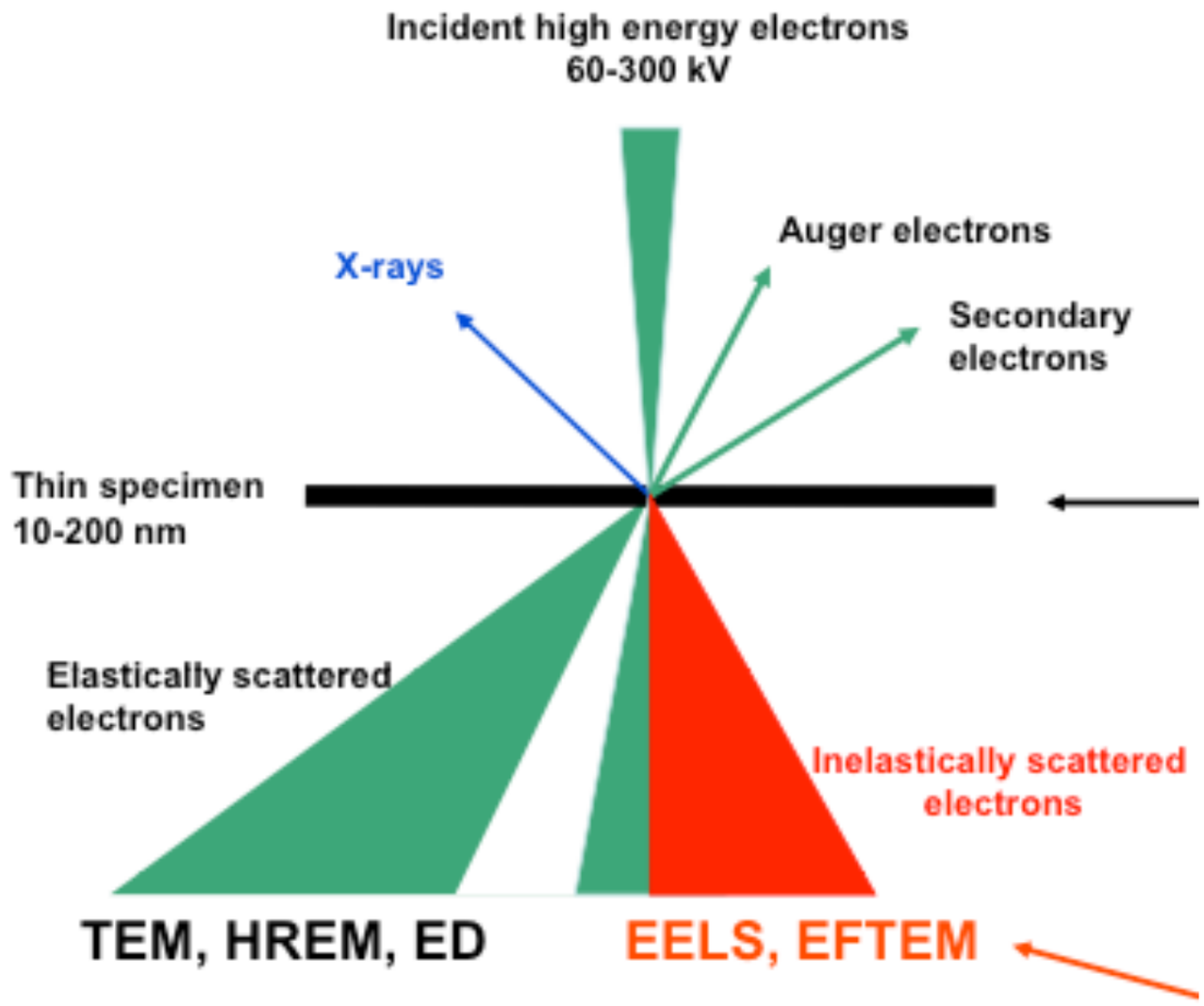

Target (100 nm Au foil)

40 cm

Detector/aperture = 2 x 2 cm^2

Quick Rate Estimate for Mott Scattering from a Gold Foil

Cross section:

For 300 keV electrons scattering to ~ 30 deg : $d\sigma/d\Omega$ ~ 50 barns/sr or 50×10^{-24} cm^2 /sr

~ 90 deg : $d\sigma/d\Omega$ ~ 1×10^{-24} cm^2 /sr

~150 deg: $d\sigma/d\Omega$ ~ 0.25×10^{-24} cm^2 /sr

Current: 5 pA for vortex electrons => $N_e = 5\times10^{-12}/1.6\times10^{-19} \sim 4\times10^{7}$ e /sec

Target: 100 nm Gold foil =>

N_{Au} = # of scatterers = $\rho*t*N/M$ ~ 20 gm/cc * 10^{-5} cm * $6\times10^{23}/200$ gm = 6×10^{17} /cm^2

Detector solid angle: assume 2x2 cm^2 aperture placed 40 cm from target

=> solid angle = $d\Omega$ = 0.0025 sr = 2.5 msr

Rate: $d\sigma/d\Omega * N_e * N_{Au} * d\Omega$ = 4 Hz at 30^0 , 0.08 Hz at 90^0 and 0.02 Hz at 150^0

Energy of scattered electron: $E' = E/(1 + 2E*\sin^2(\theta/2)/M)$ = 299.99994 keV at 30^0

= 299.99955 keV at 90^0

= 299.99916 keV at 150^0