# George Thomson's experiment

In a powdered, microcrystalline substance there is always some crystal which has the correct angle for constructive interference $2d\cos\alpha = n\lambda$

Diffraction pattern
Each ring corresponds to one type of crystal planes.

Foil of a few 100nm

Cathode rays

K=50keV , λ=0.05A

A magnetic field can change the rings, showing the the waves are associated with the electron charge.
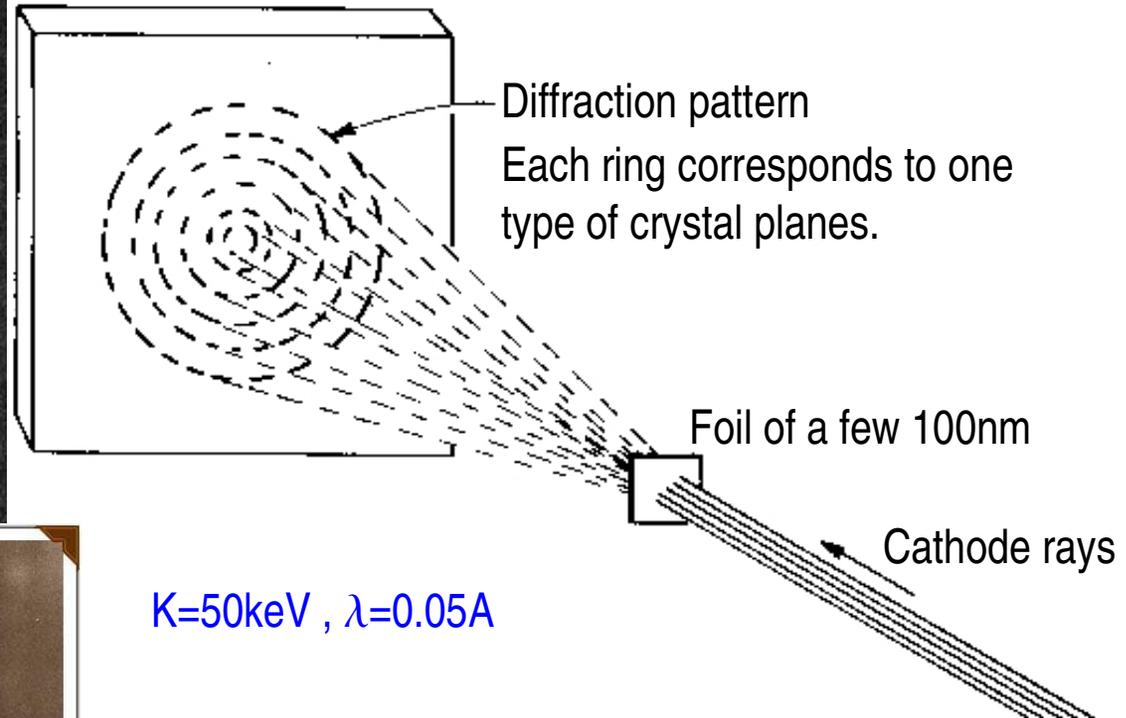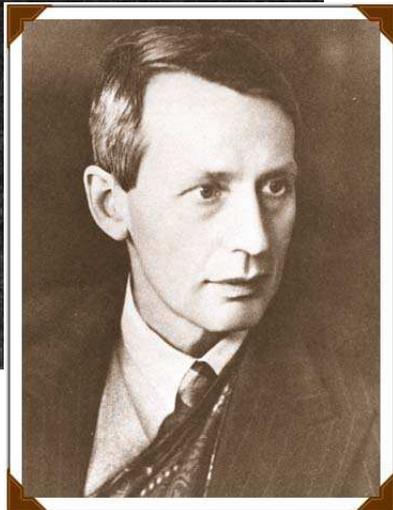
George P.Thomson
(1892-1975)
1937 Nobel prize
Son of Joseph J. T.

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Ultrafast
Electron Diffraction

r(A)

r(A)
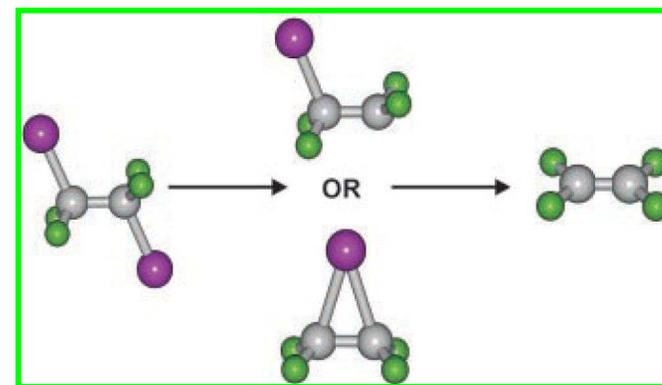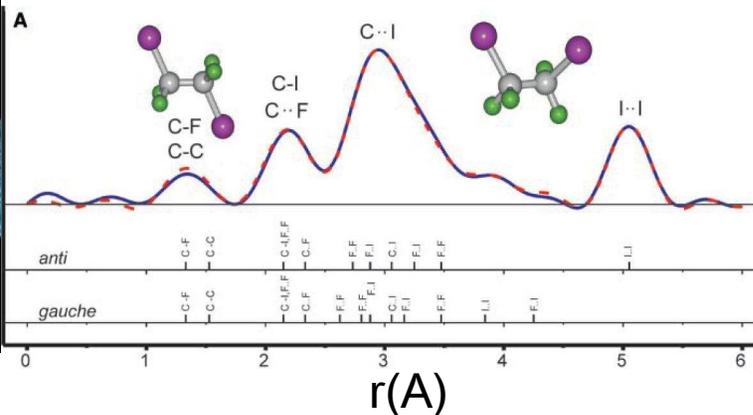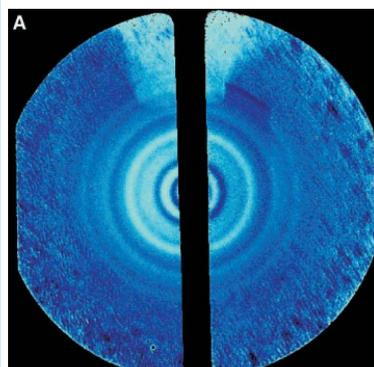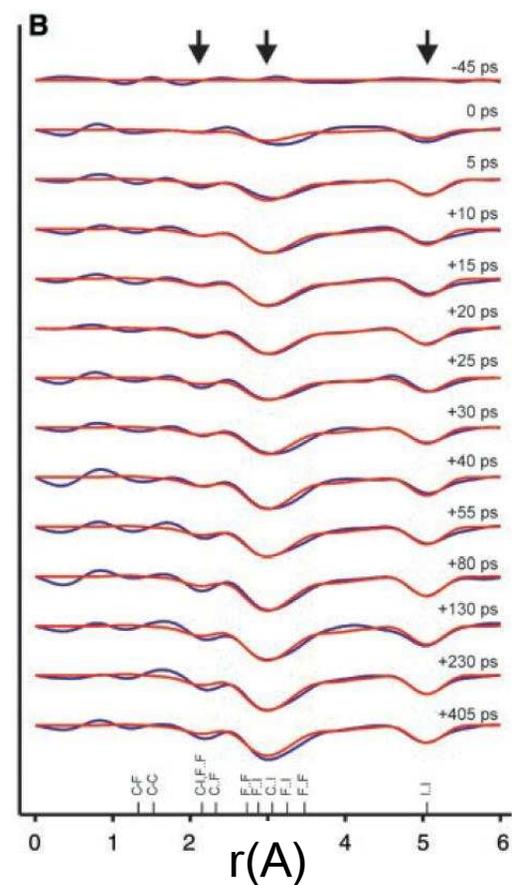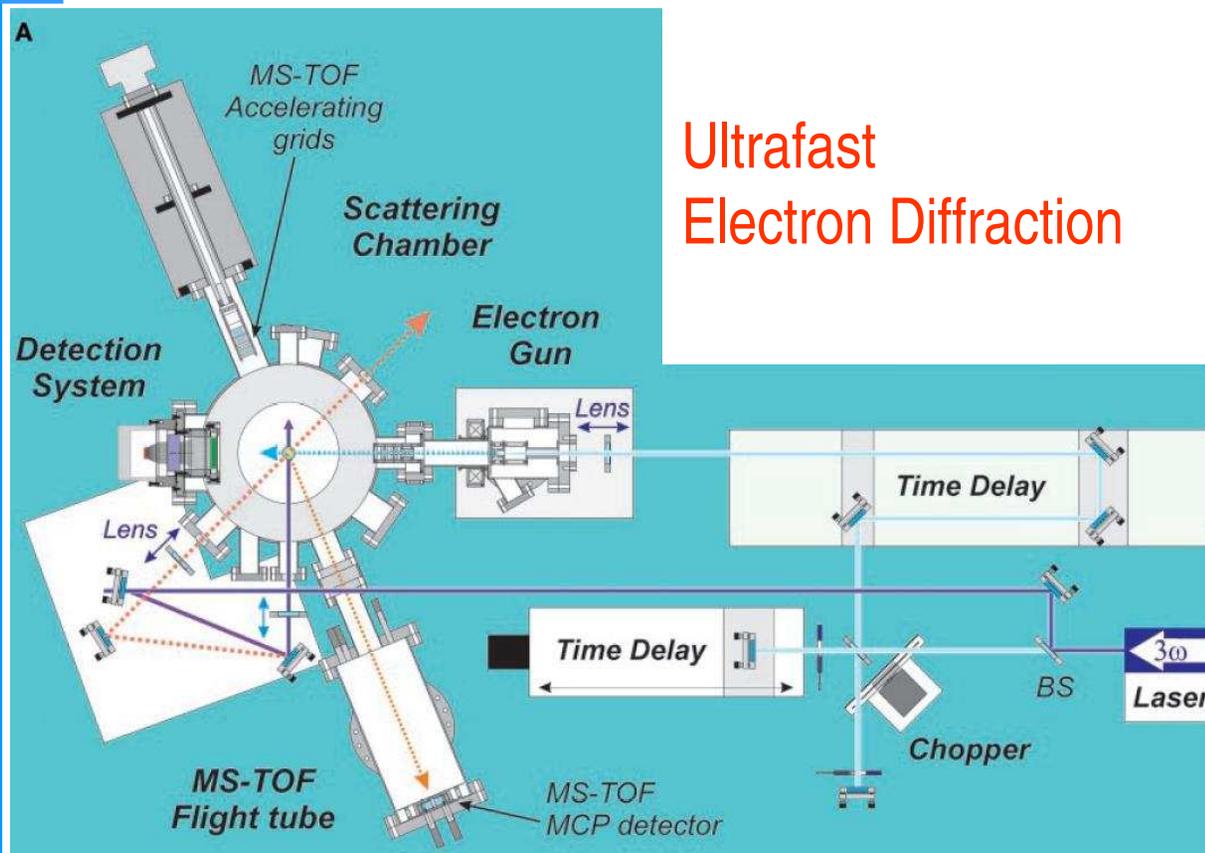
Waves in Electron Microscopes

Solenoid lenses

K=200keV , λ=0.025A
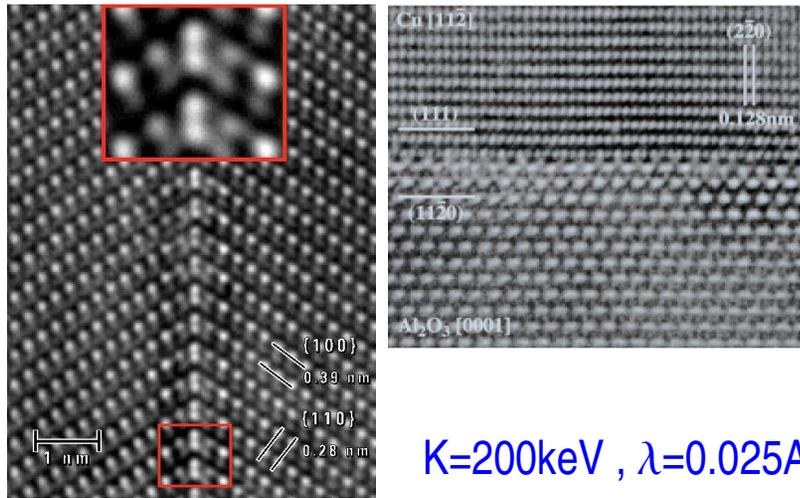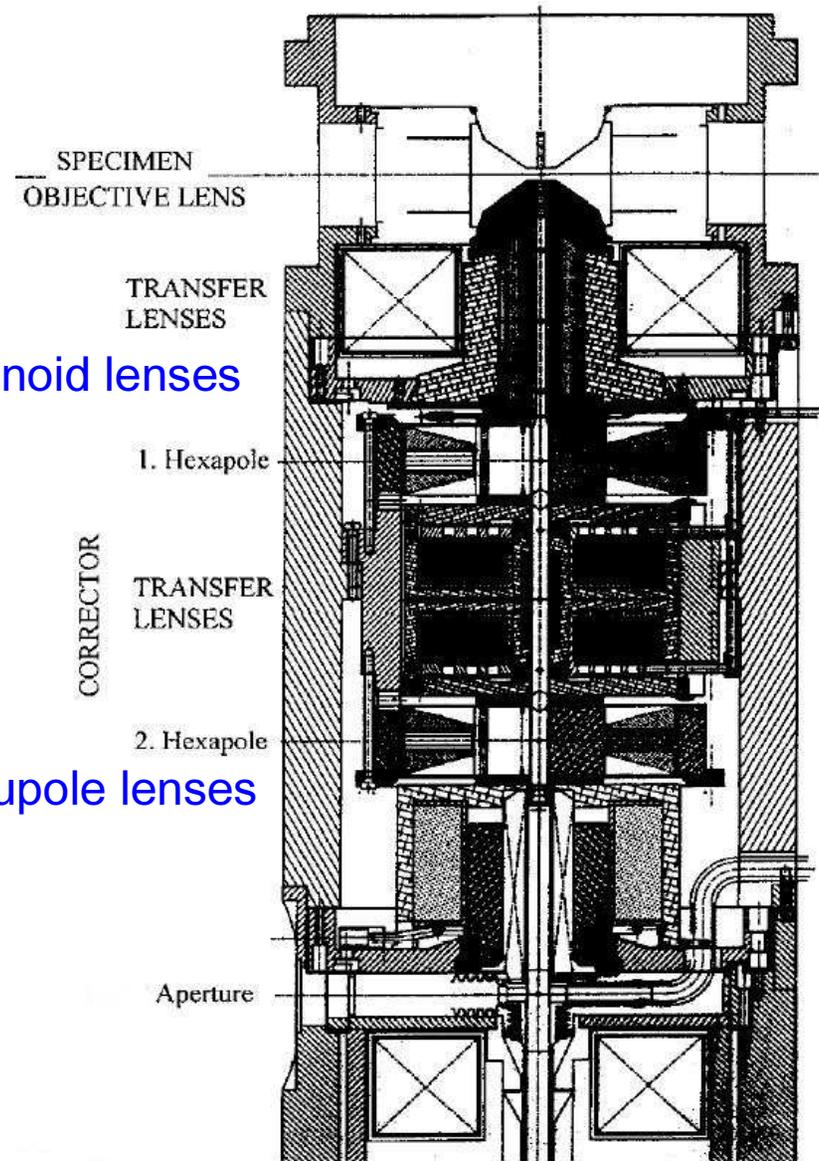
Sextupole lenses

Ernst Ruska
(1906-1987)
1986 Nobel prize

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SPECIMEN
OBJECTIVE LENS

TRANSFER
LENSES

1. Hexapole

CORRECTOR

TRANSFER
LENSES

2. Hexapole

Aperture

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Formation of optical images

At low exposure, the few photons that lead to a reaction in a photographic plate are statistically distributed. Hits of individual photons can be observed.

With increasing exposure, the interferences of electromagnetic waves that refract in the lens of the camera and form the image become apparent. The image formed by many photons forms corresponds to the image formed by interfering electromagnetic waves.

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