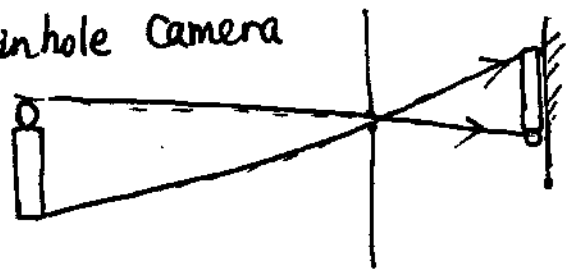
Lect 5 light : Ray mode — reflection — Geometric optics

① Ray model — in the uniform media, light travels like straight lines. Visible lights are E-M waves with $\lambda \approx 0.5\mu m$. At the scale of 1mm that our eye's resolution, visible lights behave as light rays.

* Pinhole Camera

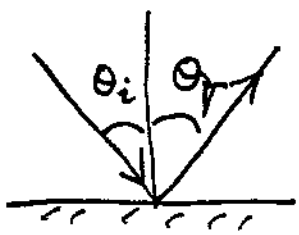


no lens
exposure time is long
the shape of pinhole doesn't matter as long as it is small.

The light spot in the shade of a leafy tree is the image of the sun.
In the sun eclipse, the spot shape also changes from ○ → ☽.

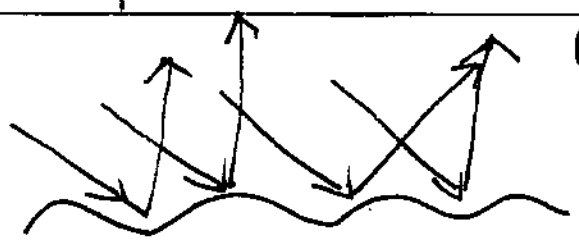
② Reflection from a plane mirror

normal line
incident angle θ_i
reflection angle θ_r



law of reflection: $\theta_i = \theta_r$.

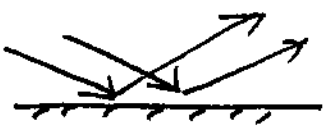
diffusive reflection:



reflection on rought surface.

The law of reflection still holds locally with respect to the local normal line. the reflected light goes all the direction.

specular reflection:



Ex

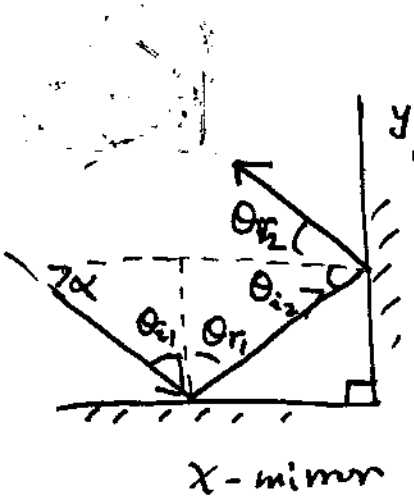
$\theta_{r_1} = \theta_{i_1}$

$\theta_{r_1} + \theta_{i_2} = 90^\circ$

$\theta_{i_2} = \theta_{r_2}$

$\Rightarrow \theta_{i_1} + \theta_{r_2} = 90^\circ$ $\Rightarrow \alpha = \theta_{r_2}$

$\theta_{i_1} + \alpha = 90^\circ$ $\Rightarrow$ incident light // outgoing beam

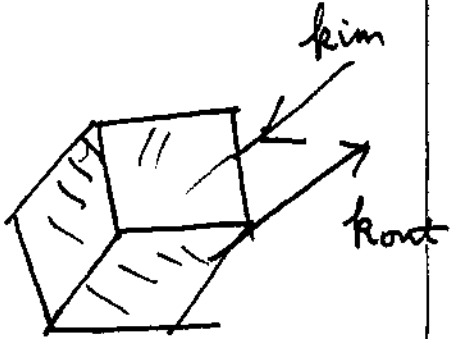


incident light $\vec{k} = k_x \vec{i} + k_y \vec{j}$

after reflection x-mirror. $k_y \to -k_y$, k_x doesn't change

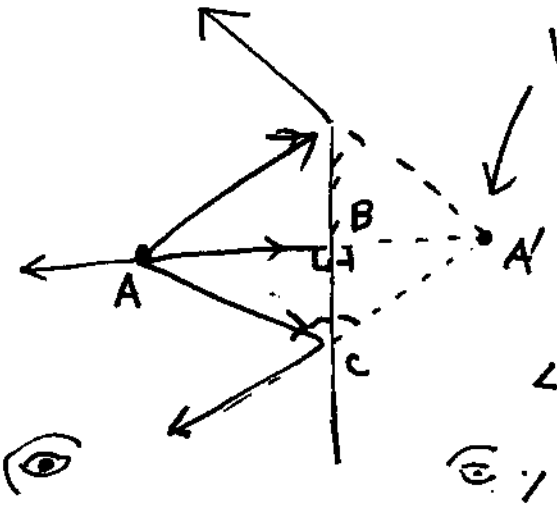
y-mirror $k_x \to -k_x$

$\Rightarrow \vec{k} \to -k_x \vec{i} - k_y \vec{j} = -\vec{k}$



Corner-like reflector:

✱ plane mirror - imaging



$\Rightarrow$ A and A' are symmetric with respect to the mirror

Rt $\triangle ABC \cong$ Rt $\triangle A'BC$

$\angle ACB = \angle A'CB$

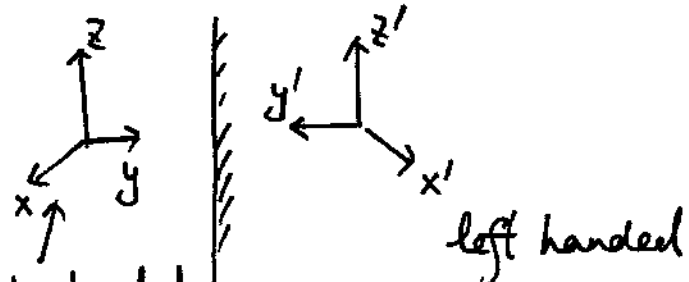
$BC = BC$

All the reflected light rays look as if they came from A'.

A' is the image, it's the actual crossing point of light rays but the crossing point of the reverse extention lines — virtual image.

✱ vector v.s. axial vectors

image:

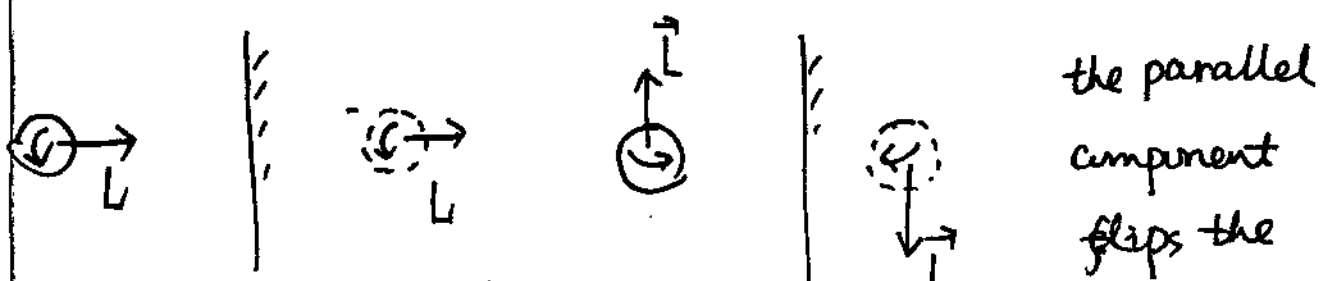


vectors:

components parallel to the mirror do not change

component perpendicular to the plane reverse its direction.

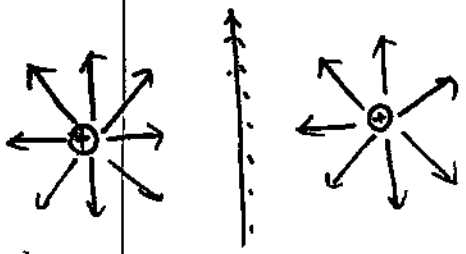
but for axial vectors, say angular momentum.



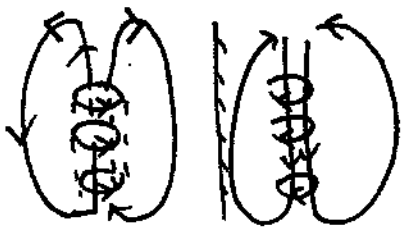
the perpendicular component doesn't change

the parallel component flips the direction

how about $\vec{E}$ and $\vec{B}$ field

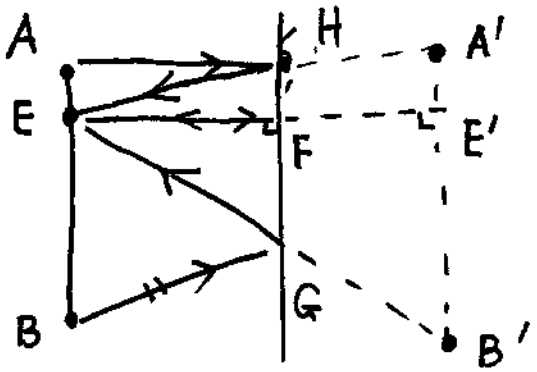


$\vec{E}$ is vector



$\vec{B}$ is axial vector

Example:



$\Delta EHG \sim \Delta EA'B'$

$EF = \frac{1}{2} EE'$

$\Rightarrow HG = \frac{1}{2} A'B' = \frac{1}{2} AB$

we only need half length of AB.

the mirror height