

*Performance Characteristics
of
WDS and EDS Detectors*

Part 2 - EDS

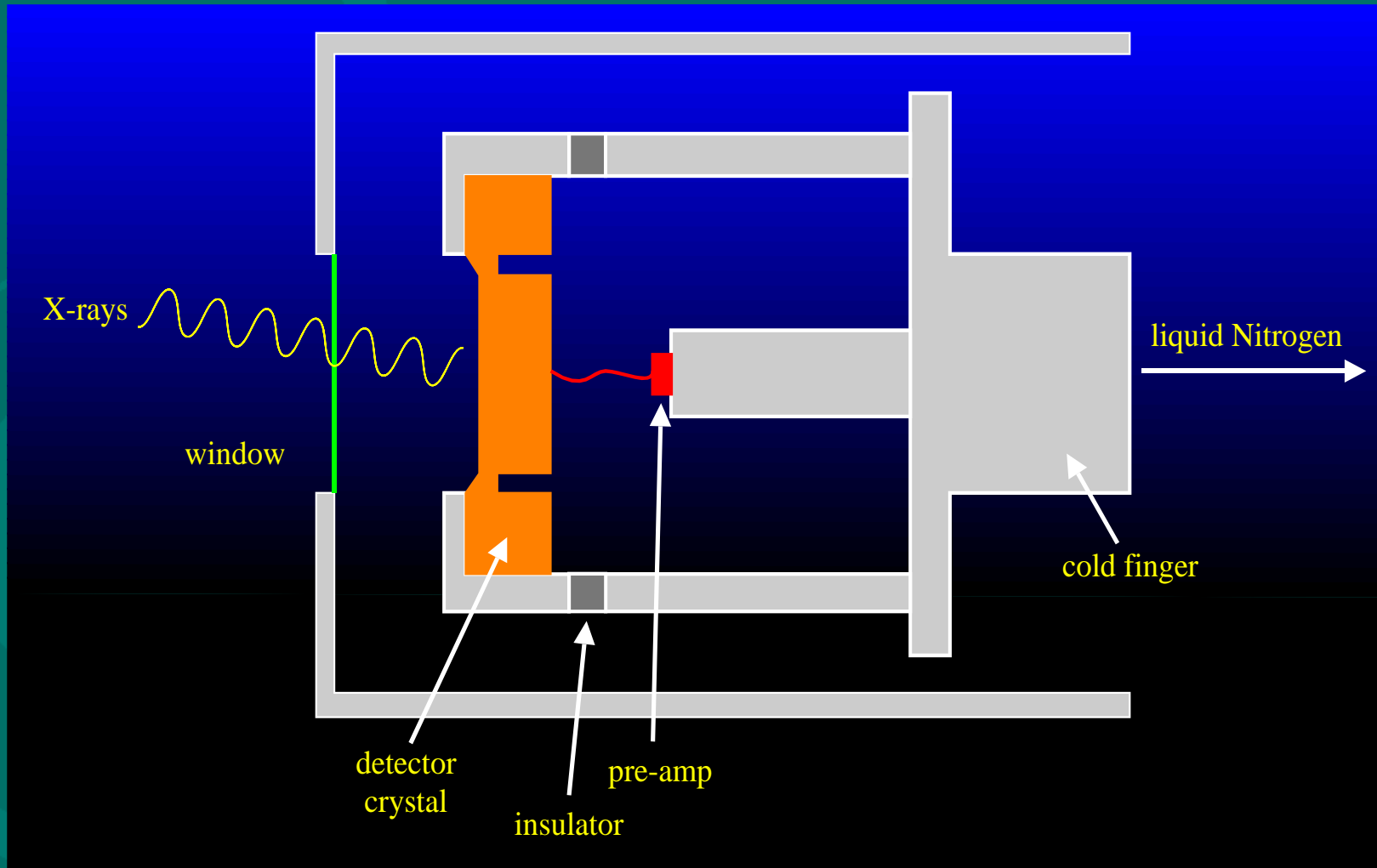
*Mike Matthews
AWE*

Outline

- Energy Dispersive Spectrometers
 - *basic principles*
 - *characteristics*
 - *practical performance*
- Summary

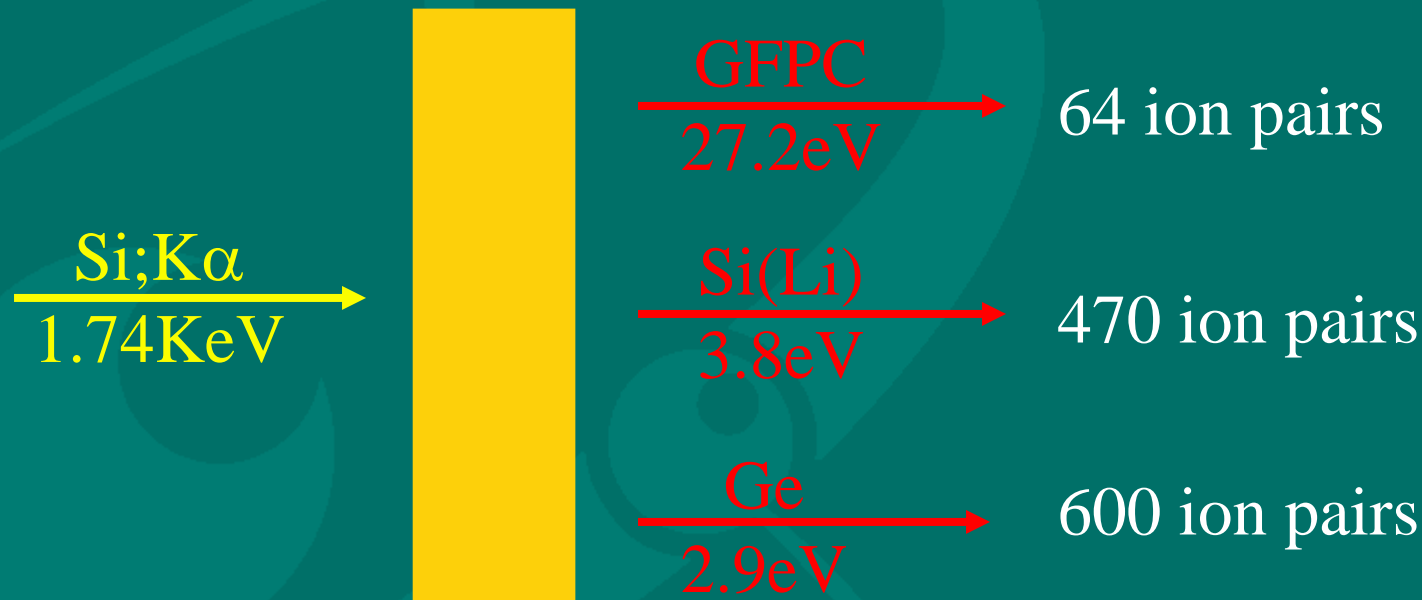
Energy Dispersive Spectrometers

- Principles of operation



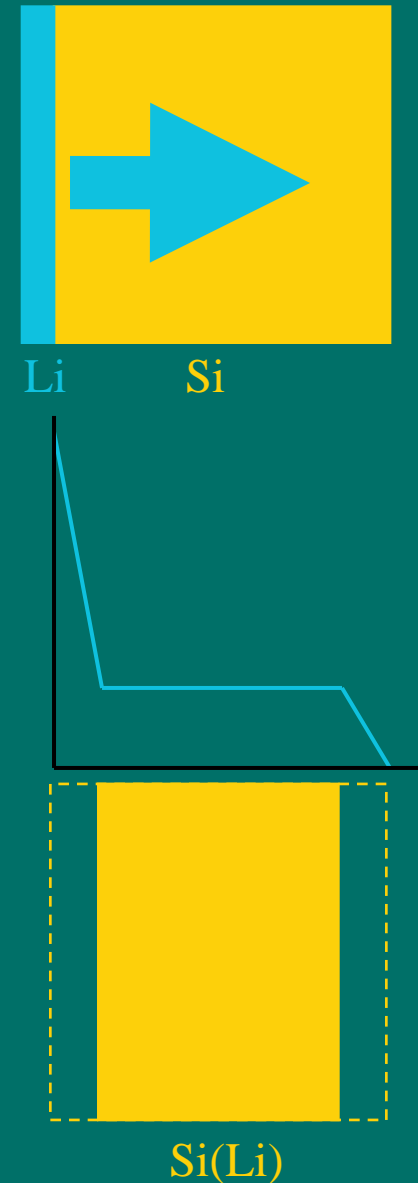
Energy Dispersive Spectrometers

- Principles of operation

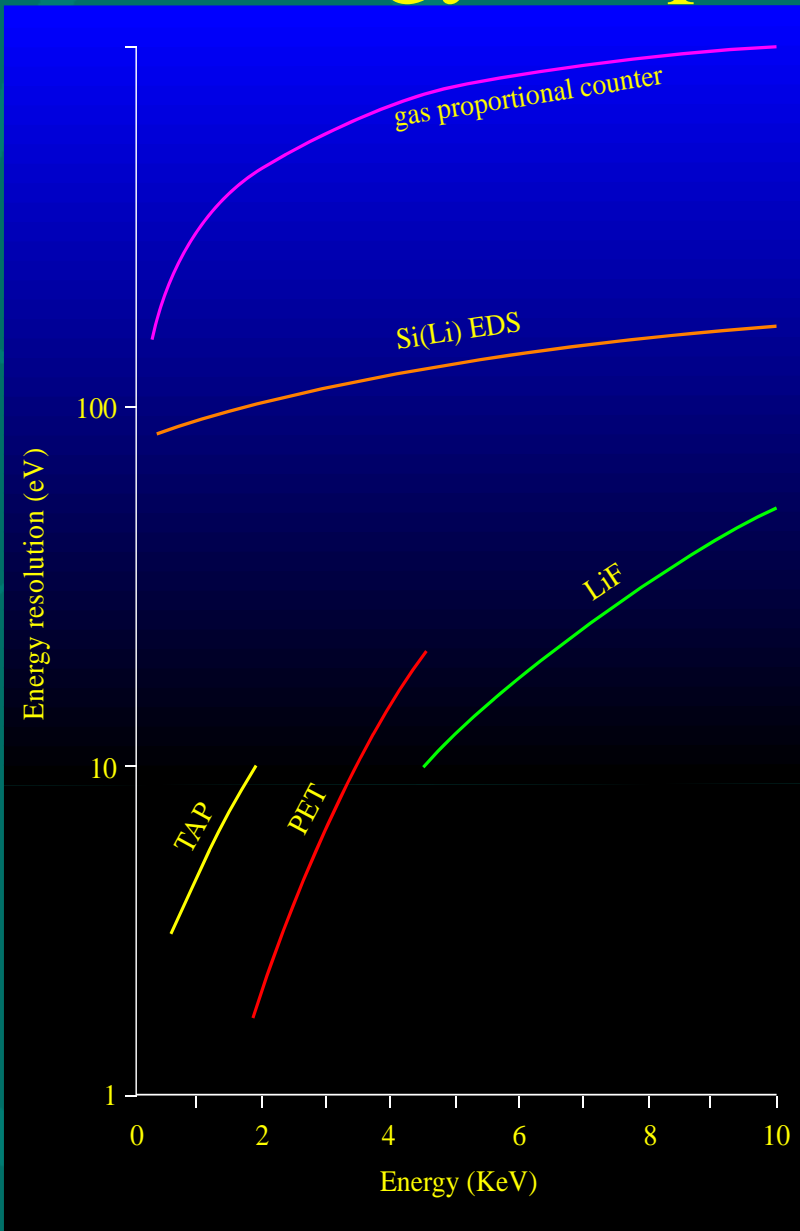


Energy Dispersive Spectrometers

- Si(Li)
 - Intrinsic impurities in ‘pure’ Si
 - Counteraction by Li
 - Li ‘drifting’
- Advantages
 - mechanically simpler
 - no de-focussing
 - parallel X-ray collection
 - simple to apply



Energy Dispersive Spectrometers

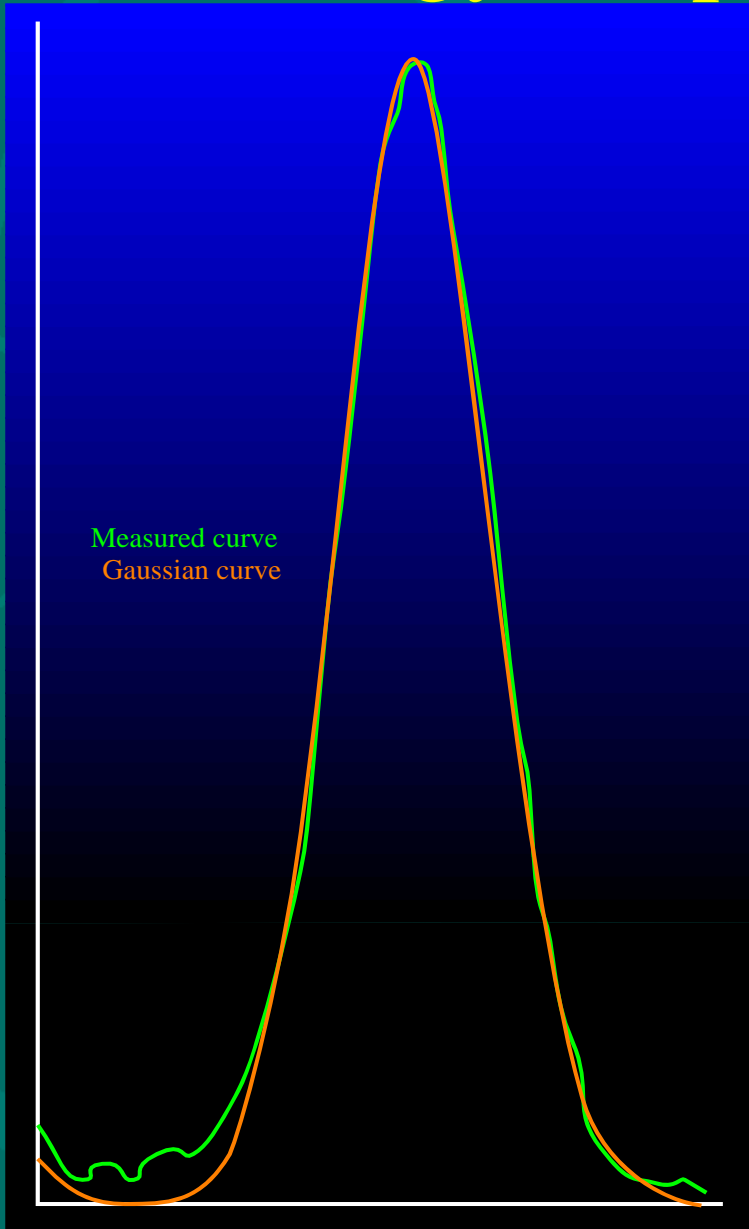


- Factors Affecting Resolution

- Noise

- Statistical
 - Thermal
 - Electrical

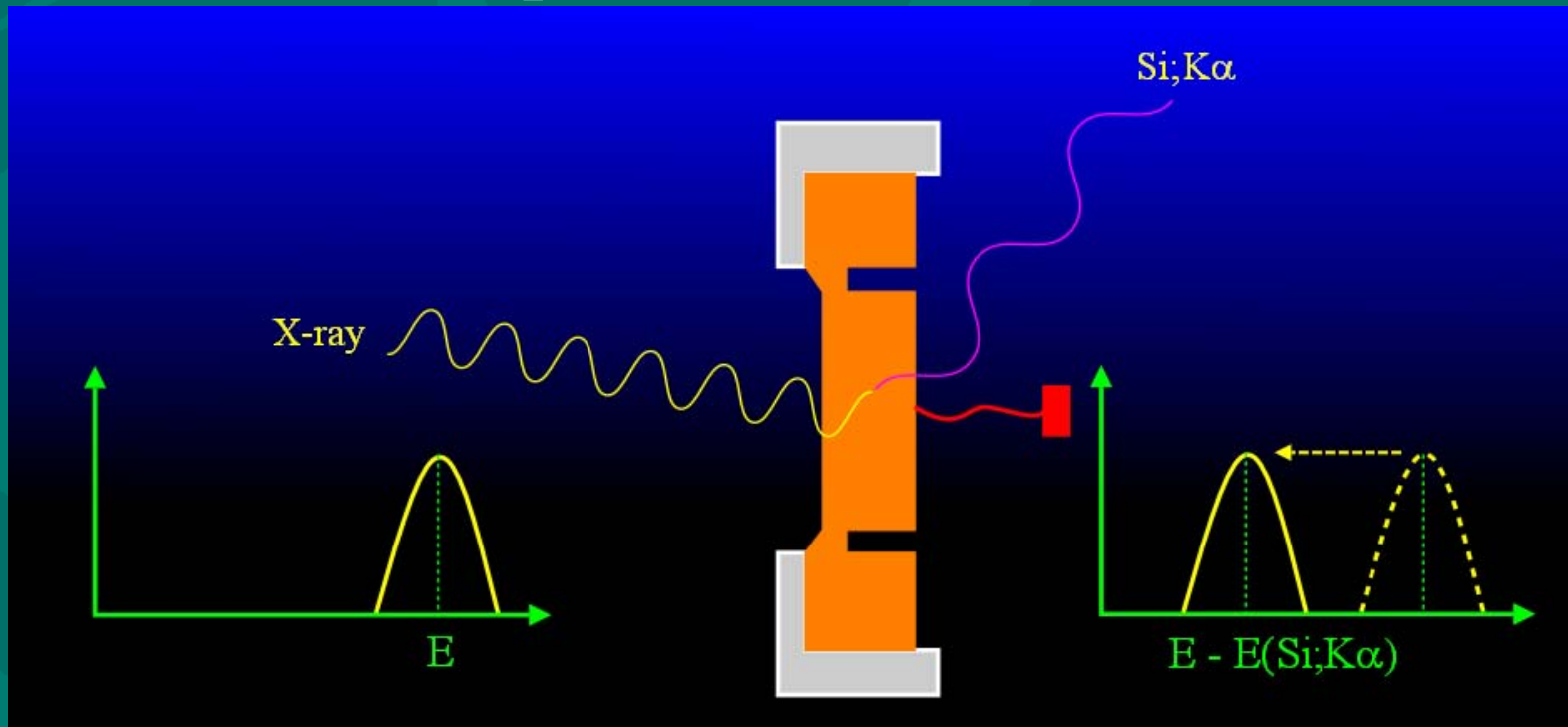
Energy Dispersive Spectrometers



- Factors Affecting Resolution
 - Incomplete charge collection
 - Dead layer
 - Trapping

Energy Dispersive Spectrometers

- Escape Peaks
 - Absorption by Si;K shell
 - Emission of Si;K α X-ray
 - Poor re-absorption



Energy Dispersive Spectrometers

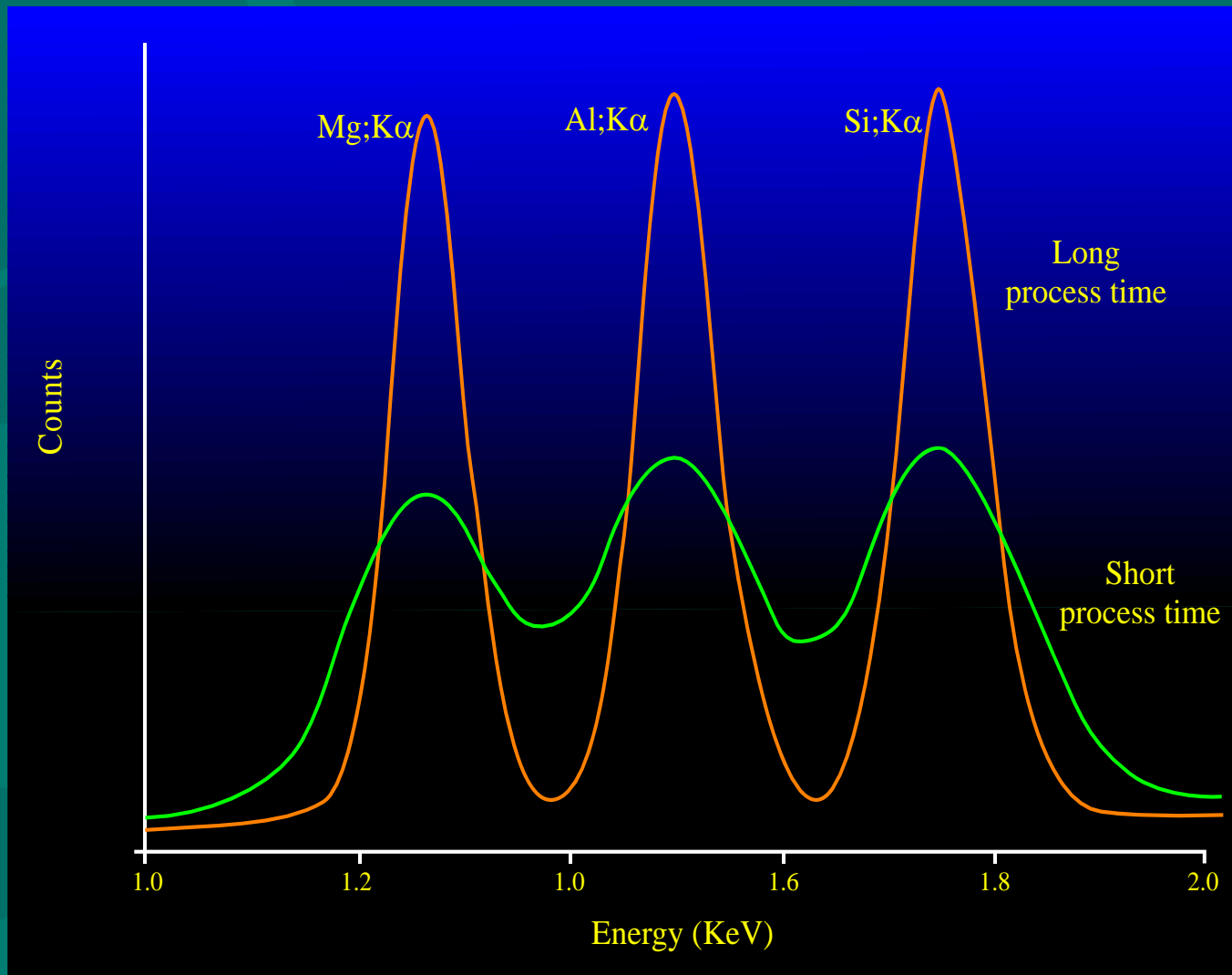
- Internal Fluorescence
 - Excitation of Si;K α in the dead layer
 - Lose auger electron
 - Absorb Si;K α X-ray
 - Direct excitation of Si;K α
 - Background radiation
 - Stray electrons
 - Si;K α peak in spectrum

Energy Dispersive Spectrometers

- Dead Time
 - Pulse process time
 - Time Constant
 - Count rate
 - Resolution

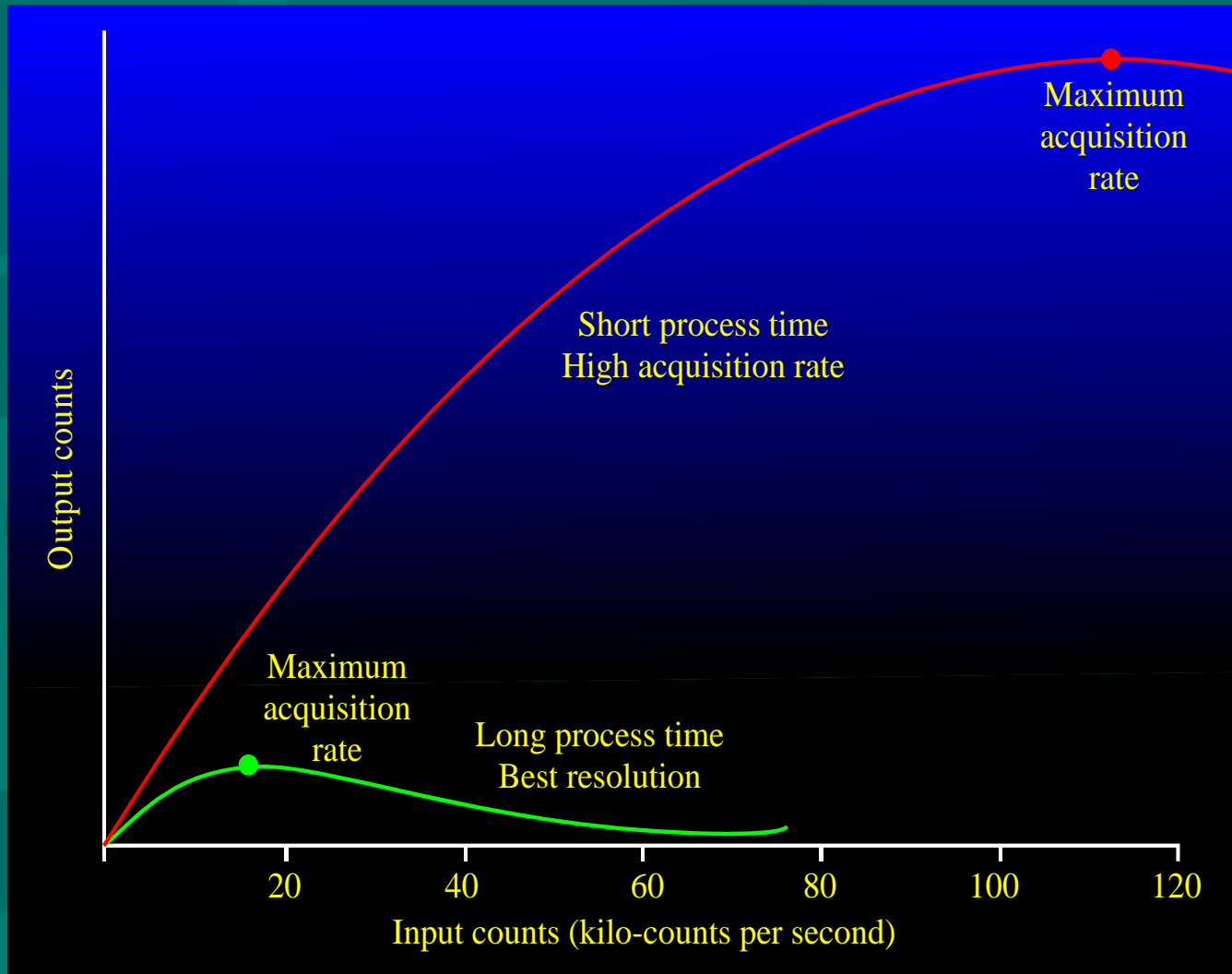
Energy Dispersive Spectrometers

- Dead Time



Energy Dispersive Spectrometers

- Dead Time

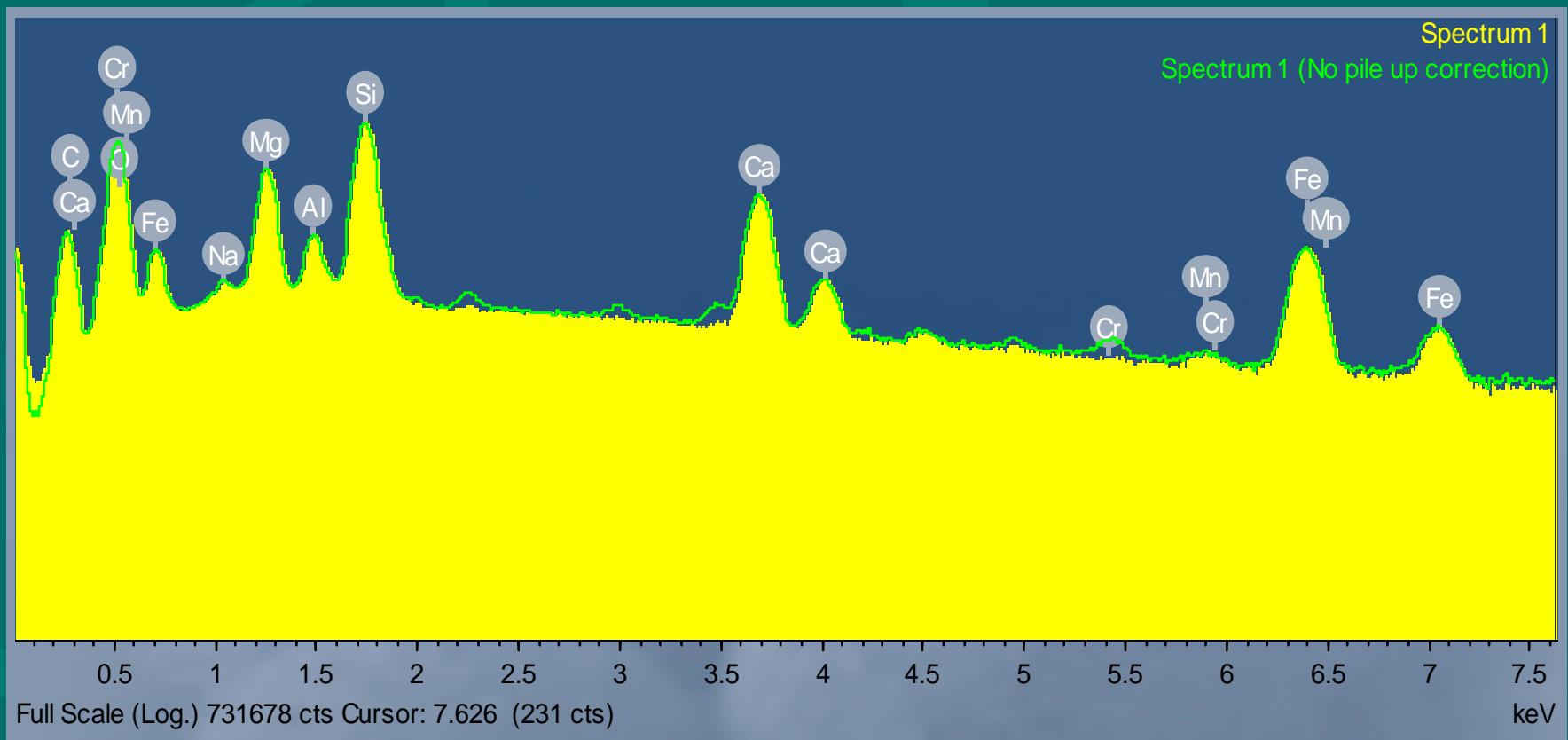


Energy Dispersive Spectrometers

- Dead Time
 - Time variant pulse processing
 - Low noise FET's
 - High speed ADC
 - Intelligent base-lining

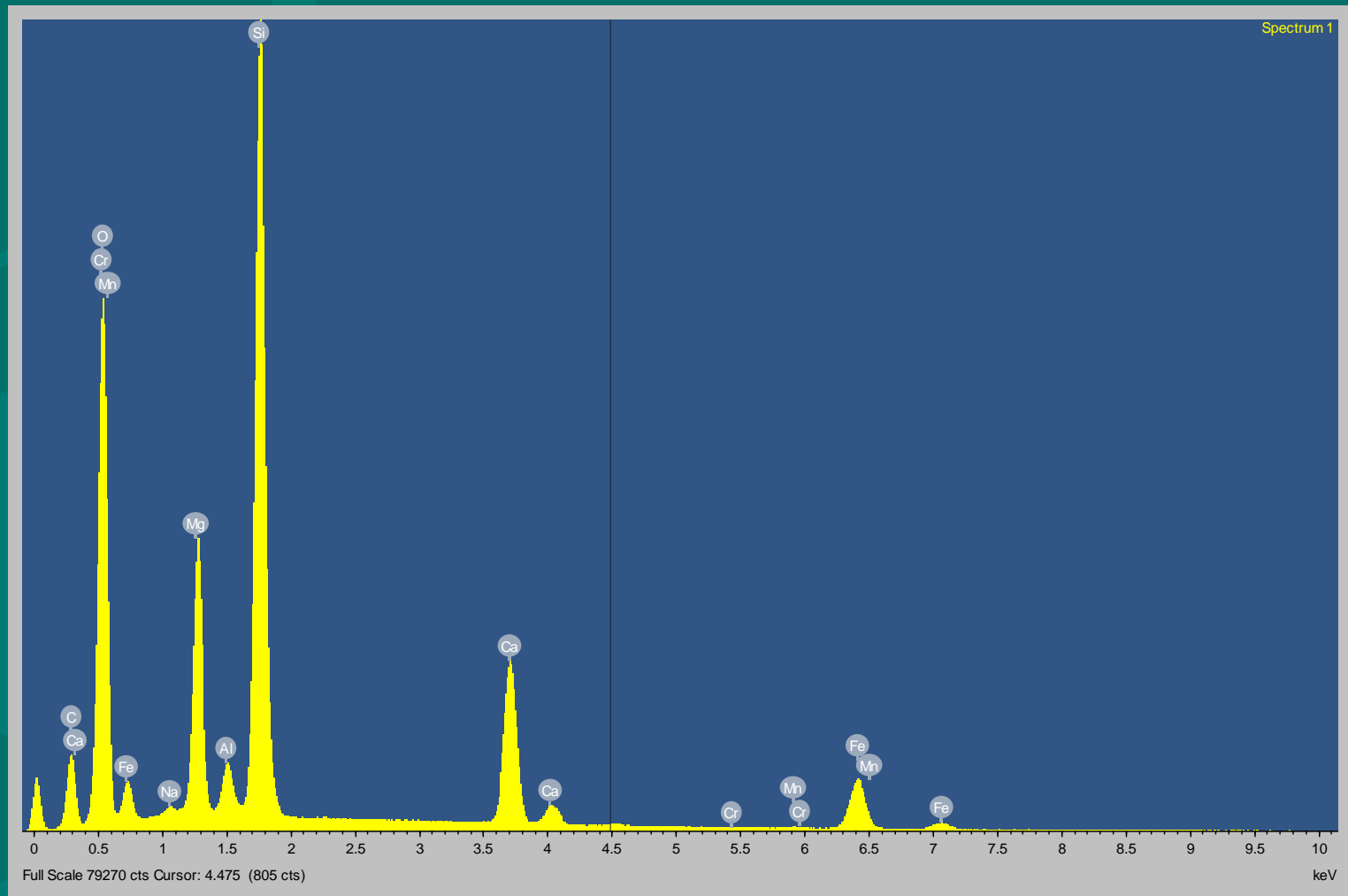
Energy Dispersive Spectrometers

- Pulse Pile-Up
 - Sum peaks
 - Reduced parent peak



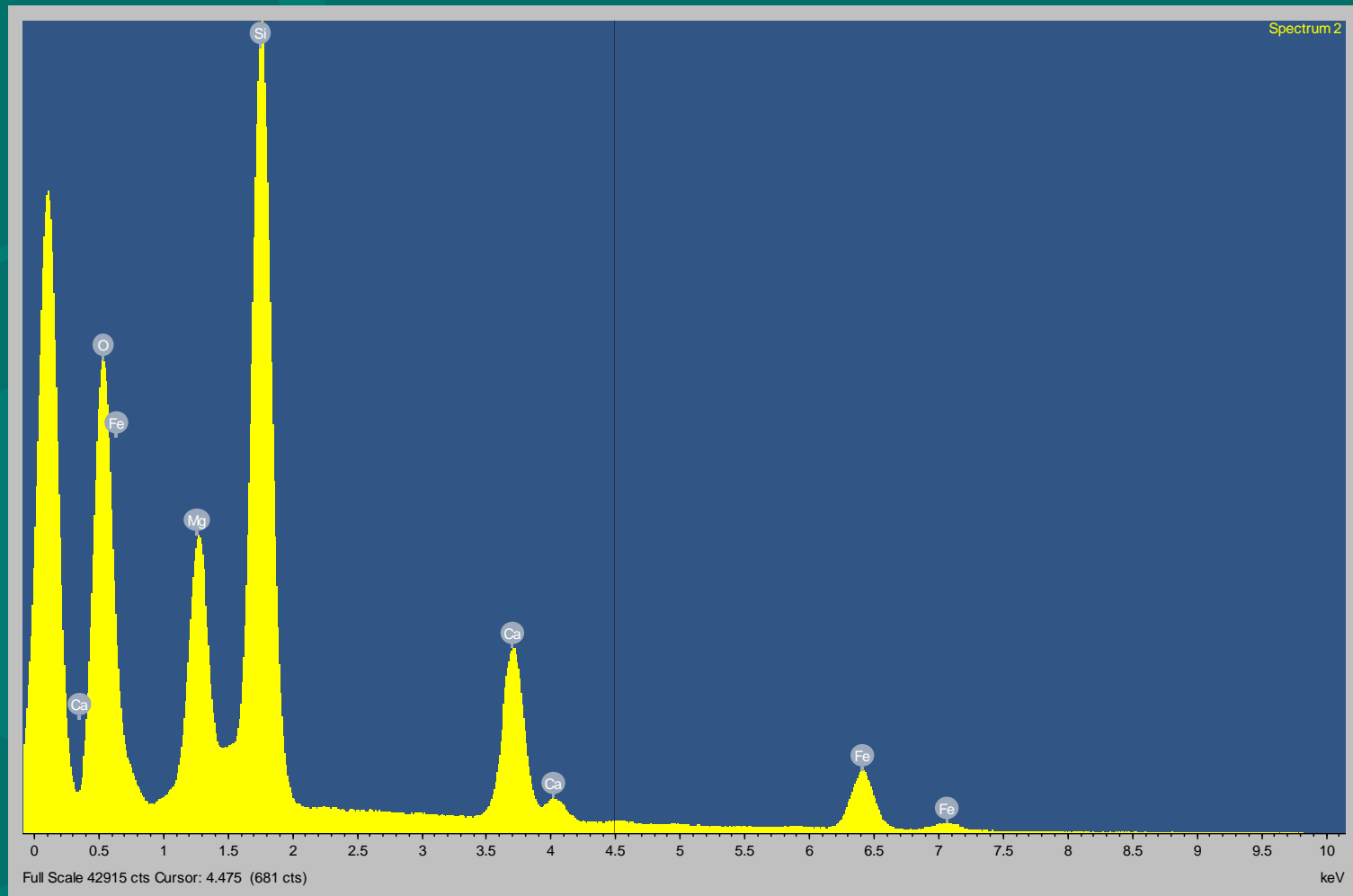
Energy Dispersive Spectrometers

- Counter Window



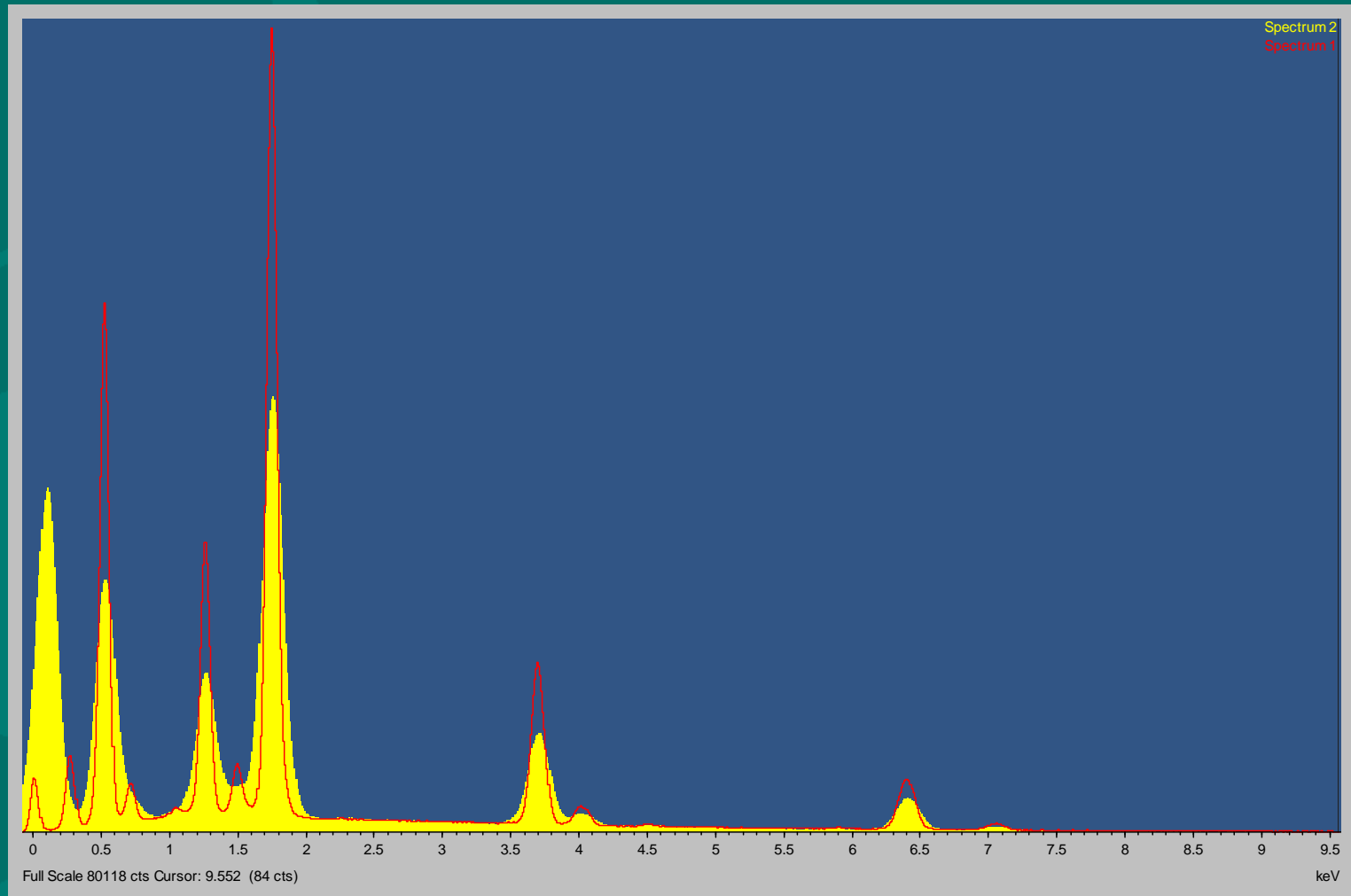
Energy Dispersive Spectrometers

- Counter Window



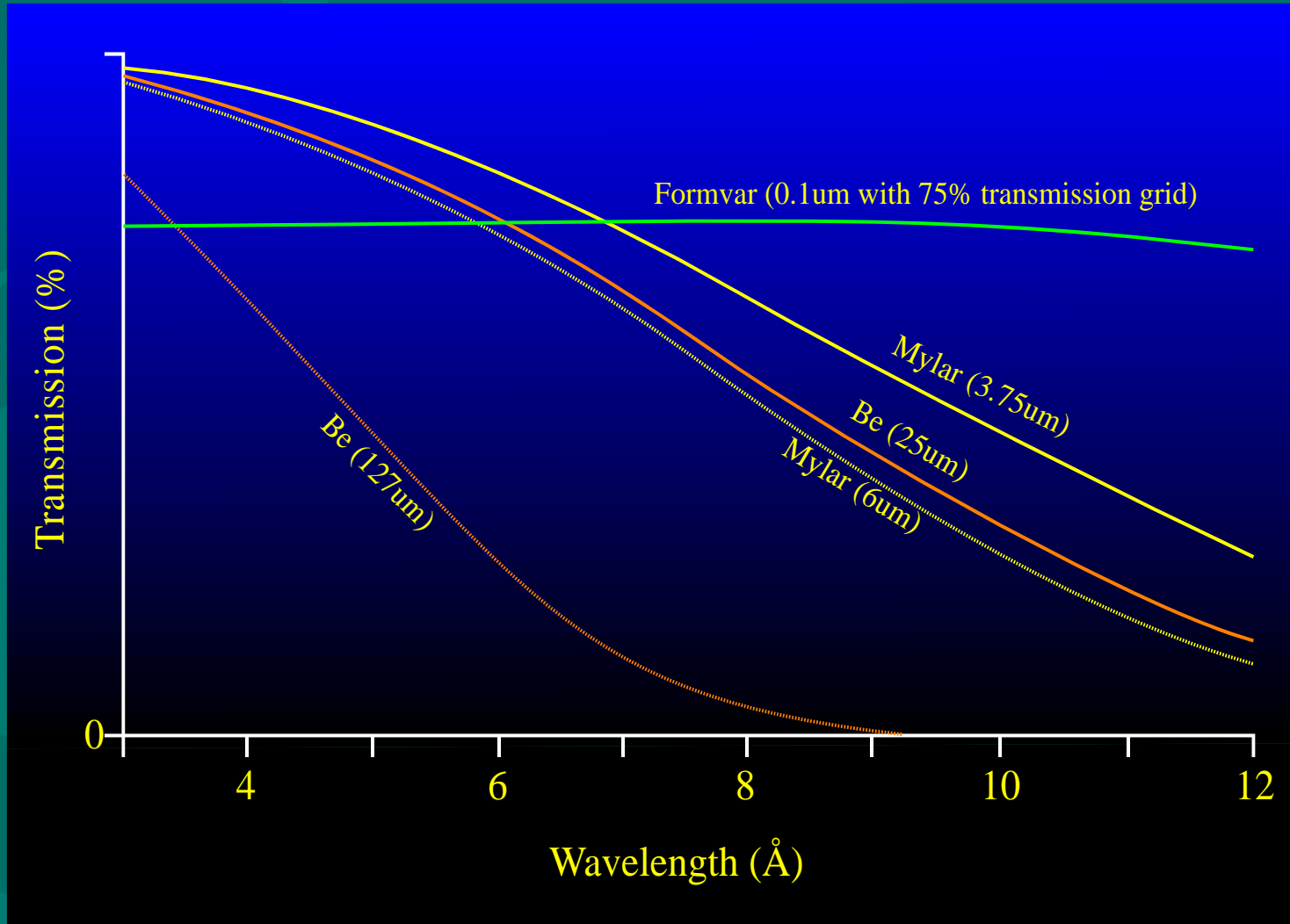
Energy Dispersive Spectrometers

- Counter Window



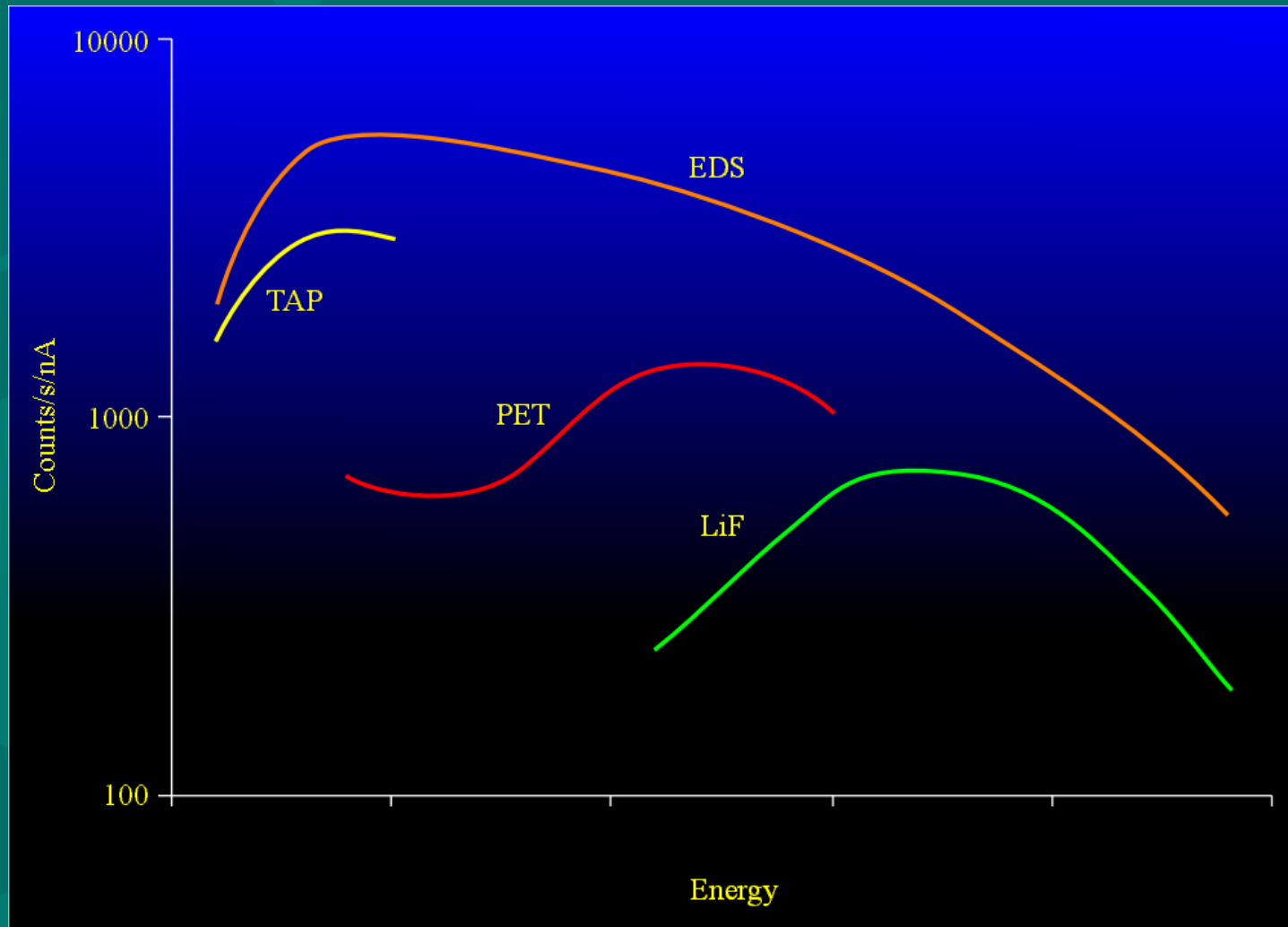
Energy Dispersive Spectrometers

- Counter Window



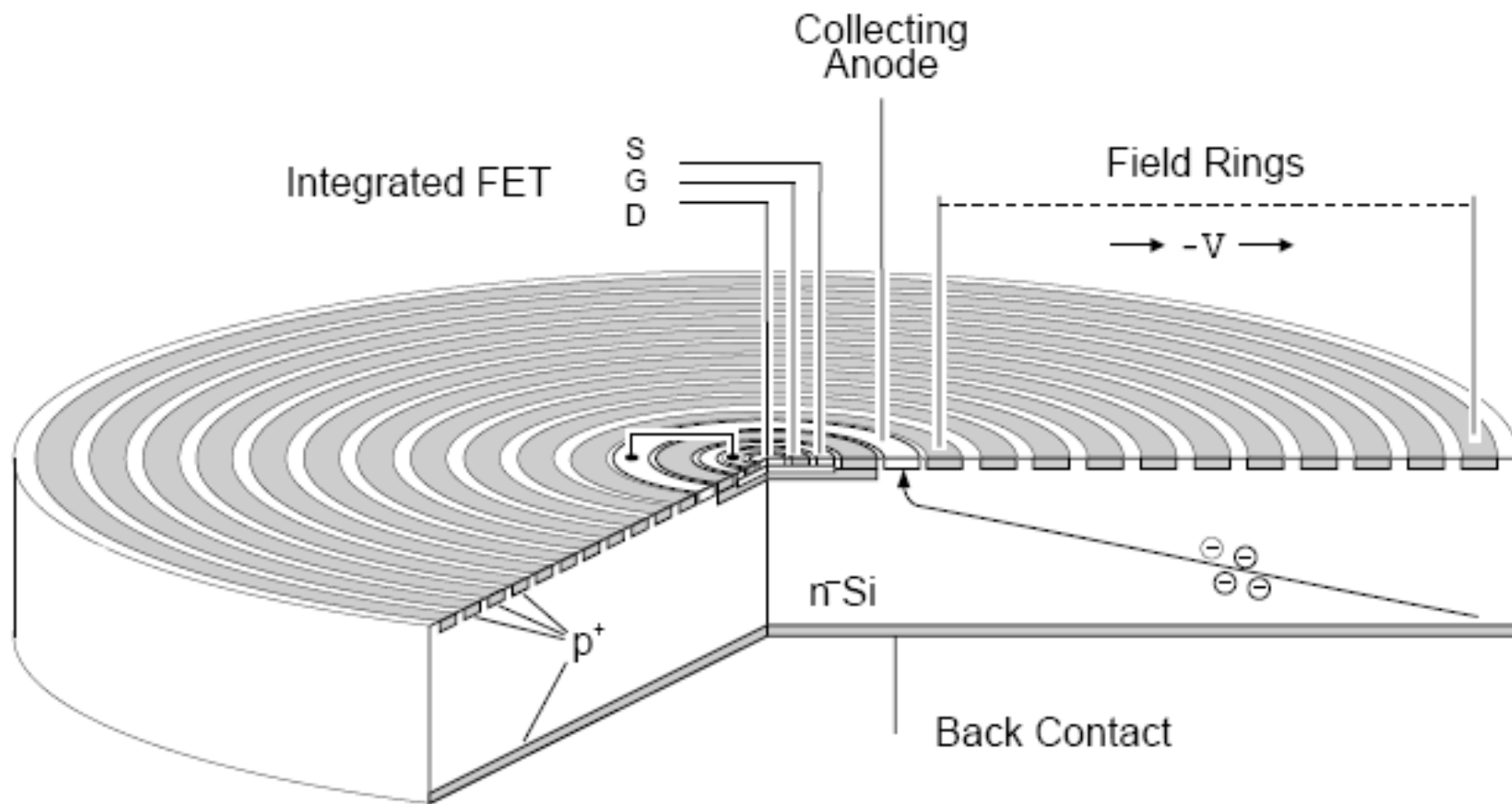
Energy Dispersive Spectrometers

- Efficiency



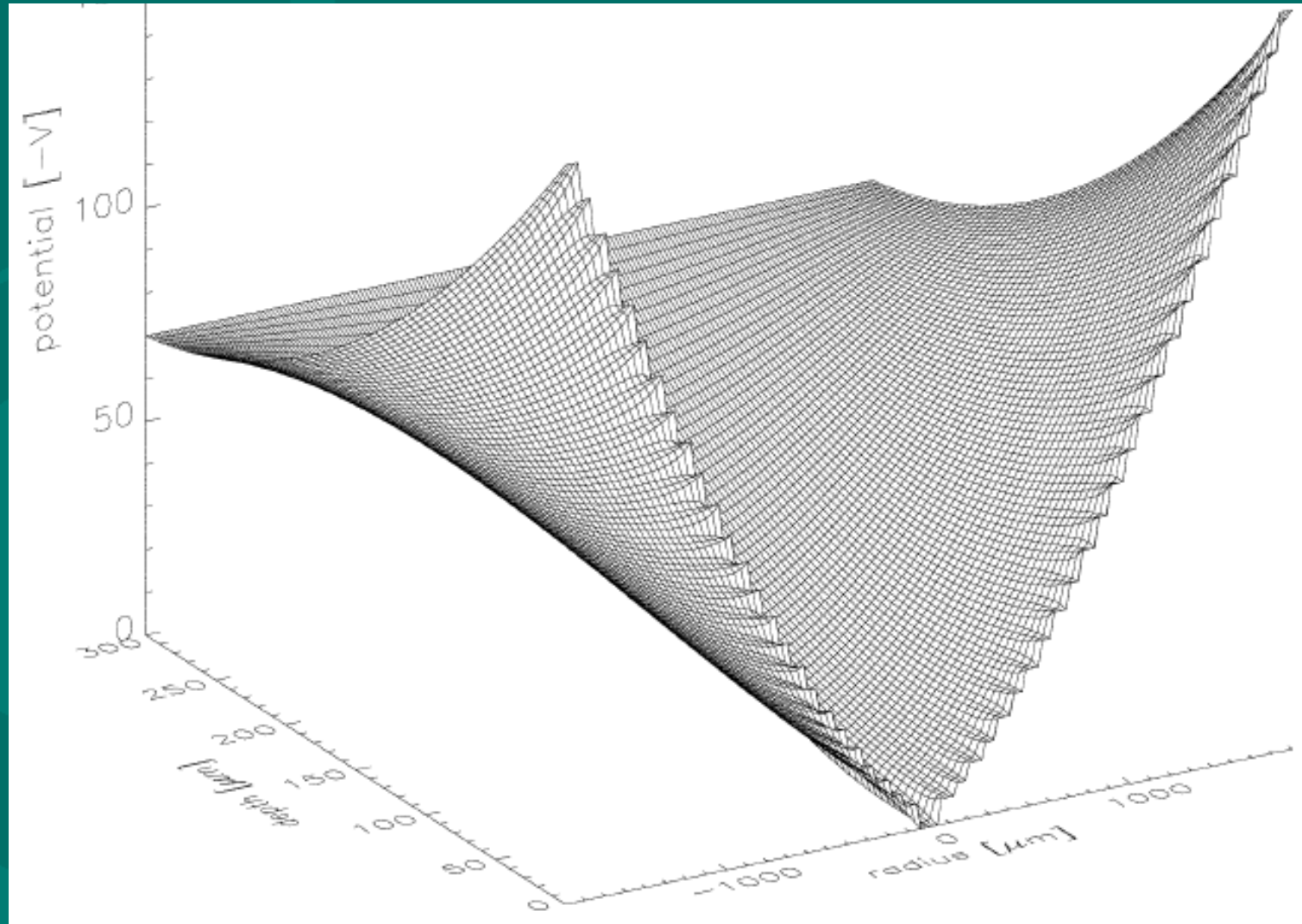
Energy Dispersive Spectrometers

- Silicon Drift Detectors



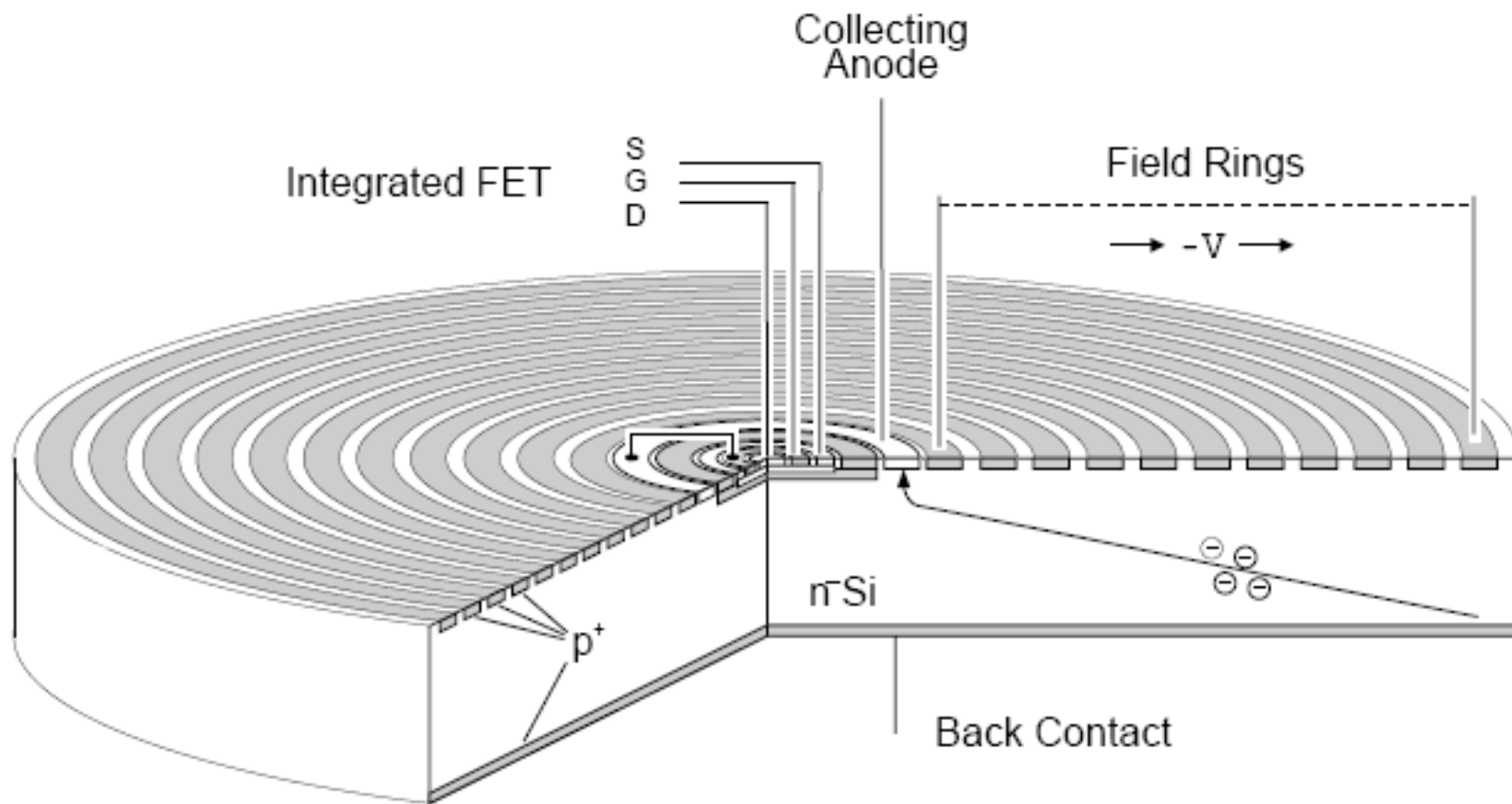
Energy Dispersive Spectrometers

- Silicon Drift Detectors



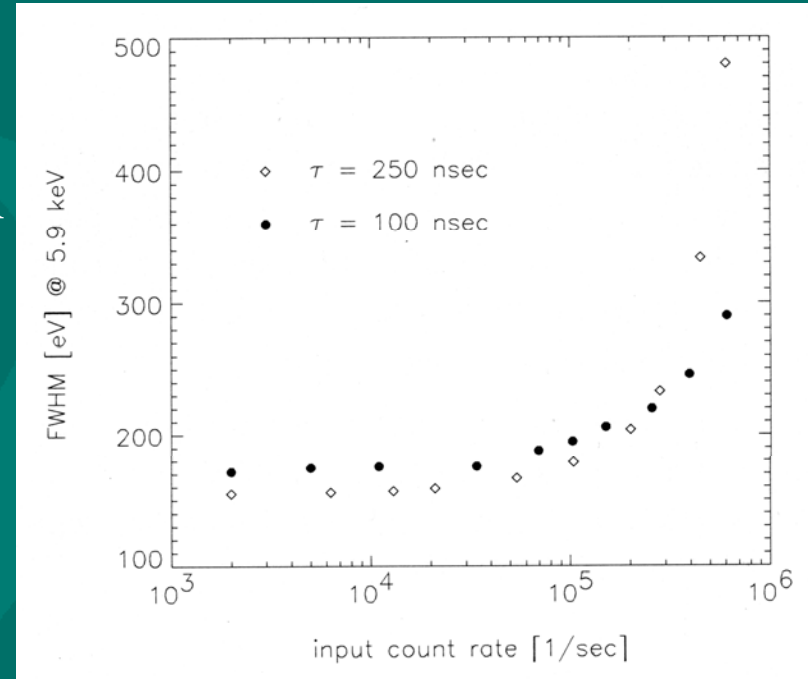
Energy Dispersive Spectrometers

- Silicon Drift Detectors



Energy Dispersive Spectrometers

- Silicon Drift Detectors
 - + Very low capacitance
 - Higher energy resolution
 - Shorter shaping times
 - High count rates
 - + Very low leakage current
 - Only moderate cooling
 - + Self re-setting anode
 - Simple DC voltage to operate
 - No detector clock re-set overhead
 - + Simple robust package



Energy Dispersive Spectrometers

- Silicon Drift Detectors
 - Thin
 - >90% efficiency @ 10KeV
 - >50% efficiency @ 20KeV
 - FET ‘burn’
 - Pulse pile-up
 - ICC
 - Low energy performance
 - Ballistic deficit

Energy Dispersive Spectrometers

- Summary
 - + Simple to apply
 - + Parallel acquisition
 - + Virtually no pre-configuration
 - + No De-focussing
 - Poor resolution
 - Overlaps
 - Detection limits
 - Poorer accuracy and precision
 - Spectrum artefacts
 - Escape peaks
 - Si;K α peak
 - Sum peaks



End of Part 2

Thank you for your attention