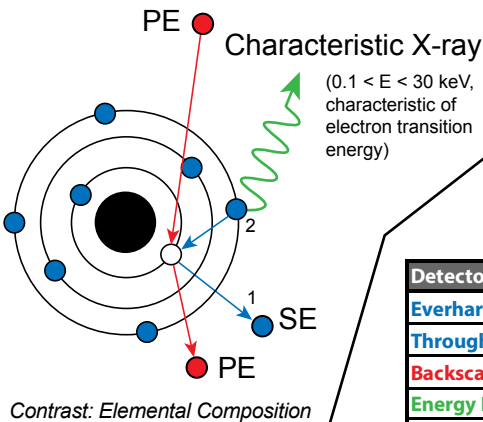
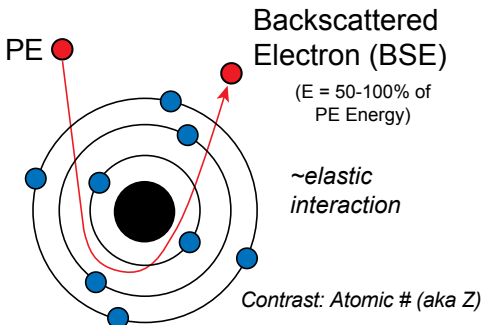
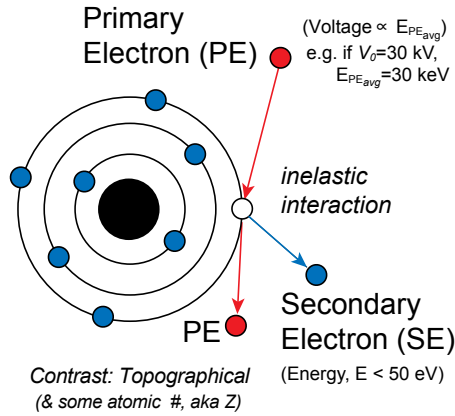


Scanning Electron Microscopy (SEM) Concepts

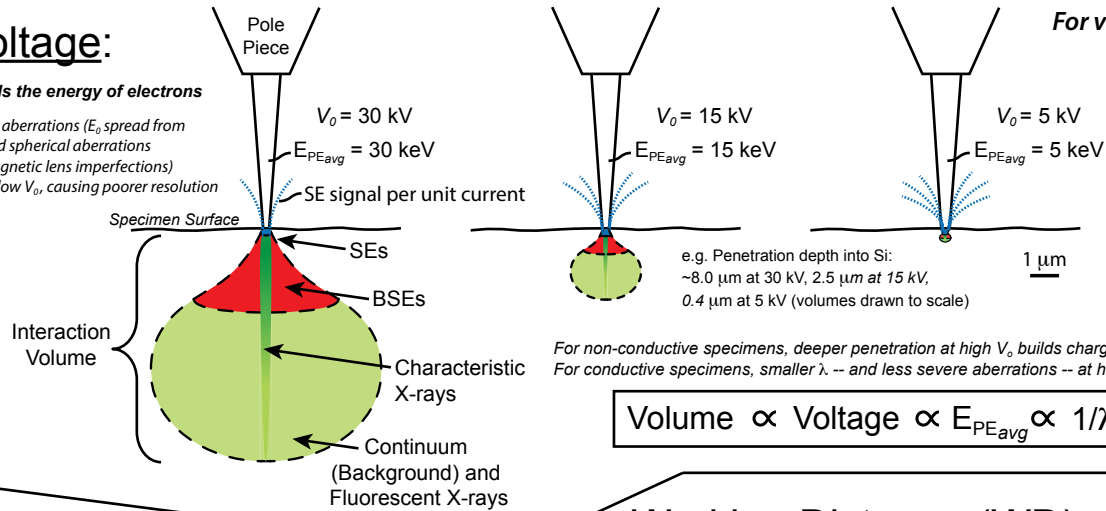
Electron Interactions:



Voltage:

Controls the energy of electrons

Chromatic aberrations (E_s spread from source) and spherical aberrations (electromagnetic lens imperfections) worsen at low V_0 , causing poorer resolution



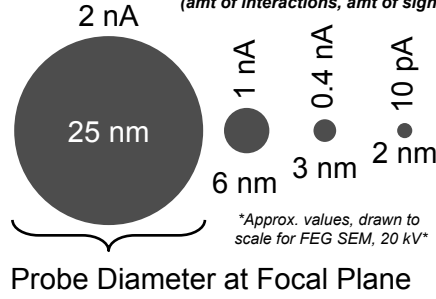
For video tutorials, search: 'KNI Caltech YouTube'

Simulate beam-specimen interactions using CASINO Monte Carlo software, available free online
gel.usherbrooke.ca/casino/index.html

$$\text{Volume} \propto \text{Voltage} \propto E_{PE_{avg}} \propto 1/\lambda_{PE}$$

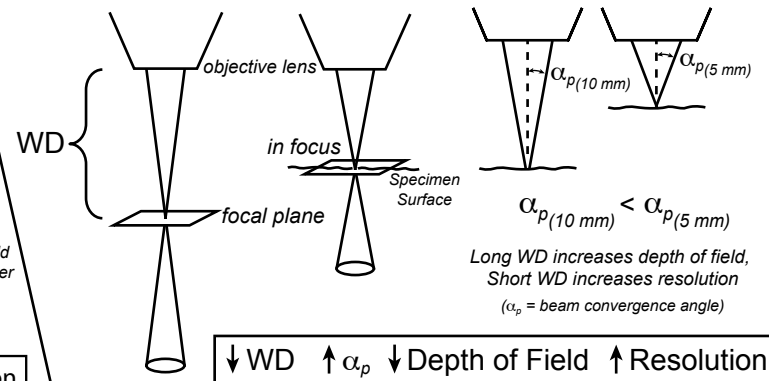
Current:

Controls the amount of electrons (amt of interactions, amt of signal)



↓ Probe Current ↓ Probe Diameter ↓ Signal ↑ Resolution

Working Distance (WD):



Detectors:

*Tip: In the absence of a dedicated BSED, switch to a negative bias (e.g. -50 V) on the TLD to reject low energy SEs and operate it as a de facto BSED (works best in Immersion Mode). Also, you can increase the positive bias of the ETD or TLD to pull in lower energy SEs and thus boost the signal.

Detector	Signal	Recommended Current	Information Detected
Everhart-Thornley Detector (ETD) ^{1,2,3,4}	SE	1-200 pA (Spot 1-3)	Surface Topography
Through-the-Lens Detector (TLD) ^{1,2,3}	SE*	1-200 pA (Spot 1-3)	Surface Topography
Backscattered Electron Detector (BSED) ⁴	BSE	50 pA - 2 nA (Spot 2-5)	Atomic # (Z) Contrast
Energy Dispersive Spectroscopy (EDS) ^{2,3}	X-ray	100 pA - 10 nA (Spot 3-7)	Elemental Composition
Wavelength Dispersive Spectroscopy (WDS) ²	X-ray	100 pA - 10 nA (Spot 3-7)	Elemental Composition

