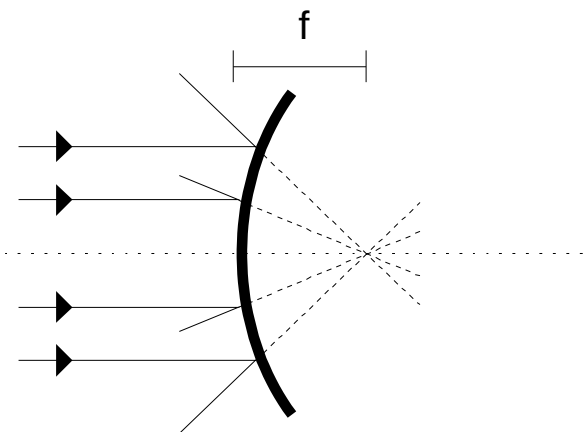
Konkava



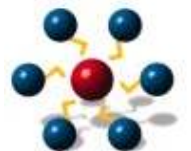
Fokallängd



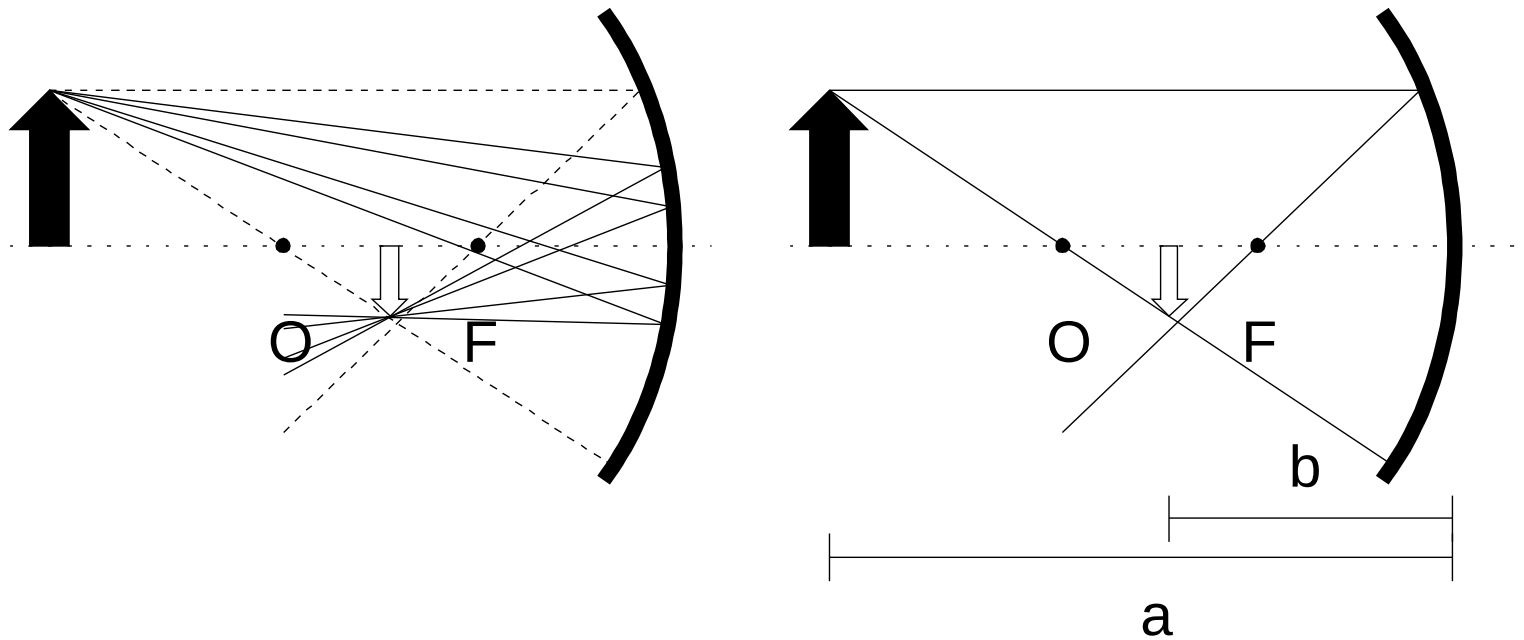
Positiv



Negativ

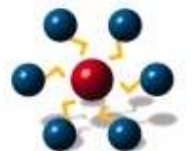


Spegelformel

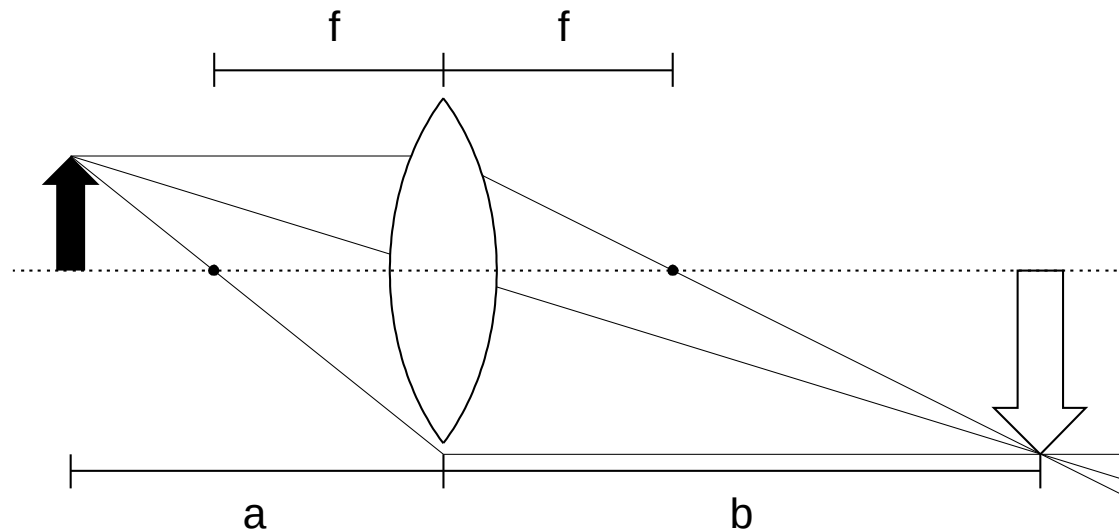


$$\frac{1}{a} + \frac{1}{b} = \frac{1}{f}$$

Förstoring $M = \frac{b}{a}$



Linsformel



$$\frac{1}{a} + \frac{1}{b} = \frac{1}{f}$$

Förstoring $M = \frac{b}{a}$



Linsfel

⇒ Aberration

- ▶ Olika delar bryter olika starkt

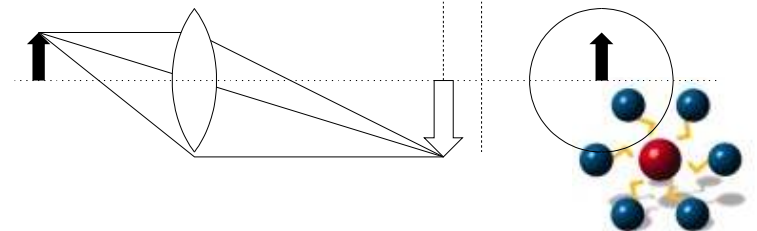
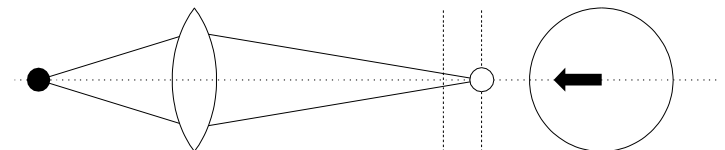
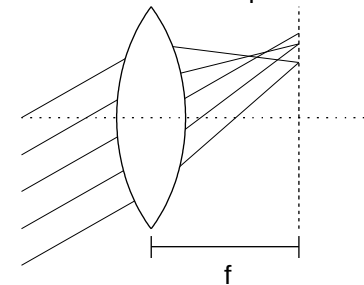
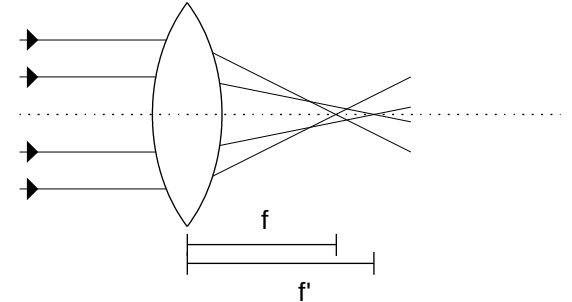
⇒ Koma

- ▶ Parallela strålar fokuseras fel

⇒ Astigmatism

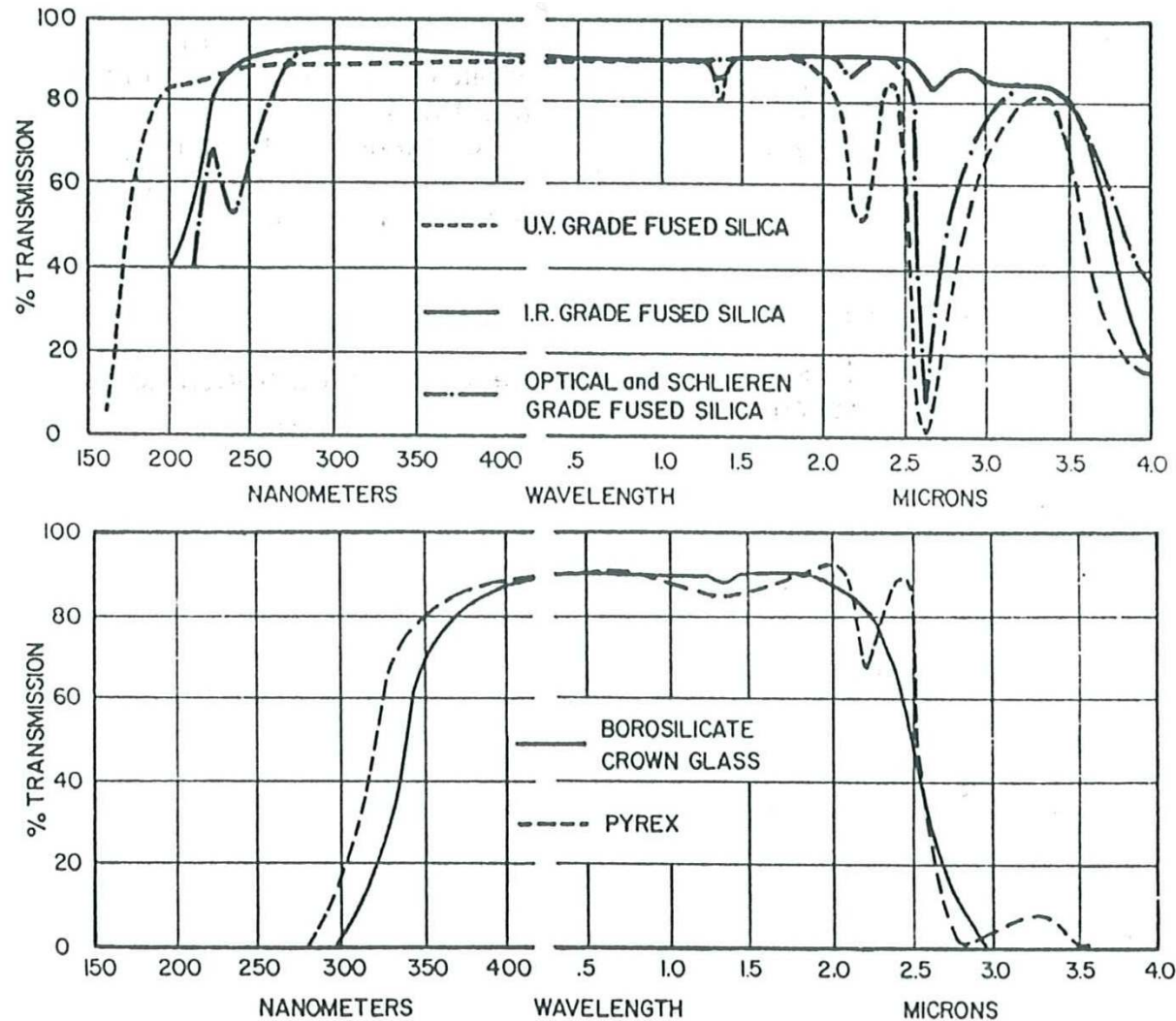
- ▶ Olika bränvidd i vertikal och horisontell riktning

⇒ Färgfel



Genomskinlighetsdata

**TYPICAL
TRANSMISSION
DATA
(10 mm thickness)**



Spegelmaterials eflektans

