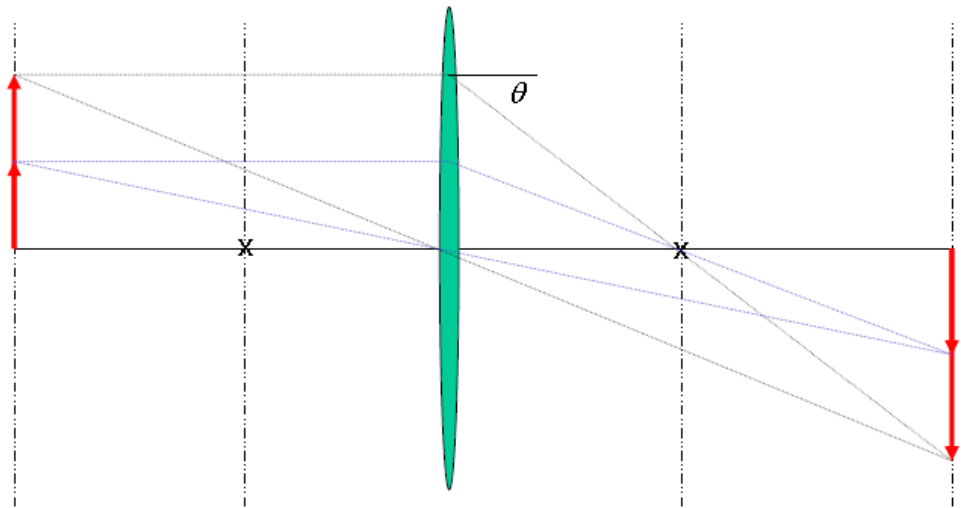


SEM (Astigmatism)

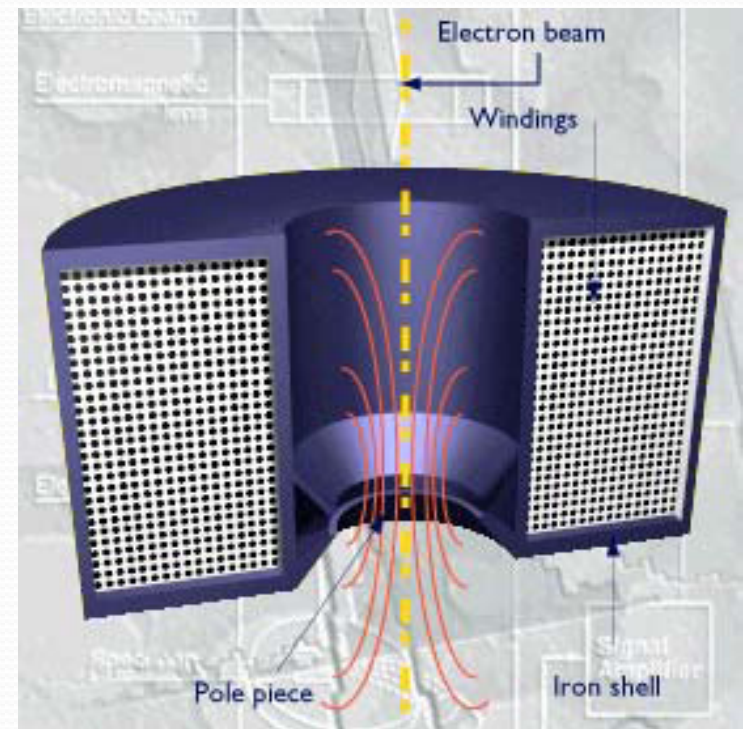
Aftab Ahmed.

Lens Systems

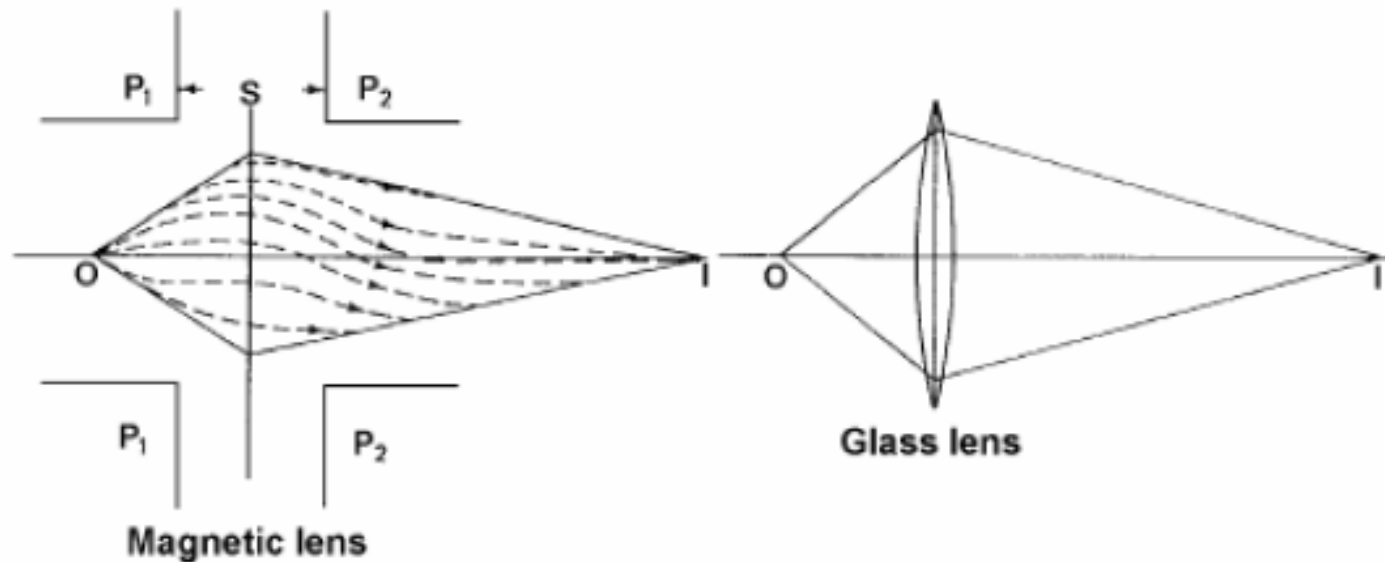
- Glass lenses can be used to converge or diverge light.



- Electrons can be deflected by electric and magnetic fields.



Lens Systems



- Each lens forms an image I from object O , but the electrons rotate in a spiral trajectory about the lens axis as they pass through the magnetic field between the pole pieces.

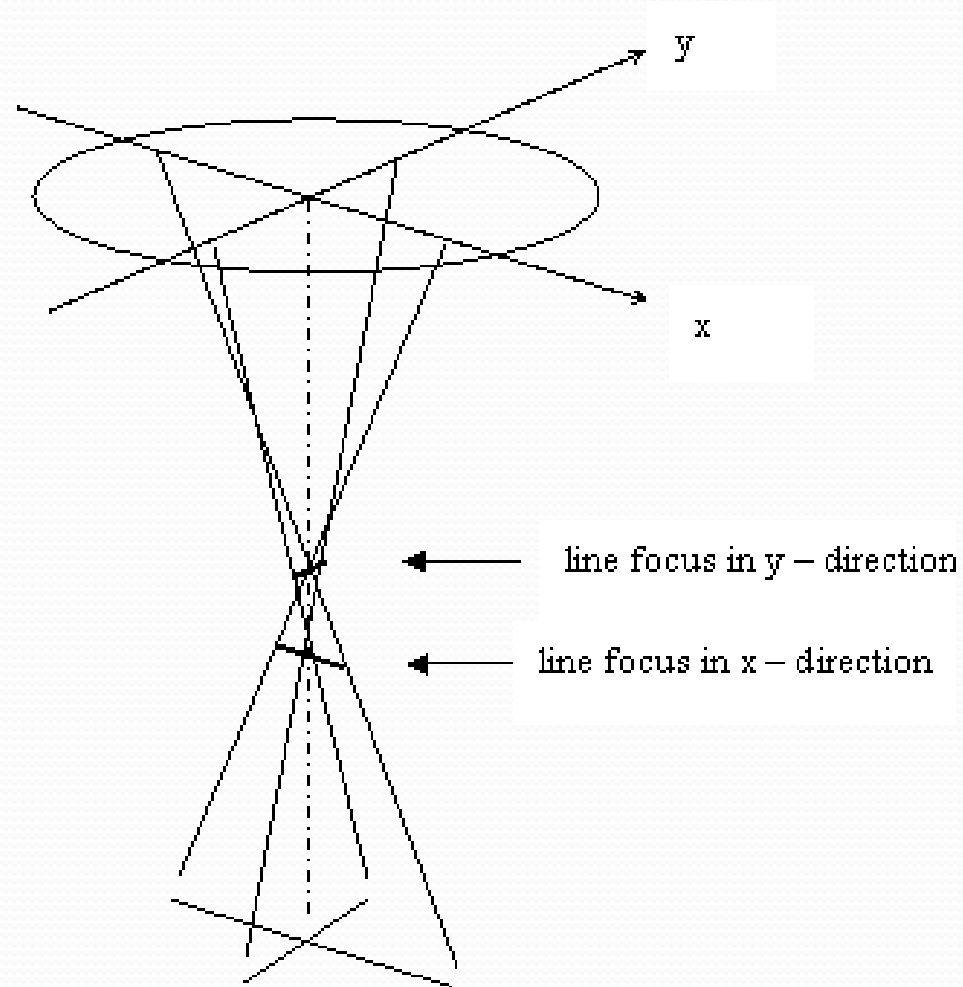
Aberrations of lenses

- The most important aberrations are:

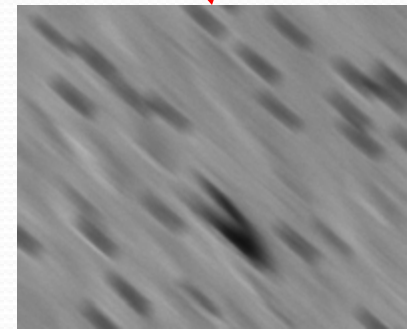
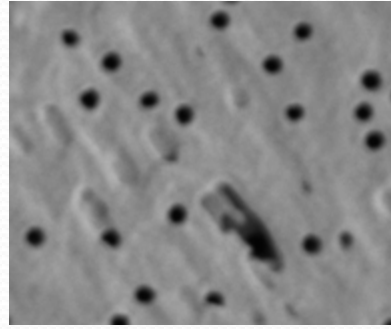
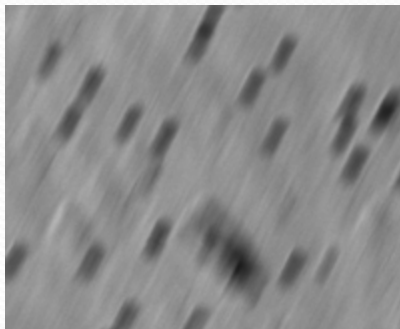
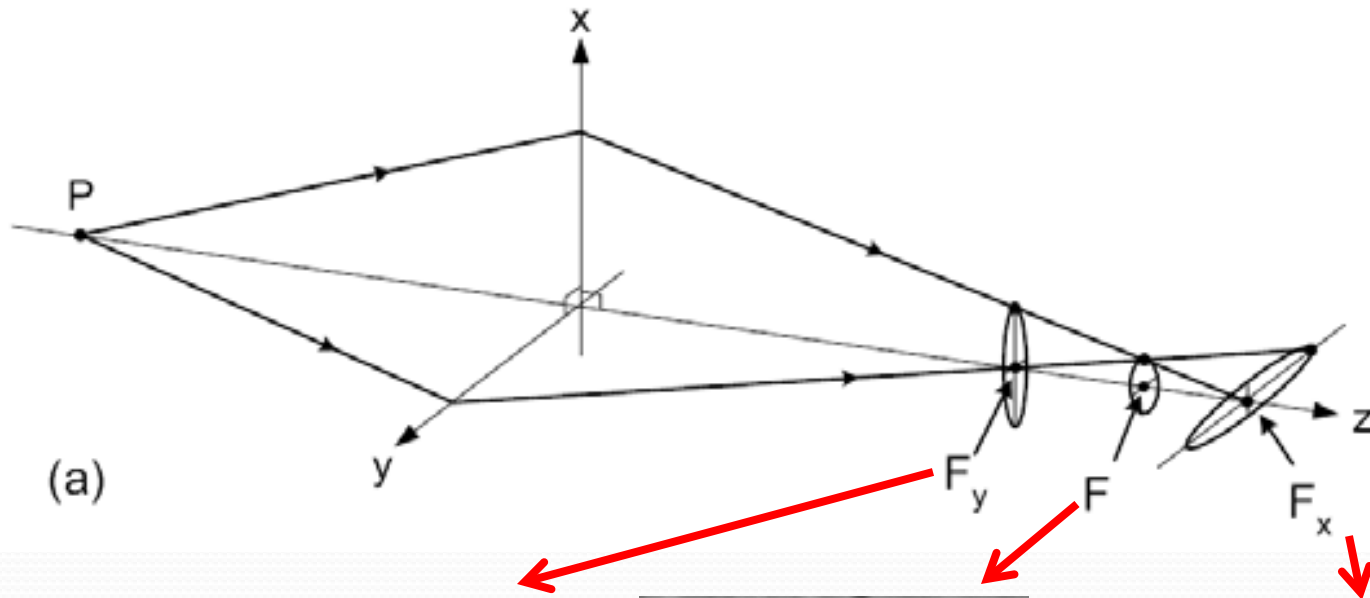
1. Spherical aberration
2. Chromatic aberration
3. Astigmatism

Astigmatism

- Arises when the lens is more powerful in one plane than in the plane normal to it
- Causes points to be imaged as short lines



Astigmatism



Most common causes

- Inhomegenities of lens
- Heavy contamination & dirt particles
- Magnetic fields:

external:

motors & transformers etc.

internal:

magnetic specimens

Most common causes

- Scratches on final lens
- Misalignment of beam in SEM column/gun hardware
- Charging of specimen

Time dependant phenomenon

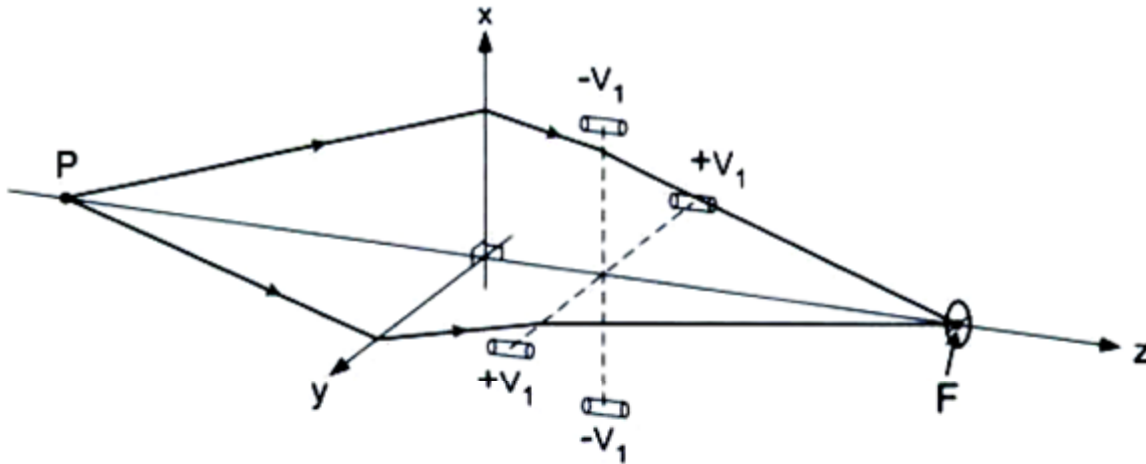
- Hence astigmatism is time-dependent
- Cannot be 'designed out'
- Inevitably requires continuous correction

Correction

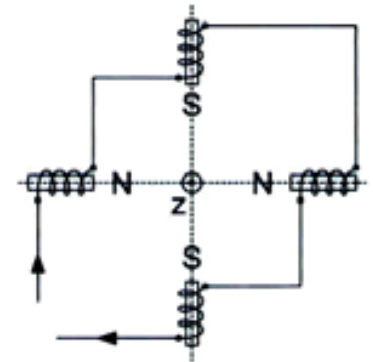
- With glass optics astigmatism is corrected using an additional lens of **strength & asymmetry opposed** to the asymmetry of the basic lens.
- **Electron optics, same principle employed:**

Stigmator lens apposed to main lens,
strength & direction of its asymmetry
user-variable

Correction

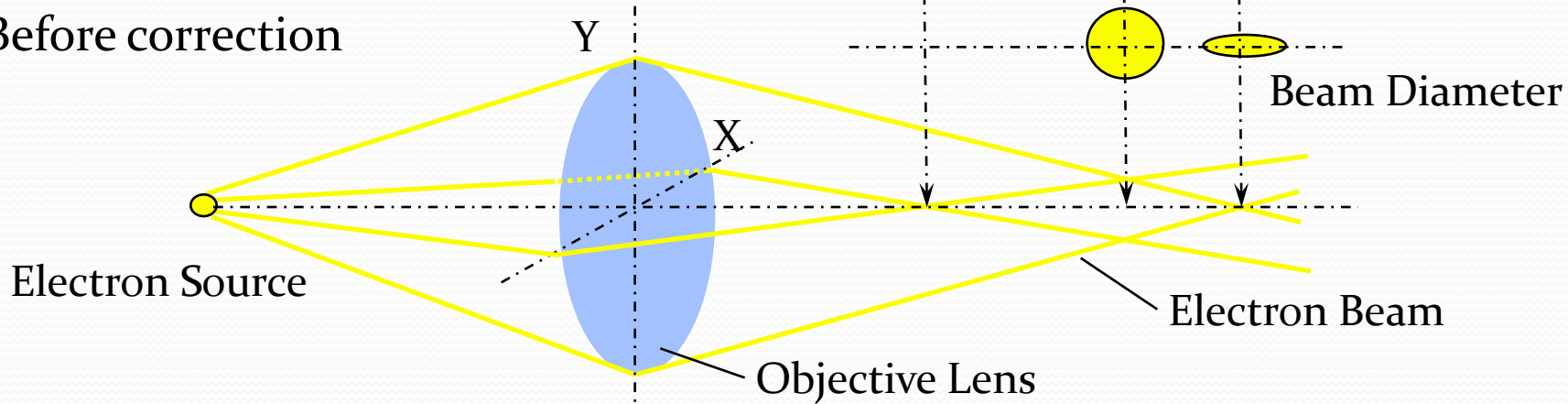


- Astigmatism can be corrected using additional elements called stigmators contained inside the objective lens

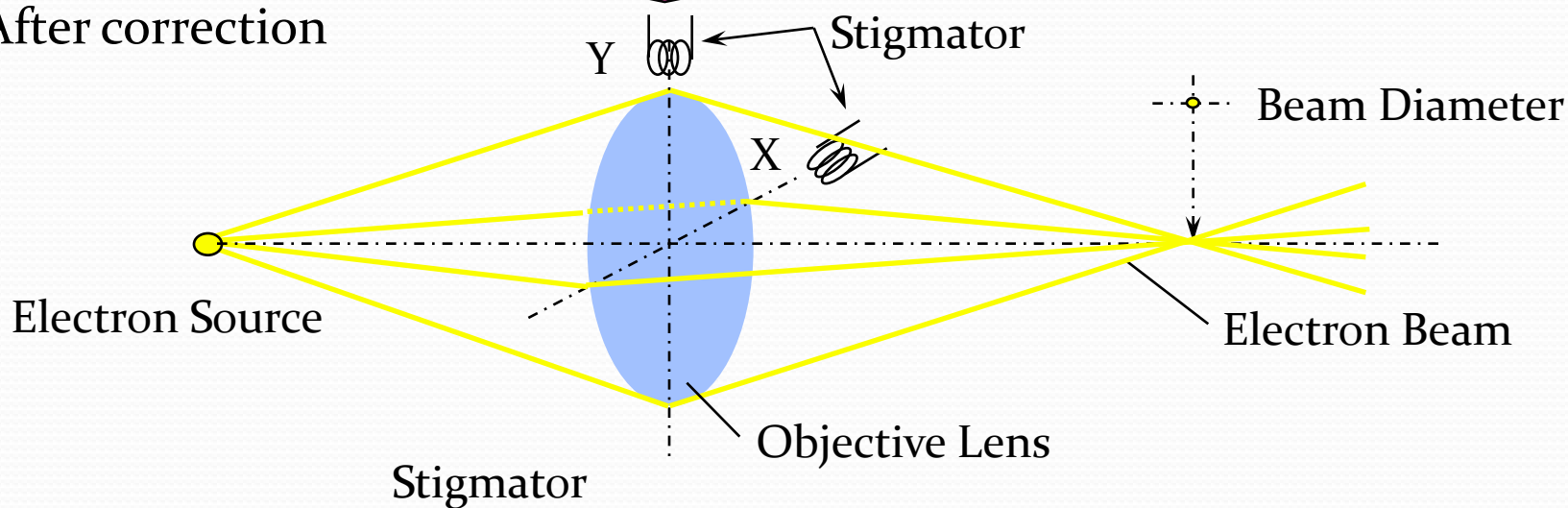


Magnetostatic quadrupole lens is basis of a stigmator

Before correction



After correction



Astigmatism correction method



Thank You.