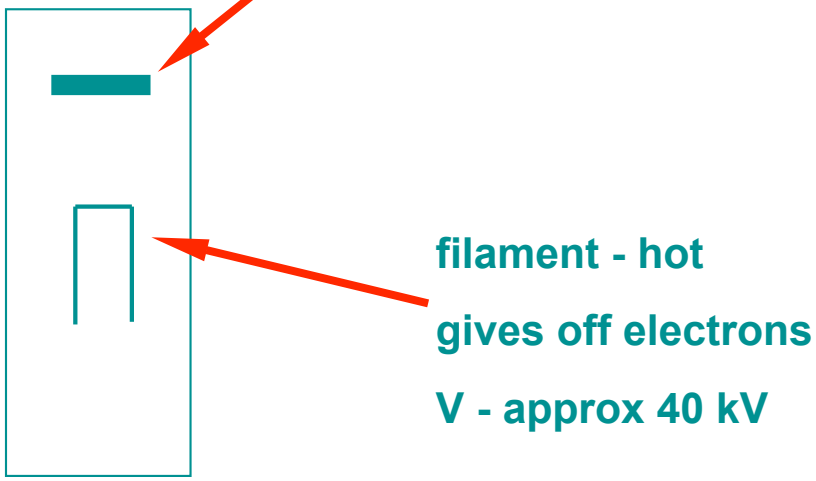
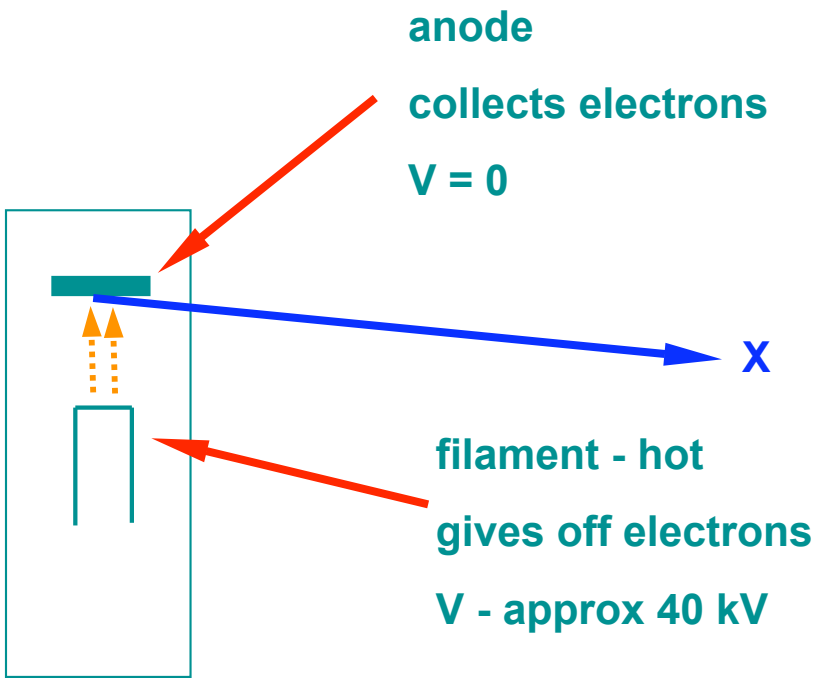
Instrumentation - making x-rays

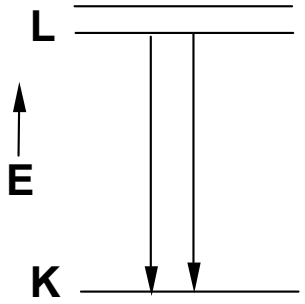
'Laboratory' x-ray tubes



Instrumentation - making x-rays

'Laboratory' x-ray tubes



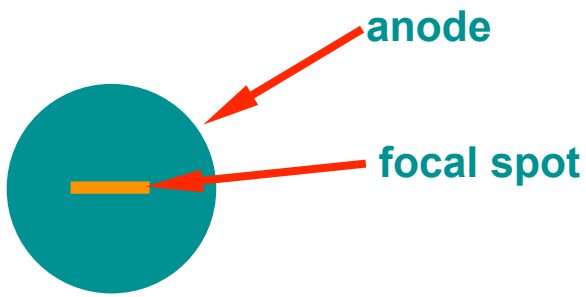


$\lambda = hc/E$

$\lambda(\text{Å}) = 12.4/kV$

Instrumentation - making x-rays

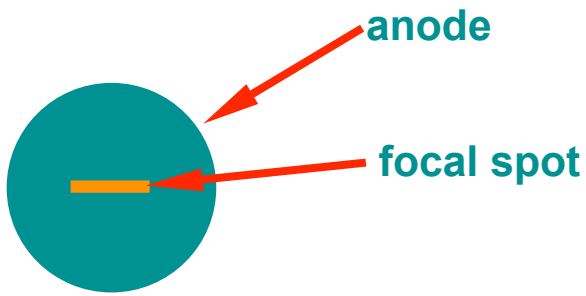
'Laboratory' x-ray tubes



Filament geometry & electron focusing determine size, shape of focal spot, which influences size, shape of beam from tube

Instrumentation - making x-rays

'Laboratory' x-ray tubes

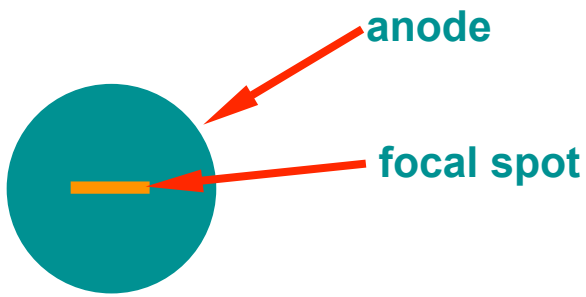


Filament geometry & electron focusing determine size, shape of focal spot, which influences size, shape of beam from tube

For highest intensity, want smallest size possible, but power limited by rate of heat transfer in anode

Instrumentation - the beam

'Laboratory' x-ray tubes

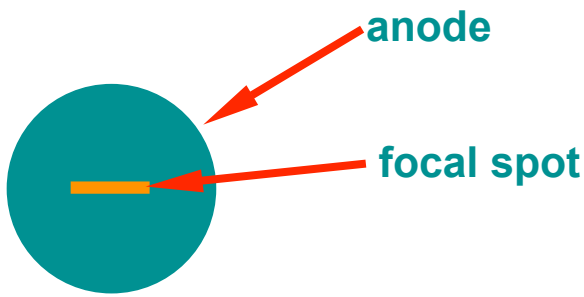


1st problem - tubes usually have liner focal spot w/ finite width

microfocus tubes

Instrumentation - the beam

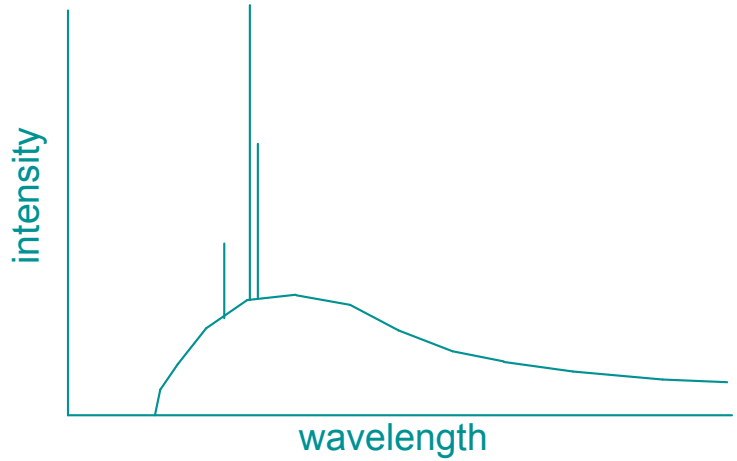
'Laboratory' x-ray tubes



1st problem - tubes usually have liner focal spot w/ finite width

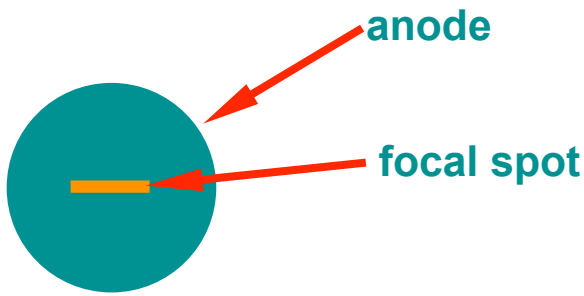
microfocus tubes

2nd problem - x-ray spectrum



Instrumentation - the beam

'Laboratory' x-ray tubes

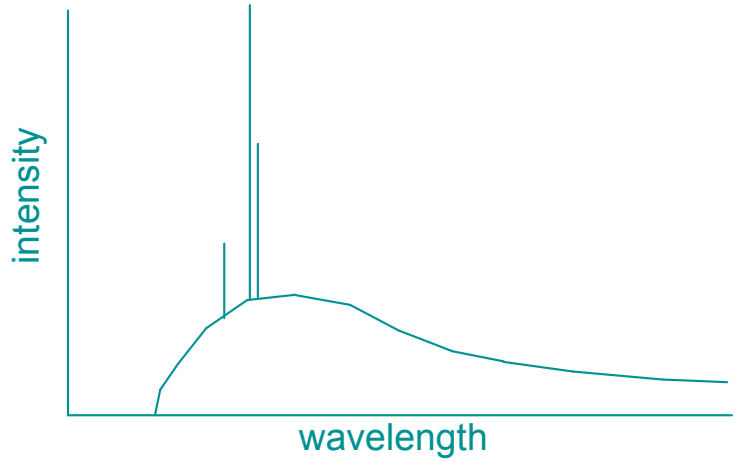


1st problem - tubes usually have liner focal spot w/ finite width

microfocus tubes

2nd problem - x-ray spectrum

Need beam conditioning



Instrumentation - the beam

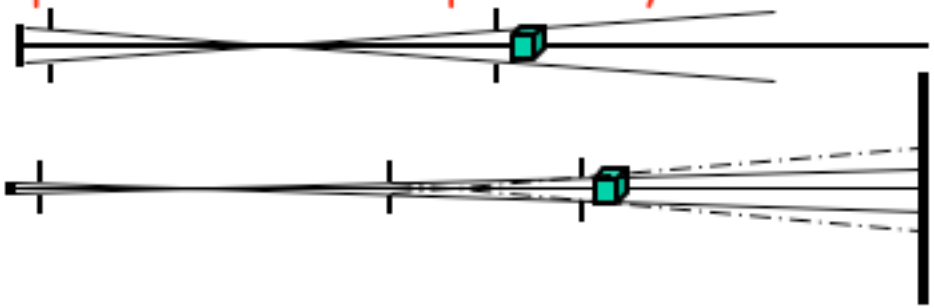
'Laboratory' x-ray tubes

looking at beam

Pinhole collimator

- large intensity loss
- spectrum problems remain
- beam divergence probs

Two-pinhole and three-pinhole systems

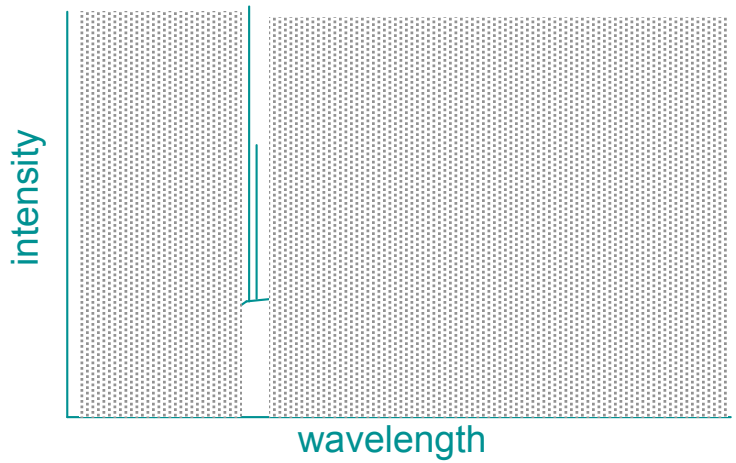


Instrumentation - the beam

'Laboratory' x-ray tubes

Pinhole collimator
- large intensity loss
- spectrum problems remain
- beam divergence probs

Monchromator
- nearly single WL
- beam size probs yet
- beam divergence probs



Instrumentation - the beam

'Laboratory' x-ray tubes

Solns:

Decrease focal spot size

power limited, but

flux still high

spectrum probs remain

Instrumentation - the beam

'Laboratory' x-ray tubes

Solns:

Decrease focal spot size
power limited, but
flux still high

spectrum probs remain

Use new optics
flux high
monochromatic

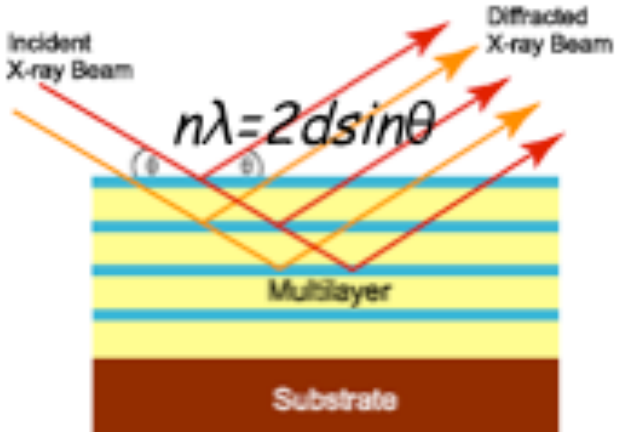
Instrumentation - the beam

'Laboratory' x-ray tubes

Use new optics

flux high
monochromatic

- Based on constructive interference
- Performance is characterized by the reflectivity as a function of incident angle, i.e. rocking curve



Instrumentation - the beam

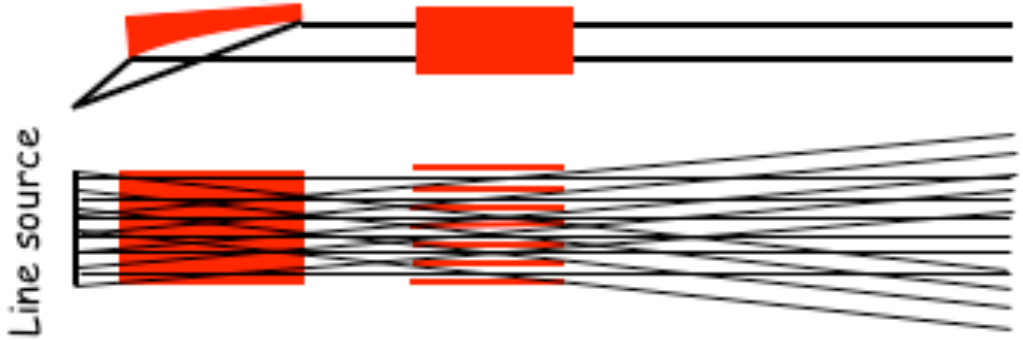
'Laboratory' x-ray tubes

Use new optics

flux high
monochromatic

1-D example:

- Reflect x-ray in one of two perpendicular planes only
- The x-rays in the other plane (usually called axial plane or vertical plane) are conditioned by slit, Soller slit, or combination of these elements
- Line source usually is the choice of the source



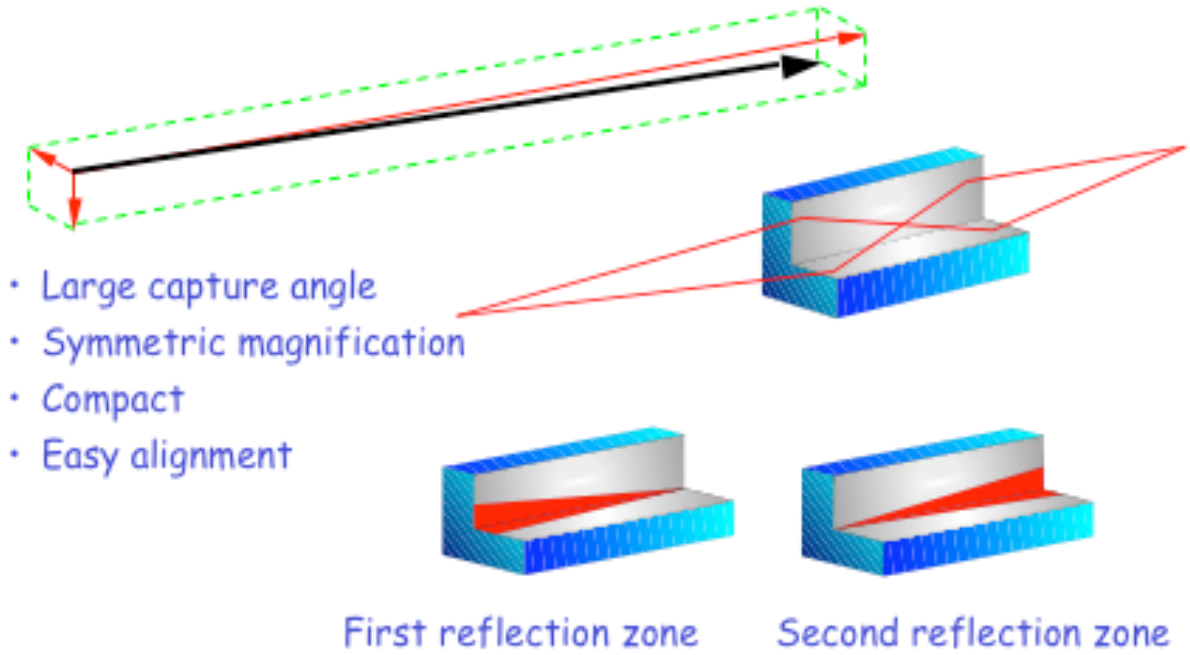
Instrumentation - the beam

'Laboratory' x-ray tubes

Use new optics

flux high
monochromatic

2-D:

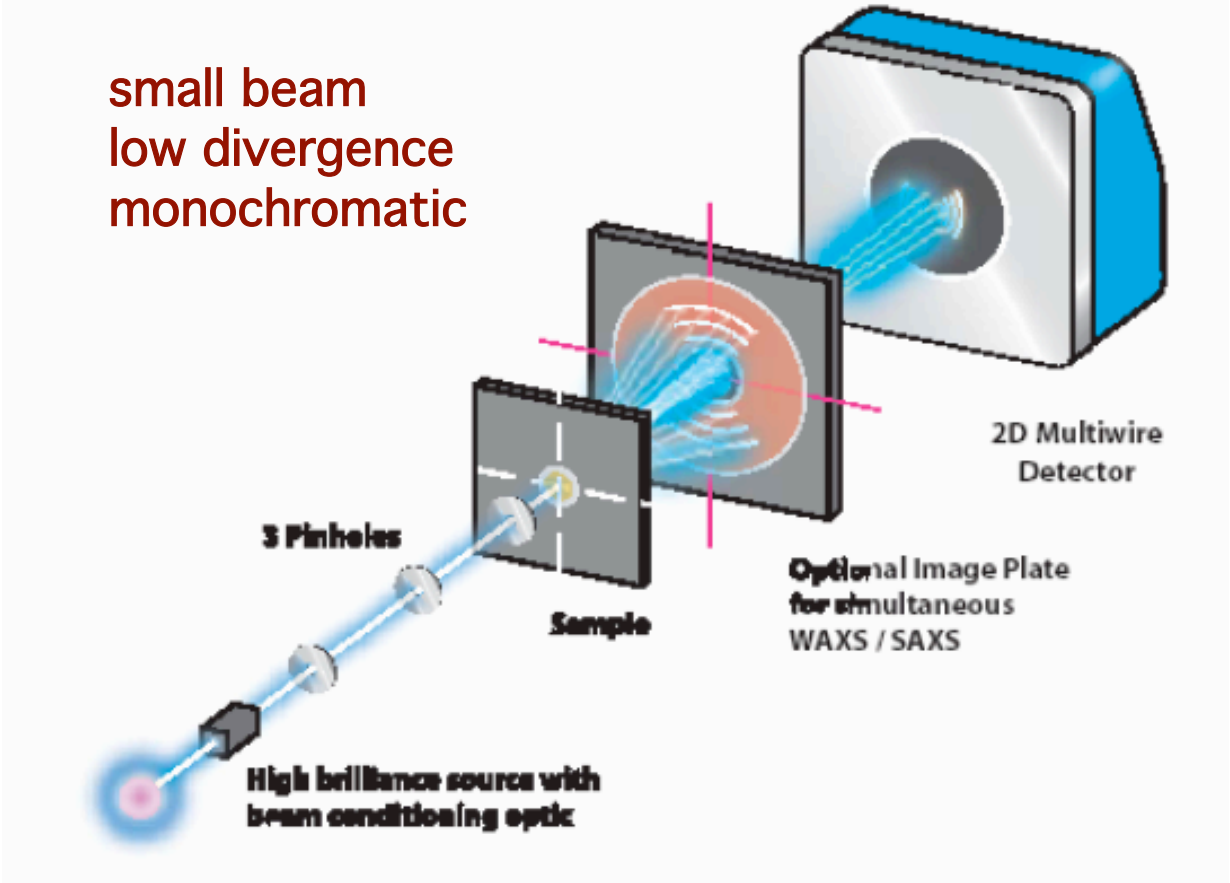


Instrumentation - the beam

'Laboratory' x-ray tubes

Small focal spot + new 2-D optics + pinholes + distance

small beam
low divergence
monochromatic



Instrumentation - saxs system